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Bell Labs Innovations



**4ESS™ Switch**  
**Common Channel Signaling Systems**  
**Common Network Interface (CNI)**

**System Description Manual**

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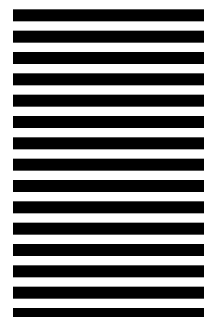
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---

# Contents

---

|  |                       |   |
|--|-----------------------|---|
|  | <b>Overview</b>       | 1 |
|  | ■ About This Document | 1 |
|  | ■ Reason for Reissue  | 1 |
|  | ■ Scope               | 2 |

---

|          |                                                        |      |
|----------|--------------------------------------------------------|------|
| <b>1</b> | <b>High-Level Description</b>                          | 1-1  |
|          | ■ General                                              | 1-1  |
|          | ■ Capabilities and Features                            | 1-1  |
|          | ■ Common Network Interface System Overview             | 1-4  |
|          | ■ Common Network Interface Software Architecture       | 1-5  |
|          | ■ Common Network Interface System Description          | 1-10 |
|          | ■ Common Network Interface System Operation            | 1-18 |
|          | ■ Common Network Interface System Reliability Features | 1-23 |

---

|          |                                           |      |
|----------|-------------------------------------------|------|
| <b>2</b> | <b>Hardware Description and Functions</b> | 2-1  |
|          | ■ General                                 | 2-1  |
|          | ■ Equipment Features and Requirements     | 2-2  |
|          | ■ Equipment Descriptions                  | 2-7  |
|          | ■ Equipment Addressing and Assignments    | 2-45 |

---

|          |                                                            |     |
|----------|------------------------------------------------------------|-----|
| <b>3</b> | <b>Signaling Links</b>                                     | 3-1 |
|          | ■ General                                                  | 3-1 |
|          | ■ Common Channel Signaling 7 (CCS7) Signaling Links (SLKs) | 3-2 |

---

## Contents

|                                                                  |      |
|------------------------------------------------------------------|------|
| ■ D-Channel and Special Access Data Channel Signaling Links      | 3-14 |
| ■ International Link Node (ILN) Signaling Links                  | 3-25 |
| ■ Small Computer System Interface Node (SIN) Links               | 3-31 |
| ■ Ethernet Interface Node (EIN) Links                            | 3-34 |
| ■ Increased Buffer Size of SS7 Satellite Nodes using BEC Feature | 3-37 |

---

|          |                                             |      |
|----------|---------------------------------------------|------|
| <b>4</b> | <b>Message Flow</b>                         | 4-1  |
| ■        | General                                     | 4-1  |
| ■        | Common Channel Signaling Network Overview   | 4-1  |
| ■        | Open Systems Interconnection Protocol Model | 4-5  |
| ■        | Common Channel Signaling 7 Protocol         | 4-7  |
| ■        | Common Channel Signaling Network Routing    | 4-8  |
| ■        | Common Network Interface Ring Message Flow  | 4-10 |

---

|          |                                                   |       |
|----------|---------------------------------------------------|-------|
| <b>5</b> | <b>Measurements, Reports, and Critical Events</b> | 5-1   |
| ■        | General                                           | 5-1   |
| ■        | Description of Measurements                       | 5-2   |
| ■        | Description of Reports                            | 5-80  |
| ■        | Description of Critical Events                    | 5-114 |
| ■        | Measurement Output Control Table                  | 5-129 |

---

## Contents

---

|          |                                                                        |      |
|----------|------------------------------------------------------------------------|------|
| <b>6</b> | <b>Maintenance Guidelines</b>                                          | 6-1  |
|          | ■ General                                                              | 6-1  |
|          | ■ Common Network Interface Ring Maintenance Description                | 6-1  |
|          | ■ Maintenance Functions, Hardware, and Equipment                       | 6-11 |
|          | ■ Trouble Indicators and Display Pages                                 | 6-28 |
|          | ■ Common Channel Signaling No. 7 Digital Signaling Link Maintenance    | 6-40 |
|          | ■ Universal Link Node (ULN)                                            | 6-46 |
|          | ■ D-Channel and Special Access Data Channel Signaling Link Maintenance | 6-55 |
|          | ■ Diagnostics                                                          | 6-60 |
|          | ■ Audits                                                               | 6-81 |
|          | ■ Processor Recovery Messages                                          | 6-93 |
|          | ■ International Link Node Signaling-Link Maintenance                   | 6-96 |
|          | ■ Small Computer Systems Interface Node Maintenance                    | 6-96 |
|          | ■ Ethernet Interface Node Maintenance                                  | 6-97 |
|          | ■ 3B Computer Maintenance Functions                                    | 6-98 |

---

|              |   |
|--------------|---|
| <b>Notes</b> | 1 |
|--------------|---|

---

|              |              |         |
|--------------|--------------|---------|
| <b>index</b> | <b>Index</b> | index-1 |
|--------------|--------------|---------|



# Contents



|           |                 |      |
|-----------|-----------------|------|
| <b>GL</b> | <b>Glossary</b> | GL-1 |
|-----------|-----------------|------|



|            |                      |       |
|------------|----------------------|-------|
| <b>ABB</b> | <b>Abbreviations</b> | ABB-1 |
|------------|----------------------|-------|



---

# Figures

---

## 1

### High-Level Description

|      |                                                                  |      |
|------|------------------------------------------------------------------|------|
| 1-1. | IMS Configuration                                                | 1-7  |
| 1-2. | Common Network Interface (CNI) Ring—<br>4ESS™ Switch Application | 1-11 |
| 1-3. | Signal Transport Footprint Standardization<br>with 4ESS™ Switch  | 1-14 |
| 1-4. | Dual Ring Structure — Normal                                     | 1-20 |
| 1-5. | Dual Ring Structure — Isolated                                   | 1-21 |

---

## 2

### Hardware Description and Functions

|       |                                                 |      |
|-------|-------------------------------------------------|------|
| 2-1.  | Typical Ring Node Cabinet Layouts               | 2-8  |
| 2-2.  | Link Node (LN) Units (Type A and B)             | 2-13 |
| 2-3.  | DS1 Units (Type A and B)                        | 2-14 |
| 2-4.  | 3B Interface (3BI) Units                        | 2-15 |
| 2-5.  | Integrated Ring Node (IRN) Unit                 | 2-16 |
| 2-6.  | Fuse and Control Panel Mounting                 | 2-29 |
| 2-7.  | Ring Node Cabinet Fan Unit<br>Assembly          | 2-32 |
| 2-8.  | Digital Facility Access (DFA) Cabinet<br>Layout | 2-33 |
| 2-9.  | Digital Service Unit (DSU) Mounting             | 2-34 |
| 2-10. | Channel Service Unit (CSU)<br>Mounting          | 2-37 |
| 2-11. | Digital Service Adapter (DSA)<br>Mounting       | 2-38 |
| 2-12. | AC Power Unit Mounting                          | 2-39 |
| 2-13. | AC Power Distribution Unit Mounting             | 2-40 |
| 2-14. | Fuse and Control Panel Mounting                 | 2-41 |
| 2-15. | Typical Signaling Transport Frame<br>(STF)      | 2-42 |

---

# Figures

---

## 3

### Signaling Links

|       |                                                                |      |
|-------|----------------------------------------------------------------|------|
| 3-1.  | Common Channel Signaling 7 (CCS7)<br>Signaling Links           | 3-4  |
| 3-2.  | Common Channel Signaling 7 (CCS7)<br>Signaling Link Lengths    | 3-5  |
| 3-3.  | Signaling Transport Frame Equipment<br>Connection              | 3-6  |
| 3-4.  | D-Channel Connectivity                                         | 3-14 |
| 3-5.  | Special Access Data Channel Signaling<br>Link Block Diagram    | 3-16 |
| 3-6.  | Individual Per Call Control (iPCC)<br>System                   | 3-17 |
| 3-7.  | ISDN D-Channel Testing Capability                              | 3-22 |
| 3-8.  | International Link Node Signaling Link<br>Block Diagram        | 3-26 |
| 3-9.  | Small Computer System Interface Node<br>Hardware Configuration | 3-31 |
| 3-10. | Ethernet Interface Node Hardware<br>Configuration              | 3-34 |

---

## 4

### Message Flow

|      |                                                                                               |      |
|------|-----------------------------------------------------------------------------------------------|------|
| 4-1. | Simplified Common Channel Signaling<br>(CCS) Network                                          | 4-3  |
| 4-2. | Common Network Interface Ring—4ESS™<br>Switch Application                                     | 4-4  |
| 4-3. | Common Channel Signaling Network<br>Signaling Link and Signal Transfer Point<br>Configuration | 4-9  |
| 4-4. | ISUP Common Channel Signaling No. 7<br>Call Processing Equipment Layout                       | 4-11 |
| 4-5. | ISUP 1B Format — Initial Address<br>Message                                                   | 4-12 |
| 4-6. | ISUP Common Channel Signaling No. 7<br>Call Processing                                        | 4-13 |

---

## Figures

|      |                                                          |      |
|------|----------------------------------------------------------|------|
| 4-7. | ISUP — Initial Address Message for CCS7 Routing          | 4-14 |
| 4-8. | OPC and CIC translated to TSN During SS7 Call Processing | 4-16 |

---

## 5 Measurements, Reports, and Critical Events

|      |                                            |       |
|------|--------------------------------------------|-------|
| 5-1. | Layout of the Scheduled SNPR1 Report       | 5-90  |
| 5-2. | Layout of the Scheduled Daily SNPR2 Report | 5-96  |
| 5-3. | Layout of the Scheduled Daily SEPR Report  | 5-101 |
| 5-4. | Layout of the Scheduled MPR Report         | 5-103 |
| 5-5. | Layout of the Scheduled 15MPR Report       | 5-108 |
| 5-6. | Layout of the Scheduled 30MPR Report       | 5-110 |
| 5-7. | Layout of the Scheduled RINGEX Report      | 5-113 |

---

## 6 Maintenance Guidelines

|      |                                                          |      |
|------|----------------------------------------------------------|------|
| 6-1. | Common Network Interface Dual Ring Structure             | 6-2  |
| 6-2. | Common Network Interface Link Node Architecture          | 6-5  |
| 6-3. | Common Network Interface Ring Structure During Isolation | 6-9  |
| 6-4. | Example of Index Page (100)                              | 6-33 |
| 6-5. | Example of Ring Status Summary Page (1105)               | 6-34 |
| 6-6. | Example of Ring Group Display Page (1106)                | 6-35 |

---

## Figures

|       |                                                                                  |      |
|-------|----------------------------------------------------------------------------------|------|
| 6-7.  | Example of Data Link Node/Attached Processor Interface Stream Status Page (1107) | 6-36 |
| 6-8.  | Example of Link Status Summary Page (1108)                                       | 6-37 |
| 6-9.  | Example of AT&T Trigger Platform (ATP) Status Page 1109                          | 6-38 |
| 6-10. | Example of Display Page 1110—Specific HSL T1 Test Request Page                   | 6-39 |
| 6-11. | Layout of Facility Equipment for 56 Kbps Links and High-Speed A-Links            | 6-47 |
| 6-12. | Processor Recovery Message Format                                                | 6-93 |

---

# Tables

---

## 1

### High-Level Description

|      |                             |     |
|------|-----------------------------|-----|
| 1-A. | Central Processor Functions | 1-8 |
| 1-B. | Node Processor Functions    | 1-9 |

---

## 2

### Hardware Description and Functions

|      |                                            |      |
|------|--------------------------------------------|------|
| 2-A. | Environmental Limits                       | 2-6  |
| 2-B. | DLN Capacity Figures 4E19/4E22<br>Generics | 2-21 |

---

## 3

### Signaling Links

|      |                                                                          |      |
|------|--------------------------------------------------------------------------|------|
| 3-A. | Signaling Link State Transitions                                         | 3-7  |
| 3-B. | AT&T 500B Digital Service Unit<br>Options                                | 3-11 |
| 3-C. | DATATEL* Digital Service Unit<br>Options                                 | 3-12 |
| 3-D. | AT&T 2556 Digital Service Unit<br>Options                                | 3-13 |
| 3-E. | Channel Service Unit Options                                             | 3-13 |
| 3-F. | TF5 Digital Service Adapter Options                                      | 3-13 |
| 3-G. | Signaling Link State Transitions                                         | 3-20 |
| 3-H. | Signaling Link State Transitions                                         | 3-28 |
| 3-I. | Small Computer System Interface Node<br>Signaling Link State Transitions | 3-33 |
| 3-J. | Ethernet Interface Node Signaling Link<br>State Transitions              | 3-36 |
| 3-K. | Parameter Values for 56 Kbps Links in a<br>Linkset                       | 3-38 |

---

# Tables

---

## 4

### Message Flow

|                                                                                                                |     |
|----------------------------------------------------------------------------------------------------------------|-----|
| 4-A. Open Systems Interconnection (OSI)<br>Model Layer Identification                                          | 4-5 |
| 4-B. Common Channel Signaling 7 Protocol<br>Layer Identification                                               | 4-7 |
| 4-C. Common Channel Signaling 7 Protocol<br>Layers Equivalency to Open Systems<br>Interconnection Model Layers | 4-7 |

---

## 5

### Measurements, Reports, and Critical Events

|                                                                                   |       |
|-----------------------------------------------------------------------------------|-------|
| 5-A. CCIS 6 to CCS7 Measurement<br>Correspondence                                 | 5-9   |
| 5-B. Alphabetical Index of Measurements<br>(CNI, IMS, PBX, T1, HSA, and ESF)      | 5-10  |
| 5-C. Interprocess Message Switch (IMS)<br>Measurement Descriptions                | 5-16  |
| 5-D. CCS7 Common Network Interface (CNI)<br>Measurement Descriptions              | 5-40  |
| 5-E. Private Branch Exchange (PBX)<br>Measurement Descriptions                    | 5-68  |
| 5-F. T1 Measurement Descriptions, CNI 11.4<br>and Later                           | 5-76  |
| 5-G. High Speed Link (1.544) Measurement<br>Descriptions, CNI 11.4 and Later      | 5-77  |
| 5-H. Extended Super Frame (ESF) Error Count<br>Description, CNI 11.4 and Later    | 5-79  |
| 5-I. Common Channel Signaling (CCS) Network<br>Critical Event (CNCE) Descriptions | 5-117 |
| 5-J. Initial Critical Event Table                                                 | 5-132 |
| 5-K. Initial User View Descriptor Table                                           | 5-137 |
| 5-L. Initial Exception Table                                                      | 5-143 |
| 5-M. Initial History File Descriptor Table                                        | 5-149 |

---

## Tables

|      |                                                |       |
|------|------------------------------------------------|-------|
| 5-N. | Report Generators                              | 5-151 |
| 5-O. | Initial Scheduler Table<br>(Notes 1 through 4) | 5-154 |

---

## 6 Maintenance Guidelines

|      |                                                                                  |      |
|------|----------------------------------------------------------------------------------|------|
| 6-A. | Automatic Ring Recovery Response to<br>Isolation and CP Maintenance<br>States    | 6-20 |
| 6-B. | Common Network Interface Trouble<br>Indicators and Analysis — Output<br>Messages | 6-30 |
| 6-C. | Common Network Interface Trouble<br>Indicators and Analysis — Visual<br>Alarms   | 6-31 |
| 6-D. | Common Network Interface Trouble<br>Indicators and Analysis — Audible<br>Alarms  | 6-32 |
| 6-E. | All-Test-Passed (ATP) Status Page<br>Commands                                    | 6-38 |
| 6-F. | DGN Message Input Variations                                                     | 6-63 |
| 6-G. | <b>OP:RING</b> Input Message Variations                                          | 6-63 |
| 6-H. | Physical Node Identification<br>(Decimal Representation)                         | 6-65 |
| 6-I. | Physical Node Addresses<br>(Decimal Representation)                              | 6-69 |
| 6-J. | Physical Node Identification<br>(Hexadecimal Representation)                     | 6-73 |
| 6-K. | Physical Node Address<br>(Hexadecimal Representation)                            | 6-77 |
| 6-L. | Audit Execution Sequence                                                         | 6-84 |
| 6-M. | Audit Abort Codes                                                                | 6-89 |



# Overview

---

## Contents

|                            |   |
|----------------------------|---|
| <b>About This Document</b> | 1 |
| <b>Reason for Reissue</b>  | 1 |
| <b>Scope</b>               | 2 |



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## Overview

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### About This Document

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This document contains system description and operational information describing Common Network Interface (CNI) equipment as applicable to the 4ESS™ Switch. Thus, CNI features, equipment, and/or applications that pertain to other switching systems are not covered in this document. Additional information for CNI equipped 4ESS Switch offices is provided in the following documents:

- 234-351-120AC — *Common Network Interface Trouble Clearing and Routine Maintenance*
- 234-153-055AC — *Common Network Interface Growth*
- AT&T IM-4A001-01 — *4ESS Switch/APS Input Message Manual*
- AT&T OM-4A001-01 — *4ESS Switch/APS Output Message Manual*
- AT&T 4ESS Switch Translation Guide (TG4) Division 12 - CNI Data Management System (DMS).

### Reason for Reissue

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This document is reissued to support CNI equipment operating with CNI software Release 13.4 for the 4ESS switch with the 4E23R1 (4AP16) generic program.

## Scope

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The following briefly describes the content of each section in this document:

**Overview**— Provides a description of the content of the Common Network Interface (CNI) system description document.

- 1 High-Level Description** — Provides a high-level overview and description of the CNI system.
- 2 Hardware Description and Functions** — Provides a physical and functional description of the CNI system hardware.
- 3 Signaling Links** — Provides a description of Common Channel Signaling No. 7 (CCS7), D-Channel (DCHN), Special Access Data Channel (SADC), and international link node (ILN) signaling links.
- 4 Message Flow** — Provides a description of how different types of signaling messages are routed by the CNI system application.
- 5 Measurements, Reports, and Critical Events** — Lists and defines all measurements, critical events, and fixed format reports provided in the CNI application.
- 6 Maintenance Guidelines** — Provides maintenance guidelines and other maintenance related descriptive information.

**Glossary** — Provides a list of terms and definitions used in this document.

**Notes** — Provided to enable the user of this document to make convenient notes.

**Acronyms** — Contains a list of acronyms and abbreviation used in this document.

**Index** — Provides listings and page numbers of all subjects in this document.

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# High-Level Description

# 1

---

## Contents

|                                                             |      |
|-------------------------------------------------------------|------|
| <b>General</b>                                              | 1-1  |
| <b>Capabilities and Features</b>                            | 1-1  |
| <b>Common Network Interface System Overview</b>             | 1-4  |
| <b>Common Network Interface Software Architecture</b>       | 1-5  |
| ■ Common Network Interface Subsystem                        | 1-5  |
| ■ Interprocess Message Switch Subsystem                     | 1-6  |
| ■ Software Subsystem Functions                              | 1-7  |
| <b>Common Network Interface System Description</b>          | 1-10 |
| <b>Common Network Interface System Operation</b>            | 1-18 |
| <b>Common Network Interface System Reliability Features</b> | 1-23 |
| ■ Node Initialization                                       | 1-23 |
| ■ Full Process Initialization                               | 1-23 |
| ■ Critical Node Restore                                     | 1-24 |
| ■ Protected Application Segment                             | 1-25 |

---

## High-Level Description

# 1

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### General

This section provides a high-level description of the Common Network Interface (CNI) System as equipped for and applicable to the 4ESS™ Switch. The Common Network Interface system abilities and features, system overview, software architecture, system description, system operation, and reliability features are subjects in this document.

---

### Capabilities and Features

The CNI System provides the following capabilities and features:

- a. High message-handling capacity
- b. Ability to connect the 4ESS switch to the Call Detail Recording Platform (CDRP) for the purpose of transmitting call event data using either the Small Computer System Interface (SCSI) Node (SIN) or the Ethernet Interface Node (EIN).
- c. Terminations for different link types and speeds:
  - Encrypted and unencrypted 56-kb/s links (CCS7 only)
  - 4.8 kb/s SADCs links
  - 64-kb/s DCHNs links
  - Unencrypted 64-kb/s world-links (CCITT7 only)

- Unencrypted 1.544 Mbps high-speed A-links (CCS 7 only—beginning with CNI Software Release 11.4)
  - Universal Link Node (ULN) which serves as a platform for high-speed A-links, for a direct connection of T1 CCS 7 link.
- d. Reliable system operation software:
- *Fault Recovery* — Automatically attempts system recovery following a hardware fault.
  - *Diagnostics* — Analyzes and resolves most faults while identifying suspect circuit packs within a cabinet.
  - *System Integrity* — Ensures a working system in the presence of errors and overload conditions.
  - *Human Interfaces* — Provides for surveillance, control, and maintenance.
- e. Measurements: The CNI system is able to collect and report performance measurements and critical event data to facilitate office maintenance, engineering, and administration. Reports can be generated locally and transmitted to remote collection centers. The CNI system provides various reports:
- Scheduled and demanded reports
  - Total office and link specific reports
  - Generic defined fixed format and user defined flexible format reports
  - Real-time notification of CCS network critical events.
- f. Software and Hardware Integrity Audits:
- System Audits
  - Internal data audits on a per-link basis and total office basis
  - Neighbor node hardware audits.
- g. Disk and Tape Backup Ability: All file systems, operating software, and data bases can be backed up via disk and/or tape.
- h. Initialization: Should faults occur that require reinitialization, the CNI system provides several levels. The first levels do not interrupt normal system operation, but as reinitialization attempts progress, service is interrupted.

- i. Incore Function Replacement: Allows the CNI system SLMK and CNIINIT kernel processes to implement the UNIX\* System RTR field update mechanism known as "Incore Function Replacement." *Field update* is the method used to install selected software changes at field sites. *Incore function* replacement is a type of field update performed on a running process where the unit of change is a function or specific bytes of data. *Function replacement* modifies a feature and/or data without having to kill and restart the process. This eliminates rebooting the system and creating the process from disk.
- j. Maintenance and Fault Recovery: In addition to the reliability features, previously described, the CNI system has tools and facilities for fault detection, isolation, and recovery:
  - Automatic Ring Recovery (ARR) program
  - Ability to isolate faulty sections of the ring and to quarantine single nodes that require maintenance
  - Diagnostics for nodes and links (automatic and demand)
  - Quick ring reinitialization—even in the presence of failures
  - Overload and congestion controls for the ring, nodes, links, and central processor.

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\* UNIX is a registered trademark of Novell, Inc.

## **Common Network Interface System Overview**

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The CNI system is a stored program controlled (SPC) subsystem designed to provide a 4ESS Switch interface, as shown in Figure 1-2, to the Common Channel Signaling (CCS) network. This interface allows the 4ESS Switch to route CCS messages to and receive CCS messages from other switching offices, data bases, and signal transfer points (STPs) within the CCS switching network. The CNI system also allows direct digital connections from customer premise equipment (PBXs, etc.) to the 4ESS Switch and provides access to the international CCS switching network.

The CNI system provides the hardware (control nodes, user nodes, etc.) and software (control programs, user node protocols, protocol handling programs, etc.) required to implement the communication functions that are common to all users. The CNI system uses the 3B Computer as a central processing unit. The central processor interfaces with a community of peripheral processors known as nodes. Nodes are defined as access points on the ring where digital information either enters, exits, or is further processed. The nodes are serially connected in a "ring-type" network by the dual ring. One ring propagates data in the opposite direction of the other ring, which permits ring reconfiguration as part of automatic fault recovery. This redundancy in the ring design is partly responsible for the system's high level of availability.

The CNI system software is divided into subsystem components that include the following:

- a. 3B Computer UNIX RTR operating system
- b. Common Network Interface (CNI) subsystem
- c. Interprocess Message Switch (IMS) subsystem
- d. Application support subsystem.

All software subsystems are designed to work together so that each subsystem builds upon the lower level. Each subsystem performs some share of the functions necessary to keep the system operational. Lower level software modules provide the basic services necessary for the higher level software to perform its functions. Each subsystem is independently partitioned software and possesses characteristics (for example, protocol, maintenance, measurements) unique to a particular system function.

## **Common Network Interface Software Architecture**

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The CNI system 3B Computer central processing unit performs its functions using the **UNIX** RTR operating system. This system enables applications to meet the high availability demands of real-time processing in telecommunication systems. In addition, the UNIX RTR operating system provides a multi-execution environment for other software subsystems used by the common network interface. This multi-execution environment permits layered CNI and IMS software functions to co-exist as background tasks.

The 3B Computer is primarily responsible for performing processing functions as defined by the 4ESS Switch Attached Processor application software. The CNI/IMS subsystem software is embedded in the Attached Processor application software. This creates an operating environment where the CNI/IMS subsystem software provides the instructions necessary for the 3B Computer to function as the CNI ring central processor while the application software is fulfilling primary responsibilities as an Attached Processor System (APS).

In addition to CNI/IMS subsystem software being embedded in the Attached Processor application software, the Attached Processor application software must be enhanced to handle administrative, maintenance, and operational functions for the CNI ring. Some 4AP generic CNI ring enhancements include the following:

- CNI initialization
- DLN configuration management
- 3B Computer CNI system display pages
- CNI recent change interface (Data Management System).

### **Common Network Interface Subsystem**

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The common network interface (CNI) subsystem software allows 3B Computer equipped switching offices, data bases, and other CNI equipped offices to be connected to the common channel signaling (CCS) switching network. The CNI subsystem contains the software needed to implement the communication protocol functions that are common to all users interfacing with the CCS switching network.

The CNI subsystem utilizes the CCS7, CCITT7, Q.931, and SADC protocols. The CCS7 protocol is used to control the destination routing of signaling messages between CCS7 nodes within the CCS network. The CCITT7 protocol is similar to the CCS7 protocol and is used for the destination routing of signaling messages associated with CNI equipped international switching centers (ISCs).



The ISC functions as a gateway between the international and domestic CCS network using international link nodes (ILNs) as interfacing hardware. The Q.931 and SADC protocols are used to provide direct digital connections between customer premise equipment (CPE) via D-Channel (DCHN) and SADC nodes, respectively. In addition, the CNI subsystem incorporates another common subsystem known as the interprocess message switch (IMS) subsystem.

### **Interprocess Message Switch Subsystem**

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The IMS subsystem is a high-capacity packet switching software package that allows data messages to be routed between application functions in the community of peripheral processors. This multiprocessing of data messages is performed in a reliable environment with a minimal amount of delay.

The IMS subsystem performs its functions using a hardware configuration consisting of a 3B Computer central processor, an interconnecting "ring-type" dual bus, direct memory access (DMA) via dual serial channels (DCHNs) between the central processor and ring hardware (RPCN and DLN), and application nodes as illustrated in Figure 1-1. Nodes provide ring access for both the central processor and the application. Software to provide application and central processor message distribution, interprocess communication strategies, craft interface, hardware maintenance, system initialization, audits, and measurements are all contained in the IMS subsystem. The community of peripheral processors utilize an internal communication protocol and is independent of all signaling network protocols.

The IMS subsystem makes use of distributed processing. Distributed processing is controlled by the community of peripheral processors working through an interconnection with a central processor, along with the software necessary to support high-capacity packet communications. The community of peripheral processors are interconnected in a "ring-type" busing arrangement via direct memory access (DMA) hardware. The message-distributing software allows messages to be moved from one microprocessor to another and also permits messages to be sent from one process to another process. The IMS software is embedded in the CNI software, and the CNI software is embedded in the UNIX Real Time Reliable (RTR) operating system.

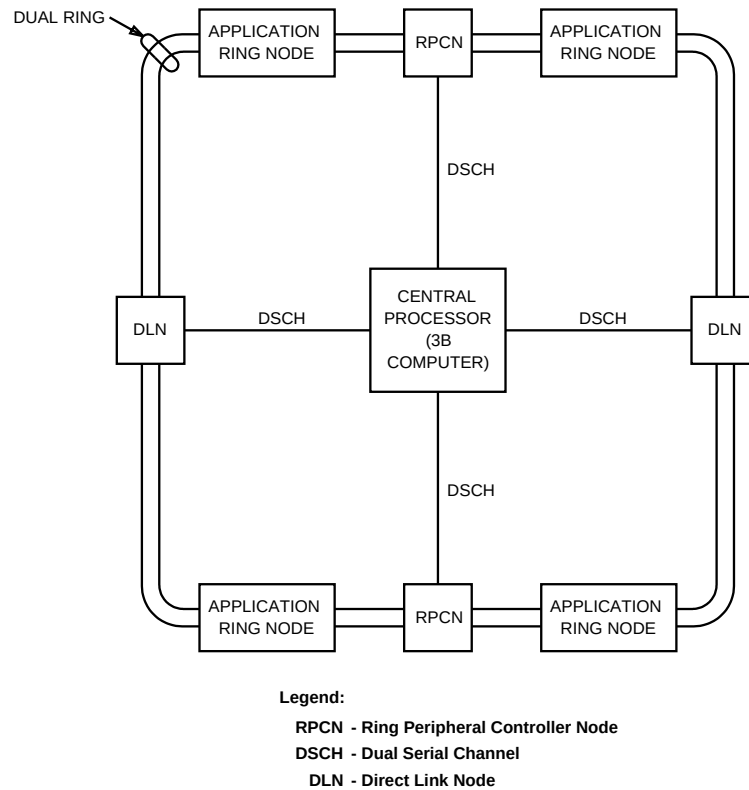


**Figure 1-1. IMS Configuration**

## Software Subsystem Functions

A breakdown of the functions performed by each software subsystem in the central processor and node processor are shown in Tables 1-A and 1-B. The RPCN and LN functions are performed independently from, but in cooperation with, the central processor functions.

The processors used with CNI software include the 3B Computer central processor, the node processor (NP) circuitry of all nodes, and the attached processor (AP) circuitry of DLNs. Each software subsystem has a set of processes operating under the control of central processor software in main memory. These subsystems and associated functions are identified in Table 1-A. The operating system schedules the processes involved so that the operating system functions are performed in coordination with all other processes. Processes in the central processor often communicate with node

processes to perform functions. The CNI/IMS system can relay messages (maintenance messages) between cooperating processes in different processors.

**Table 1-A. Central Processor Functions**

| <b>Subsystem</b> | <b>Functions</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| UNIX RTR         | <ul style="list-style-type: none"> <li>• User PDS command execution and display page access</li> <li>• Audit control</li> <li>• Execution environment for all CNI software</li> <li>• ECD maintenance</li> </ul>                                                                                                                                                                                                                                                                                                                        |
| CNI              | <ul style="list-style-type: none"> <li>• Initialization</li> <li>• Measurement and critical event generation</li> <li>• Measurement data cumulation, history file maintenance, and report generation</li> <li>• CNILOG file maintenance and message outputting</li> <li>• Data base updating (point code routing data, link data, and MOCT data)</li> <li>• Link management and link status auditing</li> <li>• Overload and insanity detection</li> <li>• CCS7 routing and load sharing (MTP and SCCP routing)</li> </ul>              |
| IMS              | <ul style="list-style-type: none"> <li>• System initialization and downloading of nodes</li> <li>• Measurement generation and collection</li> <li>• Error detection, error message analysis, and ring recovery</li> <li>• Maintenance of ring and nodes, and ring reconfiguration</li> <li>• Diagnostics administration</li> <li>• Real-time overload control and insanity detection</li> <li>• Display pages</li> <li>• Ring node control auditing</li> <li>• Software trace reporting control</li> <li>• Message switching</li> </ul> |

In DLNs, the attached processor (AP) circuitry performs application-specific functions. These functions include translations for trunk signaling, network management interface for direct signaling, an interface to the common network interface (CNI) system, and the ability to interface the 4ESS Switch Attached Processor Interface (API) via direct memory access (DMA).

Many of the subsystem functions performed by the RPCNs or the LNs are under control of software in the respective node processor's memory. As in the central processor, in each node processor memory, each subsystem has a set of processes. The node processor contains instructions that schedules these

various processes. Node processor memory is smaller than central processor memory because nodes are responsible for fewer functions. Note that there are only IMS functions in an RPCN because the only role of the RPCN in the interprocess message switch is to move messages between the central processor and the ring.

**Table 1-B. Node Processor Functions**

| <b>Subsystem</b> | <b>Functions</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| IMS in RPCN      | <ul style="list-style-type: none"> <li>• Measurement generation</li> <li>• Error detection</li> <li>• Ring hardware state data administration</li> <li>• Maintenance and stand-alone ring and NP diagnostics</li> <li>• Message flow control to central processor</li> <li>• Local audit control (for example, neighbor node audits)</li> <li>• Signaling message and interprocess message transporting between ring and central processor</li> </ul>                                                   |
| CNI in LN        | <ul style="list-style-type: none"> <li>• Measurement generation</li> <li>• Link interface diagnostics</li> <li>• Overload and congestion controls</li> <li>• Discrimination and distribution of messages from the ring and network</li> <li>• Alternate routing for banded messages</li> <li>• Link and signaling route management</li> <li>• Signaling link protocol execution</li> </ul>                                                                                                              |
| IMS in LN        | <ul style="list-style-type: none"> <li>• Measurement generation</li> <li>• Error detection</li> <li>• Ring hardware state data administration</li> <li>• Maintenance and stand-alone ring and NP diagnostics</li> <li>• Internal overload and overflow control</li> <li>• Local audit control (for example, neighbor node audits)</li> <li>• Signaling message and interprocess message transporting between ring and link</li> <li>• Execution environment for the CNI application software</li> </ul> |

## **Common Network Interface System Description**

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The CNI system consists of a dual serial bus that connects nodes to form a ring (Figure 1-2). All nodes contain the following circuitry and software:

- Node processor (NP) circuitry
- Ring Interface (RI) circuitry
- Special-purpose circuitry (3BI circuit, DLN-Attached Processor circuit, etc.) for Ring Peripheral Controller Node (RPCN) and Direct Link Node (DLN) applications only
- Applicable network facility link interface circuitry
- Software to support ring interface
- Software to determine node function

The node processor circuitry enables the node to perform specific autonomous functions. The ring interface circuitry controls the inserting of messages onto the ring and removing messages from the ring. Due to there being two separate rings and the fact that messages on ring 0 flow in ascending address order and messages on ring 1 flow in descending address order, circuitry for RI0 is different from the circuitry for RI1. Special-purpose circuitry is designed to perform very specific functions that are only applicable to the ring peripheral controller nodes (RPCNs) and direct link nodes (DLNs). Link interface circuitry enables the nodes to be connected to the appropriate network facilities. Software provides the necessary instructions to perform all processes involved to operate the CNI system.

Nodes designed to interface with the CNI system for specific applications (CCS7, DCHN, SADC, etc.) are commonly referred to as application link nodes. Nodes that provide access to the central processor are referred to as ring peripheral controller nodes (RPCNs) and nodes that aid in performing signal processing normally performed by the central processor (3B Computer) are referred to as direct link nodes (DLNs). An example of one DLN function is the sending and receiving of CCS information to and from the Attached Processor Interface (API) via the 3B Computer direct memory access (DMA) buffers. All nodes are interconnected by a dual ring bus which provides access between all nodes for internode communication. This system of interconnected processors uses an internal packet communication protocol which is independent of any application network protocol. Furthermore, the ring does not determine the destination of the data given to it. That determination is made by the nodes.

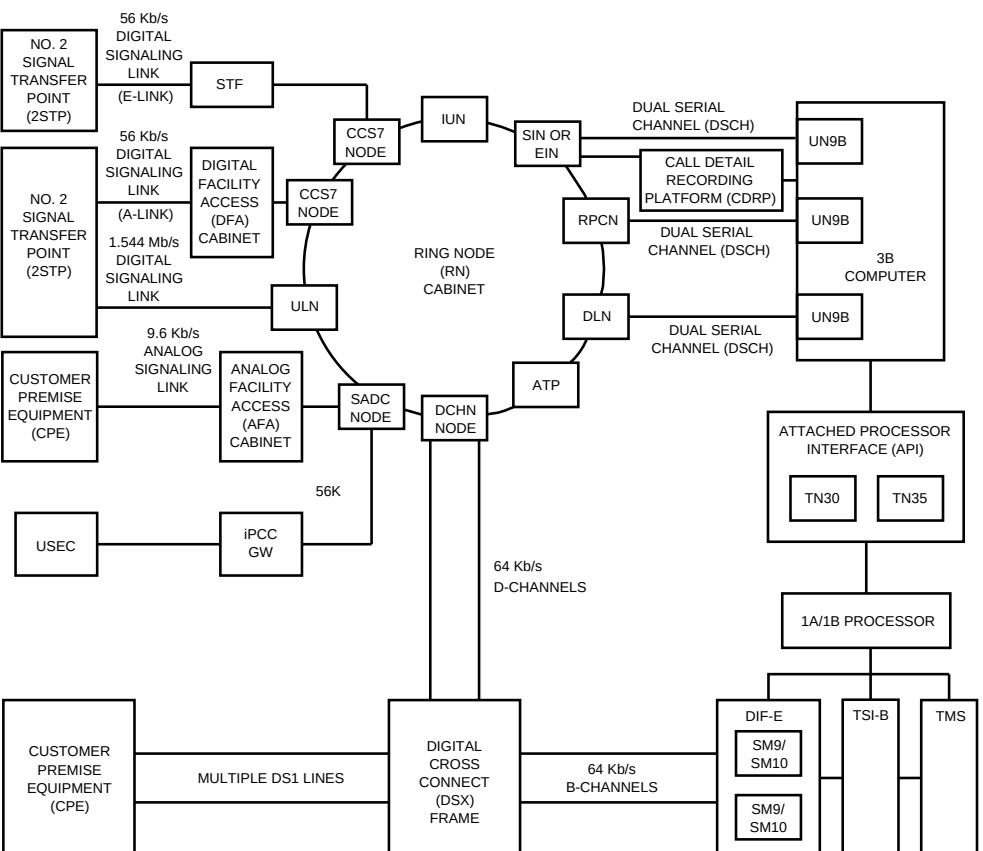


**Figure 1-2. Common Network Interface (CNI) Ring—4ESS™ Switch Application**

In the physical sense, nodes consist of a group of circuit packs that are mounted in units housed in cabinets. The ring is actually a high-speed data bus between the nodes. The nodes interfacing with the central processor (3B Computer) connect to DMA controllers in the central processing unit via high-speed dual serial channels (DSCHs).

The following is a typical example of the node switching function:

1. A message arrives at the node.
2. The node determines if the message is to be routed directly to an outgoing node or routed to the central processor (3B Computer) for additional processing.
3. Messages destined to an outgoing node are passed around the ring until the desired outgoing node is reached, removed from the ring, and appropriately processed for final disposition.
4. Messages destined to the central processor (3B Computer) for additional processing is routed to the central processor, additional processing performed, and retained in the central processor for final disposition or returned to the ring with an identified outgoing node designation. Messages returned to the ring with an identified outgoing node destination are passed around the ring until the desired outgoing node is reached, removed from the ring, and appropriately processed for final disposition.

The CNI system function of moving messages around the ring is basically accomplished using the node circuitry described in the preceding paragraph. However, to transfer messages between the node processor of specific node applications and the appropriate network facility requires link interface (LI) circuitry. The link interface circuitry converts node processor messages to a compatible format that interfaces with the appropriate facility access circuits.

Since many CNI system functions require considerable processing power and are often centralized functions, the ring and nodes themselves are not sufficient to establish a complete CNI system. Therefore, a centralized computer or central processor is required to complete the system. This central processor is the 4ESS Switch Attached Processor System (APS) 3B Computer. Special nodes have been designed to interface the ring to the 3B Computer. These nodes are identified as the RPCN and DLN.

As with other nodes, the RPCN contains node processor and ring interface circuitry as previously described. In addition, the RPCN contains 3B interface (3BI) circuitry that allows the RPCN to communicate with the 3B Computer duplex dual serial bus selector (DDSBS) circuitry. This communication consists of 3B Computer DDSBS control signals and RPCN 3BI control signals. Communication between the 3B Computer and RPCN is via a DSCH that bidirectionally transfers data in a serial format.

As with the RPCN, the DLN contains node processor, ring interface and 3B interface circuitry as previously described. The DLN also uses a dual-serial channel as its communication medium to and from the 3B Computer. In addition to this circuitry, the DLN uses direct link node-attached processor (DLN-AP) circuitry that allows the DLN to perform specific signaling message processing. The DLN-AP circuitry contains dual-port random access memory (DPRAM) that is used to store application specific software. This circuitry along with the ability of the DLN to interface with the 3B Computer gives the DLN its message processing capabilities.

Interframe buffer (IFB) circuitry is also a part of the ring. The IFB circuitry is basically designed to overcome certain physical limitations of the ring hardware. Other than to effectively increase the length of the ring, the IFB circuitry does not affect the function of the ring. However, placement of interframe buffers is important when configuring a ring.

The CNI equipped 4ESS Switch provides for the use of various application link nodes. These application link nodes include the following:

- a. Common Channel Signaling No. 7 (CCS7) nodes
- b. D-Channel (DCHN) nodes
- c. Special Access Data Channel (SADC) nodes
- d. International Link Node (ILN)
- e. IMS User Node (IUN)
- f. AT&T Trigger Platform (ATP) Node
- g. SCSI Node (SIN) or Ethernet Interface Node (EIN)
- h. Universal Link Node (ULN)

The *CCS7 node* is designed to route signaling messages between nodes within the domestic common channel signaling (CCS) switching network. The CCS7 node is supported by the CCS7 protocol. The CCS7 protocol meets all requirements as defined by the North American Standard and International Telegraph and Telephone Consultative Committee (CCITT) specifications. Each domestic CCS7 node is associated with a single 56 kb/s signaling link via a digital facility access (DFA) circuit or with the ULN, which operates at 1.544 Mb/s.

The *Signaling Transport Footprint Standardization* feature, available in 4ESS switch with the 4E22 R1 generic program, allows the signaling transport equipment to be included in the new frame, the Signaling Transport Frame (STF) which is placed in a standard location per technology footprint. The Golden Path requirements require the placement of equipment within the element footprint (at least 6 feet apart) at each end point of the signaling Transport facilities that the



equipment supports. (This is done such that single facilities do not result in service disruption). Refer to Figure 1-3.

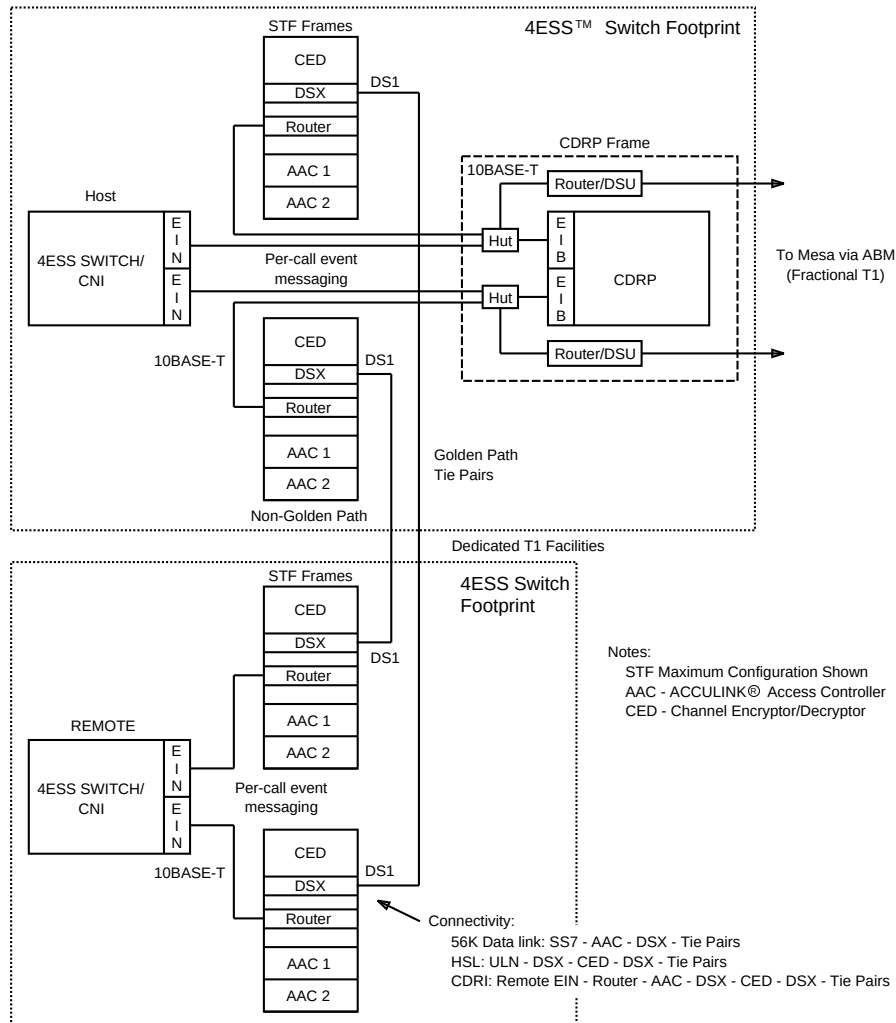


**Figure 1-3. Signal Transport Footprint Standardization with 4ESS™ Switch**

The *DCHN node* is designed to provide direct digital connections from customer premise equipment (CPE) to the CNI equipped 4ESS Switch office. The DCHN node uses the Q.931 and LAP-D (link access protocol-DCHN) protocols. The DCHN node can provide up to eight 64 kb/s clear or restricted channels. The DCHN nodes can be assigned to operate as mated pairs to form a backup configuration. One node is designated "active", and the other "standby". The active node is functional at both the Q.931 and LAP-D protocol levels; whereas, the standby node is only functional at the LAP-D protocol level until the designated active node fails. The D-Channel Expansion Feature, in CNI software Release 13.4 for 4ESS switches with the 4E23R1 generic program, increases the number of D-channel terminations in the 4ESS switches by equipping two additional HDRN cabinets in the CNI ring. The additional cabinets support 288 D-Channels. This feature is dependent on the APS upgrade to 3B21D Processor in all 4ESS switches to gain more 3B memory and real time.

The *SADC node* is designed to provide digital connections from customer premise equipment (CPE) to the CNI equipped 4ESS Switch. The SADC node uses the SADC (AT&T defined for special purpose access) and LAP-B (link access protocol-balanced) protocols. The SADC node can provide up to two 9.6 kb/s channels or a single 56 kb/s channel that interface with the network facilities via modems (2048A datasets or equivalent).

The SADC node also connects to the IPCC as shown in Figure 1-2. The 4ESS switch USEC IPCC architecture provides communication between a 4ESS switch and its USEC frames via a device that is referred to as a Gateway. The Gateway can support a maximum of four 4ESS switches in a central office. The architecture requires dual SADC nodes on the CNI ring, dual Gateways, and a dedicated Common Processor (CP) port on each USEC frame. For redundancy, dual SADC nodes function in the active/standby mode, and dual Gateways (Primary and Secondary) function in the active/active mode. The 4ESS switch sends information to the Gateway via the active SADC node on the CNI ring.

The *ILN* is a special node designed to be used with the CNI equipped 4ESS Switch International Switching Center (ISC). The ILN is designed to interface with both the international and domestic CCS networks. World (W)-links connect the international switching center ILNs to the international CCS network. The W-links provide 64 kb/s clear, nonencrypted channels via either satellite or terrestrial cable. The ILNs are designed to use both the CCITT7 and the CCS7 protocols. The CCITT7 protocol is used for all communications to and from the international common channel signaling (CCS) network while the CCS7 protocol is used for all communications to and from the domestic common channel signaling network. The ILN must also be able to support the interworkings between the telephone user part (TUP) and ISDN User Part (ISUP) protocols. The TUP protocol is used for call processing functions within the international CCS network while the domestic CCS network uses the ISUP protocol. One task that is unique to the ILN is the interpretation of ISC identification header formats. The domestic CCS network identifies ISCs with a 24-bit header format; whereas,

the international CCS network identifies ISCs with a 14-bit header format. To avoid complexity, the CNI system central processor (3B Computer) and direct link node assumes that all header formats contain 24 bits. Therefore, when an outgoing international message is received at the ILN from the domestic CCS network, the 24-bit domestic header is replaced with a 14-bit international header. When an incoming international message is received at the ILN from the international CCS network, the 14-bit international header is padded with ten zeros to create a 24-bit domestic header.

The *IUN* is used by the 4ESS Switch CNI system to pass the token to the next node on the ring without providing any facility access. The IUN is used without any link interface circuitry. However, link interface circuitry can be added in the future to convert the IUN to a totally functional node.

The *IRN* is designed and used by the CNI system to pass the token to the next node on the ring without providing any access to the ring. The IRN is designed without any link interface circuitry. However, one difference between the IRN and the IUN is that the IRN is designed with a high density backplane.

The *ATP* node is designed to control the functionality of calls requiring in-band/trigger detection for the duration of a call. In-band monitoring is achieved using SCS monitor capable ports; the ATP node controls the SCS ports by sending/receiving messages to the 1B processor via the DLN/API. Out-of-band trigger detection is achieved by the 1B processor converting signaling information into messages that get sent to the ATP node via the DLN/API. A provisional database, pumped from the 3B20 computer, specifies how to control a particular type of call. For example, ATP defines the valid triggers for a particular type of call, and the actions that should occur when those triggers are detected. The ring supports two ATP nodes, one active and the other standby. The ATP node does not have associated signaling links.

The *SCSI Node* (SIN) is designed to transmit Call Detail Recording (CDR) data to the CDR Platform (CDRP). Currently, CDR data is the data used to make Automatic Message Accounting (AMA) records and International CDR (ICDR) records. Data is transferred from the 3B Computer to the SIN via a Dual Serial Channel (DSCH) link. The data is forwarded to the CDRP over a Small Computer Systems Interface (SCSI) link. The ring supports two SIN nodes, one with the "active" link and the other with the "standby" link. Data is transmitted through the node with the active link. The node with the standby link can take over anytime the node with the active link fails.

The *EIN*, in CNI Software Release 11.4 for 4ESS switches with the 4E21R2 generic release, replaces the SIN. The EIN provides the connectivity for the CDRP to the APS and a path for transferring data between the APS and the CDRP. The data, coming into the APS memory from the 1B processor in the 4ESS switch via the attached processor interface (API), is transferred directly to the EIN over the DSCH bus. The EIN reads the data from the 3B computer and

sends it to the CDRP over the Ethernet. The EIN feature replaces the SIN and SCSI link interface with the EIN and the Ethernet Link Interface (ELI). The ring supports two EIN nodes; one is "active" and the other "standby"; the same as the SIN.

The *ULN* is a node type that is available with CNI software Release 11.4 and later. The ULN serves as a platform for the High-Speed A-Link (HSA) feature that allows 4ESS switches to access CCS7 Networks via 1.544 Mb/s A-Links. During transition to ULN, linksets contain both HSA (1.544 mb/s) and 56 kb/s links.

 **NOTE:**

A 56 Kb/s linkset that uses Basic Error Correction (BEC) available with 4ESS switch generic programs 4E21R4 and 4E22R1 and contains a satellite link **cannot** contain a 1.544 Mb/s link.

## **Common Network Interface System Operation**

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The operation of the ring is intended to be transparent to users; that is, the messages need only specify their destination, and the ring then handles the "how to get them there." Because the ring operates autonomously, no user software action is normally required to keep the ring operational. Manual maintenance actions require craft/machine interfaces via input/output messages.

Nodes are connected serially by a data bus to form the ring. Rings 0 and 1 are independent of each other while one is designated as ACTIVE and the other as STANDBY. The ACTIVE ring is used for traffic and message handling. The STANDBY ring is used to carry internal maintenance messages. The rings propagate data in opposite directions. Nodes are designed so that faulty equipment may be temporarily removed from service. A node may be either isolated, not part of the active ring segment, or quarantined, part of the active ring segment, but not operational. The node processor (NP) circuitry of a quarantined node is electrically separated from the ring. The ring may, at any point in time, contain both an active segment and an isolated segment. Only internal maintenance messages can be transmitted on the isolated ring segment.

The hardware that interfaces with the node processor (NP) circuitry to the ring is the ring interface (RI) circuitry. There are two RI circuit packs (RI0 and RI1). The NP and the RIs combined are referred to as a node. As shown in Figure 1-4, each RI consists of a pair of independent ring access circuits (RACs) and data selectors (DSs). Each RAC operates functionally as a buffer and allows messages to be inserted onto, removed from, or passed along a specific ring. The node processor circuitry communicates with each of its RACs via direct memory access buses. The DSs are used to redirect data from one ring to another in order to form an isolated segment; that is, rings 0 and 1 looped back on each other as shown in Figure 1-5.

While a message is in the RAC, it is examined by the RAC controller to determine its disposition. If the message is destined for that particular node, the node processor (NP) direct memory access (DMA) controller is instructed to read the message into NP memory. Each node has a set of buffers in NP memory used by the RAC controller when sending messages between the ring and a node. If the message is not destined for that particular node, the message is forwarded to the next node on the ring.

A special message called the token message travels around each ring and allows other messages to be placed on the ring without causing congestion. A node waits until the token message is detected in the RAC of the upstream node, holds the token there, sends any pending messages onto the ring, and then lets the token continue. Data on the ring is passed from one RAC to the next in an asynchronous fashion. Some RACs have a token track flip flop

(TTFF) that is used to locate token errors. Messages can be written in blocks (packets) containing either a single message or multiple messages. These packets are delivered to their destination node using the hardware physical address and the address specified in the message. In addition to the address, a destination channel may also be specified in the message. The destination channel is used to indicate which software function receives the message. Senders and receivers (that is, software) know which channels they are concerned with and insert the appropriate data (destination channel) into a message before transmitting it.

The following are the normal sequences for writing to and reading from the ring. These sequences are used by both a normal ring and a ring with isolated or quarantined nodes.

**a. To write a packet onto the ring:**

1. Messages are queued in the node processor (NP) buffer until the token is detected by the ring access circuit (RAC) at the upstream node (that is, node N+1 writes to the ring while the token is held in the RAC of node N).
2. The token is held in the upstream ring access circuit (RAC), and the direct memory access (DMA) controller sends all waiting messages onto the ring. However, if the total size of the write exceeds the maximum size of one message, the waiting messages are broken up into blocks no larger than the maximum size message. In this case, it may take multiple token visits to write all waiting messages onto the ring.
3. The sender is notified of direct memory access (DMA) completion, and the token is allowed to continue.

**b. To read a packet from the ring:**

1. The *ring access circuit* (RAC) detects the RAC node address in the messages and activates the direct memory access (DMA).
2. The *DMA controller* sends the message to the node processor (NP) buffer.
3. The message is queued onto the appropriate channel. If there are multiple messages that are back-to-back on the ring and they are all destined for the same node, the messages are all transferred into the NP memory before the software distributes them to the appropriate channels.

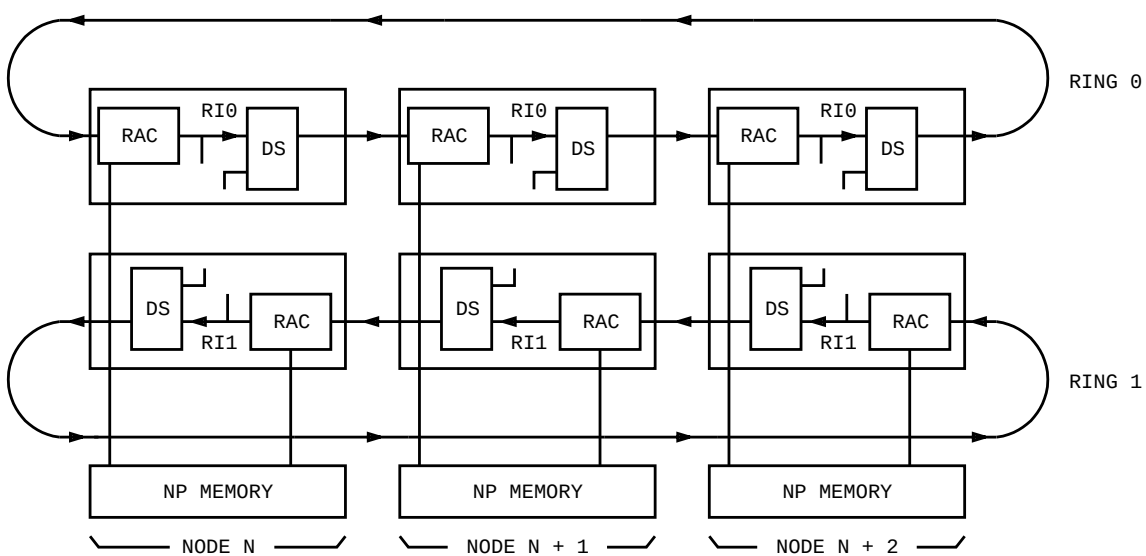


Figure 1-4. Dual Ring Structure — Normal

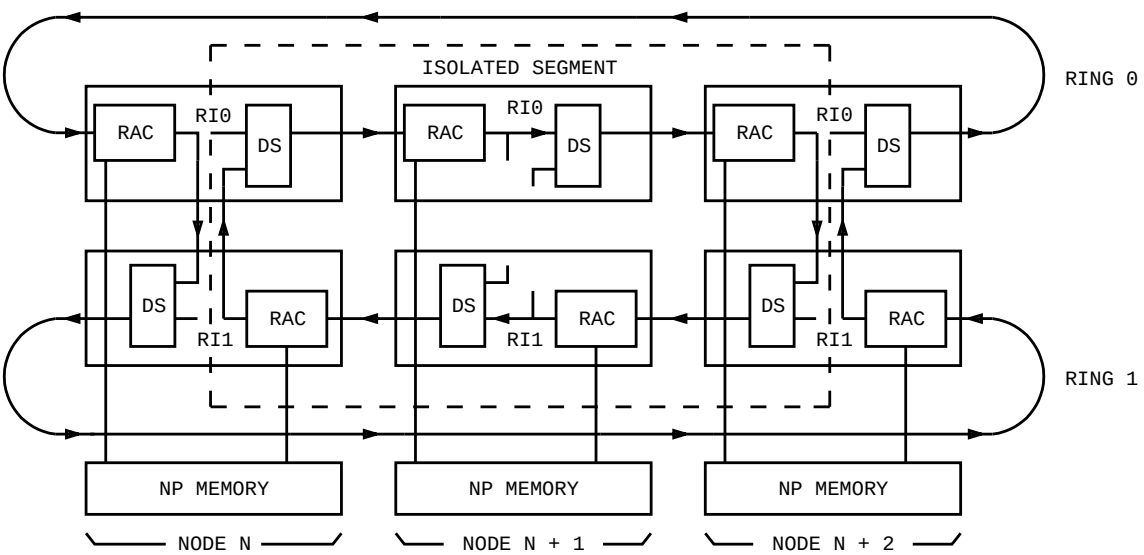


Figure 1-5. Dual Ring Structure - Isolated



Nodes are peripheral processors through which digital information enters the ring, exits the ring, or is processed further. To a degree, each node is dependent on the proper operation of other nodes. All nodes must recognize and report internal failures or ring failures to the central processor for analysis and corrective action. In some cases, special purpose nodes (RPCNs, DLNs, etc.) autonomously attempt to recover from a failure. However, severe failures require the aid of the central processor. The CNI hardware and software contains logic for detecting faulty equipment. The central processor can remove equipment from service and, if necessary, reconfigure the ring around the faulty equipment. Software identifies a beginning and ending node for the isolated segment and instructs these nodes (BISO and EISO ) to redirect rings 0 and 1 to isolate the faulty nodes. It is important to note that the BISO and EISO nodes are not part of the isolated segment but are its neighbors. The isolated nodes can then be diagnosed and/or repaired. If no faults are found, the ring can be reconfigured again and the nodes restored to service. Equipment failures associated with the ring are grouped into the following major classes:

- a. **Ring Down**—The ring is totally unusable. Some cases include hardware faults where there is no communication between the ring components; the 3B Computer may not be responding to the RPCNs; no ring traffic when the 3B Computer is operating normally, and/or both the ring and the central processor are down.
- b. **Multiple Node Isolation**—There may be faulty and nonfaulty nodes in the isolated segment. The affected nodes are in the out-of-service (OOS) isolated state and are not part of the active ring. This is usually due to hardware problems in two or more ring nodes that make normal operation in the ring impossible. Nonfaulty nodes in the segment are innocent victims.
- c. **Single Node Isolation**—The faulty node is out-of-service (OOS) and is not part of the active ring. This state is differentiated from the previous state because only one node is in the isolated segment.
- d. **Node OOS-Quarantined**—This state is the normal out-of-service (OOS) state when the node is not isolated; there may also be an isolated segment elsewhere on the ring. In this state, other nodes in the active ring may send messages through the ring interface (RI) of the faulty node. The faulty node itself may not communicate with the ring.
- e. **Unexplained Loss of Token**—This is an obscure error condition and the cause is unknown. A software token-tracking procedure is called each time this error occurs.

## **Common Network Interface System Reliability Features**

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The CNI system reliability features aid in eliminating unplanned downtime. Some of the following features are included:

- Node Initialization
- Full Process Initialization
- Critical Node Restore
- Protected Application Segment.

### **Node Initialization**

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Prior to the node initialization feature, all node restorations required that the node be pumped with text and data. The node initialization feature increases system availability by allowing nodes to be restored without being pumped.

Originally, when a node experienced a hard panic, the node was placed in the quarantine state and processes returned to boot monitor. The 3B Computer detected an out-of-service (OOS) node and issued a restore node request. A reset message was sent to the node causing it to start the "boot read-only memory" initialization process.

With the node initialization feature, most hard panics are converted to panic types. If a node experiences a firm panic, the node is placed in the quarantine state. The 3B Computer detects the out-of-service (OOS) node and the CNI system is informed that the node is no longer active. The IMS software starts a checksum audit of the nodes text and data. If the audit is successful, the node is reinitialized. If the audit is unsuccessful, the node is returned to boot monitor processes and is reinitialized with a complete pump of text and data.

### **Full Process Initialization**

---

The full process initialization (FPI) feature provides a faster and more reliable initialization response than the abort and boot initialization. The difference is in determinism, disk access, resource handling, and dependence on low level processes. The current boot scheme is as follows:

1. All CNI and IMS processes are terminated.
2. The CNI USER creates CNIINIT.
3. CNIINIT creates and sequences it's critical child processes.
4. "imsdrv.p" creates and sequences it's critical child processes and initializes the ring.
5. The CNI USER along with the CNI SLMK process, starts ring traffic.
6. Non-critical CNI and IMS processes (measurements, pages, etc.) are created and sequenced.

The full process initialization simulates a CNI level 2 initialization so that no disk access is required for the initialization to successfully complete. In addition, all CNI and IMS processes are involved in the initialization. The full process initialization proceeds as follows:

1. The CNI USER grants CNIINIT permission to begin the initialization.
2. All processes using IMS channels must terminate the use or the use is terminated.
3. CNIINIT will "sync" with and sequence the CNIINIT critical children.
4. "imsdrv.p" initializes the ring.
5. The CNI USER, along with the CNI SLMK process, starts ring traffic.
6. Non-critical processes (measurements, pages, etc.) are recovered.

## **Critical Node Restore**

---

Out-of-service nodes are restored by the IMS *Automatic Ring Recovery* (ARR) feature, which uses a priority list to determine which out-of-service nodes to restore first. If all nodes are out-of-service, the ring has no communications with the outside world and a high-priority straggly must be assigned for restoring the nodes. The ARR priority list reserves the priority four indicator to identify "user critical" nodes. Using this priority, CNI software can nominate nodes required to restore contact between the ring and the outside world. This nomination is performed by a module called the *critical node monitor*.

If all DLNs are out of service, the critical node monitor sends a message nominating a DLN to be put in priority four on the ARR priority list. Every 5 seconds the critical node monitor checks to see if the node was restored. If it is determined that the node cannot be restored, then the critical node monitor nominates another DLN until one is restored. The same procedure is performed if all nodes are out-of-service. The critical node monitor stops nominating when at least one DLN and one node has been restored.

## **Protected Application Segment**

---

The CNI data that rarely changes is referred to as *static data* and is kept in the protected application segment (PAS) of the 3B Computer memory. The PAS is a sanctuary in the 3B Computer memory which is preserved over all UNIX system RTR initializations except for a level 54 initialization. The CNI system re-uses its static data from PAS during CNI init level 2, to save time that would be wasted downloading the data from disk.

To make PAS data safe to use, it must be protected from processes that might accidentally write in it. For this purpose, CNI incorporates the "PAS Write Access Limitation" feature which limits the processes that can write in PAS. In addition, CNI upgrades this area to be "write protected" which limits not only which processes can write, but also when the permitted processes can write.

# Hardware Description and Functions

# 2

## Contents

|                                                    |      |
|----------------------------------------------------|------|
| <b>General</b>                                     | 2-1  |
| <b>Equipment Features and Requirements</b>         | 2-2  |
| ■ Physical Design Features                         | 2-2  |
| Cabinets                                           | 2-2  |
| Units                                              | 2-3  |
| Backplanes                                         | 2-3  |
| Circuit Packs                                      | 2-3  |
| ■ Environmental Requirements                       | 2-4  |
| Heat Dissipation                                   | 2-4  |
| Temperature, Humidity, and Altitude                | 2-4  |
| Electromagnetic Compatibility                      | 2-4  |
| ■ Power Distribution                               | 2-5  |
| <b>Equipment Descriptions</b>                      | 2-6  |
| ■ Ring Node Cabinet                                | 2-6  |
| General                                            | 2-6  |
| Link Node Units                                    | 2-10 |
| DS1 Units                                          | 2-10 |
| 3B Interface Unit                                  | 2-11 |
| Integrated Ring Node Unit                          | 2-11 |
| Ring Peripheral Controller Node Circuit Packs      | 2-17 |
| Direct Link Node Circuit Packs                     | 2-19 |
| Small Computer System Interface Node Circuit Packs | 2-20 |
| Ethernet Interface Node (EIN) Circuit Packs        | 2-21 |
| Application Link Nodes Circuit Packs               | 2-22 |

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## Contents

|                                             |      |
|---------------------------------------------|------|
| Universal Link Node (ULN) Circuit Packs     | 2-24 |
| AT&T Trigger Platform (ATP) Circuit Packs   | 2-25 |
| International Link Node Circuit Packs       | 2-25 |
| T1 Facility Access Circuit Pack             | 2-26 |
| Interframe Buffer Circuit Packs             | 2-26 |
| Fuse and Control Panel                      | 2-27 |
| Fan Units                                   | 2-28 |
| ■ Digital Facility Access Cabinet           | 2-28 |
| Digital Service Unit                        | 2-29 |
| Channel Service Unit                        | 2-34 |
| Digital Service Adapter                     | 2-35 |
| AC Power Unit                               | 2-38 |
| Fuse and Control Panel                      | 2-40 |
| ■ Signaling Transport Frame (STF) Cabinet   | 2-41 |
| Single Signaling Termination Element        | 2-42 |
| High Speed Links                            | 2-42 |
| High Speed Links Encryption                 | 2-43 |
| Golden Path Project                         | 2-43 |
| <b>Equipment Addressing and Assignments</b> | 2-44 |
| ■ Node Addressing                           | 2-44 |
| ■ Node Assignments                          | 2-44 |
| ■ Facility Assignments                      | 2-45 |

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## Hardware Description and Functions

# 2

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### General

This section provides a physical and functional description of the CNI system hardware as equipped for and applicable to the 4ESS™ Switch. This section also describes CNI system equipment features and requirements, equipment descriptions, and equipment addressing and assignments.

The CNI system uses the 3B Computer as its central processing unit. The central processor interfaces with a community of peripheral processors known as nodes arranged in a ring-type local network. The nodes that interface with the central processor connect to direct memory access (DMA) controllers in the central processing unit via high-speed dual serial channels (DSCHs). *Nodes* are defined as access points on the ring where digital information either enters onto the ring, exits the ring, or is processed further. Digital information is transferred to and from the central processor for processing via special nodes known as ring peripheral controller nodes (RPCNs). Digital information enters from and exits to transmission facilities via other nodes known as application link nodes. All nodes are serially connected by the dual rings which propagate data in opposite directions and permit ring reconfiguration as part of automatic fault recovery. This redundancy in the ring design is partly responsible for the system's high level of availability.

In the physical sense, nodes consist of a group of circuit packs mounted in units that are housed in cabinets. The ring is actually a high-speed data bus between these nodes. Interconnection to a facility from the nodes is made through facility access circuits. Facility access cabinets contain the facility access circuits, data sets, and other circuits that permit access to signaling links (SLKs). Distribution frames provide terminations to make transmission facility assignments to specific

signaling links. In addition, distribution frames permit a convenient method to reassign terminations.

Signaling links are the medium by which messages are transferred to and from CNI systems in the domestic Common Channel Signaling (CCS) network, international CCS network, and special access customer premise equipment. Signaling link transmission rates vary according to the application for which the signaling link supports. Both digital and analog signaling links may exist in a CNI system.

## **Equipment Features and Requirements**

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### **Physical Design Features**

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A modular approach to the physical design of the CNI system hardware has been emphasized in order to achieve the flexibility necessary to configure a specific system to its end requirements. Except for some miscellaneous circuits, all interunit and intercabinet wiring is connectorized. This permits system growth and changes to be made with a minimum of cabling difficulties. The equipment is bolted together and secured to the building in individual cabinet line-ups. The equipment has been designed to meet the New Equipment Building Standards (NEBS) and restrictions of Underwriters Laboratories (UL).

### **Cabinets**

The basic support structure for all related equipment is a steel cabinet enclosure. All units, backplanes, and circuit pack assemblies must be matched to the application cabinet. The steel cabinet enclosures are equipped with doors on the front and back. The rear doors are ventilated. Cabinets are 6 feet 4 inches high, 2 feet 2 inches wide, and 2 feet 6 inches deep. Each cabinet is equipped with casters and leveling feet that are insulating, nylon-type, and adjustable. A skirt is provided to conceal the feet and enclose the space at the bottom of the cabinets. Cabinets are bolted together, side-by-side, to form a single cabinet lineup. Cabling between cabinets is routed via overhead cabling racks or through holes provided in the side of the cabinets.

Within the cabinets, the individual unit assemblies are supported by mounting plates. Mounting plates span the area between the cabinet uprights and the height is determined by the units they support. The units, backplanes, and circuit packs described below are all housed in cabinets.



In the small scale integrated (SSI) ring node cabinet, the cabinets are designated 00 and 32. In the High Density (HD) ring node cabinet, the cabinets are designated 06 and 38. In the Gateway Cabinet, the cabinets are designated 28 and 60. With the D-Channel Expansion Feature, available in CNI Software Release 13.4, the number of D-channel terminations is increased by equipping two HDRN cabinets with up to six shelves. These HDB cabinets are designated 12 and 14 or 44 and 46.

## **Units**

Shelf units form the basic building block for cabinets. Shelf units are formed from various parts such as apparatus mountings, card guides, circuit packs, connectors, and interconnecting wiring. Circuit packs and other equipment are housed in apparatus mountings that are attached to the mounting plate. Within the apparatus mountings are guides that align the circuit packs with the connector pin field on the backplane. The backplane is also attached to the mounting plate.

## **Backplanes**

The backplane assembly provides the means of making intercabinet and intracabinet connections via the printed wiring board connectors and backplane pin fields. The backplane assembly also supports mechanical alignment of the apparatus mountings and circuit packs. The mounting plate provides the structural support for both the apparatus mountings and the backplane assembly. The apparatus mountings, circuit pack organizers, are attached to one side of the mounting plate, and the backplane assembly is attached to the other side.

Circuit pack connectors plug onto a field of square pins (25-mil) placed on 0.125 inch centers. The pins are press-fitted into an epoxy-glass backplane. The backplane may be unplated and serve only as a holder for the pins which can be wire-wrapped on the opposite side. However, in most cases, a double-sided or multilayer-printed wiring board is used. The backplane terminals are finished with a hard gold plate and are inserted from the equipment side of the backplane. They extend 0.700 inch from either side of the backplane. Before assembly, a cover coat is applied over the backplane to prevent short circuits caused by possible solder smears or foreign matter. After assembly, the pins are straightened to ensure proper alignment.

## **Circuit Packs**

Circuit packs are housed in apparatus mountings. Within the apparatus mountings are guides to align the circuit packs with the connector pin field at the back of the shelf assembly. All circuit packs are keyed to prevent the insertion of a wrong circuit pack in a slot. The circuit packs within a unit are horizontally

spaced across the cabinet with sufficient space between the boards to provide air flow for cooling.

## **Environmental Requirements**

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### **Heat Dissipation**

In general, the CNI system can be characterized as a high heat system. The heat dissipation of equipment cabinets vary up to a maximum of 1740 watts with a maximum of 25 watts per circuit pack. The integrated circuits used in circuit pack designs require that the operating circuit board temperature does not exceed 70 degrees Celsius—158 degrees Fahrenheit. This temperature restriction aids in ensuring reliable circuitry operation.

Where necessary, cabinets are equipped with DC powered fans to ensure that maximum operating temperatures are not exceeded even under the worst case of office ambient temperature conditions. The fan units are designed to draw ambient office air into the bottom of the cabinet and move it vertically through circuit pack mountings above the fan unit. Covers are provided on the front of units to prevent air leaks. To further prevent air leakage, there is virtually zero clearance between units as they are successively stacked in a cabinet. To maintain cooling efficiency, the air intake at the fan unit and the air outlet at the top of the stack must be kept free of physical obstructions. The fan unit is equipped with a filter that must be periodically replaced to keep the filter from becoming dirty or clogged. Maximum cooling performance requires strict adherence to specified filter maintenance routines.

### **Temperature, Humidity, and Altitude**

The CNI system equipment has been designed to remain operational when installed in central offices located from 200 feet below sea level to 10,000 feet above sea level. Room ambient temperature and humidity limits are identified in Table 2-A.

### **Electromagnetic Compatibility**

The CNI system equipment has been designed for electromagnetic compatibility (EMC) with existing switching office equipment. The equipment operates properly in an environment where ambient Radio-frequency (RF) fields are equal to or less than 10 volts per meter. In addition, the CNI system equipment has been designed to minimize electromagnetic interference (EMI). Electrostatic discharges damage CNI equipment. Therefore, a grounded anti-static wrist strap must be worn when handling equipment. The wrist strap should be connected to a ground that is common to the equipment ground. When an appropriate wrist strap is not available, always touch grounded metal before handling equipment. Never pass an unprotected piece of equipment to a person that is not grounded.

**Table 2-A. Environmental Limits**

| <b>Description</b>                                                                         | <b>Limit</b>      |
|--------------------------------------------------------------------------------------------|-------------------|
| Operating temperature                                                                      | +40° F to +100° F |
| Short-term temperature (less than 72 consecutive hours and not more than 15 days per year) | +35° F to +120° F |
| Nominal (or wide band) temperature                                                         | +65° F to +80° F  |
| Maximum rate of temperature change                                                         | 15° F per hour    |
| Operating relative humidity*                                                               | 20% to 55%        |
| Short-term relative humidity*                                                              | 20% to 80%        |

\*Relative humidity considerably less than 80% occurs for ambient temperatures above 95° F. During a short-term emergency condition of 120° F, the relative humidity should be below 20%.

### **Power Distribution**

A -48 volt power supply is required to supply all load units associated with the CNI system. Each cabinet load unit is powered by "ORed" power. 495FA power converters are used to supply power to nodes. Power converters are configured to minimize the number of nodes that fail due to a single converter failure. Each ring peripheral controller node (RPCN) is powered by a single converter. The power distribution for direct link nodes (DLNs) is the same as power distribution for application link nodes. Power distribution in the analog facility access (AFA) and digital facility access (DFA) cabinets is diversified so that in the case of a fuse or power failure, only one-half of the associated units are affected.

The 4ESS Switch office provides a backup power supply for both the 3B Computer and CNI system. The backup power supply allows the equipment to function without a capacity loss during adverse primary-power failures.

## **Equipment Descriptions**

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### **Ring Node Cabinet**

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#### **General**

The ring node cabinet (RNC) (Figure 2-1) provides ring bus connections between the nodes, access to the application, and access to the 3B Computer. Each ring node cabinet contains application link nodes, ring peripheral controller nodes (RPCNs), and direct link nodes (DLNs). The number of cabinets required is determined by the traffic forecast for each office. However, a minimum of two ring node cabinets is required for the 4ESS Switch application. The ring bus within the cabinet consists of short backplane wiring between the nodes within the cabinet. The ring bus between the cabinets consists of a balanced cable pair.

Each ring node cabinet must contain at least two interframe buffer (IFB) circuit packs to allow proper data transmission over the intercabinet cabling. The IFB circuitry is provided to make an electrical transition between the ring bus (balanced cable pair) and TTL-type signals associated with a node's ring interface circuitry. Therefore, an IFB circuit pack is required where the ring bus enters, before first node, and exits, after last node, the ring node cabinet.

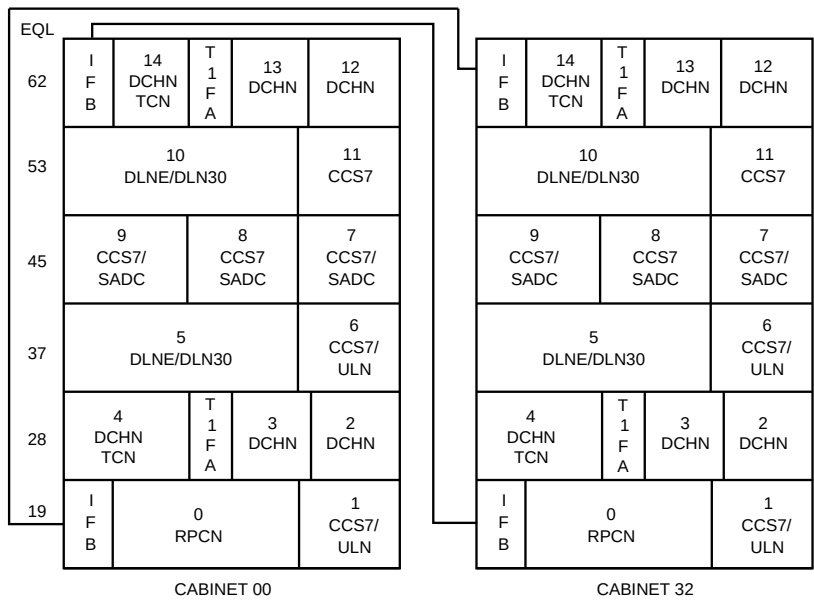
The ring node cabinet equipment is housed in the following 132B apparatus mountings:

- a. Link Node (LN) units
- b. DS1 units
- c. 3B Interface (3BI) units
- d. Integrated Ring Node (IRN) Unit.

The apparatus mounting units are designed to accept required DC-to-DC converters and circuit packs in addition to providing the necessary backplane wiring to construct the following:

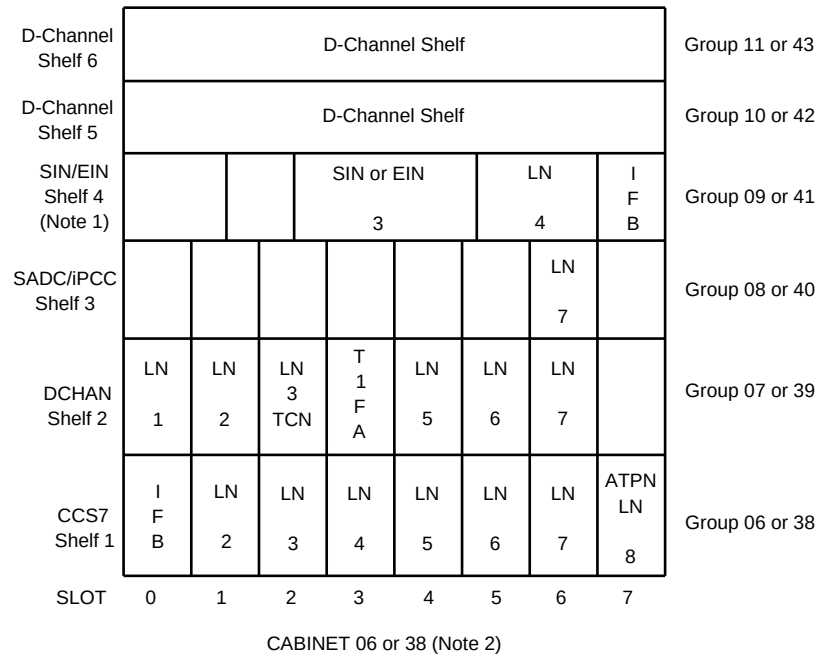
- a. Special purpose nodes (RPCNs and DLNs)
- b. Application link nodes (CCS7, SADC, DCHN, and ULN)
- c. International link nodes (ILNs)
- d. Other applicable circuitry (IFBs, T1FAs, etc.).

The ring node cabinet also contains a fuse and control panel and fan unit assemblies.



Small Scale Integrated (SSI) Ring Node Cabinet Layout

Figure 2-1. Typical Ring Node Cabinet Layout (Sheet 1 of 3)



NOTE 1: SIN Shelf may be installed in Position 3 if office is NOT equipped with an SADC node (for iPCC). However, it will still be numbered 09/41 in software.

NOTE 2: Unlike SSI Cabinets 00 and 32, the flow is always to the RIGHT in High Density Cabinet 06 and 38.

High Density (HD) Ring Node Cabinet Layout

**Figure 2-1. Typical Ring Node Cabinet Layout (Sheet 2 of 3)**

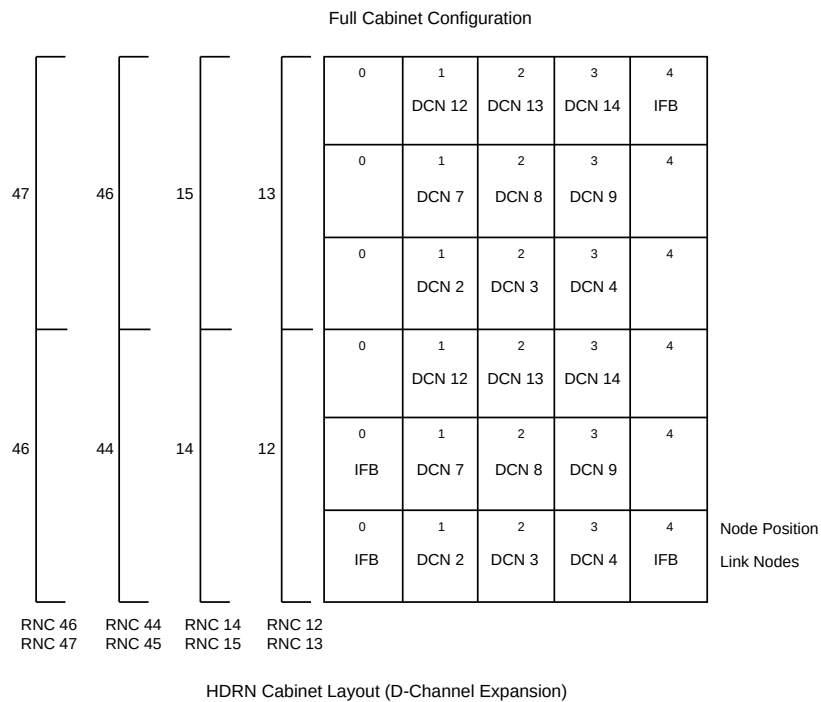


Figure 2-1. Typical Ring Node Cabinet Layout (Sheet 3 of 3)

## Link Node Units

Link node (LN) units (Figure 2-2) can be equipped to support three application link nodes of the same type (CCS7 or SADC) or a mixture of three application link nodes (CCS7, SADC, or IUN). Link node units are identified as type "A" and type "B" units. Type "A" units are equipped with nodes that are addressed in ascending order from left to right. Type "B" units are equipped with nodes that are addressed in descending order from right to left. These address sequences are determined by the backplane wiring of the units; thus, making type "A" and type "B" units not interchangeable. Type "A" and type "B" units are equipped in the ring node cabinet in an alternate fashion, starting initially with a type "A" unit. ***When ordering link node units, the equipment engineer must be particularly careful to specify the proper unit type.*** The J-specifications and schematic diagrams (SDs) for type "A" and type "B" link node units as applicable to the 4ESS Switch are as follows:

- Link Node Unit A (J-3F011AB-1/SD-3F009-01)
- Link Node Unit B (J-3F011AC-1/SD-3F010-01).

### ⇒ NOTE:

Beginning with CNI software Release 11.4, a new link node, ULN, is available in the SSI cabinet. Universal link nodes are equipped in the 3BI unit backplanes rather than the link node units.

## DS1 Units

DS1 units (Figure 2-3) can be equipped to support three application link nodes of the same type (DCHN only) or a mixture of three nodes (DCHNs and IUNs). Like link node units, DS1 units are identified as type "A" and type "B" units. Type "A" units are equipped with nodes that are addressed in ascending order from left to right. Type "B" units are equipped with nodes that are addressed in descending order from right to left. These address sequences are determined by the unit's backplane wiring, thus making type "A" and type "B" units not interchangeable. Type "A" and type "B" units are equipped in the ring node cabinet in an alternate fashion, initially starting with a type "A" unit. ***When ordering DS1 units, the equipment engineer must be particularly careful to specify the proper unit type.*** The J-specifications and schematic diagrams (SDs) for type "A" and type "B" DS1 units, as applicable to the 4ESS Switch, are as follows:

- DS1 Unit A (J-3F011DB-1/SD-3F038-01)
- DS1 Unit B (J-3F011DC-1/SD-3F039-01).



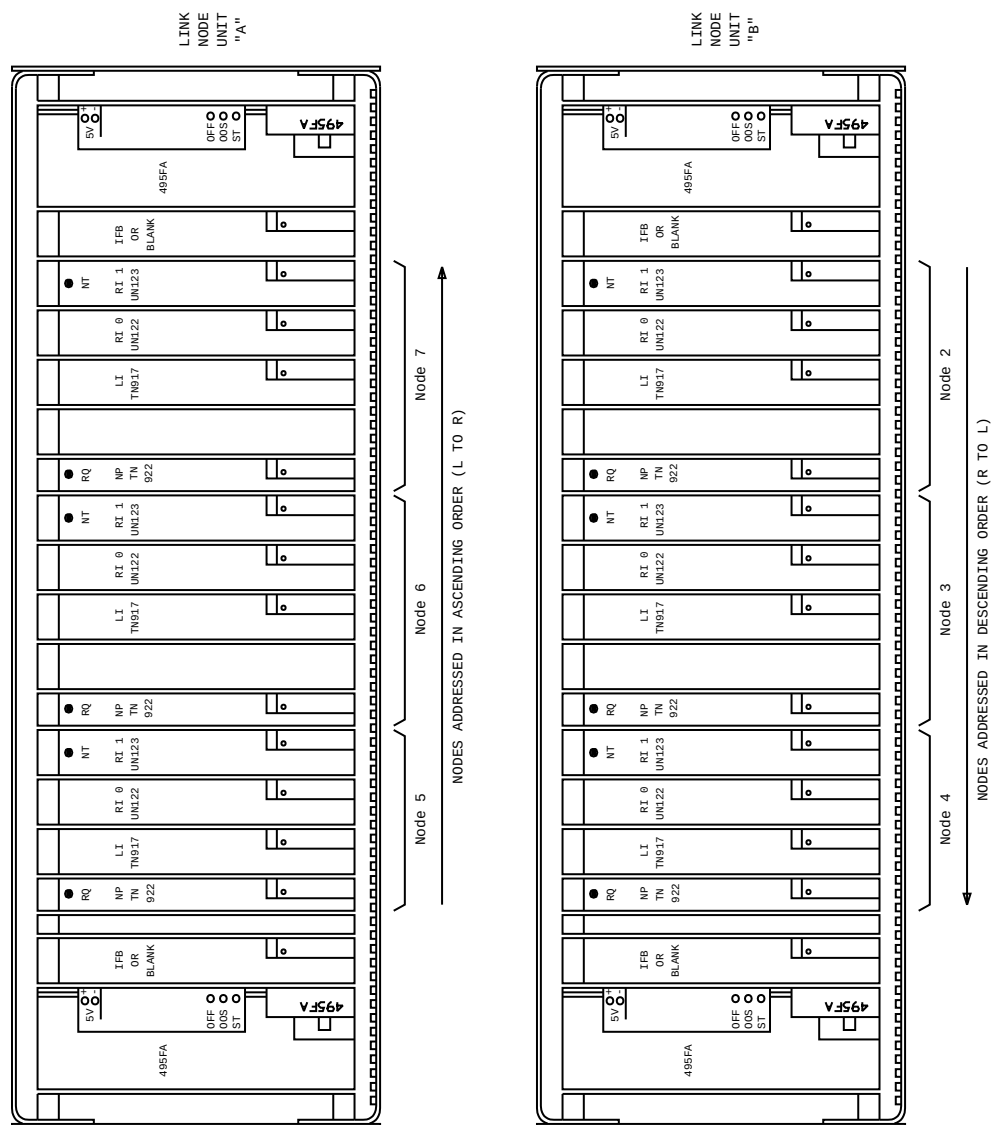
### **3B Interface Unit (3BI)**

The 3B interface (3BI) unit (Figure 2-4) can be equipped to support either a ring peripheral controller node (RPCN), a direct link node (DLN), or a universal link node (ULN) in addition to one application link node (CCS7, SADC, or IUN). The nodes are addressed in ascending order from left to right. As with link node units and DS1 units, the address sequence is determined by backplane wiring. The J-specification and schematic diagram (SD) for the 3B interface unit as applicable to the 4ESS Switch are J-3F011AA-1 and SD-3F048-01.

### **Integrated Ring Node Unit (IRN)**

The integrated ring node (IRN) unit (Figure 2-5) can be equipped to support eight node positions. The node positions are identified as 0 through 7. All node positions (0 through 7) can be equipped with international link nodes (ILNs), CCS7 nodes, or DCHN nodes. However, all equipped nodes in an IRN unit must be of the same type with the exception of an IUN. When necessary, node positions 0 and 7 can be equipped with an interframe buffer (IFB), and node position 3 can be equipped with a T1 facility access (T1FA) interface. The nodes are addressed in ascending order from left to right; and, as with all other units, the address sequence is determined by backplane wiring. Ring node cabinets equipped with IRN units containing ILNs, DCHN, and CCS7 nodes in the 4ESS Switch environment are identified as high density backplane (HDB) cabinets, as illustrated in Figure 2-5. The J-specification and schematic diagram (SD) for the IRN (UN303B) /IRN2 (UN304B) unit as applicable to the 4ESS Switch are J3F011DC-1 and SD-3F037-1 for the SSI cabinet and J3F011GB-1 and SD-3F050-1 for the HD cabinet. The D-Channel Expansion Feature, in CNI Software Release 13.4, increases the number of D-Channel terminations in the 4ESS switches by equipping two HDRN cabinets with up to six (J3F011GA-1) shelves—each shelf supporting up to 24 D-channels. This feature is dependent on the APS upgrade to the 3B21D Processor in all the 4ESS switches to gain more 3B memory and real time.

The 5-node IRN unit is shown in Figure 2-5, Page 2, and is arranged for 5-node positions labeled 0 - 4. The SIN circuit pack or the EIN circuit pack is in node position 2; the ATP is in node position 3. The applicable J-specification is J-3F011GA-1.



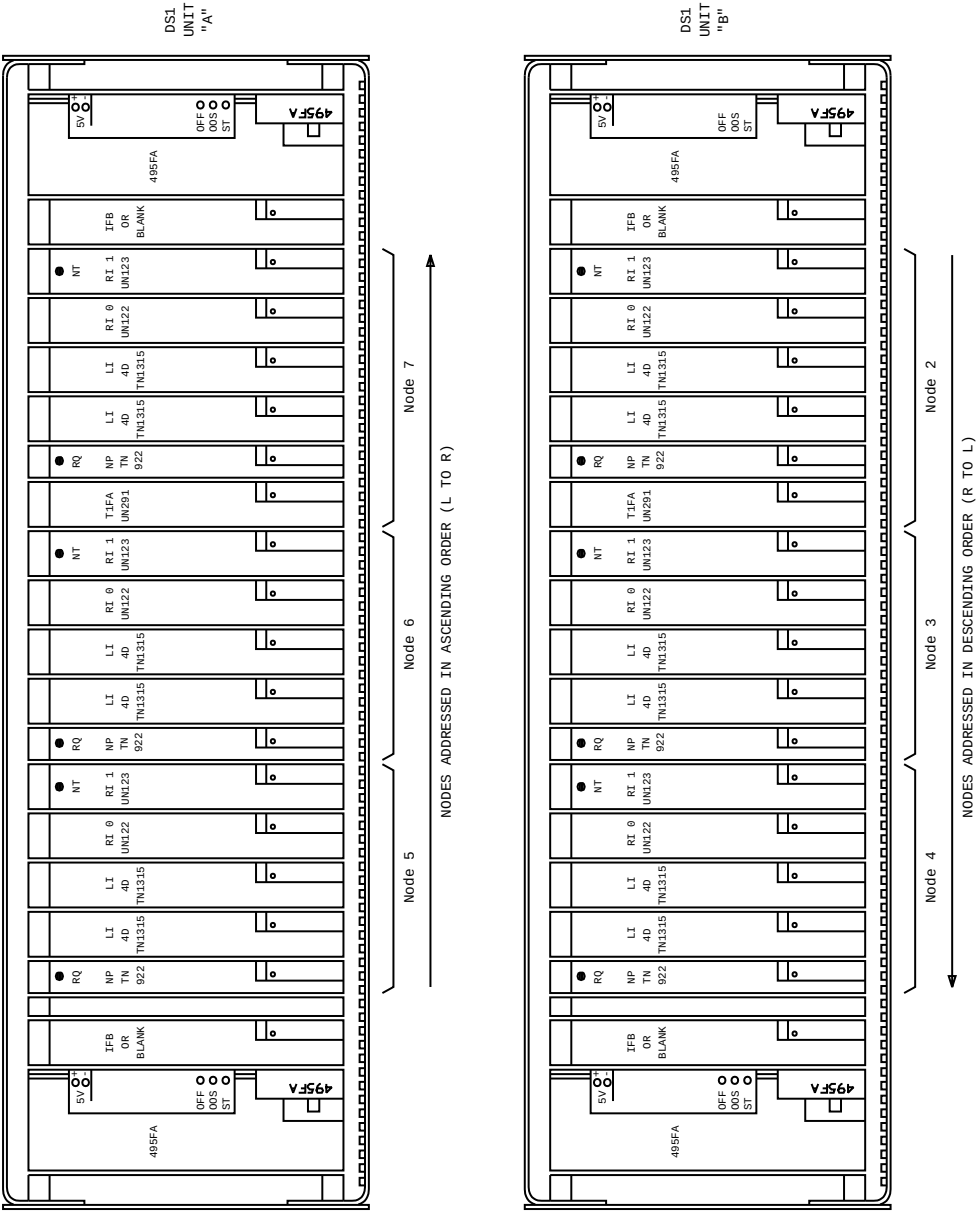


Figure 2-3. DS1 Units (Type A and B)

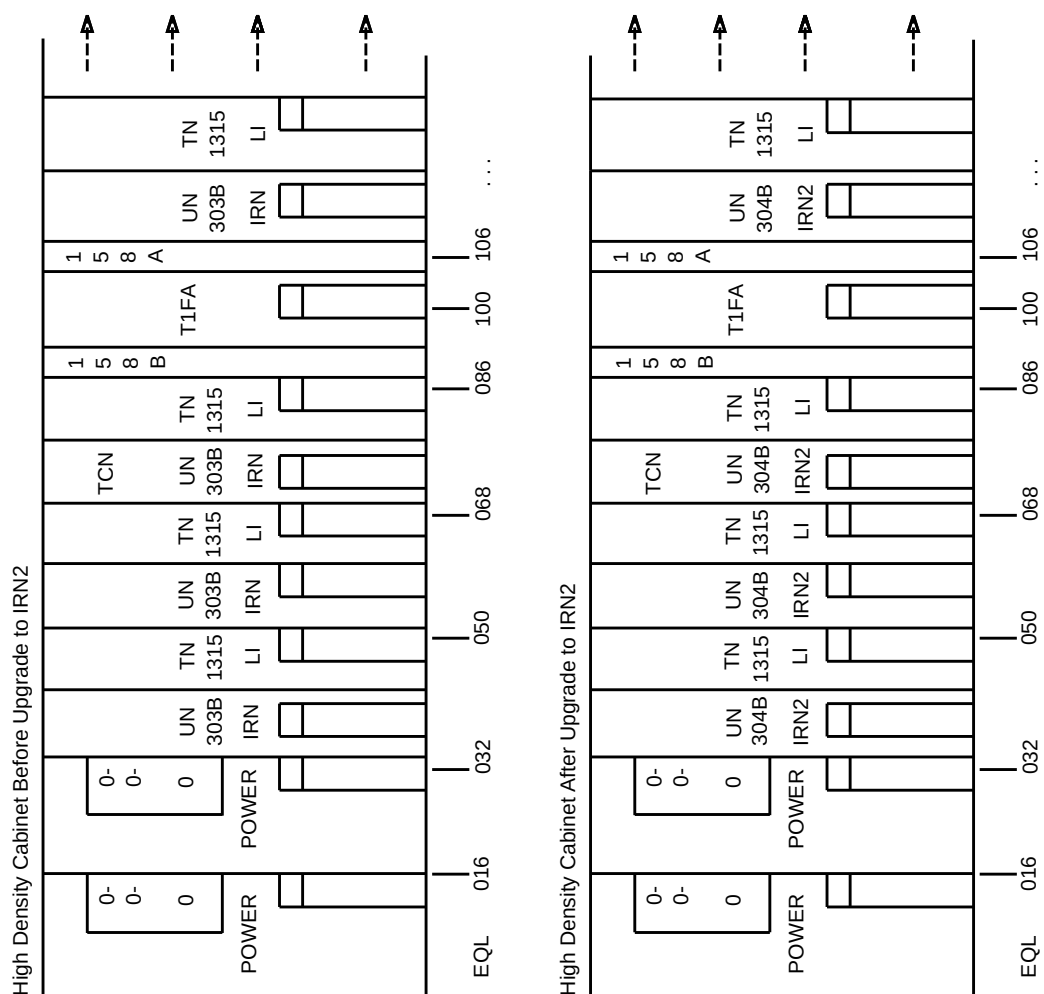
3BI EQUIPPED WITH RPCN AND ULN

|                       |             |        |                       |                       |             |             |             |                       |                       |                       |                       |                            |                       |                       |             |                       |
|-----------------------|-------------|--------|-----------------------|-----------------------|-------------|-------------|-------------|-----------------------|-----------------------|-----------------------|-----------------------|----------------------------|-----------------------|-----------------------|-------------|-----------------------|
| P<br>O<br>W<br>E<br>R | I<br>F<br>B | N<br>P | B<br>L<br>A<br>N<br>K | B<br>L<br>A<br>N<br>K | R<br>I<br>0 | R<br>I<br>1 | 3<br>B<br>I | D<br>D<br>S<br>B<br>S | B<br>L<br>A<br>N<br>K | B<br>L<br>A<br>N<br>K | B<br>L<br>A<br>N<br>K | T<br>N<br>2<br>5<br>2<br>0 | U<br>N<br>3<br>9<br>7 | B<br>L<br>A<br>N<br>K | I<br>F<br>B | P<br>O<br>W<br>E<br>R |
|-----------------------|-------------|--------|-----------------------|-----------------------|-------------|-------------|-------------|-----------------------|-----------------------|-----------------------|-----------------------|----------------------------|-----------------------|-----------------------|-------------|-----------------------|

3BI EQUIPPED WITH DLN AND ULN

|                       |             |        |              |                       |             |             |             |                       |                       |                       |                       |                            |                       |                       |             |                       |
|-----------------------|-------------|--------|--------------|-----------------------|-------------|-------------|-------------|-----------------------|-----------------------|-----------------------|-----------------------|----------------------------|-----------------------|-----------------------|-------------|-----------------------|
| P<br>O<br>W<br>E<br>R | I<br>F<br>B | N<br>P | A<br>P<br>30 | B<br>L<br>A<br>N<br>K | R<br>I<br>0 | R<br>I<br>1 | 3<br>B<br>I | D<br>D<br>S<br>B<br>S | B<br>L<br>A<br>N<br>K | B<br>L<br>A<br>N<br>K | B<br>L<br>A<br>N<br>K | T<br>N<br>2<br>5<br>2<br>0 | U<br>N<br>3<br>9<br>7 | B<br>L<br>A<br>N<br>K | I<br>F<br>B | P<br>O<br>W<br>E<br>R |
|-----------------------|-------------|--------|--------------|-----------------------|-------------|-------------|-------------|-----------------------|-----------------------|-----------------------|-----------------------|----------------------------|-----------------------|-----------------------|-------------|-----------------------|

Figure 2-4. 3B Interface (3BI) Units





## Ring Peripheral Controller Node Circuit Packs (RPCN)

The ring peripheral controller node (RPCN) provides access to the CNI system central processor (3B Computer). This access is used to transfer information between the ring and 3B Computer for maintenance, administrative, and message processing functions. The RPCNs are located on the ring in a manner so that the number of application link nodes between the RPCNs are approximately equal. This minimizes the possibility that more than one RPCN will be included in a multiple application link node isolation.

Every node on the ring is associated with a RPCN through software. This association allows all nodes to determine the appropriate destination for 3B Computer bound messages. Software balances the load between RPCNs to prevent one RPCN from becoming overloaded. Two RPCNs are required in a CNI system designed for the 4ESS Switch application.

The RPCN consists of the following circuit packs:

- a. *Ring Interface (RI)*—Ring interface circuitry provides access to the dual ring. There are two distinct ring interface circuits:
  - Ring Interface 0 (RI0)—UN122/UN122B/UN122C
  - Ring Interface 1 (RI1)—UN123/UN123B.

Ring interface 0 circuitry interfaces with ring 0 while ring interface 1 circuitry interfaces with ring 1. Two ring interface circuits are required due to the flow of messages on the rings. Messages flow in ascending address order on ring 0 and in descending address order on ring 1.

The ring interface circuitry (RI0 and RI1) provides the circuits necessary to insert messages onto the rings, extract messages from the rings, pass messages along the rings, and perform message error checks in addition to other ring interface maintenance functions. The ring interface circuitry also controls ring reconfiguration, thus permitting faulty nodes to be isolated. Many functions are duplicated in both ring interface circuits. However, some functions are performed for both rings by one ring interface circuit.

- b. *Node Processor (NP)*—The node processor (TN922) provides the circuits necessary to control node operations. Most node processor responsibilities are performed by intelligent circuitry that utilizes on-board memory containing stored processing data.

The node processor is essentially a self-contained microcomputer composed of a central processing unit (CPU), memory, interrupt logic, input/output ports, and direct memory access (DMA) circuitry for ring communication. Node processor software is downloaded from the 3B Computer into NP memory during CNI system initialization. Node

processor software varies depending on the type of node—application link node, DLN, or RPCN. Software processes that perform node processor operations are scheduled and executed by the CPU on a priority basis.

Primary responsibilities of the node processor for all node applications include the following:

- Relay messages between the ring and signaling link
  - Provide temporary storage/buffer for messages
  - Process maintenance messages in addition to data messages
  - Control DMA circuitry used to perform ring read and write operations
  - Identify problems and notify the control processor of such problems
  - Control messages between the ring and the 3B Computer when associated with a RPCN application
  - Control messages between the ring interface circuitry and the attached processor; and between the 3B interface circuitry and the attached processor when associated with a DLN application.
- c. *3B Interface (3BI)*—The 3B interface (TN914) circuitry provides an interface between the node processor and the duplex dual serial bus selector (DDSBS). When viewed from the DDSBS circuitry, the 3B interface circuitry can be described as a writable control port and readable status port. By controlling the direct memory access (DMA) operations to the node processor and DDSBS, the 3BI circuitry allows the node processor and central processor (3B Computer) to send and receive data when it is ready. This operation is accomplished with a data buffer that is accessible by both the node processor and the DDSBS. The various control and status registers along with interrupt circuitry allow concurrent operation of the node processor, 3B interface, and DDSBS circuitry. The 3B interface also provides data conversion between the 16-bit data bus in the node processor and the 36-bit data bus in the DDSBS.

The 3B interface communications are via a DMA or a programmed input/output (I/O) utility provided by the 3B Computer operating system. The DMA is generally used to transfer blocks of messages and involves queuing the data at the transmitting end for subsequent transfer by the receiving end. During each message switch cycle, software in the node processor or 3B Computer determines the status of any pending request before queuing more data. The



programmed I/O utility is initiated and used by the central processor to issue urgent commands or synchronize data transfers.

- d. *Duplex Dual Serial Bus Selector (DDSBS)*—The DDSBS (TN69/TN69B) circuitry serves as a termination for the dual serial channels (DSCHs) between the central processor (3B Computer) and 3B interface (3BI) circuitry of applicable nodes (RPCNs and DLNs). Each control unit in the central processor contains a number of DSCHs used for data transmission. At the applicable node (RPCN or DLN) the multiple DSCHs terminate at the DDSBS circuitry. The DDSBS circuitry selects the appropriate channels upon request. In addition, the DDSBS circuitry bidirectionally converts data between the parallel format of the 3B interface circuitry and the serial format of the DSCHs.

### **Direct Link Node Circuit Packs (DLN)**

The DLN relieves the CNI system central processor (3B Computer) of performing specific functions when interfacing with the 4ESS Switch 1A/1B Processor. These functions include processing messages between the 1A/1B Processor and the ring, providing ring related translations, and reformatting messages. The following are the two versions of the DLN that exist:

- DLN-Enhanced (DLNE)
- IRN2 DLN (DLN30)

The DLN-enhanced (DLNE) consists of the following circuit packs:

- a. *Integrated Ring Node (IRN)*: The integrated ring node (UN303B) circuit pack has been designed using very large scale integrated (VLSI) circuitry. This design allows the IRN circuitry to perform all operations previously performed by the small scale integrated (SSI) ring interface 0 (UN122/UN122B/UN122C), ring interface 1 (UN123/UN123B), and node processor (TN922) circuit packs previously described. The IRN is functionally, physically, and electrically compatible to the three SSI circuit packs.
- b. *Attached Processor (AP30)*: The attached processor (AP30) circuitry (TN1630B) is utilized by the DLNE; The attached processor AP30 circuitry has been designed to support an increased message capacity. The attached processor AP30 circuitry communicates with the IRN circuitry (UN303B) to perform all operations.
- c. *3B Interface (3BI)*: The 3B interface circuitry (TN914) performs the same functions for the DLNE as for the RPCN.
- d. *Duplex Dual Serial Bus Selector (DDSBS)*: The DDSBS circuitry TN69B performs the same functions for the DLNE as for the RPCN.

The IRN2 DLN (DLN30) (available in the 4E22R1 generic program) consists of the following circuit packs:

- a. *Integrated Ring Node (IRN2)*: The integrated ring node (UN304B) circuit pack has been designed using very large scale integrated (VLSI) circuitry. This design allows the IRN2 circuitry to perform all operations previously performed by the small scale integrated (SSI) ring interface 0 (UN122/UN122B/UN122C), ring interface 1 (UN123/UN123B), and node processor (TN922) circuit packs previously described. The IRN2 is functionally, physically, and electrically compatible to the three SSI circuit packs.
- b. *Attached Processor (AP30)*: The attached processor (AP30) circuitry (TN1630) is utilized by the DLN30; The attached processor AP30 circuitry has been designed to support an increased message capacity. The attached processor AP30 circuitry communicates with the IRN2 circuitry (UN304B) to perform all operations.
- c. *3B Interface (3BI)*: The 3B interface circuitry (TN914) performs the same functions for the DLN30 as for the RPCN.
- d. *Duplex Dual Serial Bus Selector (DD SBS)*: The DD SBS circuitry TN69B performs the same functions for the DLN30 as for the RPCN.

The message capacity of the DLNs is dependent on the 4ESS switch generic program. Table 2-B lists the message capacity.

**Table 2-B. DLN Capacity Figures 4E19/4E22 Generics**

| APS Generic | 4ESS™<br>Switch<br>Generic | DLN Memory<br>[terms supported] | 1-Way DLN<br>Message Capacity<br>[msg/sec/DLN] | 2-Way DLN<br>Message Capacity<br>[msg/sec/DLN] |
|-------------|----------------------------|---------------------------------|------------------------------------------------|------------------------------------------------|
| 4AP12       | 4E19                       | 107,520K                        | 1425                                           | 1200                                           |
| 4AP13/14    | 4E20/21                    | 107,520K                        | 1550                                           | 1317                                           |
| 4AP15*      | 4E22                       | 107,520K                        | 1850                                           | 1800                                           |

\*Assumes IRN2 ring node processor upgrade.

### Small Computer System Interface Node (SIN) Circuit Packs

The SIN consists of the following circuit packs.

- a. *Integrated Ring Node (IRN)*: The integrated ring node (IRN) (UN304B) circuit pack has been designed using very large scale integrated (VLSI) circuitry. This design allows the IRN circuitry to perform all operations previously performed by the small scale integrated (SSI) ring interface 0 (UN122/UN122B/UN122C), ring interface 1 (UN123/UN123B), and node processor (TN922) circuit

packs previously described. The IRN is functionally, physically, and electrically compatible to the three SSI circuit packs.

- b. *3B Interface (3BI)*: The 3B interface circuitry (TN914) performs the same functions for the SIN as for the RPCN.
- c. *Duplex Dual Serial Bus Selector (DDSBS)*: The DDSBS circuitry (TN69/TN69B) performs the same functions for the SIN as for the RPCN.
- d. *Small Computer System Interface (SCSI)*: The SCSI (TN1804) circuit pack supports the SCSI connection to the CDRP. The SCSI CP plugs into the SPARE slot of the 5 node IMS unit, and the SCSI cable connects the AT&T Star Server® symmetrical multiprocessor computer to the SCSI CP via the paddleboard (which plugs into the back of the 5-node IMS unit).

### **Ethernet Interface Node (EIN) Circuit Packs**

The EIN consists of the following circuit packs.

- a. *Integrated Ring Node (IRN)*: The integrated ring node (IRN) (UN304B) circuit pack has been designed using very large scale integrated (VLSI) circuitry. This design allows the IRN circuitry to perform all operations previously performed by the small scale integrated (SSI) ring interface 0 (UN122/UN122B/UN122C), ring interface 1 (UN123/UN123B), and node processor (TN922) circuit packs previously described. The IRN is functionally, physically, and electrically compatible to the three SSI circuit packs.
- b. *3B Interface (3BI)*: The 3B interface circuitry (TN914) performs the same functions for the EIN as for the RPCN.
- c. *Duplex Dual Serial Bus Selector (DDSBS)*: The DDSBS circuitry (TN69/TN69B) performs the same functions for the EIN as for the RPCN.
- d. *Ethernet Link Interface (ELI)*: The ELI circuit pack (TN4016) supports the Ethernet access to the CDRP via paddleboard 9822EB.

The ELI faceplate has 3 LEDs which indicate the following:

- LED 1 (Green) - Indicates the polarity of Ethernet receives signals flipped.
- LED 2 (Green) - Indicates that the Ethernet link is active.
- LED 3 (Red) - Indicates the board is in test, and the loopback relay is engaged.

**NOTE:**

For the retrofit of SIN to EIN, the EIN does not require any new arrangement of the frames; however, an additional wire is required from EQL-Pin 098-006 to EQL-Pin-098-007. The ELI circuit pack TN4016 has a bank of dip switches which currently are not used and can be set in any position.

**Application Link Nodes Circuit Packs (CCS7, SADC, DCHN, and ULN)**

Application link nodes provide CNI system ring entry and exit points that permit analog and digital signaling links of specific applications to send and receive messages via the ring. Various link nodes designed for specific applications are available to interface with the ring. Application link nodes are defined by their signaling link data rate (64kb/s, 56kb/s, or 9.6kb/s); signaling protocol, and data security requirements. In addition, link nodes control message flow and provide link protocol control, ring operations, and many other functions associated with the message switching environment. Application link nodes consist of the following circuit packs:

- a. *Ring Interface (RI)*: The ring interface circuitry (UN122/UN122B/UN122C for RI0 and UN123/UN123B for RI1) performs the same functions for the application link nodes as for the RPCN.
- b. *Node Processor (NP)*: The node processor circuitry (TN922) performs the same functions for the application link nodes as for the RPCN.
- c. *Integrated Ring Node (IRN)*: The integrated ring node (IRN) (UN303B/UN304B) circuit pack has been designed using very large scale integrated (VLSI) circuitry. This design allows the IRN circuitry to perform all operations previously performed by the small scale integrated (SSI) ring interface 0 (UN122/UN122B/UN122C), ring interface 1 (UN123/UN123B), and node processor (TN922) circuit packs previously described. The IRN is functionally, physically, and electrically compatible to the three SSI circuit packs. Application link nodes (CCS7, and IUN) utilizing the IRN (UN303B/UN304B) circuit pack or application link node (DCHN) utilizing the IRN2 (UN304B) circuit pack in the 4ESS Switch environment are commonly referred to as high-density backplane (HDB) application link nodes.
- d. *Link Interface (LI)*: The link interface (LI) circuitry performs the function of transferring data between the signaling link (SLK) and the node processor. The link interface circuitry is controlled by Common Network Interface (CNI) software and primarily provides the proper protocol for bidirectionally interfacing the signaling link with the ring. Signaling link load-sharing and data security functions are other

responsibilities of the link interface circuitry. Due to the unique functions performed by the link interface circuitry for application-specific signaling links (SLKs), this circuitry is different for all link node applications. Link interface descriptions for CCS7, SADC, and DCHN nodes are as follows:

### **Common Channel Signaling No. 7 Node**

Link interface circuitry for the CCS7 node is identified as "LI" (TN917 or TN917B). The "LI" circuitry bidirectionally converts the node processor TTL-type signaling to a signaling type that is compatible with the digital facility access (DFA) frame circuits. The DFA frame circuits require a RS423 signaling format. The TN917 link may be updated with the improved processor outage (IMPROCOT) feature. (This is done using a PROM kit.) A maximum of one "LI" (TN917 or TN917B) link interface can be equipped per CCS7 node. Therefore, a fully equipped CCS7 node can accommodate one signaling link.

The universal link node (ULN) is a node type available with CNI Software Release 11.4 and later. The ULN serves as a platform for the High-Speed A-Link (HSA) feature that allows 4ESS switches to access CCS7 Networks via 1.544 Mb/s A-Links.

### **Special Access Data Channel Node**

Link interface circuitry for the SADC node is identified as "LI4S" (TN1316). The "LI4S" circuitry bidirectionally converts the node processor TTL-type signaling to a signaling type that is compatible with the SADC signaling link. One major difference between the "LI4S" (TN1316) link interface and the "LI" (TN916) link interface is that each "LI4S" can accommodate four signaling links via 2096 or equivalent data sets. Other differences between the "LI4S" (TN1316) and "LI" (TN916) link interfaces are:

- a. The "LI4S" contains no read-only memory (ROM).
- b. The "LI4S" diagnostics are stored in random access memory (RAM) as opposed to ROM for the "LI" link interface.
- c. Diagnostic and operational programs are downloaded to the "LI4S" link interface in two stages. The programs are first downloaded from the central processor (3B Computer) to the node processor and then from the node processor to the "LI4S" link interface.

A maximum of two "LI4S" (TN1316) link interfaces can be equipped per SADC node. Therefore, a fully equipped SADC node can accommodate eight signaling links.

### D-Channel Node

Link interface circuitry for the DCHN node is identified as "LI4D" (TN1315). The "LI4D" circuitry bidirectionally converts the node processor TTL-type signaling to a signaling type that is compatible with the DCHN signaling link. Like the "LI4S" (TN1316) link interface used with SADC nodes, one major difference between the "LI4D" (TN1315) link interface and the "LI" (TN916 or TN917/TN917B) link interface is that each "LI4D" can accommodate four signaling links. Other differences between the "LI4D" (TN1315) and "LI" (TN916 or TN917/TN917B) link interfaces are as follows:

- a. The "LI4D" contains no read only memory (ROM).
- b. The "LI4D" diagnostics are stored in random-access memory (RAM) as opposed to ROM for the "LI" link interface.
- c. Diagnostic and operational programs are downloaded to the "LI4D" link interface in two stages. The programs are first downloaded from the central processor (3B Computer) to the node processor and then from the node processor to the "LI4D" link interface.
- d. The "LI4D" contains DS1 facility access circuitry that serves the four associated signaling links. This circuitry formats the data of each signaling link into a DS0 bit stream.

In the SSI cabinet, two "LI4D" (TN 1315) link interfaces are equipped per DCHN node. In the HD cabinet, one "LI4D" (TN 1315) link interface is equipped for the DCHN node. Therefore, a fully equipped DCHN node can accommodate eight signaling links in the SSI cabinet and four signaling links in the High Density (HD) cabinet. With the added D-Channel terminations, the maximum DCHN nodes supported by the 4ESS Switch is 54 (234 D-channel). With the D-Channel Expansion Feature (CNI Software Release 13.4), an additional 288 D-Channels may be supported. ***This feature is dependent on the APS upgrade to the 3B21D Processor.***

### Universal Link Node (ULN) Circuit Packs

The ULN (and HSA) features are part of CNI Software Release 11.4 for the 4ESS switch with the 4E21R1 Generic Program and consist of the following circuit packs.

- a. *Ring Interface Board (RIB)*: The RIB circuit pack (UN397) provides two microprocessors, an Application Processor, a Ring Processor, and independent memory blocks for each processor. This ring interface subsystem interfaces with the IMS rings.
- b. *Link Interface Board (LIB)*: The LIB circuit pack with T1 Link Option Module (TN2520) provides two microprocessors, an Application Processor, a Link Processor, and independent memory blocks for each processor. The LIB is the link module subsystem to the CCS7 1.544 Mb/s

T1 link.

A maximum of eight ULNs may be equipped in a 4ESS switch office. However, the typical 4ESS switch office is four High Speed A-links. Linksets contain both the HSA (1.544 mb/s) and 56 kb/s links. A 56 kb/s linkset that uses BEC (available with 4ESS switch generic: programs 4E21R4 and 4ESSR1) and contains a satellite link cannot contain a 1.544 mb/s link.

### **AT&T Trigger Platform (ATP) Circuit Packs**

The ATP node consists of a single IRN2 (UN304B) circuit pack (no-link-interface circuit pack). This node is loaded with IMS code and ATP application software used in the AT&T Trigger Platform (ATP) Junior feature in the 4E20R1 generic package.

### **International Link Node Circuit Packs (ILN)**

International link nodes (ILNs) provide CNI system ring entry and exit points that allow access to the international Common Channel Signaling (CCS) network. The ILNs are used with CNI systems associated with International Switching Centers (ISCs). The ILN must be compatible with both the domestic CCS network using CCS7 signaling messages, and the international CCS network, using CCITT7 signaling messages. International link nodes consists of the following circuit packs:

- a. *Integrated Ring Node (IRN)*: The integrated ring node (IRN/IRN2) (UN303B/UN304B) circuit pack has been designed using very large scale integrated (VLSI) circuitry. This design allows the IRN circuitry to perform all operations performed by the small scale integrated (SSI) ring interface 0 (UN122/UN122B/UN122C), ring interface 1 (UN123/UN123B), and node processor (TN922) circuit packs previously described for application link nodes. The IRN is functionally, physically, and electrically compatible to the three SSI designed circuit packs. All international link nodes (ILNs) utilize the IRN (UN303B/UN304B) circuit pack in the 4ESS Switch environment and are commonly referred to as high-density backplane (HDB) international link nodes. Refer to Figure 2-5.
- b. *Link Interface (LI)*: The link interface circuitry performs the functions of transferring data between the signaling link and the node processor circuitry on the IRN circuit pack. The link interface circuitry is controlled by the CNI software and primarily provides the circuits to bidirectionally interface the signaling link with the ring. As with the DCHN node, the ILN utilizes the "LI4D" (TN1315) link interface. The functions performed by the "LI4D" link interface for the ILN are identical to the functions performed for the DCHN node. Although the "LI4D" has the capacity to accommodate four signaling links, only one 64 Kb/s signaling link is associated with an "LI4D" link interface in the

ILN environment. A maximum of one "LI4D" (TN1315) link interface can be equipped per ILN. Therefore, a fully equipped ILN can accommodate one signaling link.

### **T1 Facility Access Circuit Pack (T1FA)**

The T1 facility access (T1FA) circuitry (UN291) multiplexes and demultiplexes the signal links associated with DCHN nodes in the DS1 unit and international link nodes (ILNs) in the integrated ring node (IRN) unit. Up to a maximum of 24 DS0 64kb/s signaling links can be multiplexed into a single DS1 1.544 Mb/s bit stream. In converse, a single DS1 1.544 Mb/s bit stream can be demultiplexed into 24 DS0 64kb/s signaling links. A node is always required to monitor and control the T1 facility access (T1FA) functions. This node is identified as the control node and must be physically located adjacent to the T1FA circuitry. In addition to monitoring and controlling T1FA circuitry, the control node performs its initial functions as a DCHN node or international link node (ILN).

Incoming signals are connected directly to the T1FA circuitry (UN291). However, outgoing signals from the T1FA circuitry pass through an equalizer network before connecting to the DS1 equipment. The equalizer plugs directly onto the backplane pins and is considered a part of the customized cabling. Cable lengths determine the correct equalizer to be used with specific applications.

The T1FA circuitry uses three LEDs to indicate facility status. A red LED indicates a near-end facility failure, a yellow LED indicates a far-end facility failure, and a green LED indicates normal operations. In addition to the LEDs, a pushbutton is available to initiate self-tests. If a self-test failure occurs, the red and green LEDs light simultaneously.

### **Interframe Buffer Circuit Packs (IFB)**

The ring interface circuitry of a node drives each bus on the dual ring with a TTL-type signal. The distance this signal can be transmitted without decay is limited to a few inches of cable. Therefore, when the ring cabling extends from a node in one ring node cabinet to a node in another ring node cabinet, some compensation is necessary. The interframe buffer (IFB) provides this compensation with balanced drivers and receivers. The balanced drivers and receivers of the IFB solve the electrical problems caused by connections made using longer cable lengths. An identical pair of IFBs must be installed on the ring at any point where the cable length between nodes exceeds 25 inches.

In addition to providing a balanced transmission media between nodes, the IFBs also provide first-in first-out (FIFO) buffers to pad the message storage capacity of the ring. There are two types of interframe buffers:



1. Padded IFBs (TN915/TN1506/TN1509, TN1803)
2. Unpadded IFBs (TN918/TN1508).

Unpadded IFBs (TN918/TN1508) provide 16 bytes of storage; while padded IFBs (TN915 and TN1506/TN1509) provide 512 bytes and 4K bytes of storage, respectively. This is an important IFB characteristic since the data storage capacity of the ring must be equal to or greater than two times the length of the longest message (508 bytes x 2) plus the length of the token (8 bytes). This requirement must be met in order to avoid a message propagation on the ring. Both the TN915 and TN918 operate at a 4 Mb/s data transfer rate; whereas, the TN1506/TN1508/TN1509 is capable of operating at a rate up to 8 Mb/s.

**⇒ NOTE:**

If the ring contains 80% or more IRN/IRN2 nodes and all RPCNs are IRN/IRN2, any TN918 circuit packs should be upgraded to TN1508 circuit packs.

A minimum of four padded IFBs (TN915 or equivalent) must be installed on the ring. This provides a padded IFB at the entry node and exit node in each ring node cabinet. If additional IFBs are required between the entry and exit nodes to meet cabling specifications, pairs of unpadded IFBs (TN918 or equivalent) should be installed.

## **Fuse and Control Panel**

The fuse and control panel (Figure 2-6) provide the ring node cabinet with fuse blocks to fuse units within the cabinet, a portable data terminal jack, an office telephone jack, a 660-type telephone circuit jack, and power/alarm circuitry controls. The power/alarm circuitry controls include the following:

- Alarm Cutoff key
- Lamp Test key
- Power Alarm Reset key.

The "ALARM CUTOFF" key closes SCAN circuits that request the processor to silence the present audible alarm. However, subsequent alarms are not inhibited by this action. The "LAMP TEST" key activates the FA lamp on the fuse panel and the PWR ALM lamp on the control panel. The "PWR ALM RESET" key is used to release all activated alarm relays after power troubles have been cleared. However, if the power alarm is due to a problem with the cabinet fan units, the problem must be corrected and the fan unit alarm "ON/RESET" key operated prior to operating the PWR ALM RESET key on the fuse and control panel. The J-specifications and SD for the fuse and control panel as applicable to the 4ESS Switch are J-3F011AD/AF and SD-3F022-01.

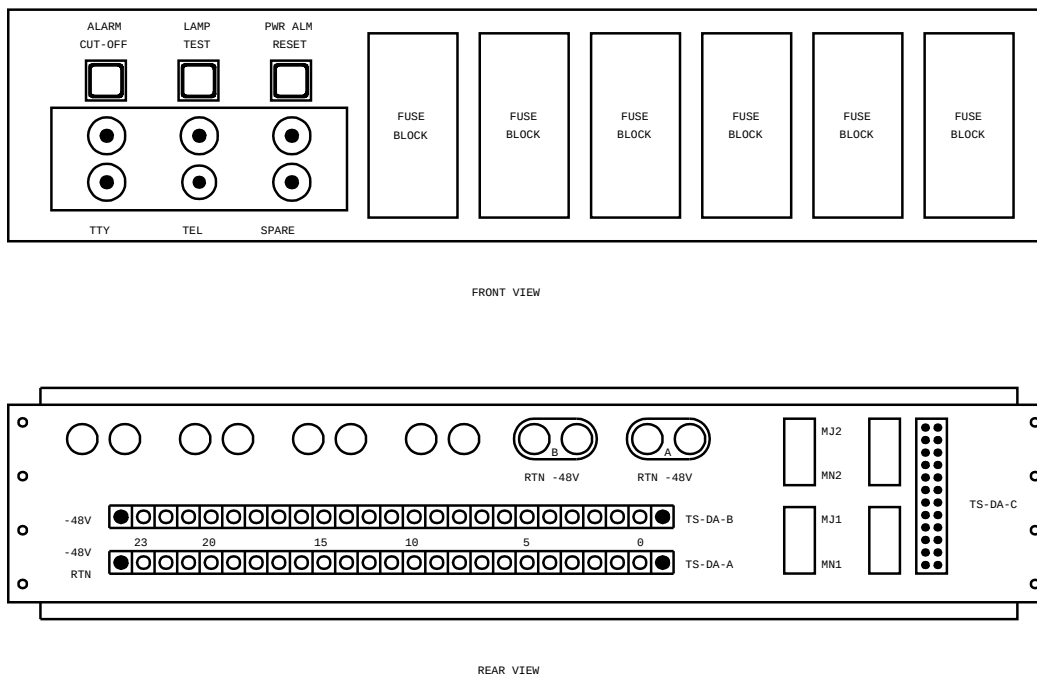


**Figure 2-6. Fuse and Control Panel Mounting**

## Fan Units

The ring node cabinet contains two fan unit assemblies (Figure 2-7). Each fan unit assembly consists of two fans, a filter, and control panel. The fans provide cooling for the circuit packs. The filter is washable and should be serviced on a routine basis. The control panel consists of two status LEDs (FAN A and FAN B), an OFF pushbutton, and an ON/RESET pushbutton. The status LEDs light when power is removed from the associated fan unit. The OFF pushbutton removes power from both fans. The ON/RESET pushbutton restores power to both fans and/or resets alarm circuitry within the unit. The J-specification and schematic diagram (SD) for the fan unit assembly as applicable to the 4ESS Switch are J-3F011AE and SD-3F022-01, respectively.

## Digital Facility Access Cabinet

The digital facility access (DFA) cabinet (Figure 2-8) contains circuits that provide an interface between digital signaling links (SLKs) and nodes. This interface is known as a digital facility access (DFA) circuit. A digital facility access circuit is

required for each node connected to a digital signaling link. Therefore, each digital facility access circuit in the digital facility access cabinet serves one digital signaling link. A fully equipped digital facility access cabinet can provide ten digital facility access circuits, thus providing the interface equipment necessary to connect ten nodes to ten digital signaling links.

The primary functions of the digital facility access circuit is to convert the RS449 digital signal format to a bandpass bipolar signal usable by the 56 kb/s digital signaling link and provide loopback circuitry to enable signaling link tests to be performed. Three basic units make up the digital facility access circuit hardware:

1. Digital Service Unit (DSU)
2. Channel Service Unit (CSU)
3. Digital Service Adapter (DSA).

### **Digital Service Unit**

The digital service unit (DSU) (Figure 2-9) in conjunction with the digital service adapter (DSA) and possibly a channel service unit (CSU) is used to provide access from the node to the network's synchronous transmission system. The primary function of the digital service unit (DSU) is to convert the RS232/V.35 signaling format to an acceptable signal that can be transmitted on the 56kb/s digital data service transmission facility. Several versions of the digital service unit is available for use with the digital facility access (DFA) circuits:

- AT&T 500B Digital Service Unit
- AT&T 2556A Digital Service Unit
- DCP3189 Digital Service Unit.

### **AT&T 500B Digital Service Unit**

Data access circuits utilizing the AT&T 500B DSU are completed using the DSA and the channel service unit (CSU). The DSU receives serial, unipolar data and transmits a baseband, bipolar signal whose frequency corresponds to the transmitted data rate. The data and clock signals between the node side of the DSA and the DSU conform to the requirements of a balanced interface per V.35 CCITT recommendations, while the control signals conform to the Electronic Industries Association (EIA) RS-232C standard. The signals between the CSU side of the DSA and the DSU are loopback and data signals. In essence, for a transmitted signal, the DSU receives signals from the node through the DSA to the CSU. A received signal from the facility follows the same path in reverse. Connections between the DSU and the DSA are via connectorized cable. Leads from the line side of the DSU and to the CSU are data transmission pairs (T, R, T1, and R1). In the case of a co-located office, the transmission leads bypass the CSU and connect to facility equipment.

To enhance error detection on unencrypted links, the DSU detects bipolar violations and informs the link interface circuitry. This causes the link interface circuitry to detect a link error and enter the octet counting mode. In this mode, the link interface circuitry is searching for the next flag.

There are different versions of the AT&T 500B DSU for different signaling speeds. When a 56-kb/s signaling speed is used, the DSU version is a AT&T 500B-L1/5. The DSU consists of a transmitter, receiver, control logic, and customer interface circuits mounted on two circuit packs and interconnected by a flexible cable harness.

A slide switch and four LEDs are provided on the DSU. Normally, the switch is in the center position for data mode operation. The other two positions of the switch provide loopback control for testing toward the line side or drop side on the transmit-receive leads. The LEDs indicate the power and signal present status of the DSU and the type of loopback control being used.

When the AT&T 500B DSU is used for accessing synchronous transmission facilities (long haul), only the addition of a retaining clamp is required at the mounting unit. However, if the AT&T 500B DSU is used to access a nonsynchronous transmission facility (short-haul metallic), a 112A circuit module is added internally to the DSU to control synchronization. When the AT&T 500B DSU contains the 112A circuit module, it is designated a 502B DSU. The 112A circuit module is added to the 500 DSU when the link serves a co-located office. The signaling link length from a co-located office is short enough to not require the CSU.

#### **AT&T 2556A Digital Service Unit**

The AT&T 2556A digital service unit (DSU) is currently used with the digital service adapter (DSA) to provide a digital facility access circuit. All functions performed by both the DSU and the CSU are performed by this unit. Access from the node to the synchronous 56 kb/s digital data service transmission facility is provided by the DSU via the DSA. The access is intended for full-duplex operation in a 4-wire application. Normally, this type of access involves long-haul synchronous transmission facilities. When the AT&T 2556A DSU is used for accessing these type facilities, only the addition of a retaining clamp is required at the mounting unit. However, if the AT&T 2556A DSU is used to access a nonsynchronous transmission facility (short-haul metallic), an internal switch option controlling DSU timing must be activated to control synchronization. ***This timing option must only be activated at one end of the link, the master location.***

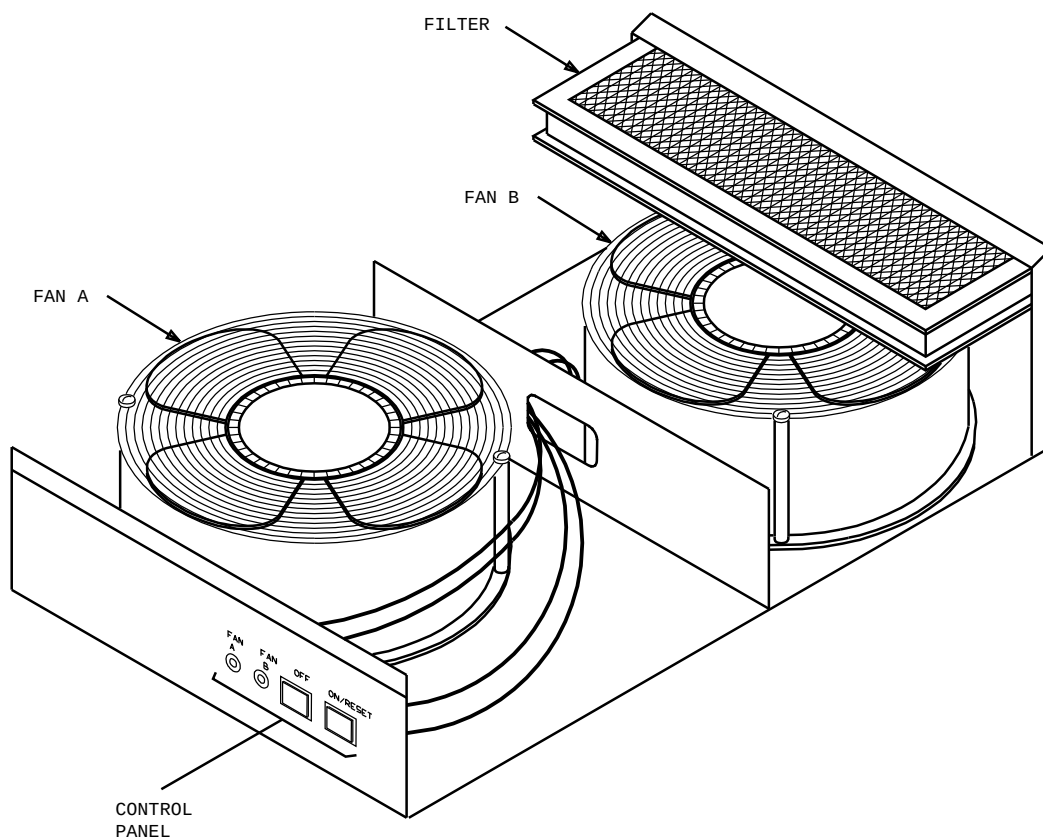


**Figure 2-7. Ring Node Cabinet Fan Unit Assembly**

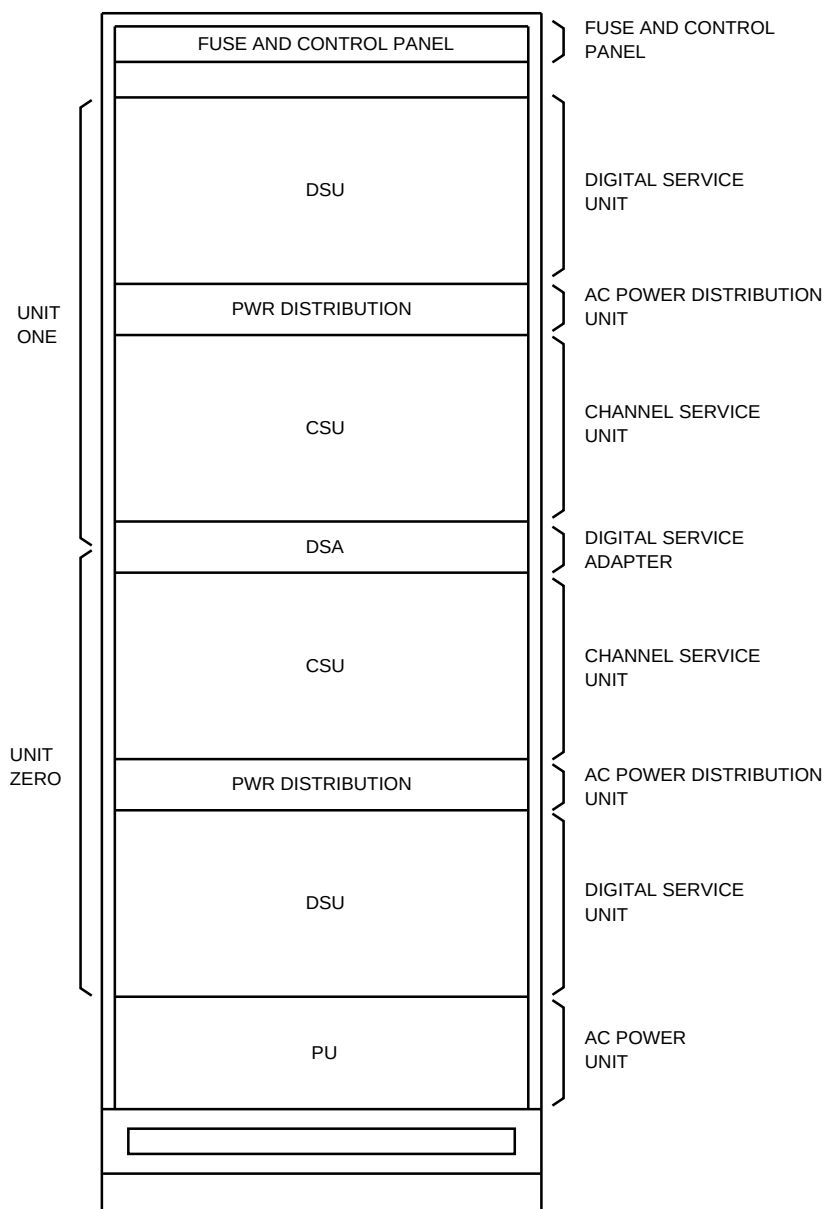


**Figure 2-8. Digital Facility Access (DFA) Cabinet Layout**

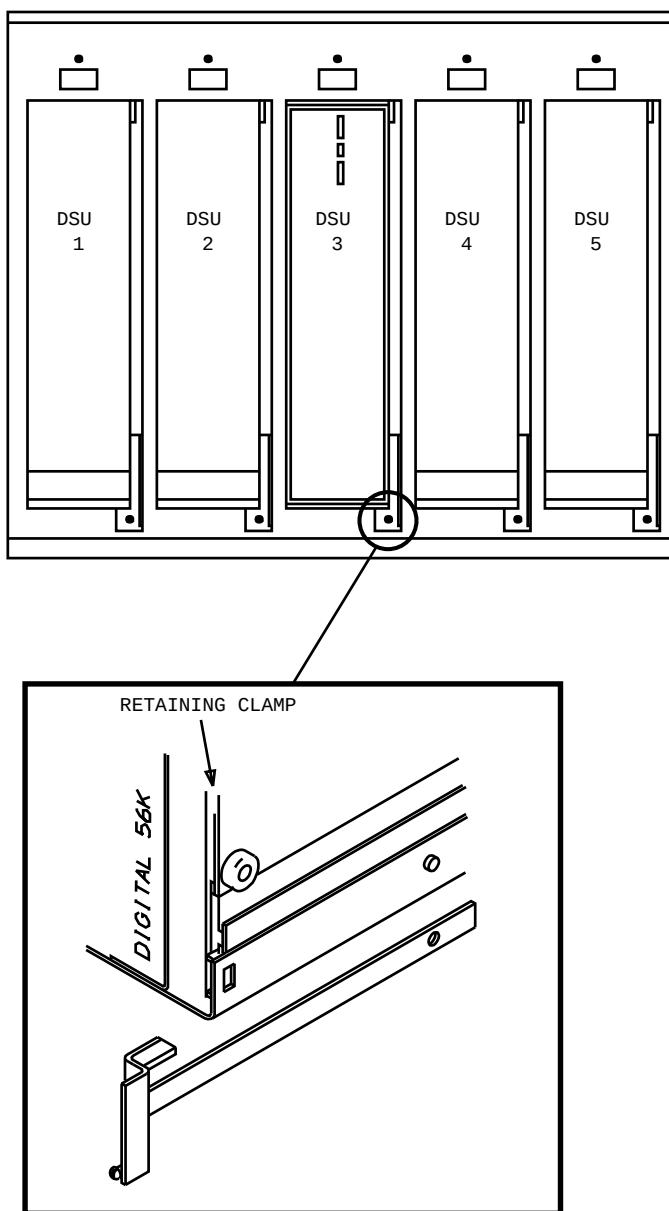


**Figure 2-9. Digital Service Unit (DSU) Mounting**

The AT&T 2556A DSU receives serial data in a V.35 signaling format and transmits a baseband, bipolar signal whose frequency corresponds to the transmitted data rate. The data and clock signals between the DSA and the DSU conform to the requirements of a balanced interface V.35 per CCITT recommendation, while the control signals from the DSA conform to the Electronic Industries Association (EIA) RS-232C standards. In addition, a local loopback lead allows the DSA to command the DSU to assume a loopback configuration. This configuration provides software control of the loopback mode. On the line side of the DSU, connectorized cable containing two pairs of transmit and receive leads connect with the facility. Essentially, the DSU consists of a transmitter, receiver, control logic, and customer interface circuits.

To enhance error detection on unencrypted links, the DSU detects bipolar violations and informs the link interface circuitry. This causes the link interface circuitry to detect a link error and enter the octet counting mode. In this mode, the link interface circuitry is searching for the next flag.

### **DCP3189 Digital Service Unit**

The DCP3189 digital service unit (DSU) is functionally the same as the AT&T 2556A DSU. Essentially, the DSU consists of transmitter, receiver, control logic, and customer interface circuits, which are contained on a single circuit pack. The DSU is equipped with ten front panel LEDs that display data, control signals, and diagnostics. The LEDs indicate the power and signal present status of the DSU and the type of loopback control being used when it is initiated. AC power is provided to the DSU via a mounting that contains two power circuit packs. These circuit packs operate in an active/standby mode such that each circuit pack can provide power to all DSUs in the nest. Each DSU is individually fused.

There are three front panel loopback controls: local digital, local analog, and remote digital. Under normal conditions, a software-controlled loopback is used rather than the front loopback panel controls. Circuit board mounted switches control programming, diagnostics, and loopback enabling. These switches select the data speed required in the office. Also, when the signaling link connects to a co-located office, these switches are used to select the internal clock option.

### **Channel Service Unit**

The channel service unit (CSU) (Figure 2-10) is used only with the 56kb/s digital data service transmission facility and is primarily intended for full-duplex operation in a four-wire application. No channel service unit is required for short-haul signaling links to a co-located office. The channel service unit provides access to the synchronous 56kb/s digital data service transmission facility while providing maintenance testing abilities, equalization, wave shaping, and loop loss. Data is transmitted via the channel service unit in a modified bipolar format.



Physically, the channel service unit consists of a housing, a power unit, and two circuit packs interconnected by a flexible cable harness. The circuit packs consist of a transmitter and receiver. They are of the HR-type and are coded according to the signaling speed being used. Digital signaling links operating with a 56 Kb/s signaling speed use the 550A-L1/5 CSU.

The receiver circuit pack provides a fixed-line build-out network and an automatic-line build-out network. The two networks compensate for variations in the gauge and length of cable. The transmitter circuit pack is equipped with a relay that can be operated by a remote test center to set up a loopback circuit. The relay contacts bridge the leads toward the facility and open the leads toward the digital service adapter. A pair of transmit leads and a pair of receive leads connect the channel service unit with the digital service adapter. A status indicator lead connects the channel service unit with the associated node. The node is informed, via the status indicator lead, when a loopback has been set up so that an attempt will not be made to use the channel

A PWR and TST LED is provided on the channel service unit. The PWR LED is lighted when AC power is supplied to the channel service unit and 8.2V DC is available from the power unit. The TST LED is lighted when a remote test center has a loopback established for testing purposes.

### **Digital Service Adapter (DSA)**

Each DSA (Figure 2-11) is associated with a digital service unit (DSU) and possibly a channel service unit (CSU). A CSU may not be required when the signaling link is used in a co-located arrangement. All signals transmitted to or received from a digital signaling link (SLK) pass through a digital service adapter.

The digital service adapter provides signal level translations between the RS442/RS423 link interface signaling format and the RS232/V.35 digital service unit signaling format. Control lead signals conform to the unbalanced RS232 format standards; while the data and clock leads conform to the balanced V.35 CCITT format standards. The digital service adapter also provides an external loopback on the line side of the digital service unit. The loopback is controlled by the central processor (3B Computer) and is established by the operation of a relay in the digital service adapter. The relay contacts bridge the transmission leads in the local direction. When the relay is in the normal or non-operated state, the leads are cut through to the signaling link.

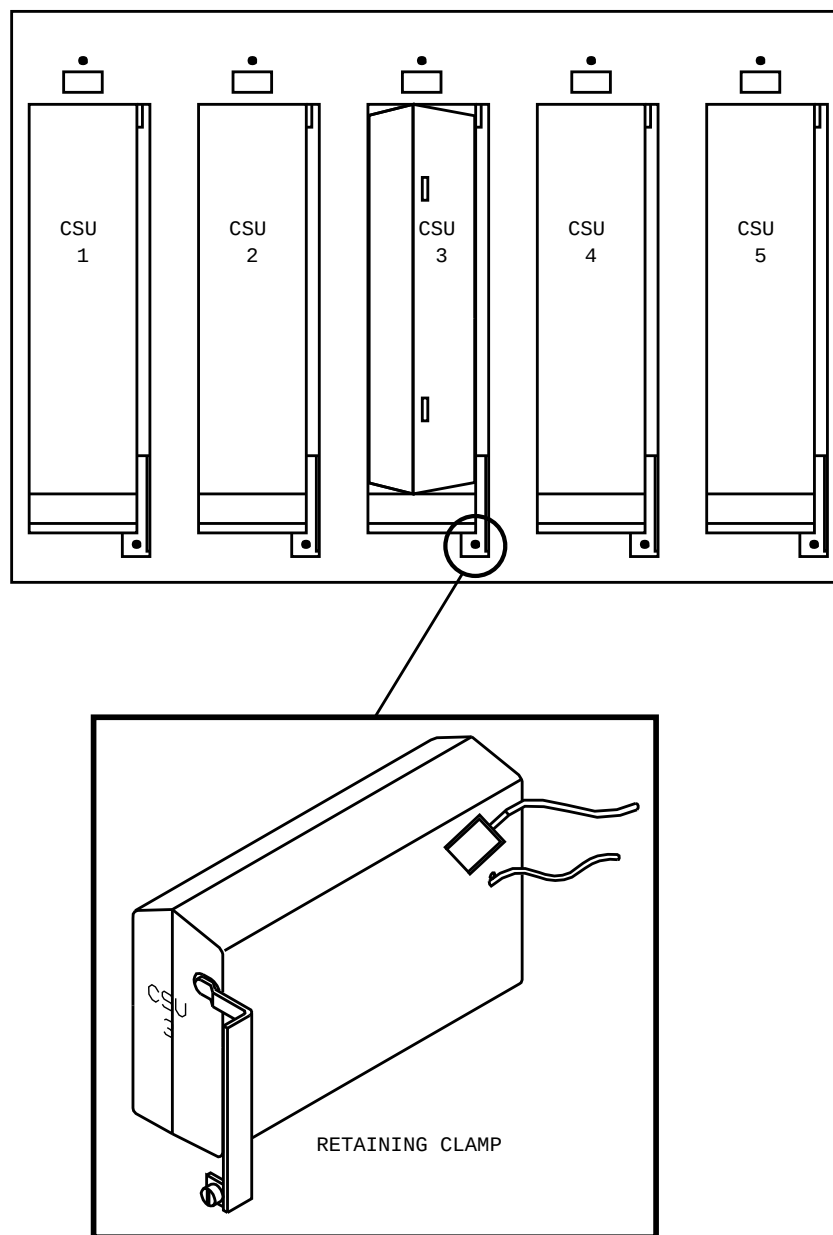


**Figure 2-10. Channel Service Unit (CSU) Mounting**

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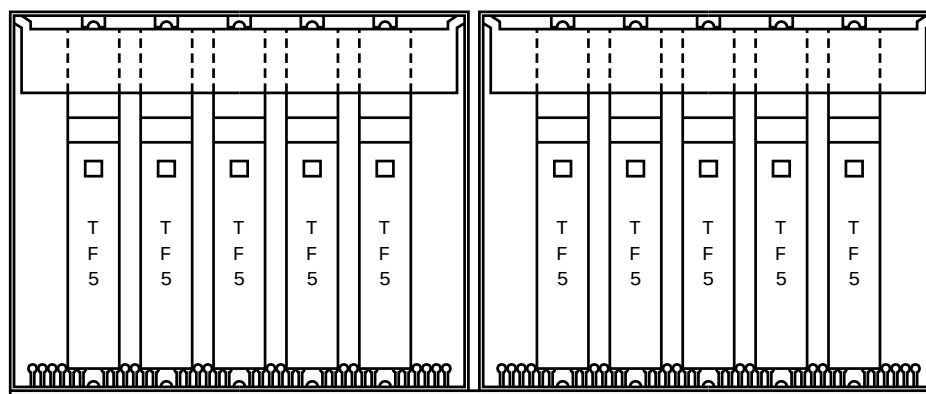


**Figure 2-11. Digital Service Adapter (DSA) Mounting**

The digital service adapter is equipped with the circuitry to select the signaling speed at which the digital facility access circuit operates. Two miniature-ganged switches are set to different positions to obtain the correct signaling speed. All digital facility access circuits used by the common channel signaling (CCS) signaling speed. However, signaling speeds of 2.4, 4.8, and 9.6 Kb/s can be provided for other digital signaling link applications.

The following are the two versions of the digital service adapter (DSA) that exist:

1. TF5 Digital Service Adapter
2. TF9 Digital Service Adapter.

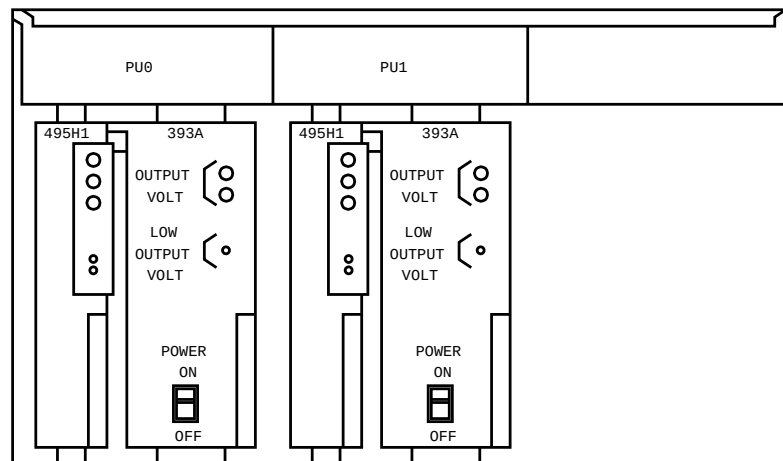
Both versions of the digital service adapter perform the same functions with the exception that the TF9 DSA does not connect to the line side of the data selector unit. The reason for two versions of the digital service adapter is the digital service unit used with each. The TF5 digital service adapter is used when a AT&T 500B data service unit or an unmodified AT&T 2556 data service unit/channel service unit (DSU/CSU) combination is used. The TF9 digital service adapter is used when a DATATEL\* digital service unit or a modified AT&T 2556 (2556 L-1A/2) data service unit/channel service unit (DSU/CSU) is used.

\* Register trademark of DATATEL Inc.

Both digital service adapters, TF5 and TF9, operate using -48V DC and include DC-to-DC converters to convert the -48V DC to various voltage levels required for on-board integrated circuits. All input/output wiring is made using connectorized cables and backplane connector fields.

### AC Power Unit

The AC power unit (Figure 2-12) houses two -48V DC to 120V AC inverters. Each inverter consists of a 393A and a 495H1 power module. These inverters (A and B) supply power to the AC power distribution units.



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**Figure 2-12. AC Power Unit Mounting**

Each AC power distribution unit (Figure 2-13) is equipped with five duplex receptacles that are accessed from the rear of the unit and five 70G fuses associated with the receptacles. The AC power distribution unit receptacles provide power for the DSUs and CSUs.

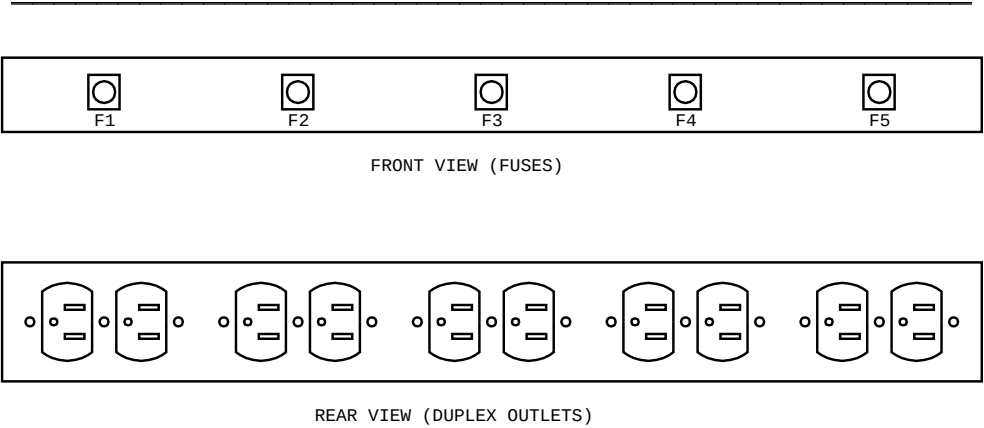


**Figure 2-13. AC Power Distribution Unit Mounting**

## Fuse and Control Panel

The fuse and control panel (Figure 2-14) provides the DFA cabinet with fuse blocks to fuse units within the cabinet, a portable data terminal jack, an office telephone jack, a 660-type telephone circuit jack, and power/alarm circuitry controls. The power/alarm circuitry controls include the following:

- Alarm Cutoff Key
- Lamp Test Key
- Power Alarm Reset Key.

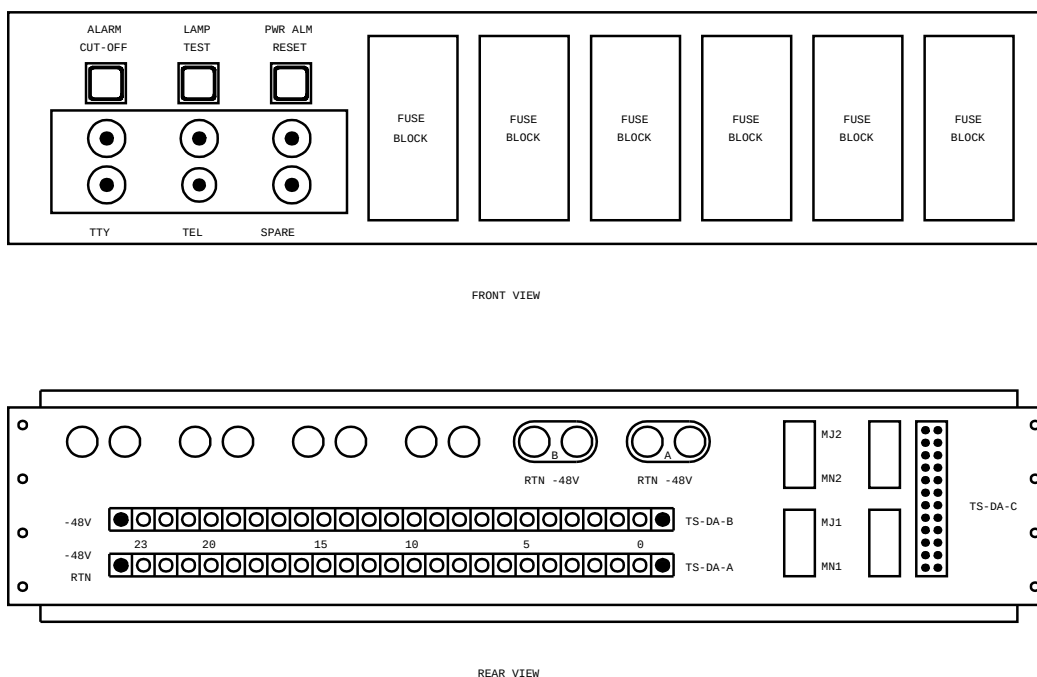


**Figure 2-14. Fuse and Control Panel Mounting**

The ALARM CUTOFF key closes SCAN circuits that request the processor to silence the present alarm. However, subsequent alarms are not inhibited by this action. The LAMP TEST key activates the FA lamp on the fuse panel and the PWR ALM lamp on the control panel. The PWR ALM RESET key is used to release all activated alarm relays after power troubles have been cleared. However, if the power alarm is due to a problem with the cabinet fan units, the problem must be corrected and the fan unit alarm ON/RESET key operated prior to operating the PWR ALM RESET key on the fuse and control panel.

## Signaling Transport Frame (STF) Cabinet

The signaling Transport Frame (STF) cabinet (Figure 2-15) contains all the hardware elements associated with the end points of a signaling transport facility.

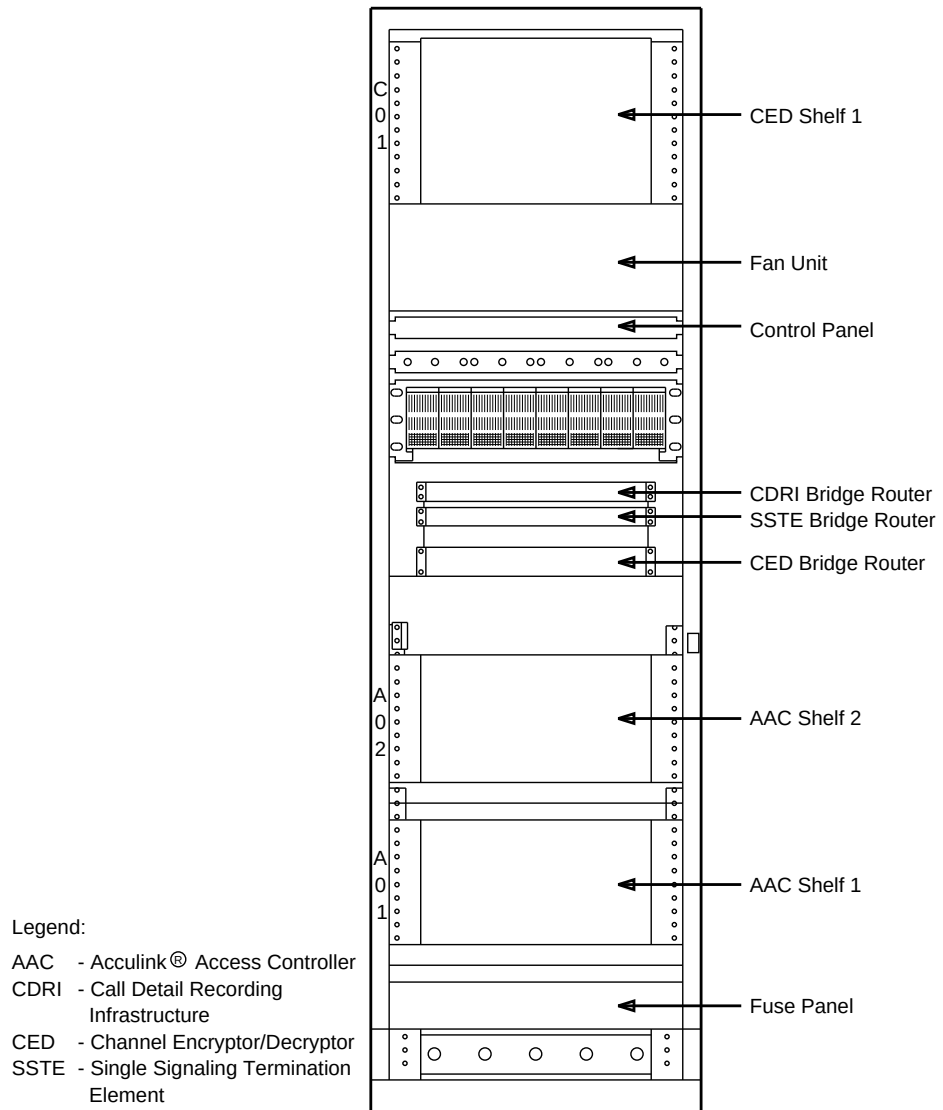


**Figure 2-15. Typical Signaling Transport Frame (STF)**

The STF cabinet equipment replaces the following existing equipment.

- Digital Service Unit (DSU)/Channel Service Unit (CSU)
- D4 Channel Bank
- Automated Bit Access Test System (ABATS)
- Digital Access Cross-Connect System (DACS)
- Network Channel Office Equipment (NCOE).

The cabinet contains hardware elements associated with the end points of a signaling transport facility that include the following features:

- Single Signaling Termination Element
- High Speed Links
- High Speed Links Encryption
- Golden Path Project.

These features are discussed in the following paragraphs.

### **Single Signaling Termination Element**

The Single Signaling Termination Element (SSTE) provides 56 Kbp/s links for the CCS7 network using modern technology. It simplifies the network/operation support system infrastructure while improving overall network reliability. As noted previously, the SSTE replaces the DSU/CSU, D4, ABATS, DACS and NCOE. It incorporates ABATS and NCOE functionality in a single unit which can also be used in SPOI offices.

The SSTE involves the placement of one or more Acculink® Access Controllers (AAC) in a standard location within the 4ESS switch footprint and wired to the DSX.

### **High Speed Links**

The High Speed Links feature allows the 2 Signaling Transfer Points (2STPs) in the AT&T Switched Network (ASN) to support 1.544 Mbs B and C signaling links. This increase in link speed requires the Universal Link Node (ULN) which is a new link node to support the 1.544 Mbps link termination. This allows larger volumes of CCS7 signaling messages while conserving the number of link terminations, decreasing network complexity,, and lowering costs. In addition, this feature allows the ASN to process message signal units with significantly higher average length without degrading the quality of service. The ULNs are to be wired to the DSX.



Another High Speed Links feature allows 4ESS switches in the ASN to access the CCS7 network via 1.544 Mbps A links. This provides an alternative to the 56 Kbps A links, which is beneficial in a signaling network where the signaling end points generate large volumes of signaling loads. In addition, it also frees-up the 2 STP link termination for other features or network growth.

### **High Speed Links Encryption**

The High Speed Links Encryption feature involves the placement of one shelf of encryption devices to be placed in the 4ESS switch footprint and wired to the DSX. This equipment assures that the High Speed Links are secure by encrypting the links at the digital services interface (DSI) facility level.

### **Golden Path Project**

The Golden Path project is an equipment and facility implementation methodology to provide, maintain, and track intra-office path diversity (physical separation) within all CCS7 network locations. A major objective for each technology within a CCS7 network location is to assure that a single failure does not cause a service disruption.

The Golden Path project requires that a digital service cross-connect (DSX) panel and a fuse panel be placed in a standard location in the 4ESS switch footprint.

## Equipment Addressing and Assignments

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### Node Addressing

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Each node (LN, RPCN, DLN, ILN, etc.) on the ring has a physical and machine address assigned to it. The physical address is assigned using strapped wiring on the backplane of each unit. Each address is unique to the cabinet, group number, and the position, member number, in the cabinet. Therefore, units are not interchangeable without modifying the address strapping and ensuring that shelf units are correctly numbered left to right or right to left. The machine address is based on the physical address, which is determined by group and member number. There are 64 (0 through 63) groups and 16 (0 through 15) members in each group. The formula to compute the machine address is illustrated by the following example:

$$\text{Machine address} = (16)(x) + y$$

$x$  = Group number (0 through 63)

$y$  = Member number (0 through 15).

Using the above formula:

A LN in position 15 of group 32 has machine address  
 $(16)(32) + 15 = 527$ .

A RPCN in position 0 of group 32 has machine address  
 $(16)(32) + 0 = 512$ .

### Node Assignments

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It is recommended that node assignments be made in a manner so that, in the event of a ring failure, paired nodes would not both be isolated by most multiple ring fault configurations. Diversity can be provided by using an intricate node assignment and power distribution scheme.

To provide maximum reliability in the event of a ring reconfiguration, it is recommended that the RPCNs be spaced with an approximately equal number of nodes between RPCNs. This number is determined by dividing the number of nodes by the number of required RPCNs. The DLNs should also be spaced apart from each other on different shelves and away from RPCNs.

### **Facility Assignments**

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The equipment engineer and the administration/engineering support organization should work together in making facility assignments. In general, assignments should take paired links and links from the same location and separate them according to power diversity within the cabinets.

# Signaling Links

# 3

## Contents

|                                                                        |      |
|------------------------------------------------------------------------|------|
| <b>General</b>                                                         | 3-1  |
| <b>Common Channel Signaling 7 (CCS7)</b>                               |      |
| <b>Signaling Links (SLKs)</b>                                          | 3-2  |
| ■ General                                                              | 3-2  |
| ■ Common Channel Signaling 7 (CCS7) Signaling Link States              | 3-7  |
| ■ Common Channel Signaling 7 (CCS7) Signaling Link Hardware Indicators | 3-9  |
| ■ Common Channel Signaling 7 (CCS7) Signaling Link Hardware Options    | 3-10 |
| Common Channel Signaling 7 (CCS7) Signaling Link Routing               | 3-10 |
| <b>D-Channel and Special Access Data Channel</b>                       |      |
| <b>Signaling Links</b>                                                 | 3-14 |
| ■ General                                                              | 3-14 |
| ■ D-Channel Signaling Link Backup                                      | 3-18 |
| ■ D-Channel and Special Access Data Channel Signaling Link States      | 3-18 |
| ■ Special Access Data Channel Signaling Link Tests                     | 3-21 |
| ■ D-Channel Signaling Link Tests                                       | 3-21 |
| Link Check Internal Test                                               | 3-21 |
| Link Check Test                                                        | 3-24 |
| Loopback                                                               | 3-24 |
| ■ D-Channel and Special Access Data Channel Signaling Link Routing     | 3-24 |

---

## Contents

|                                                                       |      |
|-----------------------------------------------------------------------|------|
| <b>International Link Node (ILN) Signaling Links</b>                  | 3-25 |
| ■ General                                                             | 3-25 |
| ■ International Link Node Signaling Link States                       | 3-25 |
| ■ International Link Node Signaling Link Tests                        | 3-29 |
| Link Check Internal                                                   | 3-29 |
| Link Check                                                            | 3-29 |
| Loopback                                                              | 3-30 |
| ■ International Link Node Signaling Link Routing                      | 3-30 |
| <b>Small Computer System Interface Node (SIN) Links</b>               | 3-31 |
| ■ General                                                             | 3-31 |
| ■ Small Computer System Interface Node Link States                    | 3-32 |
| ■ Small Computer System Interface Node Signaling Link Tests           | 3-33 |
| <b>Ethernet Interface Node (EIN) Links</b>                            | 3-34 |
| ■ General                                                             | 3-34 |
| ■ Ethernet Interface Node Link States                                 | 3-35 |
| ■ Ethernet Interface Node Signaling Link Tests                        | 3-36 |
| <b>Increased Buffer Size of SS7 Satellite Nodes using BEC Feature</b> | 3-37 |
| ■ General                                                             | 3-37 |
| ■ Description                                                         | 3-37 |
| ■ Growth of Satellite Links With BEC                                  | 3-38 |
| ■ Degrowth of Satellite Links With BEC                                | 3-38 |

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## Signaling Links

# 3

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### General

The CNI ring application link nodes interface with the CCS7 network or customer premise equipment (CPE) via signaling links. Signaling links associated with the 4ESS Switch CNI ring can be categorized into the following groups:

- Common Channel Signaling 7 (CCS7) signaling links
- D-Channel (DCHN) and Special Access Data Channel (SADC) signaling links
- International Link Node (ILN) signaling links.
- Small Computer System Interface Node (SIN) Links
- Ethernet Interface Node (EIN) Links

Each in-service link of a link set is associated with one or more signaling link selection (SL5) codes. The Balancing Load Selection On-Link selection (BLSLS) feature, available with CNI 10.5 generic program, ensures that SLS codes are evenly distributed among the in-service links.

## Common Channel Signaling 7 (CCS7) Signaling Links (SLKs)

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### General

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Common Channel Signaling No. 7 (CCS7) signaling links (SLKs), Figure 3-1, operate at 56 kb/s and is comprised of a digital service adapter (DSA) and a digital service unit (DSU) which may be used in conjunction with a channel service unit (CSU). The digital service adapter may be either a TF5 or TF9 circuit pack; the digital service unit may be one of the following:

- AT&T 500B DSU
- AT&T 500B DSU/AT&T 550A CSU combination
- DATATEL\* DSU/CSU combination
- AT&T 2556 DSU/CSU combination.

The TF5 digital service adapter is used with a AT&T 500B DSU, a AT&T 500B DSU/AT&T 550A CSU combination, or an unmodified AT&T 2556 DSU/CSU combination. The TF9 digital service adapter is used with a **DATATEL** DSU/CSU combination or a modified AT&T 2556 (2556 L-1A/2) DSU/CSU combination.

#### **NOTE:**

The modified AT&T 2556 (2556 L-1A/2) DSU/CSU combination provides loopback abilities. Presently, the AT&T 2556 L-1A/2 is not available.

For the ULN (1.544 Mb/s) link, the signaling link runs directly from the Ring Node Frame (Link Interface CP) to the Transmission Facility.

The High Speed Links (HSA) feature allows 4ESS switches to access the CCS7 network via 1.544 Mb/s A-Links. Linksets contain both the HSA (1.544 Mb/s) and 56 kb/s links. A 56 kb/s linkset that uses BEC, available with CNI software Releases 11.4, 4A, and 12.4.7.2, and contains a satellite link cannot contain a 1.544 Mb/s link.

The SLK length determines whether or not a channel service unit (CSU) and/or transmission facility is required for digital transmissions. When a transmission facility is not required, internal timing must be provided by modifying the control office digital service unit (DSU). This is accomplished by adding a transmit clock (112A circuit module, J3F010, List 6) to the AT&T 500B DSU. The AT&T 500B DSU with an added 112A circuit module is designated as a AT&T 502B DSU.

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\* Registered trademark of DATATEL Inc.

The length of the SLK determines the configuration of digital service units (DSUs), channel service units (CSUs), and transmission facilities used with digital signaling links. Signaling link lengths can be classified as follows:

- 1000 feet or less (Case A)
- Greater than 1000 feet but less than or equal to 9 miles (Case B)
- Greater than 9 miles (Case C).

Cases A, B, C, and D (Figure 3-2) use block diagrams to illustrate the configuration of DSUs, CSUs, and transmission facilities used with the different signaling link length classifications.

Case A (Figure 3-2) illustrates a signaling link with a length of 1000 feet or less. Under this condition, only a DSU is required at each end of the signaling link. At the designated control office, a AT&T 502B DSU (AT&T 500B DSU with 112A circuit module modification) must be used to provide internal timing. The other office uses a AT&T 500B DSU. Neither a CSU nor a transmission facility is required with this signaling link.

Case B (Figure 3-2) illustrates a signaling link with a length greater than 1000 feet but less than or equal to 9 miles. Under this condition, a DSU and CSU are required at both ends of the signaling link. At the 4ESS Switch office, a AT&T 502B DSU (AT&T 500B DSU with 112A circuit module modification) must be used to provide internal timing. The other office uses a AT&T 500B DSU. No transmission facility is required with this signaling link. However, repeaters are required for distances greater than 3 miles. A maximum of two repeaters may be installed per signaling link.

Case C (Figure 3-2) illustrates a signaling link with a length greater than 9 miles. Under this condition, a DSU and CSU is required at both ends. A transmission facility is also required with this signaling link. Timing is provided by the transmission facility; so, a AT&T 500B DSU is used at both ends of this arrangement.

Case D (Figure 3-2) illustrates a signaling link that uses the **DATATEL** DSU/CSU combination or AT&T 2556 DSU/CSU combination. A transmission facility may or may not be used with this signaling link. A transmission facility is not required for collocated offices. If a transmission facility is not required, the **DATATEL** or AT&T 2556 DSU/CSU combination must be set up via options provided to operate as a AT&T 502B DSU. For the **DATATEL** DSU/CSU combination, Switch 1-Position 5 must be enabled (ON) to provide this feature. For the AT&T 2556 DSU/CSU combination, Switch Position 6 must be enabled (ON) to provide the same feature.

When the STF is used, the connection from the host to the remote 4ESS switch is through dedicated T1 facilities as shown in Figure 3-3.



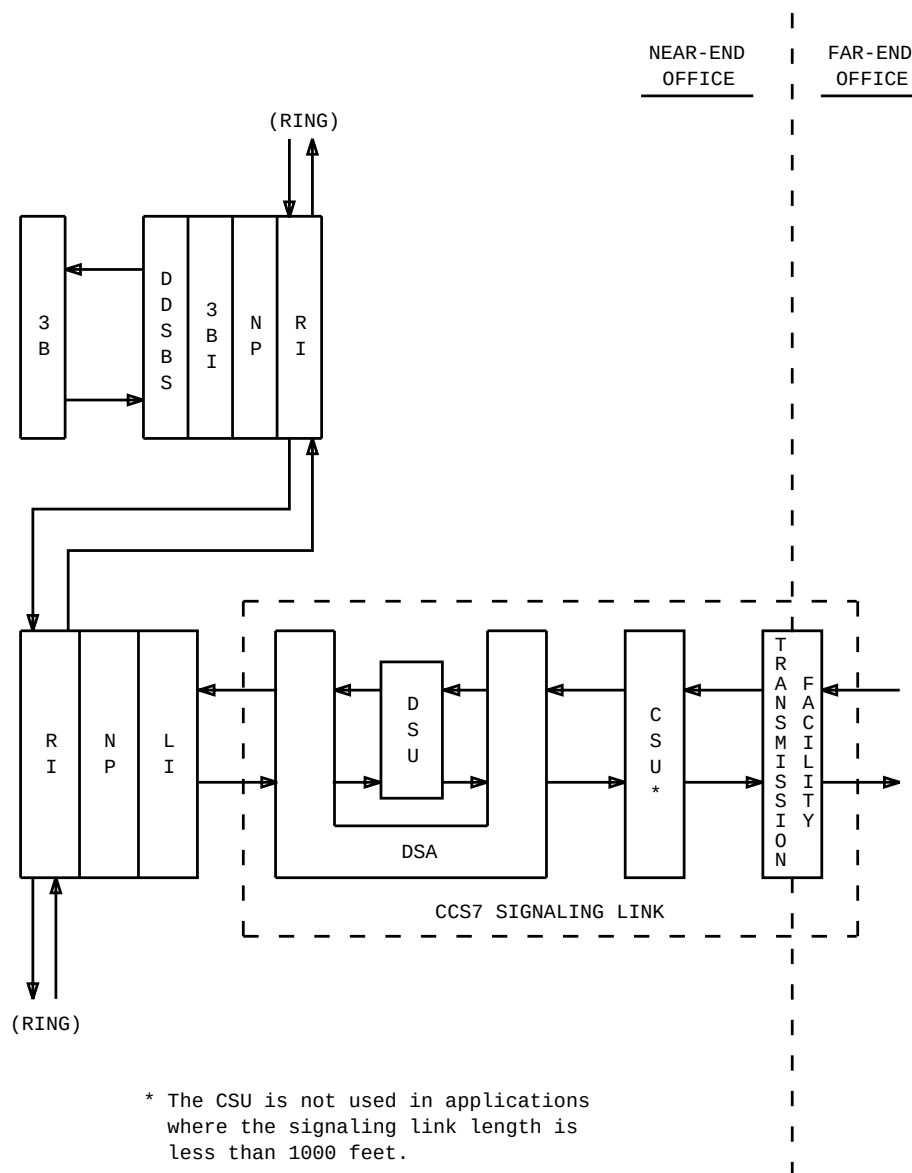
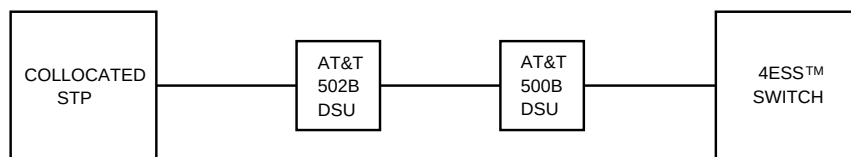
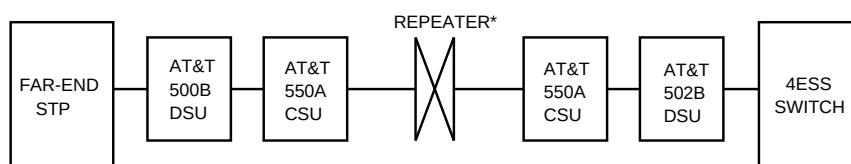


**Figure 3-1. Common Channel Signaling 7 (CCS7) Signaling Links**

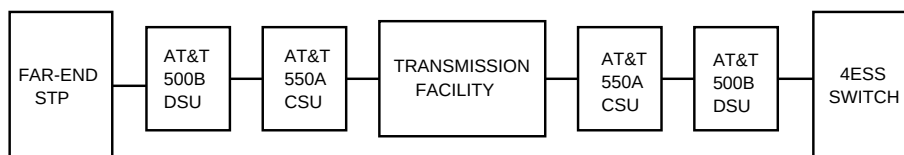


Case A — Signaling link length 1000 feet or less.

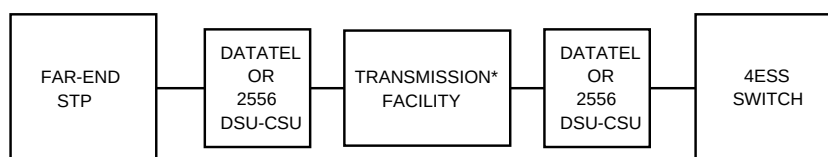


\* A repeater is required every 3 miles.

Case B — Signaling link length greater than 1000 feet but less than or equal to 9 miles.



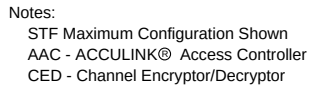
Case C — Signaling link length greater than 9 miles.



\* Transmission facility not required for collocated offices

Case D — Signaling link using combined DSU/CSU.

**Figure 3-2. Common Channel Signaling 7 (CCS7) Signaling Link Lengths**



### Figure 3-3. Signaling Transport Frame Equipment Connection

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## Common Channel Signaling 7 (CCS7) Signaling Link States

Three *major CCS7 signaling link states* exist: **UNEQUIPPED**, **UNAVAILABLE**, and **AVAILABLE**. To change from one major state to another, a recent change (RC) function must be used. The major states are considered static states because they can only be changed by performing a recent change, and their status resides in both main memory and on the disk. In a system boot, the major states of the signaling links are restored from the disk.

Table 3-A shows the transitions that can be made from one signaling link state to another. A signaling link in one state can be changed to another state via either a recent change or PDS command.

**Table 3-A. Signaling Link State Transitions**

| From          | To                 |                    |                  |            |
|---------------|--------------------|--------------------|------------------|------------|
| UNEQP         | UNAVL<br>GROW      | UNAVL<br>TEST      | -                | -          |
| UNAVL<br>GROW | UNEQP              | UNAVL<br>TEST      | -                | -          |
| UNAVL<br>TEST | UNAVL<br>GROW      | AVL<br>MOOS        | -                | -          |
| AVL<br>MOOS   | AVL<br>OOS         | AVL<br>IS          | -                | -          |
| AVL<br>OOS    | UNAVL<br>GROW<br>* | UNAVL<br>TEST<br>* | AVL<br>MOOS<br>* | AVL<br>IS  |
| AVL<br>IS     | UNAVL<br>GROW      | UNAVL<br>TEST      | AVL<br>MOOS      | AVL<br>OOS |

\* Transient state that is automatically accessed when signaling link is moved to the AVL-IS state.

In addition to the major states, there are related *minor signaling link states*. The minor states are under control of program documentation standard (PDS) commands found in the Input Message Manual and Output Message Manual. The minor states are considered dynamic states because they can easily be changed via PDS input commands, and their status is stored in main memory only. In a system boot, the minor states are set to either *Grow* or *OOS*.

The following paragraphs describe some basic characteristics about each signaling link state:

- a. **UNEQUIPPED:** The signaling link has no link configuration data in main memory or on the disk. Diagnostics can be run while in this state.
- b. **UNAVAILABLE:** The signaling link must be in this state for the user to change link configuration data.

Two minor states, **Grow** and **Test**, are associated with this major state. While in the **UNAVAILABLE-Grow** state, no link usage information (for example, cyclic redundancy check [crc] errors, etc.) is provided to the user. The signaling links that have passed their installation acceptance tests and are not ready for preservice testing should be left in the **UNAVAILABLE-Grow** state.

When the signaling link is ready for preservice testing, it should be moved to the **UNAVAILABLE-Test** state. While in this state, the signaling link provides the user with link usage information (crc errors detected on the link, number of unsolicited frames received on the link, etc.), but does not start the link protocol. A low cycle redundancy check (crc) error count indicates that the link is properly terminated to another protocol entity. Unlike some other signaling links, the protocol on the link cannot execute while in the self-looped mode. Attempting to do this causes protocol exception measurement counts but has no other adverse effect.

- c. **AVAILABLE:** Three minor states, **In-Service**, **Out-of-Service**, and **Manual Out-of-Service**, are associated with this major state. When a signaling link is moved from the **UNAVAILABLE** state to the **AVAILABLE** state, the signaling link is first moved to the **AVAILABLE-OOS** state while the protocol attempts to be established. If the signaling link protocol is successfully established, the signaling link is moved to the **AVAILABLE-IS** state. Once in this state, the signaling link is in service, and signaling traffic can commence. In general, all signaling links should be moved to the **AVAILABLE-IS** state by the service-order due date.

A signaling link in the **AVAILABLE-IS** state is automatically moved to the **AVAILABLE-OOS** state, when an extended error condition occurs—greater than 90 seconds of link outage. The system automatically attempts to recover signaling links in this state; that is, return them to the **AVAILABLE-IS** state. This activity continues indefinitely; unless, the node is removed manually for diagnostics; or the link is moved to the **AVAILABLE-MOOS** state.

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If it is necessary to work on a signaling link in the **AVAILABLE-IS** state, such as running diagnostics or replacing hardware, the link must manually be removed from service. When the link is moved to the **AVAILABLE-MOOS** state, the protocol on the link is disconnected. However, the link is still monitored for valid and invalid frames.

### **Common Channel Signaling 7 (CCS7) Signaling Link Hardware Indicators**

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The CCS7 signaling link DSU is responsible for providing link node access to the synchronous digital data system (DDS) through the digital service adapter (DSA) and the CSU. The AT&T 2556 and **DATATEL** DCP3189/DCP3189-B DSUs combine the DSU and CSU circuitry into one unit. All DSUs receive serial, unipolar data and transmit a baseband, bipolar signal with a frequency corresponding to the transmission data rate. Data and clock signals passed from the link node to the DSA and DSU meet CCITT V.35 recommendations for a balanced interface while control signals conform to the Electronic Industries Association (EIA) RS-232C requirements. Generally, transmitted signals flow from the link node to the DSU via the DSA and CSU, while signals received from the facility follows the same route in reverse.

All DSUs are capable of communicating with each other, but different DSU types offer unique functions. The most effective testing involves end-to-end testing using the same DSU types. However, testing between unlike DSUs can still offer valuable maintenance information. One attendant end-to-end tests cannot be performed between unlike DSU types, but tests can be performed if both offices have voice communication. It is also possible for testing to be performed from remote test centers.

The following is a description of loopback mode switches and lamps pertaining to end-to-end testing for the AT&T 500B DSU/AT&T 550A CSU combination, AT&T 2556 DSU, and **DATATEL** DCP3189/DCP3189-B DSU.

#### **a. AT&T 500B DSU/AT&T 550A CSU Combination:**

##### Loopback Mode Switches

- LL** - Operation of the **LL** switch provides local bidirectional loopback at the DSU line interface.
- RT** - Operation of the **RT** switch provides unidirectional loopback at the V.35 interface toward the facility.

##### Loopback Lamp Indicators

- LL** - The **LL** lamp when illuminated indicates when the LL switch is operated or when a CHANNEL LOOPBACK command is received from the network.

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**b. AT&T 2556 DSU**

## Loopback Mode Switches

- LL** - Operation of the **LL** switch provides local loopback at the DSU line interface. There is a 5-second pause after operation.
- DL** - Operation of the **DL** switch provides digital loopback at the DSU line interface.

**c. DATATEL DCP3189/DCP3189-B DSU**

## Loopback Mode Switches

- LAL** - Operation of the **LAL** switch provides local loopback at the DSU line interface.
- LDL** - Operation of the **LDL** switch provides digital loopback at the DSU line interface.

## Loopback Lamp Indicators

- TST** - The **TST** lamp when illuminated indicates when the DSU is in the test mode.
- CMP** -  
The **CMP** lamp when illuminated indicates successful reception of test pattern.

**Common Channel Signaling 7 (CCS7) Signaling  
Link Hardware Options**

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The CCS7 signaling link DSU, CSU, and digital service adapter (DSA) hardware have options that can be set for specific applications. These options for specific hardware types are identified in Tables 3-B through 3-F.

**Common Channel Signaling 7 (CCS7) Signaling  
Link Routing**

The CCS7 signaling link routing activity can include the addition and the deletion of CCS7 signaling links, and changing CCS7 link configuration data. Signaling link routing is via a combination of input/output messages and recent change/verify functions using the maintenance CRT.

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**Table 3-B. AT&T 500B Digital Service Unit Options**

| <b>Designation</b> | <b>Name</b>                                                         | <b>Setting</b>                                                                  |
|--------------------|---------------------------------------------------------------------|---------------------------------------------------------------------------------|
| XL                 | System status removed                                               | H1 header position 8 shunted                                                    |
| XN                 | Switch LED assembly installed                                       | -                                                                               |
| XO                 | LL spring clip installed                                            | -                                                                               |
| YK or YL           | Signal ground connected (YK) or disconnected (YL) from frame ground | S1 switch either IN or OUT depending on what provides the best SLK performance. |
| YR                 | Circuit assurance removed                                           | H1 header position 5 shunted                                                    |
| YS                 | Continuous request to send                                          | H1 header position 2 shunted                                                    |

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**Table 3-C. DATATEL\* Digital Service Unit Options**

| Switch Designation | Switch Position | Setting (Note) |
|--------------------|-----------------|----------------|
| <b>S1</b>          | 1               | OFF            |
|                    | 2               | OFF            |
|                    | 3               | ON             |
|                    | 4               | ON             |
|                    | 5               | OFF*           |
|                    | 6               | OFF            |
|                    | 7               | ON             |
|                    | 8               | ON             |
| <b>S2</b>          | 1               | OFF            |
|                    | 2               | ON             |
|                    | 3               | OFF            |
|                    | 4               | ON             |
|                    | 5               | ON             |
|                    | 6               | ON             |
|                    | 7               | ON             |
|                    | 8               | ON             |

**Note:** Do not change the setting on the **DATATEL** DSU while the power is ON.

\* This switch should be ON when the DSU is modified to be a AT&T 502B.

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\* DATATEL is a registered trademark of DATATEL Inc.

**Table 3-D. AT&T 2556 Digital Service Unit Options**

| Switch Position | Setting | Switch Position | Setting |
|-----------------|---------|-----------------|---------|
| 1               | Enable  | 7               | Disable |
| 2               | Disable | 8               | Disable |
| 3               | Enable  | 9               | Enable  |
| 4               | Disable | 10              | Enable  |
| 5               | Disable | 11              | Enable  |
| 6               | *       | 12              | Enable  |

\* This switch should be enabled when the DSU is modified to be a AT&T 502B (metallic facility).

**Table 3-E. Channel Service Unit Options**

| Designation | Name                                                                       | Setting                                                                        |
|-------------|----------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| WV          | Fixed line build-out network installed                                     | H1 header position<br>3, 5, and 9 shunted                                      |
| YK or YL*   | Signal ground either connected (YK) or disconnected (YL) from frame ground | S1 switch either IN or OUT depending on what provides the best SLK performance |

**Table 3-F. TF5 Digital Service Adapter Options**

| Switch | Setting |
|--------|---------|
| S1A    | ON      |
| S1B    | OFF     |

## D-Channel and Special Access Data Channel Signaling Links

### General

The D-channel (DCHN) SLKs (Figure 3-4) operate at 64 kb/s with either a “clear” (64C) or “restricted” (64R) format. The SADC signaling link operates at 9600 b/s for CPE application. For the individual per call control (iPCC) application, the SADC signaling link operates at 56Kb/s.

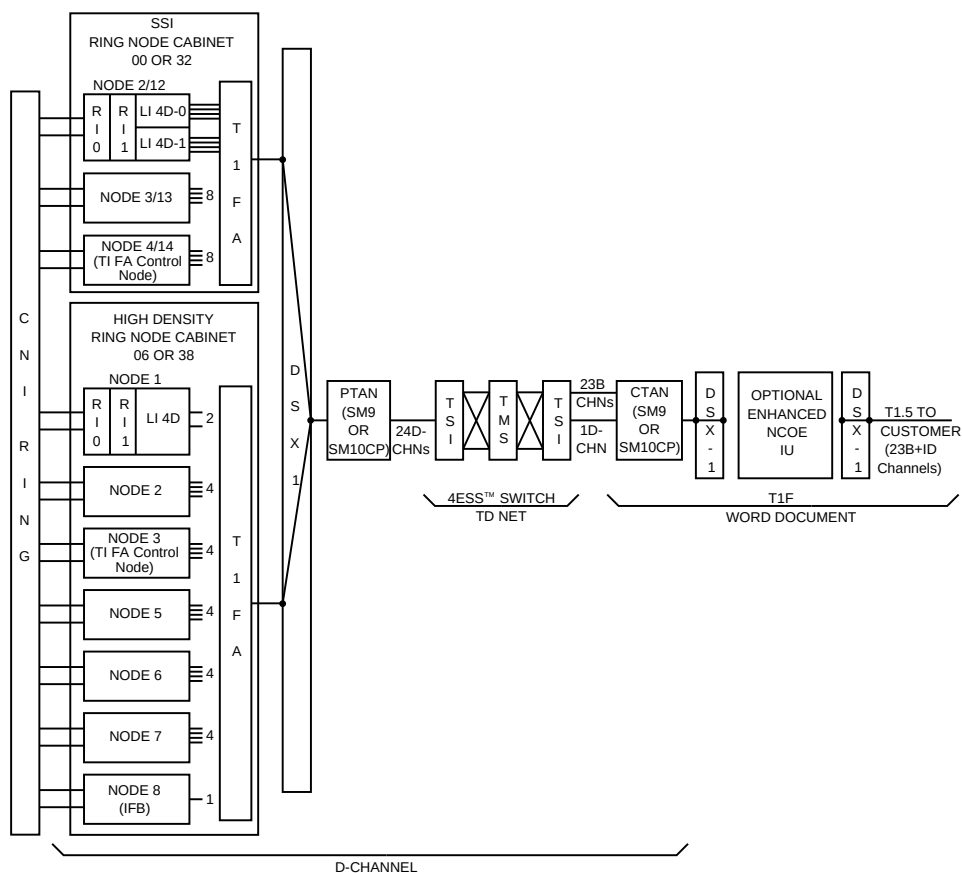


**Figure 3-4. D-Channel Connectivity**

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The DCHN signaling link arrives at the 4ESS Switch via a DS1 line from CPE. The DS1 line terminates onto a DIF. The D-channels are switched through the time division network (TDN) via "nailed-up" connections to the digital cross-connect (DSX) frame. The DSX frame serves as a distribution point where D-channels are distributed to the appropriate T1 facility access (T1FA) circuitry associated with assigned DCHN nodes. The T1FA circuitry is used to multiplex and demultiplex DCHN signaling link data to and from the DSX frame and DCHN node link interface (LI) circuitry.

The SADC signaling link for CPE application (Figure 3-5) hardware consists of a data set and an analog transmission facility. Each SADC signaling link is connected to a 2096 data set operating at 9600 b/s. The data set provides synchronous, serial, binary signals for transmission over 4-wire analog facilities. The SADC signal link hardware is normally housed in an analog facility access (AFA) cabinet.

The SADC signaling link for the IPCC application is shown in Figure 3-6. The IPCC feature includes the following major components:

- One to four 4ESS switches
- Two SADC links and nodes per 4ESS switch
- One gateway cabinet
- Four interlinks
- One roll-up 730 multi-tasking graphics terminal
- One to 120 USEC frames and USEC links.

Special access data channel links ("A") connect from the SADC node on the CNI ring of the 4ESS switch to the gateway primary and secondary units within the cabinet. The SADC node in the HD ring node cabinet (HD RNC) 06, is designated Group 8, node 7 is always linked to the primary gateway controller. The SADC node in HD RNC 38, designated Group 40, node 7 is always linked to the secondary gateway controller. These SADC links, between the CNI ring and the Gateway cabinet, are 56 kbps and can span to 4000 ft. A maximum of four 4ESS switches can be connected to the gateway cabinet via SADC links.

There are two types of interfaces to data facilities associated with DCHN and SADC nodes, *LI4D* and *LI4S*.

The *LI4D* link interface is associated with DCHNs and provides four interface links to a T1FA circuit.

The *LI4S* link interface is associated with SADC nodes and provides four interface links for connection to data sets. Link management functions are on a per-link basis, and each DCHN and SADC signaling link is completely

independent, as far as tests are concerned. At any one time, some signaling links on a node could be in service while others are out of service, unavailable, or unequipped.

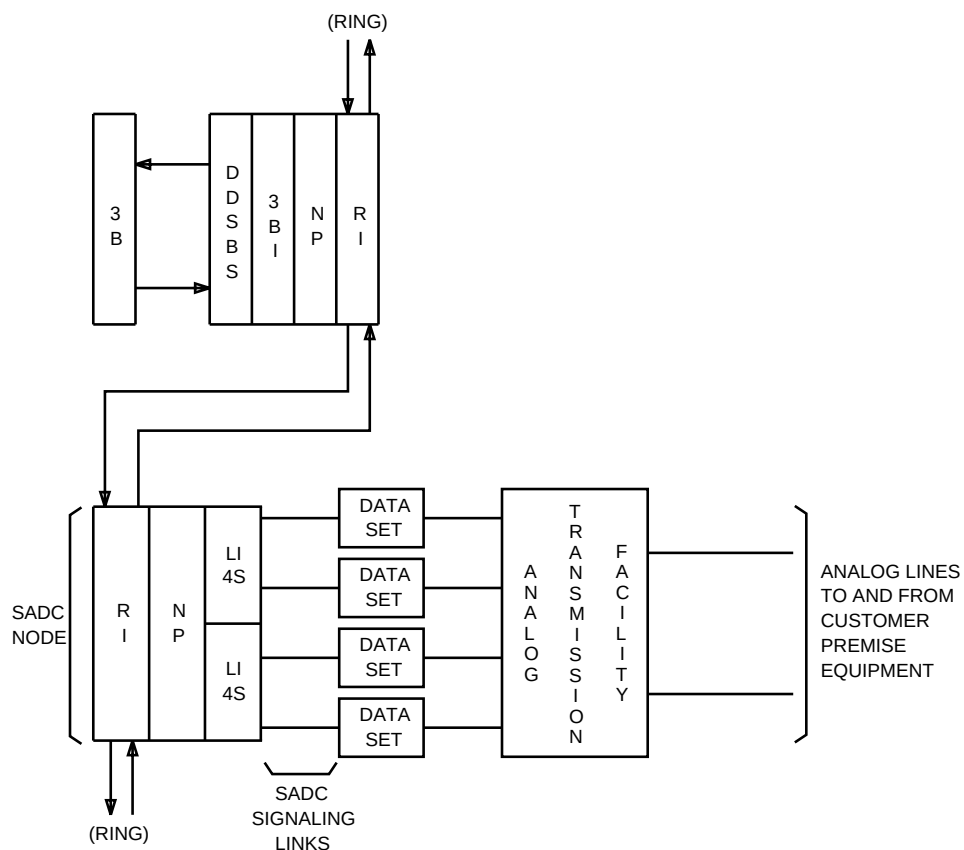


**Figure 3-5. Special Access Data Channel Signaling Link Block Diagram**

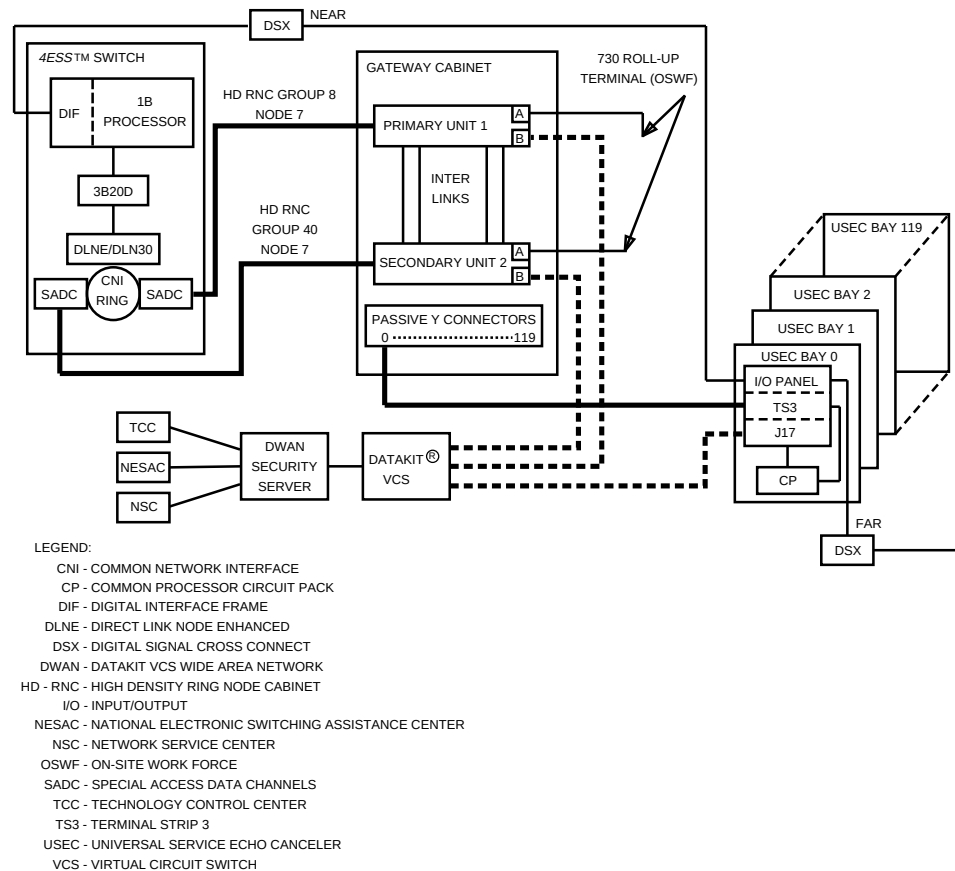


**Figure 3-6. Individual Per Call Control (iPCC) System**

## **D-Channel Signaling Link Backup**

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The DCHN signaling link backup is an optional Q.931 protocol procedure that allows two DCHN signaling links to operate as a mated pair. The two signaling links are designated as ACTIVE and STANDBY. The active DCHN signaling link carries all Q.931 signaling messages; while the standby signaling link serves as a backup, if failures occur. However, the standby signaling link is active for Layer 2 functions. The Q.931 signaling is moved from the active to the standby DCHN signaling link, in the case of a link failure or a near-end/far-end request. Both signaling links of a mated pair cannot be assigned to the same cabinet.

## **D-Channel and Special Access Data Channel Signaling Link States**

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Three major DCHN and SADC signaling link states exist: **UNEQUIPPED**, **UNAVAILABLE**, and **AVAILABLE**. To change from one major state to another, a recent change (RC) function must be used. The major states are considered static states because they can only be changed by performing a recent change, and their status resides in both main memory and on the disk. In a system boot, the major states of the signaling links are restored from disk.

In addition to the major states, there are related minor signaling link states. The minor states are under control of PDS commands found in the Input Message Manual and Output Message Manual. The minor states are considered dynamic states because they can easily be changed via PDS input commands, and their status is stored in main memory only. In a system boot, the minor states are set to either **Grow** or **OOS**.

The following paragraphs describe some basic characteristics about each signaling link state:

- a. **UNEQUIPPED:** The signaling link has no link configuration data in main memory or on the disk. Diagnostics can be run while in this state; but the test for connection to the 2096 data set is skipped for SADC signaling links.
- b. **UNAVAILABLE:** The signaling link must be in this state for the user to change link configuration data. For SADC signaling links, a phase that tests the connection of the link to the 2096 data set is executed when diagnostics are run.

Two minor states, **Grow** and **Test**, are associated with this major state. While in the **UNAVAILABLE-Grow** state, no link usage information (for example, cyclic redundancy check errors, etc.) is provided to the user. The signaling links that have passed their

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installation acceptance tests and are not ready for preservice testing should be left in the **UNAVAILABLE-Grow** state.

When the signaling link is ready for preservice testing, it should be moved to the **UNAVAILABLE-Test** state. While in this state, the signaling link provides the user with link usage information (crc errors detected on the link, number of unsolicited frames received on the link, etc.) but does not start the link protocol. A low cycle redundancy check (crc) error count indicates that the link is properly terminated to another protocol entity. Unlike some other signaling links, the protocol on the link cannot execute while in the self-looped mode. Attempting to do this causes protocol-exception measurement counts, but has no other adverse effect.

Certain tests can be run on DCHN signaling links when they are in the **UNAVAILABLE-Test** state.

- c. **AVAILABLE:** Four minor states, **In-Service, Standby, Out-of-Service, and Manual Out-of-Service**), are associated with this major state. However, the **AVAILABLE-STANDBY** state is only applicable to the backup DCHN signaling link of a mated DCHN signaling link pair. When a signaling link is moved from the **UNAVAILABLE** state to the **AVAILABLE** state, the signaling link is first moved to the **AVAILABLE-OOS** state while the protocol attempts to be established. If the signaling link protocol is successfully established, the signaling link is moved to the **AVAILABLE-IS** state. Once in this state, the signaling link is in service and signaling traffic can commence. In general, all signaling links should be moved to the **AVAILABLE-IS** or **AVAILABLE-STBY** state by the service order due date.

A mated signaling link in the **AVAILABLE-IS** or **AVAILABLE-STBY** state is automatically moved to the **AVAILABLE-OOS** state immediately upon failure; whereas, a nonmated signaling link is automatically moved to the **AVAILABLE-OOS** state after an extended error condition occurs—greater than 90 seconds of link outage. When a failure occurs on a mated signaling link pair, the DCHN mated pair feature attempts to place the standby link in the **AVAILABLE-IS** state. A continual attempt is made to restore a failed standby signaling link to the **AVAILABLE-STBY** state. The system automatically attempts to return all nonmated signaling links in the **AVAILABLE-OOS** state to the **AVAILABLE-IS** state. This activity continues indefinitely unless the node is manually removed from service for diagnostics, or the signaling link is placed in the **AVAILABLE-MOOS** state.



If it is necessary to work on a signaling link in the **AVAILABLE-IS** or **AVAILABLE-STBY** state, such as running diagnostics or replacing hardware, the link must manually be removed from service. However, it must be remembered that placing an unmated signaling link in the **AVAILABLE-MOOS** state results in customer service outage. When the link is moved to the **AVAILABLE-MOOS** state, the protocol on the link is disconnected. However, the link is still monitored for valid and invalid frames.

The DCHN signaling link tests that can be run while in the **UNAVAILABLE-Test** state can also be run in the **AVAILABLE-MOOS** state.

Table 3-G shows the transitions that can be made from one signaling link state to another. A signaling link in one state can be changed to another state via either a recent change or PDS command.

**Table 3-G. Signaling Link State Transitions**

| From          | To                 |                    |                  |            |           |
|---------------|--------------------|--------------------|------------------|------------|-----------|
| UNEQP         | UNAVL<br>GROW      | UNAVL<br>TEST      | -                | -          |           |
| UNAVL<br>GROW | UNEQP              | UNAVL<br>TEST      | -                | -          |           |
| UNAVL<br>TEST | UNAVL<br>GROW      | AVL<br>MOOS        | -                | -          |           |
| AVL<br>MOOS   | AVL<br>OOS         | AVL<br>IS          | -                | -          |           |
| AVL<br>OOS    | UNAVL<br>GROW<br>* | UNAVL<br>TEST<br>* | AVL<br>MOOS<br>* | AVL<br>IS  |           |
| AVL<br>STBY   | UNAVL<br>GROW      | UNAVL<br>TEST      | AVL<br>MOOS      | AVL<br>OOS | AVL<br>IS |
| AVL<br>IS     | UNAVL<br>GROW      | UNAVL<br>TEST      | AVL<br>MOOS      | AVL<br>OOS |           |

\* Transient state that is automatically accessed when signaling link is moved to the AVL-IS state.

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## Special Access Data Channel Signaling Link Tests

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The four RS449 ports of the LI4S link interface are intended to be connected to 9600 b/s data sets, such as the 2096, via the 12A applique circuit pack. The 2096 data set provides an analog loopback which is used for testing the RS449 interface, the 12A applique circuitry, and most of the data set. These tests are performed by diagnostic phase 56/66.

## D-Channel Signaling Link Tests

---

The D-channel Signaling Link Tests are shown in Figure 3-7. There are two tests provided by Link Management to assist in testing the DCHN signaling link. They are the Link Check Internal and Link Check tests. These tests are implemented via the **LKC:SLK** input message. The **LKC:SLK** message can also be used to establish a Link Check Loopback, which enables the signaling link to be tested from the facility side or request the status of a Link Check test in progress.

With the DCHN signaling link in the **UNAVAILABLE-TEST** or **AVAILABLE-MOOS** state, the user can request three separate signaling link tests using the **LKC:SLK** input message. These are Link Check Internal, Link Check, and Loopback. All of these tests are requested on a per-link basis and can be performed while a node is processing traffic on other signaling links. An explanation of these three tests is provided in the following paragraphs.

For specific details on the signaling link tests, refer to TOP 234-153-055AC — *4ESS Switch Common Network Interface (CNI) Growth/Degrowth*.

### Link Check Internal Test

The Link Check Internal test, as shown in Figure 3-7, sets up a loop at the output of the "LI4D" link interface circuitry toward the ring and transmits messages onto the loop to verify that the node hardware for that signaling link is operational. This test returns a PASS or FAIL indication in an output message. A **LKC:SLK** input message is used to start the Link Check Internal test.

In the event of a declared link failure, a Link Check Internal test is automatically performed after the generation of a critical event. If the test fails, additional critical events are generated to provide notification of the failure. For specific details on the link check internal test, refer to TOP 234-153-055AC — *4ESS Switch Common Network Interface (CNI) Growth/Degrowth*.

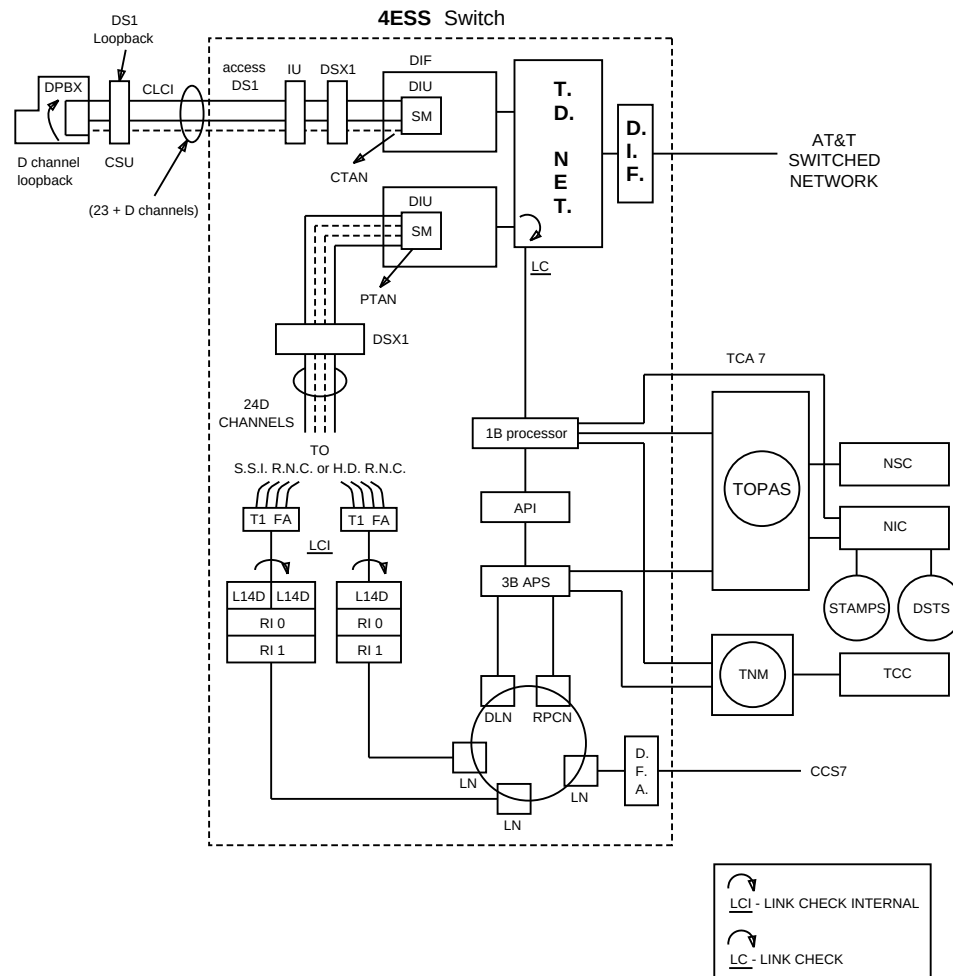


Figure 3-7. ISDN D-Channel Testing Capability (Sheet 1 of 2)

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**Legend:**

API = Attached Processor Interface  
APS = Attached Processor System  
CCS7 = Common Channel Signaling No. 7  
CSU = Channel Service Unit  
CTAN = Customer Trunk Appearance Number  
D.F.A. = Digital Facility Access  
DIF = Digital Interface Frame  
DIU = Digital Interface Unit  
DLN = Direct Link Node  
DPBX = Digital Private Branch Exchange  
DS1 = Digital System 1  
DSTS = Digital Services Test System  
DSX = Digital Cross Connect  
IU = Integrated Unit  
LCI = Link Check Internal  
LN = Link Node  
NIC = Network Interface Controller  
NSC = Network Services Center  
PTAN = Port Trunk Appearance Number  
RPCN = Ring Peripheral Controller Node  
SM = Switching Module  
STAMPS = System for Test Access and Maintenance of Protocol Service  
TCA = Test Control Area  
TCC = Technology Control Center  
T.D.NET. = Time Division Network  
TNM = Total Network Management  
TOPAS = Testing Operation Provisioning and Administration System

**Figure 3-7. ISDN D-Channel Testing Capability (Sheet 2 of 2)**

## Link Check Test

The Link Check test allows the user to test a physical signaling link to determine whether the signaling link has broken down and if the error rate on the link is acceptable. The Link Check test assumes that a loopback has already been set up on the facility toward the node. Link Check is a variable duration procedure which returns either a success code or one of three error codes.

During a Link Check test, the "LI4D" link interface circuitry sends a stream of flags (01111110) and an occasional Link Check message. The LI4D link interface then monitors the return bit stream. The LI4D circuitry accumulates the number of frame errors received, the errored seconds, and verifies that it is receiving some flags and at least some of the messages it sent. Based on these parameters, the Link Check test either passes or fails. In either case, the number of errors detected and the number of errored seconds is given in an output message. If the Link Check test fails, the reason for failure is also given. The possible failures include the following:

- No flags received
- Flags received but no Link Check messages received
- Error threshold exceeded.

Using the **LKC:SLK** input message, the user can either start a Link Check test, terminate a Link Check test, or request the current status of a Link Check test. For specific details on the Link Check tests, refer to TOP 234-153-055AC — *4ESS Switch Common Network Interface (CNI) Growth/Degrowth*.

## Loopback

Using the **LKC:SLK** input message, the user can set up a loopback at the output of the "LI4D" link interface circuitry toward the facility. By leaving the link in this state and generating a stream of data into the loopback, the link can be tested from the facility side by the far end.

## D-Channel and Special Access Data Channel Signaling Link Routing

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The DCHN and SADC signaling link routing activity can include the addition of DCHN and SADC signaling links, the deletion of DCHN and SADC signaling links, and changing DCHN and SADC link configuration data. Signaling link routing is performed via a combination of input/output messages and recent change/verify functions using the maintenance CRT.

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## **International Link Node (ILN) Signaling Links**

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### **General**

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The international link node (ILN) signaling link (Figure 3-8) operates at 64 kb/s with a "clear" (64C) format. The ILN signaling link data arrives at the 4ESS Switch digital cross-connect (DSX) frame via DS1 lines from international switching centers (ISCs). The DSX frame serves as a distribution point where ILN signaling links are distributed to the 4ESS Switch. The ILN signaling links are terminated onto 4ESS Switch digital interface frames (DIFs). Signaling link data is switched through the time division network (TDN) via "nailed-up" connections and distributed to the appropriate T1 facility access (T1FA) circuitry associated with assigned international link nodes (ILNs). The T1FA circuitry is used to multiplex and demultiplex ILN signaling link data to and from the 4ESS Switch and ILN link interface (LI) circuitry.

In reverse, the T1FA circuitry multiplexes twenty-four 64 kb/s ILN signaling links into a 1.544 Mb/s bit stream. The 1.544 Mb/s bit stream is returned to the DSX frame where the data is separated and transmitted to associated international switching centers (ISCs).

The LI4D link interface is associated with international link nodes and provides one signaling link to the T1FA circuitry. Link management functions are on a per-link basis, and each ILN signaling link is completely independent as far as tests are concerned.

### **International Link Node Signaling Link States**

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Three *major international link node (ILN) signaling link states* exist: *UNEQUIPPED*, *UNAVAILABLE*, and *AVAILABLE*. To change from one major state to another, a recent change (RC) function must be used. The major states are considered static states because the major states can only be changed by performing a recent change, and the status of the major states resides in both main memory and on the disk. In a system boot, the major states of the signaling links are restored from disk.

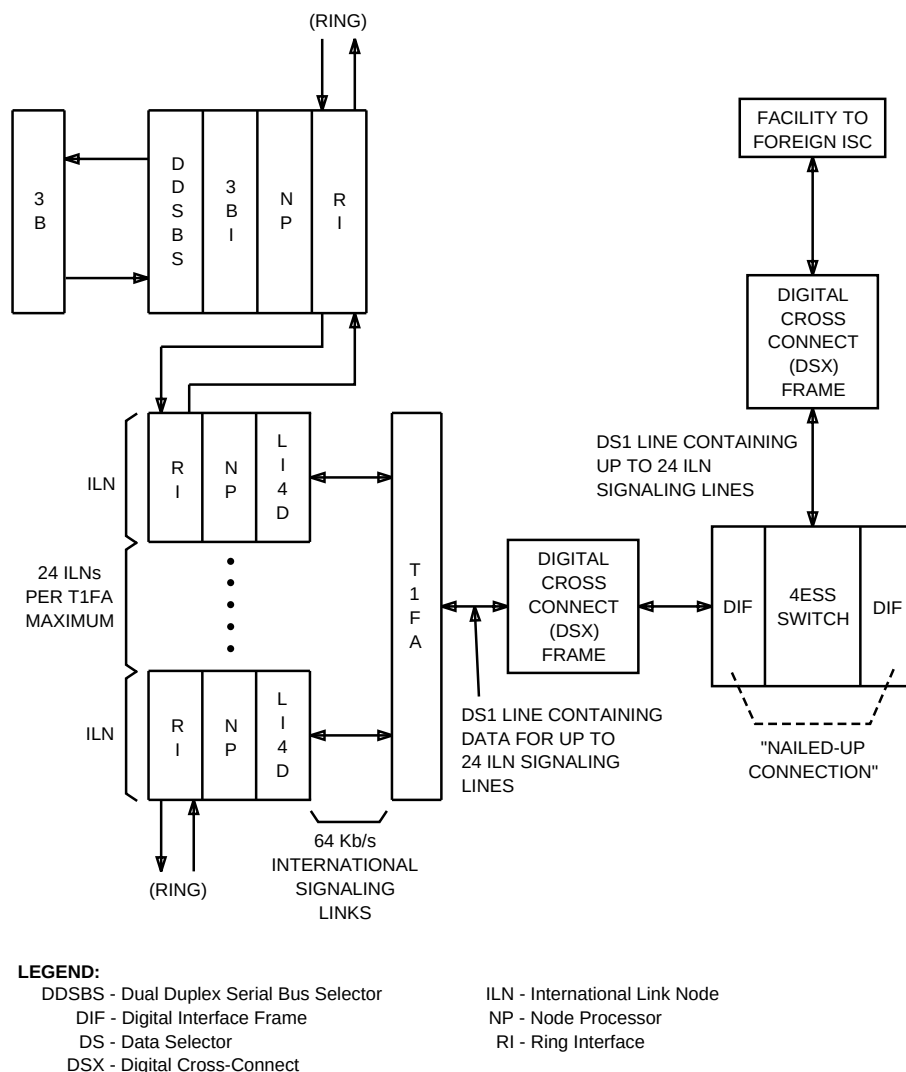


**Figure 3-8. International Link Node Signaling Link Block Diagram**

In addition to the major states, there are related *minor signaling link states*. The minor states are under control of program documentation standard (PDS) commands found in the Input Message Manual and Output Message Manual. The minor states are considered dynamic states because they can easily be changed via PDS input commands, and their status is stored in main memory only. In a system boot, the minor states are set to either *Grow* or *OOS*.

The following paragraphs describe some basic characteristics about each signaling link state:

- a. **UNEQUIPPED:** The signaling link has no link configuration data in main memory or on the disk. Diagnostics can be run while in this state.
- b. **UNAVAILABLE:** The signaling link must be in this state for the user to change link configuration data.

Two minor states, **Grow** and **Test**, are associated with this major state. While in the **UNAVAILABLE-Grow** state, no link usage information (e.g., cyclic redundancy check [crc] errors, etc.) is provided to the user. The signaling links that have passed their installation acceptance tests and are not ready for preservice testing should be left in the **UNAVAILABLE-Grow** state.

When the signaling link is ready for preservice testing, it should be moved to the **UNAVAILABLE-Test** state. While in this state, the signaling link provides the user with link usage information (crc errors detected on the link, number of unsolicited frames received on the link, etc.) but does not start the link protocol. A low cycle redundancy check (crc) error count indicates that the link is properly terminated to another protocol entity. Unlike some other signaling links, the protocol on the link cannot execute while in the self-looped mode. Attempting to do this causes protocol exception measurement counts but has no other adverse effect.

- c. **AVAILABLE:** Three minor states, *In-Service*, **Out-of-Service**, and **Manual Out-of-Service**, are associated with this major state. When a signaling link is moved from the **UNAVAILABLE** state to the **AVAILABLE** state, the signaling link is first moved to the **AVAILABLE-OOS** state while the protocol attempts to be established.

If the signaling link protocol is successfully established, the signaling link is moved to the **AVAILABLE-IS** state. Once in this state, the signaling link is in service and signaling traffic can commence. In general, all signaling links should be moved to the **AVAILABLE-IS** state by the service order due date.

A signaling link in the **AVAILABLE-IS** state is automatically moved to the **AVAILABLE-OOS** state when an extended error condition occurs—greater than 90 seconds of link outage. The system automatically attempts to recover signaling links in this state; that is, return them to the **AVAILABLE-IS** state. This activity continues indefinitely unless the node is removed manually for diagnostics, or the link is moved to the **AVAILABLE-MOOS** state.



If it is necessary to work on a signaling link in the **AVAILABLE-IS** state, such as running diagnostics or replacing hardware, the link must manually be removed from service. When the link is moved to the **AVAILABLE-MOOS** state, the protocol on the link is disconnected. The link is still monitored for valid and invalid frames.

Table 3-H shows the transitions that can be made from one signaling link state to another. A signaling link in one state can be changed to another state via either a recent change or PDS command.

**Table 3-H. Signaling Link State Transitions**

| From       | To           |              |            |         |
|------------|--------------|--------------|------------|---------|
| UNEQP      | UNAVL GROW   | UNAVL TEST   | -          | -       |
| UNAVL GROW | UNEQP        | UNAVL TEST   | -          | -       |
| UNAVL TEST | UNAVL GROW   | AVL MOOS     | -          | -       |
| AVL MOOS   | AVL OOS      | AVL IS       | -          | -       |
| AVL OOS    | UNAVL GROW * | UNAVL TEST * | AVL MOOS * | AVL IS  |
| AVL IS     | UNAVL GROW   | UNAVL TEST   | AVL MOOS   | AVL OOS |

\* Transient state that is automatically accessed when signaling link is moved to the AVL-IS state.

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## **International Link Node Signaling Link Tests**

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There are two tests provided by Link Management to assist in testing the ILN signaling link. They are the Link Check Internal and Link Check tests. These tests are implemented via the **LKC:SLK** input message. The **LKC:SLK** message can also be used to establish a Link Check Loopback, which enables the signaling link to be tested from the facility side or request the status of a Link Check test in progress.

With the ILN signaling link in the **UNAVAILABLE-TEST** or **AVAILABLE-MOOS** state, the user can request three separate signaling link tests using the **LKC:SLK** input message. These are Link Check Internal, Link Check, and Loopback. All of these tests are requested on a per-link basis. An explanation of these three tests is provided in the following paragraphs.

### **Link Check Internal**

The Link Check Internal test sets up a loop at the output of the "LI4D" link interface circuitry toward the node processor and transmits messages onto the loop to verify that the "LI4D" link interface circuitry for that signaling link is operational. This test returns a PASS or FAIL indication in an output message. An **LKC:SLK** input message is used to start the Link Check Internal test.

In the event of a declared link failure, a Link Check Internal test is automatically performed after the generation of a critical event. If the test fails, additional critical events are generated to provide notification of the failure.

### **Link Check**

The Link Check test allows the user to test a physical signaling link to determine whether the signaling link has broken down and if the error rate on the link is acceptable. The Link Check test assumes that a loopback has already been set up on the facility toward the node. Link Check is a variable duration procedure which returns either a success code or one of three error codes.

During a Link Check test, the "LI4D" link interface circuitry sends a stream of flags (01111110) and an occasional link check message. The "LI4D" link interface then monitors the return bit stream. The LI4D circuitry accumulates the number of frame errors received, the errored seconds, and verifies that it is receiving some flags and at least some of the messages it sent. Based on these parameters, the Link Check test either passes or fails. In either case, the number of errors detected and the number of errored seconds is given in an output message. If the Link Check test fails, the reason for failure is also given. The possible failures include:

- No flags received
- Flags received but no Link Check messages received
- Error threshold exceeded.

Using the **LKC:SLK** input message, the user can either start a Link Check test, terminate a Link Check test, or request the current status of a Link Check test.

### **Loopback**

Using the **LKC:SLK** input message, the user can set up a loopback at the output of the LI4D link interface circuitry toward the facility. By leaving the signaling link in this state and generating a stream of data into the loopback, the far-end can test the link from the facility side.

### **International Link Node Signaling Link Routing**

International link node (ILN) signaling link routing activity can include the addition of ILN signaling links, the deletion of ILN signaling links, and changing ILN link configuration data. Signaling link routing is performed via a combination of input/output messages and recent change/verify functions using the maintenance CRT.

## Small Computer System Interface Node (SIN) Links

### General

The SIN node is designed to transmit call detail recording (CDR) data to the CDR platform (CDRP). Currently, CDR data is the data used to make automatic message accounting (AMA) records and international CDR (ICDR) records. Data is transferred from the 3B computer to the SIN via a Dual Serial Channel (DSCH) link. The data is forwarded to the CDRP over a SCSI link. The ring supports two SIN nodes, one with the "active" link and the other with the "standby" link. Data is transmitted through the node with the active link. The node with the standby link can take over any time the node with the active link fails. The SCSI cable connects the CDRP to the SCSI circuit pack via the paddleboard, which plugs into the back of the 5 node IMS unit. Since the maximum length of the SCSI cable is only 25 meters, the CDRP must be co-located with the 4ESS Switch. Refer to Figure 3-9.

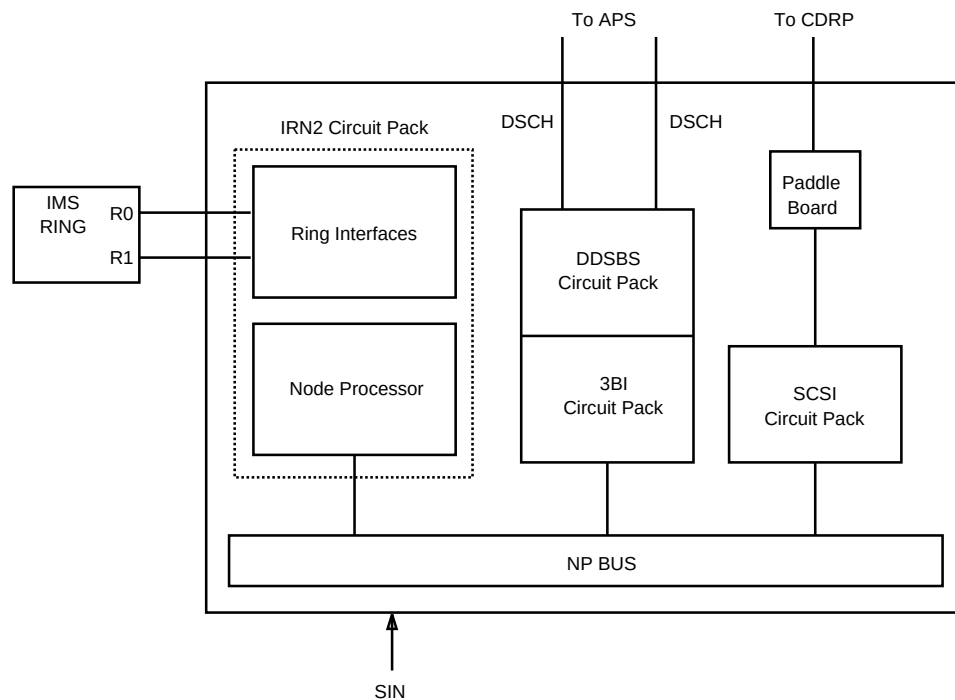


**Figure 3-9. Small Computer System Interface Node Hardware Configuration**

## Small Computer System Interface Node Link States

---

The following paragraphs describe some basic characteristics about each signaling link state:

- a. **UNEQUIPPED:** The signaling link has no link configuration data in main memory or on the disk. Diagnostics can be run while in this state.
- b. **UNAVAILABLE:** The signaling link must be in this state for the user to change link configuration data.

While in the **UNAVAILABLE-GROW** state, no link usage information (for example, cyclic redundancy check [crc] errors, etc.) is provided to the user. The signaling links that have passed their installation acceptance tests and are not ready for preservice testing should be left in the **UNAVAILABLE-GROW** state.

- c. **AVAILABLE:** In this link state, the following minor link states are allowed:
  - In-Service (IS) - The link protocol has been established and CDR data is being passed to the CDRP.
  - Standby (STBY) - The link protocol has been established, but no CDR data is being passed to the CDRP. The link is ready to be changed to IS if the current IS link goes OOS.
  - Out-of-Service - The link protocol has not been established. The node is waiting for the CDRP to bring the link up.
  - Manual Out-of-Service (MOOS) - The link has been taken OOS manually by an input command. The node ignores any attempts by the CDRP to bring the link up.

Table 3-I shows the transitions that can be made from one signaling link state to another.

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**Table 3-I. Small Computer System Interface Node Signaling Link State Transitions**

| From             | To              |                  |                  |
|------------------|-----------------|------------------|------------------|
| UNEQP            | UNAVL<br>GROW   | -                | -                |
| UNAVL<br>GROW    | UNEQP           | AVL<br>MOOS      | -                |
| AVL<br>MOOS<br>* | UNAVL<br>GROW   | AVL<br>OOS       | -                |
| AVL<br>OOS<br>*  | AVL<br>IS<br>*  | AVL<br>STBY      | AVL<br>MOOS<br>* |
| AVL<br>IS<br>*   | AVL<br>OOS<br>* | AVL<br>STBY<br>* | -                |
| AVL<br>STBY<br>* | AVL<br>OOS<br>* | AVL<br>IS<br>*   | -                |

\* The CHG:SLK input command is used to change the minor link state. The IS and STBY links can be switched by either changing the IS link to STBY or changing the STBY link to IS. Also, if the link is OOS or STBY, the link can be taken MOOS. If the link is MOOS, it can be changed to OOS using the auto restore service (ARST) option. In this case, the link state is eventually changed to IS or STBY when the CDRP establishes the link protocol.

### **Small Computer System Interface Node Signaling Link Tests**

There are no link tests that can be initiated by the SIN side of the link. Loopback tests can be initiated by the CDRP.

## Ethernet Interface Node (EIN) Links

### General

The EIN node is designed to transmit call detail recording (CDR) data to the CDR platform (CDRP). Currently, CDR data is the data used to make automatic message accounting (AMA) records and international CDR (ICDR) records. Data is transferred from the 3B computer to the EIN via a Dual Serial Channel (DSCH) link. The data is forwarded to the CDRP over a ELI link. The ring supports two EIN nodes, one with the "active" link and the other with the "standby" link. Data is transmitted through the node with the active link. The node with the standby link can take over any time the node with the active link fails. The ELI cable connects the CDRP to the ELI circuit pack via the paddleboard, which plugs into the back of the 5 node IMS unit. The ELI cable is available to order in lengths of 25, 50, 75, and 100 meters. Refer to Figure 3-10.

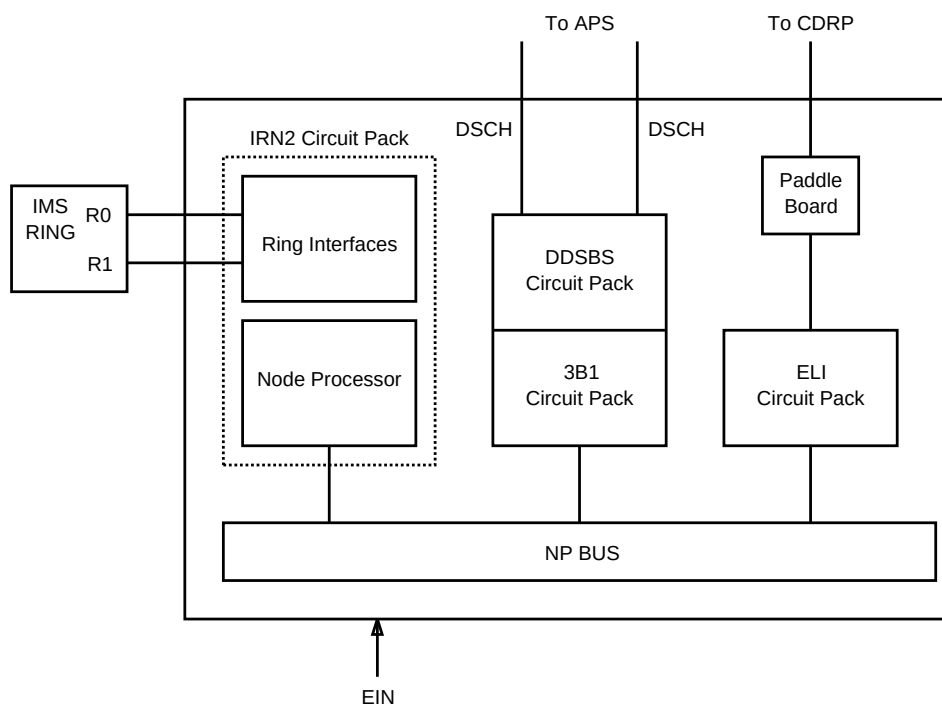


**Figure 3-10. Ethernet Interface Node Hardware Configuration**

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## Ethernet Interface Node Link States

The following paragraphs describe some basic characteristics about each signaling link state:

- a. **UNEQUIPPED:** The signaling link has no link configuration data in main memory or on the disk. Diagnostics can be run while in this state.
- b. **UNAVAILABLE:** The signaling link must be in this state for the user to change link configuration data.

While in the **UNAVAILABLE-GROW** state, no link usage information (for example, cyclic redundancy check [crc] errors, etc.) is provided to the user. The signaling links that have passed their installation acceptance tests and are not ready for preservice testing should be left in the **UNAVAILABLE-GROW** state.

- c. **AVAILABLE:** In this link state, the following minor link states are allowed:
  - In-Service (IS) - The link protocol has been established and CDR data is being passed to the CDRP.
  - Standby (STBY) - The link protocol has been established, but no CDR data is being passed to the CDRP. The link is ready to be changed to IS if the current IS link goes OOS.
  - Out-of-Service - The link protocol has not been established. The node is waiting for the CDRP to bring the link up.
  - Manual Out-of-Service (MOOS) - The link has been taken OOS manually by an input command. The node ignores any attempts by the CDRP to bring the link up.

Table 3-J shows the transitions that can be made from one signaling link state to another.



**Table 3-J. Ethernet Interface Node Signaling Link State Transitions**

| From             | To              |                  |                  |
|------------------|-----------------|------------------|------------------|
| UNEQP            | UNAVL<br>GROW   | -                | -                |
| UNAVL<br>GROW    | UNEQP           | AVL<br>MOOS      | -                |
| AVL<br>MOOS<br>* | UNAVL<br>GROW   | AVL<br>OOS       | -                |
| AVL<br>OOS<br>*  | AVL<br>IS<br>*  | AVL<br>STBY      | AVL<br>MOOS<br>* |
| AVL<br>IS<br>*   | AVL<br>OOS<br>* | AVL<br>STBY<br>* | -                |
| AVL<br>STBY<br>* | AVL<br>OOS<br>* | AVL<br>IS<br>*   | -                |

\* The CHG:SLK input command is used to change the minor link state. The IS and STBY links can be switched by either changing the IS link to STBY or changing the STBY link to IS. Also, if the link is OOS or STBY, the link can be taken MOOS. If the link is MOOS, it can be changed to OOS using the auto restore service (ARST) option. In this case, the link state is eventually changed to IS or STBY when the CDRP establishes the link protocol.

### **Ethernet Interface Node Signaling Link Tests**

There are no link tests that can be initiated by the EIN side of the link. Loopback tests can be initiated by the CDRP.

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## Increased Buffer Size of SS7 Satellite Nodes using BEC Feature

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### General

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The Increased Buffer Size of SS7 Satellite Nodes Using Basic Error Correction (BEC) feature, available with 4ESS switch generic programs 4E21R4 and 4E22R1, enables the deployment of satellite links that use the BEC error correction mode instead of the Preventive Cyclic Retransmission (PCR) mode. The BEC mode was designed for terrestrial links; the PCR mode was designed for satellite links. It has been determined that the BEC mode can be used for satellite links when traffic volume is low.

Although this feature is deployed at all 4ESS switch sites, it applies only to those sites that are equipped with satellite links.

The purpose of the increased buffer size of SS7 satellite nodes using the BEC feature is to allow BEC on satellite links where traffic volume is low.



#### **CAUTION:**

*This feature is directed to solve the problem of using BEC on satellite links to Alaska from the lower 48 states and **is not** intended for widespread use. The use of satellite links between Alaska and the lower 48 states increases facility diversity and improves network reliability. Once the software containing this feature is installed, **this feature cannot be deactivated**; however, satellite links with BEC mode can be degrown.*

### Description

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The Increased Buffer Size of SS7 Satellite Nodes Using Basic Error Correction (BEC) feature enables the deployment of satellite links that use the BEC error correction mode instead of the PCR mode, which was designed for satellite links.

Satellite links have a longer transmission delay than terrestrial links. To accommodate this longer transmission delay, for linksets with the error correction mode of BEC and at least one satellite link, the recommended values for the re-transmission buffer (RXQLen) size and for several message acknowledgment timers [Message Transfer Part (MTP) Level 2 and 3] have been changed.

To enable the acceptance of satellite link parameters, the CNI functional area CNIDBA, which facilitates recent change of link configuration data, has been modified to allow the link transmission MEDIUM of satellite with the error correction mode of BEC.

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To alert the operations personnel of a discrepancy in either the RXQLEN value or the MEDIUM, the NIDATA 2 audit has been modified to perform audits on satellite links and linksets containing at least one satellite link.

### **Growth of Satellite Links With BEC**

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When growing a satellite link in a linkset, the re-transmission buffer (RXQLEN) size and message acknowledgment timer values, for each terrestrial link in the linkset, must be changed to the values shown in Table 3-K, column *At Least One Satellite Link in the Linkset*. The values of RXQLEN and T1.111.3 T7 are changed on a per link basis using recent change procedures. The values for T1.111.4 T1 through T6 are changed on a per linkset basis using recent change procedures.

### **Degrowth of Satellite Links With BEC**

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When degrowing the last satellite link using BEC from a linkset, the RXQLEN size and message acknowledgment timer values for the remaining terrestrial links must be changed back to terrestrial values. Table 3-K, column "All Terrestrial Links in the Linkset", shows the values to use when the linkset contains only terrestrial links. The values are changed on a per linkset basis using recent change procedures, except for the RXQLEN value which is changed on a per link basis.

**Table 3-K. Parameter Values for 56 Kbps Links in a Linkset**

| <b>Parameter Name</b>                                                     | <b>At Least One Satellite Link in the Linkset</b>             | <b>All Terrestrial Links in the Linkset</b> |
|---------------------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------|
| MTP T1.111.3<br>Timer T7*<br>(Delay of Acknowledgment)                    | 2.0 sec. for satellite links<br>1.0sec. for terrestrial links | 1.0 sec.                                    |
| RXQLEN Re-transmission buffer                                             | 4000 bytes                                                    | 910 bytes                                   |
| MTP T1.111.4<br>Timer T1<br>(Delay to avoid mis-sequencing in changeover) | 0.8 sec.                                                      | 0.5 sec                                     |

**Table 3-K. Parameter Values for 56 Kbps Links in a Linkset (Contd)**

| Parameter Name                                                                            | At Least One Satellite Link in the Linkset | All Terrestrial Links in the Linkset |
|-------------------------------------------------------------------------------------------|--------------------------------------------|--------------------------------------|
| MTP T1.111.4<br>Timer 2<br>(Waiting for<br>changeover<br>Acknowledgment)                  | 1.3 sec.                                   | 0.7 sec.                             |
| MTP T1.111.4<br>Timer T3<br>(Delay to avoid<br>mis-sequencing in<br>changeback)           | 0.8 sec                                    | 0.5 sec                              |
| MTP T1.111.4<br>Timer 4<br>(Waiting for<br>changeback<br>acknowledgment,<br>First Try)    | 1.1 sec                                    | 0.5 sec.                             |
| MTP T1.111.5<br>Timer 5<br>(Waiting for<br>changeback<br>acknowledgment,<br>second try)   | 1.1 sec                                    | 0.5 sec                              |
| MTP T1.111.4<br>Timer T6<br>(Delay to avoid<br>mis-sequencing on<br>controlled rerouting) | 0.8 sec.                                   | 0.5 sec.                             |

\* The MTP T1.111.3 Timer T7 value for terrestrial links in a linkset with at least one satellite link does **not** change from the value for terrestrial links in a linkset with all terrestrial links.

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## Message Flow

# 4

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### Contents

|                                                       |      |
|-------------------------------------------------------|------|
| <b>General</b>                                        | 4-1  |
| <b>Common Channel Signaling Network</b>               |      |
| <b>Overview</b>                                       | 4-1  |
| <b>Open Systems Interconnection Protocol Model</b>    | 4-5  |
| <b>Common Channel Signaling 7 Protocol</b>            | 4-7  |
| <b>Common Channel Signaling Network Routing</b>       | 4-8  |
| <b>Common Network Interface Ring Message</b>          |      |
| <b>Flow</b>                                           | 4-10 |
| ■ ISUP Common Channel Signaling No. 7 Call Processing | 4-10 |

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## Message Flow

# 4

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### General

This section is intended to provide an understanding of the “message flow” processes from both the common channel signaling (CCS) network and common network interface (CNI) ring perspective.

### Common Channel Signaling (CCS) Network Overview

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The purpose of implementing the CNI ring into the 4ESS™ Switch environment is to gain access to the common channel signaling (CCS) network. The CCS network is utilized by the 4ESS Switch to communicate with other switching offices regarding call setup, calls in-progress, call disconnects, specialized data bases, etc. The communication exchanged is referred to as signaling. The CCS network allows signaling data to be exchanged over paths that are separate from voice paths.

A simplified illustration of a CCS network is shown in Figure 4-1. The network is comprised of signal transfer points (2STPs), network control points (NCPs), and switching systems (4ESS Switches, 5ESS® Switches, 1A ESS™ Switches, etc); all interconnected via signaling links (SLKs). Each stored program-controlled system (2STP, NCP, Switching System, etc.) must be equipped with a CNI ring. A brief description of the functions performed by each CCS network component is as follows:

- Signal Transfer Point (STP) — The STP routes data from one connecting office to another while also administrating the CCS network.
- Network Control points (NCPs) — The NCP contains data that provides a variety of custom routing, billing, and calling services to CCS network users.
- Switching Systems — Switching systems communicate to each other by exchanging signaling data over the CCS network. The signaling data is used to setup voice paths, make data base queries, obtain switching system status, etc.
- Signaling Links (SLKs) — Signaling links are used to transfer data between users of the CCS network. The following types of signaling links are used in the CCS network:
  1. Access (A) links — A-links are used to connect all switching offices and network control points (NCPs) in the same region to a mated pair of STPs. All A-links are equipped in pairs with one signaling link to each local STP within a region.
  2. Bridge (B) links - B-links are used to connect a mated pair of STPs in one region to a mated pair of STPs in another region.
  3. Cross (C) links — C-links are used to connect a STP to it's mate STP in the same region.
  4. Extended access (E) links — E-links are used to connect a gateway 4ESS Switch to a 2STP gateway in another region. These links are used to carry alternate signaling transport network (ASTN), network interconnect (NI) backup traffic.

As previously stated, each system connected to the CCS network must be equipped with a CNI ring. The CNI ring provides the signaling link ring access nodes, ring bus structure, control nodes and 3B Computer (Figure 4-2). All users of the CCS network are connected together using specific signaling links (A-, B-, or C-links) and CNI ring access nodes (CCS7 nodes). The exchange of information between CCS7 nodes over digital signal links within the CCS network is governed by the CCS7 signaling protocol. The CCS7 protocol is based on a modified structure of the open systems interconnection (OSI) model.

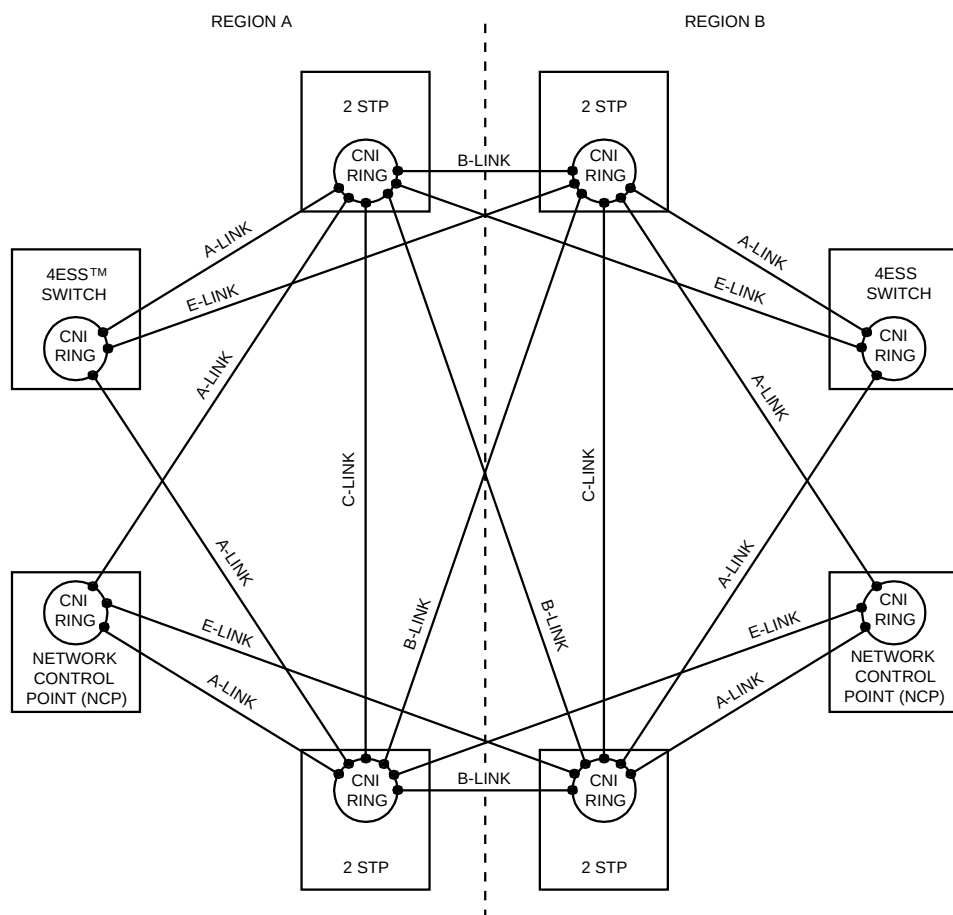


**Figure 4-1. Simplified Common Channel Signaling (CCS) Network**



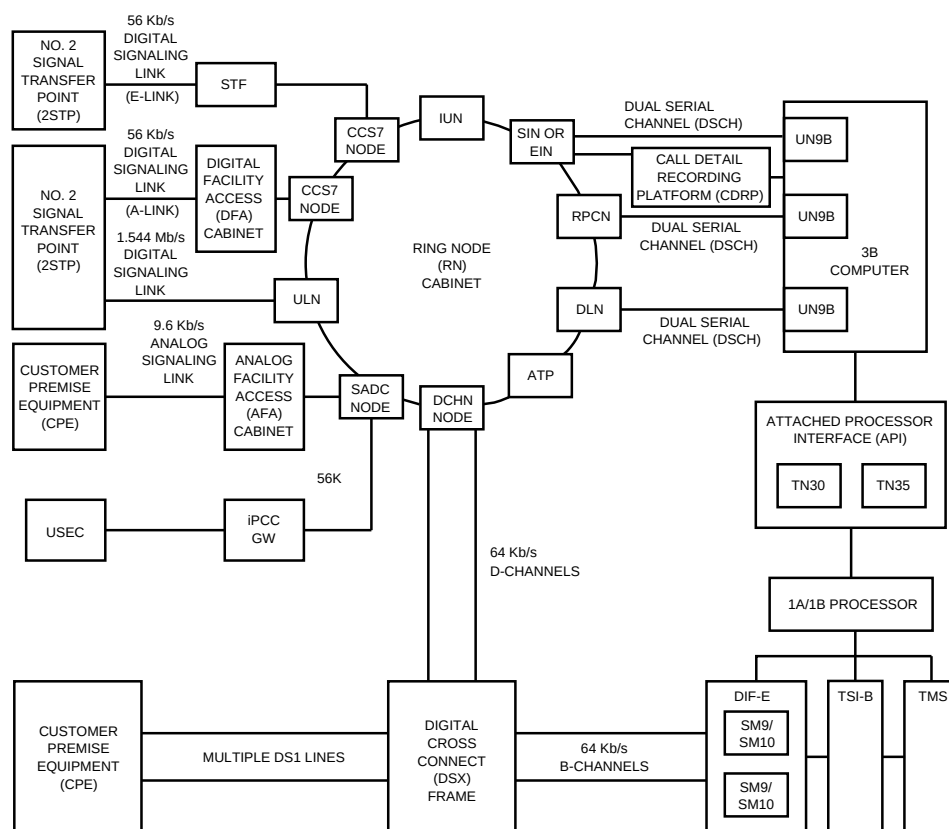


**Figure 4-2. Common Network Interface Ring—4ESS™ Switch Application**

## Open Systems Interconnection (OSI) Protocol Model

The OSI protocol model consists of seven layers defined by the International Telegraph and Telephone Consultative Committee (CCITT) to standardize the interconnection and exchange of signaling information between common channel signaling (CCS) system users. At the time of development, the OSI model identified the common communication functions found in all systems, precisely defined the functions, placed the functions into a specific hierarchy, and grouped the functions into seven distinct layers. Interfaces between the seven layers were defined to allow specific layers to work with other layers within the model. Each layer performs a specific function and is dependent on the layers below it to accomplish a task.

The seven layers (Table 4-A) can be categorized into two basic groups consisting of three layers each and a layer serving as a bridge between the two groups. Layers 1 through 3 are network specific and define the characteristics of the network data link and addressing scheme. Layers 5 through 7 are end-user specific and define the method users can communicate with each other in addition to describing service characteristics between the end-user layers (5 through 7) and network layers (1 through 3).

**Table 4-A. Open Systems Interconnection (OSI) Model Layer Identification**

| Layer | Identification | Use                  |
|-------|----------------|----------------------|
| 7     | Application    | End-User<br>Specific |
| 6     | Presentation   |                      |
| 5     | Session        |                      |
| 4     | Transport      | Bridge               |
| 3     | Network        | Network<br>Specific  |
| 2     | Data Link      |                      |
| 1     | Physical       |                      |

The following list identifies each of the seven OSI model layers and defines associated functions performed.

**Physical Layer** — Defines the physical, electrical, and functional characteristics of a signaling data link. In addition, the Physical Layer controls the data circuits and the transfer of bits to and from the network elements.

**Data Link Layer** — Determines signaling link to transmit messages on and controls the network connections. The network layer will setup, maintain, and terminate connections between the individual network elements that provide the hardware or software for the transport layer.

**Transport Layer** — Controls the transfer of data between end users, thereby relieving users of concerns regarding transfer details.

**Session Layer** — Establishes, maintains, and terminates the communication session between users. The session layer determines which user has the right to transmit information at a given time and synchronizes activities of other uses.

**Presentation Layer** — Responsible for preserving the information transferred between the end user applications and resolving any syntax differences that occur during transmission.

**Application Layer** — Serves the end user by providing information required by the software application. These applications could be data for airline reservations, credit card checking, or other meaningful communication to the end users.

## Common Channel Signaling 7 (CCS7) Protocol

The common channel signaling 7 (CCS7) protocol identifies the set of rules governing the exchange of data and communication techniques to control the CCS network. The CCS7 protocol consists of five layers (Table 4-B).

**Table 4-B. Common Channel Signaling 7 Protocol Layer Identification**

| Layer | Identification                                         |
|-------|--------------------------------------------------------|
| 5     | Operations, Maintenance and Administration Part (OMAP) |
| 4     | Transaction Capabilities (TC)                          |
| 3     | Integrated Services Digital Network-User Part (ISUP)   |
| 2     | Signaling Connection Control Part (SCCP)               |
| 1     | Message Transfer Part (MTP)                            |

The five CCS7 protocol layers are designed to encompass the basic functions defined by the seven layer OSI model. Table 4-C identifies the relationship between the five CCS7 protocol layer and the seven layers of the OSI model.

**Table 4-C. Common Channel Signaling 7 Protocol Layers Equivalency to Open Systems Interconnection Model Layers**

| CCS7 Protocol Layer                                    | Equivalent OSI Model Layer                                |
|--------------------------------------------------------|-----------------------------------------------------------|
| Operation, Maintenance, and Administration Part (OMAP) | Application                                               |
| Translation Capabilities (TC)                          | Transport, Session, Presentation, and Part of Application |
| ISDN-User Part (ISUP)                                  | Transport, Session, Presentation, and Part of Application |
| Signaling Connection Control Part (SCCP)               | Transport and Part of Network                             |
| Message Transfer Part (MTP)                            | Physical, Data Link, and Part of Network                  |

The five CCS7 protocol layers define the rules that permit the common channel signaling (CCS) network to exchange data, process data-basic queries, and perform operation, administrative, and maintenance functions. The following list identifies each of the five CCS7 protocol layers and defines associated functions performed.

**Message Transfer Part (MTP)** — Provides routing instructions to route messages around the ring to their appropriate destination.

**Signaling Connection Control Part (SCCP)** — Provides routing instructions to route messages to specialized centers

**Integrated Services Digital Network User Part (ISUP)** — Provides standard call setup and termination instructions to process CCS7 messages.

**Transaction Capabilities (TC)** — Performs the function of retrieving required data from specified data bases.

**Operations, Maintenance, and Administration Part (OMAP)** — Provides instructions for routing operation, maintenance, and administrative messages in addition to instructions to test the routing process.

## **Common Channel Signaling (CCS) Network Routing**

---

Data is exchanged throughout the CCS network over digital signaling links. The signaling links connect to CCS7 nodes on the CNI ring. Arrangements are made throughout the CCS network to ensure the reliable exchange of data during the presence of signaling link transmission disturbances or network failures.

All A-links in a CNI equipped office are duplicated (Figure 4-3). One signaling link is assigned to each of the two signal transfer points (STPs) in a region. Each signaling link is designed to operate normally at 40 percent capacity and function in a load-sharing manner. If the volume of data increases to over 40 percent, an addition pair of signaling links must be added to handle the load. In the event of a signaling link failure, the mate signaling link supports the total load until the failing link can be restored. In addition to signaling links being duplicated, mated 2STPs contain identical routing data. This duplication of routing data further expands the reliability of signaling link selection. Information being exchanged from 4ESS Switch office A to 4ESS switch office B (Figure 4-3) is normally transmitted via signaling link A1, processed through 2STP 0, and retransmitted via signaling link A3. In the event that signaling link A3 fails, the information is transmitted to 2STP 1 via cross (C) link C1, processed through 2STP 1, and

retransmitted via signaling, link A4. The CCS network signal link (A-, B- and C-links) and 2STP configurations provide a multiple combination of paths that information may use to reach its final destination. However, if all signaling links to an office (A1 and A2 or A3 and A4) fail, the office becomes isolated and cannot perform CCS network functions. Under this condition, the local 2STPs broadcast a message over the network indicating that the office is isolated and no traffic should be sent to the office.

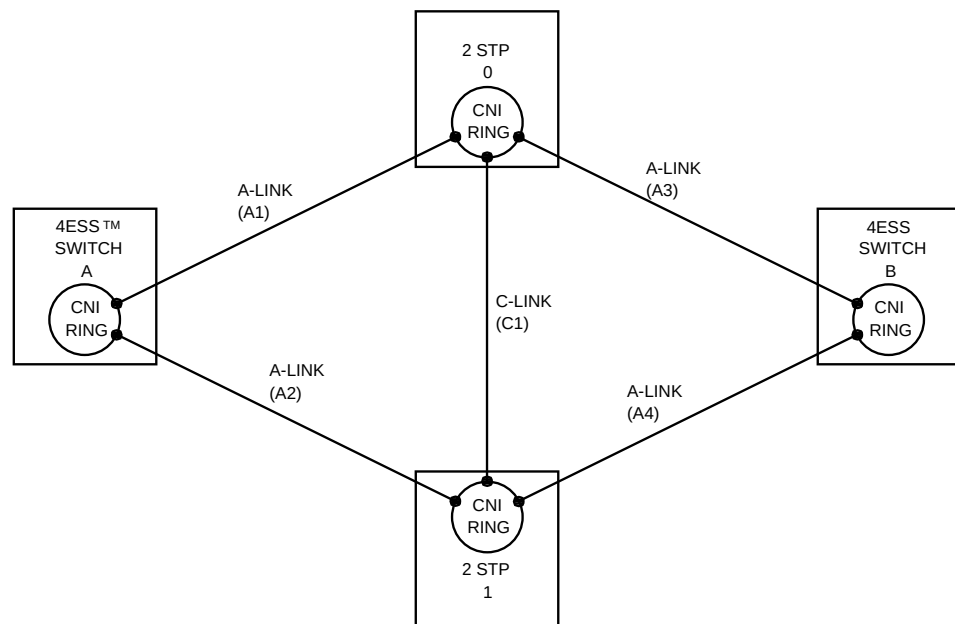


**Figure 4-3. Common Channel Signaling Network Signaling Link and Signal Transfer Point Configuration**

## **Common Network Interface (CNI) Ring Message Flow**

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### **ISUP Common Channel Signaling No. 7 Call Processing**

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The ISDN-UP of the CCS7 protocol is used for CCS7 connection-oriented messages. Figure 4-4 shows a layout of the equipment involved in processing a call for CCS7 trunks. The following is a description of a call that is originating from an LO (local) switching office and is terminating over a CCS7 trunk to another SPC switching office in the CCS7 network.

1. Assume that an incoming call is recognized at the 4ESS switch over a local trunk. The associated SP collects the digits received over the local trunk using the TSN assigned to the trunk. When all the digits are collected, the SP sends the dialed digits to the 1B processor for translation.
2. For this example, assume that the 1B translation identifies the outgoing trunk group as CCS7 trunks. Since the outgoing trunk is a CCS7 type, the 1B processor ISUP formats the message and sends it to the DLN via the API and CNIBUF.
3. The ISUP - initial address message (IAM), received by the DLN, contains the TSN of the associated outgoing TAN and the dialed telephone company BCD digits. The message also contains the ISUP message type, nature of connection, and other information as shown in Figure 4-5. The DLN-AP translates the TSN into a destination point code for routing the message over the CCS network and a circuit identification code (CIC) to identify the trunk at the far-end switching office. Note that the ISUP 1B format uses a 24-bit word (0 through 23) and has bits 24 through 31 added as a pad for messages from the 1B processor to the 3B computer. (Refer to Figure 4-6.)
4. After the DLN-AP translates the TSN into a DPC and a CIC, it reformats the CCS7 message into a 32-bit word format as shown in Figure 4-7. The DLN also uses the signaling link selection (SLS) field to specify the outgoing CCS7 link for transmission. The MTP function of the CNI software in the DLN uses the SLS field to perform load balancing over the available CCS7 links.

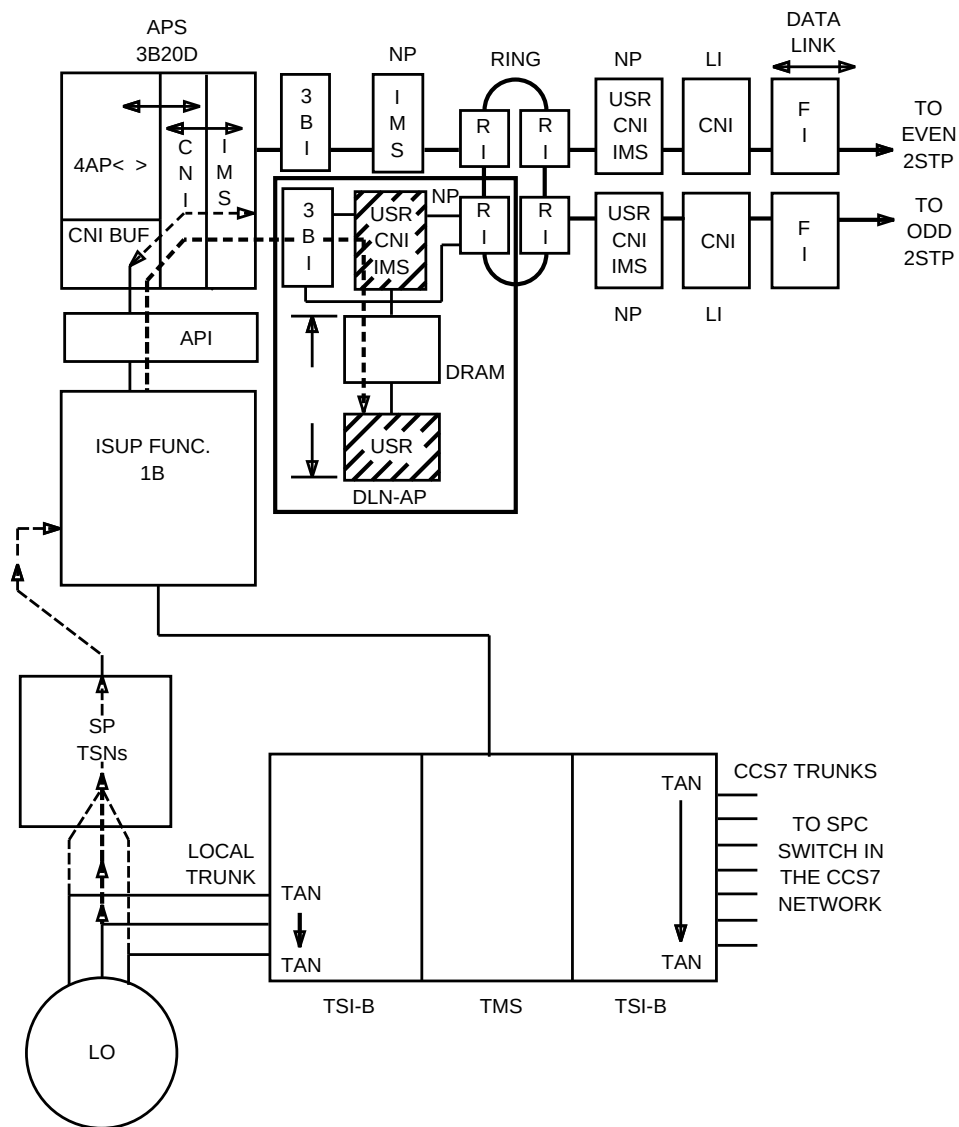


**Figure 4-4. ISUP Common Channel Signaling No. 7 Call Processing Equipment Layout**



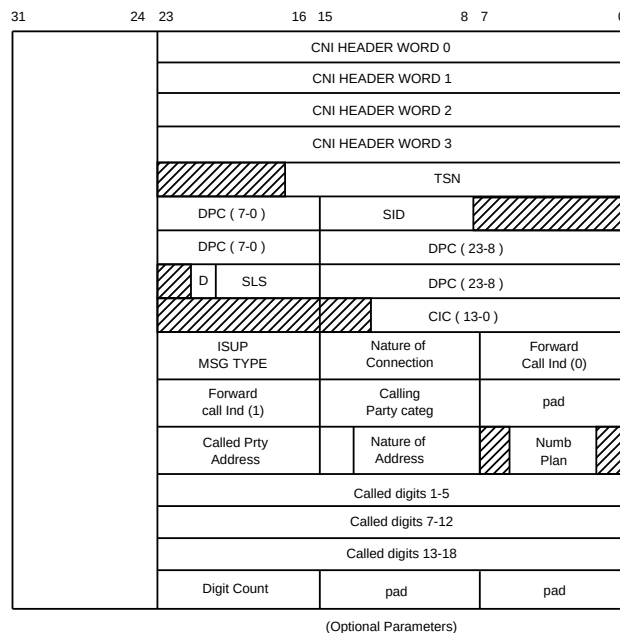


**Figure 4-5. ISUP 1B Format — Initial Address Message**

- Once the outgoing CCS7 link is determined, the CNI software writes the RNA address of the outgoing link. The IMS software transports the message around the ring from the DLN to the designated CCS7 node. The CNI software transmits the message over the signaling link to the 2STP.

Various messages are required during a ISUP call setup. The ISUP MSG TYPE field is used to identify one of the following types:

- ISUP - IAM (initial address message)
- ISUP - CRO (continuity recheck outgoing)
- ISUP - CRI (continuity recheck incoming)
- ISUP - REL (release message)
- ISUP - ANS (answer message)

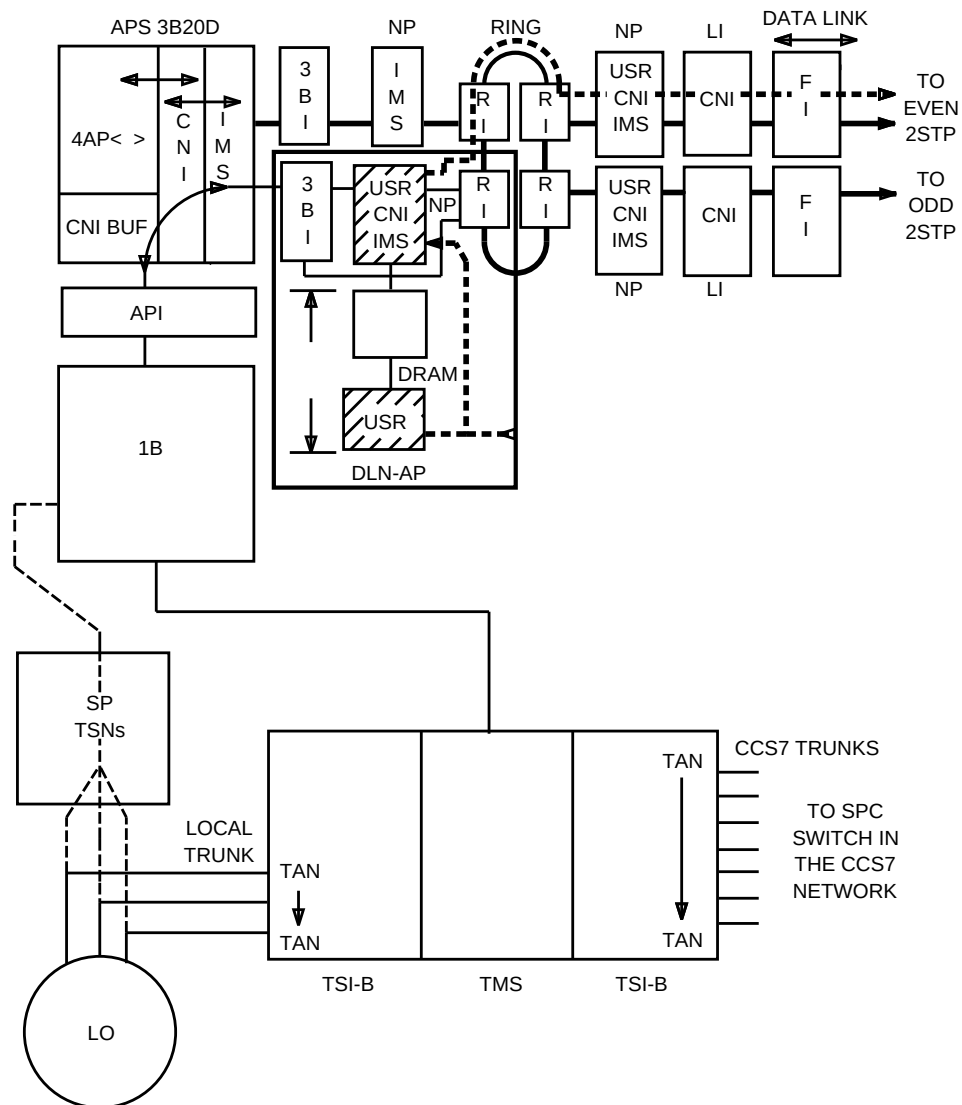


**Figure 4-6. ISUP Common Channel Signaling No. 7 Call Processing**

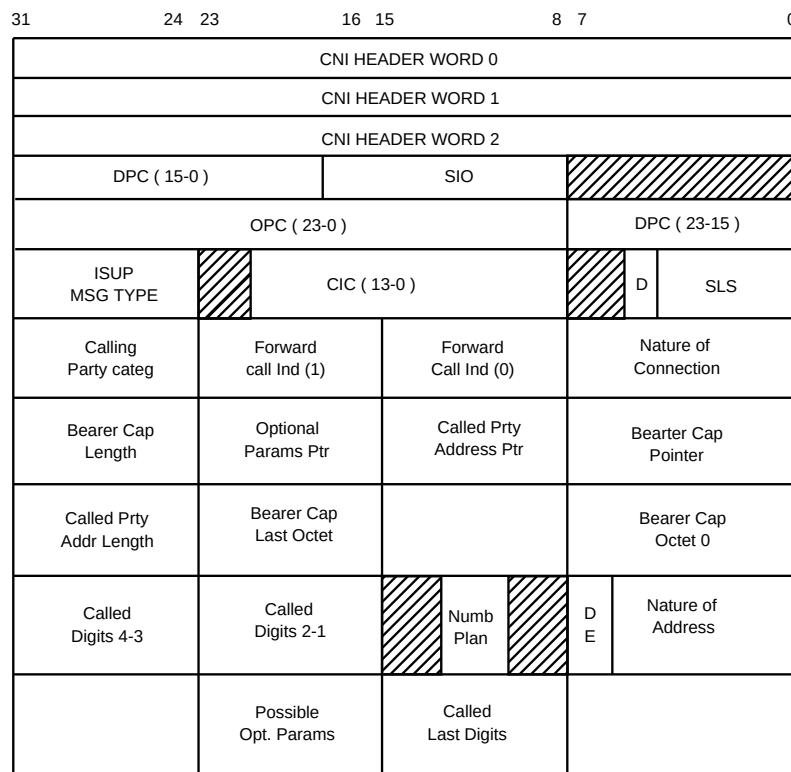


**Figure 4-7. ISUP — Initial Address Message for CCS7 Routing**

The preceding ISUP message types are routed in the same manner as described for the IAM call process. However, different functions are performed by the 1B processor for each message type (for example, continuity tests, etc.).

- When subsequent ISUP messages are received from the far-end switch via the 2STP, the CCS7 node routes the message to the DLN. The DLN translates the originating point code (OPC) and CIC into a TSN related to the IAM message for the particular call setup. Since the IAM contains the DPC and OPC, the terminating switch uses the OPC as a DPC for routing the subsequent messages back to the originating office. Therefore, the DLN can relate all subsequent messages to the initial IAM message transmitted. (Refer to Figure 4-8.)
- When the TSN has been translated by the DLN, a 24-bit word ISUP message is formatted and sent to the 1B for processing. During an ISUP call setup, the originating office puts up the trunk connection to perform

the continuity test, if required. If the test is successful and the ANS message is received from the terminating office, the TAN-to-TAN trunk connection is made at both ends. (Refer to Figure 4-8.)

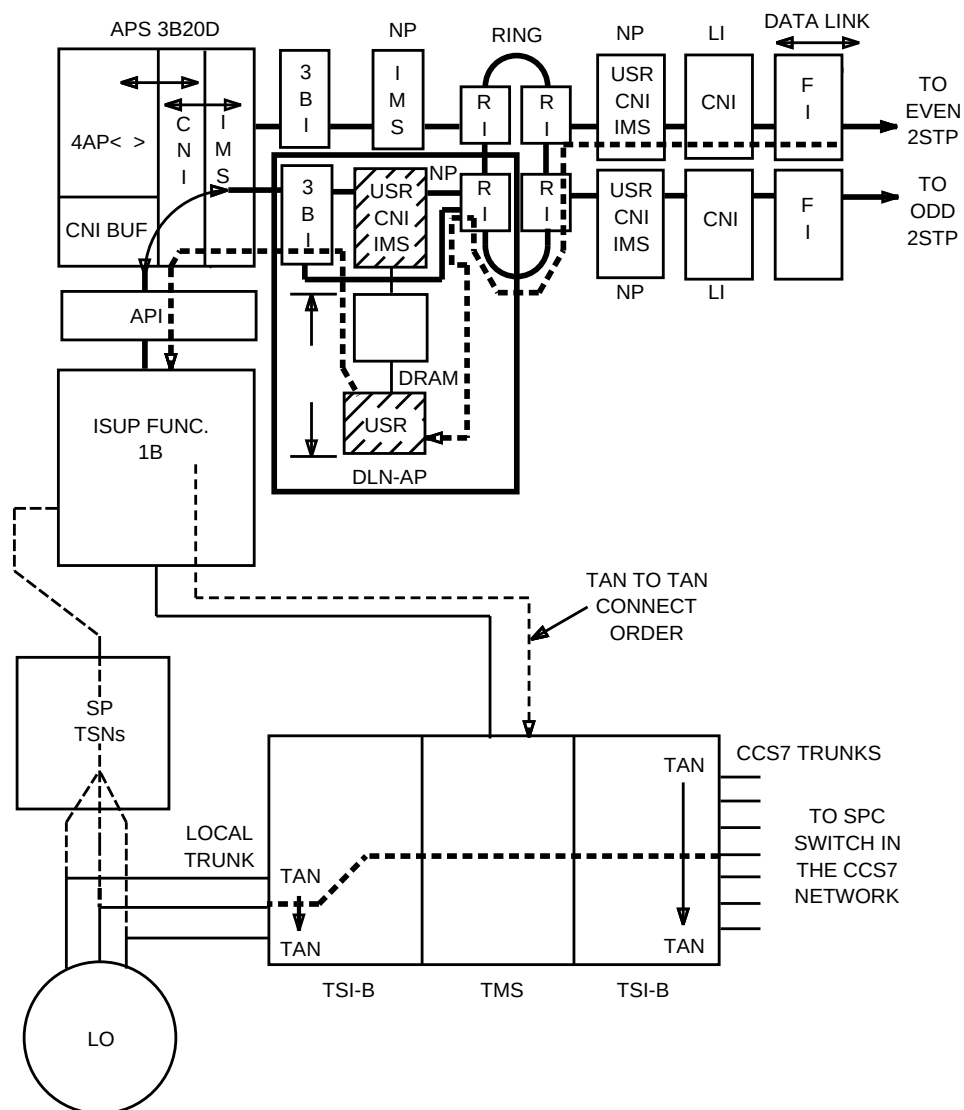


**Figure 4-8. OPC and CIC translated to TSN During SS7 Call Processing**

# Measurements, Reports, and Critical Events

# 5

## Contents

|                                                               |      |
|---------------------------------------------------------------|------|
| <b>General</b>                                                | 5-1  |
| <b>Description of Measurements</b>                            | 5-2  |
| ■ Introduction                                                | 5-2  |
| ■ Sources of Measurements                                     | 5-3  |
| Ring Node Oriented Measurements                               | 5-3  |
| Link Oriented Measurements                                    | 5-4  |
| Total Office Measurements                                     | 5-5  |
| ■ Measurement Process Phases                                  | 5-5  |
| ■ Measurement Listing Descriptions                            | 5-8  |
| <b>Description of Reports</b>                                 | 5-80 |
| ■ Introduction                                                | 5-80 |
| ■ Report Data                                                 | 5-80 |
| ■ Network Clock                                               | 5-82 |
| ■ Reports and Measurement Data Output                         | 5-83 |
| ■ Report Formats                                              | 5-84 |
| Fixed Format                                                  | 5-84 |
| Flexible Format                                               | 5-85 |
| ■ Signaling Network Performance Report, Part 1                | 5-87 |
| General                                                       | 5-87 |
| Header Information                                            | 5-88 |
| CCS7 Signaling Load and Signaling Performance<br>Measurements | 5-88 |
| PBX Signaling Load and Signaling Performance<br>Measurements  | 5-93 |
| ■ Signaling Network Performance Report, Part 2                | 5-94 |

---

## Contents

|                                                                 |       |
|-----------------------------------------------------------------|-------|
| General                                                         | 5-94  |
| Header Information                                              | 5-94  |
| Loss of Signaling Capability                                    | 5-95  |
| CCS7 Signaling Link Performance                                 | 5-95  |
| PBX Signaling Link Performance                                  | 5-95  |
| ■ Signaling Equipment Performance Report                        | 5-99  |
| ■ Machine Performance Report                                    | 5-102 |
| General                                                         | 5-102 |
| Header Information                                              | 5-104 |
| System Initializations                                          | 5-104 |
| No Message Signal Unit Processing                               | 5-105 |
| RPC Node Performance                                            | 5-105 |
| Link Node (LN) Performance                                      | 5-106 |
| Ring Performance                                                | 5-106 |
| Internal Congestion                                             | 5-107 |
| ■ Fifteen-Minute Marginal Performance Report                    | 5-107 |
| General                                                         | 5-107 |
| ■ Thirty-Minute Marginal Performance Report                     | 5-109 |
| General                                                         | 5-109 |
| Header Information                                              | 5-109 |
| CCS7 Links                                                      | 5-111 |
| CCS7 Clusters                                                   | 5-112 |
| PBX Links                                                       | 5-112 |
| ■ Five-Minute Ring Exception Report                             | 5-112 |
| <b>Description of Critical Events</b>                           | 5-114 |
| ■ Introduction                                                  | 5-114 |
| ■ Critical Event Logging                                        | 5-114 |
| ■ Common Channel Signaling Network Critical Events Descriptions | 5-116 |
| <b>Measurement Output Control Table</b>                         | 5-129 |
| ■ Overview                                                      | 5-129 |
| ■ Critical Event Table                                          | 5-130 |
| ■ Administering Measurement Reports                             | 5-131 |
| User View Descriptor Table                                      | 5-135 |
| Exception Table                                                 | 5-136 |
| History File Descriptor Table                                   | 5-141 |
| Scheduler Table                                                 | 5-149 |

---



## Contents

- MOCT Interaction When Generating Scheduled Reports 5-155



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## Measurements, Reports, and Critical Events

# 5

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### General

This section is composed of the following four parts that describe the meaning and use of measurement data and critical event messages generated in a CNI-equipped office.

- a. **Description of Measurements:** The measurements taken, the occurrences that those measurements record, and the internal mechanisms involved in collecting the measurement data are discussed.
- b. **Description of Reports:** The scheduled and demand reports available to users are listed and explained.
- c. **Description of Critical Events:** The CCS network critical-event messages and the occurrences they report are described.
- d. **Measurement Output Control Table:** The format and administration of the five tables composing the measurement output control table (MOCT) are described. This data base is responsible for controlling the output of all measurement reports and critical event messages.

A measurement data plan is intended to provide maintenance and support personnel (users) with data at several different levels. The data is output to users at the level of detail and time intervals required. This is done by taking one common set of measurements in memory, extracting and compiling desired information, and sending the resulting messages and reports to the specified users either automatically or on demand.

## Description of Measurements

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### Introduction

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This part describes the sources of measurements, the generation of measurement data, and measurement descriptions.

A measurement can be defined as a “register” that represents the cumulative total of or duration of some occurrence. There are approximately 400 measurements made in a CNI-equipped office. A measurement represents something that happens within the office. This could be an action that occurred within the office as a response to some occurrence outside the office. Therefore, some measurements pertain to the office itself, while others are significant to the entire signaling network. A measurement can be a count of the number of times something happened. For example, it could represent the number of times a new state is entered. Also, it could be the length of time the state lasted. Measurement timers are generally stored in units of milliseconds—exceptions are noted in the measurement descriptions. Most measurements represent occurrences that register in the node processor (NP) or link interface (LI) circuits. Some measurements represent occurrences declared by the central processor.

The measurement data is organized within main memory and on disk files. These files are generated from the measurements collected in the NPs, the LIs, and the central processor. Accessing the data requires that the measurements be identified by some naming conventions. The following conventions are for naming a measurement:

- a. The mnemonic represents, as closely as possible, the occurrence being measured. The mnemonic is derived from a set of abbreviations representing typical occurrences in a CNI-equipped office. These abbreviations are combined to describe the occurrence.
- b. The suffix **T** signifies a measurement of an interval, not the number of occurrences.
- c. The suffix **TE** signifies a threshold has been exceeded.
- d. Names include only letters and digits—no special characters.
- e. Names are unique and contain no more than 12 characters.

The names given to measurements are used by the MOCT. The MOCT controls measurement output to accommodate current operation, administration, and maintenance needs.

## Sources of Measurements

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The following are two basic sources of measurements in an office:

- **Plant Measurements:** originate in the *UNIX\** RTR 21.17 Operating System. Refer to the *UNIX\* RTR Operating System, Output Message Manual, 3B20D and 3B21D Computers*, 303-081 for plant measurement descriptions.
- **CNI Measurements:** an occurrence recognized by the CNI-equipped office.

The CNI measurements can be classified into several groups. These measurements are referred to as ring node oriented, link oriented, and total office oriented. This distinction is useful from a maintenance standpoint; faults generally fall into one of these categories. Identifying the source of the error as either a link, a ring node, or the office in general makes troubleshooting easier. Furthermore, the software architecture roughly follows the preceding categories. However, it is not necessary to know which software subsystem generates each measurement.

The measurement data is collected, stored, and output to various destinations within and outside the office. Specifically, UNIX RTR Operating System reports and CNI reports both appear on the maintenance terminal and printer. Support organizations can also request plant or CNI measurement data. An understanding of the source data for particular measurements is very important when designing a customized report.

As previously stated, CNI measurements can be classified into three specific categories:

- Ring node oriented measurements
- Link oriented messages
- Total office measurements.

## Ring Node Oriented Measurements

Ring node oriented measurements include ring blockages, node isolations, ring read/write errors, etc. Ring node measurements are mostly concerned with counts and transmission errors relating to internal messages—such as messages between the central processor and the ring. Software in the node either pegs these counts or notifies the central processor. The counts are maintained in buffers in the node processors and possibly the central processor. Occasionally, an error notification is sent to the central processor to report error

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\* UNIX is a trademark of Novell, Inc.

conditions in the ring. In addition to responding to the reported error, software in the central processor often updates the corresponding per-office counts and/or per-node counts. This report to the central processor occurs in real time independently from the periodic data collection. The measurements maintained in the central processor are collected for history file generation at the same time the node counts are collected.

The node is also responsible for collecting the link counts maintained by the link interface. The LI counts are read by the NP and placed in NP buffers for subsequent reporting to the central processor.

The IMS measurement descriptions identify the following three types of ring node oriented measurements:

1. RPC—Per node measurement originated in a ring peripheral controller (RPC)
2. IUN—Per node measurement originated in some ring node other than a ring peripheral controller
3. NP—Per node measurement originated in any node processor.

### **Link Oriented Measurements**

Link oriented measurements cover traffic volume counts and error conditions related to CCS messages. Some examples are signaling errors, link failures, link congestions, and buffer overloads. The traffic counts reflect the operating load of the system. This data is most useful in engineering the office and the entire CCS network. This category of measurements also includes those showing network abnormalities such as processor outages and emergency restarts.

Link oriented measurements are maintained in buffers in the link interface circuits and the node processors, and possibly, the central processor when notified by the node. The link interface circuit allows messages, carried between signal points, to enter and exit the CNI system. Since the LI is basically a buffer circuit between the node and the data link, the counts pegged by the LI are very specific traffic related counts. The measurements are usually taken from a circuit standpoint rather than on a message basis.

Other link-related counts are pegged by software in the node and are based on the message discrimination performed by the node. Furthermore, the node software has a view of the function of the node and can therefore recognize larger events than the link interface. These counts are maintained in the node.

The CCS7 CNI measurement descriptions identify CCS7 link oriented measurements. The CCS7 protocol is a new internationally accepted standard that allows more efficient and flexible use of the CCS network.

## Total Office Measurements

Total office measurements provide an office view of various occurrences. Some, such as the office EMR counts, indicate the impact of corresponding, per-link and per-node, occurrences on the entire office. Others are not specific to any link or node, and are therefore inherently total office counts. The office measurements include processor outages, initializations, ring failures, link failures, and various counts related to message processing in general—not specific to any link or node. These counts are maintained solely in the central processor. The measurements are pegged in the central processor and are either recognized by the central processor as initializations or ringdown or are reported to the central processor by the nodes when the counts occur.

The IMS measurement descriptions identify two types of total office measurements:

- **Office:** Total office measurement.
- **CHN:** Originated for a particular channel—possibly in a ring node or the central processor. When a message is to be read from or written to the ring, an association is made between an open channel and the buffer containing the message. This is via a queue that is dedicated to the channel. A channel can be thought of as a “mailbox” that messages can be sent to and from. The central processor manages the 256 possible channel—each intended for a specific type of message—that can carry messages.

## Measurement Process Phases

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The measurement history files are disk based files used to store the transient data associated with measurements. The data is considered transient since no cumulative day-to-day record is automatically generated. The generation of measurement history data involves three phases:

1. Data generation — Recognizes and pegs the counts in software
2. Data collection — Accumulation of raw measurements from all nodes periodically
3. Data processing — Creates history files via the MOCT.

These phases take the raw measurement values from buffers in the various processors—node processors and the central processor—cumulate them, and organize them into user accessible data files on disk. The following is a discussion of this process. Understanding the data generation process requires a basic knowledge of the hardware architecture and the UNIX RTR Operating System file structure.

To be measured, an occurrence must first be recognized by the application. This takes place in the various processors in real time. The link interface maintains counts of CCS level 2 protocol measurements for its associated links; the counts represent link related measurements. The cumulative counts are copied to buffers in the node processor of each ring node at data collection time. Likewise, the node processor maintains counts of various occurrences related to messages and the ring. These too are stored in buffers in the node processor. Every 5 minutes the central processor broadcasts a message to all ring nodes requesting the measurement data in the ring node buffers. As each ring node receives this message, the data in the buffers is sent to the central processor to be stored in main memory.

**⇒ NOTE:**

If IMS measurements are not inhibited, all nodes respond to the message. If IMS measurements are inhibited, only the ring peripheral controller nodes (RPCNs) respond. The counts in central processor measurement buffers, except inhibited measurements, are then combined with the counts from the ring nodes to form a complete set of measurement data.

The central processor, ring node, and link interface buffers are cleared and begin cumulating data for the next 5-minute period. The collected data now resides in main memory as the last 5-minute measurements. The last period measurement (LPM) is a shared data library and is available for use in reports.

Therefore, every 5 minutes the central processor receives all measurement data collected over the preceding 5-minute period. This data consists of IMS, CNI, and application measurement counts. It represents the smallest collection period available to the MOCT and the user. All subsequent data processing builds on this data set. If IMS measurements are inhibited, some of the IMS counts collected by the central processor have not accumulated further. However, the LPM data is still available to the user. The CNI and application counts and all available IMS counts are accumulated as described later. From this description, three limitations are apparent and must be kept in mind when analyzing measurement data:

1. Although the measurements register in real time, the report generation software becomes aware of them only at 5-minute intervals at best. For reporting purposes, a piece of measurement data can be up to 5 minutes old.
2. If just one ring node is faulty or out of communication with the ring (for example, the node processor fails), the measurement data for any affected 5-minute interval is incomplete. That ring node is not reporting any measurements. Data from all ring nodes must be combined in main memory when building the LPM. This problem is relieved by flagging invalid or incomplete data on output reports.

3. If IMS measurements are inhibited, some reports may display IMS counts as zero. Flexible format reports with IMS measurements either ignore these counts or they are not output at all. Also, the **DUMP:SMEAS** command refuses requests to display certain IMS counts. Counts that are unavailable when IMS measurements are inhibited include the following:
  - All IMS counts collected from IMS user nodes (IUNs)
  - All IMS channel measurements
  - All IUN counts other than IMNPDI, OOSCFG, OOSCFG, OOSAU, OOSAUT, OOSMN, and OOSMNT.

The final phase in generating the data files is the processing of the LPM data residing in main memory. This processing is intended to generate files of measurement data that cover longer periods of time and are thus useful in producing reports. The basic data file used is the last 15-minute file (L15M). To get this file, the LPM (5 minutes of measurements data) is cumulated in main memory for 15 minutes. Every 15 minutes the cumulated data is written to disk as an L15M file. The L15M file is one of the "past" measurement files mentioned below. The focal point of the data base processing is the history file descriptor table (HFDT). The HFDT is one of the measurement output control tables. Every 15 minutes, the HFDT is scanned for the purpose of processing measurement data. Any processing that needs to be done is specified in the HFDT. This allows users to specify measurement collection periods that fit their needs. Upon completion of a history file, the report schedule table is scanned to generate any reports necessary. Note that the LPM data is available for use in reports, but is not available for generating history files via the HFDT.

The data files used in the HFDT consist of "current" measurements and "past" measurements. These files are collectively referred to as history files. The current measurement data files contain the cumulative totals for the current collection period. This data is copied into the corresponding past measurement data file at the end of the current collection period. Thus, the past measurement files contain the measurement data for the entire preceding collection period, while the current measurement files at any given time may not contain data for the full collection period. Any history data files created are stored on disk and are available for reports. However, each history file is associated with a particular collection period such as '15 min,' '1 hr,' or '1 day.' The history files are not associated with a particular day or time of day. In other words, the files are reused at the end of their respective collection periods. These disk files are not automatically backed up. Only certain past measurement files are used in fixed format reports.

## Measurement Listing Descriptions

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Most CCS7 measurements have a CCIS 6 counterpart as shown in Table 5-A. This table does not imply that the exact same thing is being measured with the CCIS 6 and the CCS7 measurements. In fact, corresponding measurements sometimes use different units for CCIS 6 versus CCS7. The table only shows a functional correspondence between the two.

This correspondence is especially true with the traffic measurements. Some traffic related-measurements on CCS7 links are on a virtual-link basis, and their meaning is the same as the meaning of the respective CCIS 6 link measurements. However, when a CCS7 measurement is not on a virtual-link basis, the measurement is pegged on a per-link basis and may or may not correspond to a CCIS measurement.

**⇒ NOTE:**

All CCS7 measurements are not shown in Table 5-A.

Table 5-B provides an alphabetical index of the measurement description tables (Table 5-C, 5-D, 5-E, 5-F, 5-G, and 5-H). When looking for a particular measurement description, refer to the Alphabetical Index of Measurements (Table 5-B). In Table 5-B, locate the desired measurement name and identify the associated table (Table 5-C, 5-D, 5-E, 5-F, 5-G, or 5-H). Refer to the associated table and locate the desired measurement name for a description.

Tables 5-C through 5-H list the measurement descriptions by subsystems [IMS, CCS7 CNI, PBX, T1, High-Speed A-Link (HSA) and Extended Super Frame (ESF)]. The tables provide the measurement name, type, and description. The measurement type indicates the measurement is specific to some protocol, some particular unit, or the whole office. The measurement names and descriptions are presented alphabetically, and are intended to aid the reader in understanding the source, meaning, and use of each measurement. Most importantly, the descriptions help users to develop their own views of the measurement data. These views can then be scheduled for output as reports using the MOCT.

In addition, the measurement descriptions reference other applicable measurements. These references may provide additional information and are also intended to eliminate duplicate descriptions of similar measurements. Transmit and receive measurements are usually similar. However, when applicable differences are noted, unless otherwise indicated, transmit and receive measurements count the same things only in opposite directions.



For example, the signal units received measurement includes the same types of signal units as the signal units transmitted measurement. This similarity also applies to the measurements of events related to one of the dual rings. Ring 0 format errors mean the same thing for ring 0 as ring 1 format errors for ring 1.

**Table 5-A. CCIS 6 to CCS7 Measurement Correspondence**

| CCIS 6                                             | CCS7                                              | CCIS 6                                             | CCS7                                                     |
|----------------------------------------------------|---------------------------------------------------|----------------------------------------------------|----------------------------------------------------------|
| DRP6MSG_<br>EMR<br>EMRPO<br>L6ACO_<br>L6ACO_TE     | DRP7MSG_<br>L7EMR<br>L7EMRPO<br>L7ACO<br>L7ACOTE  | L6BOLX<br>L6BOFX<br>L6POR<br>L6POX<br>L6SUPR       | L7LCON_X<br>L7LCDIS_X<br>L7POR<br>L7POX<br>L6SUPRV_      |
| L6ACOFE_<br>L6ACONE_<br>L6AFLT<br>L6BOFR<br>L6BOLR | L7ACOFE<br>L7ACONE<br>L7AFLT<br>L7BOFR<br>L7BOLR  | L6SUPX<br>L6XBFLOOK<br>L6XBFOC<br>MGANSR<br>MGANSX | L6SUPXV_<br>L7XBFLOOK<br>L7XBFOC<br>MGANSRV_<br>MGANSXV_ |
| L6BYTO3B<br>L6DIF<br>L6FLD<br>L6MFLT<br>L6MCOFE_   | L7BYTO3B<br>L7DIF<br>L7FLD<br>L7MFLT<br>L7MCOFE   | MGIAMR<br>MGIAMX<br>MRSBCO6<br>MRSNTO6<br>MGSLOOP  | MGIAMRV_<br>MGIAMXV_<br>MRSBCO7<br>MRSNTO7<br>MSG7LOOP   |
| L6MCONE_<br>L6MGR<br>L6MGX<br>L6MRPBC<br>L6MRPNT   | L7MCONE<br>MGMSUR<br>MGMSUX<br>L7MRPBC<br>L7MRPNT | SUER_<br>SUER_TE<br>SUR<br>SUX<br>SURX_<br>SURX_TE | CRCER<br>CRCERTE<br>BYR<br>BYX<br>BYRX<br>BYRXTE         |

**Note:** A “\_” is used when the measurement name includes a virtual link number (0 through 7). For simplicity, the actual virtual link number is not shown.

**Table 5-B. Alphabetical Index of Measurements (CNI, IMS, PBX, T1, HSA, and ESF)**

| Measurement Name | Associated Table | Measurement Name | Associated Table |
|------------------|------------------|------------------|------------------|
| ABOFL            | C                | CODBLRL_         | E                |
| ABOFS            | C                | CODBLTL_         | E                |
| ALIPA            | F                | CODTRVL_         | E                |
| ARRATT           | C                | CODTTRL_         | E                |
| ARREXR           | C                | COFFDIF          | E                |
| ARRFLR           | C                | COINESTN         | E                |
| BESERR           | C                | COIREQL_         | E                |
| BES              | F                | COMSGRL_         | E                |
| BLK0             | C                | COMSGTL_         | E                |
| BLK1             | C                | CONFGT           | C                |
| BLKG0            | C                | CONFG            | C                |
| BLKG1            | C                | COS7CRFSRCM      | D                |
| BUFSW            | C                | COS7DCHNOOS      | D                |
| BYMSUR           | D                | COS7DSDSRCM      | D                |
| BYMSUX           | D                | COS7ERRSRCM      | D                |
| BYRL_            | E                | COS7LCDINV       | D                |
| BYRXL_           | E                | COS7RLCSRCM      | D                |
| BYRXTE           | D                | COS7UNERNA       | D                |
| BYRX             | D                | CRCERL_          | E                |
| BYR              | D                | CRCERTE          | D                |
| BYSR             | D                | CRCER            | D                |
| BYSX             | D                | CUTOCUMSG        | C                |
| BYXL_            | E                | CUTOCUWDS        | C                |
| BYX              | D                | CUTORMSG         | C                |
| CLFAT            | D                | CUTORWDS         | C                |
| CLFA             | D                | DCFLABNT         | D                |
| CLFSPT           | D                | DCFLHWPT         | D                |
| CLFSP            | D                | DCFLSWPT         | D                |
| CLFT             | D                | DCFLXDAT         | D                |
| CLF              | D                | DCFLXDCT         | D                |
| CMBCLFT          | G                | DCFLXERT         | D                |
| CMBCLF           | G                | DLN10800         | C                |
| CNTMOOS          | C                | DLN10FAIL        | C                |
| CNTOOS           | C                | DLN10NETBLK      | C                |
| COCNGSTN         | E                | DLN10SDN         | C                |
| COCNGTMN         | E                | DLN10SSP         | C                |

**Table 5-B. Alphabetical Index of Measurements [(CNI, IMS, PBX, T1, HSA, and ESF) Contd]**

| Measurement Name | Associated Table | Measurement Name | Associated Table |
|------------------|------------------|------------------|------------------|
| DLN6800          | C                | ERCVERR          | C                |
| DLN6FAIL         | C                | ERSECL           | E                |
| DLN6NETBLK       | C                | ERSECTE          | D                |
| DLN6SDN          | C                | ERSEC            | D                |
| DLN6SSP          | C                | ESF              | H                |
| DLNATPDROP       | C                | ES               | F                |
| DLNBASE          | C                | ETRANSERR        | C                |
| DLNBIBC          | C                | FORRXBY          | D                |
| DLNBIMC          | C                | FORRX            | D                |
| DLNBOBC          | C                | FS               | F                |
| DLNBOMC          | C                | GTTPERFD         | D                |
| DLNBUSY          | C                | GTTUNBC          | D                |
| DLNCFNIN         | C                | GTTUNBT          | D                |
| DLNCFNOUT        | C                | GTTUNNT          | D                |
| DLNCSOUT         | C                | ICMPMSGRCV       | C                |
| DLNGIBC          | C                | ICMPMSGSENT      | C                |
| DLNGIMC          | C                | IDLE             | C                |
| DLNGOBC          | C                | IFBPTER1         | C                |
| DLNGOMC          | C                | IFBTER0          | C                |
| DLNSIN           | C                | ILLEGAL          | C                |
| DLNTBSY          | C                | IMNPDIF          | C                |
| DLNUUIDROP       | C                | IMOFFDIF         | C                |
| DMAFLT           | C                | INBOF            | C                |
| DMAMISS          | C                | INIT0T           | C                |
| DRP7MSG1         | D                | INIT0            | C                |
| DRP7MSG2         | D                | INIT1AT          | C                |
| DRP7MSG3         | D                | INIT1A           | C                |
| DRPEMSG1         | D                | INIT1BT          | C                |
| DRPEMSG2         | D                | INIT1B           | C                |
| DRPEMSG3         | D                | INIT2T           | C                |
| DRPMGRG          | E                | INIT2            | C                |
| DRPRABOV2        | G                | INIT3T           | C                |
| DRTMOOS          | C                | INIT3            | C                |
| DRTOOS           | C                | INIT4T           | C                |
| DSCHWDSREC       | C                | INIT4            | C                |
| DSCHWDSSNT       | C                | INITBTT          | C                |

**Table 5-B. Alphabetical Index of Measurements [(CNI, IMS, PBX, T1, HSA, and ESF) Contd]**

| Measurement Name | Associated Table | Measurement Name | Associated Table |
|------------------|------------------|------------------|------------------|
| INITBT           | C                | L7LCDIS3X        | D                |
| IPFMTER0         | C                | L7LCON1XT        | D                |
| IPFMTER1         | C                | L7LCON1X         | D                |
| IPSM0            | C                | L7LCON2XT        | D                |
| IPSM1            | C                | L7LCON2X         | D                |
| IUNOVL0          | C                | L7LCON3XT        | D                |
| IUNOVL1          | C                | L7LCON3X         | D                |
| IUNOVL2          | C                | L7LNKACTT        | D                |
| L6MGRV_          | D                | L7MCOFE          | D                |
| L6MGXV_          | D                | L7MCONE          | D                |
| L6SUPRV_         | D                | L7MFLT           | D                |
| L6SUPXV_         | D                | L7MGSR           | D                |
| L7ACOFE          | D                | L7MG SX          | D                |
| L7ACONE          | D                | L7MRPBC          | D                |
| L7ACOTE          | D                | L7MRPNT          | D                |
| L7ACO            | D                | L7MSINVSIO       | D                |
| L7AFLT           | D                | L7PORT           | D                |
| L7BADRTG         | D                | L7POR            | D                |
| L7BOFRT          | D                | L7POXT           | D                |
| L7BOFR           | D                | L7POX            | D                |
| L7BOLRT          | D                | L7RBF0C          | D                |
| L7BOLR           | D                | L7RTGAUD         | D                |
| L7BYTO3B         | D                | L7THRSWMSU       | D                |
| L7DIF            | D                | L7TRMDMSUS       | D                |
| L7EMRPOT         | D                | L7TRMSUOCT       | D                |
| L7EMRPO          | D                | L7TSMSUOCT       | D                |
| L7EMRT           | D                | L7XBFLOOK        | D                |
| L7EMR            | D                | L7XBFOC          | D                |
| L7FLALIGN        | D                | LKESTBL_         | E                |
| L7FLDT           | D                | LOFC             | F                |
| L7FLD            | D                | LOT_N            | C                |
| L7LCDIS1XT       | D                | LOT_R            | C                |
| L7LCDIS1X        | D                | LPAFLTL_         | E                |
| L7LCDIS2XT       | D                | LPAUDFL_         | E                |
| L7LCDIS2X        | D                | LPBOFRL_         | E                |
| L7LCDIS3XT       | D                | LPBOFRTL_        | E                |

**Table 5-B. Alphabetical Index of Measurements [(CNI, IMS, PBX, T1, HSA, and ESF) Contd]**

| Measurement Name | Associated Table | Measurement Name | Associated Table |
|------------------|------------------|------------------|------------------|
| LPBOLRL_         | E                | MRRING           | C                |
| LPBOLRTL_        | E                | MRSBCO7          | D                |
| LPDIF            | E                | MRSNTO7          | D                |
| LPFLDTL_         | E                | MSG7LOOP         | D                |
| LPLCONRT         | E                | MSGREC           | C                |
| LPLCONR          | E                | MSGSNT           | C                |
| LPLCONXT         | E                | MSINVSIO         | D                |
| LPLCONX          | E                | MSUDISC_         | D                |
| LPMFTL_          | E                | MXRG0            | C                |
| LPMGXFL_         | E                | MXRG1            | C                |
| LPSFAILT_        | E                | NACRETE          | D                |
| LPSPFAIL_        | E                | NACR             | D                |
| LPSWITCHZ        | E                | NOCMGT           | D                |
| LPTMPFLT_        | E                | NOCMG            | D                |
| LPTMPFL_         | E                | NPPTER           | C                |
| LPXBFOCL_        | E                | OOSAUT           | C                |
| MGANSRV_         | D                | OOSAU            | C                |
| MGANSXV_         | D                | OOSCFGT          | C                |
| MGFMTERL_        | E                | OOSCFG           | C                |
| MGIAMRV_         | D                | OOSMNT           | C                |
| MGIAMXV_         | D                | OOSMN            | C                |
| MGMSURL_         | E                | PANICS           | C                |
| MGMSUR           | D                | PIOFLT           | C                |
| MGMSUXL_         | E                | PROTEXRL_        | E                |
| MGMSUX           | D                | PRTOERR          | C                |
| MGRUAL_          | E                | PTERTE           | C                |
| MGRXL_           | E                | Q931MGRL_        | E                |
| MGUNAL_          | E                | Q931MGXL_        | E                |
| MINTRA           | C                | RABTER           | D                |
| MRBADRTG         | D                | RABT             | D                |
| MRINTCH          | C                | RACER0           | C                |
| MRNIAUT          | C                | RACER1           | C                |
| MRNIAU           | C                | RBOFBLK          | C                |
| MRNRING          | C                | RBOF             | C                |
| MRRGQ0           | C                | RCOPTER0         | C                |
| MRRGQ1           | C                | RCOPTER1         | C                |

**Table 5-B. Alphabetical Index of Measurements [(CNI, IMS, PBX, T1, HSA, and ESF) Contd]**

| Measurement Name | Associated Table | Measurement Name | Associated Table |
|------------------|------------------|------------------|------------------|
| RDFMTER0         | C                | SC7RGTR          | D                |
| RDFMTER1         | C                | SC7RLNN          | D                |
| RDINHER0         | C                | SC7RLSS          | D                |
| RDINHER1         | C                | SC7RNATL         | D                |
| RDWNT            | C                | SC7R             | D                |
| RDWN             | C                | SC7UDSX          | D                |
| RETMG            | E                | SCRERPRO         | D                |
| RETRY            | C                | SCRERUATY        | D                |
| RGCNFGT          | C                | SCRERUA          | D                |
| RGCNFG           | C                | SCRERUNE         | D                |
| RINTCH           | C                | SCRGTR           | D                |
| RIPTER0          | C                | SCRLNN           | D                |
| RIPTER1          | C                | SCRLSS           | D                |
| RJCTMG           | E                | SCRNATL          | D                |
| RNIMNT           | C                | SCR              | D                |
| RNIMN            | C                | SCSILNKRTY       | C                |
| RPCBOF           | C                | SCSRTR           | D                |
| RRBOVFLW0        | C                | SCSRTX           | D                |
| RRBOVFLW1T       | C                | SCSSTR           | D                |
| RRBOVFLW1        | C                | SCSSTX           | D                |
| RRBOVFLW2T       | C                | SCUDSX           | D                |
| RRBOVFLW2        | C                | SES              | F                |
| RRBOVFLW3T       | C                | SEVERSEC         | D                |
| RRBOVFLW3        | C                | SEVERSEC         | D                |
| RSTTRMT          | C                | SFPTER0          | C                |
| RTESETUNT        | D                | SFPTER1          | C                |
| RTESETUN         | D                | SLIPS            | F                |
| RTGAUDFL         | D                | SPIAPOT          | D                |
| RTMSGSRC         | C                | SPIAPO           | D                |
| RTOCUMSG         | C                | SPIAT            | D                |
| RTOCUWDS         | C                | SPIA             | D                |
| SBMEMERR         | G                | SPIPOT           | D                |
| SC7RERPRO        | D                | SPIPO            | D                |
| SC7RERUATY       | D                | SPISPPOT         | D                |
| SC7RERUA         | D                | SPISPPO          | D                |
| SC7RERUNE        | D                | SPISPT           | D                |

**Table 5-B. Alphabetical Index of Measurements [(CNI, IMS, PBX, T1, HSA, and ESF) Contd]**

| Measurement Name | Associated Table | Measurement Name | Associated Table |
|------------------|------------------|------------------|------------------|
| SPISP            | D                | WDSREC           | C                |
| SPIT             | D                | WDSSNT           | C                |
| SPI              | D                | WRRGQ0           | C                |
| SQL              | D                | WRRGQ1           | C                |
| SRNIAUT          | C                | WSMER0           | C                |
| SRNIAU           | C                | WSMER1           | C                |
| SRSCTRAN         | D                | WTFMTER0         | C                |
| SRSTTRAN         | D                | WTFMTER1         | C                |
| SSATRAN          | D                | WXRG0            | C                |
| SSPTRAN          | D                | WXRG1            | C                |
| SSTTRAN          | D                | XBFFULLL_        | E                |
| THRSWMSU         | D                | XBFFULLTL_       | E                |
| TLNKACTV         | D                |                  |                  |
| TRMDMSUS         | D                |                  |                  |
| TRMSUOCT         | D                |                  |                  |
| TSMSUOCT         | D                |                  |                  |
| U0OVLD1T         | G                |                  |                  |
| U0OVLD1          | G                |                  |                  |
| U0OVLD2T         | G                |                  |                  |
| U0OVLD2          | G                |                  |                  |
| U10VLD1T         | G                |                  |                  |
| U10VLD1          | G                |                  |                  |
| U10VLD2T         | G                |                  |                  |
| U10VLD2          | G                |                  |                  |
| ULOVLD1T         | G                |                  |                  |
| ULOVLD1          | G                |                  |                  |
| ULOVLD2T         | G                |                  |                  |
| ULOVLD2          | G                |                  |                  |
| UNRCMSGREC       | C                |                  |                  |
| UNVL             | D                |                  |                  |
| UROVLD1          | G                |                  |                  |
| UROVLD2T         | G                |                  |                  |
| UROVLD2          | G                |                  |                  |
| WBOFNL           | C                |                  |                  |
| WBOFN            | C                |                  |                  |
| WBOFO            | C                |                  |                  |

**Table 5-C. Interprocess Message Switch (IMS) Measurement Descriptions**

| Name (Type)       | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ABOFL<br>(Office) | Long message type application buffer overflow. This count is for the long type single message read buffers referred to in the ABOFS description. It is pegged when there are no more buffers of this type available.                                                                                                                                                                                                                                                                                                                                                                                     |
| ABOFS<br>(Office) | Short message type application buffer overflow. Messages delivered to IMS channels in the single message read mode are copied into buffers allocated from a common pool—each buffer holds one message. A pointer to the buffer is placed in the read list for the channel (refer to the RBOF description). For memory efficiency, there are two buffer sizes, short and long. This count is pegged whenever an attempt is made to allocate a short-type, single-message, read buffer when the buffer pool is empty. If possible, the message is returned to its origination; otherwise, it is discarded. |
| ARRATT (NP)       | Automatic Ring Recovery (ARR) restoral attempts. The ARR program attempts to diagnose and restore nodes to a working state when a node fails. If a node is alleged to be faulty, ARR diagnoses the node by attempting a conditional restore. An isolated segment may contain nodes with no faults associated with them—innocent victims due to multiple failures on the ring. They are restored unconditionally when they become reachable by ARR one of the faulty nodes in the segment must be restored first. This count is pegged each time ARR attempts to restore a node.                          |
| ARREXR (NP)       | Automatic Ring Recovery restoral failure is due to excessive restore rate. Each time ARR restores a node, it increments a counter in the ECD in addition to the ARRATT measurement. If that counter exceeds a certain threshold within a given time, the node has a recurring fault. This count is then pegged, and the node is marked for manual intervention.                                                                                                                                                                                                                                          |



**Table 5-C. Interprocess Message Switch (IMS) Measurement Descriptions (Contd)**

| <b>Name (Type)</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ARRFLR (NP)        | Automatic Ring Recovery restoral failures. If ARR is unsuccessful at restoring a node, this count is pegged. If the failure to restore is due to a legitimate diagnostic failure, the node is marked for manual intervention. If the diagnostic is aborted due to other reasons, it is retried later. Refer to the ARRATT description.                                                                                                                                                                                                                                                                               |
| BLK0 (Office)      | Ring 0 blockage. This count is pegged once if a blockage is reported on ring 0 by one or more nodes during a particular listen interval (refer to the BLKG0 description). It is the cumulative count of incidents on ring 0 that result in blockages and a corresponding ring reconfiguration. Each incident may involve multiple blockage reports from many nodes.                                                                                                                                                                                                                                                  |
| BLK1 (Office)      | Ring 1 blockage. Refer to the BLK0 description.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| BLKG0 (NP)         | Ring 0 blockage. Each node contains a ring interface circuit used to access the dual rings. This circuit contains a buffer called a ring access circuit (RAC). Blockages are detected when a RAC has been unable to propagate data to its downstream neighbor for a predetermined period of time. If too much time elapses without any data being transferred, a blockage is reported to the central processor, and this count pegs for the reporting node. The node then dequeues some data to reset the blockage timers of upstream nodes. This is sometimes ineffective, resulting in multinode blockage reports. |
| BLKG1 (NP)         | Ring 1 blockage. Refer to the BLKG0 description.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| BUFSW (NP)         | Ring receive buffer switch. When the node reads messages from the ring, the data is DMAed to buffers in the node processor memory. Each buffer has a fixed length. If the DMA requires another buffer, it is interrupted, a new buffer is allocated, this count is pegged, and the DMA continues.                                                                                                                                                                                                                                                                                                                    |
| BUSERR (NP)        | The number of SCSI bus errors that are logged by the SIN node.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

**Table 5-C. Interprocess Message Switch (IMS) Measurement Descriptions  
(Contd)**

| <b>Name (Type)</b>    | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| BXMITN3B<br>(NP)      | This is the number of bytes transmitted from the node to the 3B. This count is increased by the size in the bytes for each message sent to the 3B.                                                                                                                                                                                                                                                                                           |
| CNTMOOS<br>(NP)       | The count of times a SCSI link went manually out of service (OOS) for a SIN node.                                                                                                                                                                                                                                                                                                                                                            |
| CNTOOS (NP)           | The count of times a SCSI link went out of service (OOS) for a SIN node.                                                                                                                                                                                                                                                                                                                                                                     |
| CONFG (NP)            | Begin/end point of isolation segment. This count is incremented whenever the specified node is either a BISO or EISO node. Whenever a node adjacent to this node is isolated, this node may become the begin-end point depending on how the ring is reconfigured (refer to the SRNIAU or MRNIAU description). The begin-end node is not isolated. Rather, the ring interface circuits in the node cause rings 0 and 1 to loop on each other. |
| CONFGT (NP)           | Duration of begin/end point of isolation segment. The length of time a node is either a BISO or EISO node.                                                                                                                                                                                                                                                                                                                                   |
| CUTOCUMSG<br>(Office) | 3B computer to 3B computer IMS messages. This is a cumulative count of all messages delivered between two channels in the central processor.                                                                                                                                                                                                                                                                                                 |
| CUTOCUWDS<br>(Office) | 3B computer to 3B computer IMS message words. This is a cumulative count of all words delivered between two channels in the central processor. It is incremented by the size of a message when the message is queued for the destination channel.                                                                                                                                                                                            |
| CUTORMSG<br>(RPC)     | 3B computer to ring peripheral controller IMS messages. This is a cumulative count of all messages transmitted to a specific ring peripheral controller. The RPC may or may not be the final destination of the message. The messages could be sent to other nodes on the ring. Messages queued in write buffers are delivered to the ring at each invocation of the message switch.                                                         |

**Table 5-C. Interprocess Message Switch (IMS) Measurement Descriptions (Contd)**

| <b>Name (Type)</b> | <b>Description</b>                                                                                                                                                                                                                                    |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CUTORWDS (RPC)     | 3B computer to ring peripheral controller IMS message words. This is the cumulative count of the sizes of all the messages transmitted to a specific RPC. The count is in 3B computer words; each word is 4 bytes. Also see the CUTORMSG description. |
| DLNATPDROP (AP)    | Number of ISUP ATP parameters that the DLN dropped because the message exceeded the Max. Length.                                                                                                                                                      |
| DLNBASE (AP)       | Base cycle counter 10ms/base cycle.                                                                                                                                                                                                                   |
| DLNBIBC (AP)       | Counter for bad Ring to 1A DMA message blocks in the DLN.                                                                                                                                                                                             |
| DLNBIMC (AP)       | Counter for bad inbound signaling messages in the DLN. Message size invalid, fail translations or contain a bad length field.                                                                                                                         |
| DLNBOBC (AP)       | Counter for bad 1A to Ring DMA message blocks in the DLN.                                                                                                                                                                                             |
| DLNBOMC (AP)       | Counter for bad outbound signaling messages in the DLN. Message size invalid, fail translations or contain a bad length field.                                                                                                                        |
| DLNBUSY (AP)       | Peg count of 125us idle in 5 minutes.                                                                                                                                                                                                                 |
| DLNCFNIN (AP)      | Number of confusion messages that the DLN received from the network and is sending to the 1A.                                                                                                                                                         |
| DLNCFNOUT (AP)     | Number of confusion messages that the DLN received from the 1A and is sending to the network.                                                                                                                                                         |
| DLNSIN (AP)        | Number of incoming SIN messages in the DLN.                                                                                                                                                                                                           |
| DLNCSOUT (AP)      | Number of outgoing SIN messages in the DLN.                                                                                                                                                                                                           |
| DLNGIBC (AP)       | Counter for good Ring to 1A DMA message blocks in the DLN.                                                                                                                                                                                            |
| DLNGIMC (AP)       | Counter for good input signaling messages in the DLN from the network that have been reformatted to the 1A.                                                                                                                                           |
| DLNGOBC (AP)       | Counter for good 1A to Ring DMA message blocks in the DLN.                                                                                                                                                                                            |

**Table 5-C. Interprocess Message Switch (IMS) Measurement Descriptions  
(Contd)**

| <b>Name (Type)</b> | <b>Description</b>                                                                                                                         |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| DLNGOMC (AP)       | Counter for good output DLN signaling messages that get sent from the 1A out to the signaling network.                                     |
| DLNTBSY (AP)       | Count of too busy cycles in the DLN when less than .5 ms segments of routine background tasks were not able to run in the last base cycle. |
| DLNUUIDROP (AP)    | Number of ISUP UUI parameters that the DLN dropped because the message exceeded the maximum length.                                        |
| DLN6FAIL (AP)      | Total of DLN SCCP 6 digit GTT messages that were not sent because of translation failures.                                                 |
| DLN6NETBLK (AP)    | Total of DLN SCCP 6 digit GTT messages that were not sent out to the network because of routing failure or congestion.                     |
| DLN6SDN (AP)       | Total DLN SCCP 6 digit GTT messages processed for TT=252.                                                                                  |
| DLN6SSP (AP)       | Total of DLN SCCP 6 digit GTT messages that were not sent out to the signaling network because the subsystem is prohibited.                |
| DLN6800 (AP)       | Total DLN SCCP 6 digit GTT messages processed for TT=253.                                                                                  |
| DLN10FAIL (AP)     | Total of DLN SCCP 10 digit GTT messages that were not sent because of translation failures.                                                |
| DLN10NETBLK (AP)   | Total of DLN SCCP 10 digit GTT messages that were not sent out to the network because of routing failure or congestion.                    |
| DLN10SDN (AP)      | Total DLN SCCP 10 digit GTT messages processed for TT=252.                                                                                 |
| DLN10SSP (AP)      | Total of DLN SCCP 10 digit GTT messages that were not sent out to the signaling network because the subsystem is prohibited.               |
| DLN10800 (AP)      | Total DLN SCCP 10 digit GTT messages processed for TT=253.                                                                                 |

**Table 5-C. Interprocess Message Switch (IMS) Measurement Descriptions  
(Contd)**

| <b>Name (Type)</b>  | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DMAFLT<br>(RPC/DLN) | Direct memory access fault. The central processor communicates with the node via both DMA and program I/O requests (the PIOFLT count indicates faults detected during the latter). The DMA is used when a large amount of data needs to be sent to or from the ring and it is not necessary for the sending process to wait for a completion. Hardware (such as the DMA controller, the DDSBS, or 3B computer interface) detects the fault (for example, an incorrect address) while Direct Memory Accessing data. When a fault is detected, the DMA is interrupted; this error is reported to the central processor, and the count pegs. |
| DMAMISS<br>(RPC)    | Direct memory access missed. When the message switch wants to send messages to an RPC or DLN (once each invocation), it first checks to see if the RPC or DLN is ready to accept more messages (that is, it has finished the DMA for the last message switch cycle). If the DMA is complete, the message switch can use the RPC or DLN to send messages to the ring. If the DMA has not finished, the RPC or DLN cannot be used and this count pegs.                                                                                                                                                                                      |
| DRTMOOS<br>(NP)     | The time duration for all the MOOS SCSI links on a SIN node.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| DRTOOS (NP)         | The time duration for all the OOS SCSI links on a SIN node.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| DSCHWDSREC<br>(NP)  | The number of words received over the Dual Serial Channel on the SIN node from the 3B.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| DSCHWDSSNT<br>(NP)  | The number of words sent over the Dual Serial Channel from the SIN node from the 3B.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| ERCVERR             | Ethernet Receive Errors. The number of Ethernet receive errors. This count includes frame check sequence errors, framing errors, collisions detected late in frame receipt, missed and runt (<64 bytes) packets.                                                                                                                                                                                                                                                                                                                                                                                                                          |
| ETRANSERR           | Ethernet Transmit Errors. The number of Ethernet transmit errors. This count includes collisions, excessive collisions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

**Table 5-C. Interprocess Message Switch (IMS) Measurement Descriptions  
(Contd)**

| <b>Name (Type)</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ICMPMSGRCV (NP)    | Internet Control Message Protocol (ICMP) Messages Received. The number of ICMP messages received. Internet Control Message Protocol is the error handling protocol of IP. High ICMP traffic is an indicator of network problems. This count also pegs when "echo responses," that is, ping messages, are handled by the EIN and responded to.                                                                                                                                                                                                         |
| ICMPMSGSENT (NP)   | Internet Control Message Protocol Messages Sent. The number of internet control message protocol (ICMP) messages sent. This count also pegs when "echo responses," that is, ping messages, are handled by the EIN and responded to.                                                                                                                                                                                                                                                                                                                   |
| IDLE (NP)          | A relative measure of node processor idle time. Tasks in a node, both message processing and maintenance processing, are scheduled by preemptive priority. When all other tasks have completed, the node processor executes the idle routine; this routine is assigned the lowest possible priority. This count is incremented by the idle routine in an amount proportional to the time spent idle. This idle routine also sets the idle flag indicating there is no work. The idle flag is checked and cleared every 10 ms by the overload monitor. |
| IFBPTER0 (NP)      | Interframe buffer (IFB) parity error on ring 0. The IFB is considered to be part of the input circuitry of the downstream node. Parity errors detected in the IFB are reported by that node. This error can be considered equivalent to a hard parity error, but occurring in the associated IFB (refer to the RIPTER0 description).                                                                                                                                                                                                                  |
| IFBPTER1 (NP)      | Interframe buffer parity error on ring 1. Refer to the IFBPTER0 description.                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| ILLEGAL (NP)       | Number of messages processed by the illegal message handler. This includes such messages as source match, destination channel closed, or returned messages. Refer to RTMSGSRC, MRINTCH, and MRRING descriptions.                                                                                                                                                                                                                                                                                                                                      |

**Table 5-C. Interprocess Message Switch (IMS) Measurement Descriptions (Contd)**

| Name (Type)       | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| IMNPDIF (NP)      | <p>Node processor data integrity flag. If this count is zero, the data collected is good. If the count is nonzero, it indicates the data collected by the central processor is incomplete. The following describes the meanings of the bits (the IMOFFDIF measurement describes how these bits are derived). The measurement value is as follows: 00000000<i>abcd0efg</i>0000000000000000h in binary:</p> <p>Where:</p> <ul style="list-style-type: none"> <li>a = Data collection period skipped</li> <li>b = Data collection period aborted</li> <li>c = Node did not respond<br/>(no measurements received)</li> <li>d = Periodic data collection initialized</li> <li>e = Data collection process faulted during data</li> <li>f = Node removed</li> <li>g = Node grown</li> <li>h = Node initialized<br/>(this value is collected in the node).</li> </ul> |
| IMOFFDIF (Office) | <p>Per office data integrity flag. If this count is zero, the data collected is good. If the count is nonzero, it indicates the data collected by the central processor is incomplete. The data integrity flag is used to determine if an event has occurred in the period of interest which causes the data collected for that period to be suspect. The data integrity flag is actually a decimal representation of one 32-bit word describing the error condition. To determine the meaning of the count, it must be converted from decimal to binary and the bits analyzed. In the following, the measurement value is represented as 00000000<i>ab0c0d</i>00000000000000000000 in binary. Each bit in the word that is set (more than one can be set) indicates a particular error:</p>                                                                    |

**Table 5-C. Interprocess Message Switch (IMS) Measurement Descriptions  
(Contd)**

| Name (Type)                     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| IMOFFDIF<br>(Office)<br>(Contd) | Where:<br>a = Data collection period skipped<br>b = Data collection period aborted<br>c = Periodic data collection initialized<br>d = Data collection process sustained a fault.                                                                                                                                                                                                                                                                                                          |
| INBOF (NP)                      | Failure to obtain a new ring receive buffer. Messages are read into buffers in node memory as described under the BUFSW measurement. If there are no more buffers available when a buffer switch is attempted, this count is pegged. Any messages not read are then Direct Memory Accessed into the "throwaway" portion of NP memory (effectively discarding them). This count should always be the same as the RRBOVFLW3 count.                                                          |
| INIT0<br>(Office)               | Number of level 0 IMS initializations that started. Level 0 is the audit level. When invoked either automatically or manually by an input message, selected audits start. Should a critical audit fail, then the initialization may escalate to level 1B. At level 0, the message switch is running. Note that the IMS initialization levels are basically the same as the corresponding application and operating system levels.                                                         |
| INIT0T<br>(Office)              | Duration of level 0 IMS initialization. Since the initialization sequences for levels 0, 1A, and 1B do not recreate any IMS processes, these durations are exclusive of the boot prologue and the boot level initializations.                                                                                                                                                                                                                                                             |
| INIT1A<br>(Office)              | Number of level 1A IMS initializations that started. This is the recovery level and may be triggered by internal problems. Tables are rebuilt from information in the central processor and ring nodes. A level one system initialization triggers either an IMS level 1A or 1B. During level 1A, IMS is capable of switching messages but messages may be lost due to audits and reinitialization of communications between the central processor and ring. It may escalate to level 1B. |



**Table 5-C. Interprocess Message Switch (IMS) Measurement Descriptions (Contd)**

| <b>Name (Type)</b>  | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| INIT1AT<br>(Office) | Duration of level 1A IMS initialization. Refer to the INIT0T description.                                                                                                                                                                                                                                                                                                                                                                                      |
| INIT1B<br>(Office)  | Number of level 1B IMS initializations that started. During level 1B, IMS is not capable of switching messages (messages are lost).                                                                                                                                                                                                                                                                                                                            |
| INIT1BT<br>(Office) | Duration of level 1B IMS initialization. Refer to the INIT0T description.                                                                                                                                                                                                                                                                                                                                                                                      |
| INIT2<br>(Office)   | Number of level 2 IMS initializations that started. This level immediately escalates to a level 3.                                                                                                                                                                                                                                                                                                                                                             |
| INIT2T<br>(Office)  | Duration of level 2 IMS initialization. Refer to the INIT3T description.                                                                                                                                                                                                                                                                                                                                                                                       |
| INIT3<br>(Office)   | Number of level 3 IMS initializations that started. This is the lowest boot level. If the boot is unsuccessful, CNI and IMS abort. If possible, the previously existing ring configuration is maintained; if necessary, a quick reconfiguration is attempted. Selected nodes may be downloaded.                                                                                                                                                                |
| INIT3T<br>(Office)  | Duration of level 3 IMS initialization. The boot level initialization durations do not include the time spent aborting IMS, the time spent recreating the driver, nor the time spent in the boot prologue.                                                                                                                                                                                                                                                     |
| INIT4<br>(Office)   | Number of level 4 IMS initializations that started. This is the highest boot level. If the boot is unsuccessful due to a software problem, CNI and IMS abort. If the boot is unsuccessful due to a hardware problem, IMS is still capable of performing diagnostics. If the boot is successful, all ring nodes are downloaded. It allows the system to operate even if no usable ring configuration is established. Also, automatic recovery can be inhibited. |
| INIT4T<br>(Office)  | Duration of level 4 IMS initializations. Refer to the INIT2T description.                                                                                                                                                                                                                                                                                                                                                                                      |
| INITBT<br>(Office)  | Number of IMS boot prologues that start. This counts how many times IMS is booted (recreated), whereas the initialization levels 2, 3, and 4 counts indicate how many times the boot leads to those particular sequences.                                                                                                                                                                                                                                      |

**Table 5-C. Interprocess Message Switch (IMS) Measurement Descriptions  
(Contd)**

| <b>Name (Type)</b>            | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| INITBT<br>(Office)<br>(Contd) | If an initialization fails, it may be retried automatically. Also, since level 2 invokes level 3, the sum of INIT2, INIT3, and INIT4 could exceed this count.                                                                                                                                                                                                                                                                               |
| INITBTT<br>(Office)           | Duration of IMS boot prologue. This measurement begins when the IMS driver is created. It is exclusive of the boot level initialization durations.                                                                                                                                                                                                                                                                                          |
| IPFMTER0<br>(NP)              | Ring input format error on ring 0. This error is detected at the input to the RAC. It occurs whenever a message passing through the RAC buffer has format problems; that is, the message is too short to contain a valid header or is longer than the header indicates. This condition is checked even if the message is not read by the node. Furthermore, the format error is also pegged by the RDFMTER0 count when the message is read. |
| IPFMTER1<br>(NP)              | Ring input format error on ring 1. Refer to the IPFMTER0 description.                                                                                                                                                                                                                                                                                                                                                                       |
| IPSM0 (NP)                    | Ring 0 input source match. Whenever a message on the ring is not dequeued by the node to which it is destined, the message continues to traverse the ring to the sending node. The sender then detects the message, removes and discards it, and notifies the central processor. Then this count pegs for the destination node.                                                                                                             |
| IPSM1 (NP)                    | Ring 1 input source match. Refer to the IPSM0 description.                                                                                                                                                                                                                                                                                                                                                                                  |
| IUNOVLD0<br>(IUN)             | Number of times the IMS user node entered overload level 0 (the normal state). The IUNOVLD_ measurements indicate the number of times the node is in a state in which all available CPU time is consumed (refer to the IDLE description). Entering this state indicates the processor is idle (it pegs when the NP returns to level 0 from level 1 or 2).                                                                                   |
| IUNOVLD1<br>(IUN)             | Number of times the IMS user node entered overload level 1. The node processor has not been idle for some time. Messages from the user apparatus are processed on a "clocked" schedule to reduce NP load.                                                                                                                                                                                                                                   |

**Table 5-C. Interprocess Message Switch (IMS) Measurement Descriptions (Contd)**

| Name (Type)      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| IUNOVL2<br>(IUN) | Number of times the IMS user node entered overload level 2. The node processor has not been idle for a longer period of time. Messages from the ring and the user apparatus are processed on a “clocked” schedule to further reduce NP load.                                                                                                                                                                                                                                                                                               |
| LOT_N<br>(OFF)   | Unexplained loss of token on a normal two-ring system. This count increments once when an unexplained loss of the token message occurs on ring 0, ring 1 or on both rings simultaneously.                                                                                                                                                                                                                                                                                                                                                  |
| LOT_R<br>(OFF)   | Unexplained loss of token on a reconfigured single-ring system. This count increments once when an unexplained loss of the token message occurs on a reconfigured ring. The sum of LOT_N and LOT_R equals the total count of unexplained loss of token events.                                                                                                                                                                                                                                                                             |
| MINTRA (RPC)     | <p>For a particular ring peripheral controller (RPC) node, this count increments when the following occurs:</p> <ul style="list-style-type: none"> <li>■ An intra node IMS message is generated within that RPC.</li> <li>■ A message is generated by that RPC and specifically addressed to the 3B as its final destination.</li> <li>■ A message is generated by the 3B and specifically addressed to that RPC as its final destination.</li> </ul> <p>This count is not tied to any other count. A very small count is not unusual.</p> |
| MRINTCH (NP)     | <p>Message returned to the ring due to destination channel being closed. When a message is sent to a closed channel in a node, the message must be returned (refer to the RINTCH description).</p> <p><b>Note:</b> This count is a cumulative total for all channels in the node, while RINTCH is counted per channel in the central processor.</p>                                                                                                                                                                                        |

**Table 5-C. Interprocess Message Switch (IMS) Measurement Descriptions  
(Contd)**

| <b>Name (Type)</b>  | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MRNIAU<br>(Office)  | Automatic multiple ring node isolation. When a node is isolated, the ring is reconfigured to group all isolated nodes into one isolated segment. The nodes involved may have been isolated automatically, manually, or as innocent victims of the ring reconfiguration. If the segment has more than one node and the most recently isolated node is isolated by automatic action, the entire segment is considered to be isolated automatically. This count is pegged when the ring is successfully reconfigured automatically and the node is isolated.                                                                                                                                      |
| MRNIAUT<br>(Office) | Duration of automatic multiple ring node isolation. This is the cumulative time in which an automatically generated ring configuration exists with more than one node isolated.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| MRNRING (NP)        | Message returned from ring. When the node receives a message that is not accepted by the destination, the returned message control code is detected; the message is discarded, and this count is pegged. See the MRRING, RINTCH, and MRINTCH descriptions for reasons why messages are returned.                                                                                                                                                                                                                                                                                                                                                                                               |
| MRRGQ0 (NP)         | Message received from ring 0 queued. In the node processor, messages from the ring (via DMA reads) are placed in one of the ring receive buffers in memory. A separate list of pointers (queue) to the messages in the buffers is maintained for each channel—except in-place channels. This count is the cumulative total of all messages from ring 0 queued for any of these channels. At a ring peripheral controller, this count is the number of blocks given to the active ring channel. A block may contain several messages. In the case of in-place channels, messages are processed in the buffers. After processing, these messages may be queued to be read by some other channel. |
| MRRGQ1 (NP)         | Message received from ring 1 queued. Refer to the MRRGQ0 description.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

**Table 5-C. Interprocess Message Switch (IMS) Measurement Descriptions (Contd)**

| <b>Name (Type)</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MRRING (Office)    | Message returned to ring with "returned message" control code (destination did not accept message). This count is the number of times messages are returned to the ring because the destination channel is not open; the destination's read queue is full; or there is no buffer space for the message. If the message is not already a returned message, this count is pegged. Then, the "returned message" control code is added to the message; source and destination addresses are swapped; and the message is sent to the ring. If the message is already a returned message, it is discarded and this count is unaffected. |
| MSGREC (NP)        | The number of messages received via the SCSI link from the CDRP to the SIN node.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| MSGSNT (NP)        | The number of messages sent via the SCSI link from the SIN node to the CDRP.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| MXRG0 (NP)         | Message transmitted to ring 0. When a message is to be transmitted to the ring, a pointer to the buffer in NP memory containing the message is placed on a queue. The queue represents a block of messages to be Direct Memory Accessed to the ring. This count is incremented at each DMA by the number of messages in the block to be sent to ring 0.                                                                                                                                                                                                                                                                           |
| MXRG1 (NP)         | Message transmitted to ring 1. Refer to the MXRG0 description.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| NPPTER (NP)        | Node processor parity error. This count is pegged when the node reports an internal memory parity error. This error currently results in the node processor putting itself in a quarantine state and is not reported to the central processor. Therefore, this count is presently ineffective and should always be zero.                                                                                                                                                                                                                                                                                                          |
| OOSAU (NP)         | Automatic out of service. This count is the number of times the node entered either the out-of-service state or standby state from another state due to automatic action due to failing diagnostics or some automatically detected fault. The node maintenance state may later change to manual; but until the major state changes, it is considered to be "automatic out of service."                                                                                                                                                                                                                                            |

**Table 5-C. Interprocess Message Switch (IMS) Measurement Descriptions (Contd)**

| <b>Name (Type)</b>    | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| OOSAU (NP)<br>(Contd) | This count does not peg if the node is an innocent victim of a ring reconfiguration (see the OOSCFG description).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| OOSAUT (NP)           | Duration of “automatic out of service.” This is the cumulative total of the time the node is in this state.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| OOSCFG (NP)           | Out of service due to ring reconfiguration. This count is the number of times the node has entered either the out-of-service state or standby state from some other state due to automatic action and because it is an innocent victim of a ring reconfiguration. When this state is first entered, the node is isolated. The node maintenance state may later change to manual, but until the major state changes, it is considered to be “automatic out of service.” This count also includes those situations where the node is removed from service due to the entire ring down or a ring reconfiguration in progress. |
| OOSCFGT (NP)          | Duration out of service due to ring reconfiguration. This is the cumulative total of time the node is in this state.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| OOSMN (NP)            | Manual out of service. This count is the number of times the node has entered either the out-of-service state or standby state from some other state due to manual action. The node maintenance state may later change to automatic; but until the major state changes, it is considered to be “manual out of service.”                                                                                                                                                                                                                                                                                                    |
| OOSMNT (NP)           | Duration of “manual out of service.” This is the cumulative total of time the node is in this state.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| PANICS (NP)           | Number of recoverable errors. There are conditions which force the node processor to restart. If the condition does not prevent processing from continuing, it is called a soft error and this count pegs. If the processor must be rebooted, it is called a hard error, and it does not effect this count; it does not peg because error logging is not possible.                                                                                                                                                                                                                                                         |

**Table 5-C. Interprocess Message Switch (IMS) Measurement Descriptions (Contd)**

| <b>Name (Type)</b>  | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PIOFLT<br>(RPC/DLN) | Fault received after a program I/O request is issued to a ring peripheral controller. The program I/O is used by the central processor mostly for sending commands to a RPC and for receiving status information from a RPC. There are two types of requests used: (1) <i>hardware</i> which causes some hardware action or (2) <i>software</i> which sends a command to some process. In both cases, the sending process waits for the program I/O request to complete. If hardware (such as the DMA controller, the DDSBS, or 3B computer interface) detects a fault during the I/O, this error is reported to the central processor and the count pegs. |
| PRTOERR<br>(NP)     | The number of SCSI protocol errors that are logged by the SIN node.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| PTERTE (NP)         | Number of times soft parity error exceeded a threshold. A "leaky bucket" cumulative count of both SFPTER0 and SFPTER1 is kept by the central processor. When that count exceeds a threshold, this count is pegged, and a ring reconfiguration is triggered to isolate the offending node.                                                                                                                                                                                                                                                                                                                                                                  |
| RACER0 (NP)         | Ring access controller (RAC) problem on ring 0. The RAC has a set of condition bits in its status ports that indicate troubles in the RAC. When the node processor observes problems in the RAC for ring 0 (indicated by the condition bits), it attempts to clear the problem for a maximum of 10 retries. If unsuccessful, this error report is issued to the central processor and the count pegs.                                                                                                                                                                                                                                                      |
| RACER1 (NP)         | Ring access controller problem on ring 1. Refer to the RACER0 description.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| RBOF (CHN)          | Single message read list buffer overflow. Each central processor channel using single-message read mode, is allocated a single message read list. This list contains pointers to the messages destined for this channel. The message is actually contained in a buffer from a pool of buffers shared among all single message read list users. The message switch tries to deliver a message to this channel by placing a pointer in the read list.                                                                                                                                                                                                        |

**Table 5-C. Interprocess Message Switch (IMS) Measurement Descriptions (Contd)**

| <b>Name (Type)</b>    | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RBOF (CHN)<br>(Contd) | If all pointer slots in the read list contain pointers to messages waiting to be read by the channel owner, this count pegs. This is an indication that messages are being queued faster than the owner of the channel can read them. Block message read list buffer overflow. This count is the block mode equivalent of the RBOF count. A central processor channel using block read mode is allocated a block read list (or buffer).                                                                                                                  |
| RBOFBLK<br>(CHN)      | This structure is actually just buffer space to hold messages destined for this channel, in contrast to the single message read list. The buffer is allocated from a common pool. The actual message is copied into the channel's private buffer space. If there is not room in the buffer to hold a new message for this channel—the read list is full—the message switch pegs this count. Block read buffers are circular; if there is room, messages are put after the last message delivered and before the oldest message that is still being used. |
| RCOPTER0<br>(NP)      | Ring access controller output parity error on ring 0. This parity error is generated in the node processor when a message from the RAC for ring 0 is read into the node processor memory. Since the parity is good when the data is transferred into the RAC, the problem is internal to the RAC.                                                                                                                                                                                                                                                        |
| RCOPTER1<br>(NP)      | Ring access controller output parity error on ring 1. Refer to the RCOPTER0 description.                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| RDFMTER0<br>(NP)      | Ring read format error on ring 0. Read format errors are detected in the RAC buffer during the reading of the message into NP memory and are usually due to partial or truncated messages received by the node. The size specified in the header is greater than the actual message size as received. Unless the node is an RPC, read format errors are not generated when a broadcast message is involved.                                                                                                                                              |



**Table 5-C. Interprocess Message Switch (IMS) Measurement Descriptions (Contd)**

| <b>Name (Type)</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RDFMTER1 (NP)      | Ring read format error on ring 1. Refer to the RDFMTER0 description.                                                                                                                                                                                                                                                                                                                                                          |
| RDINHER0 (NP)      | Read inhibit error on ring 0. Data in the RAC is read into the NP by direct memory access. The node contains a timer that allows a specific time for the read operation. If after the timer expires no data has been transferred, the node reports this error to the central processor and the count is pegged.                                                                                                               |
| RDINHER1 (NP)      | Read inhibit error on ring 1. Refer to the RDINHER0 description.                                                                                                                                                                                                                                                                                                                                                              |
| RDWN (Office)      | Entire ringdown. This count is pegged whenever the ring maintenance state is changed to indicate the entire ring is down (it is unusable). All nodes peg either the OOSAU, OOSCFG, or OOSMN count when this occurs, depending on their maintenance states.                                                                                                                                                                    |
| RDWNT (Office)     | Duration of entire ringdown. This is the cumulative total of the time the ring maintenance state is ringdown.                                                                                                                                                                                                                                                                                                                 |
| RETRY (NP)         | TCP Retransmission Retries. The number of TCP retransmission retries.                                                                                                                                                                                                                                                                                                                                                         |
| RGCNFG (Office)    | Ring containing an isolated segment. This count pegs when an isolated segment is successfully established—a node is isolated by manual or automatic action. This count is the sum of the SRNIAU, MRNIAU, and RNIMN counts.                                                                                                                                                                                                    |
| RGCNFGT (Office)   | Duration of ring containing an isolated segment. This is the cumulative time during which the ring had at least one node isolated—the sum of the SRNIAUT, MRNIAUT, and RNIMNT counts.                                                                                                                                                                                                                                         |
| RINTCH (CHN)       | Message returned to the ring due to closed destination channel. When a message is sent to a closed channel in the central processor, it must be returned. If the message is a returned message, it is discarded, and the count is not pegged. Otherwise, the “returned message” control code is added to the message; source and destination addresses are swapped; the message is sent to the ring; and the count is pegged. |

**Table 5-C. Interprocess Message Switch (IMS) Measurement Descriptions  
(Contd)**

| <b>Name (Type)</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RIPTER0 (NP)       | Ring interface (hard) parity error or orphan byte condition on ring 0. This count is pegged if the parity error exists after retry (refer to the SFPTER0 count). The node does not accept the data. This usually results in a corresponding blockage report from the upstream node.                                                                                                                                                                                                                                                                                                                                                                |
| RIPTER1 (NP)       | Ring interface (hard) parity error or orphan byte condition on ring 1. Refer to the RIPTER0 description.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| RNIMN<br>(Office)  | Zero or more ring nodes isolated manually. This count is similar to the MRNIAU count except it is caused by manual action. If the most recently isolated node is isolated by manual action, the entire isolated segment is considered to be isolated manually. An isolated segment with zero nodes is possible when growing nodes. Unequipped nodes are isolated by placing the BISO and EISO nodes around the unequipped nodes. After the nodes are grown and diagnosed, ARR restores them to service and the isolated segment disappears. This count is pegged when the ring is successfully reconfigured manually, and the segment is isolated. |
| RNIMNT<br>(Office) | Duration of zero or more ring nodes isolated manually. See the RNIMN description for an explanation of zero nodes isolated. This is the cumulative time that a manually generated ring configuration exists with an isolated segment.                                                                                                                                                                                                                                                                                                                                                                                                              |
| RPCBOF<br>(RPC)    | Ring peripheral controller (RPC) buffer overflow. The message switch sends and receives messages to the ring by direct memory access channels to the RPCs. During each message switch cycle, the RPC sends messages in its buffer to the central processor. Also, the central processor sends messages to the RPC buffer. This count pegs when the message switch tries to add a message to the buffer when it is full.                                                                                                                                                                                                                            |

**Table 5-C. Interprocess Message Switch (IMS) Measurement Descriptions (Contd)**

| <b>Name (Type)</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                                          |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RRBOVFLW0 (NP)     | Number of times the ring node has transitioned to overflow state 0 (the normal, no discard state). Messages in the ring receive buffers are being processed at least as fast as they are being received. If the node is an RPC, all IMS user nodes associated with it are notified of the overflow state of the node —this is true for all overflow states. |
| RRBOVFLW1 (NP)     | Number of times the ring node has transitioned to overflow state 1. Messages are being received faster than they can be processed, and buffer occupancy has exceeded the threshold for overflow—all overflow states are associated with some threshold. In state 1, a warning of imminent overflow is sent.                                                 |
| RRBOVFLW1T (NP)    | Duration of ring receive buffer overflow state 1.                                                                                                                                                                                                                                                                                                           |
| RRBOVFLW2 (NP)     | Number of times the ring node has transitioned to overflow state 2. When an IUN (only) is in state 2, any non-IMS messages read from the ring are discarded. All IUNs are notified of their home RPC's overflow state. When the home RPC is in state 2 or 3, the IMS does not allow non-IMS messages to be written to the home RPC.                         |
| RRBOVFLW2T (NP)    | Duration of ring receive buffer overflow state 2.                                                                                                                                                                                                                                                                                                           |
| RRBOVFLW3 (NP)     | Number of times the ring node has transitioned to overflow state 3. In state 3, the node is in the "throw away" mode. In this state, both the IUNs and RPCs DMA messages read from the ring into a throwaway area of memory (effectively discarded).                                                                                                        |
| RRBOVFLW3T (NP)    | Duration of ring receive buffer overflow state 3.                                                                                                                                                                                                                                                                                                           |
| RSTTRMT (NP)       | Successful restarts without reload. This count is presently ineffective and should always be zero.                                                                                                                                                                                                                                                          |
| RTMSGSRC (IUN)     | Message received with a source address match. If a message from this node traversed the ring without being taken, the RI hardware detects a match of the source address.                                                                                                                                                                                    |

**Table 5-C. Interprocess Message Switch (IMS) Measurement Descriptions (Contd)**

| <b>Name (Type)</b>           | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RTMSGSRC<br>(IUN)<br>(Contd) | Upon matching, the message is removed from the ring. If the message is not a broadcast message, this count is pegged, and a report is sent to the central processor (see the IPSM_ description).                                                                                                                                                                                                                  |
| RTOCUMSG<br>(RPC)            | Ring peripheral controller to 3B computer IMS messages. This measurement is a cumulative count of messages received by the central processor from a specific RPC. It is similar to the CUTORMSG count.                                                                                                                                                                                                            |
| RTOCUWDS<br>(RPC)            | Ring peripheral controller to 3B computer IMS message words. Each message read from or written to the ring is composed of a number of 3B computer words. The number varies with message type and message data. It is similar to the CUTORWDS count.                                                                                                                                                               |
| SCSILNKRTY<br>(NP)           | The number of retries to send a message over the SCSI link from the SIN node to the CDRP.                                                                                                                                                                                                                                                                                                                         |
| SFPTER0 (NP)                 | Soft (transient) parity error on ring 0. This parity error is generated in the RAC while receiving data. After detecting this error, the node requests the RAC to retry the parity error check. If the parity condition is gone, this count is pegged, and the error is considered transient. If the parity condition still exists, the node considers it to be a hard parity (refer to the RIPTER0 description). |
| SFPTER1 (NP)                 | Soft (transient) parity error on ring 1. Refer to the SFPTER0 description.                                                                                                                                                                                                                                                                                                                                        |
| SRNIAU<br>(Office)           | Automatic single ring node isolation. This count is similar to the MRNIAU count. If an isolated segment has only one node that is isolated by automatic action, the segment is considered to be isolated automatically. This count is pegged whenever the ring is successfully reconfigured and the node is isolated.                                                                                             |
| SRNIAUT<br>(Office)          | Duration of automatic single ring node isolation. This is the cumulative time in which an automatically generated ring configuration exists with a single node isolated.                                                                                                                                                                                                                                          |
| TDPRCNG0<br>(NP)             | This is the time, in milliseconds, the node spent in the normal no-overload state.                                                                                                                                                                                                                                                                                                                                |

**Table 5-C. Interprocess Message Switch (IMS) Measurement Descriptions  
(Contd)**

| <b>Name (Type)</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TDPRCNG1<br>(NP)   | This is the time, in milliseconds, the node spent in the first level of overload. USER1 interrupt (link data available) operates in a clocked schedule mode for small scale integration (SSI) IUNs. The clocked schedule has the effect of reducing overhead (thus freeing real time) at the expense of increased delays. In this mode, the interrupt remains turned off except when enabled by the overload monitor control mechanism.                                                                                                                                                                                                                                                             |
| TDPRCNG2<br>(NP)   | This is the time, in milliseconds, the node spent in the second level of overload. Both USER1 and End-of-Message interrupts operate in a clocked schedule mode for SSI IUNs.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| UNRCMSGREC<br>(NP) | The number of unrecognized messages that the SIN node application received.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| WBOFN (CHN)        | New write list buffer overflow. Each IMS central processor channel that originates messages is allocated a buffer—this is the new write list—for building messages. When a message is to be built, a request is made for space in this buffer.                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| WBOFN (CHN)        | If the request exceeds the available space in the buffer—the write list overflows—this count is pegged. This is an indication that the destination RPC has not finished a previous DMA. Normally, the message switch empties the write buffer each cycle. Long new write list buffer overflow. This is the long buffer equivalent of the WBOFN count. The buffers used for the long write lists are separate from those used for the short write lists. This count is pegged if a request for space in a long buffer exceeds the available space. This is an indication that the destination RPC has not finished a previous DMA. Normally, the message switch empties the write buffer each cycle. |

**Table 5-C. Interprocess Message Switch (IMS) Measurement Descriptions  
(Contd)**

| <b>Name (Type)</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| WBOFO (CHN)        | Old write list buffer overflow. The buffers used to write old messages are the same buffers used to read messages. The messages are read, processed in place, and then written. Each channel is allocated a list of pointers to the buffers containing the messages, the old write list. When too many messages are waiting—the write list is full—this overflow count pegs. This is an indication that the destination RPC has not finished a previous DMA. Normally, the message switch empties the write buffer each cycle. |
| WDSREC (NP)        | The number of words received via the SCSI link from the CDRP to the SIN node.                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| WDSSNT (NP)        | The number of words sent via the SCSI link from the SIN to the CDRP node.                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| WRRGQ0 (NP)        | 3B computer words received from ring 0 queued. This count is the cumulative total of the number of words in all messages from ring 0 queued for any channel. Refer to the MRRGQ0 description.                                                                                                                                                                                                                                                                                                                                  |
| WRRGQ1 (NP)        | 3B computer words received from ring 1 queued. This count is the cumulative total of the number of words in all messages from ring 1 queued for any channel. Refer to the MRRGQ1 description.                                                                                                                                                                                                                                                                                                                                  |
| WSMER0 (NP)        | Write source match error on ring 0. The source address in a message being written to the ring does not match the node's address as specified in the RI hardware. Since the WSMER condition is counted against the WTFMTER count, this count should always be 0.                                                                                                                                                                                                                                                                |
| WSMER1 (NP)        | Write source match error on ring 1. Refer to the WSMER0 description.                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| WTFMTER0 (NP)      | Ring write format error on ring 0. When the token is detected in the RAC, the node begins transmitting any messages that have queued. This error is detected while attempting to write to the ring.                                                                                                                                                                                                                                                                                                                            |

**Table 5-C. Interprocess Message Switch (IMS) Measurement Descriptions (Contd)**

| <b>Name (Type)</b>       | <b>Description</b>                                                                                                                                                                                                                                                                                                           |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| WTFMTER0<br>(NP) (Contd) | If the source address in a message being written does not match the node's address as specified in the RI hardware or the message is too short to contain a valid header, it is reported to the central processor; this count is pegged, and the write is inhibited. The buffer that is being sent to the ring is discarded. |
| WTFMTER1<br>(NP)         | Ring write format error on ring 1. Refer to the WTFMTER0 description.                                                                                                                                                                                                                                                        |
| WXRG0 (NP)               | 3B computer words transmitted to ring 0. This count is incremented by the number of words Direct Memory Accessed to ring 0 as described under the MXRG0 count.                                                                                                                                                               |
| WXRG1 (NP)               | 3B computer words transmitted to ring 1. This count is incremented by the number of words Direct Memory Accessed to ring 1 as described under the MXRG1 count.                                                                                                                                                               |

**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions**

| Name (Type)      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| BYMSUR<br>(CCS7) | Message signal unit bytes received. This count, along with the BYMSUX, MGMSUR, and MGMSUX counts, provides a good measure of traffic flow on the link. A message signal unit contains CCS message data (refer to the MGMSUR count for the types of signal units). When a message signal unit is received, regardless of the message type, this count is incremented in the link interface by the length of the signal unit in bytes, not including flags between signal units.                                                                                                                                                                                                                                                               |
| BYMSUX<br>(CCS7) | Message signal unit bytes transmitted. Refer to the BYMSUR description.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| BYR (CCS7)       | Total bytes received excluding flags. Data is transmitted over CCS7 links using signal units. All signal units have one flag byte or possibly more at the end to delimit between signal units. Also, all signal units contain a header and check bits. When any level 2- or 3-type signal unit is received, these flag bytes are removed and this count is incremented in the link interface by the length of the signal unit in bytes, including header and check bits. The BYMSUR measurement is included in this measurement. Furthermore, this count includes bytes from all types of signal units (message, link status, or fill-in). Therefore, it is usually a very large value. This count does not include bytes received in error. |
| BYRX (CCS7)      | Retransmitted bytes excluding flags. Signal units are composed of varying numbers of bytes, depending on the type of signal unit and the information it contains. Only message signal units (level 3 type) are retransmitted. Should the node determine that a signal unit must be retransmitted, described under the NACR count, this count is incremented in the link interface by the number of bytes sent. This would be the number of bytes in the erroneous signal unit and any subsequent signal units not positively acknowledged, including headers and check bits.                                                                                                                                                                 |
| BYRXTE<br>(CCS7) | Threshold exceeded for BYRX. When the BYRX count has exceeded a certain value, this count pegs. It indicates too many signal units are being retransmitted.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |



**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| <b>Name (Type)</b>    | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| BYRXTE (CCS7) (Contd) | This could be due to a synchronization problem (refer to the L7FLALIGN count) or due to the far end receiving signal units in error.                                                                                                                                                                                                                                                                                                                                                                                                            |
| BYSR (CCS7)           | Non-ECIS bytes received excluding flags. Messages are transmitted over CCS7 links in message signal units. These signal units are composed of varying numbers of bytes, depending on the type of signal unit and the information it contains. Each signal unit includes a header, check bits, and at least one flag, removed by the link interface. Upon receiving a message signal unit containing data other than ECIS6, this count is incremented by the length of the signal unit in bytes. This measurement is usually a very large value. |
| BYSX (CCS7)           | Non-ECIS bytes transmitted. Refer to the BYSR description.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| BYX (CCS7)            | Total bytes transmitted excluding flags. This includes any bytes due to retransmitted messages. Note that since the BYR count does not include bytes due to signal units received in error, this count may very likely differ from the BYR count at the far end. Refer to the BYR description for more detail.                                                                                                                                                                                                                                  |
| CLF (link set)        | Link set failure. When the last available link in the set fails, this count pegs and the appropriate TFx and TCx messages are sent. This count includes the total link set failures. Refer to the CLFA, CLFB, and CLFC descriptions for specific link set failure scenarios.<br><b>Failure of a link set may result in a signaling point isolation</b> (if the combined link set has failed).                                                                                                                                                   |
| CLFA (Office)         | A-link set failure. This is a cumulative total of the CLF count for all A-link sets in the office.                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| CLFAT (Office)        | Duration of A-link set failure.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| CLFSP (Office)        | Link set failure. This is a cumulative count of all link set failures in the office. See the CLF description.                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| CLFSPT (Office)       | Duration of link set failure. This count is a cumulative duration of all link set failures in the office. See the CLFT description.                                                                                                                                                                                                                                                                                                                                                                                                             |

**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| <b>Name (Type)</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CLFT (link set)    | Duration of link set failure. This time period begins when the last link in the link set fails. The time period ends when any link in the set restores. This count indicates the total time the link set is failed.                                                                                                                                                                                                                                                                             |
| COS7CRFSRCM (CCS7) | Number of times a "CREF" message is sent due to a source match.                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| COS7DCHNOOS (CCS7) | Number of times an incoming CO-SCCP message is discarded due to the destination D-channel being OOS.                                                                                                                                                                                                                                                                                                                                                                                            |
| COS7DSDSRCM (CCS7) | Number of times a CO-SCCP message is discarded due to source match.                                                                                                                                                                                                                                                                                                                                                                                                                             |
| COS7ERRSRCM (CCS7) | Number of times an "ERROR" message is sent due to a source match.                                                                                                                                                                                                                                                                                                                                                                                                                               |
| COS7LCDINV (CCS7)  | Number of times an incoming CO-SCCP message is discarded due to an invalid or unequipped LACID.                                                                                                                                                                                                                                                                                                                                                                                                 |
| COS7RLCSRCM (CCS7) | Number of times an "RLC" message is sent due to a source match.                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| COS7UNERNA (CCS7)  | Number of times an incoming CO-SCCP message is discarded due to an unequipped ring node.                                                                                                                                                                                                                                                                                                                                                                                                        |
| CRCER (CCS7)       | Cyclic redundancy check errors (CRCER). The link interface checks for data errors in received signal units using the check bits that are part of the received signal unit. If the CRC check fails, the signal unit is discarded, this count is pegged, and a negative acknowledgment is sent. Otherwise, the signal unit is accepted and a positive acknowledgment is sent. When the rate of these errors exceeds a predetermined value, the node is notified and the link is marked as failed. |
| CRCERTE (CCS7)     | Threshold exceeded for CRCER. When the CRCER count exceeds a certain value, this count pegs. It is an indication that the data link carrier failed.                                                                                                                                                                                                                                                                                                                                             |
| DCFLABNT (CCS7)    | Cumulative duration of signaling link declared failures due to abnormal FIBR/BNSR. This count pegs in the central processor.                                                                                                                                                                                                                                                                                                                                                                    |
| DCFLHWPT (CCS7)    | Cumulative duration of signaling link declared failures due to general hardware problems. This count pegs in the central processor.                                                                                                                                                                                                                                                                                                                                                             |

**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| <b>Name (Type)</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DCFLSWPT<br>(CCS7) | Cumulative duration of signaling link declared failures due to general software problems. This count pegs in the central processor.                                                                                                                                                                                                                                                                            |
| DCFLXDAT<br>(CCS7) | Cumulative duration of signaling link declared failures due to excessive delay of acknowledgment. This count pegs in the central processor.                                                                                                                                                                                                                                                                    |
| DCFLXDCT<br>(CCS7) | Cumulative duration of signaling link declared failures due to excessive duration of congestion. This count pegs in the central processor.                                                                                                                                                                                                                                                                     |
| DCFLXERT<br>(CCS7) | Cumulative duration of signaling link declared failures due to excessive error rate. This count pegs in the central processor.                                                                                                                                                                                                                                                                                 |
| DRP7MSG1<br>(CCS7) | Number of priority level 1 messages dropped due to RPC congestion. The node examines the service information octet field in the message to determine its priority before sending it on the ring. Except for ECIS6 messages (see the DRPEMSG_ descriptions) this count is the cumulative total of all messages discarded due to level 1 RPC congestion. The DRP6MSG1 description explains the discard strategy. |
| DRP7MSG2<br>(CCS7) | Number of priority level 2 messages dropped due to RPC congestion. This count is similar to the DRP7MSG1 count (refer to that description) and is the cumulative total of all messages discarded due to level 2 RPC congestion.                                                                                                                                                                                |
| DRP7MSG3<br>(CCS7) | Number of priority level 3 messages dropped due to RPC congestion. This count is similar to the DRP7MSG1 count (refer to that description) and is the cumulative total of all messages discarded due to level 3 RPC congestion.                                                                                                                                                                                |
| DRPEMSG1<br>(CCS7) | Number of priority level 1 ECIS6 messages dropped due to RPC congestion. This count pegs for any ECIS6 message discarded due to level 1 RPC congestion; the mechanism is similar to that for the DRP7MSG1 count. Note that the DRPEMSG_ counts are not included in the DRP7MSG_ counts.                                                                                                                        |

**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| <b>Name (Type)</b>   | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DRPEMSG2<br>(CCS7)   | Number of priority level 2 ECIS6 messages dropped due to RPC congestion. This count is similar to the DRPEMSG1 count (refer to that description) and is the cumulative total of all messages discarded due to level 2 RPC congestion.                                                                                                                                                             |
| DRPEMSG3<br>(CCS7)   | Number of priority level 3 ECIS6 messages dropped due to RPC congestion. This count is similar to the DRPEMSG1 count (refer to that description) and is the cumulative total of all messages discarded due to level 3 RPC congestion.                                                                                                                                                             |
| ERSEC (CCS7)         | Number of 1-second intervals with at least one error. Each second, the link interface determines if any signal units have been received in error (counted by the CRCER measurement). If there have been signal unit errors, this count pegs. It is not a count of the number of errors that occurred. This measurement is an indicator of long-term performance of the link.                      |
| ERSECTE<br>(CCS7)    | Threshold exceeded for ERSEC. When the ERSEC count has exceeded a certain value, this count pegs. The error is an indication of facility performance degradation.                                                                                                                                                                                                                                 |
| FORRX<br>(CCS7)      | The link experienced a forced retransmit cycle. When the far end indicated received errors, the affected messages are retransmitted and this count pegs in the link interface (LI). A large number of forced retransmit cycles could cause transmit buffer congestion and discarding of messages. This count indicates there are high queuing delays which could cause a reduction in throughput. |
| FORRXBY<br>(CCS7)    | Bytes retransmitted during forced retransmit mode. This count is pegged in the link interface (LI) and is the cumulative total of bytes transmitted during forced retransmit cycles.                                                                                                                                                                                                              |
| GTTPERFD<br>(Office) | Total number of CCS7 global title translations performed by the SCCP in the central processor.                                                                                                                                                                                                                                                                                                    |
| GTTUNBC<br>(Office)  | Global title translation could not be performed due to congestion.                                                                                                                                                                                                                                                                                                                                |

**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| <b>Name (Type)</b>  | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| GTTUNBT<br>(OFF)    | Unable to perform Global Title Translation on message received from the local network due to no translation for address of such nature. This is also referred to as GTT failure diagnostic 0. This is the total number of GTTs for the local NID that failed due to no translation table being assigned for the specified global title (GT) type. The sum of this count and the GTTUNTT count is the total number of such failures for the office.                                                                                                                                                                                                                                                                                                                |
| GTTUNNT<br>(Office) | Global title translation could not be performed due to congestion.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| LINKDLAY<br>(LN7)   | <p>This is the average link output delay, measured in milliseconds, for sampled MSUs. This is calculated during report generation with the following algorithm.</p> <p><b>LINKDLAY = N*W*</b> (byte emission time)</p> <p>Where:</p> <p><b>N</b> is a multiplication factor to adjust the header bytes on the link in comparison with the header bytes waiting in the link transmission buffer.</p> <p><b>N = (average message length + 7) / (average message length +5)</b></p> <p><b>W</b> is the average number of message bytes waiting in the link transmit buffer determined by the following:</p> <p><b>W = cumbyt / MSUSAMPL</b></p> <p>Byte emission time is 0.143 milliseconds, the time required to transmit all bits of a byte on a 56 kbps link.</p> |
| L6MGRV_<br>(CCS7)   | ECIS6 messages received on virtual link. Since ECIS messages are the only banded messages received on a CCS7 link, this is the total count of all banded messages received for the indicated virtual link. These messages are not included in the total CCS7 messages received (the L7MGSR count). This count includes initial address (MGIAMRV_) and answer (MGANSRV_) messages. Refer to the L6MGR count also.                                                                                                                                                                                                                                                                                                                                                  |

**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| Name (Type)        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| L6MGXV_<br>(CCS7)  | ECIS6 messages transmitted on virtual link. Since ECIS messages are the only banded messages transmitted on a CCS7 link, this count is the total of all banded messages transmitted for the indicated virtual link. It includes the MGIAMX_ and the MGANSX_ counts. See also the L6MGX description.                                                                                                                                                                                                                                                                                                                                                                     |
| L6SUPRV_<br>(CCS7) | Telephone message signal units received on virtual link. Since ECIS messages are the only banded messages received on a CCS7 link, this is the total count of all signal units involved in banded messages received for the indicated virtual link. This count does not include SYNC, ACU, or PRO signal units.                                                                                                                                                                                                                                                                                                                                                         |
| L6SUPXV_<br>(CCS7) | Telephone message signal units transmitted on virtual link. Since ECIS messages are the only banded messages transmitted on a CCS7 link, this is the total count of all signal units involved in banded messages transmitted for the indicated virtual link. This count does not include SYNC, ACU, or PRO signal units.                                                                                                                                                                                                                                                                                                                                                |
| L7ACO (CCS7)       | Automatic changeover. This is the sum of near-end (L7ACONE) and far-end (L7ACOFE) changeovers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| L7ACOTE<br>(CCS7)  | Automatic changeover threshold exceeded. When the L7ACO count has exceeded a certain value, this count pegs. The link is experiencing excessive errors causing repeated changeovers to another link.                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| L7ACOFE<br>(CCS7)  | Automatic changeover (COV) initiated by the far end (changeover order has been received). A COV involves transferring signaling messages from the unavailable link to other links (any links in the combined link set or C-links). A C-link COV causes messages to be load balanced between any other available C-links. Both the changeover order and acknowledgment are sent on another link in the specified link's set. When the order is received from the far end, this count pegs and either a COV or emergency COV is initiated. The latter is used when the node is OOS, or the far end indicates out of sequence messages. The following is the COV sequence: |

**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| Name (Type)                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| L7ACOFE<br>(CCS7)<br>(Contd) | <p>(1) The link is removed from service and no new messages are given to the node—message handling pauses.</p> <p>(2) Messages remaining in the transmit/retransmit buffers are retrieved and sent in sequence on other links. An emergency COV does not attempt to retrieve messages from the retransmit buffer. Furthermore, if the link node is OOS, the link failed due to near-end PRO, or the far end is blocked by the failure, no messages are retrieved.</p> <p>(3) Message handling resumes with new messages sent to the other links and only synchronization signal units sent on this link.</p> <p>If the COV is automatic, the link changes back when synchronism is restored. If the link cannot sync and change back within 3 minutes, 10 minutes if a long key exchange is involved, it is declared failed (the L7FLD count pegs).</p> |
| L7ACONE<br>(CCS7)            | Automatic changeovers initiated at the near end. This occurs usually due to excessive errors on the link. If all links in the combined link set are OOS or the C-links are unable to handle the additional load, an EMR occurs and changeover is denied. If allowed, this count pegs and either a changeover or emergency changeover is initiated. The sequence is described under the L7ACOFE measurement. The sequence indicated is followed; except, a changeover order is sent to the far end rather than being received. Furthermore, all acknowledgments must be received before starting the changeover.                                                                                                                                                                                                                                         |
| L7AFLT (CCS7)                | Duration of automatic link out of service including duration of declared failure. Refer to the L6AFLT description.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| <b>Name (Type)</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| L7BADRTG (CCS7)    | Message signal units (MSUs) discarded due to bad or no routing data. If the translation for a received DCIS6 message (that is, an SCCP class 0 message) fails due to no translation data, it is discarded in the incoming node; count is pegged; and a UDS message is returned to the originator. If a received non-DCIS6 message has a destination point code related to an outgoing CCIS 6 pool, it is discarded in the incoming node; count is pegged. Refer to the MRSNTO7 count for the total number of DCIS6 messages discarded in the central processor due to translation failure. |
| L7BOFR (CCS7)      | The receive buffer in a CCS7 link node overflows. Refer to the L6BOFR description.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| L7BOFRT (CCS7)     | Duration of the receive buffer overflow. This timer pegs in the link interface. Refer to the L6BOFRT description.                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| L7BOLR (CCS7)      | The receive buffer in a CCS7 link node overloads. Refer to the L6BOLR count for a description of buffer overload. No messages are discarded in the overload state. When overload occurs, the link interface stops transmitting positive acknowledgments to the far end until the congestion abates. The far end responds by limiting traffic to the near end.                                                                                                                                                                                                                              |
| L7BOLRT (CCS7)     | Duration of the receive buffer overload. This timer pegs in the link interface. Refer to the L6BOLRT description.                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| L7BYTO3B (CCS7)    | The CCS7 message bytes sent to 3B computer. This count is incremented by the size of the message when it is sent to the central processor. See the L6BYTO3B description.                                                                                                                                                                                                                                                                                                                                                                                                                   |
| L7DIF (CCS7)       | CNI CCS7 data integrity flag. Refer to the L6DIF description.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| L7EMR (CCS7)       | Emergency restart due to local failure. This count pegs only if there are virtual links assigned to the indicated CCS7 link. Refer to the EMR description.                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| L7EMRPO (CCS7)     | Emergency restart due to far-end processor outage. This count pegs only if there are virtual links assigned to the indicated CCS7 link. Refer to the EMRPO description.                                                                                                                                                                                                                                                                                                                                                                                                                    |



**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| <b>Name (Type)</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| L7EMRPOT (CCS7)    | Duration of emergency restart due to far-end processor outage.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| L7EMRT (CCS7)      | Duration of emergency restart due to local failure.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| L7FLALIGN (CCS7)   | Alignment failure. This count indicates the number of signal units received in error during the initial alignment procedure. This procedure is the first part of the level 2 protocol and is done once whenever a link is restored. When a link is out of alignment (a flag is detected within a signal unit where it is not expected), the link is sending only status signal units indicating that fact. Once alignment is achieved, the link begins a prove-in period. During the prove-in, the error rate monitor counts signal units received in error. Once prove-in is complete, the link is ready and traffic may start. The link interface now reports the error rate, and the value is accumulated into this count.                                                      |
| L7FLD (CCS7)       | Declared link failure. A declared failure could be due to a 1-minute continuous buffer overload, a sanity check failure, a 30-second far-end processor congestion, or a changeover lasting more than 3 minutes (10 minutes if a long key exchange is involved). The changeover could be due to far-end request or because errors exceeded the threshold for changeover. This count pegs and the appropriate Tfx or TCx messages are broadcast. The link is diagnosed (if the failure is due to a far-end PRO, diagnostics wait until the outage ends). This failure could also cause the combined link set to fail; refer to the CLF measurement in this case. Some of the actions leading to declared failure are described in the L7BOLR, L7ACOF, L7PCR, and CRCER descriptions. |
| L7FLDT (CCS7)      | Duration of declared link failure (L6FLDT description).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| L7LCDIS1X (CCS7)   | Level 1 transmit buffer congestion discard. This count is the number of times the transmit buffer occupancy reached the indicated threshold for message discard. Selected messages are being discarded by the strategy under the MSURMV measurement.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| <b>Name (Type)</b>             | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| L7LCDIS1X<br>(CCS7)<br>(Contd) | Note that since the corresponding onset level has been reached, far-end signaling points are also discarding messages according to that strategy due to receipt of transfer controlled messages. This count does not peg again at least until occupancy drops below the corresponding abatement threshold.                                                                                                                                                                                                                                                                                                                                                                    |
| L7LCDIS1XT<br>(CCS7)           | Duration of level 1 congestion discard, end at abatement.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| L7LCDIS2X<br>(CCS7)            | Level 2 transmit buffer congestion discard. This is the next higher discard level from discard level 1. Refer to the L7LCDIS1X measurement for a description of actions taken.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| L7LCDIS2XT<br>(CCS7)           | Duration of level 2 congestion discard, end at abatement.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| L7LCDIS3X<br>(CCS7)            | Level 3 transmit buffer congestion discard. This is the next higher discard level from discard level 2 and is currently the highest discard level possible. Refer to the L7LCDIS1X measurement for a description of actions taken.                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| L7LCDIS3XT<br>(CCS7)           | Duration of level 3 congestion discard, end at abatement.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| L7LCON1X<br>(CCS7)             | Level 1 transmit buffer congestion onset. This count is the number of times the transmit buffer occupancy reached the indicated threshold for congestion. The congestion level is higher than the corresponding abatement level but lower than the corresponding discard level. At each onset level, the node reports the congestion state to the central processor. Network management messages (transfer controlled) are then broadcast to adjacent signaling points to limit messages to the affected node. To avoid further congestion of the transmit buffer, the far end initiates the discard strategy used by nodes at the discard level. See the MSURMV measurement. |

**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| <b>Name (Type)</b>  | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| L7LCON1XT<br>(CCS7) | Duration of level 1 congestion onset, end at abatement. This time period includes levels 2 and 3 also. If the node remains in the same congestion level (1, 2, or 3) for 60 seconds, it is taken OOS and diagnosed. However, since the duration timers for each level are cumulative, they may exceed this 60-second limit.                                                           |
| L7LCON2X<br>(CCS7)  | Level 2 transmit buffer congestion onset. Messages are being discarded according to the level 1 strategy. The node reports the level 2 congestion state to the central processor. Actions are taken as described under the L7LCON1X measurement.                                                                                                                                      |
| L7LCON2XT<br>(CCS7) | Duration of level 2 congestion onset, end at abatement. This time period includes level 3 also.                                                                                                                                                                                                                                                                                       |
| L7LCON3X<br>(CCS7)  | Level 3 transmit buffer congestion onset. Messages are being discarded according to the level 2 strategy. The node reports the level 3 congestion state to the central processor. Actions are taken as described under the L7LCON1X measurement.                                                                                                                                      |
| L7LCON3XT<br>(CCS7) | Duration of level 3 congestion onset, end at abatement.                                                                                                                                                                                                                                                                                                                               |
| L7LNKACTT<br>(LN7)  | Signaling link active time. This time starts when the link restores to service and stops when the link fails or is moved to the MOOS state. This count pegs in the central processor.                                                                                                                                                                                                 |
| L7MCOFE<br>(CCS7)   | Far-end manual changeover request has been received, usually due to a need for link changes or maintenance. The far end has requested and permission has been granted to initiate a changeover. Either a changeover or emergency changeover is initiated. The sequence is described under the L7ACOFE description.                                                                    |
| L7MCONE<br>(CCS7)   | Near-end manual changeover due to local maintenance action. The changeover could be denied if removing the link from service would cause the far end to become inaccessible. This end requests permission from the far end to initiate a changeover (the far end pegs the L7MCOFE count). If the far end grants permission, either a changeover or emergency changeover is initiated. |

**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| <b>Name (Type)</b>           | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| L7MCONE<br>(CCS7)<br>(Contd) | The sequence is described under the L7ACOFE description. The sequence indicated is followed; except, a changeover request is sent to the far end rather than being received. Furthermore, all acknowledgments must be received before starting the changeover.                                                                                                                                                                                                                                                                                                                                                         |
| L7MFLT<br>(CCS7)             | Duration of manual link out of service. Refer to the L6MFLT description.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| L7MGSR<br>(CCS7)             | Non-ECIS6 messages received. This count includes only SCCP and network management messages ECIS6 messages are pegged by the L6MGRV_ counts. The count pegs in the node when the message is received from the link interface.                                                                                                                                                                                                                                                                                                                                                                                           |
| L7MG SX<br>(CCS7)            | Non-ECIS6 messages transmitted. Refer to the L7MGSR description.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| L7MRPBC<br>(CCS7)            | ECIS6 message rejected due to congestion. Banded messages are transmitted on CCS7 links using ECIS6. This count is a cumulative total for all virtual links assigned to the indicated link. Refer to L6MRPBC.                                                                                                                                                                                                                                                                                                                                                                                                          |
| L7MRPNT<br>(CCS7)            | ECIS6 message rejected due to no translation data. Banded messages are transmitted on CCS7 links using ECIS6. This count is a cumulative total for all virtual links assigned to the indicated link. Refer to the L6MRPNT description.                                                                                                                                                                                                                                                                                                                                                                                 |
| L7MSINVSIO<br>(LN7)          | Message signal units (MSUs) discarded due to invalid Service Indicator Octet (SIO). This measurement is also counted per office as the sum of this measurement for all CCS7 links.                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| L7POR (CCS7)                 | Far-end processor outage occurred. This count is not the number of PRO signal units received but a count of the number of processor outage events recognized by the specified link. When the far-end office sends the message, it indicates that office is undergoing initialization or is overloaded. The far-end link interface is in the processor outage send mode (see the L7POX description). The problem is treated as a link failure. Only fill-in signal units are transmitted and a changeover is initiated. This count pegs once when the first PRO is received and not again at least until the PROs stop. |

**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| <b>Name (Type)</b>  | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| L7PORT<br>(CCS7)    | Duration of far-end processor outage.                                                                                                                                                                                                                                                                                                                                                                                                                  |
| L7POX (CCS7)        | Link interface in processor outage send mode. This is similar to the PRO send mode for a CCIS 6 link (see the L6POX measurement); except, a continuous stream of link status signal units are sent instead of PRO signal units. These link status signal units indicate the processor outage condition.                                                                                                                                                |
| L7POXT<br>(CCS7)    | Duration of processor outage in effect. This timer pegs in the link interface.                                                                                                                                                                                                                                                                                                                                                                         |
| L7RBFOC<br>(CCS7)   | Average receive buffer length in bytes (usually is very small). This is the average occupancy of the buffer. This measurement is obtained by periodically checking buffer length, cumulating the number of bytes used, and then dividing by the number of times the length is checked. Since this is a measure of how long messages are staying in the buffer, it is a relative measure of the load on the link. The count pegs in the link interface. |
| L7RTGAUD<br>(CCS7)  | Routing audit failure. This is an automatic audit that checks consistency of the pool to point code table. The data for two pools is checked every 10 seconds. The active 3B computer data is checked first. If errors are found, an output message is generated and the errors corrected. Next, the data is checked in all CCS7 nodes. When the pool to point code audit finds errors in the node, they are corrected and this count pegs.            |
| L7THRSWMSU<br>(LN7) | Through-switched message-signal units (MSUs). This is the number of MSUs received by the node in which the destination address does not specify this signaling point. This is the case for most non-global title routed messages and should be very close to the MGMSUR count. The sum of this count and the L7TRMDMSUS count should equal the MGMSUR count.                                                                                           |
| L7TRMDMSUS<br>(LN7) | Terminated message signal units (MSUs). This is the number of MSUs received by the node in which the destination address specifies this signaling point.                                                                                                                                                                                                                                                                                               |

**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| <b>Name (Type)</b>             | <b>Description</b>                                                                                                                                                                                                                                                                                                          |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| L7TRMDMSUS<br>(LN7)<br>(Contd) | One example of this type of message would be a global title message requiring global title translation. This count normally has a very small value.                                                                                                                                                                         |
| L7TRMSUOCT<br>(LN7)            | Terminated MSU octets (refer to the L7TRMDMSUS count for more details). This count is incremented by the length of the MSU in bytes (including header and check bits). It should be noted that the headers on messages counted by this measurement are 8 bytes longer than the headers on messages counted in the LI.       |
| L7TSMSUOCT<br>(LN7)            | Through-switched MSU octets (refer to the L7THRSWMSU count for more details). This count is incremented by the length of the MSU in bytes (including header and check bits). It should be noted that the headers on messages counted by this measurement are 8 bytes longer than the headers on messages counted in the LI. |
| L7XBFOCK<br>(CCS7)             | Number of transmit buffer visits by the link interface. This is the number of times the link interface checked buffer occupancy in order to calculate the L7XBFOC and L7RBFOC counts. This count pegs in the link interface.                                                                                                |
| L7XBFOC<br>(CCS7)              | Average transmit buffer length in bytes (usually is zero). Refer to the L6XBFOC description.                                                                                                                                                                                                                                |
| MGANSRV_<br>(CCS7)             | Answer messages received on virtual link. This is the total count of all answer messages received for the indicated virtual link. Refer to the MGANSR description.                                                                                                                                                          |
| MGANSXV_<br>(CCS7)             | Answer messages transmitted on virtual link. This is the total count of all answer messages transmitted for the indicated virtual link. Refer to the MGANSX description.                                                                                                                                                    |
| MGIAMRV_<br>(CCS7)             | Initial address messages received on virtual link. This is the total count of all IAM messages received for the indicated virtual link. Refer to the MGIAMR description.                                                                                                                                                    |
| MGIAMXV_<br>(CCS7)             | Initial address messages transmitted on virtual link. This is the total count of all IAM messages transmitted for the indicated virtual link. Refer to the MGIAMX description.                                                                                                                                              |
| MGMSUR<br>(CCS7)               | Message signal units received. Data is transmitted over CCS7 links using three types of signal units:                                                                                                                                                                                                                       |

**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| <b>Name (Type)</b>          | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MGMSUR<br>(CCS7)<br>(Contd) | <p>Level 3 - Message signal units containing CCS message information; these are passed to/from the node.</p> <p>Level 2 - Link status signal units (indicating such things as alignment status, out of service, or PRO send mode)</p> <p>Level 2 - Fill-in signal units (used for alignment control during link recovery).</p> <p>This count is pegged in the link interface when a level 3 type signal unit is received. It is essentially a count of all CCS7 CCS traffic messages. It includes ECIS6 messages, SCCP messages, and network management messages. This count, along with MGMSUX, BYMSUR, and BYMSUX provides a good measure of traffic flow on the link.</p> |
| MGMSUX<br>(CCS7)            | Message signal units transmitted. When a message signal unit is transmitted, this count is pegged in the link interface. Refer to the MGMSUR description.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| MRBADRTG<br>(office)        | Message signal units (MSUs) discarded due to routing data error (no routing data). This count is a cumulative total for all CCS7 MSUs handled by the SCCP in the central processor.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| MRSBCO7<br>(Office)         | The Destination routed CCIS6 (DCIS6) message rejected due to congestion. Direct signaling (DS) messages are transmitted on CCS7 links using DCIS6. If the transmit buffer of the outgoing link is congested or the far end of that link is sending processor congestion messages, the DS message is discarded; this count is pegged in the central processor; and a UDS message is returned to the originator (see MRSBCO6).                                                                                                                                                                                                                                                 |
| MRSNT07<br>(Office)         | The DCIS6 message rejected due to no translation data. Direct signaling messages are transmitted on CCS7 links using DCIS6. If the translation for a DCIS6 message fails, it is blocked. The message is discarded, this count is pegged in the central processor, and a UDS message is returned to the originator.                                                                                                                                                                                                                                                                                                                                                           |

**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| Name (Type)                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MSG7LOOP<br>(CCS7)           | <p>The CCS7 messages “looped” in the network. Before a CCS7 message is transmitted, a check is made for a looping message. Looping usually occurs when:</p> <ol style="list-style-type: none"> <li>(1) The message is blocked at some other node (see the MRSBCO7 and MRSNTO7 counts) and must be returned to this node to be sent to the origination.</li> <li>(2) The normal outgoing route is blocked and the message must be rerouted.</li> </ol> <p>If the outgoing link set for the message, is a direct or combined link set containing the incoming link and the message is a UDS type, it is looping. This count is pegged, and the message is not sent. Furthermore, if the incoming link is a C-link, a TFP or TCP response is returned on the incoming link.</p>                                                                                                                                                                                                             |
| MSINVSIO<br>(CCS7 or Office) | <p>Message signal units (MSUs) discarded due to invalid Service Indicator Octet (SIO). This measurement is also counted per office as the sum of this measurement for all CCS7 links.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| MSUDISC_<br>(CCS7)           | <p>Messages removed due to link congestion. The CCS7 discard strategy (for level 1, 2, or 3) is described as follows:</p> <p>The node first checks the priority of a message before transmitting it. The priority is contained in the service information octet field and is compared with the congestion state of the transmit buffer. Refer to the L7LCDIS_X measurement description. If the priority is less than the congestion level, the message is removed; the corresponding count pegs, and a return message may be sent. Priority 0 messages peg MSUDISCO, priority 1 messages peg MSUDISC1, and priority 2 messages peg MSUDISC2. The return message is sent only if the received message is not a UDS type. If the message to be transmitted is a unit data type SCCP message, a UDS message is created and returned to the originator. If the priority of the message is equal to or greater than the congestion level, it is transmitted and this count is not pegged.</p> |



**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| Name (Type)   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MSUSAMPL (LN) | <p>This is the number of message signal units (MSUs) sampled for link output delay. Link output delay is the interval beginning when the message has been placed in the outgoing signaling link transmission buffer and ending when the last bit of the message has been transmitted on the outgoing signaling link.</p> <p>During each 10-second time interval, every SS7 link node samples the first outgoing MSU at the time it is placed in the link interface (LI) transmit buffer. If an MSU is not transmitted during the interval, no action is taken. A 10-second interval, where no sample is taken is counted as 0; otherwise, the interval is counted as 1. The collected 5-minute value is always 30 or less.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| NACR (CCS7)   | <p>Negative acknowledgment (ACU) "event" occurred. Upon receiving a negative ACU, this count is pegged once for the first signal unit that must be queued for retransmission and not again until the event ends. If subsequent signal units must be queued for retransmission—for example, due to a sequence error—this count is not pegged. Once sequencing is correct, the event has ended. The basic error correction method in CCS7 involves both positive and negative acknowledgments. Each signal unit has a forward sequence number and indicator and a backward sequence number and indicator in its header. The backward sequence number and indicator in a received signal unit is compared with the forward sequence number and indicator in a previously transmitted signal unit to determine whether a positive or negative ACU is being indicated by the far end. Each received signal unit normally, positively acknowledges the previously transmitted signal unit; this occurs at both ends of a link. Any signal units not positively acknowledged are queued for retransmission. A positive ACU, received for any transmitted signal unit, positively acknowledges all previously transmitted signal units. Conversely, a negatively-acknowledged signal unit is retransmitted along with any previously transmitted signal units not yet positively acknowledged.</p> |

**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| Name (Type)     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NACRTE (LN7)    | Number of hourly thresholds exceeded for negative acknowledgements received. This count pegs in the central processor.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| NOCMG (Office)  | The number of times the system entered a state in which it could not process CCS messages. The basis of this measurement is an internal timer which records the current time once each second, as long as messages are being processed. When an inability to process messages is detected, the timer stops and a flag is set indicating the "no message processing state." When the problem clears, the timer starts and the elapsed time is calculated. The flag is reset and this count is incremented.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| NOCMGT (Office) | The accumulated time (in seconds) during which no messages could be processed. See the NOCMG measurement for a description.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| OCCUPMSU (LN7)  | <p>This is the link transmission buffer average occupancy based on 10-second scans. Occupancy is defined as the buffer contents measured in MSUs immediately before a sample MSU is placed in the buffer for transmission on the link. At the time of sampling, the LI transmit buffer content (cotb) is measured in bytes and added to the cumulative byte total (cumbyt) to be reset every 5 minutes. The average occupancy, measured in MSUs, is obtained by dividing the cumulative byte total by the number of MSUs sampled (MSUSAMPL) and by the average message length. The average message length is calculated by dividing the bytes transmitted (BYMSUX) by the MSUs transmitted (MGMSUX) during a standard measurement interval. The reported average occupancy is rounded off to the nearest larger integer.</p> <p style="text-align: center;"><b>OCCUPMSU = cumbyt / MSUSAMPL *<br/>(average message length)</b></p> <p>Where:</p> <p style="text-align: center;"><b>Average message length = BYMSUX / MGMSUX</b></p> |

**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| <b>Name (Type)</b>     | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RABT<br>(CCS7)         | Number of abort events received on the link. When an abort event, also called an octet counting event, is indicated by receiving more than seven consecutive "1" bits, this count is pegged in the link interface (LI). This condition is caused by either hardware and/or software problems or T1 digital facility resynchronization.                                                                                                                                                                                                                                                  |
| RABTER<br>(CCS7)       | Number of octets received in error during abort events. Errors detected during abort events are included in the signal unit error rate monitor. This count is the cumulative total of these errors and is pegged in the link interface. The average burst size of facility failures is this count divided by the received abort (RABT) count.                                                                                                                                                                                                                                           |
| RTESETUN<br>(Cluster)  | Route set unavailable. The application uses a specific set of routes to send messages to a specific cluster of destinations. Availability of the route set is determined by the availability of the link sets along the path to the cluster. Failure of any link set could result in one or more members becoming inaccessible to this office. This count is pegged whenever a member of the indicated cluster becomes inaccessible due to route set unavailability. This count is the total number of times a member became inaccessible, but does not indicate current accessibility. |
| RTESETUNT<br>(Cluster) | Duration of route set unavailable. This is not the cumulative duration of each member's inaccessibility. Rather it is the total time during which any member in the indicated cluster is inaccessible; individual events could overlap.                                                                                                                                                                                                                                                                                                                                                 |
| RTGAUDFL<br>(Office)   | Routing audit failure. This is the total number of times the routing audit failed for any node in the office See the L7RTGAUD description.                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| SC7R (CCS7)            | Signaling connection control part (SCCP) message received. This is the total number of messages received by the SCCP in the node. These messages may be global title routed or point code routed and some may be sent to the central processor for handling.                                                                                                                                                                                                                                                                                                                            |

**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| <b>Name (Type)</b>     | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SC7R (CCS7)<br>(Contd) | This count includes messages destined for this point code (the SC7RLNN count) or destined for some other point code, not counted presently. It is pegged in the node when the message is received from the network.                                                                                                                                                                             |
| SC7RERPRO (CCS7)       | SCCP message destined for a prohibited subsystem. The prohibited subsystem may be either local or distant. This is the total number of messages received by SCCP in the node destined for a prohibited subsystem. The count is pegged in the node when the message is received from the network.                                                                                                |
| SC7RERUA (CCS7)        | SCCP message destined for an unknown address or global title. SCCP global title routed messages are destined for the central processor for global title translation. This is the total number of messages received by SCCP in the node destined for an unknown address. The count is pegged in the node when the message is received from the network. See the SCRERUA description.             |
| SC7RERUATY (CCS7)      | SCCP message destined for an unknown address or global title type. SCCP global title routed messages are destined for the central processor for global title translation. This is the total number of messages received by SCCP in the node destined for an unknown address type. The count is pegged in the node when the message is received from the network. See the SCRERUATY description. |
| SC7RERUNE (CCS7)       | SCCP message destined for an unequipped subsystem. This is the total number of messages received by SCCP in the node destined for an unequipped subsystem. The count is pegged in the node when the message is received from the network.                                                                                                                                                       |
| SC7RGTR (CCS7)         | SCCP message destined for global title routing. This is the total number of messages received by SCCP in the node using global title routing (for example, DCIS6 messages). A global title is either a function number or an NPA-NXX. The count is pegged in the node when the message is received from the network.                                                                            |

**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| <b>Name (Type)</b>   | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SC7RLNN<br>(CCS7)    | SCCP message destined for the local network node. This is the total number of messages received by SCCP in the node destined for this point code. The count is pegged in the node when the message is received from the network.                                                                                                                                                                                                                           |
| SC7RLSS<br>(CCS7)    | SCCP messages destined for an equipped local subsystem. This is the total number of messages received by SCCP in the node destined for an equipped local subsystem. The destination PC is a subsystem at this node. It is pegged in the node when the message is received from the network.                                                                                                                                                                |
| SC7RNATL<br>(CCS7)   | Messages discarded due to a blocked point code. When any message destined for an inaccessible signaling point is received, it is discarded and this count is pegged in the incoming node. This count is cumulative for all point codes.                                                                                                                                                                                                                    |
| SC7UDSX<br>(CCS7)    | Unit data service (UDS) message transmitted in response to a unit data message type failure. When a unit data message is received by SCCP in the node, a UDS may be sent to the originator. If SCCP cannot deliver a message to its destination for one of the defined UDS reasons and the message indicates a UDS message should be returned, the UDS is formatted and returned to the originator. This count is pegged in the node when the UDS is sent. |
| SCR<br>(Office)      | Signaling connection control part (SCCP) message received. This is the total number of messages received by SCCP in the central processor. These messages may be global title routed or point code routed. This count includes messages destined for this point code, the SCRLNN count, or destined for some other point code, presently no count. It is pegged when the message is received by the central processor.                                     |
| SCRERPRO<br>(Office) | The SCCP message destined for a prohibited subsystem. The prohibited subsystem may be either a local or a distant subsystem.                                                                                                                                                                                                                                                                                                                               |

**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| Name (Type)                     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SCRERPRO<br>(Office)<br>(Contd) | This is the total number of locally originated SCCP messages received by message handling in the central processor destined for a prohibited subsystem. The count is pegged when the message is received by message handling in the central processor.                                                                                                                                                                                                                                                                                                                                                                                              |
| SCRERUA<br>(Office)             | The SCCP message destined for an unknown address. A locally originated SCCP global title routed message can be translated to a DPC (called global title translation). Should the application be unable to translate the global title in the received message (that is, the address is unknown), this count is pegged and a UDS message may be returned. This count is not to be confused with the SCRERUATY measurement. While this count indicates the number of messages that failed global title translation due to no translation data, the latter is a count of messages received for translation of a global title type that is not provided. |
| SCRERUATY<br>(Office)           | The SCCP message destined for an unknown address type. Should the application not provide the capability to translate the global title type in the received message, the message handler pegs this count. This count is the total number of locally originated SCCP messages received by message handling in the central processor that are destined for global title translation of an unknown or, more specifically, a nonprovided address type. See the SCRERUA description.                                                                                                                                                                     |
| SCRERUNE<br>(Office)            | The SCCP message destined for an unequipped subsystem. This is the total number of locally originated SCCP messages received by message handling in the central processor which are destined for a subsystem that is currently unequipped. The count is pegged when the message is received by message handling in the central processor.                                                                                                                                                                                                                                                                                                           |
| SCRGTR<br>(Office)              | The SCCP message destined for global title routing. This is the total number of messages received by the SCCP in the central processor using global title routing (for example, DCIS6 messages). A global title is either a function number or an NPA-NXX.                                                                                                                                                                                                                                                                                                                                                                                          |

**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| <b>Name (Type)</b>         | <b>Description</b>                                                                                                                                                                                                                                                                                                                         |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SCRGTR<br>[Office (Contd)] | The count is pegged when the message is received by message handling in the central processor.                                                                                                                                                                                                                                             |
| SCRLNN<br>(Office)         | The SCCP message destined for the local network node. This is the total number of messages received by the SCCP in the central processor destined for this point code. The count is pegged when the message is received by message handling.                                                                                               |
| SCRLSS<br>(Office)         | The SCCP message destined for an equipped local subsystem. This is the total number of locally originated SCCP messages received by message handling in the central processor which are destined for a local subsystem that is equipped. The count is pegged when the message is distributed by message handling in the central processor. |
| SCRNATL<br>(Office)        | This count is currently ineffective—it is always zero.                                                                                                                                                                                                                                                                                     |
| SCSRTR<br>(Office)         | Subsystem routing test message received. This is the total number of such messages received by the SCCP. When the message is received by the central processor, this count is pegged.                                                                                                                                                      |
| SCSRTX<br>(Office)         | Subsystem routing test message transmitted. This is the total number of such messages transmitted by the SCCP. When the message is sent by the central processor, this count is pegged.                                                                                                                                                    |
| SCSSTR<br>(Office)         | Subsystem status test message received. This is the total number of such messages received by the SCCP. When the message is received by the central processor, this count is pegged.                                                                                                                                                       |
| SCSSTX<br>(Office)         | Subsystem status test message transmitted. This is the total number of such messages transmitted by the SCCP. When the message is sent by the central processor, this count is pegged.                                                                                                                                                     |
| SCUDSX<br>(Office)         | A Unit data service (UDS) message is transmitted in response to a unit data message type failure. When a locally originated unit data message is received by message handling in the central processor, a UDS message may be sent to the originator.                                                                                       |

**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| <b>Name (Type)</b>            | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SCUDSX<br>(Office)<br>(Contd) | If the SCCP cannot deliver the message to its destination for one of the defined UDS reasons and the message indicates a UDS message should be returned, the UDS is formatted and returned to the originator. This count is pegged when the UDS message is sent by message handling in the central processor.                                                                                                                                     |
| SEVERSEC<br>(CCS7)            | Severe error seconds. This count is the total number of seconds during which the link had more than 64 errors (indicating a bit error rate ratio greater than 1 in 1000). It is pegged in the link interface (LI) and can be used to monitor and characterize T1 facility failures.                                                                                                                                                               |
| SPI (CCS7)                    | Adjacent signaling point isolation due to local failure or received TFX. A link set along a path to the indicated destination failed causing a complete failure of all signaling paths to the destination. Failure of any signaling path is caused by either a local link set failing or the receipt of a TFX message indicating some link set along the path to the destination failed. Refer to the SPIA, SPIB, and SPIC descriptions.          |
| SPIA<br>(Office)              | Adjacent signaling point isolation due to local failure on A-link. This condition occurs when all C-links are unavailable, and the last available A-link to the indicated destination fails or receives a TFX message indicating some link set along a path to the destination failed. This is a cumulative total of the SPI count for all A-links in the office. The appropriate per-link count is also pegged in this situation (SPI or SPIPO). |
| SPIAPO<br>(Office)            | Adjacent signaling point isolation due to far-end processor outage on A-link. At present, this count is ineffective—it is always zero. See the SPIA count.                                                                                                                                                                                                                                                                                        |
| SPIAPOT<br>(Office)           | Duration of the above. At present, this count is ineffective—it is always zero. See the SPIAT description.                                                                                                                                                                                                                                                                                                                                        |
| SPIAT<br>(Office)             | Duration of the above. See the SPIA description.                                                                                                                                                                                                                                                                                                                                                                                                  |



**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| <b>Name (Type)</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                         |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SPIPO (CCS7)       | Adjacent signaling point isolation due to far-end processor outage. A link failed due to receiving PROs from the far end causing a complete failure of all signaling paths to the indicated destination from this office. The effect is the same as the SPI due to local failure or received TFX. See the SPI description. |
| SPIPOT (CCS7)      | Duration of the SPIPO. This time period begins when the local link fails due to receiving PROs. It ends when any link set along a path to the destination restores. The count is the total time the far end is isolated from this office.                                                                                  |
| SPISP (Office)     | Adjacent signaling point isolation due to local failure. This is a cumulative count of all SPIs for all links in the office. Refer to the SPI description.                                                                                                                                                                 |
| SPISPPO (Office)   | Adjacent signaling point isolation due to far-end processor outage. At present, this count is ineffective—it is always zero. See the SPISP count.                                                                                                                                                                          |
| SPISPPOT (Office)  | Duration of the above. At present, this count is ineffective—it is always zero).                                                                                                                                                                                                                                           |
| SPISPT (Office)    | Duration of the above. This count is the cumulative duration of all SPIs for all links in the office.                                                                                                                                                                                                                      |
| SPIT (CCS7)        | Duration of the above. This time period begins when a link set along a path to the indicated destination fails causing it to be isolated. It ends when any link set along a path to the destination restores. The count is the total time the far end is isolated from this office.                                        |
| SQL (CCS7)         | Link quality. A relative measure indicating the percentage of time the link has operated without errors (0 - 100 percent). (Derived from the ERSEC count.)                                                                                                                                                                 |
| SRSCTRAN (LNKSET)  | Signaling-route-set-congestion-test messages transmitted. Although this measurement is pegged in the central processor, it is not reported, collected, nor accumulated by CNI.                                                                                                                                             |
| SRSTTRAN (LNKSET)  | Signaling-route-set-test messages transmitted. Although this measurement is pegged in the central processor, it is not reported, collected nor accumulated by CNI.                                                                                                                                                         |

**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| Name (Type)         | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SSATRAN<br>(LNKSET) | <p>Subsystem-allowed transmitted. Although this measurement is pegged in the central processor, it is not reported, collected, nor accumulated by CNI. This measurement counts the subsystem-allowed messages when the following are transmitted:</p> <ul style="list-style-type: none"> <li>(1) A local signaling connection control part (SCCP) subsystem goes in-service</li> <li>(2) A response is made to an incoming subsystem status test (SST) concerning an in-service subsystem</li> <li>(3) A signal transfer point (STP) performs a broadcast upon receipt of a subsystem-allowed message.</li> </ul> |
| SSPTRAN<br>(LNKSET) | <p>Subsystem-prohibited transmitted. Although this measurement is pegged in the central processor and Signaling System No. 7 (SS7) node, it is not reported, collected, nor accumulated by CNI. This measurement counts the subsystem-prohibited messages when the following are transmitted:</p> <ul style="list-style-type: none"> <li>(1) A local SCCP subsystem goes out-of-service</li> <li>(2) A response is made to receipt of a message destined for a local out-of-service subsystem</li> <li>(3) An STP performs a broadcast upon receipt of a subsystem-prohibited message.</li> </ul>                 |
| SSTTRAN<br>(LNKSET) | <p>Subsystem-status-test transmitted. Although this measurement is pegged in the central processor, it is not reported, collected, nor accumulated by CNI. This measurement counts all subsystem-status-test messages which are sent to verify the status of SCCP subsystems in the network for which this office marked out-of-service.</p>                                                                                                                                                                                                                                                                      |
| TPROCOTG<br>(LN7)   | <p>This is the cumulative duration of node processor outage (processor outage refers to an out-of-service node processor). This count, measured in milliseconds, is a CNI accumulation of IMS measurements OOSAUT, OOSCFG, and OOSNT.</p>                                                                                                                                                                                                                                                                                                                                                                         |

**Table 5-D. CCS7 Common Network Interface (CNI) Measurement Descriptions (Contd)**

| Name (Type)    | Description                                                                                                                                                                                                                                                                                                               |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| UNVL (CCS7)    | Link unavailable. A relative measure indicating the percentage of time the link is out of service (0 - 100 percent).                                                                                                                                                                                                      |
| ZPEAKOCC (LN7) | <p>This is the link transmission buffer peak occupancy, measured in MSUs, based on 10-second scans. This is obtained by dividing the largest value of cotb (maxcotb) by the average message length. A maxcotb is determined for each desired time interval.</p> <p><b>ZPEAKOCC = maxcotb / average message length</b></p> |

**Table 5-E. Private Branch Exchange (PBX) Measurement Descriptions**

| <b>Name (Type)</b>     | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| BYRL_<br>(PBX link)    | Total bytes received excluding the flag. Data is transmitted over PBX links using frames. All frames have one flag byte at the beginning to delimit between frames. Also, all frames contain a level 2 address, control bytes, and CRC check bytes. The flag byte is removed when any level 2, supervisory or unnumbered type, or level 3, information type, frame is received. This count is incremented in the LI by the length of the frame in bytes, including address, control, and CRC bytes. Therefore, it is usually a very large value. This count does not include bytes received in error. |
| BYRXL_<br>(PBX link)   | Retransmitted bytes excluding the flag. Frames are composed of varying numbers of bytes from 5 to 260, depending on the type of frame and the information it contains. Only level 3 type (information) frames are retransmitted. Should the node determine a frame must be retransmitted (described under the NACRL_ count), this count is incremented in the LI by the number of bytes sent. This would be the number of bytes in the erroneous frame and any subsequent frames not positively acknowledged.                                                                                         |
| BYXL_<br>(PBX link)    | Total bytes transmitted excluding the flag. This includes any bytes due to retransmitted messages. Note that since the BYRL_ count does not include bytes due to frames received in error, this count may very likely differ from the BYRL_ count at the far end. Refer to the BYRL_ description for more detail.                                                                                                                                                                                                                                                                                     |
| COCNGSTN<br>(PBX)      | Number of times CO-SCCP congestion starts.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| COCNGTMN<br>(PBX)      | Number of clock ticks for CO-SCCP congestion.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| CODBLRL_<br>(PBX link) | Number of user-bound CO-SCCP data messages blocked for the specified D-channel.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| CODBLTL_<br>(PBX link) | Number of network-bound CO-SCCP data messages blocked for the specified D-channel.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

**Table 5-E. Private Branch Exchange (PBX) Measurement Descriptions (Contd)**

| <b>Name (Type)</b>     | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CODTRVL_<br>(PBX link) | Number of CO-SCCP messages received by SCCP from a CCS7 network (ring) for the specified D-channel.                                                                                                                                                                                                                                                                                                             |
| CODTTRL_<br>(PBX link) | Number of CO-SCCP data messages transmitted by SCCP towards a CCS7 network (ring) for the specified D-channel.                                                                                                                                                                                                                                                                                                  |
| COINESTN<br>(PBX)      | Number of indirect connections established.                                                                                                                                                                                                                                                                                                                                                                     |
| COIREQL_<br>(PBX link) | Number of indirect connections requested by the user on the specified D-channel.                                                                                                                                                                                                                                                                                                                                |
| COMSGRL_<br>(PBX link) | Number of CO-SCCP messages received by SCCP from a CCS7 network (ring) for the specified D-channel.                                                                                                                                                                                                                                                                                                             |
| COMSGTL_<br>(PBX link) | Number of CO-SCCP messages transmitted by SCCP towards a CCS7 network (ring) for the specified D-channel.                                                                                                                                                                                                                                                                                                       |
| CRCERL_<br>(PBX link)  | Cyclic redundancy check errors. The LI checks for data errors in received frames using the check bytes that are part of the received frame. If the CRC check fails, the frame is discarded and this count is pegged in the LI. Otherwise, the frame is accepted and a positive acknowledgment may be sent. A high CRCERL_ count and a low ERSECL_ count within a given time period indicates a burst of errors. |
| DRPMGRG<br>(PBX)       | Number of messages dropped due to ring congestion. This count is currently ineffective—it is always zero.                                                                                                                                                                                                                                                                                                       |
| ERSECL_<br>(PBX link)  | Number of 1-second intervals with at least one error. This count is not the number of errors that occurred. Each second, the LI determines if any frames have been received in error (counted by the CRCERL_ measurement). If so, this count pegs in the LI. The count also is pegged once each second when the LI is ignoring incoming messages. This occurs under the following conditions:                   |

**Table 5-E. Private Branch Exchange (PBX) Measurement Descriptions (Contd)**

| Name (Type)                      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ERSECL_<br>(PBX link)<br>(Contd) | <ul style="list-style-type: none"> <li>■ Upon detection of the loss of flags or receiver clock</li> <li>■ Upon detection of any off-normal state of the level 1 protocol</li> <li>■ As a result of automatic receiver turnoff during data rates which are unacceptably high.</li> </ul> <p>This measurement is an indicator of long-term link performance. It can be used in conjunction with the number of seconds since LI boot to determine link availability.</p>                            |
| LKESTBL_<br>(PBX)                | <p>Number of protocol restarts received. This count is pegged when either an ESTABLISHED INDICATION or ESTABLISH CONFIRM message is received, and the link is believed to be in service. While the link is in service, up to seven messages may be discarded by the LI each time one of these messages is received. This measurement is intended to indicate the extent to which service on the link is degraded.</p>                                                                            |
| LPAFLTL_<br>(PBX link)           | <p>Duration of automatic link failure including duration of declared failure. The system maintains separate timers for each failed state. This count pegged in the central processor is the accumulated failed time indicated by the link's failed automatic timer. The timer starts immediately after an initialization, whenever a node is removed from service, or 90 seconds after failure of the link. It stops when the link restores to service or the link state is changed to MOOS.</p> |
| LPBOFRL_<br>(PBX link)           | <p>The received buffer in a PBX node overflows. This is a count of the number of messages lost. It pegs in the LI when a level 3 frame is received and the buffer is full (refer to the LPBOLRL_ description). The frame is discarded and a receive-not-ready (RNR) control frame is sent on the link.</p>                                                                                                                                                                                       |
| LPBOFRTL_<br>(PBX link)          | <p>Duration of receive buffer overflow. This count is in units of 20 milliseconds. It starts when the first frame is discarded and ends when the overload ends.</p>                                                                                                                                                                                                                                                                                                                              |

**Table 5-E. Private Branch Exchange (PBX) Measurement Descriptions (Contd)**

| <b>Name (Type)</b>      | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LPBOLRL_<br>(PBX link)  | The receive buffer in a PBX node overloads. When messages received from the network exceed processing ability, the number of information frames in the buffer increases to the threshold for this count to peg. The count pegs in the LI once when the threshold is reached and an RNR control frame is sent on the link. It does not peg again until the overload ends (buffer occupancy drops to a predetermined abatement level).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| LPBOLRTL_<br>(PBX link) | Duration of receive buffer overload (units of 20 milliseconds).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| LPDIF<br>(PBX)          | <p>The CNI PBX node data integrity flag. The data collected is good if this count, pegged in the central processor, is zero. If the count is nonzero, it indicates the data collected by the central processor is incomplete. The data integrity flag determines if an event occurs in the period of interest which causes the data collected for that period to be suspect. The data integrity flag is a decimal representation of one 32-bit word describing the error condition. To determine the meaning of the count, it must be converted from decimal to binary and the bits analyzed. In the following, the measurement value is 00000000abcd0efg0000000000000000h in binary:</p> <p>Where:</p> <ul style="list-style-type: none"> <li>a = Data collection period skipped</li> <li>b = Data collection period aborted</li> <li>c = Node did not respond<br/>(no measurements received)</li> <li>d = Periodic data collection initialized</li> <li>e = Data collection process faulted during data collection</li> <li>f = Node removed</li> <li>g = Node grown</li> <li>h = Node initialized<br/>(this value is collected in the node).</li> </ul> |
| LPFLDTL_<br>(PBX link)  | Duration of declared link failure—normally, failed time in excess of the time to detect level 2 failure plus 90 seconds                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

**Table 5-E. Private Branch Exchange (PBX) Measurement Descriptions (Contd)**

| <b>Name (Type)</b>                | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LPFLDTL_<br>(PBX link)<br>(Contd) | <p>The timer starts when the link is declared failed. Refer to the LPFLDL_ description.</p> <p>The timer continues to run until the link restores or until the link major state is changed from the AVL state. Note that since the link is normally failed when the declared failure occurs, the failed automatic timer may already be running. This count, pegged in the central processor, is just the time due to the “declared” failure, not the total failed time (LPAFLTL_).</p> |
| LPLCONR<br>(PBX)                  | Receive buffer congestion onset. This count is currently ineffective—it is always zero.                                                                                                                                                                                                                                                                                                                                                                                                |
| LPLCONRT<br>(PBX)                 | Duration of receive buffer congestion onset. This count is currently ineffective—it is always zero.                                                                                                                                                                                                                                                                                                                                                                                    |
| LPLCONX<br>(PBX)                  | Transmit buffer congestion onset.                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| LPLCONXT<br>(PBX)                 | Duration of transmit buffer congestion onset.                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| LPMFLTL_<br>(PBX link)            | <p>Duration of manual link out of service. When a link is removed from service manually—that is, the minor state is set to MOOS—the link’s manual-failed timer starts. When the link is restored to service, it stops. This count, pegged in the central processor, is the accumulated failed time indicated. It should be noted that the failed automatic time and the failed manual time are mutually exclusive. The LPAFLTL_ and LPMFLTL_ timers cannot run concurrently.</p>       |
| LPSPFAIL_<br>(PBX link)           | Signaling path failures. This count is pegged in the central processor for the indicated link.                                                                                                                                                                                                                                                                                                                                                                                         |
| LPSFAILT_<br>(PBX link)           | Signaling path down time. This count is pegged in the central processor for the indicate link.                                                                                                                                                                                                                                                                                                                                                                                         |
| LPSWITCH_<br>(PBX link)           | Number of backup DCHN switchovers. Applies only to the primary link of duplex DCHN link pairs. (Pegged in the central processor for the indicated link.)                                                                                                                                                                                                                                                                                                                               |
| LPTMPFL_<br>(PBX link)            | <p>A temporary link failure due to level 2 protocol failure. Detection of the failure typically takes from 8 to 23 seconds. Three ways in which this failure is detected is as follows:</p>                                                                                                                                                                                                                                                                                            |



**Table 5-E. Private Branch Exchange (PBX) Measurement Descriptions (Contd)**

| Name (Type)                       | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LPTMPFL_<br>(PBX link)<br>(Contd) | <p>(1) A message is queued in the transmit buffer when the link fails and an answer time-out occurs. After 4 seconds or if the buffer overflows, level 2 software clears the transmit buffer—messages are discarded—marks the link congested, and starts automatic recovery. If the link does not restart within the next 4 seconds, this count pegs.</p> <p>(2) A disconnect frame is received from the far end. Immediately, level 2 software clears the transmit buffer and this count pegs.</p> <p>(3) The link is idle when the failure occurs. Up to 15 seconds may elapse before the periodic audit attempts to send a message. At that time, an answer time-out occurs as described in case 1.</p> |
| LPTMPFL_<br>(PBX link)<br>(Contd) | This count does not peg again at least until the link recovers. If the link does not recover within 90 seconds after detection of the failure, it is declared failed (see the LPFLDL_ description).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| LPTMPFLT_<br>(PBX link)           | Duration of temporary link failure. Each failure event could last up to 90 seconds.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| LPXBFOCL_<br>(PBX link)           | Average transmit buffer length in bytes is usually zero. This value, average occupancy of the buffer, is obtained by periodically checking buffer length, cumulating the number of bytes used, and then dividing by the number of times the length is checked. Since this is a measure of how long messages are staying in the buffers, it is a relative measure of the load on the link. The count pegs in the LI. There are two occupancy maximums, one per link and an aggregate per node.                                                                                                                                                                                                              |

**Table 5-E. Private Branch Exchange (PBX) Measurement Descriptions (Contd)**

| Name (Type)             | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MGMSURL_<br>(PBX link)  | <p>Total frames received. Data is transmitted over PBX links using three types of frames:</p> <p>Level 3 - Information frames containing PBX message information:<br/>These are passed to/from the node.</p> <p>Level 2 - Supervisory frames: Indicating such things as "receive not ready" or "frame reject"</p> <p>Level 2 - Unnumbered frames: Such as starting or terminating multiple frame operation of the data link This count is pegged in the LI when a level 2 or 3 type frame is received, including in the Q931MGRL_ count. This count is a measure of link performance.</p> |
| MGMSUXL_<br>(PBX link)  | Total frames transmitted including retransmitted frames. Refer to the MGMSURL_ description.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| MGRUAL_<br>(PBX link)   | Message received with an invalid address. This count is pegged in the LI whenever level 2 receives a frame with an invalid address from the far end. This is a very severe error, and the count should always be zero.                                                                                                                                                                                                                                                                                                                                                                    |
| MGRXL_<br>(PBX link)    | Messages retransmitted. This count pegs in the LI when a level 3 type (information) frame is retransmitted.                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| MGUNAL_<br>(PBX link)   | Messages dropped due to link unavailable. The link may be out of service, temporarily congested, or unequipped. The message is dropped and this count is incremented only if the message cannot be returned to the source node.                                                                                                                                                                                                                                                                                                                                                           |
| PROTEXRL_<br>(PBX link) | Protocol exceptions received. This count is pegged in the LI when certain unexpected events in the protocol occur; for example, receiving an unsolicited frame with the F-bit set. Usually these errors are not severe and do cause link reestablishment. It is not unusual for this count to be high.                                                                                                                                                                                                                                                                                    |

**Table 5-E. Private Branch Exchange (PBX) Measurement Descriptions (Contd)**

| <b>Name (Type)</b>       | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Q931MGRL_<br>(PBX link)  | Q931 type information frames received. Currently, all information frames are Q931 type. Therefore, this count pegs in the LI when any level 3 type frame is received. Along with the Q931MGXL_ count, it provides a good measure of traffic flow on the link.                                                                                                                                                  |
| Q931MGXL_<br>(PBX link)  | Q931 type information frames transmitted. This does not include retransmitted frames. Refer to the Q931MGRL_ description.                                                                                                                                                                                                                                                                                      |
| RETMG (PBX)              | Number of returned messages received from the ring. This is a count of information messages that were sent to the DLN and returned to this node (the incoming node). This count is pegged, and the message is discarded.                                                                                                                                                                                       |
| RJCTMG<br>(PBX)          | Messages rejected due to incoming node congestion. This count is currently ineffective—it is always zero.                                                                                                                                                                                                                                                                                                      |
| XBFFULLL_<br>(PBX link)  | Transmit buffer full events. This count is pegged in the LI when an information packet to be transmitted is received from the node and the buffer is full. The maximum number of messages are pending transmission. When this occurs, the link is marked as congested by the LI. If the return bit indicates the message can be returned to the central processor, it is; otherwise, the message is discarded. |
| XBFFULLTL_<br>(PBX link) | Duration of transmit buffer full events. This event ends when the buffer occupancy drops to a predetermined abatement level. The count is in units of 20 milliseconds.                                                                                                                                                                                                                                         |

**Table 5-F. T1 Measurement Descriptions, CNI 11.4 and Later**

| <b>Name<br/>(Type)</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                          |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| BES<br>Errors          | Count of Bursty Errored Seconds (BES) Errors: A BES is a second containing between 2 and 320 enhanced super frame (ESF) error events.                                                                                                                                                                                                       |
| ES<br>Errors           | Count of errored Seconds (ES) Errors: An ES is a second containing one or more ESF format-error events; an <i>ESF error event</i> is defined as either an out-of-frame event or a cyclic-redundancy-check code (CRC-6) error event. An OOF condition occurs when any 2 out of 4 consecutive frame synchronizing bits are received in error. |
| FS<br>Errors           | Count of Failed Seconds (FS) Errors: A FS is a second in which a failed signal state (FSS) exists. A FSS is the occurrence of 10 consecutive SES. An FSS clears after 10 consecutive seconds without an SES.                                                                                                                                |
| LOFC                   | Loss of Frame Count (LOFC): This is the number of times a RED (alarm) LOF event or a BLUE (alarm) LOF event has occurred.                                                                                                                                                                                                                   |
| SES<br>Errors          | Count of Severely Errored Seconds (SES) Errors: SES are seconds containing more than 320 ESF error events or an OOF.                                                                                                                                                                                                                        |
| SLIPS<br>Errors        | Count of Controlled Slip Seconds (CSS) Errors: Also called a SLIP event, a CSS is a second with the occurrence of slip buffer overflow or underflow.                                                                                                                                                                                        |

**Table 5-G. High Speed Link (1.544) Measurement Descriptions, CNI 11.4 and Later**

| <b>Name<br/>(Type)</b> | <b>Description</b>                                                                                                                 |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| CMBCLF<br>(LS)         | Frequency of combined linkset failure: Pegged on a combined linkset basis, whenever a combined linkset has failed.                 |
| CMBCLFT<br>(LS)        | Duration of combined linkset failure: Pegged on a combined linkset basis, whenever a combined linkset has failed.                  |
| DRPRRBOV2<br>(IUN)     | Number of messages dropped due to ring-receive-buffer-overflow state 2.                                                            |
| SBMEMERR<br>(IUN)      | Single bit Universal Link Node (ULN) memory errors.                                                                                |
| U0OVLD1<br>(IUN)       | For application Processor 0 (APP0), the number of occurrences of IMS user processor real-time Overload Level 1.                    |
| U0OVLD2<br>(IUN)       | For APP0, the number of occurrences of IMS user processor real-time Overload Level 2.                                              |
| U0OVLD1T<br>(IUN)      | For APP0, the cumulative duration, in milliseconds, of the number of occurrences of IMS user processor real-time Overload Level 1. |
| U0OVLD2T<br>(IUN)      | For APP0, the cumulative duration, in milliseconds, of the number of occurrences of IMS user processor real-time Overload Level 2. |
| U1OVLD1<br>(IUN)       | For Application Processor 1 (APP1), the number of occurrences of IMS user processor real-time Overload Level 1.                    |
| U1OVLD2<br>(IUN)       | For APP1, the number of occurrences of IMS user processor real-time Overload Level 2.                                              |
| U1OVLD1T<br>(IUN)      | For APP1, the cumulative duration, in milliseconds, of the number of occurrences of IMS user processor real-time Overload Level 1. |

**Table 5-G. High Speed Link (1.544) Measurement Descriptions, CNI 11.4 and Later (Contd)**

| <b>Name<br/>(Type)</b> | <b>Description</b>                                                                                                                           |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| U1OVLD2T<br>(IUN)      | For APP1, the cumulative duration, in milliseconds, of the number of occurrences of IMS user processor real-time Overload Level 2.           |
| ULOVL1D1<br>(IUN)      | For link processor, the number of occurrences of IMS user processor real-time Overload Level 1.                                              |
| ULOVL1D2<br>(IUN)      | For link processor, the number of occurrences of IMS user processor real-time Overload Level 2.                                              |
| ULOVL1D1T<br>(IUN)     | For link processor, the cumulative duration, in milliseconds, of the number of occurrences of IMS user processor real-time Overload Level 1. |
| ULOVL1D2T<br>(IUN)     | For link processor, the cumulative duration in milliseconds, of the number of occurrences of IMS user processor real-time Overload Level2.   |
| UROVL1D1<br>(IUN)      | For ring processor, the number of occurrences of IMS user processor real-time Overload Level 1.                                              |
| UROVL1D2<br>(IUN)      | For ring processor, the number of occurrences of IMS user processor real-time Overload Level 2.                                              |
| UROVL1D1T<br>(IUN)     | For ring processor, the cumulative duration, in milliseconds, of the number of occurrences of IMS user processor real-time Overload Level 1. |
| UROVL1D2T<br>(IUN)     | For ring processor, the cumulative duration, in milliseconds, of the number of occurrences of IMS user processor real-time Overload Level 2. |

**Table 5-H. Extended Super Frame (ESF) Error Count Description, CNI 11.4 and Later**

| Name<br>(Type) | Description                                                                                                                                                                                                                                                                     |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ESF<br>Errors  | Count of Enhanced Super Frame (ESF) errors: An ESF error event is defined as either a Cyclic Redundancy Check code (CRC-6) error event or an out-of-frame (OOF) error event. An OOF condition occurs when any 2 of 4 consecutive frame synchronizing bits are received in error |

## Description of Reports

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### Introduction

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A measurement report is a presentation of measurement data in either a fixed or a flexible format. Thus, there are basically two ways to “view” the measurement data. A report holds a specific view of the common measurement data and some reports make this view user definable via the measurement output control table (MOCT). Automatic reports are output as **REPT SMR** messages; demand reports are output as **OP SMR** messages. Report forms are available in the following two formats:

- Fixed format reports — Certain measurement data is provided in a fixed layout. This data is output automatically and on demand.
- Flexible format reports — Allows users to have any specified set of measurement data output in one of four ways. These can be scheduled or demanded.

The following paragraphs contain a general description of the various report types followed by a more detailed description of the fixed format reports. The layout of each report is illustrated with figures.

### Report Data

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The data in a report is derived from the measurements found in the history files or the LPM. Data in the report is used to evaluate the performance of the CNI-equipped office and the network. Reports provide a measure of equipment performance, signaling performance, and the details needed to identify problems and troubleshoot faults. Different reports contain different measurements. The measurement data on any particular report type is defined by the specific column and row headings shown.

All report types contain a common header section. At the top of each report is a header that provides identifying information for the following:

- Reporting office (such as software generic and CLLI\* code)
- Particular report being output (such as the report name, time, report coverage, and whether or not it is being automatically generated).

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\* Common Language is a registered trademark and CLEI, CLLI, CLCI, and CLFI are trademarks of Bell Communications Research, Inc.



Since some of the measurements in the history files are on a per-link or per-node basis, sometimes there is a necessity to accumulate the measurements to derive a useful value for outputting to users. This process takes place when generating the report. How the data is accumulated determines what information the final value provides. As an example, ring node out-of-service counts could be cumulated on the basis of link protocol (CCIS 6 or CCS7) or on the basis of the type of node they serve—IMS user or ring peripheral controller. The same measurement data is used in both cases but is aggregated differently for different uses. Furthermore, some of the counts are on a per-office basis. The per-office counts may measure the same occurrences that similar, per-link or per-node, counts measure. Therefore, each piece of data is known by a different name. The scope of a particular piece of measurement data is referred to as “granularity.” The granularity of the count determines the report in which the data is useful.

To provide information in a more usable form, some data values shown in reports are derived from measurements by algorithms; for example, a value may represent the sum of several measurements. In the figures at the end of this part, the basic measurement used to derive the value is shown. Where the value is not obtained from the history files, no name is given. Where possible, a figure shows the measurement name(s) used for each value in the report. The names shown are not strict definitions of each value nor do they appear in the actual report. They are intended to help the reader understand the source of the data and allow the reader to cross-reference to the table of measurement descriptions in the previous part.

Measurements take the following three forms:

1. Peg Counts - Indicated by a PC in the report
2. Time Durations - In hours, minutes, or seconds
3. Thresholds - Indicated by a TE in the report.

Most reports contain more than one of these three forms (for example, a peg count and its corresponding duration on one report line). When this is the case, the figures in this section, which illustrate report layouts, show the measurement name just once with an “\_” in place of the suffix.

In unusual circumstances, the data shown in a report may be incomplete. This is possible if a node is out of service or a fault occurs during measurement collection (refer to a description of the measurement process phases in the previous part). Some reports flag invalid data, while certain reports indicate when their data is questionable. In reports containing specific link data (for example, the SNPR2 and 30MPR reports), an “\*” appears in the link type field if there is no data available for the link.

## Network Clock

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The CCS network is administered and controlled by centralized support systems. The CNI generates reports and CCS network critical events (CNCE) messages for these support systems. The support systems use this information to determine the condition of the various nodes (offices) in the network. To provide uniform time stamping of the reports and messages and to maintain network synchronization in general, a “network clock” feature is supported by the system. The network clock uses the UNIX RTR Operating System internal clock in each node and various control functions between nodes to maintain a single time reference throughout the network. Showing report periods in network time provides this single time reference for support system users. A user may check the validity of the network time using the **OP:SNAT** or **REPT:SNAT** message.

Two regional network nodes are designated as the master/mate clock pair to provide the network time to all other nodes, designated as slave nodes, in the network. Whichever node is currently the master is responsible for notifying all other nodes of the correct network time. Upon initialization of the master node, this time is set manually using a standard reference. The purpose of the mate clock node is to act as master should the current master node fail. The FORCED SWITCH message is broadcast to all offices whenever the mate is redesignated as the master node. All offices then expect and receive the proper network time from the newly designated master node. The input message **SW:CLOCK** provides a means to manually initiate a forced switch.

Under normal circumstances (all nodes functioning properly), the master node periodically broadcasts a TIME message to all other CNI-equipped offices, including the mate clock node. Each CNI-equipped office in turn responds by broadcasting the TIME message to all end offices. When an office receives the TIME message, the office updates the UNIX RTR Operating System clock and reports any deviation to users via the **REPT CMMSADM** output message. Should an office have time deviations exceeding some predefined limit, the office queries the master node in order to maintain synchronization.

Should an office—either a slave or the mate—fail and then recovers, the office also must query the current master node for the correct network time. When an office sends a QUERY message to the master, the master responds with a TIME message sent to the office requesting the time. The receiving node responds by updating its internal clock and reporting the deviation as described in the previous broadcast method. When a TIME message response is not forthcoming, a node queries the master a maximum of three times before notifying users to manually set the UNIX RTR Operating System clock. The **REPT CMMSADM** message notifies users of both normal and abnormal network clock operation (see the *Output Message Manual*).

## Reports and Measurement Data Output

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The users of the measurement data are on-site and at various support system centers. They are involved in the daily maintenance and operations of the CNI-equipped office. The support system users provide administration, maintenance, and operational support. All measurement data gathered is available to any of these users via the output control features of the MOCT. Note that when IMS measurement collection is inhibited, some measurements are not available. To determine whether or not IMS measurements are inhibited, enter **INH:IMSMEAS STATUS!**.

In addition to the scheduled printing of fixed format reports, they can be demanded at any time with the **OP:SMR** input message. The **OP:SMR** message causes the system to search the MOCT schedule table for the report specified. When the entry is found, the report is generated and printed using the current data found in the appropriate history file. Most scheduled and demand reports appear on the maintenance printer but not the maintenance CRT.

The MOCT provides for a delay of up to 5 minutes in printing scheduled reports. Thus, the report may not be output precisely at the scheduled time. Note that this tends to prevent pages of different reports scheduled to print at the same time from being intermingled. Furthermore, some reports, especially those to support systems, may be specified as *polled* reports. This means the report is not output, but is generated and stored for later retrieval.

### **NOTE:**

The system is usually busiest at 15-minute intervals updating history files and printing scheduled reports. Therefore, the user should normally not demand a report at these times; but wait 5 to 10 minutes after this period to request these reports.

In addition to reporting measurements, measurement data can be demanded on an individual measurement basis at any time. Individual measurement messages provide more current real-time data than reports. Therefore, individual measurement messages are most useful to office personnel when troubleshooting. Specific measurement data can be requested by office personnel using the **DUMP:SMEAS** message. This message can output specific measurements for specified links, nodes, etc and has the option of printing data on all links, nodes, etc. The data is retrieved from the history files described earlier and output according to measurement type. The data is sent to the indicated destination in the form of an output message. On-site users may use the message to obtain more detailed measurements of conditions identified by a scheduled report. This message is not available to support system users. See the *Input/Output Manual* for information on requesting measurement data.

Support system users, on the other hand, receive measurement data from the CNI-equipped office via BX.25 data links. These support systems use the BX.25 data links for reception of reports and messages. Reports and PDS messages are sent to the support system via different BX.25 data links.

Reports designated as “polled” in the MOCT are saved in specific files in a standard system directory. Support system users and on-site users may request data from these files using the **DUMP:SFIL** message. This command searches the directory for the specified file and outputs the file to the requesting user.

## Report Formats

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The CNI application provides both *fixed format* and *flexible format* reports are administered by the MOCT. The report names found in the MOCT are indicative of not only the format, but also the frequency of output, the source history files, and the scheduled/demand aspect of the indicated report. The report names are specified by a centralized administrative organization. Refer to the MOCT or office records for this information.

### Fixed Format

A fixed format report contains a fixed set of measurements; the contents of the report cannot be changed. The “view” in the MOCT associated with a fixed format report should not be changed. Fixed format reports cannot be tailored to user requirements. The data is presented with labels arranged in a fixed layout.

The format names are generic forms of the actual names used to specify a particular report—input message. All reports, on-site and support system reports or fixed and flexible format reports, basically fall into one of the following three categories.

- |                 |                                                                                                                                                                                                                                                                                                                              |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Total<br>Office | Total office reports provide a general view of the office. The data in the reports is a summary of office performance. There are two total office fixed format reports: <ol style="list-style-type: none"><li>1. Signaling Network Performance Report, Part 1 (SNPR1)</li><li>2. Machine Performance Report (MPR).</li></ol> |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

The SNPR1 and the MPR are scheduled to be output daily and hourly. Therefore, the SNPR1 and the MPR should be output on-site every hour.

**Detailed  
Performance**

The detailed performance reports provide a closer look at the individual links and nodes. There are separate measurements for each link in the office. Thus, the reports provide information helpful in isolating problems to a particular link or node. The reports are necessary for compiling monthly performance reports. There are two detailed performance reports:

1. Signaling Network Performance Report, Part 2 (SNPR2)
2. Signaling Equipment Performance Reports (SEPR).

The SNPR2 and the SEPR are quite lengthy. Therefore, the SNPR2 and the SEPR are scheduled to be output only once each day and only on-site.

**Exception**

Exception reports are used to single out those measurements that are significant when they exceed some predetermined value. Any measurement in an exception report that does not exceed this predetermined value is not output in the report.

Furthermore, if there are no measurements that exceed their respective thresholds, the report may not be output. The report indicates specific pieces of equipment that have experienced higher than normal errors or excessive loading. There are two fixed format exception reports:

1. Thirty-Minute Marginal Performance Report (30MRP)
2. Ring Peripheral Controller Overflow Report (RINGEX).

Both reports are output on-site indicating problems with either signaling links or RPCs, respectively.

**Flexible Format**

Flexible format reports are user-defined. The CNI allows users to create customized reports containing data pertaining to their needs via the MOCT. These reports require a view in the MOCT to specify what measurements should be printed. The view in the MOCT is used to extract measurements from the measurement data base, LPM and disk history files.

Often, users in support centers need reports for a specific purpose. If the desired information is not available in a fixed format report or a fixed format report is not scheduled to be sent to the user, a new report can be created to fit that need. Using the MOCT, the user specifies the name, content, frequency, and format of the report. In addition, the user specifies if the report is to be output automatically or only on demand. The format is specified by using the appropriate flexible format report "generator." The creation of such reports is fully described later.

Flexible format reports can be either regular reports or exception reports. The regular format shows a value for all measurements specified in the view (for all links, nodes, etc., equipped) regardless of the value. The exception format shows a value for all measurements specified if any one of those measurements has exceeded its threshold. The output for such reports consists of a report header and up to six additional parts. The report header information and additional report parts are as follows:

- a. Report header information
  - Report name
  - Day of year (1-366)
  - Number of 5-minute intervals at measurement start time.
- b. Addition report parts per:
  - Office measurements
  - Link measurements
  - Node measurements
  - Channel measurements
  - Cluster measurements
  - Link set measurements.

Each report part appears as follows:

---

*aaa* = Number of measurements in this part

List of measurement names

*bbb* = Identification of link, node, channel, cluster, or link set

Corresponding values

*ccc* = Identification of next link, node, channel, cluster or link set

Corresponding values

---

**⇒ NOTE:**

If a report is scheduled near midnight and is output the following day, the header may show the past day; the report reflects when the data was created rather than when the report is output.

Normally, flexible format reports are sent to users at support centers. As shown, the report generated is little more than a list of measurement values to be sent to the support system over dedicated data links. The user at the support center then formats the data further.

## **Signaling Network Performance Report, Part 1**

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### **General**

The Signaling Network Performance Report, Part 1 (SNPR1) is a total office report that is output automatically for each hour (the data coverage should be 12/12) and once for the entire day (data coverage 288/288). Make particular note of the time of the report. The purpose of the report is to provide an overall view of signaling performance for the office.

The report does not provide detailed measurements for each link. In fact, the data on this report cannot be directly used to determine the condition of any specific piece of hardware. Rather, it shows cumulative counts for the entire office. This report can be used to determine general performance of the office in the areas of signaling-load handled, signaling-link failures experienced, signal-unit errors detected, and the number of message-transfer failures that occurred.

This report should be checked daily for counts indicating poor link performance. The hourly reports from any period should be compared for trends and abnormalities. Keep in mind that a high count on one report is not necessarily an indication of problems. Also, the same count(s) occurring at the same time each day may point to externally induced problems.

If problems are indicated, the user should then refer to the Signaling Network Performance Report, Part 2 (SNPR2) or the Thirty-Minute Marginal Performance Report (30MPR) for detailed measurements of specific links. The counts of particular concern are as follows:

- a. Emergency Restarts (EMR)
- b. Signal Unit Errors (SUER\_TE)
- c. Retransmission Requests (SURX\_TE)
- d. Repeated and Skipped ACUs (AURSTE).

The basic layout of the SNPR1 report is shown in Figure 5-1. There are three sections to this report:

1. Header information
2. CCS7 link data
3. PBX link data.

Each link data section contains signaling load measurements and signaling performance measurements.

### **Header Information**

The header information section contains the following:

- a. Office identification
- b. Report type
- c. Time
- d. Data coverage.

### **CCS7 Signaling Load and Signaling Performance Measurements**

The CCS7 signaling load and signaling performance measurements identify the number of messages received and transmitted for various CCS7 message types and various failure conditions for CCS7 links (that is, signaling point isolations, buffer congestion, declared failures, changeovers). These measurements include counts and exception threshold measurements for certain error



conditions that indicate poor link performance. Also shown are message counts (ECIS6 and DCIS6) discarded due to blockage or translation failure, counts of looping messages, the number of routing audit failures, and global title translation counts, total and failures. The following list contains information to be considered when interpreting the measurements:

- a. Byte and signal unit load counts are pegged in the link interface. The byte and signal unit load counts do not include SYNC, ACU, or PRO messages; these counts do include signal units received in error.
- b. Message counts, based on a determination of message type, are pegged in the node. Message counts include messages that may subsequently be blocked at the outgoing node.
- c. The ECIS signaling load measurements count all CCIS 6 messages that are sent or received on CCS7 virtual links. Furthermore, the count of CCS7 routed messages includes the ECIS type.
- d. Signaling point isolation is similar to the EMR condition; they both indicate failure of all signaling paths to an adjacent signaling point. A signaling path failure is indicated by local link failure, far-end processor outage, or receipt of TFX messages indicating some link in a path to the destination has failed.
- e. Discarding messages due to link congestion is related to the transmit buffer occupancy and the priority of the message to be transmitted. If the priority level is less than the congestion level, the message is discarded. Depending on several factors, a return message may be sent indicating the reason for discard.
- f. Level 1 congestion is the lowest congestion state for the link. The duration measurement for this state indicates the length of time the buffer occupancy is above normal. The peg count indicates how often occupancy is above normal, but not the severity of the congestion.
- g. Errored seconds is the number of 1-second intervals during which signal units were received with errors. It is not a count of signal unit errors. Detected errors is the number of signal units that failed the parity check. An excess of these could cause the link to be declared failed.
- h. Looping messages are usually caused by congestion or blockage at an outgoing link combined with messages returned from some far-end office. When looping counts are high, look for other counts indicating congestion, blockage, no translation, and possibly discarded messages.

```

xx REPT SMR SNPR1 STARTED
SIGNALING NETWORK PERFORMANCE REPORT - PART 1

REPORTING OFFICE: local CLLI code REPORT INTERVAL: hourly or daily
CURRENT GENERIC: gen_id AUTOMATIC REPORT
DATE: mm/dd/yy, TIME: hh:mm:ss
REPORT PERIOD (NWT): mm/dd/yy, hh:mm:ss THRU mm/dd/yy, hh:mm:ss
DATA COVERAGE: nnn/288

SIGNALING LOAD --- RECEIVED TRANSMITTED
CCIS6 SIGNAL UNITS: SUR SUX
CCIS6 ROUTED MESSAGES: L6MGR L6MGX
CCIS6 DIRECT SIG MSGS: L6MGRS L6MGXS

SIGNALING PERFORMANCE --- PEG TIME
COUNT (SEC)
-----
CCIS6 PERFORMANCE ---
EMERGENCY RESTART EMRSP EMRSPT
TRANSMIT BUFFER OVERLOAD L6BOLX L6BOLXT
DECLARED LINK FAILURES L6FLD L6FLDT
AUTOMATIC SIG LINK CHANGEOVERS L6ACO_
RECEIVE BUFFER OVERFLOW L6B0FR
RECEIVE BUFFER OVERLOAD L6B0LR L6B0LRT
EXCEPTION REPORTS (THRESHOLDS EXCEEDED) ---
SIGNAL UNIT ERRORS SUER_TE
RETRANSMISSION REQUESTS SURX_TE
REPEATED AND SKIPPED ACU'S AURSTE
AUTOMATIC CHANGEOVERS L6ACO_TE
MESSAGE TRANSFER FAILURES ---
POTS MSGS BLOCKED L6MRPBC
UNEQUIPPED POTS LABEL (NO TRANSLATION) L6MRPNT
DIRECT SIG MSGS REFUSED (BLOCKED) MRSBC06+L6MRSBC
DIRECT SIG MSGS REFUSED (NO TRANSLATION) MRSNT06
TRANSMIT BUFFER OVERFLOW L6B0FX
INITIAL ADDRESS MSGS DROPPED MRUNVL
LOOPED DIRECT SIG MSGS MGSLOOP
DS & 511 MSGS DROPPED (RPC/DLN CONGESTION) DRP6MSG1+2+3

```

Page 1 of 5

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**Figure 5-1. Layout of the Scheduled SNPR1 Report (Sheet 1 of 4)**

xx REPT SMR SNPR1 IN PROG

|                       |          |             |  |
|-----------------------|----------|-------------|--|
| SIGNALING LOAD ---    | RECEIVED | TRANSMITTED |  |
| CCS7 MSU BYTES:       | BYMSUR   | BYMSUX      |  |
| CCS7 ROUTED MSGS:     | MGMSUR   | MGMSUX      |  |
| ECIS MESSAGES:        | L6MGRV_  | L6MGXV_     |  |
| TOTAL GTR MSGS REC'D: | SC7RGTR  |             |  |

|                                             |              |           |
|---------------------------------------------|--------------|-----------|
| SIGNALING PERFORMANCE ---                   | PEG          | TIME      |
|                                             | COUNT        | (SEC.)    |
| CCS7 PERFORMANCE ---                        |              |           |
| SIG LINK CONGESTION ONSET (LEVEL 1)         | L7LCON1X     | L7LCON1XT |
| DECLARED LINK FAILURES                      | L7FLD        | L7FLDT    |
| AUTOMATIC CHANGEOVERS                       | L7ACO        |           |
| RECEIVE BUFFER OVERFLOW                     | L7B0FR       |           |
| RECEIVE BUFFER OVERLOAD                     | L7B0LR       | L7B0LRT   |
| TRANSMIT BUFFER DISCARD LEVEL 1             | L7LCDIS1X    |           |
| ROUTING AUDIT FAILURES                      |              |           |
| EXCEPTION REPORTS (THRESHOLDS EXCEEDED) --- |              |           |
| ERRORED SECONDS                             | ERSECTE      |           |
| DETECTED ERRORS                             | CRCERTE      |           |
| BYTES RETRANSMITTED                         | BYRXTE       |           |
| AUTOMATIC CHANGEOVERS                       | L7ACOTE      |           |
| MESSAGE TRANSFER FAILURES ---               |              |           |
| ECIS MSGS REFUSED - BLOCKED                 | L7MRPBC      |           |
| ECIS MSGS REFUSED - NO TRANSLATION          | L7MRPNT      |           |
| DCIS MSGS REFUSED - BLOCKED                 | MRSBC07      |           |
| DCIS MSGS REFUSED - NO TRANSLATION          | MRSNT07      |           |
| ECIS6 MSGS DROPPED - RPC/DLN CONGESTION     | DRPEMSG1+2+3 |           |
| LOOPING CCS7 MSGS                           | MSG7LOOP     |           |
| GIT REFUSED - BLOCKED                       | GTTUNBC      |           |
| GIT REFUSED - NO TRANSLATION                | GTTUNNT      |           |
| SIG LINK MESSAGES DISCARDED                 | MSUDISC0+1+2 |           |
| MSGS DROPPED - RPC/DLN CONGESTION           | DRP7MSG1+2+3 |           |
| SCCP MSGS - UNKNOWN ADDRESS (LN7)           | SC7RERUA     |           |
| SCCP MSGS - UNKNOWN ADDRESS TYPE (LN7)      | SC7RERUATY   |           |
| SCCP MSGS - UNEQUIPPED SUBSYSTEM (LN7)      | SC7RERUNE    |           |
| SCCP MSGS - PROHIBITED SUBSYSTEM (LN7)      |              |           |
| SCCP MSGS - UNKNOWN ADDRESS (OFC)           | SCRERUA      |           |
| SCCP MSGS - UNKNOWN ADDRESS TYPE (OFC)      | SCRERUATY    |           |
| SCCP MSGS - UNEQUIPPED SUBSYSTEM (OFC)      | SCRERUNE     |           |
| SCCP MSGS - PROHIBITED SUBSYSTEM (OFC)      | SCRERPRO     |           |

Page 2 of 5

**Figure 5-1. Layout of the Scheduled SNPR1 Report (Sheet 2 of 4)**

```
xx REPT SMR SNPR1 IN PROG

SIGNALING LOAD ---
CCITT7 MSU BYTES:      RECEIVED      TRANSMITTED
CCITT7 ROUTED MSGS:    BYMSUR        BYMSUX
TOTAL GTR MSGS REC'D:  MGMSUR        MGMSUX
SC7RGTR

SIGNALING PERFORMANCE ---
CCITT7 PERFORMANCE ---
SIG LINK CONGESTION ONSET (LEVEL 1)
DECLARED LINK FAILURES
AUTOMATIC CHANGEOVERS
RECEIVE BUFFER OVERFLOW
RECEIVE BUFFER OVERLOAD
TRANSMIT BUFFER DISCARD
ROUTING AUDIT FAILURES
EXCEPTION REPORTS (THRESHOLDS EXCEEDED) ---
ERRORED SECONDS
DETECTED ERRORS
BYTES RETRANSMITTED
AUTOMATIC CHANGEOVERS
MESSAGE TRANSFER FAILURES ---
LOOPING CCITT7 MSGS
SIG LINK MESSAGES DISCARDED
MSGs DROPPED - DLN/RPC CONGESTION

PAGE 3 OF 5

xx REPT SMR SNPR1 IN PROG

SIGNALING PERFORMANCE ---
CCS7 & CCITT7 PERFORMANCE ---
SIGNALING POINT ISOLATION
LINK SET FAILURE
MESSAGE TRANSFER FAILURES ---
MSUS DISCARDED - ROUTING DATA ERROR

PEG      TIME
COUNT  (SEC.)
-----

SPISP    SPISPT
CLFSP    CLFSPT
```

PAGE 4 OF 5

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**Figure 5-1. Layout of the Scheduled SNPR1 Report (Sheet 3 of 4)**

---

xx REPT SMR SNPR1 IN PROG

|                                    |           |             |             |
|------------------------------------|-----------|-------------|-------------|
| SIGNALING LOAD ---                 | RECEIVED  | TRANSMITTED |             |
| PBX BYTES:                         | BYRL_     | BYXL_       |             |
| PBX MESSAGES:                      | MGMSURL_  | MGMSUXL_    |             |
| PBX Q.931 MSGS:                    | Q931MGRL_ | Q931MGXL_   |             |
| SIGNALING PERFORMANCE ---          |           | PEG         | TIME        |
| PBX PERFORMANCE ---                |           | COUNT       | (SEC.)      |
| SIGNALING PATH FAILURE             |           |             |             |
| DECLARED LINK FAILURE              |           | LPFLDL_     | LPFLDTL_    |
| TEMPORARY LINK FAILURE             |           | LPTMPFLDL_  | LPTMPFLDTL_ |
| RECEIVE BUFFER OVERLOAD            |           | LPBOLRL_    | LPBOLRTL_   |
| TRANSMIT BUFFER FULL EVENTS        |           | XBFFULLL_   | XBFFULLTL_  |
| NUMBER OF LINK RESTARTS            |           | LKESTAB_    |             |
| SIGNALING SWITCHOVERS SUCCESSFUL   |           |             |             |
| SIGNALING SWITCHOVERS FAILURES     |           |             |             |
| MESSAGE TRANSFER FAILURES ---      |           |             |             |
| MSGS RECEIVED FOR UNAVAILABLE LINK |           | MGUNAL_     |             |
| MSGS RECEIVED WITH INVALID ADDRESS |           |             |             |

PAGE 5 OF 5

xx REPT SMR SNPR1 COMPL

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**Figure 5-1. Layout of the Scheduled SNPR1 Report (Sheet 4 of 4)**

### **PBX Signaling Load and Signaling Performance Measurements**

The PBX signaling load and signaling performance measurements identify the number of messages received and transmitted for various PBX message types, and various failure conditions for PBX links (that is, buffer congestion, temporary and declared failures, and link establishment attempts). These are indicators of poor link performance. Also shown are counts of messages discarded due to translation failures. Note that the PBX signaling load and signaling performance measurements are very similar to the CCS7 signal load and signaling performance measurements previously described.

## **Signaling Network Performance Report, Part 2**

---

### **General**

The Signaling Network Performance Report, Part 2 (SNPR2) is a detailed report of signaling link performance. The SNPR2 is output automatically once each day; the data coverage should be 288/288. The purpose of the report is to provide enough detail on each signaling link in the office to allow troubleshooting of faulty links and the compilation of statistical data on each link. Due to the amount of data provided in this report, many pages of output can be expected. Each page of the report is output as a single message; that is, the printer prints each page of the report with no other output interspersed, but the entire report may not be contiguous.

The SNPR2 report and the thirty-minute marginal performance report (30MRP) are the main sources for analyzing link failures and marginal performance. The SNPR2 provides an overview of signaling capabilities for the office giving a detailed description of CCS7 link performance. This report should be checked whenever link problems are indicated. Of particular concern are the counts in the CCS7 link performance sections. Most of this data is an expansion of similar total office data provided on the SNPR1 report. The SNPR2 reports should be compared each day to determine trends in signaling link problems and provide long-term analysis of intermittent problems.

In the link performance sections of the SNPR2 report, data is provided for each equipped link, if all measurements on the particular report line in question are nonzero. If there is no data available for a link, the type field is set to “\*.” The measurements for each link are listed on separate lines with link identification (far-end CLLI code, layer number, link type, group number, and member number) to the left of each. The basic layout of the SNPR2 report is shown in Figure 5-2. The four sections to the report are as follows:

- Header information
- Loss of signaling capability
- CCS7 signaling link performance
- PBX signaling link performance.

### **Header Information**

The header information section provides office identification, report type, time, and data coverage. In addition, this section shows the number of equipped links in the office and the combined active time for all links.

### **Loss of Signaling Capability**

The loss of signaling capability section indicates how often and for how long particular categories of links were unable to provide signaling. The degree that signaling can be impaired is identified as follows:

- a. The emergency restart indicates loss of signaling (banded or ECIS6) to an adjacent office. This data is cumulative for all CCS7 links.
- b. A signaling point isolation indicates loss of signaling to an adjacent office. The count that pegs in this case is the SPI count for the link type of the last link to fail causing the isolation.
- c. A link set failure indicates alternate routing is necessary to the far-end office and all affected destinations. If the link set failure results in failure of the combined link set, then the far-end becomes isolated.

### **CCS7 Signaling Link Performance**

The CCS7 signaling link performance section provides the most important measurements for analyzing CCS7 link performance. The following are the four separate groups of measurements in this section:

- Failed time, errored seconds, detected signal unit errors, and bytes retransmitted
- Automatic changeovers, declared failures, and link set failures
- Signaling point isolations, discarded message signal units, and transmit buffer congestion
- Emergency restarts.

Refer to the CCS7 performance description of the SNPR1 report for important points to consider when analyzing the CCS7 signaling link performance measurements.

### **PBX Signaling Link Performance**

The PBX signaling link performance section provides the most important measurements for analyzing PBX link performance. The following are the three separate groups of measurements in this section:

- Failed time (total, automatic, and manual)
- Declared failures, temporary link failures, number of link establishment attempts, and messages destined for an unavailable link
- Messages with an invalid address, transmit buffer full events, and receive buffer overloads.

xx REPT SMR SNPR2 STARTED

SIGNALING NETWORK PERFORMANCE REPORT - PART II

REPORTING OFFICE: *local CLLI code*                      REPORT INTERVAL: *daily*  
CURRENT GENERIC: *gen\_id*                      AUTOMATIC REPORT  
DATE: *mm/dd/yy*, TIME: *hh:mm:ss*  
REPORT PERIOD (NWT): *mm/dd/yy, hh:mm:ss* THRU *mm/dd/yy, hh:mm:ss*  
DATA COVERAGE: *nnn/288*

|                                  | CCIS6     | CCS7      | CCITT7    | PBX       |
|----------------------------------|-----------|-----------|-----------|-----------|
| TOTAL NO. OF EQUIPPED LINKS:     | <i>nn</i> | <i>nn</i> | <i>nn</i> | <i>nn</i> |
| TOTAL LINK OOS TIME (SECS):      | (Note 1)  | (Note 2)  | (Note 2)  |           |
| DURATION RCV'D PROCESSOR OUTAGE: | L6PORT    | L7PORT    | L7PORT    |           |
| TOTAL NO. OF POOLS/LINK SETS:    | <i>nn</i> | <i>nn</i> | <i>nn</i> | <i>nn</i> |

LOSS OF SIGNALING CAPABILITY ---

-----EMR-----  
PC                      SEC  
A/E LINKS:    EMRA            EMRAT  
B LINKS:       EMRB           EMRBT  
C LINKS:       EMRC           EMRCT

LOSS OF SIGNALING CAPABILITY ---

|            | --CCS7 SPI-- |       | --CCS7 LSF-- |       |
|------------|--------------|-------|--------------|-------|
|            | PC           | SEC   | PC           | SEC   |
| A/E LINKS: | SPIA         | SPIAT | CLFA         | CLFAT |
| B LINKS:   | SPIB         | SPIBT | CLFB         | CLFBT |
| C LINKS:   | SPIC         | SPICT | CLFC         | CLFCT |

LOSS OF SIGNALING CAPABILITY ---

|          | --CCITT7 SPI-- |      | --CCITT7 LSF-- |      |
|----------|----------------|------|----------------|------|
|          | PC             | SEC  | PC             | SEC  |
| W LINKS: | SPI            | SPIT | CLF            | CLFT |

Notes:

1. Sum of L6AFLT and L6MFLT.
2. Sum of L7AFLT and L7MFLT.

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**Figure 5-2. Layout of the Scheduled Daily SNPR2 Report (Sheet 1 of 4)**



xx REPT SMR SNPR2 IN PROG

CCIS6 SIGNALING LINK PERFORMANCE ---

| FAR END CLLI-LAYER | T | GR-MEM | VFL | ---ACO--- |    | -SU-ERR- |    | -SU-RXMT- |    | -R&S-ACU- |    |
|--------------------|---|--------|-----|-----------|----|----------|----|-----------|----|-----------|----|
|                    |   |        |     | PC        | TE | PC       | TE | PC        | TE | PC        | TE |
| nnnn nn nn nnn-nn  | a | nn-nn  | A   | L6ACOB_   |    | SUERB_   |    | SURXB_    |    | AURS_     |    |
| nnnn nn nn nnn-nn  | a | nn-nn  | B   | L6ACOA_   |    | SUERA_   |    | SURXA_    |    | AURS_     |    |

CCIS6 SIGNALING LINK PERFORMANCE ---

| FAR END CLLI-LAYER | T | GR-MEM | OOS-TIME |    |    | -DCL-FLR- |     | --EMR-- |     | -EMR-PO- |     |
|--------------------|---|--------|----------|----|----|-----------|-----|---------|-----|----------|-----|
|                    |   |        | HH       | MM | SS | PC        | SEC | PC      | SEC | PC       | SEC |
| nnnn nn nn nnn-nn  | a | nn-nn  | (Note 1) |    |    | L6FLD_    |     | EMR_    |     | EMRPO_   |     |
| nnnn nn nn nnn-nn  | a | nn-nn  | (Note 1) |    |    | L6FLD_    |     | EMR_    |     | EMRPO_   |     |

CCIS6 SIGNALING LINK PERFORMANCE ---

| FAR END CLLI-LAYER | T | GR-MEM | ---XMIT BUFFER--- |    | --OVLD-- |     | PRO XMTD |     | PRO-RCVD |     |
|--------------------|---|--------|-------------------|----|----------|-----|----------|-----|----------|-----|
|                    |   |        | OVFL              | PC | PC       | SEC | PC       | SEC | PC       | SEC |
| nnnn nn nn nnn-nn  | a | nn-nn  | L6B0FX            |    | L6B0LX_  |     | L6P0X_   |     | L6P0R_   |     |
| nnnn nn nn nnn-nn  | a | nn-nn  | L6B0FX            |    | L6B0LX_  |     | L6P0X_   |     | L6P0R_   |     |

CCIS7 SIGNALING LINK PERFORMANCE ---

| FAR END CLLI-LAYER | T | GR-MEM | ---ACO--- |    | --ERSEC-- |    | --CRCER-- |    | -BYT-RXMT |    |
|--------------------|---|--------|-----------|----|-----------|----|-----------|----|-----------|----|
|                    |   |        | PC        | TE | PC        | TE | PC        | TE | PC        | TE |
| nnnn nn nn nnn-nn  | a | nn-nn  | L7ACO_    |    | ERSEC_    |    | CRCER_    |    | BYRX_     |    |
| nnnn nn nn nnn-nn  | a | nn-nn  | L7ACO_    |    | ERSEC_    |    | CRCER_    |    | BYRX_     |    |

CCIS7 SIGNALING LINK PERFORMANCE ---

| FAR END CLLI-LAYER | T | GR-MEM | OOS-TIME |    |    | ----LSF--- |      | --DCL-FLR- |        |
|--------------------|---|--------|----------|----|----|------------|------|------------|--------|
|                    |   |        | HH       | MM | SS | PC         | SEC  | PC         | SEC    |
| nnnn nn nn nnn-nn  | a | nn-nn  | (Note 2) |    |    | CLF        | CLFT | L7FLD      | L7FLDT |
| nnnn nn nn nnn-nn  | a | nn-nn  | (Note 2) |    |    | CLF        | CLFT | L7FLD      | L7FLDT |

Notes:

1. Sum of L6AFLT and L6MFLT.
2. Sum of L7AFLT and L7MFLT.

Figure 5-2. Layout of the Scheduled Daily SNPR2 Report (Sheet 2 of 4)

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xx REPT SMR SNPR2 IN PROG
CCS7 SIGNALING LINK PERFORMANCE ---
                                ---XMIT BUFFER---
                                MSURMV  CONG-LEV1  PRO-XMTD  PRO-RCVD
FAR END CLLI-LAYER T GR-MEM      PC  PC  SEC  PC  SEC  PC  SEC
-----
nnnn nn nn nnn-nn  a nn-nn  (NOTE 1) L7LCON1X_  L7POX_  L7POR_
nnnn nn nn nnn-nn  a nn-nn  (NOTE 1) L7LCON1X_  L7POX_  L7POR_
CCS7 SIGNALING LINK PERFORMANCE ---
                                --EMR--  --EMR-P0--  --SPI--  --SPI-P0--
FAR END CLLI LAYER T GR-MEM      PC SEC  PC  SEC  PC  SEC  PC  SEC
-----
nnnn nn nn nnn-nn  a nn-nn  L7EMR_  L7EMRPO_  SPI_  SPIP_
nnnn nn nn nnn-nn  a nn-nn  L7EMR_  L7EMRPO_  SPI_  SPIP_
CCITT7 SIGNALING LINK PERFORMANCE ---
                                --ACO--  --ERSEC--  --CRCER--  --BYT-FORRX-
FAR END CLLI-LAYER T GR-MEM      PC TE  PC  TE  PC  TE  PC  TE
-----
nnnn nn nn nnn-nn  a nn-nn  L7ACO_  ERSEC_  CRCER_  FORRXBY
nnnn nn nn nnn-nn  a nn-nn  L7ACO_  ERSEC_  CRCER_  FORRXBY
CCITT7 SIGNALING LINK PERFORMANCE ---
                                OOS-TIME  ----LSF---  --DCL-FLR-
FAR END CLLI-LAYER T GR-MEM      HH MM SS  PC  SEC  PC  SEC
-----
nnnn nn nn nnn-nn  a nn-nn  (NOTE 2) CLF  CLFT  L7FLD L7FLDT
nnnn nn nn nnn-nn  a nn-nn  (NOTE 2) CLF  CLFT  L7FLD L7FLDT
CCITT7 SIGNALING LINK PERFORMANCE ---
                                ---XMIT BUFFER---
                                MSURMV  CONG-LEV1  PRO-XMTD  PRO-RCVD
FAR END CLLI-LAYER T GR-MEM      PC  PC  SEC  PC  SEC  PC  SEC
-----
nnnn nn nn nnn-nn  a nn-nn  (NOTE 1) L7LCON1X_  L7POX_  L7POR_
nnnn nn nn nnn-nn  a nn-nn  (NOTE 1) L7LCON1X_  L7POX_  L7POR_
CCITT7 SIGNALING LINK PERFORMANCE ---
                                ----SPI----  ----SPI-P0----
FAR END CLLI-LAYER T GR-MEM      PC  SEC  PC  SEC
-----
nnnn nn nn nnn-nn  a nn-nn  SPI_  SPIP_
nnnn nn nn nnn-nn  a nn-nn  SPI_  SPIP_

```

**Notes:**

1. Sum of MSUDISC0, MSUDISC1, and MSUDISC2.
2. Sum of L7AFLT and L7MFLT.

**Figure 5-2. Layout of the Scheduled Daily SNPR2 Report (Sheet 3 of 4)**

xx REPT SMR SNPR2 IN PROG

PBX SIGNALING LINK PERFORMANCE ---

| TYPE | GR-MN-C-P | OOS TIM<br>HR MIN | OOS-AUTO<br>(SEC) | OOS-MAN<br>(SEC) | SIG FLR<br>PC SEC |
|------|-----------|-------------------|-------------------|------------------|-------------------|
| ---- | -----     | -----             | -----             | -----            | -----             |
| aaaa | nn-nn-n-n | LP_FLTL_          | LPAFLTL_          | LPMFLTL_         | LPSPFAIL_         |
| aaaa | nn-nn-n-n | LP_FLTL_          | LPAFLTL_          | LPMFLTL_         | LPSPFAIL_         |

PBX SIGNALING LINK PERFORMANCE ---

| TYPE | GR-MN-C-P | DCL FLR<br>PC SEC | TMP LK FLR<br>PC SEC | LINK<br>RESTARTS | MSGS RCV<br>UNAVL |
|------|-----------|-------------------|----------------------|------------------|-------------------|
| ---- | -----     | -----             | -----                | -----            | -----             |
| aaaa | nn-nn-n-n | LPFLD_            | LPTMPFL_             | LKESTAB_         | MGUNAL_           |
| aaaa | nn-nn-n-n | LPFLD_            | LPTMPFL_             | LKESTAB_         | MGUNAL_           |

PBX SIGNALING LINK PERFORMANCE ---

| TYPE | GR-MN-C-P | MSGS RCV<br>INVLD ADDR | XMT BUF FULL<br>NODE SEC | RCV BUF OVLD<br>NODE SEC | SWITCHOVR<br>SUC FLD |
|------|-----------|------------------------|--------------------------|--------------------------|----------------------|
| ---- | -----     | -----                  | -----                    | -----                    | -----                |
| aaaa | nn-nn-n-n | MGRUAL_                | XBFFULL_                 | LPBOLR_                  | LPSWITCH LPINSWITCH  |
| aaaa | nn-nn-n-n | MGRUAL_                | XBFFULL_                 | LPBOLR_                  | LPSWITCH LPINSWITCH  |

**Figure 5-2. Layout of the Scheduled Daily SNPR2 Report (Sheet 4 of 4)**

## Signaling Equipment Performance Report

The Signaling Equipment Performance Report (SEPR) is a detailed report on node performance. It is output once each day; the data coverage should be 288/288. The purpose of the report is to provide a profile of each node's status for the reporting period.

The report should be examined to note any excessive counts. Of particular concern are the automatic out-of-service (OOS) count and duration (OOSAU\_), and reconfigured OOS count and duration (OOSCFG\_) columns. This is especially true with the RPC node section. Proper RPC operation is critical to the message switching function.

Any node out of service may be caused by node processor or ring interface problems. In the case of a link node, the problem may also be caused by poor link performance. When a link is declared failed, the node is automatically removed from service to perform diagnostics. However, keep in mind that a normal link is not necessarily declared failed when the node is removed due to

other problems. Likewise, in the case of an RPCN, it may be caused by D-channel node (DSCH) problems. The report may indicate problems with a specific node or the ring in general.

The SEPR report does not provide a detailed analysis of why a node failed. Out-of-service counts and durations are provided for each node according to the major cause of the change to the OOS or standby state.

Three conditions that are mutually exclusive in effect may cause this report to be generated: Automatic action due to a node or link fault, Manual action, and Ring reconfiguration affecting a normally operating node.

Also, a total count of the number of times the node restarted for any reason is provided. The following are a few points to consider when interpreting this report:

- The duration counts are cumulative for all occurrences (that is, not associated with a single occurrence).
- The OOS counts indicate the *initial* reason for a node being removed. The node maintenance state may change without affecting the OOS measurements as long as the major state remains the same. For example, a node removed due to failing diagnostics causes the OOS automatic count to peg. Later changing the node state to MOOS does not cause the OOS manual count to peg.
- Each SADC or DCHN node serves up to eight PBX links. When the node is OOS, the links are unavailable.

The data is provided, one node per line, with group and member number identification to the left. If a node had not been in the OOS state at any time during the reporting period, then it is not shown in the report. The basic layout of the SEPR report is shown in Figure 5-3. The five sections to the report are as follows:

1. Header information
2. CCS7 link node performance
3. SADC link node performance
4. DCHN link node performance
5. Ring peripheral controller node (RPCN) performance.

xx REPT SMR SEPR STARTED  
SIGNALING EQUIPMENT PERFORMANCE REPORT

REPORTING OFFICE: *local CLI code*      REPORT INTERVAL: *daily*  
CURRENT GENERIC: *gen\_id*      AUTOMATIC REPORT  
DATE: *mm/dd/yy*, TIME: *hh:mm:ss*  
REPORT PERIOD (NWT): *mm/dd/yy, hh:mm:ss* THRU *mm/dd/yy, hh:mm:ss*  
DATA COVERAGE: *nnn/288*

## CCIS6 LN PERFORMANCE

| GRP       | MEM       | ERROR   | OOS_AUTO |        | OOS_MAN |        | OOS_CNFG |         |
|-----------|-----------|---------|----------|--------|---------|--------|----------|---------|
| NUM       | NUM       | COUNT   | COUNT    | SEC    | COUNT   | SEC    | COUNT    | SEC     |
| ---       | ---       | -----   | -----    | -----  | -----   | -----  | -----    | -----   |
| <i>nn</i> | <i>nn</i> | RSTTRMT | 00SAU    | 00SAUT | 00SMN   | 00SMNT | 00SCFG   | 00SCFGT |
| <i>nn</i> | <i>nn</i> | RSTTRMT | 00SAU    | 00SAUT | 00SMN   | 00SMNT | 00SCFG   | 00SCFGT |

## CCS7 LN PERFORMANCE

| GRP       | MEM       | ERROR   | OOS_AUTO |        | OOS_MAN |        | OOS_CNFG |         |
|-----------|-----------|---------|----------|--------|---------|--------|----------|---------|
| NUM       | NUM       | COUNT   | COUNT    | SEC    | COUNT   | SEC    | COUNT    | SEC     |
| ---       | ---       | -----   | -----    | -----  | -----   | -----  | -----    | -----   |
| <i>nn</i> | <i>nn</i> | RSTTRMT | 00SAU    | 00SAUT | 00SMN   | 00SMNT | 00SCFG   | 00SCFGT |
| <i>nn</i> | <i>nn</i> | RSTTRMT | 00SAU    | 00SAUT | 00SMN   | 00SMNT | 00SCFG   | 00SCFGT |

## SADC LN PERFORMANCE

| GRP       | MEM       | ERROR   | OOS_AUTO |        | OOS_MAN |        | OOS_CNFG |         |
|-----------|-----------|---------|----------|--------|---------|--------|----------|---------|
| NUM       | NUM       | COUNT   | COUNT    | SEC    | COUNT   | SEC    | COUNT    | SEC     |
| ---       | ---       | -----   | -----    | -----  | -----   | -----  | -----    | -----   |
| <i>nn</i> | <i>nn</i> | RSTTRMT | 00SAU    | 00SAUT | 00SMN   | 00SMNT | 00SCFG   | 00SCFGT |
| <i>nn</i> | <i>nn</i> | RSTTRMT | 00SAU    | 00SAUT | 00SMN   | 00SMNT | 00SCFG   | 00SCFGT |

## DCHN LN PERFORMANCE

| GRP       | MEM       | ERROR   | OOS_AUTO |        | OOS_MAN |        | OOS_CNFG |         |
|-----------|-----------|---------|----------|--------|---------|--------|----------|---------|
| NUM       | NUM       | COUNT   | COUNT    | SEC    | COUNT   | SEC    | COUNT    | SEC     |
| ---       | ---       | -----   | -----    | -----  | -----   | -----  | -----    | -----   |
| <i>nn</i> | <i>nn</i> | RSTTRMT | 00SAU    | 00SAUT | 00SMN   | 00SMNT | 00SCFG   | 00SCFGT |
| <i>nn</i> | <i>nn</i> | RSTTRMT | 00SAU    | 00SAUT | 00SMN   | 00SMNT | 00SCFG   | 00SCFGT |

## RPC NODE PERFORMANCE

| GRP       | MEM       | ERROR   | OOS_AUTO |        | OOS_MAN |        | OOS_CNFG |         |
|-----------|-----------|---------|----------|--------|---------|--------|----------|---------|
| NUM       | NUM       | COUNT   | COUNT    | SEC    | COUNT   | SEC    | COUNT    | SEC     |
| ---       | ---       | -----   | -----    | -----  | -----   | -----  | -----    | -----   |
| <i>nn</i> | <i>nn</i> | RSTTRMT | 00SAU    | 00SAUT | 00SMN   | 00SMNT | 00SCFG   | 00SCFGT |
| <i>nn</i> | <i>nn</i> | RSTTRMT | 00SAU    | 00SAUT | 00SMN   | 00SMNT | 00SCFG   | 00SCFGT |

xx REPT SMR SEPR COMPL

**Figure 5-3. Layout of the Scheduled Daily SEPR Report**

## **Machine Performance Report**

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### **General**

The Machine Performance Report (MPR) is a total office report that is output automatically for each hour (the data coverage should be 12/12) and once for the entire day (data coverage 288/288). Make particular note of the time of the report. The purpose of the report is to provide an overall view of the message switching capability for the office.

The report does not provide detailed measurements for each link or node. The MPR shows cumulative counts for the entire office. This report can be used to determine the message switching status of the office in general (that is, the number of times it initialized and how long CCS messages were not processed) or the status of the ring in general (that is, node OOS counts, ring reconfigurations, and ring congestion levels).

This report should be checked daily for counts indicating ring node failures or degraded ring performance. The hourly reports from many periods should be compared for trends and abnormalities. Keep in mind that a high count on one report is not necessarily an indication of problems. Also, the same count(s) occurring at the same time each day may point to externally induced problems. If problems are indicated, the user should then refer to the Signaling Equipment Performance Report (SEPR) or Ring Exception (RINGEX) report for detailed measurements of specific nodes.

The basic layout of the MPR report is shown in Figure 5-4. The following are the seven sections to the MPR report:

1. Header information
2. System initializations
3. No message signal unit processing
4. RPCN performance
5. Link node (LN) performance
6. Ring performance
7. Internal congestion.

xx REPT SMR MPR STARTED  
MACHINE PERFORMANCE REPORT

REPORTING OFFICE: *local clli code* REPORT INTERVAL: *hourly or daily*  
CURRENT GENERIC: *gen\_id* AUTOMATIC REPORT  
DATE: *mm/dd/yy* TIME: *hh:mm:ss*  
REPORT PERIOD (NWT): *mm/dd/yy, hh:mm:ss* THRU *mm/dd/yy, hh:mm:ss*  
DATA COVERAGE: *nnn/288*

## SYSTEM INITIALIZATIONS

|     | LEVEL-0 |         | LEVEL-1 |         | LEVEL-1A |         | LEVEL-1A |         |
|-----|---------|---------|---------|---------|----------|---------|----------|---------|
|     | COUNT   | SEC     | COUNT   | SEC     | COUNT    | SEC     | COUNT    | SEC     |
| CNI | CINIT0  | CINIT0T | CINIT1  | CINIT1T | N/A      |         | N/A      |         |
| IMS | INIT0   | INIT0T  | N/A     |         | INIT1A   | INIT1AT | INIT1A   | INIT1AT |

## SYSTEM INITIALIZATIONS

|     | LEVEL-2 |         | LEVEL-3 |         | LEVEL-4 |         |
|-----|---------|---------|---------|---------|---------|---------|
|     | COUNT   | SEC     | COUNT   | SEC     | COUNT   | SEC     |
| CNI | CINIT2  | CINIT2T | CINIT3  | CINIT3T | CINIT4  | CINIT4T |
| IMS | N/A     |         | INIT3   | INIT3T  | INIT4   | INIT4T  |

## NO MESSAGE SIGNAL UNIT PROCESSING

| COUNT | SEC   |
|-------|-------|
| NOCMG | NOCMG |

RPC/DLN NODE PERFORMANCE - RPC COUNT: *nn*

| ERRORS  | OOS-AUTO |        | OOS-MAN |        | OOS-CNFG |        |
|---------|----------|--------|---------|--------|----------|--------|
| COUNT   | COUNT    | SEC    | COUNT   | SEC    | COUNT    | SEC    |
| RSTTRMT | OOSAU    | OOSAUT | OOSMN   | OOSMNT | OOSCFG   | OOSCFG |

LN NODE PERFORMANCE - LN COUNT: *nn*

| ERRORS  | OOS-AUTO |        | OOS-MAN |        | OOS-CNFG |        |
|---------|----------|--------|---------|--------|----------|--------|
| COUNT   | COUNT    | SEC    | COUNT   | SEC    | COUNT    | SEC    |
| RSTTRMT | OOSAU    | OOSAUT | OOSMN   | OOSMNT | OOSCFG   | OOSCFG |

**Figure 5-4. Layout of the Scheduled MPR Report (Sheet 1 of 2)**

## RING PERFORMANCE

| SNGL ISOLAT<br>COUNT | SEC     | MULT ISOLAT<br>COUNT | SEC     | RING DOWN<br>COUNT | SEC   | MAN NODE ISOLAT<br>COUNT | SEC    |
|----------------------|---------|----------------------|---------|--------------------|-------|--------------------------|--------|
| -----                |         | -----                |         | -----              |       | -----                    |        |
| SRNIAU               | SRNIAUT | MRNIAU               | MRNIAUT | RDWN               | RDWNT | RNIMN                    | RNIMNT |

## INTERNAL CONGESTION

|                         | OVERFLOW<br>LEVEL_1 | OVERFLOW<br>LEVEL_2 | OVERFLOW<br>LEVEL_3 |
|-------------------------|---------------------|---------------------|---------------------|
|                         | -----               | -----               | -----               |
| RPC RING RECEIVE BUFFER | RRBOVFLW1           | RRBOVFLW2           | RRBOVFLW3           |
| LN RING RECEIVE BUFFER  | N/A                 | RRBOVFLW2           | RRBOVFLW3           |

xx REPT SMR MPR COMPL

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**Figure 5-4. Layout of the Scheduled MPR Report (Sheet 2 of 2)****Header Information**

The header information contains the following:

- Office identification
- Report type
- Time
- Data coverage.

**System Initializations**

The system initialization section shows how many times specific levels occurred and how long for each subsystem. The application starts the CNI initialization, and the CNI starts IMS. Since initialization of each subsystem is triggered by a higher level subsystem, the counts for a particular level are normally the same for all subsystems. A few points to consider when interpreting the measurements in this section are as follows:

- A UNIX RTR Operating System or application level 1 leads to either a 1A or 1B IMS level; there is no level 1 in the IMS initialization strategy. The message switch is stopped by the level 1B but not by the level 1A.



- Levels 0, 1, 1A, or 1B do not include a boot.
- The UNIX RTR Operating System 5x levels generally correspond to the application x levels.

The meaning of each initialization level is as follows:

- |                         |                                                                                                                    |
|-------------------------|--------------------------------------------------------------------------------------------------------------------|
| 0 — Audit Level:        | No interruption of message switching. This is currently not implemented.                                           |
| 1 — Recovery level:     | Process communication and data tables are reinitialized. No processes are recreated but some messages may be lost. |
| 3 — Lowest boot level:  | All processes are recreated and RPCs are pumped.                                                                   |
| 4 — Highest boot level: | All processes are recreated and all nodes are pumped.                                                              |

### **No Message Signal Unit Processing**

The “No message signal unit performance” section indicates how many times the CNI entered a state in which CCS messages could not be processed. This should be at least the sum of the IMS levels 1B, 3, and 4; although the state could occur without an initialization.

### **RPC Node Performance**

The RPCN performance section provides out-of-service counts and durations, for RPCs in general, according to the major cause of the change to the OOS or standby state. The following are the three conditions, all mutually exclusive in effect, that may cause this report to be generated:

- Automatic action due to a node or link fault
- Manual action
- Ring reconfiguration affecting a normally operating node.

Also, a cumulative count of the number of times any node restarted for any reason is provided. The data provided in this section and the LN Performance section is similar to the per-node data in the signaling equipment performance report (SEPR).

The following list contains a few points to consider when interpreting the measurements:

- The OOS counts indicate the initial reason for a node being removed. The node maintenance state may change without affecting the OOS measurements as long as the major state remains the same. For example, a node removed due to failing diagnostics causes the OOS

automatic count to peg. Later changing the node state to MOOS does not cause the OOS manual count to peg.

- A node changing to the OOS state does not necessarily result in a corresponding ring reconfiguration, shown under Ring Performance. If the state of the ring interface hardware is quarantined usable, the node may be OOS yet still part of the active ring.

### **Link Node (LN) Performance**

The link node performance section provides out-of-service counts and durations for link nodes in general according to the major cause of the change to the OOS or standby state. The data shown is the sum for CCS7 and PBX link nodes.

### **Ring Performance**

The ring performance section provides a profile of ring performance during the reporting period, including counts and durations of automatic ring isolations, manual ring isolations, and ring down time. The following list contains a few points to consider when interpreting the data:

- An isolated segment is considered automatically generated if the most recently isolated node is isolated by automatic action. If the most recently isolated node is isolated by manual action, the isolated segment is considered manually generated. The RNIMN count pegs for zero, one, or more nodes isolated.
- The single and multiple node isolation durations are mutually exclusive.
- Multiple node isolated segments are of particular concern not only due to their larger impact on message switching, but also because multiple node isolated segments may contain normally operating nodes that are innocent victims of the reconfiguration. Quick restoration of these nodes is important.
- When growing nodes, first manually reconfigure the ring with an isolated segment (zero nodes isolated) where the nodes are to be grown.
- The ring has two transient states, *configuring* and *restoring*, and three quiescent states, *normal*, *isolated*, and *down*. These are minor maintenance states. Only the down state is explicitly counted. The total ring normal time, including transient states, is the reporting period less single and multiple isolation times and less ring down time.

## Internal Congestion

The internal congestion section indicates the general level of congestion in the ring. A RPC count pegs each time any RPC node enters a particular level of ring-receive buffer congestion. A link node count pegs each time any LN or PBX node enters a particular level of ring receive buffer congestion. The buffers become congested if IMS is delivering messages to the node faster than processing the messages already in the buffers. The congestion controls become progressively more severe as the occupancy level of the buffer increases; at RPC level 1, LNs are warned of imminent overflow at their home RPC. The following are a few points to consider when interpreting the data:

- Messages are discarded only in IUNs. However, the RPC congestion levels are more critical for two reasons: (1) all IUNs are affected by them, and (2) communication between the central processor and ring is affected.
- There are both IMS actions and CNI actions based on the congestion level. The CNI actions are intended to preclude any discarding of messages by IMS. For more information on the number of messages discarded, refer to the `DRP_MSG_` measurements.
- The IMS maintenance-type messages are affected only at level 4 congestion.

## Fifteen-Minute Marginal Performance Report

### General

The Fifteen-Minute Marginal Performance Report (15MPR) is a detailed exception report of signaling link performance that can be output automatically each 15 minutes. The 15MPR is output only if one of the measurements contained in the report exceeds some predefined threshold. The purpose of the report is to identify links that are showing marginal performance. The 15MPR provides a set of measurements that indicate various problems with the link, such as parity errors in received signal units, alignment problems, excessive changeovers, or excessive downtime.

This report should be checked whenever link problems are indicated. The fifteen-minute reports from many periods should be compared for trends and abnormalities. Look for failures associated with an individual link, a group of links, or a particular far-end office.

The basic layout of the 15MPR report is shown in Figure 5-5.

xx RING REPT SMR A15MPR15 STARTED  
MACHINE RESOURCE PERFORMANCE REPORT

REPORTING OFFICE: local clli           REPORT INTERVAL: hourly or daily  
CURRENT GENERIC: gen\_id           AUTOMATIC REPORT  
DATE: mm/dd/yy, TIME: hh:mm:ss  
REPORT PERIOD (NWT): mm/dd/yy, hh:mm:ss THRU mm/dd/yy, hh:mm:ss  
DATA COVERAGE: nnn/288

| IDLE<br>TIME | KERN<br>TIME | KPROC<br>TIME | USER<br>TIME | PAGES<br>SWAPIN | PAGES<br>SWAPOUT | APS<br>DKRATE | PROC<br>CRTD | PROC<br>TERM |  |  |  |  |  |  |  |  |  |  |  |
|--------------|--------------|---------------|--------------|-----------------|------------------|---------------|--------------|--------------|--|--|--|--|--|--|--|--|--|--|--|
| %040         | %020         | %025          | %011         | 000000          | 000000           | 0009          | 0119         | 0120         |  |  |  |  |  |  |  |  |  |  |  |
| CCS7         | BYTES        | MSUS          | FLD          | DLN             | BASE/            | BLOCKS        | MESGS        | ERR          |  |  |  |  |  |  |  |  |  |  |  |
| NODES        | IN/OUT       | IN/OUT        | CNT          | NODES           | TBSY             | IN/OUT        | IN/OUT       | IN/OUT       |  |  |  |  |  |  |  |  |  |  |  |
| 00-01        | 00015514     | 00000775      | 000          | 00-05           | 088515           | 00000823      | 00001917     | 000015       |  |  |  |  |  |  |  |  |  |  |  |
|              | 00016160     | 00000794      |              |                 | 000288           | 00004115      | 00004432     | 000000       |  |  |  |  |  |  |  |  |  |  |  |
| 00-06        | 00000000     | 00000000      | 000          | 00-10           | 088542           | 00000000      | 00000000     | 000000       |  |  |  |  |  |  |  |  |  |  |  |
|              | 00000000     | 00000000      |              |                 | 000000           | 00000000      | 00000000     | 000000       |  |  |  |  |  |  |  |  |  |  |  |
| 00-08        | 00000000     | 00000000      | 000          | 32-05           | 088532           | 00002729      | 00003031     | 000000       |  |  |  |  |  |  |  |  |  |  |  |
|              | 00000000     | 00000000      |              |                 | 000128           | 00000937      | 00002195     | 000000       |  |  |  |  |  |  |  |  |  |  |  |
| 00-12        | 00000000     | 00000000      | 000          | 32-10           | 088541           | 00000000      | 00000000     | 000000       |  |  |  |  |  |  |  |  |  |  |  |
|              | 00000000     | 00000000      |              |                 | 000000           | 00000000      | 00000000     | 000000       |  |  |  |  |  |  |  |  |  |  |  |
| 06-02        | 00000000     | 00000000      | 000          |                 |                  |               |              |              |  |  |  |  |  |  |  |  |  |  |  |
|              | 00000000     | 00000000      | 000          |                 |                  |               |              |              |  |  |  |  |  |  |  |  |  |  |  |
| 06-02        | 00000000     | 00000000      | 000          |                 |                  |               |              |              |  |  |  |  |  |  |  |  |  |  |  |
|              | 00000000     | 00000000      | 000          |                 |                  |               |              |              |  |  |  |  |  |  |  |  |  |  |  |
| 06-07        | 00000000     | 00000000      | 000          |                 |                  |               |              |              |  |  |  |  |  |  |  |  |  |  |  |
|              | 00000000     | 00000000      | 000          |                 |                  |               |              |              |  |  |  |  |  |  |  |  |  |  |  |
| 32-01        | 00025678     | 00001376      | 000          |                 |                  |               |              |              |  |  |  |  |  |  |  |  |  |  |  |
|              | 00027789     | 00001456      | 000          |                 |                  |               |              |              |  |  |  |  |  |  |  |  |  |  |  |
| 32-06        | 00000000     | 00000000      | 000          |                 |                  |               |              |              |  |  |  |  |  |  |  |  |  |  |  |
|              | 00000000     | 00000000      | 000          |                 |                  |               |              |              |  |  |  |  |  |  |  |  |  |  |  |
| 32-08        | 00000000     | 00000000      | 000          |                 |                  |               |              |              |  |  |  |  |  |  |  |  |  |  |  |
|              | 00000000     | 00000000      | 000          |                 |                  |               |              |              |  |  |  |  |  |  |  |  |  |  |  |
| 32-12        | 00000000     | 00000000      | 000          |                 |                  |               |              |              |  |  |  |  |  |  |  |  |  |  |  |
|              | 00000000     | 00000000      | 000          |                 |                  |               |              |              |  |  |  |  |  |  |  |  |  |  |  |
| 38-02        | 00000000     | 00000000      | 000          |                 |                  |               |              |              |  |  |  |  |  |  |  |  |  |  |  |
|              | 00000000     | 00000000      | 000          |                 |                  |               |              |              |  |  |  |  |  |  |  |  |  |  |  |
| 38-07        | 00000000     | 00000000      | 000          |                 |                  |               |              |              |  |  |  |  |  |  |  |  |  |  |  |
|              | 00000000     | 00000000      | 000          |                 |                  |               |              |              |  |  |  |  |  |  |  |  |  |  |  |
| 08/08/90     | 08:01:09     | #007879       |              |                 |                  |               |              |              |  |  |  |  |  |  |  |  |  |  |  |

xx RING REPT SMR A15MPR15 COMPL

**Figure 5-5. Layout of the Scheduled 15MPR Report**

## **Thirty-Minute Marginal Performance Report**

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### **General**

The Thirty-Minute Marginal Performance Report (30MPR) is a detailed exception report of signaling link performance and can be output automatically each 30 minutes (the data coverage should be 6/6). The 30MPR is output only if one of the measurements contained in the report exceeds some predefined threshold. The purpose of the report is to identify links that are showing marginal performance. This report provides a set of measurements that indicate various problems with the link, such as parity errors in received signal units, alignment problems, excessive changeovers, or excessive downtime.

This report should be checked whenever link problems are indicated. The thirty-minute reports from many periods should be compared for trends and abnormalities. Look for failures associated with an individual link, a group of links, or a particular far-end office.

If any measurement in a particular section exceeds its threshold as specified in the measurement output control table (MOCT), all equipped links are printed in that section. Those measurements that exceed their threshold are identified by an “\*”. If no measurements in a section exceed their threshold, the section is not printed. Depending on how many links are included in the report, there may be many pages of output.

The basic layout of the 30MPR report is shown in Figure 5-6. The following list contains the four sections to this report:

1. Header information
2. CCS7 links
3. CCS7 clusters
4. PBX links.

### **Header Information**

The header information section provides the following:

- Office identification
- Report type
- Time
- Data coverage.

xx REPT SMR 30MPR STARTED

SIGNALING LINK 30 MINUTE MARGINAL PERFORMANCE REPORT

REPORTING OFFICE: *local clli*                      REPORT INTERVAL: *half hourly*  
 CURRENT GENERIC: *gen\_id*                      AUTOMATIC REPORT  
 DATE: *mm/dd/yy*, TIME: *hh:mm:ss*  
 REPORT PERIOD (NWT): *mm/dd/yy, hh:mm:ss* THRU *mm/dd/yy, hh:mm:ss*  
 DATA COVERAGE: *nnn/288*

CCIS6 LINKS:

| FAR END CLLI-LAYER T GR-MEM VFL | OOS TIM<br>MIN SEC | SU ERR | SU RXMT | AURS  |
|---------------------------------|--------------------|--------|---------|-------|
| -----                           | -----              | -----  | -----   | ----- |
| nnnn nn nn nnn-nn a nn-nn B     | (NOTE 1)           | SUERB  | SURXB   | AURS  |
| nnnn nn nn nnn-nn a nn-nn A     | (NOTE 1)           | SUERA  | SURXA   | AURS  |

CCIS6 LINKS:

| FAR END CLLI-LAYER T GR-MEM VFL | AUT CHG OVER | CB SM   |
|---------------------------------|--------------|---------|
| -----                           | -----        | -----   |
| nnnn nn nn nnn-nn a nn-nn B     | L6ACOB       | L6CBSMB |
| nnnn nn nn nnn-nn a nn-nn A     | L6ACOA       | L6CBSMA |

CCIS6 LINKS:

| FAR END CLLI-LAYER T GR-MEM | OOS TIM<br>MIN SEC | CRCER | BY RX | AUTO<br>CHG OVER |
|-----------------------------|--------------------|-------|-------|------------------|
| -----                       | -----              | ----- | ----- | -----            |
| nnnn nn nn nnn-nn a nn-nn   | (NOTE 2)           | CRCER | BYRX  | L7ACO            |
| nnnn nn nn nnn-nn a nn-nn   | (NOTE 2)           | CRCER | BYRX  | L7ACO            |

CCS7 LINKS:

| FAR END CLLI-LAYER T GR-MEM | ERSEC | UNVL  |
|-----------------------------|-------|-------|
| -----                       | ----- | ----- |
| nnnn nn nn nnn-nn a nn-nn   | ERSER | UNVL  |
| nnnn nn nn nnn-nn a nn-nn   | ERSER | UNVL  |

Notes:

1. Calculated from L6CCTA or L6ACTB (the description details how to derive total link OOS time)
2. This is the sum of L7AFLT and L7MFLT.

Figure 5-6. Layout of the Scheduled 30MPR Report (Sheet 1 of 2)

## CCS7 CLUSTERS:

| CLUSTER | TYPE  | ROUTE SET UNAVAILABLE |           |
|---------|-------|-----------------------|-----------|
|         |       | COUNT                 | SEC       |
| -----   | ----- | -----                 | -----     |
| aaa     | aaaa  | RTESETUN              | RTESETUNT |

xx REPT SMR 30MPR IN PROG

## PBX LINKS:

| TYPE | GR-MN-C-P | OOS TIME<br>(MINS) | ERSEC   | CRCER   |
|------|-----------|--------------------|---------|---------|
| ---- | -----     | -----              | -----   | -----   |
| aaaa | nn-nn-n-n | LP_FLTL_           | ERSECL_ | CRCERL_ |
| aaaa | nn-nn-n-n | LP_FLTL_           | ERSECL_ | CRCERL_ |

## PBX LINKS:

| TYPE | GR-MN-C-P | BY RX  | MSG RXMT | MSG RCV'ed<br>FOR UNA LINK | PROTOCOL<br>EX RCVD |
|------|-----------|--------|----------|----------------------------|---------------------|
| ---- | -----     | -----  | -----    | -----                      | -----               |
| aaaa | nn-nn-n-n | BYRXL_ | MGRXL_   | MGUNAL_                    | PROTEXRL_           |
| aaaa | nn-nn-n-n | BYRXL_ | MGRXL_   | MGUNAL_                    | PROTEXRL_           |

## PBX LINKS:

| TYPE | GR-MN-C-P | NUMBER OF LINK<br>RESTARTS | TEMP LINK FAIL<br>TIME (SEC) |
|------|-----------|----------------------------|------------------------------|
| ---- | -----     | -----                      | -----                        |
| aaaa | nn-nn-n-n | LKESTAB_                   | LPTMPFLT_                    |
| aaaa | nn-nn-n-n | LKESTAB_                   | LPTMPFLT_                    |

xx REPT SMR 30MPR COMPL

**Figure 5-6. Layout of the Scheduled 30MPR Report (Sheet 2 of 2)****CCS7 Links**

The CCS7 links section provides two groups of measurements. The *first group* contains the total OOS time, a count of signal units received with parity errors, a count of bytes retransmitted, and the number of automatic changeovers initiated from the link. The *second group* contains the number of errored seconds and the percentage of total time the link is unavailable. The following list contains some points to consider when interpreting these measurements:

- Errored seconds is the number of 1-second intervals during which signal units were received with errors, not a count of signal unit errors. An excess of detected errors such as CRCER could cause the link to be declared failed.

- Since the changeover/changeback sequence on a CCS7 link involves more extensive data retrieval than on a CCIS 6 link, the same number of changeovers could cause a longer link downtime.

### CCS7 Clusters

The CCS7 cluster section shows peg counts and durations for each equipped cluster, local and remote. The counts indicate the CNI office is unable to route messages to any destination in the indicated cluster. Note that the corresponding link set failure count also pegs when a route set becomes unavailable.

### PBX Links

The PBX links section provides two groups of measurements. The *first group* contains the total OOS time, the number of errored seconds, and a count of signal units received with parity errors. The *second group* contains the counts of bytes and messages retransmitted, a count of messages received with format errors, and a count of messages received with protocol exceptions.

### Five-Minute Ring Exception Report

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The Five-Minute Ring Exception (RINGEX) report is a detailed exception report of RPC congestion status and can be output automatically every 5 minutes (the data coverage should be 1/1). The report is output only if one of the measurements contained in the report exceeds some predefined threshold. If no measurements exceeded their thresholds, the message **NO RPC OVERFLOWS ENCOUNTERED** is output.

The purpose of the report is to identify RPC nodes experiencing various levels of congestion and should be used in conjunction with the machine performance report (MPR) to determine possible causes of the congestion and appropriate actions to relieve it. Give particular attention to overflow levels 2 and 3 (RRBOVFLW2\_ and RRBOVFLW3\_).

This is a one-page report with the basic layout shown in Figure 5-7. The following are two sections to this report:

1. Header information
2. Details of congestion status.

The header information includes office identification, report type, time, and data coverage. The details of congestion status identifies data relevant to congested RPCN ring receive buffers. Congestion of the RPCN ring receive buffers indicates messages are being sent to the RPCN faster than it can process them. The report shows peg counts for levels 0, 1, 2, and 3 and duration counts for



levels 1, 2, and 3. All IUNs are notified of their home RPCN's congestion status. A few points to consider when interpreting the measurements are:

- Level 0 is the normal no discard state. Messages are discarded at higher levels (only in IUNs however).
- The peg count indicates how many times the buffer occupancy reached the indicated level.

xx REPT SMR RINGEX STARTED  
RPC OVERFLOW REPORT

REPORTING OFFICE: local clli code      REPORT INTERVAL: five minutes  
CURRENT GENERIC: gen\_id                      AUTOMATIC REPORT  
DATE: mm/dd/yy,    TIME: hh:mm:ss  
REPORT PERIOD (NWT): mm/dd/yy, hh:mm:ss    THRU mm/dd/yy, hh:mm:ss  
DATA COVERAGE: nnn/001

| GRP MEM |     | OVFLW LVL 0 | OVFLW LVL 1 | OVFLW LVL 2 | OVFLW LVL 3 |
|---------|-----|-------------|-------------|-------------|-------------|
| NUM     | NUM | PC          | PC    TIME  | PC    TIME  | PC    TIME  |
| -----   |     | -----       | -----       | -----       | -----       |
| nn      | nn  | RRBOVFLW0   | RRBOVFLW1_  | RRBOVFLW2_  | RRBOVFLW3_  |
| nn      | nn  | RRBOVFLW0   | RRBOVFLW1_  | RRBOVFLW2_  | RRBOVFLW3_  |

xx REPT SMR RINGEX COMPL

**Figure 5-7. Layout of the Scheduled RINGEX Report**

## Description of Critical Events

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### Introduction

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The CCS Network Critical Events (CNCE) are predefined events that are considered indicators of abnormal network operation. They are of primary importance to both network operation and the proper functioning of the office. Both on-site and support system personnel must be immediately aware of events affecting the CCS network. The CNCE messages are output as the critical events occur. The critical event messages provide necessary real-time monitoring of the CCS network.

The CNCE messages are output as critical events occur in the office or as network events are recognized and acted upon. There are approximately 70 critical events in a CNI system. Some critical events pertain to the CCS network in general, while others have significance to the CNI also. A CNCE could represent an occurrence, the beginning of some state, or the ending of some state. Events indicating the beginning or ending of a state should occur in pairs, if not, investigate. A critical event never represents a length of time.

The following naming convention used for critical events is similar to the naming convention used for measurements.

- a. The mnemonic represents as closely as possible the actual event. The mnemonic is derived from a set of abbreviations representing typical signaling events. These abbreviations are combined to describe the event.
- b. The suffix **E** means the state indicated by the mnemonic has ended.
- c. Names may include letters, digits, or special characters.
- d. Names are unique and contain no more than 12 characters.

The names given to critical events are used by the measurement output control table (MOCT). The MOCT controls the reporting of critical events.

### Critical Event Logging

---

The recognition of critical events, occurrences to be reported, takes place in the central processor. The following information is provided to the central processor:

- a. Identification of the event that occurred (the CNCE name)
- b. If required, identification of the peripheral units involved.

Upon recognition of critical events, a CNCE message (**REPT CNCE**) is immediately output to users and automatically recorded in a critical event log file. This log file is a circular file stored on disk (/etc/log/CNCELOG). It is anticipated that the file contains a minimum of 90 minutes of the most recent CNCE messages. The messages in the log file can be retrieved. The file can be output using the **OP:LOG;CNCELOG** message. Refer to the *Input/Output Manual* for a description. Support system users cannot use this command when communications are via BX.25 data links.

The CNCE messages are sent to users both locally and at various support system centers. The office has several operation, administration, and maintenance organizations involved in its day-to-day functioning. These support systems use BX.25 data links for reception of critical event messages.

Critical event messages are generated by the critical event handler in short and long forms. The short form is intended mainly for support systems which have a reference data base containing details on the hardware identified. The long form is meant for use by the maintenance work force. Therefore, detailed information, in addition to what the short form provides, must be included. In particular, office identification (CLLI code), speed, type, layer (or SLK code), and protocol of the link must be included with the long form. If applicable, the long form also includes the VFL identification, function number, or subsystem number. When a critical event occurs, the log file is sent a long form message identifying the critical event.

The MOCT critical event table controls the reporting of critical events. This table includes information indicating which users are to be informed of any particular critical event. The critical event table also designates what form, long or short, of the message that a user receives. When the critical event handler records the message in the log file, a message is also sent to any users specified in the critical event table. Automatic reporting of critical events is in real time.

The following are examples of long and short CNCE messages. Refer to the *Output Message Manual* for a description of the fields in a CNCE message. Note that a CNCE message cannot be generated by an input command:

```
REPT CNCE
C7LCABM1X 14:00:36:59 7 02-00      ATLN_GA_TL_MS2_06 56. A
(Long form)
```

```
REPT CNCE
C7LCABM1X 14:00:36:59 7 02-00
(Short form)
```

## **Common Channel Signaling Network Critical Events Descriptions**

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The event names appearing in CNCE output messages are derived from the MOCT. Critical events that are reported by the CNCE messages are identified and described in Table 5-1. The descriptions are presented alphabetically by event name. Note that the table shows data provided by the CNCE message enclosed in parentheses. This field is either the group and member, point code, or link set identification.

Often an occurrence not only causes a CNCE message, but is also counted as a measurement. Some of the critical events in the table can be better understood by referring to the corresponding measurement. The corresponding measurement contains a more detailed description of certain "events." The measurement name should be similar to the critical event name.

**Table 5-I. Common Channel Signaling (CCS) Network Critical Event (CNCE) Descriptions**

| Name (Data)         | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| C7ACB<br>(gg-mm)    | Changeback from a failure that is not a declared failure. This is an automatic changeback to a link that previously did an automatic changeover and then restored. The changeback must normally occur within 3 minutes of the changeover. If the link interface reports a long key exchange is taking place, this time period is extended to 10 minutes. This event occurs for all automatic changebacks exclusive of the C7ACBFLD event. Refer to the L7ACO_ measurements for a description of the changeover/changeback sequence. This event is usually preceded by a C7ACO_ event.                                                                                                                                                                                                             |
| C7ACBFLD<br>(gg-mm) | Automatic changeback from declared failure. This event indicates the link is declared failed, has recovered, and traffic has been routed back to the link. This event is preceded by one of the C7FLD_ events (see these descriptions for more information on declared failure). Note that if a link is in the MOOS state and an emergency condition automatically forces the link back into service (called preemption), the C7MCB event occurs rather than this event.                                                                                                                                                                                                                                                                                                                          |
| C7ACOCOV<br>(gg-mm) | Automatic changeover initiated by the far end. A changeover involves transferring signaling messages from the unavailable link to other links. These could be any links in the combined link set or C-links. In the case of a C-link failing, the changeover results in messages being load balanced over the other available C-links. The changeover message and the acknowledgment are both sent on some other link in the specified link's set. When the changeover order is received from the far-end, this event occurs and either an automatic changeover or emergency changeover is initiated. An <b>emergency changeover</b> is done when the far-end indicates messages were received out of sequence or when the link node is out of service. The following is the changeover sequence: |

**Table 5-I. Common Channel Signaling (CCS) Network Critical Event (CNCE) Descriptions (Contd)**

| Name (Data)                    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| C7ACOCOV<br>(gg-mm)<br>(Contd) | <ol style="list-style-type: none"> <li>1. The link is removed from service and new messages are not given to the link node (message handling pauses).</li> <li>2. A changeover acknowledgment is sent to the far end on some other link in the set.</li> <li>3. Messages remaining in the transmit and retransmit buffers are retrieved and are transmitted in sequence on other links. An <b>emergency changeover</b> does not attempt the retrieval from the retransmit buffer. If the link node is out of service or the link failed due to a near-end PRO, no retrieval is done.</li> <li>4. Message handling resumes with new messages to the other links.</li> <li>5. Only synchronization messages are sent on this link.</li> </ol> <p>In the case of an automatic changeover, the link changes back when sync is regained. Then, it is "proven in" (from 3 to 15 seconds required) and restored. The CCS messages are routed back to the restored link. If the link cannot sync and change back within 3 minutes, 10 minutes if a long key exchange is involved, it is declared failed.</p> |
| C7ACOER<br>(gg-mm)             | Automatic changeover error threshold has been exceeded. The error rate monitor in the link interface has reported excessive signal unit errors. The monitor is described in more detail under the C6ACOER event. Similar actions to those described for the C7ACOCOV event are taken.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| C7ALCIF<br>(gg-mm)             | Automatic link check (ACF) failure for international links only. When a link is declared failed (a C7FLD_ event), the ALC is initiated. If the ALC is not successful within 15 seconds from the link failure, this event occurs.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

**Table 5-I. Common Channel Signaling (CCS) Network Critical Event (CNCE) Descriptions (Contd)**

| <b>Name (Data)</b>   | <b>Description</b>                                                                                                                                                                                                                                                                                                                |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| C7ALTR<br>(Linkset)  | Reports when an alternate or lower priority route is invoked for signaling traffic previously routed over a primary or higher priority route, as a result of either re-routing or changeover procedure.                                                                                                                           |
| C7ALTRE<br>(Linkset) | Reports when a priority or higher priority route is invoked for signaling traffic previously routed over an alternate or lower priority route as a result of either a re-routing or changeover procedure.                                                                                                                         |
| C7DBE                | Double bit error. An uncorrectable ULN memory error has occurred.                                                                                                                                                                                                                                                                 |
| C7FLDCOL<br>(gg-mm)  | Declared link failure due to a 1-minute continuous receive buffer overload. This event is followed by a changeover, assuming it is not denied due to a blocked path. The link is removed from service and is diagnosed.                                                                                                           |
| C7FLDCOV<br>(gg-mm)  | Declared link failure due to an automatic changeover initiated by the far-end. The changeover lasted more than 3 minutes, 10 minutes if a long key exchange is involved. Actions are taken as described under the C7FLDCOL event except no diagnostics are attempted and the changeover (the C7ACOCOV event) precedes this event. |
| C7FLDER<br>(gg-mm)   | Declared link failure due to error threshold exceeded. This is caused by an excessive number of received signal units in error. Actions are taken as described under the C7FLDCOV event except the changeover (the C7ACOER event) precedes this event.                                                                            |
| C7FLDSNT<br>(gg-mm)  | Declared link failure due to a sanity check failure. This failure is due to either software or hardware problems causing abnormal node operation. Automatic diagnostics attempt to determine the problem. Actions are taken as described under the C7FLDCOL event.                                                                |

**Table 5-I. Common Channel Signaling (CCS) Network Critical Event (CNCE) Descriptions (Contd)**

| <b>Name (Data)</b>   | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| C7LCABM1X<br>(gg-mm) | Transmit buffer level 1 congestion ends. Buffer occupancy has dropped below the threshold for level 1 abatement after transmit buffer congestion. Messages are not being discarded.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| C7LCABM2X<br>(gg-mm) | Transmit buffer level 2 congestion ends. Buffer occupancy has dropped below the threshold for level 2 abatement after transmit buffer congestion. The node reverts to level 1 discard.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| C7LCABM3X<br>(gg-mm) | Transmit buffer level 3 congestion ends. Buffer occupancy has dropped below the threshold for level 3 abatement after transmit buffer congestion. The node reverts to level 2 discard.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| C7LCDIS1X<br>(gg-mm) | <p>Transmit buffer level 1 congestion discard begins. Buffer occupancy has reached the threshold for level 1 discard to be initiated. The SS7 discard strategy (for level 1, 2, or 3) is as described below:</p> <p>The node first checks the priority of a message before transmitting it. The priority is contained in the service information octet field and is compared with the congestion state of the transmit buffer. If the priority is less than the congestion level, the message is removed and a return message may be sent. The return message is sent only if the return indicator in the received message is set. If the message to be transmitted is a unit data type SCCP message, a UDS message is created and returned to the originator. If the priority of the message is equal to or greater than the congestion level, it is transmitted.</p> <p>This event does not occur again, at least until buffer occupancy drops below the level 1 abatement threshold (signaled by the C7LCABM1X event).</p> |
| C7LCDIS2X<br>(gg-mm) | Transmit buffer level 2 congestion discard begins. Buffer occupancy has reached the threshold for level 2 discard to be initiated. The C7LCDIS1X event describes the discard strategy.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |



**Table 5-I. Common Channel Signaling (CCS) Network Critical Event (CNCE) Descriptions (Contd)**

| <b>Name (Data)</b>   | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| C7LCDIS3X<br>(gg-mm) | Transmit buffer level 3 congestion discard begins. Buffer occupancy has reached the threshold for level 3 discard to be initiated. At this point, all messages are being discarded. The C7LCDIS1X event describes the discard strategy.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| C7LCON1X<br>(gg-mm)  | Transmit buffer level 1 congestion onset begins. The congestion onset thresholds (level 1, 2, or 3) are higher than the corresponding abatement levels but lower than the corresponding discard levels. At each onset level, the node reports the congestion state to the central processor. Network management messages (transfer controlled) are then broadcast to adjacent signaling points to limit messages to the affected node. To avoid further congestion of the transmit buffer, the far end initiates the discard strategy used by nodes at the discard level, described under the C7LCDIS1X event. If the node remains in the same congestion level (1, 2, or 3) for 60 seconds, it is taken OOS and diagnosed. |
| C7LCON2X<br>(gg-mm)  | Transmit buffer level 2 congestion onset begins. Messages are being discarded according to the level 1 strategy. The node reports the level 2 congestion state to the central processor. Actions are taken as described under the C7LCON1X event.                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| C7LCON3X<br>(gg-mm)  | Transmit buffer level 3 congestion onset begins. Messages are being discarded according to the level 2 strategy. The node reports the level 3 congestion state to the central processor. Actions are taken as described under the C7LCON1X event.                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| C7LSF<br>(Linkset)   | Link set failure begins. When the last available link in the set fails, this event occurs. If the failure of the link set results in failure of the associated combined link set, another C7LSF CNCE message is output with the combined link set identification. The end of this event is signaled by the C7LSFE event.                                                                                                                                                                                                                                                                                                                                                                                                    |

**Table 5-I. Common Channel Signaling (CCS) Network Critical Event (CNCE) Descriptions (Contd)**

| <b>Name (Data)</b>            | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| C7LSF<br>(Linkset)<br>(Contd) | The CLF_ measurements describe the various link set failure scenarios. If this failure causes some destination to become isolated from this office (for example, the combined link set has failed), this event is accompanied by a C7SPI event.                                                                                                                                                                                                                                                                                                                                                   |
| C7LSFE<br>(Linkset)           | Link set failure ends. When any link in the set restores, this count pegs.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| C7MCB<br>(gg-mm)              | Manual changeback from manual changeover. This event occurs either due to manually restoring the link, at the near-end or far-end, or due to preemption of the MOOS state by an emergency condition. When the link regains sync, a changeback declaration is sent to the far end. The link state is changed to OOS and new messages are diverted back to the link. Until all acknowledgments are received, these messages are not transmitted; these messages are diverted to other links, if the link fails to return to service. Note that this event occurs before the link is made available. |
| C7MCOF<br>(gg-mm)             | Far-end manual changeover request has been received, usually due to a need for link changes or maintenance. The far end has requested and permission has been granted to initiate a changeover. Either a changeover or emergency changeover is initiated. The sequence is described under the C7ACOCOV event.                                                                                                                                                                                                                                                                                     |
| C7MCON<br>(gg-mm)             | Near-end manual changeover due to local maintenance action. The changeover could be denied if removing the link from service would cause the far-end to become inaccessible. This end requests permission from the far-end to initiate a changeover; the far end recognizes a C7MCOF event. If the far-end grants permission, either a changeover or emergency changeover is initiated. The sequence is described under the C7ACOCOV event.                                                                                                                                                       |
| C7POR<br>(gg-mm)              | Adjacent processor outage event begins; the end of this event is signaled by the C7PORE event. Refer to the C6POR description.                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

**Table 5-I. Common Channel Signaling (CCS) Network Critical Event (CNCE) Descriptions (Contd)**

| <b>Name (Data)</b>              | <b>Description</b>                                                                                                                                                                                                                                                                                                             |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| C7PORE<br>(gg-mm)               | Adjacent processor outage event ends. Refer to the C6PORE description.                                                                                                                                                                                                                                                         |
| C7RRBOVFLW0<br>(Node Processor) | ULN RRB has entered overflow State 0 and has remained in that state for a specified period of time. This message is not generated again until the next re-entry of the RRB into this state. This is normal, no-overflow state.                                                                                                 |
| C7RRBOVFLW1<br>(Node Processor) | ULN RRB has entered overflow State 1 and has remained in that state for a specified period of time. This message is not generated again until the next re-entry of the RRB into this state. No IMS action, just a warning to user.                                                                                             |
| C7RRBOVFLW2<br>(Node Processor) | ULN RRB has entered overflow State 2 and has remained in that state for a specified period of time. This message is not generated again until the next re-entry of the RRB into this state. All non-IMS messages received on active ring are discarded.                                                                        |
| C7RRBOVFLW3                     | ULN RRB has entered overflow State 3 and has remained in that state for a specified period of time. This is the highest level of overflow. This message is not generated again until the next re-entry of the RRB into this state. All messages received on active ring are discarded.                                         |
| CTRERR<br>(Point Code)          | Reports that the MTP received an outgoing signaling message with a distinction point code that does not have any routing data.                                                                                                                                                                                                 |
| C7SPI<br>(Point Code)           | An adjacent signaling point isolation begins due to local failure. A link failed causing a complete failure of all signaling paths to the indicated destination from this office. This condition is usually accompanied by a C7LSF event. The end is indicated by the C7SPIE event. See the SPI_ measurements for more detail. |
| C7SPIE<br>(Point Code)          | Adjacent signaling point isolation ends. Some failed path to the indicated destination has restored due to a local link set recovery. This event indicates the destination is no longer isolated from this office.                                                                                                             |

**Table 5-I. Common Channel Signaling (CCS) Network Critical Event (CNCE) Descriptions (Contd)**

| <b>Name (Data)</b>     | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| C7SPIO<br>(Point Code) | An adjacent signaling point isolation begins due to a far-end processor outage. A link failed due to receiving PROs from the far end causing a complete failure of all signaling paths to the indicated destination from this office. The end of this condition is indicated by the C7SPIE event. See the C7SPI description.                                                                                                                                                                                                                                                                                           |
| C7SSAF<br>(Subsystem)  | Received a subsystem allowed message. Receiving an SSA message indicates the subsystem, either local or nonlocal, has become allowed. The SSA messages sent by the far end are in response to subsystem status test messages, and the SSP messages sent by the far end are in response to signaling messages destined for a prohibited subsystem. This event and the following C7SSPF event occur only if the following conditions are met: <ol style="list-style-type: none"> <li>1. The indicated subsystem is in the same region</li> <li>2. It is simplex or duplex with the mate subsystem prohibited.</li> </ol> |
| C7SSPF<br>(Subsystem)  | Received a subsystem prohibited message. Receiving an SSP message indicates the subsystem, either local or nonlocal, has become prohibited causing it to be blocked. However, an SSP concerning a subsystem at an inaccessible point code is ignored and does not cause this event, any SSP broadcast, or any routing update. Refer to the C7SSAF description for more detail.                                                                                                                                                                                                                                         |
| CPALCIF<br>(PBX Only)  | Automatic link check (ALC) failure on the specified link. When a link is declared failed, the CPFLD or CPFLDNS event, the ALC is initiated. If the ALC is not successful within 15 seconds from the link failure, this event occurs.                                                                                                                                                                                                                                                                                                                                                                                   |
| CPARSFLD<br>(PBX Link) | Automatic return to service from a declared failure.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

**Table 5-I. Common Channel Signaling (CCS) Network Critical Event (CNCE) Descriptions (Contd)**

| <b>Name (Data)</b>     | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CPDIS<br>(PBX Link)    | A duplex D-channel link has transitioned from the temporary out-of-service (OOS) state to the in-service (IS) state.                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| CPDOOS<br>(PBX Link)   | A duplex D-channel link has transitioned to the temporary OOS state.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| CPDSERVF<br>(PBX Link) | A SERV message exchange has failed on the specified D-channel link. The SERV message is sent several times and, if no acknowledgment is received (T321 timer expires), this event occurs. This indicated either a Layer 3 protocol problem, a provisioning problem, or a hardware failure other than facility failure. This event occurs when a link attempts to transition to the in-service (IS) state. Note that since the SERV message exchange is not done for standby links, a standby link could have latent Layer 3 problems.                                 |
| CPDSTBY<br>(PBX Link)  | A duplex D-channel link has transitioned to the standby (STBY) state. If the link was in declared failure, this event indicates it has recovered.                                                                                                                                                                                                                                                                                                                                                                                                                     |
| CPDUMOOS<br>(PBX Link) | The mate D-channel link fails while the indicated link is in the manual out-of-service (MOOS) state. No switchover occurs until manual action removes the MOOS state. If the link remains in the MOOS state, the system attempts to recover the mate link normally. This event is a warning of possible service outage.                                                                                                                                                                                                                                               |
| CPFLD<br>(PBX Link)    | Declared link failure (this only applies to PBX links with diagnostic). The link state is change to OOS, and the central processor is informed. For a D-channel link failure, this event indicates a signaling path failure; therefore, any associated B-channels are removed from service. There are various reasons for the failure, including the following:<br><br>Layer 1 protocol down (probably failure of DS0 or DS1, no explicit indication of L1 failure)<br><br>Layer 2 protocol down (protocol exceptions and inability to establish link within 90 sec.) |

**Table 5-I. Common Channel Signaling (CCS) Network Critical Event (CNCE) Descriptions (Contd)**

| <b>Name (Data)</b>             | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CPFLD<br>(PBX Link)<br>(Contd) | DDS code received.<br>Disconnect message received from far end<br>Level 2 error threshold exceeded (usually facility problems).                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| CPFLDNS<br>(PBX Link)          | Non-signaling declared link failure of a mated link. The signaling path is still available on the backup link. The link state is changed to OOS. For the reasons for this event, see the CPFLD description.                                                                                                                                                                                                                                                                                                                                                                        |
| CPMOOSE<br>(PBX Link)          | Manual out of service ends.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| CTREDAL<br>(PBX Node)          | Red alarm declared (near-end DS1 facility failure). This is the second most severe trouble condition for a PBX node (see the CT1FAFL description). This event obstructs sensing of the yellow alarm condition. Note that this means there may be no explicit clearing of any yellow alarm in progress (normally indicated by the CTYELALC event).                                                                                                                                                                                                                                  |
| CTREDALC<br>(PBX Node)         | Red alarm cleared. Any yellow alarm in progress is also cleared.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| CT1FAFL<br>(PBX Node)          | T1 facility access (T1FA) hardware/firmware failure begins. The most severe type of trouble reported by the T1FA control node. This event means a T1FA unit has failed and any associated links are affected. Expect subsequent CPFLD critical event messages as those links are removed from service. This event obstructs sensing of the red and yellow alarm conditions (refer to the CTREDAL description). Note that this means there may be no explicit clearing of any red or yellow alarm in progress (normally indicated by the CTREDALC or CTYELALC event, respectively). |
| CT1FARCVRY<br>(PBX Node)       | T1FA hardware/firmware failure ends.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| CTYELAL<br>(PBX Node)          | Yellow alarm declared.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

**Table 5-I. Common Channel Signaling (CCS) Network Critical Event (CNCE) Descriptions (Contd)**

| <b>Name (Data)</b>           | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                               |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CTYELALC<br>(PBX Node)       | Yellow alarm declared.                                                                                                                                                                                                                                                                                                                                                                                                           |
| HSLAIS<br>(Node Processor)   | T1 Alarm Indication Signal (AIS)/Blue Signal begins. An AIS carrier failure condition (CFC) or blue alarm condition is declared to have occurred when a loss-of-frame (LOF) condition is declared and the unframed signal stream consists of virtually all " 1 " bits. That is, a blue-alarm condition is propagated by transmitting an unframed signal stream consisting of virtually all " 1s " pulses.                        |
| HSLAISE<br>(Node Processor)  | T1 Alarm Indication Signal/Blue Signal Ends. See HSLAIS.                                                                                                                                                                                                                                                                                                                                                                         |
| HSLFFER<br>(Node Processor)  | T1 Frame Format Error Rate Alarm begins. A frame-format-error-rate (FFER) condition is declared to have occurred when either a loss-of-frame (LOF) condition occurs or ten consecutive seconds occur where, during each of the ten seconds, the signal was so degraded to be called a "Severely Errored Second (SES)."                                                                                                           |
| HSLFFERE<br>(Node Processor) | T1 Frame Format Error Rate Alarm ends. See HSLFFERE.                                                                                                                                                                                                                                                                                                                                                                             |
| HSLLOF<br>(Node Processor)   | T1 Red Carrier Failure Alarm/Red Carrier Group Alarm begins. A loss-of-frame (LOF) or carrier failure condition (CFC) occurs when a loss-of-signal condition or an out-of-frame (OOF) condition (due to signal framing bit errors) occurs for some prescribed time and duty cycle/density.<br><br>A red LOF or CFC condition occurs when there is a LOF or CRC condition and the signal bits are not virtually all " 1 " pulses. |
| HSLLOFE<br>(Node Processor)  | T1 Red Carrier Failure Alarm/Red Carrier Group Alarm ends. See HSLLOF.                                                                                                                                                                                                                                                                                                                                                           |

**Table 5-I. Common Channel Signaling (CCS) Network Critical Event (CNCE) Descriptions (Contd)**

| <b>Name (Data)</b>            | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HSLLOS<br>(Node Processor)    | T1 Loss-of-Signal (LOS)/Line Format Violation Rate begins. A loss-of-signal condition is declared in the absence of signal pulses for some prescribed period.<br><br>A line-format violation (LFV) occurs when there is a violation of the prescribed signal pulse polarity sequences. When these pulse polarity violations or LFVs occur faster than some specified rate, then an LFV Rate (LFVR) failure condition is declared.                                                      |
| HSLLOSE<br>(Node Processor)   | T1 Loss of Signal/Line Format Violation Rate ends. See HSLLOS.                                                                                                                                                                                                                                                                                                                                                                                                                         |
| HSLRAI<br>(Node Processor)    | T1 Yellow Carrier Failure Alarm begins. A yellow alarm-carrier-frame condition (CFC) signal consists of sending repeating patterns of eight " 1s " followed by eight " 0s " on the extended super frame - data link (ESF-DL). The 4 Kbps ESF-DL is derived by using/stealing some small number of bits from each ESF. The ESF-DL is a relatively low bandwidth derived (maintenance) data link that gets interleaved with the 1.536 Mbps payload signal into the 1.544 Mbps T1 signal. |
| HSLRAIE<br>(Node Processor)   | T1 Yellow Carrier Failure Alarm ends. See HSLRAI.                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| RINGDOWN<br>(Node Processor)  | Ring-Down Condition has been Detected. A ring-down condition is identified when the IMS measurement RDWN is pegged. The RDWN peg count is incremented whenever the ring maintenance state is changed to indicate that the entire ring is down; that is, it is unusable. All nodes peg the OOSAU, OOSCFG, or OOSMN count when this occurs (depending on their maintenance states).                                                                                                      |
| RINGDOWNE<br>(Node Processor) | Ring-Down Condition has Ended. See RINGDOWN.                                                                                                                                                                                                                                                                                                                                                                                                                                           |



## **Measurement Output Control Table**

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### **Overview**

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The Measurement Output Control Table (MOCT) is used to control the format, frequency, destination, and content of network critical event messages and measurement reports. The following five tables are contained in the MOCT:

1. Critical Event Table (CET)
2. User View Descriptor Table (UVDT)
3. Exception Table (EXCP)
4. History File Descriptor Table (HFDT)
5. Scheduler Table (SCHD).

The CET enables users to select which critical event messages they wish to receive. A threshold can be assigned to a particular critical event which will either permit or prevent the critical event message from being transmitted. By use of the threshold, notification of a particular critical event can be stopped for a while and then resumed again later. The user can also elect to receive either a long or short form of the critical event message.

This flexibility also applies to reporting measurements. Users can define reports tailored to their specific needs. These flexible format reports can contain as many measurements as the CNI. The presence of a particular set of measurements in a report can be made contingent upon the measurement values. The measurement values can be drawn from files covering different periods of time. A report can be generated on a regular basis or when the user requests it. In short, a measurement report can be whatever the user specifies it to be in the MOCT.

It is the responsibility of the user to have an operational, administrative, and maintenance plan for the MOCT. If unmanaged, an inconsistent flow or even a loss of data and reports could result. Someone in the user's organization must take the responsibility to define which of the many possible plans is the most effective for meeting the needs and capabilities of the network. Once the plan for the operation, administration, and maintenance of the MOCT is determined, the initial CNI MOCT can be administered. The initial MOCT has been designed according to the input of users. As the need of the user changes, the MOCT changes to reflect the changes of the user.

## Critical Event Table

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A CCS network critical event is an event occurring in the network due to the result of an abnormality in network operations or as a potential cause of abnormalities. Messages that report such events are called CCS network critical event (CNCE) messages. There are a variety of critical events that can be reported by the office. Since not all critical event messages are desired by a network monitor, the Critical Event Table (CET) provides a means of selecting the ones desired to be delivered to a specified destination in the proper format. Each critical event may be directed to several destinations where each destination is represented by an output class number.

Critical event messages can be output in long or short form. The user specifies whether the long or short form is desired in the "message type" field of the CET entry. The short critical event message contains the critical event name, network time of occurrence, association field, and virtual link number. The long critical event message contains the same data items as the short critical event message plus the Common Language Location Identifier (CLLI), link speed and protocol, link type, and VFL ID.

The threshold determines whether a report is generated and sent to a particular destination. For this application, the threshold has two states (on and off). The threshold is on when it equals 1; and consequently, the report is generated and sent to the destination as defined. But in the off state, when it equals zero, the report is not generated or sent to the specified destination. The use of the off state is for user flexibility. With this flexibility, a user can receive a particular critical event message if desired. Should the user elect not to receive a particular critical event message, all that is required is to perform a recent change on the threshold value. It should be noted, however, that changing the threshold affects all users assigned to the specified destination class. The following is a sample entry in the CET:

---

| CRITICAL EVENT       |              |           |
|----------------------|--------------|-----------|
| EVENT NAME: c6fldcol |              |           |
| DESTINATION          | MESSAGE TYPE | THRESHOLD |
| 001                  | cmcesrpt     | 1         |
| 002                  | cmcelrpt     | 0         |
| 133                  | cmcesrpt     | 0         |
| 232                  | cmcelrpt     | 1         |

---

In the CET, all critical events are assigned to the destination representing the critical event log file. The critical event log file is a circular log file in the central processor. All critical event messages are sent to this log file in an on-occurrence basis. Critical event messages are stored in this log file in short form only. The log file receives all critical event messages and stores them until log file buffers are full. Once the log file is filled, the oldest CNCE messages are discarded to make room for a new CNCE message that the log file receives.

A user can look up a critical event message which has recently occurred by accessing the critical event log file. In the 4ESS switch application, the critical event log file is identified as "CNILOG". To access the critical event log file, the PDS command *OP:LOG:CNILOG* is used. If the user enters this option only, all the critical events contained in the critical event log file (CNILOG) are be printed. The user must specify additional options to receive specific data from the critical event log file (CNILOG). Refer to AT&T IM-4A001-01—**4ESS Switch/APS Input Message Manual** for all applicable options and a description of each.

The event name, destination, message type, and threshold values for the initial critical event table (CET) are identified in Table 5-J.

## **Administering Measurement Reports**

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The purpose of the remaining tables that comprise the MOCT is to specify how, what, when, and where to generate measurement reports for users. Measurements provide past, raw statistics of performance, while critical events reflect current conditions of the CNI. Measurements are periodically collected by the CNI and are stored in memory and on disk. Although the measurement process is constant, the software only collects the measurements every 5 minutes. Reporting of the CNI's performance is said to be in nonreal time, since the data contained in these reports is not immediately relayed to the user. The measurements or statistics are presented to users in measurement reports. Reports present the selected measurements in a form acceptable to users, be it a fixed format or flexible format. The fixed format reports are predefined reports whose output is specifically designed and therefore, should not be changed. Although the user has the ability to change the contents of these fixed format reports, the report generator designated for these reports cannot be changed. Thus, the designed output limits the user's ability to change the contents of these reports. The flexible format reports are defined by the user to attain a report tailored to a user's specific needs. These reports can be defined and redefined, via recent change procedures, as the user's needs change.

There are four tables used to define the contents of a particular report. These are the User View Descriptor Table, Exception Table, History File Descriptor Table, and Scheduler Table. Each of these tables is described in the following paragraphs.

**Table 5-J. Initial Critical Event Table**

| <b>Event Name</b> | <b>Destination</b> | <b>Message Type</b> | <b>Threshold</b> |
|-------------------|--------------------|---------------------|------------------|
| C7ACB             | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7ACBFLD          | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7ACOCOV          | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7ACOER           | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7BOLR            | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7BOLRE           | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7FLDCOL          | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7FLDCOV          | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7FLDER           | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7FLDSNT          | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7LCABM1X         | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7LCABM2X         | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7LCABM3X         | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7LCDIS1X         | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7LCDIS2X         | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7LCDIS3X         | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |

**Table 5-J. Initial Critical Event Table (Contd)**

| <b>Event Name</b> | <b>Destination</b> | <b>Message Type</b> | <b>Threshold</b> |
|-------------------|--------------------|---------------------|------------------|
| C7LCON1X          | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| CPARSFLD          | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| CPMOOS            | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| CTREDAL           | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7LCON2X          | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7LCON3X          | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7LSF             | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7LSFE            | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7MCB             | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7MCOF            | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7MCON            | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7POR             | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7POR             | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7PORE            | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7SPI             | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7SPIE            | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |
| C7SPIPO           | 64                 | Long                | 1                |
|                   | 65                 | Short               | 1                |

**Table 5-J. Initial Critical Event Table (Contd)**

| Event Name | Destination | Message Type | Threshold |
|------------|-------------|--------------|-----------|
| CPFLD      | 64          | Long         | 1         |
|            | 65          | Short        | 1         |
| CPMOOSE    | 64          | Long         | 1         |
|            | 65          | Short        | 1         |
| CTREDALC   | 64          | Long         | 1         |
|            | 65          | Short        | 1         |
| CTYELAL    | 64          | Long         | 1         |
|            | 65          | Short        | 1         |
| CT1FAFL    | 64          | Long         | 1         |
|            | 65          | Short        | 1         |
| CTYELALC   | 64          | Long         | 1         |
|            | 65          | Short        | 1         |
| CT1FARCVRY | 64          | Long         | 1         |
|            | 65          | Short        | 1         |

The first step in defining any measurement report is to define the measurement IDs desired in the report. This is done in the User View Descriptor Table (UVDT). This table simply contains lists of measurement IDs grouped under different view names. This view name is then used to reference the list of measurement IDs when generating the report.

The next step is to assign each measurement a threshold if this option is desired. If a threshold value is assigned to a measurement, the measurement value must exceed the threshold value in order to be included in the specified report. The assignment of thresholds to measurement IDs is done in the Exception Table (EXCP).

The next step in defining a measurement report is to define the source of the measurement values. As discussed earlier, measurements are gathered every 5 minutes. These 5-minute blocks of data are stored in the core memory in a file called LPM. Every 5 minutes, the LPM file is accumulated to form a file covering 15 minutes. The resultant 15-minute file and each subsequently accumulated history file is stored on disk. Therefore, the information in a measurement report is gathered from one of two sources:

1. LPM—In-core 5-minute data structure containing measurements collected for the last 5 minutes.
2. History file—On disk multiples of 15-minute coverages.

All sources contain the same number of measurement items. Each source differs only in the time of day covered or the length of time covered in any particular file. The history file descriptor table (HFDT) describes how various history files are accumulated.

The final step in the MOCT's generation of a report is to gather all the ingredients of the report at the specified time and output the report to the specified destination(s). This task is performed by the Scheduler Table (SCHD). There are two ways to generate a report:

1. **Scheduled:** Internal stimulus as a history file is completed. Once a history file is completed, the Scheduler Table is scanned for all entries which use the newly created history file as its source. From these entries, using the newly completed history file, a report is generated for each entry specifying the present time for activation of the report.
2. **Demanded:** OP:SMR command as stimulus. A user can specify the ingredients of a report in the Scheduler Table and not specify that the report be generated at any certain time. The user can then request or demand the report at any time with the **OP:SMR** input command.

### User View Descriptor Table

The User View Descriptor Table (UVDT) contains the lists of measurement IDs that the user designates for particular reports. Each list of measurement IDs is assigned a user view name. This view name is used as a reference to access the list of measurement IDs contained in a measurement report. Each user has different needs and therefore, requests different measurement IDs in their measurement reports. Each view name, assigned in the UVDT, defines the contents of one or more reports.

To create a new report, a new view name must be added to the UVDT. This new view name must have all the measurement IDs for the report assigned to it. To change the content of an existing report, the user must add or delete measurement IDs from the existing user view name to meet the present needs. If the user view is being used by one or more group names in the Exception Table, then the threshold(s) assigned to the measurement ID is affected also. If a measurement ID is being added, then the measurement ID and a threshold of zero is assigned to the group name in the Exception Table. If the measurement ID is being deleted, then the measurement ID and its assigned threshold are also deleted from the corresponding group name in the Exception Table.

There are five fixed format reports whose views are contained in the UVDT. However, it must be pointed out that more than one user may be receiving a particular report and would also be affected by any changes to the view name. It is therefore highly recommended that all changes be administered by a

centralized administrative entity. These views should not be changed since the report generators assigned to them are designed for a certain output and cannot be changed. The following example shows a list of measurements assigned to the user view name "ct100" in the UVDT.

---

VIEW NAME:      ct100

MEASUREMENT ID

SUX  
SUR  
mgansx  
mgansr

---

The user view and associated measurement identifications for the initial user view descriptor table (UVDT) are identified in Table 5-K.

### Exception Table

In many instances a user only wants to see a set of measurements in a report if one of them exceeds a certain threshold level. Some thresholds refer to the number of accumulated counts, while others refer to the number of seconds involving the exception. These exceptions or threshold values are assigned to a particular measurement ID in the Exception Table (EXCP). In the EXCP, a view and its associated thresholds are assigned to a group name. In this group name every measurement ID is assigned a threshold. While the requested report is being generated, the measurement values and the threshold values are compared. The measurement and the other measurements in the same group are then placed in the report only if one of them has exceeded the defined threshold value. Sets of measurements are grouped according to one of three categories:

1. Per link
2. Per node
3. Per office.

An exception report can contain several sets of measurements from one or all of these three categories. The placement of each set of measurements in the exception report is individually dependent upon the measurement values of that set exceeding the threshold values assigned to the set.



**Table 5-K. Initial User View Descriptor Table**

| <b>User View</b> | <b>Measurement IDs</b>                                       |                                                            |                                                            |                                                            |
|------------------|--------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|
| A30MPR           | AURS<br>RTESETUNT<br>L7MFLT<br>SURXB<br>ERSECL0<br>PROTEXRL0 | BYRX<br>ERSEC<br>SUERA<br>UNVL<br>CRCERL0<br>MGRXL0        | CRCER<br>L7ACO<br>SUERB<br>LPAFLT0<br>BYRXL0               | RTESETUN<br>L7AFLT<br>SURXA<br>LPMFLT0<br>MGFMTERL0        |
| AMPR             | CINIT0<br>INIT0<br>INIT4<br>NOCMGT<br>OOSCFG<br>RSTTRMT      | CINIT1<br>INIT1A<br>MRNIAU<br>OOSAU<br>OOSMN<br>SRNIAU     | CINIT3<br>INIT1B<br>MRNIAUT<br>OOSAUT<br>OOSMNT<br>SRNIAUT | CINIT4<br>INIT3<br>NOCMG<br>OOSCFG<br>RDWNT                |
| ASEPR            | OOSAU<br>OOSMN                                               | OOSAUT<br>OOSMNT                                           | OOSCFG<br>RSTTRMT                                          | OOSCFG                                                     |
| ASNPR1           | AURSTE<br>GTTUNBC<br>CRCERTE<br>ERSECTE<br>L7BOLR            | BYR<br>CLFSP<br>MRBADRTG<br>L7ACO<br>L7BOLRT               | BYRXTE<br>CLFSPT<br>EMRSP<br>L7ACOTE                       | BYX<br>GTTUNNT<br>EMRSPT<br>L7BOFR                         |
|                  | L7FLD<br>L7LCON1XT<br>MGMSUR<br>MSUDISC0<br>SPISPT           | L7FLDT<br>L7MRPBC<br>MGMSUX<br>MSUDISC1<br>SUERATE         | L7LCDIS1X<br>L7MRPNT<br>MRSBCO7<br>MSUDISC2<br>SUERBTE     | L7LCON1X<br>MSG7LOOP<br>MRSNT07<br>SPISP<br>SUR            |
|                  | SURXATE<br>SC7RGTR<br>LPFLDL3<br>LPFLDL7<br>LPFLDTL3         | SURXBTE<br>LPFLDL0<br>LPFLDL4<br>LPFLDTL0<br>LPFLDTL4      | SUX<br>LPFLDL1<br>LPFLDL5<br>LPFLDTL1<br>LPFLDTL5          | L7RTGAUD<br>LPFLDL2<br>LPFLDL6<br>LPFLDTL2<br>LPFLDTL6     |
|                  | LPFLDTL7<br>LPTMPFL3<br>LPTMPFL7<br>LPTMPFLT3<br>LPTMPFLT7   | LPTMPFL0<br>LPTMPFL4<br>LPTMPFLT0<br>LPTMPFLT4<br>LKESTBL0 | LPTMPFL1<br>LPTMPFL5<br>LPTMPFLT1<br>LPTMPFLT5<br>LKESTBL1 | LPTMPFL2<br>LPTMPFL6<br>LPTMPFLT2<br>LPTMPFLT6<br>LKESTBL2 |

**Table 5-K. Initial User View Descriptor Table (Contd)**

| User View         | Measurement IDs                                                                         |                                                                              |                                                                              |                                                                              |
|-------------------|-----------------------------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| ASNPR1<br>(Contd) | LKESTBL3<br>LKESTBL7<br>MGUNAL3<br>MGUNAL7<br>MGMSURL0                                  | LKESTBL4<br>MGUNAL0<br>MGUNAL4<br>BYXL0<br>LPBOLRL0                          | LKESTBL5<br>MGUNAL1<br>MGUNAL5<br>BYRL0<br>LPBOLRTL0                         | LKESTBL6<br>MGUNAL2<br>MGUNAL6<br>MGMSUXL0<br>MGRUAL0                        |
|                   | Q931MGXL0<br>BYXL1<br>LPBOLRL1<br>Q931MGRL1<br>BYRL2                                    | Q931MGRL0<br>BYRL1<br>LPBOLRTL1<br>XBFFULLL1<br>MGMSUXL2                     | XBFFULLL0<br>MGMSUXL1<br>MGRUAL1<br>XBFFULLTL1<br>MGMSURL2                   | XBFFULLTL0<br>MGMSURL1<br>Q931MGXL1<br>BYXL2<br>LPBOLRL2                     |
|                   | LPBOLRTL2<br>XBFFULLL2<br>MGMSUXL3<br>MGRUAL3<br>XBFFULLTL3                             | MGRUAL2<br>XBFFULLTL2<br>MGMSURL3<br>Q931MGXL3<br>BYXL4                      | Q931MGXL2<br>BYXL3<br>LPBOLRL3<br>Q931MGRL3<br>BYRL4                         | Q931MGRL2<br>BYRL3<br>LPBOLRTL3<br>XBFFULLL3<br>MGMSUXL4                     |
|                   | MGMSURL4<br>Q931MGXL4<br>BYXL5<br>LPBOLRL5<br>Q931MGRL5                                 | LPBOLRL4<br>Q931MGRL4<br>BYRL5<br>LPBOLRTL5<br>XBFFULLL5                     | LPBOLRTL4<br>XBFFULLL4<br>MGMSUXL5<br>MGRUAL5<br>XBFFULLTL5                  | MGRUAL4<br>XBFFULLTL4<br>MGMSURL5<br>Q931MGXL5<br>BYXL6                      |
|                   | BYRL6<br>LPBOLRTL6<br>XBFFULLL6<br>MGMSUXL7<br>MGRUAL7<br>XBFFULLTL7                    | MGMSUXL6<br>MGRUAL6<br>XBFFULLTL6<br>MGMSURL7<br>Q931MGXL7                   | MGMSURL6<br>Q931MGXL6<br>BYXL7<br>LPBOLRL7<br>Q931MGRL7                      | LPBOLRL6<br>Q931MGRL6<br>BYRL7<br>LPBOLRTL7<br>XBFFULLL7                     |
| ASNPR2            | AURSTE<br>CRCERTE<br>CLFT<br>ERSECTE<br>L7FLD<br>L7MFLT<br>MSUDISC2<br>SUERB<br>SUERBTE | BYRX<br>EMR<br>L7EMR<br>L7ACO<br>L7FLDT<br>L7PORT<br>SPI<br>SURXA<br>SURXATE | BYRXTE<br>EMRT<br>L7EMRT<br>L7ACOTE<br>L7LCON1X<br>MSUDISC0<br>SPIT<br>SURXB | CRCER<br>CLF<br>ERSEC<br>L7AFLT<br>L7LCON1XT<br>MSUDISC1<br>SUERA<br>SUERATE |

**Table 5-K. Initial User View Descriptor Table (Contd)**

| <b>User View</b>  | <b>Measurement IDs</b>                                                                         |                                                                      |                                                                            |                                                                            |
|-------------------|------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------------|----------------------------------------------------------------------------|
| ASNPR2<br>(Contd) | SURXBTE<br>LPFLDL3<br>LPFLDL7<br>LPFLDTL3<br>LPFLDTL7                                          | LPFLDL0<br>LPFLDL4<br>LPFLDTL0<br>LPFLDTL4<br>LPAFLTL0               | LPFLDL1<br>LPFLDL5<br>LPFLDTL1<br>LPFLDTL5<br>LPAFLTL1                     | LPFLDL2<br>LPFLDL6<br>LPFLDTL2<br>LPFLDTL6<br>LPAFLTL2                     |
|                   | LPAFLTL3<br>LPAFLTL7<br>LPMFTL3<br>LPMFTL7<br>LPTMPFLT3                                        | LPAFLTL4<br>LPMFTL0<br>LPMFTL4<br>LPTMPFLT0<br>LPTMPFLT4             | LPAFLTL5<br>LPMFTL1<br>LPMFTL5<br>LPTMPFLT1<br>LPTMPFLT5                   | LPAFLTL6<br>LPMFTL2<br>LPMFTL6<br>LPTMPFLT2<br>LPTMPFLT6                   |
|                   | LPTMPFLT7<br>LPTMPFL3<br>LPTMPFL7<br>LKESTBL3<br>LKESTBL7                                      | LPTMPFL0<br>LPTMPFL4<br>LKESTBL0<br>LKESTBL4<br>MGUNAL0              | LPTMPFL1<br>LPTMPFL5<br>LKESTBL1<br>LKESTBL5<br>MGUNAL1                    | LPTMPFL2<br>LPTMPFL6<br>LKESTBL2<br>LKESTBL6<br>MGUNAL2                    |
|                   | MGUNAL3<br>MGUNAL7<br>MGRUAL3<br>MGRUAL7<br>XBFFULLTL0                                         | MGUNAL4<br>MGRUAL0<br>MGRUAL4<br>LPBOLRL0<br>LPBOLRL1                | MGUNAL5<br>MGRUAL1<br>MGRUAL5<br>LPBOLRTL0<br>LPBOLRTL1                    | MGUNAL6<br>MGRUAL2<br>MGRUAL6<br>XBFFULLL0<br>XBFFULLL1                    |
|                   | XBFFULLTL1<br>XBFFULLTL2<br>XBFFULLTL3<br>XBFFULLTL4<br>XBFFULLTL5<br>XBFFULLTL6<br>XBFFULLTL7 | LPBOLRL2<br>LPBOLRL3<br>LPBOLRL4<br>LPBOLRL5<br>LPBOLRL6<br>LPBOLRL7 | LPBOLRTL2<br>LPBOLRTL3<br>LPBOLRTL4<br>LPBOLRTL5<br>LPBOLRTL6<br>LPBOLRTL7 | XBFFULLL2<br>XBFFULLL3<br>XBFFULLL4<br>XBFFULLL5<br>XBFFULLL6<br>XBFFULLL7 |
|                   |                                                                                                |                                                                      |                                                                            |                                                                            |
| LFTADM            | L7BYTO3B                                                                                       |                                                                      |                                                                            |                                                                            |
| NFDISK            | EMR<br>L7EMR<br>L7AFLT<br>L7LCON1X<br>L7LCON3X<br>SPI                                          | EMRPO<br>L7EMRPO<br>L7BOLR<br>L7LCON1XT<br>L7LCON3XT<br>SPIT         | EMRPOT<br>L7EMRPOT<br>L7BOLRT<br>L7LCON2X<br>L7MFLT                        | EMRT<br>L7EMRT<br>L7LCDIS3X<br>L7LCON2XT<br>L7POR                          |

**Table 5-K. Initial User View Descriptor Table (Contd)**

| User View | Measurement IDs                                       |                                                              |                                                     |                                                   |
|-----------|-------------------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------|---------------------------------------------------|
|           |                                                       |                                                              |                                                     |                                                   |
| NFLPM     | EMR<br>L7EMR<br>L7AFLT<br>L7LCON1X<br>L7LCON3X<br>SPI | EMRPO<br>L7EMRPO<br>L7BOLR<br>L7LCON1XT<br>L7LCON3XT<br>SPIT | EMRPOT<br>L7EMRPOT<br>L7BOLRT<br>L7LCON2X<br>L7MFLT | EMRT<br>L7EMRT<br>L7LCDIS3X<br>L7LCON2XT<br>L7POR |
| RINGEX    | IUNOVLD0<br>RRBOVFLW1<br>RRBOVFLW3                    | IUNOVLD1<br>RRBOVFLW1T<br>RRBOVFLW3T                         | IUNOVLD2<br>RRBOVFLW2                               | RRBOVFLW0<br>RRBOVFLW2T                           |

There must be a view defined in the UVDT for every exception group in the EXCP. However, two exception reports may use the same view. This allows the user the flexibility to assign different threshold values to the same measurement IDs for a view name. Different exception groups may be required because the two reports use different history files. To do this, the view name and its assigned measurements must appear in more than one exception group in the EXCP. Each group name specifies different threshold values, yet each group uses the same user view. The Scheduler Table (SCHD) specifies which exception group is used with which user view in the creation of the report.

---

GROUP NAME: ce2001

VIEW NAME: ce200

| MEASUREMENT ID | THRESHOLD  |
|----------------|------------|
| I6bolr         | 0000000001 |
| I6bolrt        | 0000000300 |
| I6bolx         | 0000000001 |
| I6bolxt        | 0000000060 |

---

In the example above, the exception group ce2001 contains all the measurements assigned to the user view name ce200. These measurements are listed in the MEASUREMENT ID column. The EXCP is then used to assign these measurements the threshold values listed in the THRESHOLD column.

The exception group, measurement user view, measurement identification, and measurement threshold values for the initial exception table (EXCP) are identified in Table 5-L.

### **History File Descriptor Table**

Most report generators can be applied over different time periods. These time periods are defined in the History File Descriptor Table (HFDT). The HFDT is simply a set of instructions constructing history files covering different time periods. All history files contain the same measurement IDs. One history file differs from another in the time interval it covers. The valid periods covered by history files are 5 minutes, 15 minutes, 30 minutes, hour, day to hour, and last day. Because the HFDT is constructed to meet the common requirements of all CNI reports, it is less volatile than any of the other tables. For example, a 15-minute collection period is used to accumulate a 30-minute collection period and also generate reports covering 15-minute periods of data. Should a user manipulate the history file containing this 15-minute collection period, each subsequently accumulated history file is affected. Therefore, changes to the HFDT are discouraged.

The software collects measurements and stores them in a 5-minute file in core memory called lpm. When the lpm file is complete, its contents are copied into a current 15-minute file (c15m) in core memory. Five minutes later, the lpm file is overwritten with the most current 5-minute collection period. This new data is added to the previous 5 minutes of data in the c15m file to accumulate 10 minutes of data. Five minutes later, the lpm file is again overwritten with the most current 5-minute collection period. This new data is then added to the previously accumulated 10 minutes of data to fill the current 15-minute file (c15m). Once the c15m file is filled, it is copied into the last 15-minute (l15m) file in disk memory for further accumulation. The l15m file is used to accumulate larger history files on disk. The first step in this process is to copy the l15m file into a current 30-minute (c30m) file to begin the accumulation of a 30-minute collection period. Five minutes later, the cycle repeats itself. When the lpm file is overwritten, it is then copied into the c15m file which overwrites the 15 minutes of data previously stored there. As the lpm file is updated, it adds two more 5-minute collection periods to fill the c15m file. Once the c15m file is filled, it is copied into the l15m file overwriting the 15 minutes of data previously stored there. The new l15m file is added to the c30m file to accumulate 30 minutes of data in that history file. Once the c30m file is filled, it is copied into the last 30-minute l30m file for further accumulation of larger history files. The l30m file is copied into another history file called chrm to begin the accumulation of a 60-minute data collection period. Five minutes later, the cycle again repeats itself. The 5-minute lpm file is used to accumulate a current 15-minute collection period in the c15m file which is copied into the l15m file. The last 15-minute (l15m) file is used to accumulate a new current 30-minute collection period in the c30m file which is copied into the l30m file. The last 30-minute (l30m) file is added to chrm to accumulate 60 minutes of data in that history file. Once chrm is filled, it is

copied into another 60-minute history file called lhrm for the accumulation of a current day history file. Repetition of this process allows these 60-minute files to be accumulated 24 times to create a history file covering an entire day (cday). Once the cday file has accumulated an entire day's data, it can be copied into the lday file for further use. As the new file is being created for the next day, the cday file is filled while the previous day's data is stored in the lday file. The accumulation process stops here since history files are presently limited to coverage of a single day. The cycle does not stop though. The next day, the lday file is simply overwritten with more current measurements. The following is a summary of the cycle.

1. The software collects and stores measurements in core memory in a 5-minute file called lpm.
2. The lpm file is accumulated in core memory in a current 15-minute file called c15m.
3. The c15m file is copied to another 15-minute history file in disk memory called l15m.
4. The l15m file is accumulated in disk memory in a current 30-minute history file called c30m.
5. The c30m file is copied to another 30-minute history file in disk memory called l30m.
6. The l30m file is accumulated in disk memory in a current 60-minute history file called chrm.
7. The chrm file is copied to another 60-minute history file in disk memory called lhrm.
8. The lhrm file is accumulated in disk memory in a current day history file called cday.
9. The cday file is copied to another day history file in disk memory called lday. The accumulation process stops here since history files are presently limited to a single day's coverage. The cycle does not stop though. The next day, the lday file is simply overwritten with more current measurements.

The functional use of the data items used in the HFDT is explained in the following paragraphs and is followed by an example which illustrates how the preceding data items are implemented in the HFDT. Following the example is a detailed explanation of what is happening in each time interval shown on the example.

Every 5 minutes, the HFDT is scanned. The record number depicts the order in which the entries are executed. Each time the HFDT is accessed, the lowest record number to be executed at that time is done first, and the remaining record numbers are done in ascending order for the specified time.

**Table 5-L. Initial Exception Table**

| <b>Exception Group</b> | <b>Measurement User View</b> | <b>Measurement ID</b> | <b>Measurement Threshold</b> |
|------------------------|------------------------------|-----------------------|------------------------------|
| A30MPR30               | A30MPR                       | AURS                  | 0000000003                   |
|                        |                              | BYRX                  | 0000021222                   |
|                        |                              | CRCER                 | 0000005500                   |
|                        |                              | RTESETUN              | 0000000001                   |
|                        |                              | RTESETUNT             | 0000000001                   |
|                        |                              | ERSEC                 | 0000001000                   |
|                        |                              | L7ACO                 | 0000000002                   |
|                        |                              | L7AFLT                | 0000000001                   |
|                        |                              | L7MFLT                | 0000000001                   |
|                        |                              | SUERA                 | 0000000300                   |
|                        |                              | SUERB                 | 0000000300                   |
|                        |                              | SURXA                 | 0000000300                   |
|                        |                              | SURXB                 | 0000000300                   |
|                        |                              | UNVL                  | 0000000015                   |
|                        |                              | LPAFLTLO              | 0000000001                   |
|                        |                              | LPMFLTLO              | 0000000001                   |
|                        |                              | ERSECL0               | 0000000001                   |
|                        |                              | CRCERL0               | 0000000001                   |
| NFDISKEXHR             | NFDISK                       | BYRXL0                | 0000000001                   |
|                        |                              | MGFMTERL0             | 0000000001                   |
|                        |                              | PROTEXRL0             | 0000000001                   |
|                        |                              | MGRXL0                | 0000000001                   |
|                        |                              | EMR                   | 0000000001                   |
|                        |                              | EMRPO                 | 0000000001                   |
|                        |                              | EMRPOT                | 0000000001                   |
|                        |                              | EMRT                  | 0000000001                   |
|                        |                              | L7EMR                 | 0000000001                   |
|                        |                              | L7EMRPO               | 0000000001                   |
|                        |                              | L7EMRPOT              | 0000000001                   |
|                        |                              | L7EMRT                | 0000000001                   |
|                        |                              | L7AFLT                | 0000000001                   |
|                        |                              | L7BOLR                | 0000000001                   |
|                        |                              | L7BOLRT               | 0000000001                   |
|                        |                              | L7LCDIS3X             | 0000000001                   |
|                        |                              | L7LCON1X              | 0000000001                   |
|                        |                              | L7LCON1XT             | 0000000001                   |
|                        |                              | L7LCON2X              | 0000000001                   |
|                        |                              | L7LCON2XT             | 0000000001                   |
|                        |                              | L7LCON3X              | 0000000001                   |

**Table 5-L. Initial Exception Table (Contd)**

| <b>Exception Group</b> | <b>Measurement User View</b> | <b>Measurement ID</b>                                                                                                                                                                                                                             | <b>Measurement Threshold</b>                                                                                                                                                                                                                                         |
|------------------------|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NFDISKEXHRI<br>(Contd) |                              | L7LCON3XT<br>L7MFLT<br>L7POR<br>SPI<br>SPIT                                                                                                                                                                                                       | 0000000001<br>0000000001<br>0000000001<br>0000000001<br>0000000001                                                                                                                                                                                                   |
| NFLPMEXHR              | NFLPM                        | EMR<br>EMRPO<br>EMRPOT<br>EMRT<br><br>L7EMR<br>L7EMRPO<br>L7EMRPOT<br>L7EMRT<br><br>L7AFLT<br>L7BOLR<br>L7BOLRT<br>L7LCDIS3X<br><br>L7LCON1X<br>L7LCON1XT<br>L7LCON2X<br>L7LCON2XT<br>L7LCON3X<br><br>L7LCON3XT<br>L7MFLT<br>L7POR<br>SPI<br>SPIT | 0000000001<br>0000000001<br>0000000001<br>0000000001<br><br>0000000001<br>0000000001<br>0000000001<br>0000000001<br><br>0000000001<br>0000000001<br>0000000001<br>0000000001<br>0000000001<br><br>0000000001<br>0000000001<br>0000000001<br>0000000001<br>0000000001 |
| RINGEXLPM              | RINGEX                       | IUNOVLD0<br>IUNOVLD1<br>IUNOVLD2<br>RRBOVFLW0<br>RRBOVFLW1<br><br>RRBOVFLW1T<br>RRBOVFLW2<br>RRBOVFLW2T<br>RRBOVFLW3<br>RRBOVFLW3T                                                                                                                | 0000000001<br>0000000001<br>0000000001<br>0000000001<br>0000000001<br><br>0000000001<br>0000000001<br>0000000001<br>0000000001<br>0000000001                                                                                                                         |



The history file is the result of the action or the file receiving the measurements to be accumulated. The source file is the file from which the measurements are being taken to build the specified history file. The source file may be another history file which was built from other source files. The smallest source file is a 5-minute file called lpm. This file resides in core memory and is predefined to be accumulated into a 15-minute file called l15m. The history file l15m resides in disk memory and is the smallest source file available to the user in the HFDT. Each subsequently accumulated history file resides in disk memory and is built in the HFDT.

The coverage represents the number of 5-minute accumulation periods which can be contained in the specified history file. This can range from 3 to 288, since the smallest history file available for HFDT use covers 15 minutes, and the largest is a 1-day file.

The action defines how the source file is entered into the history file. If the action is "copy," the history file does not accumulate or increase the time period covered but receives the measurements in the source file and stores them under a new history file name. This is done to store the measurements to be accumulated in a larger file when the need exists. If the action is "add," the source file is accumulated in the history file to increase the time covered by the file. For the "add" action, the source file overwrites the contents of the history file and is then added to the history file until the history file is filled.

The disposition determines what happens next. If the action is "add," the disposition is void because it has no affect on the process. If the disposition is "continue," the process proceeds to the Scheduler Table where all the reports using the updated history file are generated and returned to the HFDT. If the action is "stop," the process terminates. This is necessary if the Scheduler Table doesn't use the updated history file, and the process doesn't proceed to the Scheduler Table. A detailed discussion of the interaction of the UVDT, EXCP, HFDT, and SCHD in the generation of reports is provided later in this section.

The "**when**" field is used to determine the time the specified action takes place. If repeat equals N, the action occurs at the time specified in the "**when**" field. The number in this field multiplied by 5 minutes (smallest network measurement file time) is the network time of the action. For example, if a user wants a report generated at 01:30 network time, the entry in the "**when**" column would be 018 ( $018 \times 5 \text{ minutes} = 90 \text{ minutes} = 01:30$ ). An action in the history file can then be repeated by entering a **Y** in the "**repeat**" field. A repeat causes the action to occur at every multiple of the time specified in the "**when**" column. For example, if the "**when**" entry is 012 and the "**repeat**" entry is **Y**, then the action involved occurs every hour ( $12 \times 5 \text{ minutes} = 60 \text{ minutes} = 1 \text{ hour}$ ). If the entry in the "**repeat**" field is N, then the action occurs only at the time specified by the "**when**" entry. The following example illustrates the use of each of these data items and is followed by a more detailed description of the process.

**⇒ NOTE:**

History files updated with the “**add**” action are called current history files. These files cannot be used to cause scheduled reports to occur. This task is reserved for those files updated with the copy action.

---

| RECORD<br>NUMBER | HISTORY<br>FILE | COVERAGE | ACTION | DISP | SOURCE | WHEN |
|------------------|-----------------|----------|--------|------|--------|------|
| 00010            | c30m            | 006      | add    |      | l15m   | 003  |
| 00020            | l30m            |          | copy   | cont | c30m   | 006  |
| 00030            | chrn            | 012      | add    |      | l30m   | 006  |
| 00040            | lhrn            |          | copy   | cont | chrn   | 012  |
| 00050            | cday            | 288      | add    |      | lhrn   | 012  |
| 00060            | lday            |          | copy   | cont | cday   | 010  |

---

c30m - current 30-minute history file  
l30m - last 30-minute history file  
chrn - current hour history file  
lhrn - last hour history file  
cday - current day history file  
lday - last day history file  
cont - continue  
Y - yes  
N - no

The previous example is described below according to time of occurrence.

**At 00:15 network time**, the following occurs:

00010 The last 15-minute (l15m) file is copied to the current 30-minute (c30m) file. The network time 00:15 was calculated by multiplying the number in the “**when**” column (003) by 5 minutes. The coverage tells us that the history file c30m covers a 30-minute time period (006 x 5 minutes). The **Y** in the “**repeat**” column causes this action to occur every 15 minutes (003 x 5 minutes). Since the action is “add,” the disposition is not recognized. Therefore, it is entered as void.

**At 00:30 network time**, the following occurs: record number 00010 is repeated, and then record numbers 00020 and 00030 are initiated.

- 00010 History file l15m is added to c30m a second time. Now c30m has accumulated 30 minutes of current measurements.
- 00020 The current 30-minute (c30m) file is copied into history file l30m to be stored as the last 30 minutes. This saves the current 30-minute data for future accumulation. There is no entry in the coverage column because there is no change in the time period covered by the history file with the copy action. This action is repeated every 30 minutes starting at the present network time 00:30 (006 x 5 minutes). Once this action is complete, the "continue" entry in the disposition column (continue) tells the Scheduler Table to continue and process any reports using l30m.
- 00030 The last 30-minute l30m file is copied to current hour (chrn) file. This begins the accumulation of a 1-hour history file. The 012 entry in the "coverage" column tells us that the history file chrn covers 60 minutes (012 x 5 minutes). The **Y** entry in the "**repeat**" column causes this action to occur every 30 minutes (006 x 5 minutes).

**At 00:45 network time**, the following occurs:

- 00010 The last 15-minute (l15m) file is copied to the current 30-minute (c30m) file.

**At 00:50 network time**, the following occurs:

- 00060 The current day (cday) file is copied into the last day (lday) file. This time is represented by the 010 entry in the "**when**" column (010 x 5 minutes). This time was selected because of the many actions which congest the data base on the quarter hours immediately following 00:00 network time. The current day (cday) file could be copied into the last day (lday) file any time after the last hour of the day that it is accumulated (00:00) and before the first hour of the next day is accumulated (01:00 network time). Yet, there are many reports and files being sent and updated during the hour directly following the end of a network day. Therefore, a large volume copy, such as the copy of a current day file, should be done during a time of lesser congestion in the data base. The least congested times available for such actions are those 5-minute divisions between quarter hours, such as 00:25 and 00:50. This action is not repeated during this day due to the **N** entry in the "**repeat**" column. Once this action is complete, the "continue" entry in the disposition column tells the Scheduler Table to continue, and process any reports using the lday file.

**At 01:00 network time**, the following occurs:

- 00010 History file l15m is added to the history file c30m which then contains 30 minutes of current measurements.

- 00020 History file c30m is copied into history file l30m so that the 30 minutes of current measurements can be further accumulated in another larger history file.
- 00030 History file l30m is added to history file lhrm which will then contain 60 minutes of current data.
- 00040 The current hour (chrn) file is copied into the last hour (lhrn) file to be used to accumulate an even larger history file. This action occurs every hour, as defined by the 012 entry in the “**when**” column and the Y entry in the “**repeat**” column (012 x 5 minutes). Once this action is complete, the “continue” entry in the “disposition” column allows the Scheduler Table to continue to generate measurement reports using the lhrn file created. Note that there is no entry in the “coverage” column because there was no change in the time period covered by the new history file with the copy action.
- 00050 The last hour history (lhrn) file is copied to the current day history (cday) file. This action also occurs every hour as defined by the entries in the “**when**” column and “**repeat**” column. The history file lhrn is added to the history file cday 24 times throughout the day. Therefore, the cday file contains all the 288 possible 5-minute measurement periods in a day as is shown in the “coverage” column.

**At 01:15 network time**, the following occurs:

- 00010 The last 15-minute (l15m) file is copied to the current 30-minute (c30m) file. This action continues to occur every 15 minutes.

**At 01:30 network time**, the following occurs:

- 00010 Source file l15m is added to history file c30m. This action continues to occur every 15 minutes.
- 00020 Source file c30m is copied to history file l30m. This action continues to occur every 30 minutes.
- 00030 Source file l30m is copied to history file chrn. This action continues to occur every 30 minutes.

**At 01:45 network time**, the following occurs:

- 00010 Source file l15m is copied to history file c30m. This action continues to occur every 15 minutes.

At 02:00 network time, the following occurs:

- 00010 Source file l15m is added to history file c30m. This action continues to occur every 15 minutes.
- 00020 Source file c30m is copied to history file l30m. This action continues to occur every 30 minutes.
- 00030 Source file l30m is added to history file chrm. This action continues to occur every 30 minutes.
- 00040 Source file chrm is copied to history file lhrm. This action continues to occur every hour.
- 00050 Source file lhrm is added to history file cday. This action continues to occur every hour.

The record number, history file, action, disposition, source file, when, coverage, and repeat values for the initial history file descriptor table (HFDT) are identified in Table 5-M.

**Table 5-M. Initial History File Descriptor Table**

| Record Number | History File | Action | Disposition | Source File | When | Coverage | Repeat |
|---------------|--------------|--------|-------------|-------------|------|----------|--------|
| 00010         | C30M         | ADD    | VOID        | L15M        | 003  | 006      | YES    |
| 00020         | L30M         | COPY   | CONT        | C30M        | 006  | 000      | YES    |
| 00030         | CHRM         | ADD    | VOID        | L30M        | 006  | 012      | YES    |
| 00040         | LHRM         | COPY   | CONT        | CHRM        | 012  | 000      | YES    |
| 00050         | CDAY         | ADD    | VOID        | LHRM        | 012  | 288      | YES    |
| 00060         | LDAY         | COPY   | CONT        | CDAY        | 010  | 000      | NO     |

### Scheduler Table

The Scheduler Table (SCHD) draws all the ingredients of a report together. The report type specified in SCHD provides a skeleton of the report. The report must then be provided with the measurement data from data bases. The combination of a report type and a history file uniquely define a report. With all the ingredients for report generation defined in HFDT, UVDT, and EXCP, one may compose a report by properly combining the ingredients in an entry in the SCHD. The name of the report, representing the entry, is defined by the user. An entry in the SCHD consists of several fields:

- a. **Report name:** The name specified to represent the entry in the SCHD.
- b. **Destination:** Represented by an output class number.

- c. **Report type:** Representing a report generator to be used.
- d. **History file:** Drawn from the HFDT.
- e. **View name:** Drawn from the UVDT.
- f. **Group name:** Drawn from the EXCP. This entry is blank, if the report is not an exception report.
- g. **Activation time:** Represents the time the report begins generating. This field is only valid for scheduled reports (when repeat does not equal zero).
- h. **Repeat:** Specifies how many times the report should be generated per day. If repeat equals zero, the report is generated upon demand only.
- i. **Print if empty:** Specifies whether or not to print certain reports if they are empty (contain all zeros).
- j. **Output type:** Specifies how the report should be output:
  - 1. Polled - output to a file
  - 2. Autonomous - output to a spooler output class
  - 3. Both - output to a file and a spooler output class.
- k. **Output delay** - specifies the amount of time (in seconds) that a report should be delayed before being output (maximum 5 minutes).

Every entry in the SCHD is labeled with a report name. This item is defined by the user and is used for any future reference of the entry. A skeleton of the report is defined by the report generator specified in the report type field. There are different report generators for different types of reports, and each report generator has a specific use. Each of the five standard reports has its own fixed format report generator. These fixed format report generators only generate the desired output when used with their particular user view. There are also four flexible format report generators available for user-defined reports. Yet, each of these also has a specific use. Their use depends on the type of measurements, exception or regular, contained in the report and the source of the measurement values (core memory, lpm or disc memory, history files). A listing of the valid report generators and their characteristics is provided in Table 5-N.

For every report generated by the MOCT, there must be a view defined for it in the UVDT. Only those measurement IDs listed in the view are included in the report. If the SCHD entry is an exception report, the user must enter the group name in the EXCP which contains the required list of the measurement IDs and their thresholds in addition to the user view. A view in the UVDT serves as a screen over a history file. Where history files contain all measurements, only those listed in the user view are included in the report.

**Table 5-N. Report Generators**

| Report Generator | Report Format | Measurement Type | Source |
|------------------|---------------|------------------|--------|
| AM30MPR          | Fixed         | Exception        | Disk   |
| AMMPR            | Fixed         | Regular          | Disk   |
| AMSEPR           | Fixed         | Regular          | Disk   |
| AMSNPR1          | Fixed         | Regular          | Disk   |
| AMSNPR2          | Fixed         | Regular          | Disk   |
| CMRINGEX         | Fixed         | Exception        | LPM    |
| CMNFLPM          | Flexible      | Regular          | LPM    |
| CMNFDISK         | Flexible      | Regular          | Disk   |
| CMNFLPMEX        | Flexible      | Exception        | LPM    |
| CMNFDISKEX       | Flexible      | Exception        | Disk   |

The “**repeat**” field is used to determine whether an SCHD entry is a scheduled report or a demand report. If repeat field is set to 0, the report is generated on demand only. The user only receives a demand report when it is requested, which should only be when the user needs it and can use it. To demand a report, a valid entry must first be placed in the MOCT. The user can then demand the report at any time using the OP:SMR command as outlined in the *Input/Output Manual*. If repeat field is greater than 0, the report is scheduled. The activation time is then used to determine when the report can begin being generated. The SCHD is scanned every time a history file is completely updated. If the history file used by the SCHD entry is a 30-minute file, then the report is generated every 30 minutes for as many times as is noted in the “**repeat**” field. If the “**repeat**” field equals four and the history file is a 30-minute file, then a report is generated four times, separated by 30 minutes each time. Thus, this example covers 2 hours of data. Should the entry in the “**repeat**” field be 1, then the report is generated once a day, at the time specified in the activation field.

The actual output of the report can be done in different ways. Using the “**output type**” field, the user can specify that the report be output to a spooler output class specified in the “**destination**” field, to a file, or both. The user can prevent a report from being output when all of its measurements equal zero via the “**print if empty**” field. The output of a report can be delayed up to 5 minutes by specifying the delay time (in seconds) in the “**output delay**” field. Delaying the output of a report could help prevent spooler congestion at peak periods of spooler use.

The following is an example of six sample entries in the SCHD. The first four of these entries are scheduled reports, while the last two are demand reports.

| REPORT<br>NAME | DEST | REPORT<br>TYPE | VIEW<br>NAME | HIST<br>FILE | ACT<br>TIME | GROUP     | PRINT<br>RPT | OUT<br>EMPTY | TYPE | DELAY |
|----------------|------|----------------|--------------|--------------|-------------|-----------|--------------|--------------|------|-------|
| SC30MPR30      | 42   | SM30MPR        | SC30MPR      | L30M         | 0000        | SC30MPR30 | 048          | YES          | A    | 000   |
| SCSNPR1HR      | 42   | SMSNPR1        | SCSNPR1      | LHRM         | 0000        | NULL      | 024          | YES          | A    | 000   |
| SCMPRLDAY      | 41   | SMMPR          | SCMPR        | LDAY         | 0000        | NULL      | 001          | YES          | A    | 000   |
| REPORT_XX      | 50   | CMNFLPMEX      | VIEW_XX      | LPM          | 0000        | GROUP_XX  | 288          | YES          | A    | 000   |
| SCSEPRHR       | 96   | SMSEPR         | SCSEPR       | LHRM         | 0000        | NULL      | 000          | YES          | A    | 000   |
| REPORT_YY      | 152  | CMNFLPM        | VIEW_YY      | LPM          | 0000        | NULL      | 000          | YES          | A    | 000   |

The first entry in the report example is a scheduled report named **sc30mpr30**. The report name is defined by the user and assigned in SCHD. The measurements which comprise this report are recorded in the user view sc30mpr. Since this is an exception report, the thresholds are assigned to the measurement IDs in the exception group sc30mpr30. The actual values for the specified measurements are drawn from the history file l30m which covers 30 minutes. The report is generated the first time l30m is updated after 00:00 network time and at each 30-minute increment after that throughout the day. The initial report time is determined by the activation time while the repetition has several inputs.

The report is generated in 30-minute intervals because l30m is a 30-minute history file as defined in HFDT. The report is repeatedly generated throughout the day because the value entered in the “**repeat**” column encompasses every 30-minute increment available in a day. Once all the ingredients are collected, they are sent to the report generator sm30mpr. The report generator creates the report and sends it to the specified destination 042. The devices assigned to this destination are defined by the output class number in UNIX RTR Equipment Configuration Data (ECD).

The second entry in the example is a scheduled report named **scsnpr1hr**. The measurements which comprise this report are recorded in user view scsnpr1. Since none of the measurements contained in scsnpr1 is exception related, there is a null entry for the group name. The measurement values are drawn from the history file lhrm which covers one hour. Since the history file's coverage is an hour, the report is repeated throughout the day in 1-hour increments. It is repeated all day starting at 01:00 and ending at midnight because the 024 entry in the “**repeat**” column encompasses the entire 24-hour period of a day. Once all the ingredients are collected, they are sent to the report generator smsnpr1. The generated report is then forwarded to the specified destination 042.

The third entry in the example is for a scheduled report named **scmprlday**. The measurements which comprise this report are recorded in the user view scmpr. Since none of the measurements contained in scsnpr1 are exception related,



there is a null entry for the group name. The measurement values are extracted from the history file lday which covers a full day. The report is only generated once a day after 00:00 network time as defined by the “**activation**” and “**repeat**” fields. The ingredients are collected and the report is generated by the report generator smmpr. The final output of scmprlday is then sent to the devices assigned to destination 041 as defined by the output class number in the UNIX RTR ECD.

The fourth entry in the example is for a scheduled report named **report\_xx**. The measurements which comprise this report are recorded in the user view “view\_xx.” Since this is an exception report, the thresholds are assigned to the measurement IDs in the exception group “group\_xx.” The measurement values are drawn from lpm which covers the smallest collection period available (5 minutes). The first exception report is generated at 00:00 network time. Since the history file covers 5 minutes and the entry in the “**repeat**” column is 288, the exception report is created after each 5-minute time period in a day. Each of these 5-minute exception reports is generated using the report generator cmnflpmex and directed to the devices assigned to the destination 50 as defined by the output class number in the UNIX RTR ECD.

The fifth entry in the example is a demand report named **scseprhr**. Since there is a zero entry in the repeat field, the report is not scheduled and therefore is not generated unless it is demanded by the user. The measurements which comprise this report are recorded in the user view scsepr. Since none of the measurements contained in scsepr is exception related, there is a null entry for the group name. The measurement values are drawn from the history file l30m which covers 30 minutes. The destination listed in the entry is not used. When the report is demanded, it is generated by smsepr and sent to the user demanding the report.

The sixth entry in the example is a demand report named **report\_yy**. Since repeat equals zero, this report is not generated unless a user demands it. The measurements which comprise this report are recorded in the user view “view\_yy.” Since none of the measurements contained in “view\_yy” is exception related, there is a null entry for the group name. This demand report extracts its measurement values from lpm which covers a 5-minute time period. The destination listed in the entry is not used. When the report is demanded, it is generated by cmnflpm and sent to the user demanding the report.

The report name, report type, view name, history file, activation time, repeat, and delay values for the initial scheduler table (SCHHD) are identified in Table 5-O.

**Table 5-O. Initial Scheduler Table (Notes 1 through 4)**

| Report Name | Report Type | View Name  | History File | Act Time | Repeat | Delay |
|-------------|-------------|------------|--------------|----------|--------|-------|
| A30MPR30    | AM30MPR     | A30MPR30   | L30M         | 0000     | 048    | 060   |
| AMPRCDAY    | AMMPR       | AMPR       | CDAY         | 0000     | 000    | 000   |
| AMPRHR      | AMMPR       | AMPR       | LHRM         | 0000     | 024    | 120   |
| AMPRLDAY    | AMMPR       | AMPR       | LDAY         | 0000     | 001    | 120   |
| ASEPRCDAY   | AMSEPR      | ASEPR      | CDAY         | 0000     | 000    | 000   |
| ASEPRHR     | AMSEPR      | ASEPR      | LHRM         | 0000     | 024    | 180   |
| ASEPRLDAY   | AMSEPR      | ASEPR      | LDAY         | 0000     | 001    | 180   |
| ASNPR1CDAY  | AMSNPR1     | ASNPR1     | CDAY         | 0000     | 000    | 000   |
| ASNPR1HR    | AMSNPR1     | ASNPR1     | LHRM         | 0000     | 024    | 240   |
| ASNPR1LDAY  | AMSNPR1     | ASNPR1     | LDAY         | 0000     | 001    | 240   |
| ASNPR215    | AMSNPR2     | ASNPR2     | L15M         | 0000     | 000    | 000   |
| ASNPR2CDAY  | AMSNPR2     | ASNPR2     | CDAY         | 0000     | 000    | 000   |
| ASNPR2HR    | AMSNPR2     | ASNPR2     | LHRM         | 0000     | 024    | 300   |
| ASNPR2LDAY  | AMSNPR2     | ASNPR2     | LDAY         | 0000     | 001    | 300   |
| MEASLFT15   | MEASLFT     | LFTADM     | L15M         | 0000     | 096    | 000   |
| NFDISK      | CMNFDISK    | NFDISK     | L15M         | 0000     | 000    | 000   |
| NFDISKEX    | CMNFDISKEX  | NFDISKEXHR | L15M         | 0000     | 000    | 000   |
| NFLPM       | CMNFLPM     | NFLPM      | LPM          | 0000     | 000    | 000   |
| NFLPMEX     | CMNFLPMEX   | NFLPMEXHR  | LPM          | 0000     | 000    | 000   |
| RINGEXLPM   | CMRINGEX    | RINGEXLPM  | LPM          | 0000     | 288    | 000   |
| SLMLFTLDAY  | SLMLFT      | LFTADM     | LDAY         | 0000     | 001    | 000   |

**Notes:**

1. GROUP NAME is initially set equal to the VIEW NAME for A30MPR30, for A30MPR30, NFDISKEX, NFLPMEX, and RINGEXLPM. It is initially null for all other reports.
2. DESTINATION designation is 64 for all reports.
3. PRINT EMPTY designation is **YES** for all reports.
4. OUT TYPE designation is **A** for all reports.

## MOCT Interaction When Generating Scheduled Reports

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The generation of scheduled reports begins in the HFDT. As measurements are collected, the lpm file is updated. Each time the lpm file is updated, SCHD is scanned to see if any of its entries use the lpm file. Therefore, SCHD is scanned every 5 minutes. Of those entries using the lpm file, SCHD checks to see if the activation time is past. If the activation time is past, SCHD checks to see if the report has been generated as many times that day as the repeat value specifies. If not, the report is generated. The SCHD table draws the ingredients it needs from the lpm file, the user view, and the exception group specified in the entry.

The lpm file is then used to update the history file l15m. Each time the l15m file is updated, SCHD is scanned for its use of that file. Of those entries using the l15m file, SCHD checks to see if the activation time is past. If the activation time is past, SCHD checks to see if the report has been generated as many times that day as the repeat value specifies. If not, the report is generated. The SCHD table draws the ingredients it needs from the l15m file, the user view, and the exception group specified in the entry.

The l15m file is now used to update the history files in the HFDT. Each time an updated current file is copied into another file, the **"disposition"** field is checked. If the **"disposition"** field entry is continue, SCHD is scanned for the use of the updated file. This process begins with the copy of the c30m file to the l30m file. If the **"disposition"** field entry is continue, SCHD is scanned to see if any of its entries use the l30m file each time the copy occurs. Of those entries using the l30m file, SCHD checks to see if the activation time is past. If the activation time is past, SCHD checks to see if the report has been generated as many times that day as the repeat value specifies. If not, the report is generated. The SCHD table draws the ingredients it needs from the l30m file, the user view, and the exception group specified in the entry.

The l30m file is used to update the chrm file. Once the chrm file is completely updated, it is copied into the lhrm file. If the **"disposition"** field entry is continue, SCHD is scanned for the use of the lhrm file. Of those entries using the lhrm file, SCHD checks to see if the activation time is past. If the activation time is past, SCHD checks to see if the report has been generated as many times that day as the repeat value specifies. If not, the report is generated. The SCHD table draws the ingredients it needs from the lhrm file, the user view, and the exception group specified in the entry.

The lhrm file is used to update the cday file. Once the cday file is completely updated, it is copied into the lday file. If the **"disposition"** field entry is continue, SCHD is scanned for the use of the lday file. Of those entries using the lday file, SCHD checks to see if the activation time is past. If the activation time is past, SCHD checks to see if the report has been generated as many times that day as

the repeat value specifies. If not, the report is generated. The SCHD table draws the ingredients it needs from the lday file, the user view, and the exception group specified in the entry.

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## Maintenance Guidelines

# 6

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### Contents

|                                                              |      |
|--------------------------------------------------------------|------|
| <b>General</b>                                               | 6-1  |
| <b>Common Network Interface Ring Maintenance Description</b> | 6-1  |
| ■ Ring and Ring Node Operation                               | 6-6  |
| Message Propagation on the Ring                              | 6-6  |
| Node Addressing                                              | 6-7  |
| ■ Ring Configuration and Isolation                           | 6-8  |
| Ring Configuration                                           | 6-8  |
| Ring Isolation                                               | 6-10 |
| <b>Maintenance Functions, Hardware, and Equipment</b>        | 6-11 |
| ■ Equipment Handling Procedures                              | 6-11 |
| ■ Ring Node Cabinet Circuit Pack Description                 | 6-11 |
| ■ Power and Fuse Descriptions                                | 6-13 |
| Power                                                        | 6-13 |
| Fuse Description                                             | 6-13 |
| ■ Fan and Filter Maintenance                                 | 6-14 |
| Fan Unit Description                                         | 6-14 |
| Filter Maintenance                                           | 6-14 |
| ■ Circuit Pack Handling Precautions                          | 6-14 |
| ■ Equipment Visual Indicators                                | 6-15 |
| ■ Removing Equipment From Service                            | 6-16 |
| ■ Maintenance States                                         | 6-16 |
| Automatic Ring Recovery                                      | 6-19 |
| ■ Ring Node Equipment Removal                                | 6-21 |

---

## Contents

|                                                                             |      |
|-----------------------------------------------------------------------------|------|
| ■ Ring Node Equipment Restoral                                              | 6-22 |
| Circuit Packs and Fans                                                      | 6-23 |
| Power Distribution                                                          | 6-24 |
| Office Alarms and Trouble Indications                                       | 6-24 |
| ■ T1FA Maintenance                                                          | 6-26 |
| <b>Trouble Indicators and Display Pages</b>                                 | 6-28 |
| Trouble Indicators                                                          | 6-28 |
| Display Pages                                                               | 6-33 |
| <b>Common Channel Signaling No. 7 Digital Signaling Link Maintenance</b>    | 6-40 |
| General                                                                     | 6-40 |
| Signaling Link Process Characteristics                                      | 6-40 |
| Signaling Link Trouble Detection Mechanisms                                 | 6-41 |
| Signaling Link Alarms                                                       | 6-41 |
| Diagnostics                                                                 | 6-42 |
| Measurement Reports                                                         | 6-42 |
| Critical Events                                                             | 6-43 |
| Signaling Link States                                                       | 6-43 |
| Trouble Conditions                                                          | 6-44 |
| ■ AT&T Trigger Platform Node Maintenance                                    | 6-45 |
| General                                                                     | 6-45 |
| Trouble Conditions                                                          | 6-45 |
| Measurements                                                                | 6-45 |
| <b>Universal Link Node (ULN)</b>                                            | 6-46 |
| ■ General                                                                   | 6-46 |
| ■ ULN CCS7 Link Definition                                                  | 6-47 |
| ■ Universal Link Node Maintenance Philosophy                                | 6-48 |
| ■ Universal Link Node Feature Capabilities                                  | 6-50 |
| ■ Universal Link Node Maintenance                                           | 6-54 |
| <b>D-Channel and Special Access Data Channel Signaling Link Maintenance</b> | 6-55 |
| General                                                                     | 6-55 |
| Signaling Link Management                                                   | 6-55 |
| Trouble Conditions                                                          | 6-55 |
| Measurement Reports                                                         | 6-56 |
| Critical Events                                                             | 6-56 |

---

## Contents

|                                                           |      |
|-----------------------------------------------------------|------|
| Interprocess Message Switch Subsystem                     |      |
| Initialization                                            | 6-56 |
| Ring Initialization                                       | 6-57 |
| <b>Diagnostics</b>                                        | 6-60 |
| Performing Diagnostics                                    | 6-61 |
| Diagnostic Message Structure                              | 6-62 |
| System Diagnostics                                        | 6-62 |
| Diagnostic Phases                                         | 6-64 |
| Ring Node Addressing                                      | 6-64 |
| <b>Audits</b>                                             | 6-81 |
| Audit Scheduling and Control                              | 6-81 |
| Audit Analysis                                            | 6-86 |
| Central Node Control Audit                                | 6-90 |
| Node State Audit                                          | 6-90 |
| Direct Link Node Audit                                    | 6-91 |
| Internal Data Audits                                      | 6-91 |
| AT&T Trigger Platform (ATP) Junior Node Audit             | 6-92 |
| <b>Processor Recovery Messages</b>                        | 6-93 |
| Processor Recovery Message Format                         | 6-93 |
| Analyzing Processor Recovery Messages                     | 6-95 |
| <b>International Link Node Signaling-Link Maintenance</b> | 6-96 |
| <b>Small Computer Systems Interface Node Maintenance</b>  | 6-96 |
| ■ General                                                 | 6-96 |
| ■ Signaling Link Management                               | 6-96 |
| ■ Trouble Conditions                                      | 6-96 |
| ■ Measurement Reports                                     | 6-96 |
| <b>Ethernet Interface Node Maintenance</b>                | 6-97 |
| ■ General                                                 | 6-97 |
| ■ Signaling Link Management                               | 6-97 |
| ■ Trouble Conditions                                      | 6-97 |
| ■ Measurement Reports                                     | 6-97 |
| <b>3B Computer Maintenance Functions</b>                  | 6-98 |

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## Maintenance Guidelines

# 6

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### General

The Common Network Interface (CNI) ring maintenance includes both preventive and corrective maintenance tools. Preventive maintenance in a CNI office environment ensures that basic procedures are used to detect potential troubles and maintain normal system operation. Corrective maintenance provides for trouble detection, service recovery, trouble notification and verification, trouble isolation, and repair. Maintenance must be performed to preserve as much machine sanity as possible while operating in fault situations.

### Common Network Interface Ring Maintenance Description

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All ring nodes are constructed of hardware that perform specific functions. The hardware that controls the logic and processing functions of the ring node is identified as the node processor (NP) circuitry. The hardware that interfaces the node processor (NP) to the ring is identified as the ring interface (RI) circuitry. There are two types of ring interface circuitry (RI0 and RI1). *The node processor (NP) and ring interface (RI) circuitry combined are referred to as a ring node.*

Ring nodes are connected serially via a data bus to form the ring. Ring 0 and Ring 1 are independent of each other. Ring 0 is normally used for traffic and message handling and is the ACTIVE ring. Ring 1 is the STANDBY ring and is normally used to carry maintenance messages. The rings propagate data in opposite directions and are designed so that faulty equipment may be temporarily removed from the active system. A special message called the



"token message" travels around each ring and allows other messages to be placed onto the ring without causing congestion. Each RI has a pair of independent ring access circuits (RACs) which allow messages to be placed onto, removed from, or passed along a specific ring. Data on the ring is passed from one RAC to the next in an asynchronous fashion to assist in assuring proper ring operation (Figure 6-1).

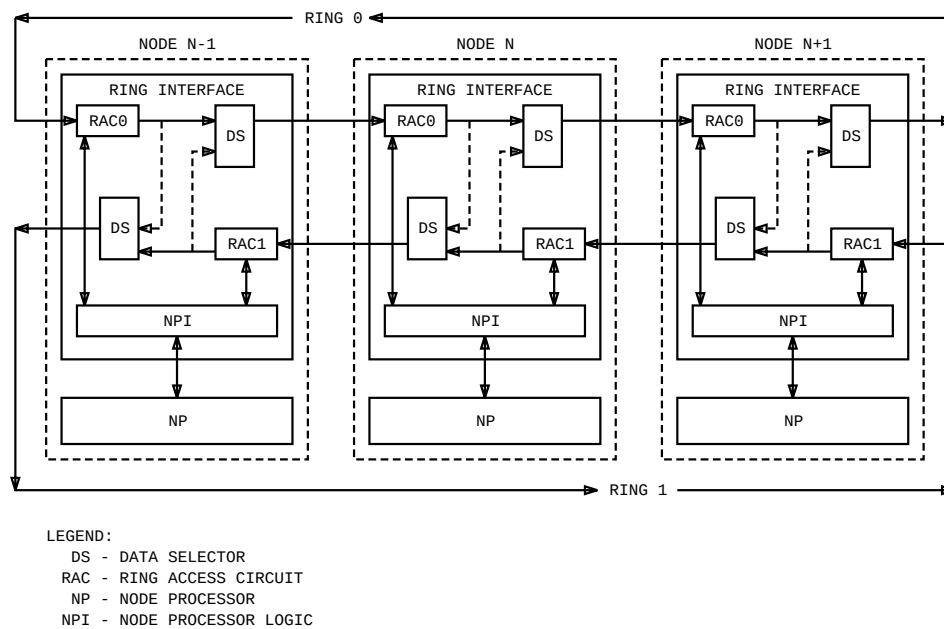


**Figure 6-1. Common Network Interface Dual Ring Structure**

*Ring nodes* (RNs) are peripheral processors where digital information enters or leaves the ring or is processed further. Ring nodes are classified into the following different types, depending upon their function:

- Application link node (LN)
- Ring Peripheral Controller Node (RPCN)
- Direct Link Node (DLN).
- Small Computer Systems Interface Node (SIN)
- Direct Link Node 30 (DLN30)

- AT&T Trigger Platform (ATP) node
- Universal Link Node (ULN)

Application LNs, RPCNs, DLNs, and ULNs are constructed using circuit packs and are located in the ring node cabinet (RNC).

An *application link node* consists of a node processor (NP), two ring interface (RI0 and RI1), and link interface (LI) circuit packs, and is located on the ring where user information enters or exits via a signaling link to be processed. It is responsible for detecting and reporting ring, node processor, and link interface failures to the 3B20 Duplex (3B) Computer. The IRN2 circuit pack (UN304B) performs all the operations previously performed by the SSI ring interface 0, SSI ring interface 1, and NP circuit packs. Common channel signaling (CCS), D-channel (DCHN), and special access data channel (SADC) nodes are examples of specific application link nodes. The CCS7 node provides a ring interface for the common channel signaling network; while the DCHN and SADC nodes provide a direct digital connection from customer premise equipment to a CNI equipped 4ESS Switch office.

The DCHN application link node uses up to two LI4D link interface circuit packs; while the SADC application link node uses up to two LI4S link interface packs. In addition, the DCHN application link node requires a T1 facility access (T1FA) circuit pack.

The *RPCN* consists of a NP, two RI (RI0 and RI1), a 3B Computer interface (3BI), and a dual duplex serial bus selector (DDSBS) circuit pack (Figure 6-2), and is located on the ring. This node is used to remove digital information from the ring and then transfer the digital information to the 3B Computer for farther processing or to enter information back onto the ring after processing. It is also responsible for detecting ring failures and reporting them to the 3B Computer for analysis. In some failures, the RPCN autonomously attempts recovery. However, severe failures require the aid of the 3B Computer.

The *DLN* is a node on the ring used to process special application messages. The DLN sends and receives applicable signaling messages to and from the 1A1B Processor Attached Processor Interface (API) circuitry via 3B Computer direct memory access (DMA) buffers. It is also responsible for detecting ring, NP, and application processor circuitry failures, and reporting them to the 3B Computer. Two DLNs are provided in a dual active/standby mode in order to circuit pack (Figure 6-2). Although the DLN is functionally more like an application LN, with the exception of direct memory access (DMA) abilities, it consists of the same circuit packs used in a RPCN plus an attached processor (AP) circuit pack.

The *S/N* node is designed to transmit CDR data to the CDRP. The SIN uses the IRN2 (UN304B) circuit pack that has been designed using VLSI circuitry. The

IRN2 is functionally, physically, and electrically equivalent to the following three SSI circuit packs:

- 3BI (TN 914) circuit pack performs the same functions for the SIN as for the RPCN.
- DDSBS (TN 69/TN 69B) circuit pack performs the same functions for the SIN as for the RPCN.
- SCSI (TN 1804) circuit pack that supports the connection to the CDRP.

The DLN30 operates in a similar manner as the DLNE. An increased traffic handling capability is made possible by using UN304B board.

The AT&T Trigger Platform (ATP) node consists of a single IRN2 (UN304) circuit pack (no-link interface). This node is loaded with IMS code and ATP application software, used in the AT&T Trigger Platform (ATP) feature in the 4E20R1 generic program, and controls the functionality of calls requiring in-band/out-of-band trigger detection for the duration of the call. The ATP node does not have associated signaling links. An active and standby ATP node are used.

Another new version of link node, beginning with CNI Software Release 11.4, is the Universal Link Node (ULN). The existing Link Nodes operate at 56 Kilobits per second (Kbps); while the ULNs operate at a 1.544 Megabits per second (Mbps) data rate. The ULN allows the signaling network to process Message Signal Units (MSUs) with significantly higher average length without reducing the quality of service. Each ULN consists of a Ring Interface Board (RIB) CP and a T1IB CP. The T1IB is a Link Interface Board (LIB) with a T1 Link Option Module. The RIB is a UN397 CP; the T1IB is a TN2520 CP.

The CNI hardware and software contains logic for detecting faulty equipment. Upon detecting such equipment, the 3B Computer can remove it from service, configure the ring around the faulty equipment, diagnose, and restore the equipment to service. Equipment failures associated with the ring are grouped in the following four major failure classes:

- a. Ring down
- b. Multiple node isolation
- c. Single node isolation
- d. Node out-of-service (OOS) - quarantined.

The "ring down" failure is a state in which the ring is unable to handle traffic. In this state, communication with the 3B Computer, except for maintenance purposes, and other nodes on the ring is lost. All LNs are in the OOS state, and all ring peripheral controller nodes (RPCNs) are in the OOS maintenance state. The RPCNs are left in this standby state to eliminate the need to restore them if service can be restored. This state affects all system operations; therefore, the problem must be corrected as soon as possible.

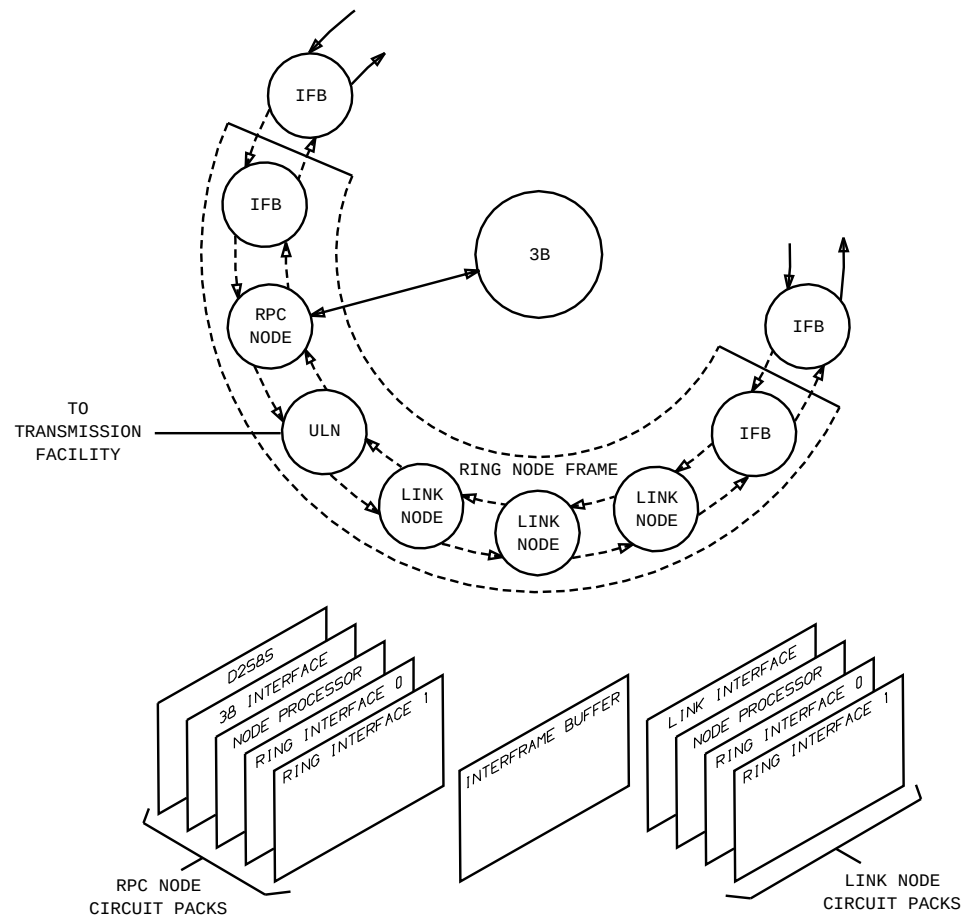


**Figure 6-2. Common Network Interface Link Node Architecture**

A "multiple link node isolation" failure is a condition in which there are two or more failures that occur on the ring, causing a potentially large isolated segment. When there is an isolated segment of multiple nodes with an established BISO and EISO node, the most probable faulty node(s) are the isolated nodes adjacent to the beginning of isolation (BISO) and end of isolation (EISO) nodes. This is assumed because both the BISO and EISO nodes of a multiple node

isolation are most likely to be established adjacent to the faulty node when attempting to recover from ring error conditions. Therefore, by troubleshooting the nodes adjacent to the BISO and EISO nodes, faults are corrected with the least amount of time and service interruption.

A "single node isolation" failure is a condition on the ring where a node has been placed in the out-of-service isolated (OOS-ISO) maintenance state. A node in this state has been isolated from the active ring. The node in isolation is enclosed by a BISO and an EISO node. Single node isolation can be caused by faulty node processors (NPs), ring interface (RI), link interfaces, interframe buffers (IFBs), cabling and/or backplane faults. The node in isolation should first be diagnosed, faults corrected, restored to service, and included back into the active ring. An isolated link node is a serious problem; immediate action must be taken to correct the problem.

A "link node out-of-service" failure is a condition on the ring where a node is removed from active service and placed in the OOS state for various reasons. A link node may be placed in either of the OOS maintenance states (OOS-NORM or OOS-ISO). When a node is placed in the OOS-ISO state, the node is first removed from service (OOS-NORM), and then isolated from the active ring (OOS-ISO). When a node is removed from service for maintenance or faults that do not interfere with system operations, the node is placed in the OOS-NORM state. A node in the OOS-ISO state is not able to communicate with the ring or perform normal node functions. However, a node in the OOS-ISO state is capable of performing and handling maintenance functions. In the OOS-NORM state, the node is quarantined and not allowed to communicate with either the 3B Computer or the ring.

When failure conditions are detected on the ring, the affected equipment is removed from service and grouped in one of the preceding four failure classes. It is also possible to remove one or more nodes from service or to configure the ring via input commands from the maintenance CRT (MCRT).

## **Ring and Ring Node Operation**

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### **Message Propagation on the Ring**

In a fully operational ring (all 3B Computer equipment and link nodes functioning), a message arrives at the link node, is processed in the link interface and node processor circuitry, is placed onto the normal traffic ring (Ring 0), and is then passed to the destination node using the assigned address. The message reaches the destination node, is processed by the node processor circuitry and is then transmitted to the link interface as outgoing messages on the link. Thus, each node must be able to propagate messages from one node to

the next on both rings (0 and 1) for a ring to be fully operational. In addition, each node must be able to transmit and receive messages.

The source ring access circuit (RAC) transfers messages, one byte at a time, to the next RAC on the ring. The destination address is compared to that node's address, and if the address fails to match, the message is sent to the next RAC. This transfer from RAC to RAC continues until the message reaches the node address which matches the message destination address.

The token message continuously travels around the ring and allows messages to be placed on the ring without causing congestion. When a node is ready to place a message onto the ring, it must wait for the arrival of the token message at the output of the previous node. When instructed to do so by the node processor, the RAC detains the token at the output of the previous RAC and allows the message(s) to be placed onto the ring. When the transfer is complete, the token is allowed to proceed to the next node on the ring.

### **Node Addressing**

A message which contains the address of both the source and destination nodes is placed on the ring via the node's RAC. The addressing of nodes on the ring are identified in terms of an integer sequence number. Nodes are interconnected so that any downstream node on Ring 0 has a higher sequence number, and any upstream node has a lower sequence number, except at the junction of the highest and lowest numbered cabinet. Addresses only have hardware and software significance and are invisible to the user. The physical ring identification is interpreted by software and presented to the user as *RPCNxx 0* or *LNxx y*, depending on the node type. The *xx* identifies the group number and the *y* identifies the node member number—position in the cabinet.

**Example:** RPCN00 0

LN00 12

LN32 15

Addresses are assigned consecutively to RPCNs and LNs. To calculate the address of any RPCN, multiply the group number by 16. For example, the address for RPCN in group 32 is 512 ( $16 \times 32 = 512$ ).

The LN addresses are calculated by multiplying the group number by 16 and adding LN member number. For example, the address for LN 15 in group 32 is 527 ( $16 \times 32 + 15 = 527$ ).

## Ring Configuration and Isolation

---

### Ring Configuration

During normal operating and traffic handling conditions, there are two separate rings. If trouble is encountered on either ring and Automatic Ring Recovery (ARR) cannot correct it, the ring is reconfigured by the 3B Computer to isolate the faulty segment. Each RAC has a data selector at its output that allows data to be directed to the mate ring. At the node preceding the faulty segment, the output of Ring 0 is redirected to the input of Ring 1. This results in one continuous ring excluding the faulty segment (Figure 6-3). The maintenance messages, on the standby ring, consume a small amount of space and do not reduce ring message capacity during ring configuration.

User input commands are used to manually include or exclude a node on the active ring. The **CFR:RING;INCLUDE** command is used to include ring nodes on the active ring. With the use of this command, only the nodes that are specified are included on the active ring segment. If no nodes are specified with this command, then all nodes in the appropriate maintenance state that are not in the active ring segment at the time of the request are included on the active ring. The **CFR:RING;EXCLUDE** command is used to isolate specified nodes from the active ring segment. This command may cause the isolation of other nodes to form a workable ring. The ring cannot be reconfigured using the INCLUDE or EXCLUDE options if either the current beginning of isolation (BISO) and/or end of isolation (EISO) nodes are not active. A ring with an inactive BISO and/or EISO node is in a transient state, and restoral of this node is given top priority.

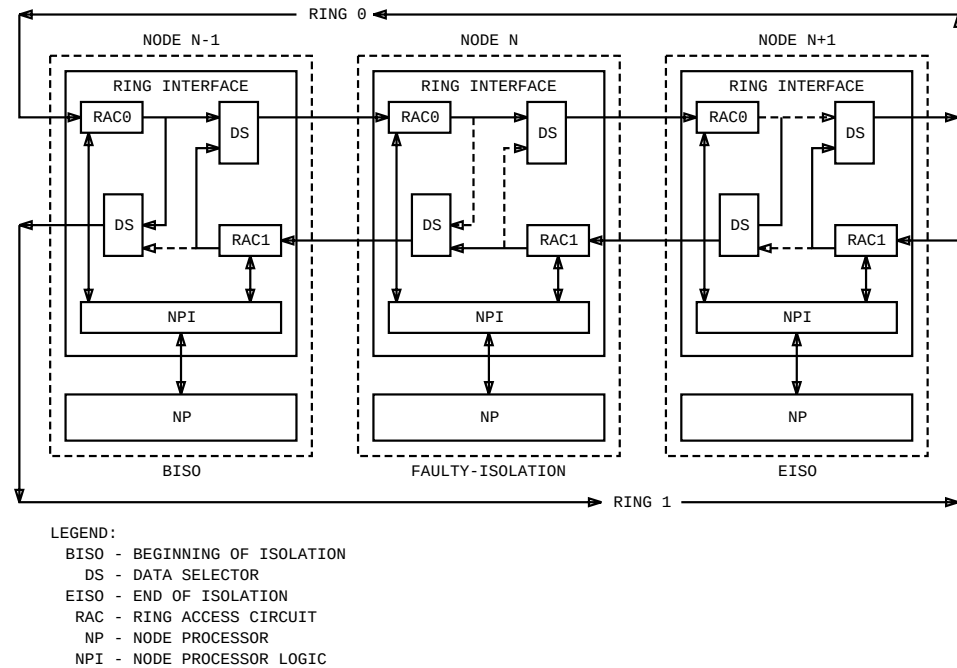


**Figure 6-3. Common Network Interface Ring Structure During Isolation**

Ring configuration is requested either automatically or manually. When faults are detected on the ring that involve ring interfaces, the 3B Computer automatically reconfigures the ring around the faults. Manual configuration, using the **CFR:RING** commands, is used to create an isolated segment on the ring to configure the ring around faults. Manual configuration requires that nodes be already removed from service when they are to be isolated. If the nodes are not removed from service the configuration request will be denied.

On a small ring, automatic ring error analysis cannot always determine which of the two adjacent nodes is at fault. When this occurs, the **CFR:RING;MOVFLT** command is used to correct ring configuration. The command initiates a request to move an indication of a faulty ring interface from the currently isolated ring node to the adjacent ring node and reconfigure the ring so that the new node becomes the isolated node.



## Ring Isolation

An isolated segment on the ring consists of one or more nodes (RPCNs or LNs) that are not permitted to handle traffic or messages, or allowed to communicate with the 3B Computer except for maintenance purposes. When an isolated segment is created on the ring, two boundary nodes identified as the BISO and EISO nodes are established to distinguish this segment of the ring.

The *BISO* node is the node in the active segment that is adjacent to the faulty or isolated segment.

An *EISO* node is the node in an active segment that is adjacent to the end of the isolated segment. The BISO and EISO nodes are not faulty nodes. They serve to identify the isolated segment and are also used to direct maintenance messages in and out of the isolated segment (Figure 3).

Nodes within an isolated segment are classified into two categories. These are faulty nodes and nonfaulty nodes. An isolated segment can have single isolated nodes or a multitude of nodes. When there is a fault on the ring that causes an isolation, the BISO and EISO nodes are established. Later, if this isolation is not cleared and another fault develops, the ring again reconfigures, creating a new isolated segment containing the original faults and the last faults detected. When the ring reconfigures the second time, the BISO and EISO nodes can change, depending on the location and direction of the second fault. When a new BISO or EISO node is created, the new BISO or EISO node must be a fully operational node in the AVAIL or OOS state.

When a BISO or EISO node is diagnosed, a request is made to remove the node from service. This request may be accepted or denied. If the system denies permission to diagnose the BISO or EISO, then it should not be forced into this condition (diagnosing, configuration, etc.) unless absolutely mandatory.

When a DLN failure occurs, the failure is detected by either the 3B Computer or the neighbor node audit which in turn isolates or quarantines the DLN from the ring. Messages are routed to the standby DLN when this condition occurs. The 3B Computer applies diagnostics to the failed DLN via access through the RPCNs and attempts to recover the DLN. An output message is received when the active DLN is or has been congested. Congestion means the DLN is at or near processing capacity and is attempting to reduce its load. The severity of the congestion is indicated by the output message. This message has no effect on ring operation; but if it appears consistently, technical assistance should be obtained.

## **Maintenance Functions, Hardware, and Equipment**

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Ring maintenance normally involves using diagnostics to identify problems at the circuit pack level. When problems cannot be resolved using this approach, additional testing is required. To aid the user under these conditions, the following maintenance, test equipment and hardware are utilized.

- a. A maintenance terminal (MCRT) to provide the interface and communications necessary for system control and display (C&D), input/output messages, and emergency action interface (EAI) control and display.
- b. A maintenance receive-only printer (MROP) to provide hard copies of input/output messages, status report information, fault/error conditions, diagnostic results, audits, and other data.
- c. Voice frequency link (VFL) test equipment and a Transmission Impairment Measuring Set (TIMS) are used for testing analog SLKs.

## **Equipment Handling Procedures**

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Specific equipment handling procedures must be observed when performing CNI ring maintenance functions. Failure to follow these procedures could result in damage to the integrated circuit packs or loss of service caused by a partially isolated or totally interrupted ring. These procedures cover the handling and replacement of all CNI equipment.

## **Ring Node Cabinet Circuit Pack Description**

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The units that make up the CNI ring are located in the ring node cabinet (RNC). The cabinet consists of the following:

- The DLN unit Ring peripheral controller node (RPCN) unit
- Link node (LN) unit (A and B)
- Direct link node (DLN) unit
- Universal Link Node (ULN)
- Fan unit
- Power converters

- Visual status indicators
- Internal and external connectorized cabling.

The units within the ring node cabinet house individual circuit packs which provide the circuitry for specific nodes. A RPCN unit is equipped with one RPCN and up to two application link nodes. The RPCN is used to remove information from the ring and transfer it to the 3B Computer for processing or return processed information back onto the ring. All ring node cabinets are equipped with an RPCN. The RPCN consists of the following circuit packs:

- Dual Duplex Serial Bus Selector (DDSBS) -- TN69B
- 3B Computer Interface (3BI) -- TN914
- Node Processor (NP) -- TN 913 or TN922
- Ring Interface 0 (RI0) -- UN122, UN122B or UN122C
- Ring Interface 1 (RI1) -- UN123 or 123B.
- IRN/IRN2 -- UN303B or UN304B

A link node unit can be equipped with up to three application link nodes. Link node units are designated as A or B. Link node unit A houses nodes within the ring node cabinet that are identified and addressed from left to right; whereas, link node unit B houses nodes that are identified and addressed from right to left. This node identification and addressing sequence has been implemented to allow the output of a link node, unit A, to be directly connected to the input of a link node, unit B; and the output of that link node, unit B, to be directly connected to the input of another link node, unit A. The basic application link node can contain the following circuit packs:

- Ring Interface (RI0) -- UN122, UN122B or UN122C
- Ring Interface (RI1) -- UN123 or 123B
- Node Processor (NP) -- TN913 or TN922
- Link Interface (LI) -- TN916 (LI); TN1315 (LI4D), TN1316 (LI4S), or TN1317
- T1 Facility Access (T1FA) -- UN291
- IRN/IRN2 -- UN303B or UN304B

The DLN unit is equipped to house one DLN and up to two application link nodes. The DLN is used to normally process signaling messages to and from the 3B Computer. Although the DLN is functionally more like a link node, the DLN consists of all circuit packs that make up a RPCN plus an attached processor (AP). The DLN consists of the following circuit packs:

- Dual Duplex Serial Bus Selector (DDSBS -- TN69B)
- 3B Computer Interface (3BI) -- TN914
- Node Processor (NP) -- TN913 or TN922
- Ring Interface 0 (RI0) -- UN122, UN122B or UN122C
- Ring Interface 1 (RI1) -- UN123 or 123B
- Attached Processor (AP) -- AP30 - TN1630B for DLNE or  
TN1630 for DLN30
- IRN/IRN2 -- UN303B (for DLNE) or UN304B for DLN30.

In addition to RPCN, DLN, and application link node circuit packs, the ring node cabinet also houses interframe buffer (IFB) circuit packs. The IFBs provide buffering circuitry between nodes in different ring node cabinets. There are two types of IFBs:

- a. Padded IFBs (IFB-P) -- TN915
- b. Unpadded IFBs (IFB-U) -- TN1508

Beginning with CNI Software Release 11.4, there is another version of the LN called the Universal Link Node (ULN). The ULN consists of the following circuits:

- Ring Interface Board (RIB) - UN397
- Link Interface Board with a T1 link option module (T1IB) - TN2520.

## **Power and Fuse Descriptions**

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### **PowerDescription**

The power converters, located in the power distribution frame and each individual CNI equipment frame provide, the necessary power required for CNI system operations. Fan units provide the necessary equipment cooling.

### **Fuse Description**

System interruption and/or the loss of nodes may be caused by the loss of a 10 amp fuse located in the ring node cabinet or a 20 amp fuse located in the power distribution frame (PDF). System interruptions may also be caused by the loss of a 250 amp fuse in the battery plant. The loss of the 20 amp fuse in the power distribution frame causes a failure to one half of the nodes in all shelf units. However, if the 250 amp fuse that is associated with the battery plant is lost, total service is adversely affected. When problems occur with fusing, an alarm is triggered; the problem must be corrected as soon as possible. In addition, the digital facility access (DFA) and analog facility access (AFA) cabinets contain fuses and power failure circuitry.

## **Fan and Filter Maintenance**

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Each fan unit assembly is equipped with a removable wire mesh air filter. When a fault is detected in one of the fans, the fan alarm (ALM) lamp on the unit and the power alarm (PWR ALM) lamp at the control panel both illuminate. Since the fans are used to cool cabinet equipment, when faults occur corrective action must be taken as soon as possible. The fans should be checked for proper operation every 6 months. The filters should be cleaned and replaced every 6 months.

### **Fan Unit Description**

The fan unit assemblies contain three fans and monitor circuitry to monitor each fan. Each fan is powered through individual fuses. The fuses are in a panel located at the base of associated cabinets. The fan unit assemblies are located in the bottom of all cabinets to force cooled air up through the units to maintain the proper operating temperature. Cabinets should be able to function properly with the loss of one fan; but with the loss of two fans, the equipment rapidly overheats. If there is only one operational fan in a cabinet and there are no office spares, a fan must be taken from another cabinet and placed in the faulty unit. It is imperative that each cabinet have at least two operational fans. It is also recommended that the office have two spare fans.

### **Filter Maintenance**

The air filters are intended to eliminate dust from the cooling air. Dust buildup on frame circuitry could lead to improper system operation. Although no alarms are associated with the fan filters, they must be properly maintained by periodic replacement. The filters are positioned horizontally, just above the fan unit in the cabinet. To replace the fan filter, simply pull the old filter from the front of the frame; remove the handle from the old filter, and attach it to the new filter; then slide the new filter, with handle, back into the frame.

## **Circuit Pack Handling Precautions**

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Before any maintenance procedures are performed on a functional ring, certain equipment handling precautions must be observed. Before removing, installing, or handling any circuit pack, proper personnel grounding techniques must be made to avoid further damage to the equipment. If a proper ground is not made before handling equipment, static electricity may damage it. To avoid the possible damage caused by the discharge of static electricity, a static control wrist strap must be worn when handling equipment. The wrist strap is used by connecting the clip lead to a nonelectrical metallic portion of the cabinet and placing the strap around the wrist. The wrist strap must be worn at all times when handling new or old equipment.

New circuit packs are always wrapped in an antistatic protective wrapper to avoid static discharge damage. Therefore, when handling new circuit packs, keep the circuit pack enclosed in the static proof wrapper until the appropriate ground connections are made and the pack is ready to be installed.

When handling old or defective circuit packs, the same static discharge precautions must be observed to prevent further damage to the pack. The old or defective circuit pack should be wrapped in the protective wrapping and returned for repair, including diagnostic failure information.

When a circuit pack or other equipment is removed for inspection or replacement, connections must be checked to assure that backplane pins are not damaged. Use care when handling circuit packs. Some circuit packs require considerable force to remove and insert.

### **Equipment Visual Indicators**

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Most equipment have visual indicators that indicate faulty or out-of-service (OOS) states. These indicators show the status of many maintenance functions. Indicators found on the node processor (NP), ring interface (RI), integrated ring node (IRN/IRN2) attached processor (AP) and link interface (LI) circuit packs are the ring quarantine (RQ), ERROR and no token (NT) lamps.

The RQ lamp is located on the NP, IRN, IRN2, T1IB, and the LI4 circuit packs. (The T1IB is a Link Interface Board (LIB) with a T1 option module.) This lamp indicates that either the NP or one of the LI circuit packs is presently in the OOS maintenance state but is still part of the active ring. The NT lamp is located on the RI, IRN, IRN2, and RIB circuit packs and indicates that there is no token message transversing around the ring. When the NT lamp is illuminated, any circuit pack may be removed from that node without affecting system operation. A red LED is used on the AP circuit pack to indicate an error.

The PWR ALM lamp illuminates on the cabinet control panel when there is a fuse failure, a power converter is unplugged, or a fan failure occurs. If more than one fan fails, a major alarm sounds.

Before any interframe buffer (IFB) circuit pack can be replaced, the NT lamp on both adjacent nodes must be illuminated. There are only two IFBs per ring node cabinet, and they are located before the first and after the last node in the cabinet. Since an IFB is adjacent to one node within its own ring node cabinet and another node in the next ring node cabinet, the NT lamp on both nodes must be illuminated before the IFB circuit pack can be extracted.

There are three LEDs on the T1FA circuit pack. The red LED indicates a near-end facility failure, the yellow LED indicates a far-end facility failure and the green LED indicates normal operation. A red/green combination indicates a self-test failure. A reset button is also provided on the T1FA board to aid in running self-tests.

In addition to the RQ and NT LEDs, the ULN is equipped with a 4-digit, hexadecimal front panel display. Many of the items displayed on the ULN faceplate continuously flash, alternating between heading and auxiliary data. For detailed information regarding the type of data displayed, refer to the "Maintenance Description" section of 256-090-182, *CNI Maintenance Manual*.

## **Removing Equipment From Service**

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Caution must be exercised when removing nodes while an isolated segment exists on the ring. Due to this action, the creation of larger isolated segments on the ring is avoided when equipment is removed from service. Therefore, all isolated segments on the ring should be corrected before other maintenance functions are performed. All affected nodes and equipment must first be removed from service before any associated equipment can be replaced.

System software may remove faulty equipment from service by taking it OOS and leaving it in the OOS-NORM maintenance state. In this state, the equipment is still part of the active ring. In addition, system software may remove faulty equipment from service and place it in the OOS-ISO maintenance state. In this state, the equipment is isolated from the active ring and is not a functional part of the ring, except for maintenance purposes.

## **Maintenance States**

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Before any manual maintenance action is invoked, ring and node maintenance states must be considered. The CNI maintenance involves both major and minor maintenance states. The classes of these states are as follows:

- Ring maintenance state
- Node major state
- Node minor state: ring position
- Node minor state: NP hardware
- Node minor state: RI hardware
- Node minor state: maintenance mode.

The maintenance states apply to LNs, RPCNs, DLNs, ULNs, DCH nodes, SADC nodes, and ILNs.

### Ring Maintenance State

The *ring maintenance state* defines the overall operational state of the ring. The ring maintenance state consists of the following:

- a. **Ring Normal:** The ring is operating normal on a two ring configuration. There are no isolated nodes on the ring.
- b. **Ring Isolated:** The ring contains an isolated segment. The nodes referred to as the beginning of isolation (BISO) and end of isolation (EISO) are active.
- c. **Ring Restoring:** The ring contains an isolated segment and restoral activity is in progress. This is a transient state but can last several minutes.
- d. **Ring Down:** The ring is totally unusable from the 3B Computer. However, the LNs may be able to communicate among themselves.
- e. **Ring Normal-Listen:** Same as Ring Normal but in "listening" mode.
- f. **Ring Isolated-Listen:** Same as Ring Isolated but in "listening" mode. This is a transient state.
- g. **Ring Restoring-Listen:** Same as Ring Restoring but in "listening" mode. This is a transient state.
- h. **Ring Configuring:** The ring is initializing, configuring, or fault recovery is in progress. This is a transient state.
- i. **Ring Configuring-No BISO/EISO:** Same as Ring Configuring but ring is a normal two ring configuration without BISO and EISO nodes. This is a transient state.
- j. **Ring Configuring-Isolated:** Same as Ring Configuring but ring contains an isolated segment. This is a transient state.

### Node Major State

During normal system operation, each node is classified into one of the system major states. The major state is the same as the equipment configuration data (ECD) and shows the overall status of a node. Node major states include the following:

- a. **Active (ACT):** The node is active and performing on-line functions.
- b. **Standby (STBY):** If the node is an RPCN, the node is operational, but the ring configuration is not complete or the ring is down. If the node is a DLN, it is the inactive DLN and can be made active through manual or automatic intervention.



- c. Initializing (INIT): The node is initializing. This is a transient state and is used to restart nodes on the ring.
- d. Off-line (OFL): The node is OOS and neither restoral or removal is permitted. The node can be diagnosed and included into the active ring when appropriate.
- e. Out-of-service (OOS): The node is OOS and unavailable for normal use but can be used for maintenance and diagnostic purposes.
- f. Grow (GROW): The node is physically being added to or removed from the ring. The node must always be configured within an isolated segment of the ring.
- g. Unequipped (UNEQ): The node is unequipped but an ECD record can exist for the node.

#### **Node Minor State: Ring Position**

The ring-position minor state indicates the position of the node, relative to the current configuration of the ring. The state values of ring positions are as follows:

- a. Normal (NORM): The node is included on the active ring and is not a BISO or EISO node.
- b. Begin isolated segment (BISO): The node is included on the active ring and forms the beginning of the isolated segment.
- c. End isolated segment (EISO): The node is included on the active ring and forms the end of the isolated segment.
- d. Isolated (ISO): The node is contained in the isolated segment.

#### **Node Minor State: Node Processor Hardware**

The node processor hardware minor state describes the node processor hardware maintenance state of a node. The node processor includes any user supplied hardware that is tested by diagnostics. The state values of the node processor hardware minor state are as follows:

- a. Usable (USBL): The node processor is usable.
- b. Faulty (FLTY): The node processor is known to be or is suspected to be faulty.
- c. Untested (UNTSTD): The condition of the node processor is unknown.

**Node Minor State: Ring Interface Hardware**

This describes the ring interface hardware maintenance state of a node. The ring interface hardware state also indicates whether a node can be included on the active ring. The ring interface hardware states are as follows:

- a. Usable (USBL): The ring interface hardware is usable.
- b. Quarantine Usable (QUSBL): The ring interface hardware is partially usable. The node can be included on the active ring but the node must be in the quarantine (OOS) state.
- c. Faulty (FLTY): The ring interface hardware is faulty and the node must be isolated.
- d. Untested (UNTSTD): The condition of the ring interface hardware is unknown.

**Node Minor State: Maintenance Mode**

The state of maintenance mode indicates whether automatic restoral of the node is attempted. The maintenance mode states are as follows:

- a. Automatic (AUTO): The node is under automatic control.
- b. Manual (MAN): The node is under manual control, and only manual-user action can restore the node to service.

**Automatic Ring Recovery (ARR)**

The CNI provides for fault detection and analysis that requires the removal and restoral of ring nodes. This removal and restoral of ring nodes may be accomplished either automatically or manually via input commands.

Within the CNI, problems are detected by nodes and reported to the 3B Computer through the RPCNs; the RPCNs forwards the problem to error analysis and recovery (EAR). The EAR is responsible for determining the probable cause of a fault, locating the fault, and requesting a ring configuration to remove the faulty equipment from the active ring. Traffic is routed around the affected equipment while ARR attempts to restore the faulty equipment.

The ARR is responsible for automatically restoring faulty nodes, innocent victim nodes, and nodes marked OOS that are found to be in the appropriate maintenance states. These maintenance states and the appropriate corresponding circuit packs are listed in Table 6-A. This table identifies treatment for all combinations of minor and ring maintenance states associated with the OOS major state.

**Table 6-A. Automatic Ring Recovery Response to Isolation and CP Maintenance States**

| Isolated | RI State    | NP State    | NM State | ARR Action                          |
|----------|-------------|-------------|----------|-------------------------------------|
| Yes      | FLTY, QUSBL | Any         | Auto     | Cond RST*                           |
| Yes      | UNTSTD      | Any         | Auto     | Cond RST*                           |
| Yes      | USBL        | Any         | Auto     | None                                |
| Yes      | ANY         | Any         | Man      | None                                |
| No       | USBL        | USBL        | Auto     | UCL RST                             |
| No       | USBL        | UNTSTD,FLTY | Auto     | Cond RST                            |
| No       | USBL        | Any         | Man      | None                                |
| No       | QUSBL       | Any         | Auto     | Cond RST                            |
| No       | QUSBL       | Any         | Man      | None                                |
| No       | UNTSTD,FLTY | Any         | Any      | ERRLOG,<br>RI = QUSBL,<br>Reprocess |

\* Recovery from nondeferrable removal and isolation due to problems (that is, recovery of a node with a "faulted" RI). The conditional restore requests inclusion in the ring if the RI tests pass. Usable hardware states are transient during the conditional restore.

**Legend:**

ARR = Automatic Ring Recovery      NP = Node Processor  
 CP = Circuit Pack                      RI = Ring Interface  
 NM = Node Maintenance              RST = Restore

The ARR procedures respond to any node in the OOS major state that has not been manually placed out of service. The ARR procedures normally attempt to restore any node once. If diagnostics fail, the faulty equipment is marked faulty and manual action is required. If diagnostics are started and aborted but no test failures are indicated, the ARR procedures attempt to restore the node a maximum of three times before any manual actions are requested.

It is important to note that if equipment is automatically removed from service for fault reasons, then manual actions should be avoided until the ARR procedures have attempted to restore the equipment and identified it for manual actions. If manual actions are desired, the ARR procedures may be inhibited using the **INH:DMQ;SRC ARR** input command. When ARR procedures are inhibited, unconditional restorals are still active. Inhibiting the ARR procedures only inhibits conditional restorals.

Nodes eligible for automatic restorals are determined by priority. The priority listing and order of node restoral is as follows:

- a. Nominated critical nodes (BISOs and EISOs)
- b. Nodes with faulty ring interfaces
- c. RPCNs eligible for unconditional restorals
- d. RPCNs eligible for conditional restorals
- e. LNs nodes eligible for unconditional restorals
- f. LNs eligible for conditional restorals.

When diagnosing and attempting to restore nodes within an isolated segment of the ring, the ARR procedures attempt to restore the end nodes of the isolated segment. The end nodes are those adjacent to either the BISO or EISO nodes. The inner nodes of the isolated segment are called innocent victim nodes, when the inner nodes are not faulty.

### **Ring Node Equipment Removal**

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When performing CNI ring maintenance, it may be necessary to manually or automatically remove a node from the active ring. To manually remove a node from service, use the **RMV:LN** or **RMV:RPCN** input command.

There are two OOS states, OOS-NORM and OOS-ISO. When a node is found to be faulty, insane, ready to be grown/degrown, or some other manual maintenance function needs to be performed, the node is first removed from service (OOS-NORM). In this state, the node is said to be quarantined and not permitted to communicate with the ring. If a node must be isolated from the active ring, the node is first removed from service (OOS-NORM). Upon successful removal from service, the node can then be excluded from the active ring and placed in the OOS-ISO state. In either OOS, state the node is allowed to communicate with only the 3B Computer for maintenance purposes. Nodes are removed from service or removed from service and isolated automatically by EAR when faults are detected.

### **Link Node Removal**

When a request is received to remove a link node from service, the major state of the node is checked, and an attempt is made to remove the node. If successful, the major state of the link node is changed to OOS-NORM, and the node is placed in the quarantine state. Success for removing the node from service depends on the associated application. For example, if the signaling link (SLK) is in service at the time of the request, and the mate SLK is not capable of handling the load that was handled by both links; the request may be denied. A **CHG:SLK** input command should be entered to request a change in the SLK

minor state. If the request is accepted, the SLK minor state is changed to the appropriate maintenance state. Upon successful removal of the SLK, the node can be removed from service efficiently.

To successfully remove a DLN from service, the standby DLN must be able to handle the active DLN's functions. Otherwise, the remove request is denied.

### **Ring Peripheral Controller Node Removal**

The removal of a RPCN from service follows the same rules and restrictions as specified for the removal of a LN, with the exception that removal of the last active RPCN on the ring is always denied. A **RMV:RPCN** input command is used to manually remove a RPCN from service. When a request is received to remove a RPCN from service, the major state of the node is checked and an attempt is made to remove the node. If successful, the RPCN's major state is changed to OOS-NORM, and the node is placed in the quarantine state. Success for removing the node from service depends on the traffic handling ability of the 3B Computer. If the traffic cannot be handled by the 3B Computer with the RPCN removed from service, the request is denied. Otherwise, the request is accepted.

### **Ring Node Equipment Restoral**

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Restoral of LNs and RPCNs are performed either conditionally or unconditionally. Manual restorals are accomplished using the **RST:LN** and **RST:RPCN** input commands.

#### **Conditional Restore**

A conditional restore is used to restore a ring node when problems are detected and diagnostics need to be run on the node. A conditional restore first attempts to remove the node from service if it is not already OOS and run diagnostic. If the node is not already isolated, diagnostics request the node to be isolated so that all diagnostic phases can be run. The isolation request could be denied if, for example, there is another node already isolated and the ring interface hardware state of the node, being restored, is unusable (USBL). This could lead to a CATP diagnostics result.

At the conclusion of diagnostics, a request is made to include the node on the active ring. If the ring interface hardware state is USBL or QUSBL and the overall condition of the ring allows it, the node is included on the active ring. If the diagnostic results were either ATP or CATP, the node is restored to service (node software downloaded, execution started, major state changed to ACTIVE). If the diagnostic results were STF, the restore is terminated and the node left either OOS-NORM or OOS-ISO.

## **Unconditional Restore**

An unconditional restore is used when diagnostics have run and all problems have been corrected. Also, an unconditional restore is used when a node has been removed from service for some reason (that is, innocent victim nodes), and no diagnostics need to be performed. When this is the case and no problems are evident, the unconditional restore may be used.

Do not perform an unconditional restore unless one of the following has occurred:

- a. A complete diagnostics has produced an all-tests-passed (ATP) response.
- b. A complete diagnostics has produced a conditional all-tests-passed (CATP) response, and the ring interface and node processor minor states are both USBL.

The unconditional restore of a node is halted if the node major state is not OOS. If the major state is OOS, an attempt is made to include the node onto the active ring. If the inclusion fails, the restoral stops. If the inclusion is successful, the node is restored to service—pumped with operational code and placed into execution—and its major state is changed to ACT.

## **Circuit Packs and Fans**

There are times when diagnostics and circuit pack replacement does not correct a problem. When this occurs, it may be necessary to check the backplane wiring, pins, and other connections for shorts or other faults that could interrupt normal system operation.

Some circuit packs contain LEDs which indicate their status or the status of the ring. The circuit packs are designed to be removed and/or replaced without powering down. Before removing any circuit pack be sure to verify its status. A wrist strap must be worn to guard against electrostatic discharge, when replacing circuit packs. No circuit pack should be removed or replaced in the system unless appropriate LEDs are illuminated.

The ring node cabinets (RNCs) contain a fan unit. The fan unit contains three -48V DC fans to provide forced air cooling for the electronic components in the cabinet. Each fan is equipped with a connector to facilitate replacement if a fan fails. In the event of fan failure, a door closes automatically to minimize air leakage from the inoperative fan opening. When a fan fails, it should be replaced before another fan or system operation is affected.

## Power Distribution

The CNI system requires a power plant with a single point ground to isolate all equipment from building ground. A -48V power supply is used to supply all load units associated with the CNI ring. Each cabinet power feeder powers one unit. A single 495FA power converter is used to supply power to link nodes within the unit. This minimizes the number of nodes that fail due to a single converter failure. Each RPCN is powered from a single converter. The link interface and node processor are not powered by separate converters.

The digital facility access (DFA) cabinet power is diversified in such a way that in case of a fuse failure, only half of the units are lost.

## Office Alarms and Trouble Indications

When trouble is encountered on the active ring, the system has four methods of alerting the user. These methods are provided by audible alarms, visual alarms, visual alarms at the 3B interface (3BI), and teletypewriter (TTY) reports.

To aid the user in the maintenance activities of the office, an alarm structure has been established. Audible alarms are used to alert the user to abnormal conditions in the office. These alarms can be set by either hardware or software failures. These alarms are used to indicate a specific degree of system failure. A priority of action has been assigned for each of the major alarms. The priority of action used for output messages result in an associated level of office alarms being triggered. These office alarms and their associated priority of action are listed as follows:

- a. CRITICAL -- A double stroke of the tone bar. This is set by the 3B Computer indicating a severe fault with a loss of service. The MROP indicator is **\*C**.
- b. MAJOR -- A single stroke on the tone bar. This is set by hardware or software failures indicating a major fault that can affect service. The MROP indicator is **\* \***.
- c. MINOR -- This is not a service affecting alarm but indicates a minor problem in the hardware or software. This alarm is identified by a bell. The MROP indicator is **\***.
- d. MANUAL -- This is a response to a manual request.
- e. AUTOMATIC -- This is a response to an automatically generated request.
- f. POWER PLANT MAJOR -- A bell that indicates a major fault in the power plant that can affect the system. There is no MROP indicator for this alarm.

An audible alarm sounds whenever any of the following conditions exist:

- a. Ring access circuit (RAC) errors occur
- b. IMS driver faults occur
- c. Certain levels of initialization occur
- d. A RPCN or LN is automatically removed from service
- e. Ring faults occur
- f. A fuse blows
- g. A power board is removed from the 3BI unit
- h. Ring is being reconfigured.

All alarms are sent to the 3B Computer. Audible alarms can be silenced by the user without correcting the fault. However, visual status indicators remain in effect until the office returns to normal operation.

To aid the user in maintenance activities, there are visual indicators associated with the alarms to assist in determining faulty equipment. These visual indicators serve as aids in determining when circuit packs and cabling can be replaced or changed without affecting system operation and function. These visual indicators are found on the following equipment:

- a. Ring interface 1
- b. Node processor
- c. Link interface (including LI4D and LI4S)
- d. T1FA
- e. Attached processor.

A visual alarm is displayed when the system detects any of the following conditions:

- a. A RPCN is automatically removed from service
- b. A LN is removed from service
- c. A link is removed from service
- d. Ring is being reconfigured
- e. Ring is down
- f. A power failure.



The visual indicators are identified as the ring quarantine (RQ) lamp and the no-token (NT) lamps. The RQ lamp is located on both the node processor and link interface. When illuminated, the RQ lamp indicates that the node processor and link interface are presently in the OOS state but the node may still be on the active ring. This indicates that messages and traffic may be passing through the node's link interface to and from other nodes on the ring but data other than maintenance messages cannot be processed by the affected node. When the RQ lamp is illuminated, only the node processor or link interface circuit pack can be removed without affecting system operation.

The NT lamp is located on the RI1 circuit pack and indicates that there is no token message appearing at either RAC serving this node. When the NT lamp is illuminated, the node is OOS and in an isolated segment of the ring. In this state, all node circuit packs can be removed without affecting any additional system operations. The ring is considered inactive if a token message is not present on the ring for more than 40 milliseconds.

The NT lamps are also adjacent to nodes, equipped with interframe buffer functions, which may require replacing IFB circuit packs or making cable changes. When IFB circuit packs are replaced, the pack should not be removed unless the NT lamp of the adjacent node is illuminated.

**⇒ NOTE:**

Both NT lamps on nodes adjacent to IFB packs are not in the same ring node cabinet. Therefore, extreme caution must be taken to ensure that appropriate NT lamps are illuminated in the correct cabinets. ***This guideline must be followed to avoid affecting system operation.***

Additional visual alarms exist in the ring node cabinet when the following conditions are observed:

- a. The RQ lamp illuminates on the node processor (NP) circuit pack when a RPCN is OOS or insane.
- b. The NT lamp illuminates on the ring interface 1 (RI1) circuit pack when there is no token circulating on either ring. This indicates that the node is isolated or the ring is down.
- c. The PWR ALM lamp lights on the control panel when there is a blown fuse or the power board is unplugged.

## **T1FA Maintenance**

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There are three LED indications on the T1FA circuit pack: red - a near-end facility failure, yellow - a far-end facility failure, green - normal operation. In addition, a red/green LED combination indicates a self-test failure.

Also contained on the T1FA circuit pack is a RESET button used for running self-tests. If the RESET button is pressed, all LEDs extinguish and one of the following events occurs:

- a. If a facility is connected to the T1FA and the T1FA passes self-tests, the green LED lights in approximately 4 seconds.
- b. If a facility is *not* connected to the T1FA and the T1FA passes self-tests, the green LED lights in approximately 4 seconds; and after approximately an additional 4 seconds, the red LED lights and the green LED extinguishes.
- c. If the T1FA *does not* pass self-tests, the red and green LEDs both light in approximately 4 seconds.

If the T1FA is functioning properly, the green LED is lit, and a near-end or far-end facility failure occurs; the red or yellow LED lights in approximately 4 seconds, and the green LED extinguishes. After the facility problem is corrected, the green LED lights in approximately 12 seconds, and the red or yellow LED extinguishes.

There are cases where a less severe trouble condition may be masked from the user by a more severe trouble condition, thus causing the less severe trouble condition not to be cleared. A list of trouble conditions from most severe to least severe is provided below:

|          |                                          |
|----------|------------------------------------------|
| CT1FAFL  | T1FA hardware or firmware failure        |
| CTREDALM | Red alarm (near-end facility failure)    |
| CTYELALM | Yellow alarm (far-end facility failure). |

Troubles reported by the CT1FAFL critical event obstruct the sensing of all less severe trouble conditions, and troubles reported by the CTREDALM critical event obstruct the sensing of the trouble conditions reported by the CTYELALM critical event. As an example, if a yellow alarm condition exists and a red alarm condition occurs before the yellow alarm condition is cleared, visibility of the yellow alarm is lost. If the red alarm condition is cleared and the yellow alarm condition is also cleared, only the CTREDALC (red alarm cleared) critical event message is issued. If the red alarm condition is cleared and the yellow alarm condition still exists, the yellow alarm condition is again reported with a CTYELALM critical event message. If a yellow alarm condition occurs after a red alarm condition occurs, the yellow alarm condition is not reported until the red alarm condition is cleared, assuming the yellow alarm condition still exists.

## **Trouble Indicators and Display Pages**

### **Trouble Indicators**

Trouble indicators are used to identify and recognize faults that occur on an active ring. The most common and recognizable trouble indicators that aid in the recognition of ring and system related problems are as follows:

- a. Audible alarms
- b. Visual alarms
- c. Output messages.

#### **Audible Alarms**

Abnormal conditions in an office are identified by both audible and visual alarms. Hardware failures, software faults, and power faults cause alarms in an office. These alarms fall into major categories. Associated with each alarm category is an audible alarm used to notify the system user by sound. These alarms and their associated tones are as follows:

- a. **Critical Alarm:** A critical alarm is set by the 3B Computer and indicates a severe fault has occurred causing a loss of service. Two strokes on the office tone bar indicates a critical alarm.
- b. **Major Alarm:** A major alarm is set by a hardware or software fault. This alarm type could also be service affecting but reacting immediately upon the fault may prevent service interruption. One stroke on the office tone bar indicates a major alarm.
- c. **Power Plant Major Alarm:** A power plant major alarm indicates a major fault in the power plant and is service affecting. This alarm rings a bell to indicate power plant problems.
- d. **Minor Alarm:** A minor alarm is set by a minor software or hardware fault and is not service affecting. This alarm rings a bell to identify a fault.

These alarms may be transferred to remote locations for monitoring in addition to being monitored by the affected CNI site.

#### **Visual Alarms**

Visual alarms are used in conjunction with audible alarms to more precisely locate faulty equipment and assist in understanding what a problem may be. Visual alarms are normally located on the MCRT, affected equipment, and aisle cabinets where the affected equipment is located.

The visual alarms associated with the MCRT are located on the top of each display page. The visual alarms are in the form of CRITICAL, MAJOR and MINOR indicators. These alarms are illuminated when there is an associated audible alarm. There are additional alarm indicators on the display pages.

There are other visual alarms used to clearly pinpoint affected and faulty equipment in an office. These visual alarms are in the form of light emitting diodes (LEDs) and are located on control panels in the cabinets. The LEDs identify equipment that may be the cause of audible and visual alarms in the office.

### **Output Messages**

Another type of trouble indicator is output messages. Output messages are used to more accurately determine what is causing a problem with faulty hardware and/or software. Output messages are printed at the MCRT and are directly related to the visual and audible alarms that occur in the office.

Tables 6-B through 6-D identify a summary of the trouble indicators that may occur in a CNI equipped 4ESS Switch office. These tables may be used to quickly analyze trouble indicators, locate and determine faulty equipment, and to direct the user to appropriate documentation.

The tables provide quick reference information listed under several major headings and include the following.

- a. **Indication:** Identifies the categories of trouble indicators encountered (output messages, visual, and audible).
- b. **Location:** Identifies various locations that different alarms can be found (MCRT, affected equipment locations, etc.)
- c. **Message or Alarm Type:** Identifies the type of alarm (output message, visual, or audible).
- d. **Alarm Severity:** Identifies the severity of the alarm.
- e. **Affected Equipment:** Identifies equipment affected by the fault that caused alarm.
- f. **Service Affect:** Identifies whether service is interrupted or not.

The columns of each table are marked with an "x" or "+" to denote the alarm severity, affected equipment and service affected. In some instances, more than one field may be marked. All alarm severity fields are sometimes marked indicating that any of the alarms may occur for the particular incident. The service affected equipment columns are marked "Yes or No" indicating if service is affected. If both columns (Yes and No) are marked, this indicates that service may or may not be affected.

**Table 6-B. Common Network Interface Trouble Indicators and Analysis —  
Output Messages**

| Alarm Indications |          |                              |                |    |    | Affected Equipment |      |     |      | Service Affect and Documents |         |    |            |    |
|-------------------|----------|------------------------------|----------------|----|----|--------------------|------|-----|------|------------------------------|---------|----|------------|----|
| Indication        | Location | Message                      | Alarm Severity |    |    | Power              | Ring |     | Link | 3B                           | Service |    | References |    |
|                   |          |                              | CRIT           | MJ | MN |                    | LN*  | RPC |      |                              | Yes     | No | CNI        | OM |
| Output Messages   | MROP     | ALM BATTERY ALM              |                | x  |    | x                  |      |     |      |                              |         | x  | 3-10       | +  |
|                   |          | CO BATTERY DISCH             |                | x  |    | x                  |      |     |      |                              |         | x  |            | +  |
|                   |          | LOST PROTECTED AC            |                | x  | x  | x                  |      |     |      | x                            | x       | x  |            | +  |
|                   |          | POWER FAILURE ON             |                | x  | x  | x                  |      |     |      | x                            | x       | x  |            | +  |
|                   |          | PWR RM ALM                   |                | x  | x  | x                  | x    | x   |      | x                            | x       |    |            | +  |
|                   |          | REPT CNCE                    | x              |    |    |                    |      |     | x    |                              | x       | x  | 3-6,7,8,9  | +  |
|                   |          | REPT DB INIT                 | x              |    |    |                    |      |     |      | x                            | x       |    | 3-2        | +  |
|                   |          | REPT DLN CNGST               |                |    |    |                    | DLN  |     |      |                              | x       | x  |            | +  |
|                   |          | REPT ERROR                   |                | x  | x  |                    | x    | x   | x    | x                            | x       | x  |            | +  |
|                   |          | REPT IMSDRV FLT              |                |    | x  |                    | x    | x   | x    |                              | x       | x  | 3-2        |    |
|                   |          | REPT IMSDRV INIT             |                | x  | x  |                    | x    | x   | x    | x                            | x       |    | 3-2        | +  |
|                   |          | REPT LN                      |                |    | x  |                    | x    |     |      |                              |         | x  | 3-5        | +  |
|                   |          | REPT RING CFR                |                |    | x  |                    | x    | x   |      |                              | x       | x  | 3-4        | +  |
|                   |          | REPT RING GROWTH             |                |    | x  |                    | x    | x   |      |                              |         | x  | 2-2        | +  |
|                   |          | REPT RING INIT               |                | x  |    |                    | x    | x   | x    | x                            | x       |    | 3-2        | +  |
|                   |          | REPT RING<br>TRANSPORT ERROR |                |    | x  |                    | x    | x   |      |                              |         | x  |            | +  |
|                   |          | REPT RPC STAT                | x              |    |    |                    |      | x   |      |                              | x       |    | 3-4        | +  |
|                   |          | RMV:LN                       |                |    | x  |                    | x    |     |      |                              |         | x  | 3-5        | +  |
|                   |          | RMV:RPCN                     |                | x  | x  |                    |      | x   |      |                              | x       | x  | 3-5        | +  |

\* Includes DLNs, D-channel (DCHN) nodes, and special access data channel (SADC) nodes.

**Table 6-C. Common Network Interface Trouble Indicators and Analysis —  
Visual Alarms**

| Alarm Indications |                                       |            | Affected Equipment |      |      |      |       | Service Affect and Documents |    |                 |    |
|-------------------|---------------------------------------|------------|--------------------|------|------|------|-------|------------------------------|----|-----------------|----|
| Indication        | Location                              | Alarm Type | Power              | Ring |      | Link | 3B20D | Service Affected             |    | Reference       |    |
|                   |                                       |            |                    | LN*  | RPC  |      |       | Yes                          | NO | CNI             | OM |
| Visual Alarms     | At MCRT                               | Critical   |                    |      | x    |      | x     | x                            |    | 3-3             | +  |
|                   |                                       | Major      | x                  | x    | x    | x    | x     | x                            |    | 3-3, 6, 7, 8, 9 | +  |
|                   |                                       | Minor      | x                  | x    | x    | x    | x     |                              | x  | 3-3, 6, 7, 8, 9 | +  |
|                   |                                       | BLDG/PWR   | x                  | x    | x    |      | x     | x                            | x  | 3-3             | +  |
|                   |                                       | SLK        |                    |      |      | x    |       | x                            |    | 3-3, 6, 7, 8, 9 | +  |
|                   |                                       | SYS EMER   | x                  |      |      |      | x     | x                            |    | 3-3             | +  |
|                   |                                       | Other      |                    |      |      |      |       |                              |    |                 |    |
|                   | Leds at Affected Equipment Location** | RNF        | RQ                 |      | x    | x    |       | x                            | x  | 3-4             | +  |
|                   |                                       |            | NT                 |      | x    |      |       | x                            |    | 3-4             | +  |
|                   |                                       |            | ALM                |      | x    | x    |       |                              | x  | 3-10            | +  |
|                   |                                       |            | RED LED            |      | T1FA |      |       | x                            |    | 3-9             | +  |
|                   |                                       |            | YEL LED            |      | T1FA |      |       | x                            |    | 3-9             | +  |
|                   |                                       |            | Error              |      | AP   |      |       | x                            | x  | 3-10            | +  |
|                   |                                       |            | PWR ALM            | x    |      |      |       |                              | x  | 3-10            | +  |
|                   |                                       | AFAF       | FAN ALM            | x    | x    | x    |       |                              | x  | 3-10            | +  |
|                   |                                       |            | 133K ALM           | x    |      |      |       |                              | x  | 3-10            | +  |
|                   |                                       |            | 130D ALM           | x    |      |      |       |                              | x  | 3-10            | +  |

\* Includes DLNs, DCHN nodes, and SADC nodes.

\*\* Most office frames are equipped with a control panel. Located on each panel is a PWR ALM lamp. If a frame is not shown in the tables, and if the PWR ALM lamp for that frame is illuminated, check the fuses and the related power faults for the affected equipment as detailed in the "Equipment Handling Procedures" section.

**Table 6-D. Common Network Interface Trouble Indicators and Analysis — Audible Alarms**

| Alarm Indications |          |                | Affected Equipment |      |     |      | Service Affect and Documents |                  |    |           |    |
|-------------------|----------|----------------|--------------------|------|-----|------|------------------------------|------------------|----|-----------|----|
| Indication        | Location | Alarm Type     | Power              | Ring |     | Link | 3B20D                        | Service Affected |    | Reference |    |
|                   |          |                |                    | LN*  | RPC |      |                              | Yes              | No | CNI       | OM |
| Audible Alarm     | Office   | ALM BAT SUPPLY | x                  |      |     |      |                              |                  | x  |           | +  |
|                   |          | CRITICAL       |                    |      | x   | x    | x                            | x                |    |           | +  |
|                   |          | MAJOR          | x                  | x    | x   | x    | x                            | x                | x  |           | +  |
|                   |          | MINOR          | x                  | x    | x   | x    | x                            |                  | x  |           | +  |
|                   |          | PWR PL MAJOR   | x                  |      |     |      | x                            | x                | x  |           | +  |

\* Includes DLNs, DCHN nodes, and SADC nodes.

## Display Pages

The on-site user is provided with status information and maintenance functions in the form of display and menu pages. Application display pages are provided by the 4APS<x> generic software.

### Index Page (100)

The Index page is the source from which all other display pages can be accessed (Figure 6-4). Several display pages show the status of the associated devices in the office. If a device fails, the appropriate page entry on the index page is identified with a red background. The user can access any desired display page listed on the "index display page" by entering the associated page number. For example, the user would enter page number "101" following **CMD>** to display the "Status Summary Area" page.

| NAME     | TYPE                            | GENERIC |          |          | <C>                     | DATE    | TIME     |
|----------|---------------------------------|---------|----------|----------|-------------------------|---------|----------|
| SYS EMER | CRITICAL                        | MAJOR   | MINOR    | BLDG/PWR | BLD INH                 | CKT LIM | SYS NORM |
| TRAFFIC  | SYS INH                         | CU      | CU PERPH | OSS LINK |                         |         |          |
| CMD>     |                                 |         |          |          | 100 - PAGE INDEX        |         |          |
| CMD      | PAGE TITLE                      |         |          | CMD      | PAGE TITLE              |         |          |
| 101      | - STATUS SUMMARY AREA           |         |          | 1105     | - RING STATUS SUMMARY   |         |          |
| 102      | - COMMON PROCESSOR DISPLAY      |         |          | 1106     | - RING GROUP STATUS     |         |          |
| 103      | - C~D UPDATE                    |         |          | 1107     | - API/DLN STREAM STATUS |         |          |
| 104      | - OS STATUS PAGE                |         |          | 1108     | - LINK STATUS SUMMARY   |         |          |
| 105      | - CRAFT FM 01                   |         |          |          |                         |         |          |
| 106      | - CRAFT FM 01                   |         |          |          |                         |         |          |
| 109      | - FIELD UPDATE                  |         |          |          |                         |         |          |
| 110      | - DISK FILE SYSTEM ACCESS INDEX |         |          |          |                         |         |          |
| 198      | - RCV/SG                        |         |          |          |                         |         |          |
| 199      | - RCV/ECD                       |         |          |          |                         |         |          |

Figure 6-4. Example of Index Page (100)



### Ring Status Summary Page (1105)

The Ring Status Summary page (Figure 6-5) displays the IMS state of every equipped node on the ring. This page is in the form of a character map where each node corresponds to a character. Characters in lower case correspond to isolated nodes. The legal states are as follows:

|                                 |                         |
|---------------------------------|-------------------------|
| A = Active                      | F or f = Off line       |
| i = Isolated and out-of-service | B or b = Initializing   |
| O = Out of service              | G or g = Growth         |
| S or s = Standby                | . or blank = Unequipped |
| U or u = Unavailable            |                         |

| NAME                           | TYPE     | GENERIC               | MAJOR | MINOR                    | <C>      | DATE | TIME     |
|--------------------------------|----------|-----------------------|-------|--------------------------|----------|------|----------|
| SYS EMER                       | CRITICAL | CU                    | CU    | PERPH                    | OS LINKS | CNI  | SYS NORM |
| OVERLOAD                       | SYS INH  |                       |       |                          |          |      | API NSC  |
| --1105 - RING STATUS SUMMARY-- |          |                       |       |                          |          |      |          |
| [RING MAINTENANCE STATE]       |          |                       |       | [NODE DATA INVALID FLAG] |          |      |          |
| 00 AAA0AAAiigA00...            |          | 01 AAAA00ii...AAAA    |       | 02 AAAAAAAAAA...AA       |          |      |          |
| 03 AAA0AAA.....                |          | 04 AAA0AAAAAAAAAAAA   |       | 05 AA0AA00AAAAAAAAA      |          |      |          |
| 06 .                           |          | 07 .                  |       | 08 .                     |          |      |          |
| 09 .                           |          | 10 .                  |       | 11 .                     |          |      |          |
| 23 .                           |          | 24 .                  |       | 25 .                     |          |      |          |
| 26 .                           |          | 27 .                  |       | 28 .                     |          |      |          |
| 29 .                           |          | 30 .                  |       | 31 .                     |          |      |          |
| 32 AAAAAAAAA000AAA..           |          | 33 AAAAAAAAAAAAAAAAAA |       | 34 AA0000AAAAAAAAAA      |          |      |          |
| 35 .                           |          | 36 .                  |       | 37 .                     |          |      |          |
| 38 .                           |          | 39 .                  |       | 40 .                     |          |      |          |
| 41 .                           |          | 42 .                  |       | 43 .                     |          |      |          |
| 55 .                           |          | 56 .                  |       | 57 .                     |          |      |          |
| 58 .                           |          | 59 .                  |       | 60 .                     |          |      |          |
| 61 .                           |          | 62 .                  |       | 63 .                     |          |      |          |
| 400 - OP:RING;DETD             |          |                       |       |                          |          |      |          |

**Figure 6-5. Example of Ring Status Summary Page (1105)**

### Ring Node Status Page (1106)

The Ring Node Status page (Figure 6-6) displays the status and detailed information for a particular range of nodes (up to 16) in a ring group. The left side of the display page provides overall status of the ring along with input controls and the right side of the display provides detailed ring node status summaries.

```

CMD< 400 OK                                - 1106 - RING NODE STATUS -
NODE NAME:                                RING MAJOR RI  NP  MAINT
                                         NODE NAME POS STATE STATE STATE MODE
RING STATUS: ISOLATED                    01 LN  04IRN NORM ACT  USBL  USBL  AUTO
ARR RESTORE: LN00 05                     02 LN  05IRN NORM ACT  USBL  USBL  AUTO
[ARR Restart]                             03 LN  06ULN NORM ACT  USBL  USBL  AUTO
[ACNR Restore or Restart]                 04 LN  07IRN NORM ACT  USBL  USBL  AUTO
CMD      FUNCTION                         05 LN  08IRN NORM ACT  USBL  USBL  AUTO
2xx      RMV node (line xx)               06
3xx      RST node (line xx)(UCL)           07
400      BISO-EISO                         08
401/402  all non-ACT(next/prev)            09
403/404  all Equipped(next/prev)           10
500      DGN Isolated Segment              11
5xx      DGN node (line xx)                12
6nn      Group nn                         13
7nn      RST NODE (line xx) COND           14
TOTAL BISO-EISO NODES: 5                   15
                                         16

```

**Figure 6-6. Example of Ring Group Display Page (1106)**

### DLN/API Stream Status Page (1107)

The direct link node/attached processor interface (DLN/API) Stream Status page (Figure 6-7) supplies the user with status information on the DLNs, the DLN stream, both Attached Processor Interface units, and the DLN/API stream. The status information for up to four DLNs is displayed on the 1107 page. This page also shows the hardware state, application state, mode, and stream status.

| NAME     | TYPE     | GENERIC |          | <CHANNEL> | DATE | TIME     |     |     |  |
|----------|----------|---------|----------|-----------|------|----------|-----|-----|--|
| SYS EMER | CRITICAL | MAJOR   | MINOR    |           |      | SYS NORM |     |     |  |
| OVERLOAD | SYS INH  | CU      | CU PERPH | OS LINKS  | CNI  | API      | NSC | HSL |  |

- 1107 - DLN/API STREAM STATUS PAGE -

|         | HDWR<br>STATE | APPL<br>STATE | MODE    | STREAM  |
|---------|---------------|---------------|---------|---------|
| LN00 05 | ACT           | ACT           | 1WAYOUT | SCANOUT |
| LN00 10 | ACT           | STBY          | 1WAYIN  | SCANIN  |
| LN32 05 | ACT           | ACT           |         |         |
| LN32 10 | ACT           | STBY          |         |         |
| API 0   | ACT           |               | TWOWAY  | BOTH    |
| API 1   | STBY          |               |         |         |

**Figure 6-7. Example of Data Link Node/Attached Processor Interface Stream Status Page (1107)**

### Link Status Display Page (1108)

The Link Status Display page (Figure 6-8) displays the status of the CCS7, SADC, and DCHN signaling links. This page shows up to eight links and can scroll forward, backward, or choose a particular link. Information displayed on the Link Status Display page includes the following:

- Link member number (group, node, and link number)
- Link protocol type (CCS7, DCHN, or SADC)
- Far-end CLLI\* code
- Node mate (if applicable)
- Link state
- Node state.

| NAME     | TYPE     | GENERIC |          | <CHANNEL> | DATE | TIME        |
|----------|----------|---------|----------|-----------|------|-------------|
| SYS EMER | CRITICAL | MAJOR   | MINOR    |           |      | SYS NORM    |
| OVERLOAD | SYS INH  | CU      | CU PERPH | OS LINKS  | CNI  | API NSC HSL |

|                                       |  |  |  |  |  |  |
|---------------------------------------|--|--|--|--|--|--|
| - 1108 - SIGNALING LINK STATUS PAGE - |  |  |  |  |  |  |
| TOTAL LINK FAILURES                   |  |  |  |  |  |  |

ENTER GROUP-MEMBER: \_ \_ \_

| CMD         | FUNCTION      |  | NEXT/PREV | FUNCTION            | NEXT/PREV | FUNCTION   |
|-------------|---------------|--|-----------|---------------------|-----------|------------|
| 20X CHG SLK | MOOS (line x) |  | 400/401   | LOCAL LINK FAILURES | 430/431   | DCHN LINKS |
| 30X CHG SLK | ARST (line x) |  | 406/407   | ALL EQUIPPED LINKS  | 440/441   | SADC LINKS |
|             |               |  | 410/411   | CCS7 LINKS          | 450/451   | SSN LINKS  |
|             |               |  | 420/421   | CIT7 LINKS          | 460/461   | SIN LINKS  |

| GROUP  | PROT | LS    |     | CIN       |       | LINK    | NODE  | PRO  |
|--------|------|-------|-----|-----------|-------|---------|-------|------|
| MEMBER | TYPE | LACID | SLC | CLLI      | MATE  | STATE   | STATE | RCVD |
| 00 01  | CCS7 | 1     | 1   | clli_code | 32 01 | AVL-IS  | ACT   | NO   |
| 00 03  | CCS7 | 2     | 2   | clli_code | 32 03 | AVL-IS  | ACT   | NO   |
| 32 01  | CCS7 | 1     | 2   | clli_code | 00 01 | AVL-00S | ACT   | NO   |
| 32 03  | CCS7 | 2     | 1   | clli_code | 00 03 | AVL-IS  | ACT   | NO   |

**Figure 6-8. Example of Link Status Summary Page (1108)**

\*

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### AT&T Trigger Platform (ATP) Status Page (1109)

The AT&T Trigger Platform (ATP) status page 1109, associated with the AT&T Trigger Platform Junior feature (Figure 6-9) allows ATP nodes to be removed, restored or switched. The primary use of this page is to determine how the ATP nodes are performing. To access this page from the 3B Processor Maintenance Cathode Ray tube (MCRT), press the **NORM/DISP** key, then enter **1109**. Table 6-E lists the commands (Pokes) that may be entered on this page.

| 1109 - ATP STATUS PAGE |                  |  |  |
|------------------------|------------------|--|--|
| ENTER:                 |                  |  |  |
| CMD                    | FUNCTION         |  |  |
| 20x                    | RMV NODE(line x) |  |  |
| 30x                    | RST NODE(line x) |  |  |
| 400                    | SW:ATP           |  |  |

| NODE      | HARDWARE STATE | APPLICATION STATE |
|-----------|----------------|-------------------|
| 1 LN06 08 | ACT            | STBY              |
| 2 LN38 08 | ACT            | ACT               |

**Figure 6-9. Example of AT&T Trigger Platform (ATP) Status Page 1109**

**Table 6-E. All-Test-Passed (ATP) Status Page Commands**

| Poke | Description                   |
|------|-------------------------------|
| 201  | Removes the first ATP node.   |
| 202  | Removes the second ATP node.  |
| 301  | Restores the first ATP node.  |
| 302  | Restores the second ATP node. |
| 400  | Switches the two ATP nodes.   |

Specific High-Speed Link T1 Test Request Page

The specific HSL T1 Test Request Page, Status Page 1110 (Figure 6-10), is a poke page for the HSAL T1 maintenance. Status Page 1110 is used to run loopback tests on the HSALs, starting with CNI Software Release 11.4 and later.

NAME

TYPE

GENERIC

<C>

DATE

TIME

SYS EMER

CRITICAL

MAJOR

MINOR

SYS NORM

OVERLOAD

SYS INH

CU

CU PERPH

OS LINKS

CNI

API

NSC

HSL

CMD<

1110 - SPECIFIC HSL T1 TEST REQUEST

ENTER GROUP-MEMBER:    \_ \_

ENTER REPORT INTERVAL:   \_ \_

LOOPBACK TESTS

NEAR END XMIT TESTS

FAR END XMIT TESTS

CMD

ACTION

CMD

ACTION

CMD

ACTION

200

SET NE LOOPBACK

202

START HIGH DENSITY

206

START HIGH DENSITY

300

CLR NE LOOPBACK

302

STOP HIGH DENSITY

306

STOP HIGH DENSITY

201

SET FE LOOPBACK

203

START LOW DENSITY

207

START LOW DENSITY

301

CLR FE LOOPBACK

303

STOP HIGH DENSITY

307

STOP LOW DENSITY

204

START YELLOW ALM

208

START YELLOW ALM

600

SET RPT INTRVL

304

STOP YELLOW ALM

308

STOP YELLOW ALM

205

START ALL ZEROS

209

START ALL ZEROS

305

STOP ALL ZEROS

309

STOP ALL ZEROS

MAJOR:

MINOR:

NELPBK:

FELPBK:

Figure 6-10. Example of Display Page 1110—Specific HSL T1 Test Request Page

## **Common Channel Signaling No. 7**

### **Digital Signaling Link Maintenance**

---

#### **General**

A *digital signaling* link is defined as the link running from the LN, not including RI circuit pack, through a digital service adapter (DSA), digital service unit (DSU), and optional channel service unit (CSU) to the transmission facility and voice frequency link (VFL) access circuit.

The objective of the signaling link maintenance strategies is to use automatic and semiautomatic actions when applicable. Signaling link troubles are automatically detected in real time. If possible, the system reconfigures to protect service. The system then diagnoses and tests the faulty signaling link prior to notifying the user of trouble.

Maintenance aids to help in locating actual and potential signaling link failures are provided in the form of signaling link display pages, audible alarms, output messages, and measurement reports. The signaling link display pages provide information on the status of signaling link states. Signaling link alarms, output messages, and measurement reports are discussed later in this part. Signaling link failures or potential failures must be corrected as soon as possible to minimize service disruption. failures into the following:

- Beginning of the signaling link
- End of signaling link
- Intervening signaling link.

The transmission link is the part of the signaling link contained between the CSUs. Transmission link control is responsible for isolating troubles within a transmission link and ultimately referring an isolated trouble to a field work group for repair. The various control responsibilities for digital signaling links should be defined by the application.

#### **Signaling Link Process Characteristics**

Much of the maintenance process for signaling links is automatic. The complete sequence for hard failures which involves user interaction are invoked only when repairs are necessary. Before repairs are required, automatic trouble detection mechanisms should determine when signaling link performance is unacceptable and reconfiguration is required.

In the event that a signaling link's performance deteriorates past an acceptable level, the automatic recovery mechanisms transfer traffic to other signaling links and attempt to reestablish the original signaling link. This is classified as a changeover. Changeovers occur when an unacceptable performance threshold is exceeded. For a 4-wire circuit, the end detecting the unacceptable performance informs the other end that the traffic should be transferred. After a successful traffic transfer, attempts are made to prove-in the defective link. A successful prove-in within 3 minutes results in a transfer of the traffic back to the original signaling link. This is classified as a changeback. In an encrypted digital signaling link, this could take up to 13 minutes due to the long key exchange. This is an encryption code exchange which may take up to 10 minutes to complete. A complete automatic recovery procedure is called a *changeover/changeback*.

Failure to reestablish the original signaling link after three attempts by Automatic Ring Recovery (ARR) procedures initiates the need for user interaction. This involves manually testing signaling link hardware, replacing any faulty equipment, and performing diagnostics until the problem is fixed. User interaction is required only when an exception report is sent or an alarm is output.

### **Signaling Link Trouble Detection Mechanisms**

Mechanisms for detecting unacceptable signaling link performance include the following:

- a. Monitoring signal units in error (SUIE) rates
- b. Detecting near-end LN failures.

Marginally acceptable signaling link performance is detected by monitoring the following:

- a. Counts of SUIE rate
- b. Changeover/changeback rates
- c. Signaling quality measurements.

### **Signaling Link Alarms**

Three different signaling link alarm severity levels exist as follows:

- a. *Critical* -- The last signaling link connected to another office has failed. It is most likely caused by signal point isolation (SPI).
- b. *Major* -- A signaling link has failed for longer than 3 to 13 minutes with a satisfactory transfer of the signaling load.
- c. *Minor* -- The signaling link performance has been below established criteria over the last 30 minutes.



## Diagnostics

Classifying a signaling link failure requires automatic and manually requested diagnostics on the link nodes. Link node diagnostics can be automatically invoked as part of the failure declaration/classifying sequence or manually initiated via an input message.

## Measurement Reports

Measurement reports are output either automatically or on demand via input messages. The following reports are useful when performing signaling link maintenance:

1. Thirty-Minute Marginal Performance Report
2. Signaling Network Performance Report, Part 1
3. Signaling Network Performance Report, Part 2

### Thirty-Minute Marginal Performance Report

Signaling link thirty-minute marginal performance reports (30MPRs) provide information on marginal performing signaling links. These reports highlight the measure of performance deterioration of the signaling links. The decision to test a marginal signaling link should be made on the basis of the data provided. The following lists show the information provided by the 30MPRs for digital signaling links:

- a. SUIE rate: The default threshold is 200 per signaling link per half hour.
- b. Retransmission request: The default threshold is 200 per signaling link per half hour.
- c. Number of automatic changeovers/changebacks: The default threshold is two changeovers per half hour.
- d. Clock half hour signaling quality: The calculation is defined as the percentage of in-service seconds that are service-free.
- e. Current day count of clock half hours: The calculation is defined as the number of 1-second intervals where at least 1 error threshold has been exceeded.
- f. Availability of digital signaling link: The calculation is defined as the percentage of time that the signaling link is unavailable for service.

## Signaling Network Performance Report

There are two parts to the signaling network performance report, *SNPR1* and *SNPR2*. The *SNPR1* provides a summary of the signaling performance in an office. The *SNPR1* is a part of the total office report and is output on-site every hour.

The *SNPR2* provides a close look at the individual links. There are separate measurements for each link in the office. Thusly, the reports provide information helpful in isolating problems to a particular link. The *SNPR2* is a part of the detailed performance reports and is output on-site every day.

## Critical Events

Critical event messages are output as critical events occur in the signal point or as network events are recognized by the signaling point.

## Signaling Link States

The state of a signaling link must be taken into consideration when performing signaling link maintenance. There are major and minor signaling link states. The major signaling link states are as follows:

- UNEQUIPPED
- UNAVAILABLE
- AVAILABLE.

To change from one major state to another, a recent change function must be used. The following are the minor signaling link states associated with the major signaling link state UNAVAILABLE:

- GROW
- TEST.

The following are minor signaling link states associated with the major signaling link state AVAILABLE:

- ACT
- OOS
- MOOS.

To change from one minor state to another, program documentation standard commands must be used.

## **Trouble Conditions**

### **Signaling Point Isolation**

*Signaling point isolation (SPI)* is defined as the office not being able to signal other adjacent signaling network nodes due to signaling link failures. This could be due to a local signaling link failure or the receipt messages indicating a failure of some other signaling link in a path to the far-end. Signaling point isolation is a critical alarmed condition.

Each signaling point isolation occurrence increments the SPI peg count associated with each affected signaling link. There is also a per-link count of the time that each affected signaling link spent in isolation. Total office SPI occurrence peg and time counts are separated by type (that is, A-link, C-link, E-link, etc.).

### **Declared Signaling Link Failure**

A declared signaling link failure occurs because automatic recovery mechanisms have not succeeded within the allotted 13 minutes to clear near-end link node failures or because processor signaling congestion (PSC) signals have been received every 8 to 10 seconds for 30 seconds from the far-end office. A declared signaling link failure requires trouble notification, and human intervention if automatic recovery procedures are not able to return the signaling link to service. A declared link failure is a major alarmed condition.

The occurrence of each link failure increments the FLD peg count associated with the affected link. The time the link is out-of-service is accumulated in the FLD-T peg count associated with the affected link. The declared link failure peg counts and times contribute to a total office FLD peg count and a total office declared link failure time. An automatic recovery from a signaling link failure is a changeover/changeback that occurs after the detection of a link failure.

### **Link Set Failure**

A link set failure is defined as a failure of a link set or combined link set. A link set failure is a major alarmed condition. Each occurrence of a link set failure causes the CLF peg count to be incremented and the per-link time count to be accumulated for the affected signaling link.

## **AT&T Trigger Platform Node Maintenance**

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### **General**

Maintenance aids provided for the AT&T Trigger Platform (ATP) node, associated with the AT&T Trigger Platform Junior feature in the 4E20R1 generic program, include display pages, output messages, audible alarms, measurements, automatic and manually requested audits, and diagnostics. Display page 1109 was created exclusively for the ATP node.

### **Trouble Conditions**

When errors are detected output messages are reported. A list of these output formats along with a description of why the message was outputted and what action should be taken can be found in the "Input/Output Message Manuals".

### **Measurements**

Standard interprocess message switch (IMS) IUN measurements are provided for an ATP node. (Refer to Section 5 for description of these measurements.)

## Universal Link Node (ULN)

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### General

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The Universal Link Node is a new node type with CNI Software Release 11.4. Functionally, the ULN processes signaling messages just as other CCS System 7 (CCS7) nodes. The main difference between the ULN and other CCS7 link nodes is the transmission speed.

The ULN provides a direct connection for a T1 facility. The link is a 1.544 megabits per seconds (Mbps) link, which is known as a high speed A-link.

The Universal Link Node feature provides specific maintenance capabilities for the T1 termination. The maintenance capabilities are implemented through the use of craft commands. This section describes sample procedures for using these craft commands.

This section does not provide the knowledge needed to determine the following:

- The conditions which dictate the transmitting of a specific test signal
- The conditions which dictate the setting of a payload loopback



**NOTE:**

The term *payload loopback* means looping back the "1.536 Mbps payload" portion of the 1.544 Mbps T1 signal. More detail about payload loopback is provided later in this section.

- The value at which to set the "periodic indication of intrusive test (PIIT)" interval.

The expert knowledge needed to make these determinations must be provided by the test-center, test-session manager.



## **Universal Link Node Maintenance Philosophy**

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The following paragraphs present a general philosophy for ULN maintenance. The division of responsibilities and names of organizations/work centers may be different for specific 4ESS switches.

Each CCS7 high-speed A-link has a signaling link control (SLC) office assigned to the link. The SLC office is responsible for the overall performance and upkeep of the link. This office is also a designated Technology Control Center (TCC) that has maintenance responsibility for the 2STP.

The TCC is the designated maintenance control office (MCO) and the overall control office (OCO). The OCO is responsible for turning up the link order in the Trunk Integrated Record Keeping System (TIRKS). This includes preservice testing and link provisioning. The TCC uses the on-site work force (OSWF) when necessary. The TCC is responsible for monitoring the performance of the high-speed signaling links and sectionalizing any problems to the near-end signaling link ULN, the transmission facilities, or the far-end signaling link ULN. Anything past the ULN (for example, the ring node frame location of the ULN) is considered a part of the transmission facility for the high-speed links.

A central (not regional) transmission link control (TLC) office is assigned the responsibility for the monitoring of the transmission facility portion of the high-speed signaling links. The TLC office is part of the National CCS Design and Implementation District/CCS7 Centralized Test Center (CDID/CTC) located in Dallas, Texas. Common channel signaling DID/CTC is the Network Control Office (NCO) for the high-speed links.

The Technology Control Center receives from the network element (for example, 4ESS switch) link level alarms and equipment maintenance messages (alarmed or non-alarmed). The message is classified as one of the following: critical, major, or minor. The TCC receives these alarm messages via 2BSCCS/TNM.

The CDID/CTC is constantly monitoring the DS1 high-speed signaling facility with the Facility Performance Analysis System (FPAS) and CCS Performance Alarm Monitor (CPAM). The CPAM alerts CDID/CTC when high-speed links fail. The FPAS collects DS1 CNCE messages.

After TCC receives alarms via 2BSCCS/TNM, the TCC queries the network element via 2BSCCS/TNM. 2BSCCS/TNM remotes the functionality that is performed by the local craft terminal at the network element. The TCC runs diagnostics on the network element equipment to sectionalize the trouble. The TCC also receives a daily report of CNCE messages on the high-speed links then sectionalizes the trouble to the network element or the DS1 link (that is, facility since they are one and the same in the case of high-speed links). To aid the TCC in sectionalizing a problem, TCC can query the network element for the record of the TCC T1 termination for the last 24 hours of DS1 (that is, high-speed link) performance data, including errored seconds (ES), severely errored seconds (SES), and bursty errored seconds (BES) via 2BSCCS/TNM.

If the TCC sectionalizes the trouble to the high-speed link facility, TCC refers the trouble to the CDID/CTC. The CDID/CTC verifies that the high-speed link trouble is in fact due to the facility and may refer the problem to the Transport Service Center (TSC). The TSC pinpoints the problem by setting up loopbacks and intrusive tests (starting/stopping test signals). The TSC goes through CDID/CTC which requests the TCC to put the high-speed link into the AVL,MOOS state. The TSC informs CDID/CTC when it sets up loopbacks and intrusive tests, as it has done prior to the deployment of ULNs. Once the link is AVL,MOOS, the loopbacks and intrusive tests can be set up.

After TSC (or CDID/CTC) takes care of the trouble, TCC tests the network element before bringing the high-speed link back to service.

If the TCC sectionalizes the trouble to the network element, TCC indicates to the OSWF what circuit packs need to be replaced. If replacing the indicated circuit packs does not fix the trouble, TCC escalates the trouble to the National Electronic System Assistance Center (NESAC).

Once the trouble is repaired, TCC brings the high-speed link back in service.

In the case of a marginally performing link, the high-speed link has high ES, SES, BES counts, and other performance measures (as determined by the discretion of CDID/CTC) as well as a high amount of changeovers/changebacks. The CDID/CTC, which is constantly monitoring the transmission facility portion of the high-speed links, requests TCC to put the link OOS. This allows CDID/CTC to set up loopbacks in the ULN and transmit intrusive test signals to determine the trouble. It is the decision of the TCC to put the high-speed link into the AVL,MOOS state or deny this request.



**⇒ NOTE:**

If the ULN is needed for service, as determined by a software process such as Emergency Restart or Critical Node Restore, the test session is ended, and the AVL,MOOS or UNA,TEST link is placed into service. The initiator of the testing is notified by the EXC T1M output message.

For more information concerning ULN maintenance, refer to 256-090-182, *CNI Maintenance Manual*.

### **Universal Link Node Feature Capabilities**

---

The following specific maintenance capabilities for the T1 termination are provided by the ULN feature:

- Automatic reporting of T1 link/facility failures and automatic reporting of alarm signals received from the facility
- On-demand testing of the T1 link/facility
- On-demand display of T1 termination status and performance measurements
- On-demand clearing of enhanced-super-frame (ESF) error-count or performance measurements.

The preceding capabilities allow the responsible maintenance centers to assess the performance and health of the T1 termination and to set/clear a payload loopback condition or start/stop transmitting a test signal to characterize T1 malfunctions. Tests, involving the transmitting of tests signals, are designed to stress the link by sending various bit patterns; status data and performance measurements data can then be requested to check the performance of the link.

The automatic reporting of T1 link/facility failures and of alarm signals is facilitated by the output of CCS7 network critical events (CNCEs).

The capabilities for on-demand testing of the T1 link/facility and on-demand display of status and performance measurements are provided through craft commands. The use of each craft command is summarized as follows:

- |         |                                                                                                                             |
|---------|-----------------------------------------------------------------------------------------------------------------------------|
| CLR:T1M | Clears either the ESF errors count or the performance measurements data for the current and historical 15-minute intervals. |
| EXC:T1M | Starts and stops transmitting test signals and sets and clears data (payload) loopback condition at the                     |

ULN. This command can be used to unconditionally stop the transmitting of a test signal when there is a failure of any kind.

|         |                                                                                                                                                  |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| OP:T1M  | Collects and displays T1 alarm and status conditions and performance measurements data of the ULN and Network Channel Office Equipments (NCOEs). |
| SET:T1M | Sets the Periodic Indication of Intrusive Test (PIIT) interval at the ULN. (Default value is 5 minutes)                                          |

Corresponding output messages for these craft commands provide status of the request and/or the data requested by the command.

The 4ESS switch Display Page 1110 contains poke commands that allow the setting or clearing of a payload loopback test, starting or stopping of the transmitting of a test signal, and setting of the PIIT interval.

The capability to clear the ESF errors count or clear the performance data counts for the current and historical 15-minute intervals is provided by the CLR:T1M craft command.

On-demand-requests, using the craft commands or the Display Page 1110 poke commands, can be targeted to the following:

- Near-end (NE) ULN
- Far-end (FE) ULN
- *Equipment* or the *facility* side of the NE NCOE
- *Equipment* or the *facility* side of the FE NCOE.

The craft commands can be initiated via the following:

- From the No. 2 Switching Control Center System/Total Network Management (2BSCCS/TNM)
- From the local terminal, the Advanced Interactive Maintenance System (AIMS) for the 4ESS switch
- Via the local or the far-end No. 2 Signal Transfer Point (2STP)
- Via the NCOEs that appear on the T1 facility.

The 2BSCCS/TNM provides Technical Control Center (TCC) access for monitoring and testing the T1 facility. The AIMS local terminal and the read-only printer (ROP) provide the 4ESS switch technicians access for monitoring and testing the T1 Facility. Requests targeted to the far-end ULN to set or clear a payload loopback condition or start or stop a test signal are activated by T1 maintenance elements over the extended super frame (ESF-Data Link (ESF-DL)).

The ULNs (and their subtended maintenance elements) do not initiate requests, to set or clear loopbacks or start or stop intrusive test signals, to the NCOE. However, the NCOEs do propagate requests, to set or clear payload loopback conditions and to start or stop test signals, to the ULNs.

The T1 Maintenance Enhancements feature enhances the existing T1 maintenance capabilities as follows:

|               |                                                                                                                                                                                                                                                                                                                                                                           |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Line Loopback | Previously, a payload loopback was available that provided the ability to loop the payload portion of the 1.544 Mbps bandwidth on high-speed links. With this feature, it is also possible to request a loopback on the entire digital signal (thus, including the maintenance channel, framing, and error check bits). Near-end and far-end line loopbacks are possible. |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                             |                                                                                                                                                                                                                               |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Automatic Test Report (ATR) | Previously, maintenance personnel could manually request status and performance data reports for tests on high-speed links. The Automatic Test Report (ATR) command enables maintenance personnel the following capabilities: |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

a. May optionally specify:

- Complete test configuration (that is, the loopbacks and/or test signals to be activated during the ATR test)
- Partial test configuration
- No part of the test configuration to be used in the ATR test (the test configuration can be partially or completely preconfigured before the ATR test is run).

b. Must specify (Not Optional):

- Duration of the test
- Whether status and performance data is to be collected from the near-end ULN, the far-end ULN, or both ULNs at the end of the test.

*The performance data reported at the end of the test reflects **ONLY THE CHANGE** in the data values that occurred during the test interval.*

Upon the completion of the ATR test, the results of the ATR test is issued automatically.

Any ATR test configuration element(s) like loopback and/or test signal, specified in the atr command itself, are automatically deactivated at the end of the ATR test. Any pre-established test configuration elements set up prior to entering the ATR command are NOT automatically deactivated at the end of the ATR test. This allows a pre-established test configuration to be used repeatedly in several successive ATR test, if necessary.

24-Hour  
Performance  
Report

This feature provides a new report that contains a summary of the DS1 performance counts for each high-speed link in the office for the previous 24-hour period. The report is output automatically via the Measurement Output Control Table. This report can also be demanded at any time.

The T1 Maintenance Enhancements feature allows the following command.

ATR:T1M

1. Collects and displays reports for tests on high-speed link automatically.
2. Allows reports for a specific period of time. (Between 1 minutes to 12-hous duration)
3. Whether measurements are to be collected at either end, one end, or both ends of the link.
4. Whether loopback is to be used at either end of the link.

## **Universal Link Node Maintenance**

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Maintenance for 56 Kbps links is comprised of the following:

- Equipment maintenance
- Facility maintenance
- Circuit maintenance.

Equipment maintenance for 56 Kbps links deals with the ring nodes [for example, small scale integration (SSI) link node (LN), ring peripheral controller (RPC)] as well as other equipment (for example, DSU, CSU). Facility maintenance for a 56 Kbps link refers to maintenance at a DS1 level; circuit maintenance refers to maintenance of a channelized circuit on a T1 as well as maintenance at the DS0 level.

For high-speed A-links (that is, ULNs) there is no DS0 level, and the T1 is nonchannelized. In essence, the circuit (or link) is the same as the unchannelized T1 facility. Universal link node (ULN) maintenance can be broken into two categories: *overall link maintenance* and *transmission link maintenance*. Overall link maintenance for ULNs is similar to maintenance for other link nodes. Anything past the ULN (that is, the ring node frame location of the ULN) is considered a part of the transmission facility.

## **D-Channel and Special Access Data Channel Signaling Link Maintenance**

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### **General**

A *D-channel* (DCHN) or *special access data channel* (SADC) is defined as a signaling link running from the DCHN or SADC node (not including ring interface circuit pack) to the far-end termination. The DCHN is either a clear or restricted digital signaling link that operates at 64 Kbps. The SADC is a clear analog signaling link that operates at 4.8 Kbps. Up to eight signaling links can terminate on one node. Signaling link failures or potential failures must be corrected as soon as possible to minimize service disruption.

For the most part, DCHN and SADC maintenance strategies are similar to CCS7 signaling link maintenance strategies. Maintenance aids including signaling link display pages, audible alarms, output messages, measurement reports and diagnostics are available. Only unique features of the DCHN and SADC maintenance plan is discussed.

### **Signaling Link Management**

Signaling link management is on a per link basis with each signaling link on a node being completely independent from the others. At any one time, some signaling links could be in the *AVAILABLE-IS* state; while other signaling links on the same node could be in the *AVAILABLE-OOS*, *UNAVAILABLE*, or *UNEQUIPPED* state. However, if the node is removed from service, all signaling links are removed from service.

With DCHNs, T1FA maintenance strategies include isolating or partitioning the signaling link failures to identify failures due to faulty T1FA circuitry. The T1FA and DCHN maintenance strategies are independent of each other.

### **Trouble Conditions**

There are a number of link outage conditions. Depending on the outage, between 0 and 8 seconds elapse before a *Temporary Link Failure* condition occurs. Attempts are made to reestablish the link. The link is marked as having level 2 congestion and flow control is initiated. If the link fails to recover within 90 seconds, it is placed in the *AVAILABLE-OOS* state, and call processing is notified via the 3B Computer. A critical event is generated at this time. If the link is reestablished within 90 seconds, flow control is removed. The number of *Temporary Link Failure* conditions and the *accumulated link outage* time measurements are reported.

## Measurement Reports

The DCHN and SADC signaling links use the same basic reports as the CCS7 signaling links. These reports consist of the 30MPR, SNPR1, and SNPR2. However, some of the measurements are different.

## Critical Events

The CNI link management generates a number of critical event messages. All critical events are on a per-link basis. Of particular importance is the declared link failure which occurs when the link state is moved from *AVAILABLE-IS* to *AVAILABLE-OOS*. The T1FA state management also generates critical events concerning T1FA circuitry.

Node failures generate critical events on a per-link basis. However, a T1FA failure does not automatically take the associated links out of service. They fail independently, and link failure events are generated.

## Interprocess Message Switch Subsystem Initialization

### General

In the event that a failure, fault, or other condition occurs that prevents normal processing or functioning of the ring, the need arises to recover the system and restore it to normal operation. The system attempts to recover itself through a fault recovery sequence. If this is ineffective and the malfunction persists, progressive automatic initialization phases are undertaken.

### ⇒ NOTE:

Do not confuse progressive automatic initialization phases with RTR boots.

The interprocess message switch (IMS) subsystem supports five levels of initialization (levels 0, 1A, 1B, 3 boot, and 4 boot). There is an *IMS abort sequence* which terminates IMS subsystems when severe problems are experienced. Abort sequences are also required preceding a 3/4 boot if IMS is running.

Each of the IMS initialization levels and the abort sequence can be requested by a particular application or subsystem that is using the IMS subsystem. Interprocess message switch (IMS) can internally request levels 0, 1A, 1B, and the abort sequence.

### ⇒ NOTE:

The user cannot directly request an IMS subsystem initialization level without requesting a CNI INIT. An IMS initialization level is internally invoked by the application or subsystem that is using the IMS subsystem.

The following two paragraphs describe the *UNIX\* RTR* message dialogue between the IMS driver process and the application or subsystem using IMS when performing a system-wide boot-strap initialization.

Once the IMS driver process is created, it proceeds to initialize the IMS subsystem. This is accomplished by using IMS to send a message that informs the application or subsystem of the IMS initialization. A request is made for information instructing the IMS driver process on what level of initialization should be performed. The application or subsystem using IMS reacts by sending a message back to the IMS driver process specifying what IMS initialization level to invoke.

After the IMS driver process completes the requested initialization level, it sends another message to the user indicating that the IMS initialization has completed. If for some reason the IMS driver process cannot complete the initialization, it notifies the CNI software that IMS is aborting.

### **Ring Initialization**

Ring initialization utilizes the ring interface hardware and attempts to provide the 3B Computer with an active communication channel to all link nodes. Ring initialization basically involves IMS initialization levels 3 and 4. In the event that either a level 3 or level 4 initialization occurs automatically or is manually requested, the IMS ring status and configuration is affected. A level 3 initialization reinitializes the message switch in the 3B Computer and a level 4 initialization performs a complete reinitialization of the message switch and the ring.

In ring initialization, the procedures for an initialization level 3 or 4 expect that the major and minor states of the link nodes have not been preserved. Knowledge within the 3B Computer of the current ring configuration and the ring maintenance state has been lost.

The following paragraphs describe the internal procedures that occur when an initialization level 3 or 4 is invoked. The user is not directly involved in these internal procedures, but is notified by an output message as to whether the initialization level succeeded or failed. The output message has eight possible output formats. A list of these output formats along with a description of why the message was outputted and what action should be taken can be found in the input/output message manuals.

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\* UNIX is a trademark of Novell, Inc.



### Initialization Level 3

Initialization level 3 restores all ring peripheral controller nodes (RPCNs), checks the status of all link nodes, and can selectively initialize nodes. A level 3 does not affect node to node communication if the ring configuration is usable.

The DLNs are treated the same as link nodes except that the 3B Computer to DLN direct memory access (DMA) is reinitialized and tested for each DLN.

A more detailed description of ring initialization procedures for a level 3 initialization is as follows:

- a. An audit of the current ring configuration is conducted to determine:
  1. Is there an active ring segment?
  2. If the complete ring is not operational, what are the BISO and EISO nodes?
  3. Does the apparent ring configuration have any inconsistencies with the current ECD?
  4. Does the apparent ring configuration pass the ring audit test?

If any of these audit operations fail or indicate some inconsistency, ring initialization escalates to Step (b). Otherwise, 3B Computer data is modified to agree with the configuration discovered on the ring, and ring initialization is declared a success. Note that this audit does not disrupt any existing node to node communications.

- b. With the failure of an audit level, any existing node communications on the ring is disrupted. All reachable nodes are silenced. The ring is partitioned into ring segments where the standby RPCNs define the segment boundaries. Ring communications are verified across each of these ring segments with the objective of combining as many segments as possible to define an active ring. If a complete ring is not possible, a binary search for ring faults is conducted within the remaining portion of the ring in an attempt to extend the acceptable ring segment beyond the current segments. If this level of initialization fails, ring initialization escalates to Step (c).
- c. This Step is defined as *ring down*. Tests are run on each node to recover usable fragments of a ring segment.

### Initialization Level 4

A level 4 initialization is a complete initialization of the ring. All node communication is stopped. All nodes are unconditionally restored. Each node is thoroughly tested and the largest fault-free ring is combined together. The DLNs are completely down loaded in a level 4 initialization. An extra step to set up and test the DMA path between the 3B Computer and the DLN also exists.

A more detailed description of ring initialization procedures for a level 4 initialization is as follows:

- a. All nodes on the ring, other than the RPCNs, are placed in the quarantined state. This is done to keep the nodes from interfering with activity while ring initialization is taking place.
- b. Through the standby RPCNs, each node is tested to determine its ability to propagate messages on the ring and to be a viable endpoint of an active ring segment. After each node is tested, the largest possible part of a ring segment is combined together to form the active ring segment. Three different cases may arise depending on what faults were encountered and how much of a ring could be combined together. The following is a list of these cases:

*Case 1*

No faults are encountered. It is possible that the whole ring exists. In this case, separate tokens are put on each ring. This results in the normal two ring system with separate tokens on each ring but only one ring being used for traffic flow.

*Case 2*

Faults are encountered. One or more nodes must be isolated to form an isolated ring segment. The indicated BISO and EISO nodes bound the isolated ring segment on each side. Ring 0 identifies the ring that propagates messages around the ring in ascending order (e.g., IUN00 1 to IUN00 2 to IUN00 3, etc.). Similarly, ring 1 identifies the ring that propagates messages around the ring in descending order. As ring 0 is moved in the direction of message propagation, the BISO node is the last node encountered in the active ring segment. Similarly, the EISO node is the first node encountered in the active ring segment as ring 0 is moved out of the isolated ring segment. In this case, the largest part of the ring is combined together. This biggest part of the ring is initialized with one token circulating on that part. The isolated ring segment is diagnosed automatically.

*Case 3*

A large number of faults are encountered preventing a sufficient portion of the ring from being combined together. In this case, the ring is down. If the ring is down, it is not possible to communicate with the node which prevents them from being initialized.

- c. After ring initialization is complete and the token or tokens are out, control is transferred to the code that deals with initializing nodes on the ring. The nodes are pumped with their code and data.

## **Diagnostics**

---

Diagnostics for the IMS and CNI serve two major purposes. First, diagnostics are run for fault detection and resolution and are invoked by manual requests. Diagnostics are also invoked by error analysis programs as part of the automatic ring recovery (ARR) of equipment that has been removed from service due to a faulty condition. Secondly, diagnostics are run for the purpose of repair verification.

The IMS/CNI system diagnostics provide diagnostic testing for the IMS and CNI hardware. These diagnostics are performed in a manner similar to those of the 3B Computer system but diagnose totally different equipment. The IMS utilizes the 3B Computer as the central processing unit. The function of the IMS is to receive messages from incoming applications and route the message to an outgoing application. The IMS utilizes a ring communication bus to totally interconnect all application terminations and the 3B Computer. The ring is a dual bus configuration and is designed such that faulty circuits can be eliminated from the active system for an indefinite period of time.

The IMS diagnostics primarily test ring nodes that is contained in the ring node cabinet (RNC). There are several types of ring nodes:

1. Ring Peripheral Controller Nodes (RPCNs)
2. Direct Link Nodes (DLNs)
3. Common Channel Signaling No. 7 (CCS7) nodes
4. D-Channel Nodes (DCHNs)
5. Special Access Data Channel (SADC) nodes.

The RPCN is used to remove data from the ring and transfer it to the 3B Computer for processing or insert processed data back onto the ring. The DLNs are used to provide direct access to the 3B Computer. The DLNs function like application link nodes but have direct memory access (DMA) capability. The DLNs contain the same circuit packs as the RPCN plus an attached processor (AP) circuit pack. The CCS7, DCHN and SADC nodes are identified as application link nodes and are used to provide entrance and exit points on the ring for specific applications. The CNI utilizes the link interface of these nodes to provide communications between the ring and the various applications offered by the network.

The DCHN and SADC nodes have modified link interface circuit packs and the DCHN nodes have an addition T1 Facility Access (T1FA) circuit pack. The Four Port Link Interface (LI4) circuit packs used with DCHN and SADC nodes is similar to the LI packs used with CCS7 nodes, but there are some significant and distinct differences in them. The LI4 has no ROM on board. It is strictly RAM based. Diagnostics and operational programs are down loaded from the 3B Computer through the node processor to four port link interfaces. The major difference between LI4 link interface and the LI link interface is that the LI4 supports four data links where as the LI link interface supports only one data link. Each node processor can support two LI4 link interface packs for a total of eight links per node processor.

The T1 Facility Access (T1FA) multiplexes/demultiplexes 24 channels between three DCHN nodes (8 channels per node) and a DS1 facility via backplane wiring. The DCHN node that contains the T1FA is identified as the T1FA Control Node (TCN).

Local maintenance access and diagnostic status information for IMS, CNI and 3B Computer functions are obtained through maintenance terminals and receive-only printers. The maintenance terminal provides the primary interface for system control and display functions, input/output messages and 3B Computer emergency action interface (EAI) functions. Inputs entered at the maintenance terminal can be monitored via remote support organizations.

The maintenance receive-only printer provides hard copies of input/output messages, report status information, fault conditions, audits, and diagnostic results. If remote maintenance is provided, it has the same terminal access and terminal capabilities as the on-site user. Because both the remote and local users have simultaneous access to system diagnostics, it is advised that diagnostic input requests be coordinated through the on-site user.

## **Performing Diagnostics**

When performing manual diagnostics, input and output messages are entered and interpreted from the maintenance terminal. For this reason, basic terminal familiarization and operating knowledge is required. An understanding of input messages and knowledge of the message data fields and formats are also important.

*UNIX RTR* software provides assistance to users for entering input messages. It can be used to complete or correct errors caused by the user. Invalid values are rejected accompanied by an appropriate error acknowledgment. Further help can then be obtained by entering a question mark (?). Help is provided for only one input message at a time. A prompting mode can be used to lead the user through the input message. When a complete input message has been constructed, the user may either execute or cancel the message. The help session is then completed.

## Diagnostic Message Structure

Listed within the following paragraphs are basic guidelines for understanding the input message format. For a detailed explanation of the message structure, refer to Input/Output message manuals. An input message can contain 96 characters separated by colons into fields. The fields of an input message are identified as the action, identification, and data field. Each field is variable in length. These fields are briefly explained as follows:

- a. Action Field: An action verb that identifies the action the system should perform. This field is always a verb such as diagnose (DGN), inhibit (INH), remove (RMV), restore (RST), etc.
- b. Identification Field: Consists of one, two, or three fields called subfields. These subfields are separated by semicolons with each containing one or more keywords. The identification field aids in structuring the message to permit a complete specification or provides additional information identifying the object of the action.
- c. Data Field: This field is either null or composed of keywords separated by commas, providing additional information pertaining to the message.

A typical diagnostic input message and format varies in length and field identifiers. The sample message below provides field separation and identification.

**DGN:nodexx y[ ;[RPT n] [,RAW] [,UCL] ] [:PH n [,TLP] ]**

Where:

**DGN:** = Action field

**nodexx y[ ;[RPT n] [,RAW] [,UCL] ] [:** = Identification field

**PH n [,TLP] ]** = Data field.

## System Diagnostics

Diagnostics on the IMS/CNI system may be performed manually. However, when the system detects a faulty condition, diagnostics are performed automatically via the automatic ring recovery (ARR) procedures. The diagnose (DGN) command is used to perform manual diagnostics in an office. Several formats of the diagnose command are detailed in Table 6-F. For a complete listing of all diagnostic input messages, refer to the input/output message manuals.

**Table 6-F. DGN Message Input Variations**

| Command             | Function                                                                                                     |
|---------------------|--------------------------------------------------------------------------------------------------------------|
| DGN:nodexx y        | Runs all automatic phases on nodexx y.                                                                       |
| DGN:nodexx y:PH a   | Runs only the specified phase (a) on nodexx y.                                                               |
| DGN:nodexx y:PH a-b | Runs all automatic phases within the specified range (a through b) on nodexx y.                              |
| DGN:nodexx y;RPT n  | Runs all automatic phases on nodexx y and repeats execution "n" times, where n is equal to or less than 255. |
| DGN:nodexx y;RAW    | Runs all automatic phases on nodexx y and prints the diagnostic results of every phase at the MROP.          |
| DGN:nodexx y;UCL    | Runs all automatic phases on nodexx y. Early terminations built into data tables are ignored.                |

When performing IMS/CNI diagnostics, obtaining the status of the system, the ring, or the a particular node may be necessary. One manner that a status report can be obtained is with the use of input messages. Table 6-G provides a list of input message formats used to produce status reports.

**Table 6-G. OP:RING Input Message Variations**

| Input Message    | Function                                                                         |
|------------------|----------------------------------------------------------------------------------|
| OP:RING,nodexx y | Provides status information for the specified node (RPCN or IUN).                |
| OP:RING,GRP xx   | Provides status information for all nodes on a specified frame/cabinet (GRP xx). |
| OP:RING          | Provides summary information of the ring.                                        |
| OP:RING;SUM      |                                                                                  |
| OP:RING;DETD     | Provides detailed status of the ring.                                            |
| OP:00S           | Provides status information of all equipment which is out-of-service             |
| OP:SLK           | Provides link status information for DCHNs and SADC nodes.                       |

## Diagnostic Phases

Diagnostic routines are broken down into phases. Phases are designed to test a unique group of functionally related hardware. Each phase may test all or part of the hardware on a single circuit pack or group of circuit packs. In addition, each node is diagnosed by its own set of diagnostic phases. Certain node hardware, such as the node processor, is used by all node types. Therefore, diagnostic phases that test this type hardware are the same for all node types.

Associated with each piece of hardware that is tested by a diagnostic phase is a list of suspected or possibly faulty circuit packs. When diagnostic failures still exist after replacing suspect hardware, analysis of the diagnostic test results must be performed. This is accomplished using the diagnostic output message and diagnostic listings. Generally, the first failing phase and the first few failing tests within that phase are most useful for analysis. If this data is not available, run diagnostics using the **RAW** option to print all test failures.

A diagnostic listing consists of a prologue followed by one or more program units. Each program unit contains a PROLOGUE, HARDWARE TESTED and HOW TESTING IS PERFORMED. The remainder of the program unit consists of program data specifying diagnostic commands.

Each diagnostic command begins with a statement number. This is the statement number that is referred to in the interactive diagnostics. Some diagnostic command lines are preceded by one or more comment lines. These are lines that begin with the character "C." They are intended to identify the purpose of the command line.

## Ring Node Addressing

The addressing of ring nodes and the manner in which cabinets are identified are for maintenance purposes. An address is identified in terms of an integer sequence number and may be represented in decimal or hexadecimal notations. The decimal notations represent the physical node identification ranging from 0 to 1023. Another decimal notation ranging from 3072 to 4095 represents the physical node addresses in machine logic. These notations are not usually seen by the users. Node addresses are listed in hexadecimal notations. These addresses are important when analyzing mismatched data. Suspected faulty nodes as well as the beginning of isolation (BISO) and the end of isolation (EISO) nodes are identified by hexadecimal node addresses. Tables 6-H through 6-K identify the physical node identifications and physical node addresses in both decimal and hexadecimal formats.

**Table 6-H. Physical Node Identification (Decimal Representation)**

| Ring Node | RPC | IMS User Nodes |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----------|-----|----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Group     | 0   | 1              | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  |
| 00        | 0   | 1              | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  |
| 01        | 16  | 17             | 18  | 19  | 20  | 21  | 22  | 23  | 24  | 25  | 26  | 27  | 28  | 29  | 30  | 31  |
| 02        | 32  | 33             | 34  | 35  | 36  | 37  | 38  | 39  | 40  | 41  | 42  | 43  | 44  | 45  | 46  | 47  |
| 03        | 48  | 49             | 50  | 51  | 52  | 53  | 54  | 55  | 56  | 57  | 58  | 59  | 60  | 61  | 62  | 63  |
| 04        | 64  | 65             | 66  | 67  | 68  | 69  | 70  | 71  | 72  | 73  | 74  | 75  | 76  | 77  | 78  | 79  |
| 05        | 80  | 81             | 82  | 83  | 84  | 85  | 86  | 87  | 88  | 89  | 90  | 91  | 92  | 93  | 94  | 95  |
| 06        | 96  | 97             | 98  | 99  | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 |
| 07        | 112 | 113            | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 |
| 08        | 128 | 129            | 130 | 131 | 132 | 133 | 134 | 135 | 136 | 137 | 138 | 139 | 140 | 141 | 142 | 143 |
| 09        | 144 | 145            | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 |
| 10        | 160 | 161            | 162 | 163 | 164 | 165 | 166 | 167 | 168 | 169 | 170 | 171 | 172 | 173 | 174 | 175 |
| 11        | 176 | 177            | 178 | 179 | 180 | 181 | 182 | 183 | 184 | 185 | 186 | 187 | 188 | 189 | 190 | 191 |
| 12        | 192 | 193            | 194 | 195 | 196 | 197 | 198 | 199 | 200 | 201 | 202 | 203 | 204 | 205 | 206 | 207 |
| 13        | 208 | 209            | 210 | 211 | 212 | 213 | 214 | 215 | 216 | 217 | 218 | 219 | 220 | 221 | 222 | 223 |
| 14        | 224 | 225            | 226 | 227 | 228 | 229 | 230 | 231 | 232 | 233 | 234 | 235 | 236 | 237 | 238 | 239 |
| 15        | 240 | 241            | 242 | 243 | 244 | 245 | 246 | 247 | 248 | 249 | 250 | 251 | 252 | 253 | 254 | 255 |
| 16        | 256 | 257            | 258 | 259 | 260 | 261 | 262 | 263 | 264 | 265 | 266 | 267 | 268 | 269 | 270 | 271 |
| 17        | 272 | 273            | 274 | 275 | 276 | 277 | 278 | 279 | 280 | 281 | 282 | 283 | 284 | 285 | 286 | 287 |
| 18        | 288 | 289            | 290 | 291 | 292 | 293 | 294 | 295 | 296 | 297 | 298 | 299 | 300 | 301 | 302 | 303 |
| 19        | 304 | 305            | 306 | 307 | 308 | 309 | 310 | 311 | 312 | 313 | 314 | 315 | 316 | 317 | 318 | 319 |



**Table 6-H. Physical Node Identification [(Decimal Representation) Contd]**

| Ring Node | RPC | IMS User Nodes |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----------|-----|----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Group     | 0   | 1              | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  |
| 20        | 320 | 321            | 322 | 323 | 324 | 325 | 326 | 327 | 328 | 329 | 330 | 331 | 332 | 333 | 334 | 335 |
| 21        | 336 | 337            | 338 | 339 | 340 | 341 | 342 | 343 | 344 | 345 | 346 | 347 | 348 | 349 | 350 | 351 |
| 22        | 352 | 353            | 354 | 355 | 356 | 357 | 358 | 359 | 360 | 361 | 362 | 363 | 364 | 365 | 366 | 367 |
| 23        | 368 | 369            | 370 | 371 | 372 | 373 | 374 | 375 | 376 | 377 | 378 | 379 | 380 | 381 | 382 | 383 |
| 24        | 384 | 385            | 386 | 387 | 388 | 389 | 390 | 391 | 392 | 393 | 394 | 395 | 396 | 397 | 398 | 399 |
| 25        | 400 | 401            | 402 | 403 | 404 | 405 | 406 | 407 | 408 | 409 | 410 | 411 | 412 | 413 | 414 | 415 |
| 26        | 416 | 417            | 418 | 419 | 420 | 421 | 422 | 423 | 424 | 425 | 426 | 427 | 428 | 429 | 430 | 431 |
| 27        | 432 | 433            | 434 | 435 | 436 | 437 | 438 | 439 | 440 | 441 | 442 | 443 | 444 | 445 | 446 | 447 |
| 28        | 448 | 449            | 450 | 451 | 452 | 453 | 454 | 455 | 456 | 457 | 458 | 459 | 460 | 461 | 462 | 463 |
| 29        | 464 | 465            | 466 | 467 | 468 | 469 | 470 | 471 | 472 | 473 | 474 | 475 | 476 | 477 | 478 | 479 |
| 30        | 480 | 481            | 482 | 483 | 484 | 485 | 486 | 487 | 488 | 489 | 490 | 491 | 492 | 493 | 494 | 495 |
| 31        | 496 | 497            | 498 | 499 | 500 | 501 | 502 | 503 | 504 | 505 | 506 | 507 | 508 | 509 | 510 | 511 |
| 32        | 512 | 513            | 514 | 515 | 516 | 517 | 518 | 519 | 520 | 521 | 522 | 523 | 524 | 525 | 526 | 527 |
| 33        | 528 | 529            | 530 | 531 | 532 | 533 | 534 | 535 | 536 | 537 | 538 | 539 | 540 | 541 | 542 | 543 |
| 34        | 544 | 545            | 546 | 547 | 548 | 549 | 550 | 551 | 552 | 553 | 554 | 555 | 556 | 557 | 558 | 559 |
| 35        | 560 | 561            | 562 | 563 | 564 | 565 | 566 | 567 | 568 | 569 | 570 | 571 | 572 | 573 | 574 | 575 |
| 36        | 576 | 577            | 578 | 579 | 580 | 581 | 582 | 583 | 584 | 585 | 586 | 587 | 588 | 589 | 590 | 591 |
| 37        | 592 | 593            | 594 | 595 | 596 | 597 | 598 | 599 | 600 | 601 | 602 | 603 | 604 | 605 | 606 | 607 |
| 38        | 608 | 609            | 610 | 611 | 612 | 613 | 614 | 615 | 616 | 617 | 618 | 619 | 620 | 621 | 622 | 623 |

**Table 6-H. Physical Node Identification [(Decimal Representation) Contd]**

| Ring Node | RPC | IMS User Nodes |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----------|-----|----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Group     | 0   | 1              | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  |
| 39        | 624 | 625            | 626 | 627 | 628 | 629 | 630 | 631 | 632 | 633 | 634 | 635 | 636 | 637 | 638 | 639 |
| 40        | 640 | 641            | 642 | 643 | 644 | 645 | 646 | 647 | 648 | 649 | 650 | 651 | 652 | 653 | 654 | 655 |
| 41        | 656 | 657            | 658 | 659 | 660 | 661 | 662 | 663 | 664 | 665 | 666 | 667 | 668 | 669 | 670 | 671 |
| 42        | 672 | 673            | 674 | 675 | 676 | 677 | 678 | 679 | 680 | 681 | 682 | 683 | 684 | 685 | 686 | 687 |
| 43        | 688 | 689            | 690 | 691 | 692 | 693 | 694 | 695 | 696 | 697 | 698 | 699 | 700 | 701 | 702 | 703 |
| 44        | 704 | 705            | 706 | 707 | 708 | 709 | 710 | 711 | 712 | 713 | 714 | 715 | 716 | 717 | 718 | 719 |
| 45        | 720 | 721            | 722 | 723 | 724 | 725 | 726 | 727 | 728 | 729 | 730 | 731 | 732 | 733 | 734 | 735 |
| 46        | 736 | 737            | 738 | 739 | 740 | 741 | 742 | 743 | 744 | 745 | 746 | 747 | 748 | 749 | 750 | 751 |
| 47        | 752 | 753            | 754 | 755 | 756 | 758 | 759 | 760 | 761 | 762 | 762 | 763 | 764 | 765 | 766 | 767 |
| 48        | 768 | 769            | 770 | 771 | 772 | 773 | 774 | 775 | 776 | 777 | 778 | 779 | 780 | 781 | 782 | 783 |
| 49        | 784 | 785            | 786 | 787 | 788 | 789 | 790 | 791 | 792 | 793 | 794 | 795 | 796 | 797 | 798 | 799 |
| 50        | 800 | 801            | 802 | 803 | 804 | 805 | 806 | 807 | 808 | 809 | 810 | 811 | 812 | 813 | 814 | 815 |
| 51        | 816 | 817            | 818 | 819 | 820 | 821 | 822 | 823 | 824 | 825 | 826 | 827 | 828 | 829 | 830 | 831 |
| 52        | 832 | 833            | 834 | 835 | 836 | 837 | 838 | 839 | 840 | 841 | 842 | 843 | 844 | 845 | 846 | 847 |
| 53        | 848 | 849            | 850 | 851 | 852 | 853 | 854 | 855 | 856 | 857 | 858 | 859 | 860 | 861 | 862 | 863 |
| 54        | 864 | 865            | 866 | 867 | 868 | 869 | 870 | 871 | 872 | 873 | 874 | 875 | 876 | 877 | 878 | 879 |
| 55        | 880 | 881            | 882 | 883 | 884 | 885 | 886 | 887 | 888 | 889 | 890 | 891 | 892 | 893 | 894 | 895 |
| 56        | 896 | 897            | 898 | 899 | 900 | 901 | 902 | 903 | 904 | 905 | 906 | 907 | 908 | 909 | 910 | 911 |
| 57        | 912 | 913            | 914 | 915 | 916 | 917 | 918 | 919 | 920 | 921 | 922 | 923 | 924 | 925 | 926 | 927 |

**Table 6-H. Physical Node Identification [(Decimal Representation) Contd]**

| Ring Node | RPC  | IMS User Nodes |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|-----------|------|----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Group     | 0    | 1              | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   | 11   | 12   | 13   | 14   | 15   |
| 58        | 928  | 929            | 930  | 931  | 932  | 933  | 934  | 935  | 936  | 937  | 938  | 939  | 940  | 941  | 942  | 943  |
| 59        | 944  | 945            | 946  | 947  | 948  | 949  | 950  | 951  | 952  | 953  | 954  | 955  | 956  | 957  | 958  | 959  |
| 60        | 960  | 961            | 962  | 963  | 964  | 965  | 966  | 967  | 968  | 969  | 970  | 971  | 972  | 973  | 974  | 975  |
| 61        | 976  | 977            | 978  | 979  | 980  | 981  | 982  | 983  | 984  | 985  | 986  | 987  | 988  | 989  | 990  | 991  |
| 62        | 992  | 993            | 994  | 995  | 996  | 997  | 998  | 999  | 1000 | 1001 | 1002 | 1003 | 1004 | 1005 | 1006 | 1007 |
| 63        | 1008 | 1009           | 1010 | 1011 | 1012 | 1013 | 1014 | 1015 | 1016 | 1017 | 1018 | 1019 | 1020 | 1021 | 1022 | 1023 |

Table 6-1. Physical Node Addresses (Decimal Representation)

| Ring Node | RPC  | IMS User Nodes |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|-----------|------|----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Group     | 0    | 1              | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   | 11   | 12   | 13   | 14   | 15   |
| 00        | 3072 | 3073           | 3074 | 3075 | 3076 | 3077 | 3078 | 3079 | 3080 | 3081 | 3082 | 3083 | 3084 | 3085 | 3086 | 3087 |
| 01        | 3088 | 3089           | 3090 | 3091 | 3092 | 3093 | 3094 | 3095 | 3096 | 3097 | 3098 | 3099 | 3100 | 3101 | 3102 | 3103 |
| 02        | 3104 | 3105           | 3106 | 3107 | 3108 | 3109 | 3110 | 3111 | 3112 | 3113 | 3114 | 3115 | 3116 | 3117 | 3118 | 3119 |
| 03        | 3120 | 3121           | 3122 | 3123 | 3124 | 3125 | 3126 | 3127 | 3128 | 3129 | 3130 | 3131 | 3132 | 3133 | 3134 | 3135 |
| 04        | 3136 | 3137           | 3138 | 3139 | 3140 | 3141 | 3142 | 3143 | 3144 | 3145 | 3146 | 3147 | 3148 | 3149 | 3150 | 3151 |
| 05        | 3152 | 3153           | 3154 | 3155 | 3156 | 3157 | 3158 | 3159 | 3160 | 3161 | 3162 | 3163 | 3164 | 3165 | 3166 | 3167 |
| 06        | 3168 | 3169           | 3170 | 3171 | 3172 | 3173 | 3174 | 3175 | 3176 | 3177 | 3178 | 3179 | 3180 | 3181 | 3182 | 3183 |
| 07        | 3184 | 3185           | 3186 | 3187 | 3188 | 3189 | 3190 | 3191 | 3192 | 3193 | 3194 | 3195 | 3196 | 3197 | 3198 | 3199 |
| 08        | 3200 | 3201           | 3202 | 3203 | 3204 | 3205 | 3206 | 3207 | 3208 | 3209 | 3210 | 3211 | 3212 | 3213 | 3214 | 3215 |
| 09        | 3216 | 3217           | 3218 | 3219 | 3220 | 3221 | 3222 | 3223 | 3224 | 3225 | 3226 | 3227 | 3228 | 3229 | 3230 | 3231 |
| 10        | 3232 | 3233           | 3234 | 3235 | 3236 | 3237 | 3238 | 3239 | 3240 | 3241 | 3242 | 3243 | 3244 | 3245 | 3246 | 3247 |
| 11        | 3248 | 3249           | 3250 | 3251 | 3252 | 3253 | 3254 | 3255 | 3256 | 3257 | 3258 | 3259 | 3260 | 3261 | 3262 | 3263 |
| 12        | 3264 | 3265           | 3266 | 3267 | 3268 | 3269 | 3270 | 3271 | 3272 | 3273 | 3274 | 3275 | 3276 | 3277 | 3278 | 3279 |
| 13        | 3280 | 3281           | 3282 | 3283 | 3284 | 3285 | 3286 | 3287 | 3288 | 3289 | 3290 | 3291 | 3292 | 3293 | 3294 | 3295 |
| 14        | 3296 | 3297           | 3298 | 3299 | 3300 | 3301 | 3302 | 3303 | 3304 | 3305 | 3306 | 3307 | 3308 | 3309 | 3310 | 3311 |
| 15        | 3312 | 3313           | 3314 | 3315 | 3316 | 3317 | 3318 | 3319 | 3320 | 3321 | 3322 | 3323 | 3324 | 3325 | 3326 | 3327 |
| 16        | 3328 | 3329           | 3330 | 3331 | 3332 | 3333 | 3334 | 3335 | 3336 | 3337 | 3338 | 3339 | 3340 | 3341 | 3342 | 3343 |
| 17        | 3344 | 3345           | 3346 | 3347 | 3348 | 3349 | 3350 | 3351 | 3352 | 3353 | 3354 | 3355 | 3356 | 3357 | 3358 | 3359 |
| 18        | 3360 | 3361           | 3362 | 3363 | 3364 | 3365 | 3366 | 3367 | 3368 | 3369 | 3370 | 3371 | 3372 | 3373 | 3374 | 3375 |
| 19        | 3376 | 3377           | 3378 | 3379 | 3380 | 3381 | 3382 | 3383 | 3384 | 3385 | 3386 | 3387 | 3388 | 3389 | 3390 | 3391 |

**Table 6-I. Physical Node Addresses [(Decimal Representation) Contd]**

| Ring Node |  | RPC  | IMS User Nodes |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|-----------|--|------|----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Group     |  | 0    | 1              | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   | 11   | 12   | 13   | 14   | 15   |
| 20        |  | 3392 | 3393           | 3394 | 3395 | 3396 | 3397 | 3398 | 3399 | 3400 | 3401 | 3402 | 3403 | 3404 | 3405 | 3406 | 3407 |
| 21        |  | 3408 | 3409           | 3410 | 3411 | 3412 | 3413 | 3414 | 3415 | 3416 | 3417 | 3418 | 3419 | 3420 | 3421 | 3422 | 3423 |
| 22        |  | 3424 | 3425           | 3426 | 3427 | 3428 | 3429 | 3430 | 3431 | 3432 | 3433 | 3434 | 3435 | 3436 | 3437 | 3438 | 3439 |
| 23        |  | 3440 | 3441           | 3442 | 3443 | 3444 | 3445 | 3446 | 3447 | 3448 | 3449 | 3450 | 3451 | 3452 | 3453 | 3454 | 3455 |
| 24        |  | 3456 | 3457           | 3458 | 3459 | 3460 | 3461 | 3462 | 3463 | 3464 | 3465 | 3466 | 3467 | 3468 | 3469 | 3470 | 3471 |
| 25        |  | 3472 | 3473           | 3474 | 3475 | 3476 | 3477 | 3478 | 3479 | 3480 | 3481 | 3482 | 3483 | 3484 | 3485 | 3486 | 3487 |
| 26        |  | 3488 | 3489           | 3490 | 3491 | 3492 | 3493 | 3494 | 3495 | 3496 | 3497 | 3498 | 3499 | 3500 | 3501 | 3502 | 3503 |
| 27        |  | 3504 | 3505           | 3506 | 3507 | 3508 | 3509 | 3510 | 3511 | 3512 | 3513 | 3514 | 3515 | 3516 | 3517 | 3518 | 3519 |
| 28        |  | 3520 | 3521           | 3522 | 3523 | 3524 | 3525 | 3526 | 3527 | 3528 | 3529 | 3530 | 3531 | 3532 | 3533 | 3534 | 3535 |
| 29        |  | 3536 | 3537           | 3538 | 3539 | 3540 | 3541 | 3542 | 3543 | 3544 | 3545 | 3546 | 3547 | 3548 | 3549 | 3550 | 3551 |
| 30        |  | 3552 | 3553           | 3554 | 3555 | 3556 | 3557 | 3558 | 3559 | 3560 | 3561 | 3562 | 3563 | 3564 | 3565 | 3566 | 3567 |
| 31        |  | 3568 | 3569           | 3570 | 3571 | 3572 | 3573 | 3574 | 3575 | 3576 | 3577 | 3578 | 3579 | 3580 | 3581 | 3582 | 3583 |
| 32        |  | 3584 | 3585           | 3586 | 3587 | 3588 | 3589 | 3590 | 3591 | 3592 | 3593 | 3594 | 3595 | 3596 | 3597 | 3598 | 3599 |
| 33        |  | 3600 | 3601           | 3602 | 3603 | 3604 | 3605 | 3606 | 3607 | 3608 | 3609 | 3610 | 3611 | 3612 | 3613 | 3614 | 3615 |
| 34        |  | 3616 | 3617           | 3618 | 3619 | 3620 | 3621 | 3622 | 3623 | 3624 | 3625 | 3626 | 3627 | 3628 | 3629 | 3630 | 3631 |
| 35        |  | 3632 | 3633           | 3634 | 3635 | 3636 | 3637 | 3638 | 3639 | 3640 | 3641 | 3642 | 3643 | 3644 | 3645 | 3646 | 3647 |
| 36        |  | 3648 | 3649           | 3650 | 3651 | 3652 | 3653 | 3654 | 3655 | 3656 | 3657 | 3658 | 3659 | 3660 | 3661 | 3662 | 3663 |
| 37        |  | 3664 | 3665           | 3666 | 3667 | 3668 | 3669 | 3670 | 3671 | 3672 | 3673 | 3674 | 3675 | 3676 | 3677 | 3678 | 3679 |
| 38        |  | 3680 | 3681           | 3682 | 3683 | 3684 | 3685 | 3686 | 3687 | 3688 | 3689 | 3690 | 3691 | 3692 | 3693 | 3694 | 3695 |

**Table 6-I. Physical Node Addresses [(Decimal Representation) Contd]**

| Ring Node | RPC  | IMS User Nodes |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|-----------|------|----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|           | 0    | 1              | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   | 11   | 12   | 13   | 14   | 15   |
| 39        | 3696 | 3697           | 3698 | 3699 | 3700 | 3701 | 3702 | 3703 | 3704 | 3705 | 3706 | 3707 | 3708 | 3709 | 3710 | 3711 |
| 40        | 3712 | 3713           | 3714 | 3715 | 3716 | 3717 | 3718 | 3719 | 3720 | 3721 | 3722 | 3723 | 3724 | 3725 | 3726 | 3727 |
| 41        | 3728 | 3729           | 3730 | 3731 | 3732 | 3733 | 3734 | 3735 | 3736 | 3737 | 3738 | 3739 | 3740 | 3741 | 3742 | 3743 |
| 42        | 3744 | 3745           | 3746 | 3747 | 3748 | 3749 | 3750 | 3751 | 3752 | 3753 | 3754 | 3755 | 3756 | 3757 | 3758 | 3759 |
| 43        | 3760 | 3761           | 3762 | 3763 | 3764 | 3765 | 3766 | 3767 | 3768 | 3769 | 3770 | 3771 | 3772 | 3773 | 3774 | 3775 |
| 44        | 3776 | 3777           | 3778 | 3779 | 3780 | 3781 | 3782 | 3783 | 3784 | 3785 | 3786 | 3787 | 3788 | 3789 | 3790 | 3791 |
| 45        | 3792 | 3793           | 3794 | 3795 | 3796 | 3797 | 3798 | 3799 | 3800 | 3801 | 3802 | 3803 | 3804 | 3805 | 3806 | 3807 |
| 46        | 3808 | 3809           | 3810 | 3811 | 3812 | 3813 | 3814 | 3815 | 3816 | 3817 | 3818 | 3819 | 3820 | 3821 | 3822 | 3823 |
| 47        | 3824 | 3825           | 3826 | 3827 | 3828 | 3829 | 3830 | 3831 | 3832 | 3833 | 3834 | 3835 | 3836 | 3837 | 3838 | 3839 |
| 48        | 3840 | 3841           | 3842 | 3843 | 3844 | 3845 | 3846 | 3847 | 3848 | 3849 | 3850 | 3851 | 3852 | 3853 | 3854 | 3855 |
| 49        | 3856 | 3857           | 3858 | 3859 | 3860 | 3861 | 3862 | 3863 | 3864 | 3865 | 3866 | 3867 | 3868 | 3869 | 3870 | 3871 |
| 50        | 3872 | 3873           | 3874 | 3875 | 3876 | 3877 | 3878 | 3789 | 3880 | 3881 | 3882 | 3883 | 3884 | 3885 | 3886 | 3887 |
| 51        | 3888 | 3889           | 3890 | 3891 | 3892 | 3893 | 3894 | 3895 | 3896 | 3897 | 3898 | 3899 | 3900 | 3901 | 3902 | 3903 |
| 52        | 2904 | 3905           | 3906 | 3907 | 3908 | 3909 | 3910 | 3911 | 3912 | 3913 | 3914 | 3915 | 3916 | 3917 | 3918 | 3919 |
| 53        | 3920 | 3921           | 3922 | 3923 | 3924 | 3925 | 3926 | 3927 | 3928 | 3929 | 3930 | 3931 | 3932 | 3933 | 3934 | 3935 |
| 54        | 3936 | 3937           | 3938 | 3939 | 3940 | 3941 | 3942 | 3943 | 3944 | 3945 | 3946 | 3947 | 3948 | 3949 | 3950 | 3951 |
| 55        | 3952 | 3953           | 3954 | 3955 | 3956 | 3957 | 3958 | 3959 | 3960 | 3961 | 3962 | 3963 | 3964 | 3965 | 3966 | 3967 |
| 56        | 3968 | 3969           | 3970 | 3971 | 3972 | 3973 | 3974 | 3975 | 3976 | 3977 | 3978 | 3979 | 3980 | 3981 | 3982 | 3983 |
| 57        | 3984 | 3985           | 3986 | 3987 | 3988 | 3989 | 3990 | 3991 | 3992 | 3993 | 3994 | 3995 | 3996 | 3997 | 3998 | 3999 |

**Table 6-I. Physical Node Addresses [(Decimal Representation) Contd]**

| Ring Node |  | IMS User Nodes |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|-----------|--|----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| RPC       |  | 0              | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   | 11   | 12   | 13   | 14   | 15   |
| 58        |  | 4000           | 4001 | 4002 | 4003 | 4004 | 4005 | 4006 | 4007 | 4008 | 4009 | 4010 | 4011 | 4012 | 4013 | 4014 | 4015 |
| 59        |  | 4016           | 4017 | 4018 | 4019 | 4020 | 4021 | 4022 | 4023 | 4024 | 4025 | 4026 | 4027 | 4028 | 4029 | 4030 | 4031 |
| 60        |  | 4032           | 4033 | 4034 | 4035 | 4036 | 4037 | 4038 | 4039 | 4040 | 4041 | 4042 | 4043 | 4044 | 4045 | 4046 | 4047 |
| 61        |  | 4048           | 4049 | 4050 | 4051 | 4052 | 4053 | 4054 | 4055 | 4056 | 4057 | 4058 | 4059 | 4060 | 4061 | 4062 | 4063 |
| 62        |  | 4064           | 4065 | 4066 | 4067 | 4068 | 4069 | 4070 | 4071 | 4072 | 4073 | 4074 | 4075 | 4076 | 4077 | 4078 | 4079 |
| 63        |  | 4080           | 4081 | 4082 | 4083 | 4084 | 4085 | 4086 | 4087 | 4088 | 4089 | 4090 | 4091 | 4092 | 4093 | 4094 | 4095 |

**Table 6-J. Physical Node Identification (Hexadecimal Representation)**

| Ring Node | RPC | IMS User Nodes |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----------|-----|----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Group     | 0   | 1              | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  |
| 00        | 000 | 001            | 002 | 003 | 004 | 005 | 006 | 007 | 008 | 009 | 00A | 00B | 00C | 00D | 00E | 00F |
| 01        | 010 | 011            | 012 | 013 | 014 | 015 | 016 | 017 | 018 | 019 | 01A | 01B | 01C | 01D | 01E | 01F |
| 02        | 020 | 021            | 022 | 023 | 024 | 025 | 026 | 027 | 028 | 029 | 02A | 02B | 02C | 02D | 02E | 02F |
| 03        | 030 | 031            | 032 | 033 | 034 | 035 | 036 | 037 | 038 | 039 | 03A | 03B | 03C | 03D | 03E | 03F |
| 04        | 040 | 041            | 042 | 043 | 044 | 045 | 046 | 047 | 048 | 049 | 04A | 04B | 04C | 04D | 04E | 04F |
| 05        | 050 | 051            | 052 | 053 | 054 | 055 | 056 | 057 | 058 | 059 | 05A | 05B | 05C | 05D | 05E | 05F |
| 06        | 060 | 061            | 062 | 063 | 064 | 065 | 066 | 067 | 068 | 069 | 06A | 06B | 06C | 06D | 06E | 06F |
| 07        | 070 | 071            | 072 | 073 | 074 | 075 | 076 | 077 | 078 | 079 | 07A | 07B | 07C | 07D | 07E | 07F |
| 08        | 080 | 081            | 082 | 083 | 084 | 085 | 086 | 087 | 088 | 089 | 08A | 08B | 08C | 08D | 08E | 08F |
| 09        | 090 | 091            | 092 | 093 | 094 | 095 | 096 | 097 | 098 | 099 | 09A | 09B | 09C | 09D | 09E | 09F |
| 10        | 0A0 | 0A1            | 0A2 | 0A3 | 0A4 | 0A5 | 0A6 | 0A7 | 0A8 | 0A9 | 0AA | 0AB | 0AC | 0AD | 0AE | 0AF |
| 11        | 0B0 | 0B1            | 0B2 | 0B3 | 0B4 | 0B5 | 0B6 | 0B7 | 0B8 | 0B9 | 0BA | 0BB | 0BC | 0BD | 0BE | 0BF |
| 12        | 0C0 | 0C1            | 0C2 | 0C3 | 0C4 | 0C5 | 0C6 | 0C7 | 0C8 | 0C9 | 0CA | 0CB | 0CC | 0CD | 0CE | 0CF |
| 13        | 0D0 | 0D1            | 0D2 | 0D3 | 0D4 | 0D5 | 0D6 | 0D7 | 0D8 | 0D9 | 0DA | 0DB | 0DC | 0DD | 0DE | 0DF |
| 14        | 0E0 | 0E1            | 0E2 | 0E3 | 0E4 | 0E5 | 0E6 | 0E7 | 0E8 | 0E9 | 0EA | 0EB | 0EC | 0ED | 0EE | 0EF |
| 15        | 0F0 | 0F1            | 0F2 | 0F3 | 0F4 | 0F5 | 0F6 | 0F7 | 0F8 | 0F9 | 0FA | 0FB | 0FC | 0FD | 0FE | 0FF |
| 16        | 100 | 101            | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 10A | 10B | 10C | 10D | 10E | 10F |
| 17        | 110 | 111            | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 11A | 11B | 11C | 11D | 11E | 11F |
| 18        | 120 | 121            | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 12A | 12B | 12C | 12D | 12E | 12F |
| 19        | 130 | 131            | 132 | 133 | 134 | 135 | 136 | 137 | 138 | 139 | 13A | 13B | 13C | 13D | 13E | 13F |



**Table 6-J. Physical Node Identification [(Hexadecimal Representation) Contd]**

| Ring Node | RPC | IMS User Nodes |     |     |     |     |     |     |     |     |     |     |     |     |     |     |    |
|-----------|-----|----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|
|           |     | 0              | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15 |
| 20        | 140 | 141            | 142 | 143 | 144 | 145 | 146 | 147 | 148 | 149 | 14A | 14B | 14C | 14D | 14E | 14F |    |
| 21        | 150 | 151            | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 | 15A | 15B | 15C | 15D | 15E | 15F |    |
| 22        | 160 | 161            | 162 | 163 | 164 | 165 | 166 | 167 | 168 | 169 | 16A | 16B | 16C | 16D | 16E | 16F |    |
| 23        | 170 | 171            | 172 | 173 | 174 | 175 | 176 | 177 | 178 | 179 | 17A | 17B | 17C | 17D | 17E | 17F |    |
| 24        | 180 | 181            | 182 | 183 | 184 | 185 | 186 | 187 | 188 | 189 | 18A | 18B | 18C | 18D | 18E | 18F |    |
| 25        | 190 | 191            | 192 | 193 | 194 | 195 | 196 | 197 | 198 | 199 | 19A | 19B | 19C | 19D | 19E | 19F |    |
| 26        | 1A0 | 1A1            | 1A2 | 1A3 | 1A4 | 1A5 | 1A6 | 1A7 | 1A8 | 1A9 | 1AA | 1AB | 1AC | 1AD | 1AE | 1AF |    |
| 27        | 1B0 | 1B1            | 1B2 | 1B3 | 1B4 | 1B5 | 1B6 | 1B7 | 1B8 | 1B9 | 1BA | 1BB | 1BC | 1BD | 1BE | 1BF |    |
| 28        | 1C0 | 1C1            | 1C2 | 1C3 | 1C4 | 1C5 | 1C6 | 1C7 | 1C8 | 1C9 | 1CA | 1CB | 1CC | 1CD | 1CE | 1CF |    |
| 29        | 1D0 | 1D1            | 1D2 | 1D3 | 1D4 | 1D5 | 1D6 | 1D7 | 1D8 | 1D9 | 1DA | 1DB | 1DC | 1DD | 1DE | 1DF |    |
| 30        | 1E0 | 1E1            | 1E2 | 1E3 | 1E4 | 1E5 | 1E6 | 1E7 | 1E8 | 1E9 | 1EA | 1EB | 1EC | 1ED | 1EE | 1EF |    |
| 31        | 1F0 | 1F1            | 1F2 | 1F3 | 1F4 | 1F5 | 1F6 | 1F7 | 1F8 | 1F9 | 1FA | 1FB | 1FC | 1FD | 1FE | 1FF |    |
| 32        | 200 | 201            | 202 | 203 | 204 | 205 | 206 | 207 | 208 | 209 | 20A | 20B | 20C | 20D | 20E | 20F |    |
| 33        | 210 | 211            | 212 | 213 | 214 | 215 | 216 | 217 | 218 | 219 | 21A | 21B | 21C | 21D | 21E | 21F |    |
| 34        | 220 | 221            | 222 | 223 | 224 | 225 | 226 | 227 | 228 | 229 | 22A | 22B | 22C | 22D | 22E | 22F |    |
| 35        | 230 | 231            | 232 | 233 | 234 | 235 | 236 | 237 | 238 | 239 | 23A | 23B | 23C | 23D | 23E | 23F |    |
| 36        | 240 | 241            | 242 | 243 | 244 | 245 | 246 | 247 | 248 | 249 | 24A | 24B | 24C | 24D | 24E | 24F |    |
| 37        | 250 | 251            | 252 | 253 | 254 | 255 | 256 | 257 | 258 | 259 | 25A | 25B | 25C | 25D | 25E | 25F |    |
| 38        | 260 | 261            | 262 | 263 | 264 | 265 | 266 | 267 | 268 | 269 | 26A | 26B | 26C | 26D | 26E | 26F |    |

**Table 6-J. Physical Node Identification [(Hexadecimal Representation) Contd]**

| Ring Node | RPC | IMS User Nodes |     |     |     |     |     |     |     |     |     |     |     |     |     |     |    |
|-----------|-----|----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|
|           |     | 0              | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15 |
| 39        | 270 | 271            | 272 | 273 | 274 | 275 | 276 | 277 | 278 | 279 | 27A | 27B | 27C | 27D | 27E | 27F |    |
| 40        | 280 | 281            | 282 | 283 | 284 | 285 | 286 | 287 | 288 | 289 | 28A | 28B | 28C | 28D | 28E | 28F |    |
| 41        | 290 | 291            | 292 | 293 | 294 | 295 | 296 | 297 | 298 | 299 | 29A | 29B | 29C | 29D | 29E | 29F |    |
| 42        | 2A0 | 2A1            | 2A2 | 2A3 | 2A4 | 2A5 | 2A6 | 2A7 | 2A8 | 2A9 | 2AA | 2AB | 2AC | 2AD | 2AE | 2AF |    |
| 43        | 2B0 | 2B1            | 2B2 | 2B3 | 2B4 | 2B5 | 2B6 | 2B7 | 2B8 | 2B9 | 2BA | 2BB | 2BC | 2BD | 2BE | 2BF |    |
| 44        | 2C0 | 2C1            | 2C2 | 2C3 | 2C4 | 2C5 | 2C6 | 2C7 | 2C8 | 2C9 | 2CA | 2CB | 2CC | 2CD | 2CE | 2CF |    |
| 45        | 2D0 | 2D1            | 2D2 | 2D3 | 2D4 | 2D5 | 2D6 | 2D7 | 2D8 | 2D9 | 2DA | 2DB | 2DC | 2DD | 2DE | 2DF |    |
| 46        | 2E0 | 2E1            | 2E2 | 2E3 | 2E4 | 2E5 | 2E6 | 2E7 | 2E8 | 2E9 | 2EA | 2EB | 2EC | 2ED | 2EE | 2EF |    |
| 47        | 2F0 | 2F1            | 2F2 | 2F3 | 2F4 | 2F5 | 2F6 | 2F7 | 2F8 | 2F9 | 2FA | 2FB | 2FC | 2FD | 2FE | 2FF |    |
| 48        | 300 | 301            | 302 | 303 | 304 | 305 | 306 | 307 | 308 | 309 | 30A | 30B | 30C | 30D | 30E | 30F |    |
| 49        | 310 | 311            | 312 | 313 | 314 | 315 | 316 | 317 | 318 | 319 | 31A | 31B | 31C | 31D | 31E | 31F |    |
| 50        | 320 | 321            | 322 | 323 | 324 | 325 | 326 | 327 | 328 | 329 | 32A | 32B | 32C | 32D | 32E | 32F |    |
| 51        | 330 | 331            | 332 | 333 | 334 | 335 | 336 | 337 | 338 | 339 | 33A | 33B | 33C | 33D | 33E | 33F |    |
| 52        | 340 | 341            | 342 | 343 | 344 | 345 | 346 | 347 | 348 | 349 | 34A | 34B | 34C | 34D | 34E | 34F |    |
| 53        | 350 | 351            | 352 | 353 | 354 | 355 | 356 | 357 | 358 | 359 | 35A | 35B | 35C | 35D | 35E | 35F |    |
| 54        | 360 | 361            | 362 | 363 | 364 | 365 | 366 | 367 | 368 | 369 | 36A | 36B | 36C | 36D | 36E | 36F |    |
| 55        | 370 | 371            | 372 | 373 | 374 | 375 | 376 | 377 | 378 | 379 | 37A | 37B | 37C | 37D | 37E | 37F |    |
| 56        | 380 | 381            | 382 | 383 | 384 | 385 | 386 | 387 | 388 | 389 | 38A | 38B | 38C | 38D | 38E | 38F |    |
| 57        | 390 | 391            | 392 | 393 | 394 | 395 | 396 | 397 | 398 | 399 | 39A | 39B | 39C | 39D | 39E | 39F |    |

**Table 6-J. Physical Node Identification [(Hexadecimal Representation) Contd]**

| Ring Node | RPC | IMS User Nodes |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----------|-----|----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Group     | 0   | 1              | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  |
| 58        | 3A0 | 3A1            | 3A2 | 3A3 | 3A4 | 3A5 | 3A6 | 3A7 | 3A8 | 3A9 | 3AA | 3AB | 3AC | 3AD | 3AE | 3AF |
| 59        | 3B0 | 3B1            | 3B2 | 3B3 | 3B4 | 3B5 | 3B6 | 3B7 | 3B8 | 3B9 | 3BA | 3BB | 3BC | 3BD | 3BE | 3BF |
| 60        | 3C0 | 3C1            | 3C2 | 3C3 | 3C4 | 3C5 | 3C6 | 3C7 | 3C8 | 3C9 | 3CA | 3CB | 3CC | 3CD | 3CE | 3CF |
| 61        | 3D0 | 3D1            | 3D2 | 3D3 | 3D4 | 3D5 | 3D6 | 3D7 | 3D8 | 3D9 | 3DA | 3DB | 3DC | 3DD | 3DE | 3DF |
| 62        | 3E0 | 3E1            | 3E2 | 3E3 | 3E4 | 3E5 | 3E6 | 3E7 | 3E8 | 3E9 | 3EA | 3EB | 3EC | 3ED | 3EE | 3EF |
| 63        | 3F0 | 3F1            | 3F2 | 3F3 | 3F4 | 3F5 | 3F6 | 3F7 | 3F8 | 3F9 | 3FA | 3FB | 3FC | 3FD | 3FE | 3FF |

Table 6-K. Physical Node Address (Hexadecimal Representation)

| Ring Node | RPC | IMS User Nodes |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----------|-----|----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Group     | 0   | 1              | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  |
| 00        | C00 | C01            | C02 | C03 | C04 | C05 | C06 | C07 | C08 | C09 | C0A | C0B | C0C | C0D | C0E | C0F |
| 01        | C10 | C11            | C12 | C13 | C14 | C15 | C16 | C17 | C18 | C19 | C1A | C1B | C1C | C1D | C1E | C1F |
| 02        | C20 | C21            | C22 | C23 | C24 | C25 | C26 | C27 | C28 | C29 | C2A | C2B | C2C | C2D | C2E | C2F |
| 03        | C30 | C31            | C32 | C33 | C34 | C35 | C36 | C37 | C38 | C39 | C3A | C3B | C3C | C3D | C3E | C3F |
| 04        | C40 | C41            | C42 | C43 | C44 | C45 | C46 | C47 | C48 | C49 | C4A | C4B | C4C | C4D | C4E | C4F |
| 05        | C50 | C51            | C52 | C53 | C54 | C55 | C56 | C57 | C58 | C59 | C5A | C5B | C5C | C5D | C5E | C5F |
| 06        | C60 | C61            | C62 | C63 | C64 | C65 | C66 | C67 | C68 | C69 | C6A | C6B | C6C | C6D | C6E | C6F |
| 07        | C70 | C71            | C72 | C73 | C74 | C75 | C76 | C77 | C78 | C79 | C7A | C7B | C7C | C7D | C7E | C7F |
| 08        | C80 | C81            | C82 | C83 | C84 | C85 | C86 | C87 | C88 | C89 | C8A | C8B | C8C | C8D | C8E | C8F |
| 09        | C90 | C91            | C92 | C93 | C94 | C95 | C96 | C97 | C98 | C99 | C9A | C9B | C9C | C9D | C9E | C9F |
| 10        | CA0 | CA1            | CA2 | CA3 | CA4 | CA5 | CA6 | CA7 | CA8 | CA9 | CAA | CAB | CAC | CAD | CAE | CAF |
| 11        | CB0 | CB1            | CB2 | CB3 | CB4 | CB5 | CB6 | CB7 | CB8 | CB9 | CBA | CBB | CBC | CBD | CBE | CBF |
| 12        | CC0 | CC1            | CC2 | CC3 | CC4 | CC5 | CC6 | CC7 | CC8 | CC9 | CCA | CCB | CCC | CCD | CCE | CCF |
| 13        | CD0 | CD1            | CD2 | CD3 | CD4 | CD5 | CD6 | CD7 | CD8 | CD9 | CDA | CDB | CDC | CDD | CDE | CDF |
| 14        | CE0 | CE1            | CE2 | CE3 | CE4 | CE5 | CE6 | CE7 | CE8 | CE9 | CEA | CEB | CEC | CED | CEE | CEF |
| 15        | CF0 | CF1            | CF2 | CF3 | CF4 | CF5 | CF6 | CF7 | CF8 | CF9 | CFA | CFB | CFC | CFD | CFE | CFF |
| 16        | D00 | D01            | D02 | D03 | D04 | D05 | D06 | D07 | D08 | D09 | D0A | D0B | D0C | D0D | D0E | D0F |
| 17        | D10 | D11            | D12 | D13 | D14 | D15 | D16 | D17 | D18 | D19 | D1A | D1B | D1C | D1D | D1E | D1F |
| 18        | D20 | D21            | D22 | D23 | D24 | D25 | D26 | D27 | D28 | D29 | D2A | D2B | D2C | D2D | D2E | D2F |
| 19        | D30 | D31            | D32 | D33 | D34 | D35 | D36 | D37 | D38 | D39 | D3A | D3B | D3C | D3D | D3E | D3F |

**Table 6-K. Physical Node Address [(Hexadecimal Representation) Contd]**

| Ring Node | RPC | IMS User Nodes |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----------|-----|----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|           | 0   | 1              | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  |
| Group     |     |                |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 20        | D40 | D41            | D42 | D43 | D44 | D45 | D46 | D47 | D48 | D49 | D4A | D4B | D4C | D4D | D4E | D4F |
| 21        | D50 | D51            | D52 | D53 | D54 | D55 | D56 | D57 | D58 | D59 | D5A | D5B | D5C | D5D | D5E | D5F |
| 22        | D60 | D61            | D62 | D63 | D64 | D65 | D66 | D67 | D68 | D69 | D6A | D6B | D6C | D6D | D6E | D6F |
| 23        | D70 | D71            | D72 | D73 | D74 | D75 | D76 | D77 | D78 | D79 | D7A | D7B | D7C | D7D | D7E | D7F |
| 24        | D80 | D81            | D82 | D83 | D84 | D85 | D86 | D87 | D88 | D89 | D8A | D8B | D8C | D8D | D8E | D8F |
| 25        | D90 | D91            | D92 | D93 | D94 | D95 | D96 | D97 | D98 | D99 | D9A | D9B | D9C | D9D | D9E | D9F |
| 26        | DA0 | DA1            | DA2 | DA3 | DA4 | DA5 | DA6 | DA7 | DA8 | DA9 | DAA | DAB | DAC | DAD | DAE | DAF |
| 27        | DB0 | DB1            | DB2 | DB3 | DB4 | DB5 | DB6 | DB7 | DB8 | DB9 | DBA | DBB | DBC | DBD | DBE | DBF |
| 28        | DC0 | DC1            | DC2 | DC3 | DC4 | DC5 | DC6 | DC7 | DC8 | DC9 | DCA | DCB | DCC | DCD | DCE | DCF |
| 29        | DD0 | DD1            | DD2 | DD3 | DD4 | DD5 | DD6 | DD7 | DD8 | DD9 | DDA | DDB | DDC | DDD | DDE | DDF |
| 30        | DE0 | DE1            | DE2 | DE3 | DE4 | DE5 | DE6 | DE7 | DE8 | DE9 | DEA | DEB | DEC | DED | DEE | DEF |
| 31        | DF0 | DF1            | DF2 | DF3 | DF4 | DF5 | DF6 | DF7 | DF8 | DF9 | DFA | DFB | DFC | DFD | DFF | DFE |
| 32        | E00 | E01            | E02 | E03 | E04 | E05 | E06 | E07 | E08 | E09 | E0A | E0B | E0C | E0D | E0E | E0F |
| 33        | E10 | E11            | E12 | E13 | E14 | E15 | E16 | E17 | E18 | E19 | E1A | E1B | E1C | E1D | E1E | E1F |
| 34        | E20 | E21            | E22 | E23 | E24 | E25 | E26 | E27 | E28 | E29 | E2A | E2B | E2C | E2D | E2E | E2F |
| 35        | E30 | E31            | E32 | E33 | E34 | E35 | E36 | E37 | E38 | E39 | E3A | E3B | E3C | E3D | E3E | E3F |
| 36        | E40 | E41            | E42 | E43 | E44 | E45 | E46 | E47 | E48 | E49 | E4A | E4B | E4C | E4D | E4E | E4F |
| 37        | E50 | E51            | E52 | E53 | E54 | E55 | E56 | E57 | E58 | E59 | E5A | E5B | E5C | E5D | E5E | E5F |
| 38        | E60 | E61            | E62 | E63 | E64 | E65 | E66 | E67 | E68 | E69 | E6A | E6B | E6C | E6D | E6E | E6F |

**Table 6-K. Physical Node Address [(Hexadecimal Representation) Contd]**

| Ring Node | RPC | IMS User Nodes |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----------|-----|----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|           | 0   | 1              | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  |
| 39        | E70 | E71            | E72 | E73 | E74 | E75 | E76 | E77 | E78 | E79 | E7A | E7B | E7C | E7D | E7E | E7F |
| 40        | E80 | E81            | E82 | E83 | E84 | E85 | E86 | E87 | E88 | E89 | E8A | E8B | E8C | E8D | E8E | E8F |
| 41        | E90 | E91            | E92 | E93 | E94 | E95 | E96 | E97 | E98 | E99 | E9A | E9B | E9C | E9D | E9E | E9F |
| 42        | EA0 | EA1            | EA2 | EA3 | EA4 | EA5 | EA6 | EA7 | EA8 | EA9 | EAA | EAB | EAC | EAD | EAE | EAF |
| 43        | EB0 | EB1            | EB2 | EB3 | EB4 | EB5 | EB6 | EB7 | EB8 | EB9 | EBA | EBB | EBC | EBD | EBE | EBF |
| 44        | EC0 | EC1            | EC2 | EC3 | EC4 | EC5 | EC6 | EC7 | EC8 | EC9 | ECA | ECB | ECC | ECD | ECE | ECF |
| 45        | ED0 | ED1            | ED2 | ED3 | ED4 | ED5 | ED6 | ED7 | ED8 | ED9 | EDA | EDB | EDC | EDD | EDE | EDF |
| 46        | EE0 | EE1            | EE2 | EE3 | EE4 | EE5 | EE6 | EE7 | EE8 | EE9 | EEA | EEB | EEC | EED | EEE | EEF |
| 47        | EF0 | EF1            | EF2 | EF3 | EF4 | EF5 | EF6 | EF7 | EF8 | EF9 | EFA | EFB | EFC | efd | EFE | EFF |
| 48        | F00 | F01            | F02 | F03 | F04 | F05 | F06 | F07 | F08 | F09 | F0A | F0B | F0C | F0D | F0E | F0F |
| 49        | F10 | F11            | F12 | F13 | F14 | F15 | F16 | F17 | F18 | F19 | F1A | F1B | F1C | F1D | F1E | F1F |
| 50        | F20 | F21            | F22 | F23 | F24 | F25 | F26 | F27 | F28 | F29 | F2A | F2B | F2C | F2D | F2E | F2F |
| 51        | F30 | F31            | F32 | F33 | F34 | F35 | F36 | F37 | F38 | F39 | F3A | F3B | F3C | F3D | F3E | F3F |
| 52        | F40 | F41            | F42 | F43 | F44 | F45 | F46 | F47 | F48 | F49 | F4A | F4B | F4C | F4D | F4E | F4F |
| 53        | F50 | F51            | F52 | F53 | F54 | F55 | F56 | F57 | F58 | F59 | F5A | F5B | F5C | F5D | F5E | F5F |
| 54        | F60 | F61            | F62 | F63 | F64 | F65 | F66 | F67 | F68 | F69 | F6A | F6B | F6C | F6D | F6E | F6F |
| 55        | F70 | F71            | F72 | F73 | F74 | F75 | F76 | F77 | F78 | F79 | F7A | F7B | F7C | F7D | F7E | F7F |
| 56        | F80 | F81            | F82 | F83 | F84 | F85 | F86 | F87 | F88 | F89 | F8A | F8B | F8C | F8D | F8E | F8F |
| 57        | F90 | F91            | F92 | F93 | F94 | F95 | F96 | F97 | F98 | F99 | F9A | F9B | F9C | F9D | F9E | F9F |

**Table 6-K. Physical Node Address [(Hexadecimal Representation) Contd]**

| Ring Node | RPC | IMS User Nodes |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----------|-----|----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Group     | 0   | 1              | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  |
| 58        | FA0 | FA1            | FA2 | FA3 | FA4 | FA5 | FA6 | FA7 | FA8 | FA9 | FAA | FAB | FAC | FAD | FAE | FAF |
| 59        | FB0 | FB1            | FB2 | FB3 | FB4 | FB5 | FB6 | FB7 | FB8 | FB9 | FBA | FBB | FBC | FBD | FBE | FBF |
| 60        | FC0 | FC1            | FC2 | FC3 | FC4 | FC5 | FC6 | FC7 | FC8 | FC9 | FCA | FCB | FCC | FCD | FCE | FCF |
| 61        | FDO | FD1            | FD2 | FD3 | FD4 | FD5 | FD6 | FD7 | FD8 | FD9 | FDA | FDB | FDC | FDD | FDE | PDF |
| 62        | FE0 | 3E1            | 3E2 | 3E3 | 3E4 | 3E5 | 3E6 | 3E7 | 3E8 | 3E9 | 3EA | 3EB | 3EC | 3ED | 3EE | 3EF |
| 63        | FF0 | FF1            | FF2 | FF3 | FF4 | FF5 | FF6 | FF7 | FF8 | FF9 | FFA | FFB | FFC | FFD | FFE | FFF |

## Audits

---

Even with powerful automatic recovery abilities such as application boot, the effects of software mutilation may seriously degrade system performance for several minutes at a time. Therefore, to ensure high reliability and availability, defensive techniques must be applied to minimize the effect of software errors and reduce the incidence of severe recovery actions. These defensive techniques are known as audits. Audits are a collection of programs used for monitoring the occurrence of errors, taking corrective action whenever possible, and reporting errors and inconsistencies encountered in application software.

Types of errors that audits search for are as follows:

- a. Errors in the state of data where a unit may be reported to be out-of-service when it is actually in service
- b. Linkage errors between tables that would cause messages to be lost as they are passed from one function to another
- c. Application integrity errors preventing jobs from running or running too long that would eventually result in a system reinitialization
- d. Consistency in errors between related tables where in many cases different subsystems have their own version.

Most audits detect and report errors, and in some cases correct the errors that are found. The most common error correction strategy for inconsistencies is to copy the more reliable version into the conflicting version. Other audits simply initialize the erroneous data.

Comparing an audit to a data base determines whether or not the related tables contain valid data, have been properly updated, and are consistent. Software mutilation could occur with any of these situations. If the error cannot be corrected via recent change, the audit corrects the problem at the time of the encounter. If this is not possible, the audit provides more detailed data on the detected error. The reports returned by the audit enable the user to manually locate and correct the errors.

### **NOTE:**

Mismatches between the 3B Computer memory and disk memory can be corrected via recent change and are therefore **NOT** corrected by any audits.

## Audit Scheduling and Control

Audits can be routine, run automatically without user intervention; user dependent, input messages must be used to initiate the audit, or a combination of the both. Also, certain audits automatically run during system initialization.



Audit records reside in the equipment configuration database (ECD) and are under control of the software integrity subsystem "audit manager". The audit manager schedules both routine and demand audits.

The audit control subsystem consists of the following:

- a. *System Integrity Monitor (SIM)* - Software integrity and audit control processes responsible for scheduling and dispatching all audits.
- b. *Equipment Configuration Database (ECD)* - Software integrity records containing information concerning the execution of audits and audit error recovery.
- c. *Output Formatter* - Provides output message format for reporting audit results to the user.
- d. *Audit Commands* - *UNIX* RTR operating system input commands (STOP:AUD, OP:AUD, OP:AUDERR, INH:AUD, and ALW:AUD) used to query and request software integrity services. Both CNI and *UNIX* RTR operating system input commands are provided to run specific audits.
- e. *Audit Requests* - Requests from trouble clearing software processes to run automatically generated audits.
- f. *Plant Measurements Interface* - Counts of audit attempts and failures stored in the plant measurements database and output on the hourly PMCR report.

### **Audit Equipment Configuration Database (ECD) Records**

Audits are identified and controlled by ECD records. All software integrity information used by system integrity monitor (SIM) is stored in the ECD. The ECD contains information used by both the operating system and the application. The ECD is maintained by the operating system. Problems with audits not running properly are most likely in the ECD. During the initialization of the audit manager after a boot and while running routine audits, SIM must access the records in the ECD. Audits are temporarily inhibited and a message is output if SIM encounters a problem accessing the ECD. If unable to allow all audits within 5 minutes, another status message is output. If the user fixes a problem in the ECD, the **ALW:AUD:ALL** command must be used to reinitialize the audit manager and begin running routine audits.

The following paragraphs describe the two types of records:

- a. A control record contains information that regulates the percentage of system time to be spent running audits, the parameters that control the scheduling of manually requested audits, and a master inhibit state used to turn off the scheduling of all routine audits.

- b. Several control records for each audit that uniquely identify the audit by name and member number. These records contain all of the information that SIM needs to schedule an audit, dispatch an audit, and report errors found by the audit.

All audits are categorized on the basis of audit type such as file manager, link and band status, or database. Each of these categories is referred to as a family, and each family has a name that contains up to six characters. In addition, a member number is used to distinguish between audits in the same family.

Each audit record contains one or more audit "instances." For an audit with only one instance, the name and member number of the audit is used to identify the audit while the instance name is null.

### **Execution Modes**

There are two aspects to any audit invocation. First, audits are grouped into either a segmented or nonsegmented category that is based on how they utilize CPU time. This is an attribute of the audit program that cannot be changed. Segmented audits relinquish the CPU after a predetermined amount of time. This is a time-slicing environment, therefore, most kernel audits execute in this mode. Running in this mode normally causes an audit to run slower than in the nonsegmented mode. However, because the continuous execution of kernel level audits could result in the lockout of lower level processes, kernel audits should execute in the segmented mode if possible. Nonsegmented audits run to completion, and report the amount of CPU time used. All operating systems or users, supervisors, and demand audits are nonsegmented. Because the time sharing of supervisor processes is controlled by the *UNIX* RTR operating system scheduler, supervisor audits execute in a nonsegmented mode.

Secondly, the audit manager provides four types of audit invocations:

1. *Routine* - Audits that are executed at a given frequency or at specified times during normal system operation. The audit manager permits one routine audit and a limited number of requested audits to run simultaneously. The maximum number of simultaneously requested audits is specified by the ECD. Routine audits run at half their normal speed while a requested audit is running.
2. *Manual* - Audits that are manually requested by means of input commands.
3. *External* - Audits that are requested by processes other than input commands. The next routinely scheduled audit may be delayed to compensate for the CPU time used by the requested audit.

4. *Demand* - Audits that are demanded by SIM as a result of a system error.

These aspects of the audit invocation are indicated in the ECD. They allow SIM to control when any particular audit runs and how much of the processor's time is used by the audit. The audit manager attempts to limit the total amount of time consumed by all routine, manual, and externally requested audits. Also, it is flexible enough to allow an audit to execute in any of the four execution modes, depending on the nature of the audit invocation. All execution modes might not be appropriate for all audits. Again, the permitted execution modes of each audit are specified in one of the ECD records for that audit.

When an audit is invoked, the sequence of events shown in Table 6-L typically occurs.

**Table 6-L. Audit Execution Sequence**

| Step | Action                                                                                                                                                                                                                                                                                                                         |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | If the audit resides in a transient process, SIM creates the process. Otherwise, it finds the audit process using information in the ECD record of the audit.                                                                                                                                                                  |
| 2    | SIM dispatches the audit.                                                                                                                                                                                                                                                                                                      |
| 3    | The audit may find and possibly correct errors. It reports each error to the audit interface library, which increments an error counter. One or more of the error reports results in the printing of a raw data output message.                                                                                                |
| 4    | The audit finishes its work and reports its termination status to the interface library, which reports the total error counts to SIM. SIM updates the error counters in the ECD record of the audit, and a final output message is printed. SIM also updates the audit's counts of attempts and failures in the PMS data base. |
| 5    | If an error threshold has been exceeded, SIM takes recovery action as specified in the ECD record of the audit.                                                                                                                                                                                                                |

## Blocking and Inhibiting Audits

Two mechanisms are available to prevent the running of audits:

- |            |                                                                                                                                                                                                                                                                                                                                 |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Blocking   | A process specifically requests the blocking of an audit. This is explicit blocking and prevents the audit from being executed in any mode. When scheduling audits, SIM implicitly blocks certain audits. It ensures that no two audits with the same name are run simultaneously.                                              |
| Inhibiting | This prevents audits from being scheduled to run routinely. Separate inhibit states are provided for all audits. The <b>INH:AUD</b> and <b>ALW:AUD</b> commands are used to control these inhibit states. Setting or resetting the master inhibit state for all audits does not affect the inhibit states of individual audits. |

Because audit inhibit states are stored in the ECD, they are not lost across an operating system level 2 initialization (boot). However, they are lost across an operating system level 3 or 4 initialization. When the system is booted in minimum configuration, all audits remain inhibited. Also if IMS or CNI is not running, certain audits pertaining to those subsystems are automatically inhibited. In full configuration, SIM allows all audits approximately 5 minutes after the boot; unless, they have been inhibited manually before the boot (level 2 only). Manually inhibited audits are not allowed automatically by SIM.

A periodic output message (**REPT AUDSTAT**) reports the inhibit status of audits when the system is running in full configuration.

## Scheduling Routine Audits

Routine audits are scheduled in the following two ways:

- |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Frequency Groups | Some audits need to run often taking a small amount of time to ensure the integrity of critical system resources that are in a constant state of flux. Many <i>UNIX</i> RTR operating system audits use this type of scheduling. How often an audit is scheduled depends on what effect an undetected error would have on the system. Each frequency group audit is assigned a specific frequency of execution. Each frequency group executes audits twice as often as the next frequency group. The frequency group of each audit is specified in one of the audit's ECD records. An audit in any specific frequency group cannot be guaranteed to execute repeatedly at a predetermined time interval. Review the Plant Measurements Common Reports (PMCR) report for details on how many times each audit is executed. |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Timed      Other audits need to run only occasionally to check on resources that change less often and some audits may need to be coordinated with other timed activities. Examples of these include database audits and file system audits. Audits that must be executed at given times of the day use the timed audit facility. Each timed audit must be scheduled to execute at a specific hour of the day (0000 to 2300) and on a specific day of the week (Sunday through Saturday). This information is maintained in the audit's ECD records of the audit. The same audit may not be both timed and in a frequency group.

### **Error Reporting and Recovery**

Errors detected by audits are grouped into categories for purposes of reporting and recovery. The error categories used by an audit are specified in its ECD records. For each category, there is an error threshold; a time interval during which errors are counted; and a list of recovery actions that should be taken, if the threshold is exceeded. Separate error counts are accumulated for each audit. No error counts are accumulated when an audit is run in the noncorrecting mode.

There are specific recovery actions taken by the audit manager. When an audit fails, a report is generated and SIM attempts to reschedule the audit. If an audit aborts, SIM attempts to run it once more in demand mode. The ECD control record may specify that SIM not demand the audit in this situation. If the ECD allows it and the audit aborted while correcting errors, SIM demands the audit once. If the audit aborts the same way a second time, SIM inhibits the audit and outputs a message. There are two stages of audit recovery:

- 0    Errors detected by the audit exceeded a threshold. The audit may be demand invoked by SIM.
- 1    The audit reported abnormal completion and errors exceeded a threshold. A different audit may be demanded.

Output messages are printed for routine and externally requested audits only if the audits report errors or abnormal completion. Output messages are always printed for manual and demand audits. However, when a demand audit is run as a recovery action for a manual audit that failed, its output may not be printed on the same terminal from which the initial input message was entered.

### **Audit Analysis**

Although information on audit execution is reported to the user via the **AUD** output messages, there are other messages that provide important audit information to the user. They should be used when an audit unexpectedly starts reporting a lot of errors. Some of these messages are produced in response to manual requests by the user, when additional audit information is needed.

Some are generated automatically—giving error and status reports. In addition, there are processor recovery messages (PRMs) that provide information to aid the user during 3B Computer recovery. Message descriptions should be referenced for suggested actions to be taken. The user should also refer to the specific audit descriptions.

Currently, two PRMs provide audit-related information to the user during 3B Computer recovery. Both messages are output by SIM. Both PRMs provide information that describes the function or possible error and any corrective action that should be taken:

- a. PRM FBxx xx07 xxxx xxxx xx xx xx  
Function code 07 indicates an audit manager initialization failure. This means that SIM was unable to initialize the audit manager because of a failure while attempting to access the ECD. Perform the following corrective actions:
  1. Verify and correct the SIM control records or audit records in the ECD. Changes to the ECD should only be made by the technical support group.
  2. Attempt to initialize the audit manager (**ALW:AUD:ALL**)
  3. Obtain technical assistance if the audit manager does not initialize.
- b. PRM FBxx xx08 xxxx xxxx xx xx xx  
Function code 08 indicates that SIM was unable to attach to the plant measurement system (PMS) database. Perform the following corrective action:
  1. Verify and correct the PMS database. Changes to this database should be verified by the technical support group.
  2. Attempt to attach the PMS database to SIM (**ALW:AUD:ALL**)
  3. Obtain technical assistance if SIM is still unable to attach to the PMS data base.

The following are the four basic types of output when analyzing audit errors:

1. **AUD** message
2. PMCR report
3. Various related messages
4. PRMs.

By correlating the information provided by these messages and reports, patterns can be identified. Also, specific data on uncorrected errors can be used to identify the suspect software or hardware causing the audit to fail. It is important to note that most audits are *correcting* audits. Nevertheless, recurrent error correction by the same audit indicate problems outside the scope of the audit. This is where identified patterns can lead to a solution of the problem.

The major items to check on the messages and reports are as follows:

- Check the types and frequencies of specific errors encountered
- Identify errors corrected, errors not corrected and quantity of errors found. The PMCR report indicates quantity of errors found by each audit. It should be noted that if an audit runs automatically and finds no errors, there is no printout associated with the audit.
- Identify when and if specific audits were executed. It should be noted that CNI system audits are considered low priority processes. If the system is loaded with a large amount of CCS traffic or other non-deferrable work, audits may not run as scheduled.
- Identify if particular audits aborted or completed.
- Identify other messages indicating changes in the state of particular units made suspect by audit errors.

A particular audit taking a long time to complete is not necessarily an indication of problems. Most audits are considered deferrable, other work could slow them down. Also, because most audits check office-dependent data structures, the amount of time required to complete depends on how the office is equipped. Audit descriptions indicate the approximate time it takes for the audit to complete. The times indicated are based on the amount of time required to execute the audit. When an audit is manually requested, it may or may not execute immediately. In a busy office, the amount of time required to execute an audit is often insignificant compared to the length of time the audit is deferred.

Audit (AUD) output messages report audit execution results to the user. There are two types of audit output messages. The first type reports raw data that pertains to specific errors found by an audit. The second type reports the termination status of the audit.

The data reported by an **AUD** error message includes four words of raw data designated DATA1, DATA2, DATA3, and DATA4. These words are printed in hexadecimal notation. Each audit prints a limited number of raw data reports which are specified in the ECD. The definitions of these data words and the maximum number of reports possible is specific to each audit. This information is provided in the output message manual. Some audits do not use the data words and are therefore identified with zeros in their respective fields. Many audit error messages provide supplementary data to facilitate analysis of the reported error conditions. The data words and supplementary data present the user with the state of various software facilities being checked by the audit.

The audit completion messages report the termination status, COMPLETED, STOPPED, or ABORTED, of the audits. If the termination status is COMPLETED, the total number of errors found and the number of errors corrected by the audit are reported in the message. If the termination status is

STOPPED, errors may have been reported before manual action stopped the audit. If the termination status is ABORTED, an abort code is provided to specify why the audit was aborted. Table 6-M identifies the audit abort codes.

**Table 6-M. Audit Abort Codes**

| Code | Meaning                                                              |
|------|----------------------------------------------------------------------|
| 3    | Audit aborted internally without completing its work                 |
| 4    | Audit was faulted while correcting errors                            |
| 5    | SIM could not start or dispatch the audit                            |
| 6    | Error was encountered in the audit control/audit library interface   |
| 7    | Audit exceeded its time-out or segment limit                         |
| 8    | SIM aborted an executing routine audit because of a blocking request |
| 9    | Transient process that was running the audit terminated              |
| 10   | A segmented audit exceeded an error threshold                        |

The PMCR report is generated by the *UNIX* RTR operating system both hourly and daily. It includes a section identified as "System Performance" that details audit activity for the preceding hour. The number of attempts SIM attempted to run the audit and the number of errors detected are identified for each audit. The actual number of successful completions of the audit and the number of errors corrected must be obtained using the **OP:AUD** input command. If an audit appears on the PMCR report, the audit is in the ECD and has tried to run.

The **OP AUDERR** output message outputs the error counts that were extracted from the ECD records for audits controlled by SIM. Such information can be useful to the user as historical data. The **OP AUDERR** output message simply furnishes statistical information regarding audits to the user.

The **REPT AUDSTAT** output message is produced automatically by the system approximately every 30 minutes. This report prints the status of inhibited audits controlled by SIM. When this message is output, one or more audits are either inhibited or blocked.

The **REPT SIMCHK** output message reports failures in SIM. If the audit manager fails to initialize after a system boot, SIM temporarily inhibits all audits and outputs this message. In addition, if SIM has difficulty accessing the ECD when routinely running audits, this message is generated. If SIM cannot allow audits to run within 5 minutes, SIM outputs another message. Manual action is required by the user to determine the cause of the problem.



### **Central Node Control Audit**

The central node control (CNC) audit is a routine audit that is run automatically a number of times every hour. The purpose of the audit is to detect and correct any inconsistencies or errors in the status of various scheduled jobs related to nodes. Internal ring node maintenance records are checked for inconsistencies which could prevent jobs, such as RST:LN, from progressing or cause jobs to be unnecessarily aborted. The two main types of jobs checked by the audit are those for node pumping and node restoral. If errors are detected, all jobs associated with the node are cancelled. Should an inconsistency be caused by some undetected problem, this audit only cancels those jobs associated with the node affected by the inconsistency. Therefore, the same jobs may be canceled every time the audit runs. If those jobs must run and the problem cannot be identified by examination of the output, a system initialization may be necessary.

If the audit is running automatically or the detailed option (DETL) was specified, up to 20 detailed reports are provided. These reports, four data words and no supplementary data, provide the restore job's state, source, and associated node address.

This audit normally takes less than 10 seconds to run depending on the number of equipped nodes in the office. If IMS is very busy at the time the audit is requested, the execution time could be lengthened considerably. This audit corrects any errors found.

### **Node State Audit**

The node state audit is a routine audit that is run automatically several times every hour. The purpose of the audit is to detect and correct any inconsistencies in the node state data maintained by IMS in the central processor. The audit currently has only one member. Member 1 compares the node availability map with the IMS driver node state data. The node availability map indicates whether a node is available or not. The node state audit is used by other software, such as the neighbor node audit, to determine node states. Normally, audit data is updated simultaneously with the IMS driver data. This audit corrects any inconsistencies by copying the IMS driver data to the node availability map.

If the audit is running automatically or the detailed option (DETL) was specified, up to 10 detailed reports are provided. These reports provide ring node identification, group and member, and node states maintained by the node availability map and IMS driver. This audit usually takes approximately 2.5 minutes to run depending on how busy the IMS is at the time. The node state audit corrects all errors found.

### **Direct Link Node Audit**

The direct link node (DLN) audit is a routine audit that is run automatically at a frequency dependent on the real-time load of the 3B Computer. The DLN audit function resides in both the 3B computer and the DLN. Data in the DLN is updated only after associated data in the 3B Computer is updated. The data in the DLN must be updated correctly and not altered accidentally at any time. The purpose of DLN audits is to ensure the integrity and accuracy of all the data/tables updated in the 3B Computer and DLN.

The data/tables of both the 3B Computer and DLN are divided into segments. Only one segment is audited at a time. All the segments are audited sequentially to complete one audit cycle. An audit failure detected against any one segment of the DLN triggers another audit request against the failed segment. If a segment fails the audit twice, the DLN audit function updates the failed segment of the DLN.

If the audit is running automatically, up to 16 reports are provided. The function is scheduled to be run by default, unless otherwise directed by the ECD entry. The DLN audit function can also be run manually. The DLN audit usually takes about 75 seconds to run depending on the office load and should be run at a medium or low priority band to restrain from using too much resources of the Audit Manager.

### **Internal Data Audits**

The internal data audits compare the tables contained in main memory with tables maintained on disk and report any mismatches. The tables are also checked for invalid data within a table and inconsistencies across tables. The audit reports all errors that are found via the appropriate **AUD:NIDATA** output message. The error code received with the output message can be used to identify the action to be taken to correct the problem in the tables. If any errors are identified that cannot be corrected via recent changes, then the audit corrects the error as necessary and reports the correction.

The internal data audits are manual audits only. To run these audits, the user must manually invoke the audit by entering **AUD:NIDATA x** where x represents the specific audit to be run (1-6). These audits should be run weekly to ensure the reliability of the CNI data base and run after completion of recent change activity to audit the success of the session. To run these audits after each recent change order is completed is not necessary. However, once the user has completed all recent change activity for a session, these audits should be activated. Any errors found by these audits should be referred to the database administrator.

## **AT&T Trigger Platform (ATP) Junior Node Audit**

The ATP node audit, associated with the AT&T Trigger Platform Junior feature in the 4E20R1 generic program, is a routine audit that is run automatically at a frequency dependent on the real-time load of the 3B computer. The purpose of the ATP audits is to ensure the integrity of data structures and resources used at an ATP node.

The audit is scheduled to run by default, unless otherwise directed by the ECD. The ATP node audit can also run manually. When run manually, the specific data structure or resource to be audited must be specified. Refer to the input/output message catalog. Manual audits usually complete within a minute.

The audit commands (**STOP:AUD**, **OP:AUD**, **OP:AUDERR**, **INH:AUD**, **ALW:AUD**) for the ATP audits are the same as other audits with one exception. The **STOP:AUD** input message only stops the next segment, of segmented audit, from proceeding. All-Test-Passed audits are not segmented; therefore, a new command, **STOP:ATPAUD**, was created.

## Processor Recovery Messages (PRM)

During system recovery, the common network interface initialization (CNIINIT) process may produce a 16-digit hexadecimal failure PRM. The PRMs are displayed on the maintenance cathode ray tube (MCRT) and printed at the maintenance receive-only printer (MROP). Failing PRMs are always output. By selecting the emergency action interface (EAI) PRM-TRAP option, the first failing PRM is trapped and displayed in reverse video on the MCRT.

### Processor Recovery Message Format

A PRM output identifies the process encountering the failure, states the reason for failure, and in many cases, includes failure data. The general format of a PRM is shown in Figure 6-12.

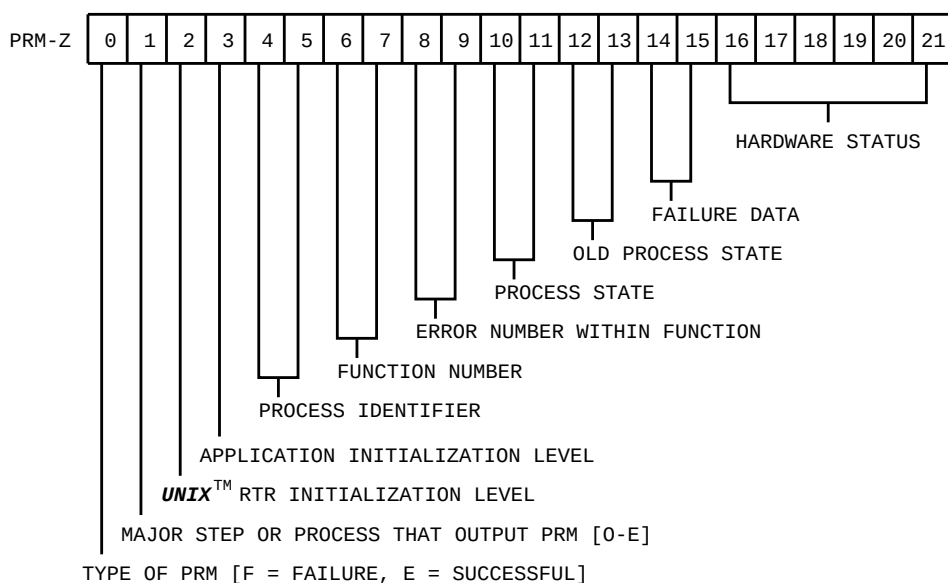


**Figure 6-12. Processor Recovery Message Format**

The definition of each digit in the PRM is as follows:

|                |                                                                                                                                                                                                                                                                                                     |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Letter Z       | = Identifies active control unit (CU)<br>Zero (0) for CU0.<br>One (1) for CU1.                                                                                                                                                                                                                      |
| Digit 0        | = Message type:<br>F = Failure<br>E = Success<br><br>A <i>failure</i> PRM (F) occurs when an error is considered fatal and a phase is called. A <i>success</i> PRM (E) is an information message which describes a function or a possible error and any corrective action that should be attempted. |
| Digit 1        | = Major step or process that output PRM. CNI PRM major step is "E" (IMS Application Process)                                                                                                                                                                                                        |
| Digit 2        | = <i>UNIX</i> RTR level of initialization.                                                                                                                                                                                                                                                          |
| Digit 3        | = Application level of initialization.                                                                                                                                                                                                                                                              |
| Digit 4 & 5    | = Two-digit process identifier. CNI PRM process identifier is "7F" (CNIINIT process)                                                                                                                                                                                                                |
| Digits 6 & 7   | = Two-digit hexadecimal function code.                                                                                                                                                                                                                                                              |
| Digits 8 & 9   | = Two-digit code identifying error within function.                                                                                                                                                                                                                                                 |
| Digits 10 & 11 | = Two-digit code identifying internal state originating process was in when the error was detected.                                                                                                                                                                                                 |
| Digits 12 & 13 | = Two-digit code identifying previous state originating process was in subsequent to state where the error was detected.                                                                                                                                                                            |
| Digits 14 & 15 | = Two-digit code identifying error data. These digits are not always used.                                                                                                                                                                                                                          |
| Digits 16-21   | = Six-digit code representing hardware status.                                                                                                                                                                                                                                                      |

**Analyzing Processor Recovery Messages (PRM)**

To analyze a PRM, complete the following procedure:

1. Examine PRM Z field to determine processor that produced PRM (CUO=0 or CU1=1).
2. Examine PRM digit 0 to determine if PRM is a success (E) or failure (F) PRM.
3. Locate received PRM in Processor Recovery Message Manual by the number or letter in digit positions 0, 1, 4, 5, 6 and 7. The underlined characters in the following example indicate the digit positions used to locate the PRM:

FE\_xy 7F34\_ eess oo00 hh hh hh

4. Read comments under **RECOVERY STEP** heading to identify the major step or process that outputs PRM.
5. Read comments under **FUNCTION** heading to determine which function within the recovery step was being performed.
6. Read comments under **PRM EXPANSION** heading to interpret any failure information provided.
7. Read comments under **EXPLANATION** heading for additional information.
8. Follow actions suggested under **CORRECTIVE ACTION** heading to correct any failures.
9. Examine PRM digits 16 through 21 to determine hardware status of 3B Computer when PRM was generated.
10. Contact appropriate technical support organization if additional information is required.

## **International Link Node Signaling- Link Maintenance**

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Maintenance on the International Link Node (ILN) signaling link (SLK) consists of maintenance on either a gateway link (G link) or world link (W link). The procedures are for ring hardware fault analysis, SLK failure greater-than-three minute analysis, exception report analysis, and long-term report analysis.

## **Small Computer Systems Interface Node Maintenance**

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### **General**

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The Small Computer Systems Interface Node (SIN) maintenance strategy is similar to the CCS7 signaling link maintenance strategy. Maintenance aids including signaling link display pages, audible alarms, output messages, measurement reports, and diagnostics are available.

### **Signaling Link Management**

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The ring has two SIN links. At most, one is IS. If a node is taken out of service, the link of the node is also taken out of service.

### **Trouble Conditions**

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If the call detail recording platform (CDRP) stops polling for data on either the in-service (IS) or STBY link, the SIN takes the link OOS. SIN automatically changes the link back to IS or STBY when the CDRP reestablishes the protocol. The link may also be taken OOS if there are excessive protocol errors on the link. When an error is detected, the REPT SIN output message explains the error and dumps information that is useful for debugging the problem.

### **Measurement Reports**

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The SIN links use the same reports as the CCS7 signaling links. Refer to "Common Channel Signaling No. 7 Digital Signaling Link Maintenance" for CCS7 SLKs measurement reports.

## **Ethernet Interface Node Maintenance**

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### **General**

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The Ethernet Interface Node (EIN) maintenance strategy is similar to the CCS7 signaling link maintenance strategy. Maintenance aids including signaling link display pages, audible alarms, output messages, measurement reports, and diagnostics are available.

### **Signaling Link Management**

---

The ring has two EIN links. At most, one is IS. If a node is taken out of service, the link of the node is also taken out of service.

### **Trouble Conditions**

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If the call detail recording platform (CDRP) stops polling for data on either the in-service (IS) or STBY link, the EIN takes the link OOS. EIN automatically changes the link back to IS or STBY when the CDRP reestablishes the protocol. The link may also be taken OOS if there are excessive protocol errors on the link. When an error is detected, the EIN output message explains the error and dumps information that is useful for debugging the problem.

### **Measurement Reports**

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The EIN links use the same reports as the CCS7 signaling links. Refer to "Common Channel Signaling No. 7 Digital Signaling Link Maintenance" for CCS7 SLKs measurement reports.



### **3B Computer Maintenance Functions**

The 3B Computer is the central processing unit (CPU) and must be able to communicate with any node on the ring in the maintenance mode. The handlers associated with each type of peripheral contain the functions needed to complete the following tasks:

- a. In-service software functions
- b. Fault detection and recovery actions
- c. Software audits
- d. Hardware audits
- e. Neighbor audits
- f. Ring audits
- g. Blockage
- h. Message format errors
- i. Abnormal end of process
- j. Parity errors
- k. Quarantine
- l. Reset.

The 3B Computer also has the function of providing system and ring initialization, node processor initialization, and reconfiguration. The 3B Computer has ultimate control of ring actions. It has the responsibility of determining fault locations and the configuration of the ring. The 3B Computer also determines whether to fault a piece of hardware, diagnose, or restart it. These decisions are based on error messages received from RPCNs and the peripheral performance history.

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**Glossary**

**GL**

---

**Contents**

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## Glossary

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### A

**Analog Signaling Link**

The link running from the link node (LN) (but not including the ring interface [RI] board) through a data set and voice-frequency link (VFL) access circuit to the transmission facility.

**AT&T Trigger Platform (ATP) Node**

A node on the ring which is used for the AT&T Trigger Platform (ATP) Junior feature.

**Attached Processor (AP)**

A circuit pack used with the direct link node (DLN) that provides expanded storage for added processing capacity on the ring.

**Available**

While in the minor state "In-Service (IS)," the signaling link is available for handling traffic. The minor state "Out of Service (OOS)" is a transient state that is automatically accessed when putting a signaling link in service or when an error condition occurs on an in-service signaling link. The minor state "Manual Out of Service (MOOS)" is used when it is necessary to manually remove the signaling link from service.

---

### B

**Beginning of Isolation (BISO) Node**

A node on the ring that is located before the beginning of an isolated segment but is not isolated itself.

---

### C

**CCITT**

An international body that controls the standards of communication protocols.

**CLLI Code**

The common language location identification code used to uniquely identify an office.

**Cluster Member**

A cluster member is a single node within a cluster. A cluster member is used to uniquely identify a specific node within a known cluster.

**Collection Period**

The time span over which report measurement data is to be collected and stored.

**Common Network Interface (CNI)**

A common subsystem software component supplied to various network components whose primary function is providing CCS network access and CCS message routing.

**Critical Event**

Events that occur in the CCS network that may affect network operations. These events are reported to users immediately.

---

**D**

**D-Channel (DCHN)**

Refers to both the signaling link and the node that is used to provide a DCHN interface between customer premises equipment (CPE) and a CNI- equipped office and is associated with a T1 facility access (T1FA) board used for multiplexing/demultiplexing DS0 signals.

**Destination Point Code (DPC)**

A unique value associated with every network component used for routing.

**Digital Signaling Link**

The link running from the link node (LN) (but not including the RI board) through a digital service adapter (DSA), digital service unit (DSU), and channel service unit (CSU) (optional) to the transmission facility.

**Direct Link Node (DLN)**

A node on the ring that functions like an interprocess message switch (IMS) user node (IUN) but contains the hardware of a ring peripheral controller node (RPCN) plus an attached processor and direct memory access (DMA) capability.

---

**E**

**End of Isolation (EISO) Node**

A node on the ring that is located after the end of an isolated segment but is not isolated itself.

**Equipment Configuration Data (ECD)**

The ECD is a UNIX® RTR-provided memory-resident data base that contains the attributes and current status of various system entities. These entities include all known processor and peripheral hardware and most software facilities. Data is stored in individually accessible records. Virtually all operations and maintenance of CNI/IMS are dependent on the ECD.

---

## I

### **IMS User Node (IUN)**

A basic node (minimum hardware components) on the ring that provides an interface between the ring and the transmission facility.

### **Integrated Service Digital Network Extended D-Channel (DCHX)**

Feature of CNI 10.4 generic program that increases tunable number of D-Channel nodes from 40 to 60. Increases maximum number of DCHNs supported per 4ESS Switch from 40 to 54.

### **Interprocess Message Switch (IMS)**

A common subsystem software component that provides a ring-based interfunction, interprocessor transport mechanism.

### **ISDN Network**

A configuration in a CNI equipped office which supports an integrated services digital network (ISDN) interface directly to customer premises equipment (CPE).

---

## L

### **Link Node (LN)**

A node on the ring where digital information enters from or exits to the transmission facility.

### **Link Set Routing**

CCS7 routing using point codes to identify the destination of link messages associated with a link set.

---

## M

### **Message Transfer Part (MTP)**

The functional part of CCS7 that transfers signaling messages as required by all the users and that also performs the necessary subsidiary functions (e.g., error control and signaling security).

---

## N

### **Node Processor (NP)**

The node processor (NP) is the central processing unit (CPU) portion of a ring node (RN). The NP controls and schedules the processes in the ring node.

---

## O

### **Overflow**

A condition that occurs when buffer occupancy exceeds some predetermined level. If related to link transmit/receive buffers, this term means the buffer is full and additional messages are necessarily discarded. If related to ring buffers (overflow states), it does not necessarily mean any buffer is full, but messages may be discarded according to some congestion strategy that is usually associated with some onset and abatement thresholds.

### **Overload**

A condition that occurs when the load on some resource is excessive. This could be a lack of real time as in the buffer overload case. The latter is synonymous with buffer congestion. Messages may be discarded even though the buffer is not full. This is usually associated with some onset and abatement thresholds.

---

## R

### **Raw Measurement**

This is the data values taken from buffers in the ring nodes. After a value is aggregated with the corresponding value from other nodes, it is known as a measurement. This measurement is cumulated with new values over time to be output after some collection period has elapsed.

### **Ring**

Refers collectively to the RPCNs, DLNs, and application link nodes that are serially connected to dual circular busses. The ring provides 4-megabyte data paths in both directions between adjacent nodes and can uniquely address up to 1024 nodes.

### **Ring Configuration**

A reconfiguration of the ring via the 3B20D Computer to isolate faulty segments.

### **Ring Interface (RI)**

One of two circuits in a ring node that interfaces the node processor to the ring. Each ring interface can access either ring 0 or ring 1 to insert messages onto, or remove

messages from the active ring. The heart of the circuit is a first-in first-out (FIFO) buffer that provides access to the ring and allows messages to circulate on the ring independent of the node.

**Ring Isolation**

A ring configuration where one or more nodes are isolated from the active ring.

**Ring Peripheral Controller Node (RPCN)**

A node on the ring where digital information is removed from the ring for transferral to the 3B20D computer for processing or placed back on the ring after processing.

---

## S

**Self-Looped**

A condition that exists when both ends of a signaling link terminate on the same ring node. All messages sent over the signaling link are looped back; thus, they are transmitted and received by the same signaling link.

**Signaling Connection Control Part (SCCP)**

An adjunct to the message transfer part (MTP) layer of CCS7 that performs interpoint code subsystem status.

**Signaling Link (SLK) States**

The signaling link states indicate the status of the signaling link. A brief description of the three major states and their associated minor states follow:

---

## T

**T1 Facility Access (T1FA)**

A board that multiplexes and demultiplexes 24 DS0 64-kb/s links into one DS1 1.544 Mb/s bit stream. A single T1FA board can serve up to 24 DCHN signaling links.

**T1FA Control Node (TCN)**

A DCHN node that contains a T1FA and has responsibility for monitoring and controlling the T1FA circuitry in addition to its normal DCHN node functions.

---

## U

### **Unavailable**

This state is used as an interim state for testing purposes before putting the signaling link in service. While in the minor state "Grow," no link usage information is provided to the user. While in the minor state "Test," link usage information is provided to the user but the signaling link does not alarm and/or interact with the network.

### **Unequipped**

In this state, no link configuration data has been assigned to the signaling link.

---

## V

### **Virtual Link**

A virtual link allows one physical link to be used for carrying traffic for eight "logical software" links.



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## Notes

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## Contents

---



## Notes

---

---

## Notes

---

## Notes

---

## Notes

---

## Notes

---

## Notes

---

## Notes



---

## Notes

---

## Notes

---

## Notes

---

## Notes

---

## Notes

---

## Notes

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## Notes

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**Abbreviations and Acronyms**

# ABB

---

**Contents**



---

## Abbreviations

---

### 2

**2STP**

No. 2 Signal Transfer Point

---

### 3

**30MPR**

Thirty-Minute Marginal Performance Report

**3BI**

3B20D Computer Interface

---

### 4

**4ESS**

4ESS Switching System

---

### A

**AAC**

Acculink Access Controller

**AAR**

Automatic Ring Recovery

**ABATS**

Automated Bit Access Test System

**ABT**

Abort

**ACI**

AT&T Communications ISDN

## Abbreviations

---

|               |                                                    |
|---------------|----------------------------------------------------|
| <b>ACO</b>    | Alarm Cutoff                                       |
| <b>ACRT</b>   | Administrative Cathode-Ray Tube                    |
| <b>ACT</b>    | Active                                             |
| <b>ACU</b>    | Acknowledgment Unit                                |
| <b>AFA</b>    | Analog Facility Access                             |
| <b>AFAF/C</b> | Analog Facility Access Frame/Cabinet               |
| <b>AIMS</b>   | Advanced Interactive Maintenance System            |
| <b>ALM</b>    | Alarm                                              |
| <b>AMA</b>    | Automatic Message Accounting                       |
| <b>ANSI</b>   | American National Standards Institute              |
| <b>AP</b>     | Attached Processor                                 |
| <b>API</b>    | Attached Processor Interface                       |
| <b>APS</b>    | Attached Processor System                          |
| <b>ARR</b>    | Automatic Ring Recovery                            |
| <b>ARS</b>    | Alarm Reset                                        |
| <b>ARST</b>   | Automatic Restore Service                          |
| <b>ASCII</b>  | American Standard Code for Information Interchange |
| <b>ASN</b>    | AT&T Switched Network                              |

## Abbreviations

---

**ASUR**

Application Specified Unconditional Restore

**ATP**

AT&T Trigger Platform

**AUTO**

Automatic

**AVL**

Available

---

**B****b/s**

Bits Per Second

**BAT**

Battery

**BCD**

Binary Coded Decimal

**BEC**

Basic Error Correction

**BES**

Bursty Errored Seconds

**BISO**

Beginning of Isolation

**BLDG**

Building

**BLSLS**

Balancing Load Selection On-Link Selection

**BWM**

Broadcast Warring Message

---

## C

### **C&D**

Control and Display

### **CATP**

Conditional All Tests Passed

### **CCIS**

Common Channel Interoffice Signaling

### **CCITT**

International Telephone and Telegraph Consultative Committee

### **CCS**

Common Channel Signaling

### **CCS6**

Message format conforming to domestic version of CCITT 6 signaling

### **CCS7**

Common Channel Signaling No. 7

### **CD**

Circuit Drawing

### **CDID**

Common Channel Signaling Design and Implementation District

### **CDR**

Call Detail Recording

### **CDRP**

Call Detail Recording Platform

### **CET**

Critical Event Table

### **CFC**

Carrier Failure Condition

### **CHRM**

Current Hour

### **CIC**

Circuit Identification Code

### **CLLI**

Common Language Location Identification

### **CNCE**

CCS Network Critical Event

## Abbreviations

---

|                |                                                    |
|----------------|----------------------------------------------------|
| <b>CNI</b>     | Common Network Interface                           |
| <b>CNIINIT</b> | Common Network Interface Initialization            |
| <b>COV</b>     | Changeover                                         |
| <b>CP</b>      | Circuit Pack                                       |
| <b>CPAM</b>    | Common Channel Signaling Performance Alarm Monitor |
| <b>CPE</b>     | Customer Premises Equipment                        |
| <b>CPU</b>     | Central Processing Unit                            |
| <b>CRC</b>     | Cyclic Redundancy Check                            |
| <b>CRCER</b>   | Cyclic Redundancy Check Error                      |
| <b>CRI</b>     | Continuity Recheck Incoming                        |
| <b>CRO</b>     | Continuity Recheck Outgoing                        |
| <b>CRT</b>     | Cathode-Ray Tube                                   |
| <b>CSS</b>     | Controlled Slip Seconds                            |
| <b>CSU</b>     | Channel Service Unit                               |
| <b>CTAN</b>    | Customer Trunk Appearance Number                   |
| <b>CTC</b>     | Centralized Test Center                            |
| <b>CU</b>      | Controller Unit                                    |

---

## **D**

### **D.F.A**

Digital Facility Access

### **DACS**

Digital Access and Cross-Connect System

### **dB**

Decibel

### **DBA**

Data Base Administration

### **dBm**

Decibels referred to 1 milliwatt

### **dBm**

Decibels referred to reference noise

### **DCHN**

D-Channel

### **DCHX**

Extended D-Channel

### **DCIS6**

Destination Routed CCIS 6

### **DDS**

Digital Data System

### **DDSBS**

Dual Duplex Serial Bus Selector

### **DETL**

Detailed Option

### **DFA**

Digital Facility Access

### **DFAF/C**

Digital Facility Access Frame/Cabinet

### **DFC**

Disk File Controller

### **DGN**

Diagnose

### **DIF**

234-100-120AC.LI "DIU" Digital Interface Unit

## Abbreviations

---

|               |                                     |
|---------------|-------------------------------------|
| <b>DL</b>     | Data Link                           |
| <b>DLN</b>    | Direct Link Node                    |
| <b>DLN-AP</b> | Direct Link Node-Attached Processor |
| <b>DLNE</b>   | Enhanced Direct Link Node           |
| <b>DMA</b>    | Direct Memory Access                |
| <b>DMERT</b>  | Duplex Multi-environment Real-time  |
| <b>DPBX</b>   | Digital Private Branch Exchange     |
| <b>DPC</b>    | Destination Point Code              |
| <b>DPRAM</b>  | Dual-Port Random Access Memory      |
| <b>DS</b>     | Data Selector                       |
| <b>DS1</b>    | Data Selector 1                     |
| <b>DSA</b>    | Digital Service Adapter             |
| <b>DSCH</b>   | Dual Serial Channel                 |
| <b>DSDD</b>   | Direct Service Dialing Domestic     |
| <b>DSI</b>    | Digital Services Interface          |
| <b>DSU</b>    | Digital Service Unit                |
| <b>DSX</b>    | Digital Cross Connect               |
| <b>DSX</b>    | Digital Cross-connect               |

---

## **E**

### **EAI**

Emergency Action Interface

### **EAR**

Error Analysis and Recovery

### **ECD**

Equipment Configuration Data

### **ECIS6**

Embedded CCIS 6

### **EIA**

Electronic Industries Association

### **EIN**

Ethernet Interface Node

### **EISO**

End of Isolation

### **ELI**Ethernet Link Interface

### **ELT**

Emergency Load Transfer

### **EMC**

Electromagnetic Compatibility

### **EMER**

Emergency

### **EMI**

Electromagnetic Interference

### **EML**

Expected Measured Loss

### **ES**

Error Seconds

### **ESF**

Enhanced Super Frame

### **EX**

Interactive Diagnostics

### **EXCT**

Exception Table



---

## **F**

### **FE**

Far End

### **FFER**

Frame Format Error

### **FIFO**

First-In First-Out

### **FLTY**

Faulty

### **FPAS**

Facility Performance Analysis System

### **FPI**

Full Process Initialization

---

## **G**

### **GSC**

Group Signaling Congestion

### **GT**

Global Title

### **GTT**

Global Title Translation

---

## **H**

### **HDB**

High Density Backplane

### **HFDT**

History File Descriptor Table

### **HSA**

High Speed A-Link

**Hz**  
Hertz

---

**I**

**IAD**  
Integrated Access Distributor

**IAM**  
Initial Address Message

**ICDR**  
International Call Detail Recording

**ICMP**  
Internet Control Message Protocol

**IFB**  
Interframe Buffer

**IFB-P**  
Interframe Buffer - Padded

**ILN**  
International Link Node

**IM**  
Input Manual

**IMS**  
Interprocess Message Switch

**INH**  
Inhibit

**INIT**  
Initializing

**IOP**  
Input/Output Processor

**iPCC**  
Individual Per Call Control

**IRN**  
Integrated Ring Node

**IS**  
In-Service

## Abbreviations

---

### **ISC**

International Switching Center

### **ISDN**

Integrated Services Digital Network

### **ISUP**

Integrated Services Digital Network User Part

### **IU**

Integrated Unit

### **IUN**

IMS User Node

---

## **K**

### **kb/s**

Kilobits Per Second

---

## **L**

### **L30M**

Last 30 Minutes

### **LAP-B**

Link Access Protocol-Balanced

### **LAP-D**

Link Access Protocol-DCHN

### **LCI**

Link Check Internal

### **lday**

Last Day

### **LED**

Light-Emitting Diode

### **LFV**

Line Format Violation

### **LFVR**

Line Format Violation Rate

**LI**

Link Interface

**LI4**

Four-Port Link Interface

**LIB**

Link Interface Board

**LKPLID**

Logical-to-Physical Link Identifier

**LL**

Local Loopback

**LN**

Link Node

**LNU**

Link Node Unit

**LO**

Local

**LOF**

Loss of Frame

**LOFC**

Loss of Frame Count

**LOS**

Loss of Signal

**LPM**

Last Period Measurement

---

**M**

**MAN**

Manual

**Mb/s**

Megabits per Second

**MCO**

Maintenance Control Office

**MCRT**

Maintenance Cathode-Ray Tube

**MDCT**

Minor Device Chain Table

**MH**

Message Handler

**MHD**

Moving Head Disk

**MJ**

Major

**MML**

Man-Machine Language

**MN**

Minor

**MOCT**

Measurement Output Control Table

**MOOS**

Manual Out of Service

**MPR**

Machine Performance Report

**MROP**

Maintenance Receive-Only Printer

**MSU**

Message Signal Units

**MTP**

Message Transfer Part

**MTTY**

Maintenance Teletype

---

**N**

**NCN**

Noncontrol Node

**NCO**

Network Control Office

**NCOE**

Network Channel Office Equipment

## Abbreviations

---

**NCP**

Network Control Point

**NE**

Near End

**NEBS**

New Equipment Building Standards

**NESAC**

National Electronic System Assistance Center

**NI**

Network Interconnect

**NIC**

Network Interface Controller

**NID**

Network Identifies

**NP**

Node Processor

**NPI**

Node Processor Interface Logic

**NRM**

Node Recovery Monitor

**NSC**

Network Services Complex

**NT**

No Token

**NTR**

No Test Run

**NUT**

Node Under Test

---

## O

**OA&M**

Operation, Administration, and Maintenance

**OCO**

Overall Control Office

**AT&T — PROPRIETARY**

Use pursuant to Company instructions

**OFL**

Overflow

**OM**

Output Manual

**OMAP**

Operations, Maintenance, and Administration Part

**OOF**

Out of Frame

**OOS**

Out of Service

**OPC**

Originating Point Code

**OSI**

Open Systems Interconnection

**OSWF**

On-Site Work Force

---

**P**

**PA**

Power Alarm

**PAS**

Protected Application Segment

**PCR**

Preventive Recyclic Retransmission

**PD**

Power Distribution

**PDF**

Power Distribution Frame

**PDS**

Program Documentation Standards

**PDT**

Page Descriptor Table

**PIIT**

Periodic Indication of Intrusive Test

## Abbreviations

---

### **PLID**

Physical Link Identification

### **PMCR**

Plant Measurement Common Reports

### **POA**

Priority of Action

### **POTS**

Plain Old Telephone Service

### **PR**

Peripheral Routing

### **PRM**

Processor Recovery Message

### **PRO**

Processor Outage

### **PSC**

Processor Congestion

### **PSM**

Power Switch Monitor

### **PTAN**

Port Trunk Appearance Number

### **PWR**

Power

---

## **Q**

### **QUSBL**

Quarantine Usable

---

## **R**

### **RABT**

Received Abort

### **RAC**

Ring Access Circuit

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Use pursuant to Company instructions



## Abbreviations

---

|               |                          |
|---------------|--------------------------|
| <b>RAM</b>    | Random Access Memory     |
| <b>RBI</b>    | Ring Interface Board     |
| <b>RC</b>     | Recent Change            |
| <b>RC/V</b>   | Recent Change and Verify |
| <b>REL</b>    | Release                  |
| <b>REX</b>    | Routine Exercise         |
| <b>RF</b>     | Radio Frequency          |
| <b>RGDP</b>   | Ring Group Display Page  |
| <b>RI</b>     | Ring Interface           |
| <b>RIB</b>    | Ring Interface Board     |
| <b>RINGEX</b> | Ring Exception           |
| <b>RMV</b>    | Remove                   |
| <b>RN</b>     | Ring Node                |
| <b>RNA</b>    | Ring Node Address        |
| <b>RNC</b>    | Ring Node Cabinet        |
| <b>RNF/C</b>  | Ring Node Frame/Cabinet  |
| <b>RNR</b>    | Receive Not Ready        |
| <b>ROM</b>    | Read Only Memory         |

**ROP**

Read-Only Printer

**RPC**

Ring Peripheral Controller

**RPCN**

Ring Peripheral Controller Node

**RQ**

Ring Quarantine

**RST**

Restore

**RTR**

Real-Time Reliable

---

**S**

**SAPI**

Service Access Point Identifier

**SCC**

Switching Control Center

**SCCP**

Signaling Connection Control Part

**SCHT**

Scheduler Table

**SCMG**

Signaling Connection

**SCSI**

Small Computer Systems Interface

**SD**

Schematic Drawing

**SDN**

Software Defined Network:

**SDT**

Segment Descriptor Table

**SEP**

Signaling End Point

|              |                                             |
|--------------|---------------------------------------------|
| <b>SEPR</b>  | Signaling                                   |
| <b>SES</b>   | Severely Errored Seconds                    |
| <b>SIM</b>   | System Integrity Monitor                    |
| <b>SIN</b>   | Small Computer Systems Interface Node       |
| <b>SIO</b>   | Service Indicator Octet                     |
| <b>SLC</b>   | Signaling Link Control                      |
| <b>SLK</b>   | Signaling Link                              |
| <b>SLMK</b>  | Signaling Link Maintenance Kernel           |
| <b>SLS</b>   | Signaling Link Selection                    |
| <b>SM</b>    | Switching Module                            |
| <b>SNPR1</b> | Signaling Network Performance Report—Part 1 |
| <b>SNPR2</b> | Signaling Network Performance Report—Part 2 |
| <b>SP</b>    | Signaling Point                             |
| <b>SPC</b>   | Stored Program Control                      |
| <b>SPI</b>   | Signaling Point Isolation                   |
| <b>SRM</b>   | Signaling Route Management                  |
| <b>SSI</b>   | Small Scale Integration                     |
| <b>SSN</b>   | Signaling Point and Subsystem Number        |

## Abbreviations

---

**SSTE**

Single Signaling Termination Element

**STBY**

Standby

**STF**

Signal Transfer Frame

**STF**

Some Tests Failed

**STP**

Signal Transfer Point

**SU**

Signal Unit

**SUIE**

Signal Units In Error

**SYS**

System

---

## T

**T.D.NET.**

Time Division Network

**T1FA**

T1 Facility Access

**TAN**

Trunk Appearance Number

**TC**

Transaction Capabilities

**TCA**

Transfer Cluster Allowed

**TCC**

Technology Control Center

**TCN**

T1FA Control Node

**TCR**

Transfer Cluster Restricted

**AT&T — PROPRIETARY**

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|              |                                                          |
|--------------|----------------------------------------------------------|
| <b>TEI</b>   | Terminal Endpoint Identifier                             |
| <b>TFA</b>   | Transfer Allowed                                         |
| <b>TFP</b>   | Transfer Prohibited                                      |
| <b>TFR</b>   | Transfer Restricted                                      |
| <b>TG4</b>   | 4ESS Switch Translation Guide                            |
| <b>TIMS</b>  | Transmission Impairment Measuring Set                    |
| <b>TIRKS</b> | Trunk Integrated Record Keeping System                   |
| <b>TLC</b>   | Transmission Link Control                                |
| <b>TLP</b>   | Transmission Level Point                                 |
| <b>TMS</b>   | Transmission Measuring Set                               |
| <b>TNM</b>   | Total Network Management                                 |
| <b>TOPAS</b> | Testing Operating Provisioning and Administration System |
| <b>TSC</b>   | Transport Service Center                                 |
| <b>TSI</b>   | Timeslot Interchange                                     |
| <b>TSN</b>   | Trunk Scanner Number                                     |
| <b>TTF</b>   | Token track flip flop                                    |

---

## U

### UCB

Unit Control Block

### UDS

Unitdata Service

### UDT

Unitdata

### UL

Underwriters Laboratories

### ULN

Universal Link Node

### UNAV

Unavailable

### UNEQ

Unequipped

### UNTSTD

Untested

### USBL

Usable

### UVDT

User View Descriptor Table

---

## V

### VFL

Voice Frequency Link

### VLSI

Very Large Scale Integration

# index

---

## **1**

1108 Link Status, 6-37

## **3**

3B Computer Maintenance Functions, 6-98  
3B Interface (3BI) Unit, 2-11, 2-18, 2-20, 2-21

## **A**

Abbreviations and Acronyms, ABB-1  
About This Document, 1  
AC Power Unit, 2-38  
AC Power Distribution Unit Mounting, 2-38  
Access Cabinet, 2-28  
Acronyms, 2  
Addressing, 2-44, 6-64  
    Equipment, 2-44  
    Node, 2-44  
    Ring Node, 6-64  
Administering Measurement, 5-131  
    Reports, 5-131  
Alarms, 6-41  
    Signaling Link, 6-41  
    Visual, 6-28  
All-Test-Passed (ATP) Status Page Commands, 6-38  
Alphabetical Index of Measurements (CNI, IMS, PBX, T1, HSA, and ESF), 5-10  
Altitude, Environmental, 2-4  
Analysis, 6-86

---

- Analyzing, 6-95
- API/DLN Stream Status Page (1107), 6-36
- Application Layer, 4-6
- Application Link Nodes Circuit Packs, 2-22
  - Integrated Ring Node, 2-22
  - Link Interface, 2-22
  - Node Processor, 2-22
  - Ring Interface, 2-22
- Assignments, 2-44
  - Equipment, 2-44
  - Facility, 2-45
  - Node, 2-44
- AT&T 2556A, 2-30
  - Digital Service Unit Options, 3-13
- AT&T 500B, 2-31
  - Digital Service Unit Options, 3-11
- AT&T Trigger Platform (ATP), 2-25, 6-45, 6-92
  - Junior Node Audit, 6-92
  - Measurements, 6-45
  - Node Maintenance, 6-45
  - Status Page (1109), 6-38
  - Trouble, 6-45
- AT&T Trigger Platform Circuit Packs,
  - IRN2 (UN304), 2-25
- ATP Node, defined, 1-16
- Attached Processor,
  - (AP30/AP30'), 2-19, 2-20
- Audible Alarms, 6-28
- Audits, 6-81, 6-83, 6-90
  - Abort Codes, 6-89
  - Analysis, 6-86
  - AT&T Trigger Platform (ATP) Junior Node, 6-92
  - Blocking and Inhibiting Audits, 6-85
  - Central Node Control, 6-90
  - Commands-UNIX\*, 6-82
  - Direct Link Node, 6-91
  - Equipment Configuration Database (ECD), 6-82
  - Error Reporting, 6-86
  - Execution Modes, 6-83
  - Execution Sequence, 6-84
  - Internal Data, 6-91
  - Node State, 6-90
  - Output Formatter, 6-82
  - Plant Measurements Interface, 6-82
  - Recovery, 6-86
  - Requests, 6-82
  - Scheduling and Control, 6-81
  - System Integrity Monitor, 6-82
- Automatic Ring Recovery (ARR), 1-24, 6-19
  - Response to Isolation and CP Maintenance States, 6-20



---

## B

- Backplanes, 2-3
- Basic Error Correction (BEC), 1-17
  - Degrowth of Satellite Links, 3-38
  - Description, 3-37
  - Growth of Satellite Links, 3-38
  - With Increased Buffer Size of SS7 Satellite Nodes, 3-37
- Blocking and Inhibiting Audits, 6-85

## C

- Cabinet Circuit Pack Description, 6-11
- Cabinets, 2-2, 2-6
  - Digital Facility Access, 2-28
  - Ring Node, 2-6
  - Signaling Transport Frame (STF), 2-41
- Call Processing,
  - ISUP Common Channel Signaling No. 7, 4-10
- Capabilities and Features, 1-1
- CCIS,
  - Signaling Transport Footprint Standardization, 1-13
- CCIS 6 to CCS7 Measurement Correspondence, 5-9
- CCS7,
  - Common Network Interface (CNI) Measurement Descriptions, 5-40
  - Clusters, 5-112
  - Link, defined, 6-47
  - Links, 5-111
  - Node, defined, 1-13
  - Signaling Link Performance, 5-95
  - Signaling Load, 5-88
  - States, 3-7
- Central Control Audit, 6-90
- Central Node Control, 6-90
  - Audit, 6-90
- Central Processor Functions, 1-8
- Changeover/Changeback, defined, 6-41
- Channel Service Unit (CSU), 2-34
  - Mounting, 2-36
  - Options, 3-13
- Circuit Packs, 2-3, 2-17, 2-19, 2-24, 6-23
  - 3B Interface, 2-20, 2-21
  - Description, 6-11
  - Direct Link Node (DLN), 2-19
  - Duplex Dual Serial Bus Selector, 2-20, 2-21
  - Ethernet Interface Node Interface, 2-21
  - Handling Precautions, 6-14
  - Integrated Ring Node, 2-20, 2-22, 2-25
  - IRN2 (UN304), 2-25
  - Link Interface, 2-22, 2-26

---

- Circuit Packs (Continued)
  - Node Processor, 2-22
  - Ring Interface, 2-17, 2-22
  - Ring Peripheral Controller Node, 2-17
  - Small Computer System Interface, 2-20
  - Small Scale Integration, 2-20
  - T1FA, 2-26
  - TN1803, 2-26
  - TN915/TN1506/TN1509, 2-26
  - TN918/TN1508, 2-26
  - Universal Link Node(ULN), 2-24
- Clock Network, 5-82
- Clusters, 5-112
- Commands-UNIX\*, 6-82
- Common Channel Signaling (CCS), 4-1, 4-8
  - Critical Events, 5-116
  - Network, 4-1, 5-116
  - Network Routing, 4-8
  - Network Signaling Link and Signal Transfer Point Configuration, 4-9
- Common Channel Signaling 7 (CCS7), 3-2, 4-7
  - Call Processing—ISUP, 4-10
  - Digital Signaling Link Maintenance, 6-40
  - Integrated Services Digital Network User Part, 4-8
  - Message Transfer Part, 4-8
  - Node, 2-23
  - Operations, Maintenance, and Administration Part), 4-8
  - Signaling Connection Control Part, 4-8
  - Signaling Link Hardware Options, 3-10
  - Signaling Link States, 3-7
  - Signaling Links, 3-2
  - Transaction Capabilities, 4-8
- Common Channel Signaling 7 (CCS7) Signaling Link,
  - Lengths, 3-5
  - Hardware Indicators, 3-9
  - Routing, 3-10
- Common Channel Signaling 7 Protocol Layer, 4-7
  - Identification, 4-7
  - Equivalency to Open Systems Interconnection Model Layers, 4-7
- Common Network Interface (CNI), 1-4, 1-5, 1-18, 4-10, 5-3
  - Dual Ring Structure, 6-2
  - Link Node Architecture, 6-5
  - Interprocess Message Switch, 1-6
  - Measurements, 5-3
  - Ring—4ESS™ Switch Application, 1-11, 4-4
  - Ring Message Flow, 4-10
  - Ring Configuration, 6-8
  - Ring Isolation, 6-10
  - Ring Maintenance Description, 6-1
  - Ring Node Operation, 6-6
  - Ring Operation, 6-6
  - Ring Structure During Isolation, 6-9

---

- Common Network Interface (CNI) (Continued)
  - Software Architecture, 1-5
  - Software Subsystem, 1-7
  - Subsystem, 1-5
  - Subsystem Components, 1-4
  - System, 1-4
  - System Description, 1-10
  - System Operation, 1-18
  - System Reliability Features, 1-23
  - Trouble Indicators and Analysis — Audible Alarms, 6-32
  - Trouble Indicators and Analysis — Output Messages, 6-30
  - Trouble Indicators and Analysis — Visual Alarms, 6-31
- Control Panel, 2-27, 2-40
- Control Table-Measurement Output, 5-129
- Critical Events, 5-1, 5-114, 5-116, 5-130, 6-43, 6-56
  - Common Channel Signaling Network, 5-116
  - D-Channel, 6-56
  - Logging, 5-114
  - Special Access Data Channel, 6-56
  - Table, 5-130
- Critical Node Restore, 1-24

## D

- D-Channel, 3-14, 3-18, 6-55, 6-57
  - Critical Events, 6-56
  - Defined, 6-55
  - Interprocess Message Switch, 6-56
  - Link Check, 3-24
  - Link Check Internal Test, 3-21
  - Loopback, 3-24
  - Measurement Reports, 6-56
  - Ring Initialization, 6-57
  - Signaling Link Backup, 3-18
  - Signaling Link Maintenance, 6-55
  - Signaling Link Management, 6-55
  - Signaling Link States, 3-18
  - Signaling Link Tests, 3-21
  - Signaling Links, 3-14
  - Trouble Conditions, 6-55
- D-Channel and Special Access Data Channel, 6-55
  - Routing, 3-24
  - Signaling Link, 3-24
- D-Channel, 3-18
  - Backup, 3-18
  - Connectivity, 3-14
  - Expansion Feature, 1-15, 2-3, 2-11, 2-24
  - Management, 6-55
  - Node, 2-24
  - Signaling, 3-21
- Data, 5-80

---

- Data Link Layer, 4-6
- Data Output,
  - Measurement, 5-83
- DATATEL\* Digital Service Unit Options, 3-12
- DCHN Node, defined, 1-15
- DGP3189, 2-34
- Degrowth of Satellite Links With Basic Error Correction, 3-38
- Descriptions, 2-1, 2-6, 3-37, 5-1, 6-11
  - Increased Buffer Size of SS7 Satellite Nodes using BEC Feature, 3-37
  - Critical Events, 5-1, 5-114
  - Measurement Output Control Table, 5-1
  - Reports, 5-1, 5-80
- DGN Message Input Variations, 6-63
- Diagnostics, 1-2, 6-60, 6-62
  - Message Structure, 6-62
  - Performing, 6-61
  - Phases, 6-64
  - System, 6-62
- Digital Facility (DFA), 2-28
  - AC Power Unit, 2-38
  - Access Cabinet, 2-28
  - Cabinet Layout, 2-32
  - Channel Service Unit (CSU), 2-34
  - Control Panel, 2-40
  - Digital Service Adapter (DSA), 2-35
  - Digital Service Unit (DSU), 2-29
  - Fuse Panel, 2-40
- Digital Service Adapter (DSA), 2-35
  - Mounting, 2-37
- Digital Service Unit (DSU), 2-29
  - AT&T 2556A, 2-30
  - AT&T 500B, 2-29
  - DGP3189, 2-34
  - Mounting, 2-33
- Digital Signaling Link, 6-40
  - Defined, 6-40
  - Maintenance, 6-40
- Direct Audit, 6-91
- Direct Link Node (DLN), 2-19, 6-91
  - 3B Interface (3BI), 2-19, 2-20
  - Attached Processor (AP30/AP30'), 2-19, 2-20
  - Audit, 6-91
  - Circuit Packs, 2-19
  - Duplex Dual Serial Bus Selector, 2-19, 2-20
  - Integrated Ring Node, 2-19, 2-20
- Display Pages, 6-28, 6-33
  - 1108 Link Status, 6-37
  - API/DLN Stream Status Page (1107), 6-36
  - Index Page (100), 6-33
  - Ring Node Status Page (1106), 6-35
  - Ring Status Summary Page (1105), 6-34

---

- Distribution, 2-5, 6-24
- DLN Capacity Figures 4E19/22 Generics, 2-20
- DLN-Enhanced (DLNE), 2-19
- DMA controller, defined, 1-19
- DS1 Units, 2-10
  - Type A and B, 2-13
- Dual Ring Structure, 1-21
  - Isolated, 1-21
  - Normal, 1-20
- Duplex Dual Serial Bus Selector, 2-19, 2-21

## **E**

- Electromagnetic Compatibility, 2-4
- Environmental, 2-4
  - Limits, 2-5
- Environmental Requirements, 2-4
  - Altitude, 2-4
  - Electromagnetic Compatibility, 2-4
  - Heat Dissipation, 2-4
  - Humidity, 2-4
  - Temperature, 2-4
- Equipment, 2-2, 2-44, 6-11, 6-22
  - Backplanes, 2-3
  - Cabinets, 2-2
  - Circuit Packs, 2-3
  - Configuration Database (ECD), 6-82
  - Connection, 3-6
  - Descriptions, 2-6
  - Fan Maintenance, 6-14
  - Fan Unit Description, 6-14
  - Features, 2-2
  - Fuse Descriptions, 6-13
  - Handling Procedures, 6-11
  - Power Descriptions, 6-13
  - Removal, Ring Node, 6-21
  - Removing From Service, 6-16
  - Restoral, 6-22
  - Ring Node Cabinet, 2-6
  - Ring Node Restoral, 6-22
  - Units, 2-3
  - Visual Indicators, 6-15
- Equipment Addressing, 2-44
  - Node Addressing, 2-44
- Equipment Assignments, 2-44
  - Facility Assignments, 2-45
  - Node Assignments, 2-44
- Equipment Requirements,
  - Power Distribution, 2-5
- Error Reporting, 6-86
- Ethernet Interface Node (EIN), 2-21, 3-1, 3-34, 3-36, 6-97

---

Ethernet Interface Node (EIN) (Continued)

- Hardware Configuration, 3-34
- Interface, 2-21
- Interface Node, 2-21
- Links, 3-1
- Links (SIN), 3-34
- Maintenance, 6-97
- Measurement Reports, 6-97
- Signaling Link, 3-36
- Signaling Link Management, 6-97
- States, 3-35

Example:

- AT&T Trigger Platform (ATP) Status Page 1109, 6-38
- Attached Processor Interface/Data Link Node Stream Status Page (1107), 6-36
- Display Page 1110—Specific HSL T1 Test Request Page, 6-39
- Index Page (100), 6-33
- Link Status Summary Page (1108), 6-37
- Ring Group Display Page (1106), 6-35
- Ring Status Summary Page (1105), 6-34

Exception Table, 5-136

Execution Modes, 6-83

- Audits, 6-83

Extended Super Frame (ESF) Error Count Description, CNI 11.4 and Later, 5-79

## F

Facility Assignments, 2-45

Failures,

- Link Set, 6-44
- Signaling Link, 6-44

Fan Maintenance, 6-14

Fan Unit, 2-28, 6-14

- Description, 6-14

Fans, 6-23

Fault Recovery, 1-2

Feature Capabilities, 6-50

- Universal Link Node, 6-50

Features:, 1-1, 1-23, 2-2

- Automatic Ring Recovery (ARR), 1-24

- Basic Error Correction (BEC) With Increased Buffer Size of SS7 Satellite Nodes, 3-37

- D-Channel Expansion Feature, 1-15, 2-3, 2-11, 2-24

- High Speed Links, 3-2

- PAS Write Access Limitation, 1-25

- Signaling Transport Footprint Standardization, 1-13

- System Reliability, 1-23

Field Updates, defined, 1-3

Fifteen-Minute Marginal Performance, 5-107

Figures:, 1-7

- 3B Interface (3BI) Units, 2-14

- AC Power Distribution Unit Mounting, 2-39

- AC Power Unit Mounting, 2-38

---

Figures: (Continued)

Channel Service Unit (CSU) Mounting, 2-36  
Common Channel Signaling 7 (CCS7) Signaling Link Lengths, 3-5  
Common Channel Signaling 7 (CCS7) Signaling Links, 3-5  
Common Channel Signaling Network Signaling Link and Signal Transfer Point Configuration, 4-9  
Common Network Interface (CNI) Ring—4ESS™ Switch Application, 1-11  
Common Network Interface Dual Ring Structure, 6-2  
Common Network Interface Link Node Architecture, 6-5  
Common Network Interface Ring Structure During Isolation, 6-9  
Common Network Interface Ring—4ESS™ Switch Application, 4-4  
D-Channel Connectivity, 3-14  
Digital Facility Access (DFA) Cabinet Layout, 2-32  
Digital Service Adapter (DSA) Mounting, 2-37  
Digital Service Unit (DSU) Mounting, 2-33  
DS1 Units (Type A and B), 2-13  
Dual Ring Structure — Isolated, 1-21  
Dual Ring Structure — Normal, 1-20  
Ethernet Interface Node, 3-36  
Ethernet Interface Node Hardware Configuration, 3-34  
Example of AT&T Trigger Platform (ATP) Status Page 1109, 6-38  
Example of Attached Processor Interface/Data Link Node Stream Status Page (1107), 6-36  
Example of Display Page 1110—Specific HSL T1 Test Request Page, 6-39  
Example of Index Page (100), 6-33  
Example of Link Status Summary Page (1108), 6-37  
Example of Ring Group Display Page (1106), 6-35  
Example of Ring Status Summary Page (1105), 6-34  
Fuse and Control Panel Mounting, 2-28, 2-40  
IMS Configuration, 1-7  
Individual Per Call Control (iPCC) System, 3-17  
Initial User View Descriptor Table, 5-137  
Integrated Ring Node (IRN) Unit, 2-15  
International Link Node Signaling Link Block Diagram, 3-26  
ISDN D-Channel Testing Capability, 3-22  
ISUP Common Channel Signaling No. 7 Call Processing, 4-13  
ISUP — Initial Address Message for CCS7 Routing, 4-13  
ISUP 1A Format — Initial Address Message, 4-12  
ISUP Common Channel Signaling No. 7 Call Processing Equipment Layout, 4-10  
Layout of Facility Equipment for 56 Kbps Links and High-Speed A-Links, 6-47  
Layout of the Scheduled 15MPR Report, 5-108  
Layout of the Scheduled 30MPR Report, 5-110  
Layout of the Scheduled Daily SEPR Report, 5-101  
Layout of the Scheduled Daily SNPR2 Report, 5-96  
Layout of the Scheduled MPR Report, 5-103  
Layout of the Scheduled RINGEX Report, 5-113  
Layout of the Scheduled SNPR1 Report, 5-90  
Link Node (LN) Units (Type A and B), 2-12  
OPC and CIC translated to TSN During SS7 Call Processing, 4-16  
Processor Recovery Message Format, 6-93  
Ring Node Cabinet Fan Unit Assembly, 2-31

---

Figures: (Continued)

- Signal Transport Footprint Standardization with 4ESS™ Switch, 1-14
- Signaling Transport Frame Equipment Connection, 3-6
- Simplified Common Channel Signaling (CCS) Network, 4-3
- Small Computer System Interface Node, 3-33
- Small Computer System Interface Node Hardware Configuration, 3-31
- Special Access Data Channel Signaling Link Block Diagram, 3-16
- Typical Ring Node Cabinet Layouts, 2-7
- Typical Signaling Transport Frame (STF), 2-41
- Filter, 6-14
  - Maintenance, 6-14
- Five-Minute Ring Exception Report, 5-112
- Fixed Format, 5-84
- Flexible Format, 5-85
- Formats, 5-84
  - Fixed, 5-84
  - Report, 5-84
- Frames,
  - Signaling Transport, 3-3
  - Signaling Transport (STF) Cabinet, 2-41
- Full Process Initialization, 1-23
- Function Replacement, defined, 1-3
- Functions, 1-7, 2-1, 6-11
- Fuse and Control Panel Mounting, 2-28, 2-40
- Fuse Descriptions, 6-13
- Fuse Panel, 2-27, 2-40

## G

- Generating Scheduled Reports-MOCT Interaction, 5-155
- Glossary, 2, GL-1
- Golden Path Project, 2-43
- Growth of Satellite Links With Basic Error Correction, 3-38

## H

- Handling Precautions, 6-14
- Handling Procedures, 6-11
- Handling Procedures, Equipment, 6-11
- Hardware, 2-1, 6-11
  - Description, 2-1
  - Equipment Features, 2-2
  - Functions, 2-1
  - Physical Design Features, 2-2
  - Requirements, 2-2
- Hardware Functions,
  - Equipment Addressing, 2-44
  - Equipment Assignments, 2-44
- Hardware Indicators, 3-9
- Hardware Options, 3-10
- Heat Dissipation, 2-4



---

- High Level Description,
  - Common Network Interface System, 1-4
  - Software Architecture, 1-5
- High Speed, 3-2
- High Speed Link (1.544) Measurement Descriptions, CNI 11.4 and Later, 5-77
- High Speed Links, 2-42, 3-2
- High Speed Links Encryption, 2-43
- High-Level Description, 2, 1-1
- History File Descriptor Table, 5-141
- Human Interfaces, 1-2
- Humidity, Environmental, 2-4

## I

- ILN, defined, 1-16
- IMS Configuration, 1-7
- Incore Functio,
  - Defined, 1-3
  - Replacement, 1-3
- Increased Buffer Size, 3-37
  - SS7 Satellite Nodes, 3-37
  - SS7 Satellite Nodes using BEC Feature, 3-37
- Index Page (100), 6-33
- Indicators,
  - Equipment Visual, 6-15
- Individual Per Call Control (iPCC) System, 3-17
- Initial Critical Event Table, 5-132
- Initial Exception Table, 5-143
- Initial History File Descriptor Table, 5-149
- Initial Scheduler Table (Notes 1 through 4), 5-154
- Initial User View Descriptor Table, 5-137
- Initialization, 1-2
- Integrated Ring Node (IRN), 2-19, 2-22, 2-25
  - Unit, 2-11, 2-15
- Integrated Services Digital Network User Part, 4-8
- Interface Link Node States, 3-32, 3-35
  - Ethernet, 3-35
  - Small Computer System, 3-32
- Interface Node (EIN) Links,
  - Ethernet, 3-34
- Interface Node (SIN) Links,
  - Small Computer System, 3-31
- Interface Node Circuit Packs, 2-20, 2-21
  - 3B Interface, 2-20, 2-21
  - Duplex Dual Serial Bus Selector, 2-20, 2-21
  - Ethernet Interface Node, 2-21
  - Integrated Ring Node, 2-20, 2-21
  - Small Computer System Interface, 2-20
  - Small Scale Integration, 2-20, 2-21
- Interface Node Maintenance, 6-96, 6-96
  - Ethernet, 6-97

---

- Interface Node Maintenance (Continued)
  - Small Computer Systems, 6-96
- Interframe Buffer Circuit Packs, 2-26
  - TN1803, 2-26
  - TN915/TN1506/TN1509, 2-26
  - TN918/TN1508, 2-26
- Internal, 3-21, 3-29
  - Audits, 6-91
  - Congestion, 5-107
- International Link Node (ILN), 2-25, 3-25, 3-29, 6-96
  - Signaling Link Tests, 3-29
  - Signaling Links, 3-25
  - Signaling-Link Maintenance, 6-96
- International Link Node Circuit Packs,
  - Integrated Ring Node, 2-25
  - Link Interface, 2-26
- International Link Node Signaling Link, 3-29, 3-30
  - Block Diagram, 3-26
  - Link Check, 3-29
  - Link Check Internal Tests, 3-29
  - Loopback, 3-30
  - Routing, 3-30
  - States, 3-25
- Interprocess Message Switch (IMS), 1-6, 6-56
  - D-Channel, 6-56
  - Measurement Descriptions, 5-16
  - Ring Initialization, 6-57
  - Special Access Data Channel, 6-56
  - Subsystem, 1-6
  - Subsystem Initialization, 6-56
- IRN, defined, 1-16
- IRN2 (UN304), 2-25
- IRN2 DLN (DLN30), 2-20
- ISDN D-Channel Testing Capability, 3-22
- Isolation, Ring, 6-10
- ISUP:,
  - 1A Format — Initial Address Message, 4-12
  - Common Channel Signaling No. 7 Call Processing, 4-13
  - Common Channel Signaling No. 7, 4-10
  - Common Channel Signaling No. 7 Call Processing, 4-10
  - Common Channel Signaling No. 7 Call Processing Equipment Layout, 4-10
  - Initial Address Message for CCS7 Routing, 4-13
- IUN, Defined, 1-16

## J

- Junior Node Audit, 6-92
  - AT&T Trigger Platform (ATP), 6-92

---

## L

- Layout of Facility Equipment for 56 Kbps Links and High-Speed A-Links, 6-47
- Layout of the Scheduled:
  - 15MPR Report, 5-108
  - 30MPR Report, 5-110
  - Daily SEPR Report, 5-101
  - Daily SNPR2 Report, 5-96
  - MPR Report, 5-103
  - RINGEX Report, 5-113
  - SNPR1 Report, 5-90
- LI4D Link Interface, 3-15
- LI4S Link Interface, 3-16
- Link Check, 3-24, 3-29
  - Internal, 3-21, 3-29
  - Test, 3-24
- Link Interface, 2-22, 2-26
  - LI4D, 3-15
  - LI4S, 3-16
- Link Node (LN), 5-106, 6-21
  - Direct Audit, 6-91
  - International, 3-25, 3-29
  - Out-of-Service, defined, 6-6
  - Performance, 5-106
  - Units, 2-10
  - Units, Type A and B, 2-12
- Link Oriented, 5-4
  - Measurements, 5-4
- Link Set Failure, 6-44
- Link Status Display Page 1108, 6-37
- Link Tests,
  - D-Channel Signaling, 3-21
- Links, 5-111
  - Ethernet Interface Node (EIN), 3-1
  - High Speed, 3-2
  - Signaling Transport Frame, 3-3
  - Small Computer System Interface Node (SIN), 3-1
- Logging, 5-114
  - Critical Event, 5-114
- Loopback, 3-24, 3-30
  - Test, 3-30
- Loss of Signaling Capability, 5-95

## M

- Machine Performance Report, 5-102
  - Internal Congestion, 5-107
  - Link Node (LN), 5-106
  - No Message Signal Unit Processing, 5-105
  - Ring Performance, 5-106

---

Machine Performance Report (Continued)  
  RPC Node Performance, 5-105  
  System Initializations, 5-104  
Maintenance, 6-14, 6-40, 6-54, 6-55  
  3B Computer Maintenance Functions, 6-98  
  Circuit Pack Handling Precautions, 6-14  
  D-Channel and Special Access Data Channel, 6-55  
  Diagnostics, 6-60  
  Digital Signaling Link, 6-40  
  Equipment, 6-11  
  Ethernet Interface Node, 6-97  
  Filter, 6-14  
  Functions, 6-11  
  Guidelines, 2, 6-1  
  Hardware, 6-11  
  Philosophy, 6-48  
  Processor Recovery Messages (PRM), 6-93  
  Small Computer Systems Interface Node, 6-96  
  State, Ring, 6-17  
  States, 6-16  
  T1FA, 6-26  
  Universal Link Node (ULN), 6-46  
  Universal Link Node Philosophy, 6-48  
Management, 6-55, 6-96, 6-97  
  Signaling Link, 6-96, 6-97  
  Signaling Link , 6-55  
Measurement Reports, 6-56, 6-96, 6-97  
  Administering, 5-131  
  D-Channel, 6-56  
  Exception Table, 5-136  
  Fifteen-Minute Marginal Performance, 5-107  
  History File Descriptor Table, 5-141  
  Scheduler Table, 5-149  
  Special Access Data Channel, 6-56  
  User View Descriptor Table, 5-135  
Measurements, 5-1, 5-5, 6-45, 5-8, 5-83  
  CCS7 Links, 5-111  
  Common Network Interface (CNI), 5-3  
  Data Output, 5-83  
  Descriptions, 5-8  
  Five-Minute Ring Exception Report, 5-112  
  Link Oriented, 5-4  
  Machine Performance Report, 5-102  
  Network Clock, 5-82  
  Output Control Table, 5-1, 5-129  
  PBX Signaling Load, 5-93  
  Plant, 5-3  
  Process Phases, 5-5  
  Ring Node Oriented, 5-3  
  Signaling Performance, 5-88, 5-93  
  Sources, 5-3

---

Measurements (Continued)  
Thirty-Minute Marginal Performance Report, 5-109  
Total Office, 5-5  
Measurements, Reports, and Critical Events, 2  
Message Flow, 2, 4-1  
Common Channel Signaling (CCS) Network, 4-1  
Common Channel Signaling 7, 4-7  
Common Network Interface Ring Message Flow, 4-10  
Open Systems Interconnection, 4-5  
Message Propagation on the Ring, 6-6  
Message Structure, 6-62  
Diagnostics, 6-62  
Message Transfer Part, 4-8  
MOCT Interaction When Generating Scheduled Reports, 5-155  
Multiple Node Isolation, 1-22

## N

Network, 4-1  
Network Clock, 5-82  
Network Routing, 4-8  
Common Channel Signaling, 4-8  
No Message Signal, 5-105  
Unit Processing, 5-105  
Nodes:, 2-23, 2-44  
Addressing, 2-44, 6-7  
Assignments, 2-44  
Central Control Audit, 6-90  
Defined, 2-1  
Initialization, 1-23  
Maintenance, 6-45  
OOS-Quarantined, 1-22  
Processor, Defined, 2-17, 2-22  
Processor Functions, 1-9  
State Audit, 6-90  
Notes, 1

## O

Office Alarms Indications, 6-24  
**OP:RING** Input Message Variations, 6-63  
OPC and CIC translated to TSN During SS7 Call Processing, 4-16  
Open Systems Interconnection (OSI), 4-5  
Application Layer, 4-6  
Data Link Layer, 4-6  
Model Layer Identification, 4-5  
Physical Layer, 4-6  
Presentation Layer, 4-6  
Protocol Model, 4-5  
Session Layer, 4-6  
Transport Layer, 4-6

---

- Operations, Maintenance, and Administration Part), 4-8
- Oriented Measurements, 5-3
- Output Control Table, 5-129
- Output Formatter, 6-82
- Output Messages, 6-29
- Overview, 1, 2
  - About This Document, 1
  - Acronyms, 2
  - Glossary, 2
  - Hardware Description and Functions, 2
  - High-Level Description, 2
  - Index, 2
  - Maintenance Guidelines, 2
  - Measurements, Reports, and Critical Events, 2
  - Message Flow, 2
  - Reason for Reissue, 1
  - Scope, 2
  - Signaling Links, 2

## **P**

- Parameter Values for 56 Kbps Links in a Linkset, 3-38, 3-39
- Part 1, 5-87
- PAS Write Access Limitation, 1-25
- PBX Links, 5-112
- PBX Signaling Link Performance, 5-95
- PBX Signaling Load, 5-93
- Performance, 5-106
- Performance Report,
  - Signaling Network, 6-43
  - Part 1, 5-87
  - Part 2, 5-94
- Performing Diagnostics, 6-61
- Phases, 6-64
- Philosophy, Universal Link Node Maintenance, 6-48
- Physical Design,
  - Backplanes, 2-3
  - Cabinets, 2-2
  - Circuit Packs, 2-3
  - Features, 2-2
  - Units, 2-3
- Physical Layer, 4-6
- Physical Node Addresses:,
  - Decimal Representation, 6-69
  - Hexadecimal Representation, 6-77
- Physical Node Identifications:,
  - Decimal Representation, 6-65
  - Hexadecimal Representation, 6-73
- Plant Measurements, 5-3
  - Interface, 6-82
- Power, 6-24

---

- Power (Continued)
  - Descriptions, 6-13
  - Distribution, 2-5, 6-24
  - Unit (AC), 2-38
- Presentation Layer, 4-6
- Private Branch Exchange (PBX) Measurement Descriptions, 5-68
- Process Characteristics, Signaling Link, 6-40
- Process Phases, 5-5
  - Measurements, 5-5
- Processor, 6-93
- Processor Recovery Messages (PRM), 6-93
  - Analyzing, 6-95
  - Format, 6-93
- Protected Application Segment, 1-25
- Protocol Model, 4-5
  - Open Systems Interconnection (OSI), 4-5

## **R**

- Reason for Reissue, 1
- Records,
  - Equipment Configuration Database (ECD), 6-82
- Recovery, 6-86
- Recovery Messages (PRM),
  - Processor, 6-93
- Removal, 6-21
  - Link Node, 6-21
  - Ring Node Equipment, 6-21
  - Ring Peripheral Controller Node, 6-22
- Removing Equipment From Service, 6-16
- Report Generators, 5-150
- Reports, 5-1, 5-80, 5-83, 6-43, 5-131
  - Administering Measurement, 5-131
  - CCS7 Clusters, 5-112
  - Data, 5-80
  - Fifteen-Minute Marginal Performance, 5-107
  - Fixed Format, 5-84
  - Flexible Format, 5-85
  - Formats, 5-84
  - Machine Performance Report, 5-102
  - PBX Links, 5-112
  - Signaling Equipment Performance, 5-99
  - Signaling Network Performance, 6-43
  - Signaling Network Performance, Part 1, 5-87
  - Thirty-Minute Marginal Performance, 5-109
  - User View Descriptor Table, 5-135
- Reports and Measurement Data Output, 5-83
- Requests, 6-82
- Requirements, 2-2, 2-4
  - Environmental, 2-4
- Restoral, 6-22

---

Restoral (Continued)  
  Circuit Packs, 6-23  
  Equipment, 6-22  
  Fans, 6-23

Ring,  
  access circuit, defined, 1-19  
  Configuration, 6-8  
  Down, 1-22  
  Interface, 2-17, 2-22  
  Isolation, 6-10  
  Maintenance Description, 6-1  
  Message Propagation, 6-6  
  Operation, 6-6  
  Performance, 5-106  
  Status Summary Page (1105), 6-34

Ring Initialization, 6-57  
  D-Channel, 6-57  
  Special Access Data Channel, 6-57

Ring Maintenance State, 6-17  
  Defined, 6-17

Ring Message Flow, 4-10  
  Common Network Interface, 4-10

Ring Node, 2-6, 6-63  
  Addressing, 6-63  
  Automatic Ring Recovery (ARR), 6-19  
  Cabinet Circuit Pack Description, 6-11  
  Cabinet Fan Unit Assembly, 2-31  
  Equipment Removal, 6-21  
  Equipment Restoral, 6-22  
  Node Addressing, 6-7  
  Operation, 6-6  
  Oriented Measurements, 5-3  
  Restoral, 6-22  
  Status Page (1106), 6-35

Ring Node Cabinet, 2-6, 6-11  
  3B Interface, 2-18  
  3B Interface Unit, 2-11  
  Application Link Nodes, 2-22  
  AT&T Trigger Platform (ATP), 2-25  
  Control Panel, 2-27  
  Digital Facility Access, 2-28  
  Direct Link Node, 2-19  
  DS1 Units, 2-10  
  Duplex Dual Serial Bus Selector, 2-19  
  Ethernet Interface Node, 2-21  
  Fan Units, 2-28  
  Fuse Panel, 2-27  
  Integrated Ring Node Unit, 2-11  
  Interframe Buffer Circuit Packs, 2-26  
  International Link Node, 2-25  
  Link Node Units, 2-10



---

- Ring Node Cabinet (Continued)
  - Node Processor, 2-17
  - Ring Peripheral Controller Node, 2-17
  - Small Computer System, 2-20
  - T1 Facility Access, 2-26
  - Universal Link Node Circuit Packs, 2-24
- Ring Peripheral Controller Node, 2-17, 6-22
  - Circuit Packs, 2-17
  - defined, 6-3
  - Ring Interface, 2-17
- Routing, 3-10, 3-24, 3-30
  - D-Channel and Special Access Data Channel Signaling Link, 3-24
  - International Link Node Signaling Link, 3-30
- RPC Node Performance, 5-105

## S

- SADC Node, defined, 1-15
- Scheduler Table, 5-149
- Scheduling and Control, 6-81
  - Audits, 6-81
  - Equipment Configuration Database (ECD), 6-82
- Scheduling Routine Audits, 6-85
- Scope, 2
- SCSI Node, defined, 1-16
- Session Layer, 4-6
- Signal Transport Footprint Standardization with 4ESS™ Switch, 1-14
- Signaling Connection Control Part, 4-8
- Signaling Equipment,
  - Performance, 5-99
  - Equipment Report, 5-99
- Signaling Link, 6-41, 6-43, 6-44, 6-55, 6-96, 6-97
  - Alarms, 6-41
  - Backup, 3-18
  - D-Channel Management, 6-55
  - Failure, 6-44
  - Hardware Indicators, 3-9
  - Hardware Options, 3-10
  - Maintenance, 6-55
  - Management, 6-55, 6-96, 6-97
  - Performance, 5-95
  - Process Characteristics, 6-40
  - States, 3-7, 3-8, 3-18, 6-43
  - Trouble Conditions, 6-44
  - Trouble Detection Mechanisms, 6-41
  - International Link Node, 3-25
  - Special Access Data Channel, 3-18
- Signaling Link Tests, 3-21, 3-29
  - Ethernet Interface Node, 3-36
  - International Link Node, 3-29
  - Small Computer System Interface Node, 3-33

---

Signaling Link Tests (Continued)  
    Special Access Data Channel, 3-21  
    Transitions, 3-7, 3-20, 3-28  
Signaling Links, 2, 3-1, 3-2, 3-14, 3-25  
    CCS7 States, 3-7  
    Common Channel Signaling 7 (CCS7), 3-2  
    D-Channel, 3-14  
    D-Channel Backup, 3-18  
    International Link Node (ILN), 3-25  
    International Link Node Signaling Link Routing, 3-30  
    LI4D Link Interface, 3-15  
    LI4S Link Interface, 3-16  
    Loopback Test, 3-30  
    Routing, 3-10  
    Small Computer System Interface Node (SIN), 3-31  
    Special Access Data Channel, 3-14  
Signaling Load, 5-88  
Signaling Network, 5-87, 6-43  
    CCS7 Signaling Load, 5-88  
Signaling Network Performance, 6-43  
    CCS7 Signaling Link, 5-95  
    Loss of Signaling Capability, 5-95  
    Measurements, 5-88  
    PBX Signaling Link, 5-95  
    Report, 6-43  
    Report, Part 1, 5-87  
    Report, Part 2, 5-94  
    Signaling Equipment Report, 5-99  
Signaling Network, Common Channel,  
    Critical Events, 5-116  
Signaling Performance, 5-88, 5-93  
Signaling Point Isolation, 6-44  
    Defined, 6-44  
Signaling Transport, 3-3  
    Cabinet, 2-41  
    Footprint Standardization, 1-13  
Signaling Transport Frame (STF), 1-13, 2-41, 3-3  
    Cabinet, 2-41  
    Equipment Connection, 3-6  
    Golden Path Project, 2-43  
    High Speed Links, 2-42  
    High Speed Links Encryption, 2-43  
    Single Signaling Termination Element, 2-42  
Signaling-Link Maintenance, 6-96  
    International Link Node, 6-96  
Simplified Common Channel Signaling (CCS) Network, 4-3  
Single Node Isolation, 1-22  
    defined, 6-6  
Single Signaling Termination Element, 2-42  
Small Computer System Interface Node (SIN), 3-1, 2-20, 3-31  
    Links, 3-1, 3-32

---

Small Computer System Interface Node (SIN) (Continued)  
    Hardware Configuration, 3-31  
    Measurement Reports, 6-96  
    Signaling Link, 3-33  
    Signaling Link Management, 6-96  
    States, 3-32  
Small Computer Systems, 6-96  
    Interface Node, 6-96  
    Interface Node Maintenance, 6-96  
Small Scale Integration, 2-20, 2-21  
Software:,  
    Architecture, 1-5  
    Subsystem, 1-7  
    Functions, 1-7  
Sources, 5-3  
    Measurements, 5-3  
Special Access Data Channel, 3-14, 3-18, 3-21, 6-55, 6-57  
    Block Diagram, 3-16  
    Critical Events, 6-56  
    Defined, 6-55  
    Interprocess Message Switch, 6-56  
    Measurement Reports, 6-56  
    Node, 2-23  
    Ring Initialization, 6-57  
    Signaling Link Maintenance, 6-55  
    Signaling Link States, 3-18  
    Signaling Link Tests, 3-21  
    Signaling Links, 3-14  
    Trouble Conditions, 6-55  
Specific High-Speed Link T1 Test Request Page, 6-39  
SS7 Satellite Nodes using BEC Feature,  
    Increased Buffer Size, 3-37  
Standards:,  
    Signaling Transport Footprint Standardization, 1-13  
States, 3-25, 3-32, 3-35, 6-16, 6-43  
    Ethernet Interface Node Link, 3-35  
    Signaling Link, 6-43  
    Small Computer System Interface Node Link, 3-32  
Static Data, defined, 1-25  
Status Page, 6-36  
    API/DLN Stream (1107), 6-36  
    AT&T Trigger Platform (ATP) (1109), 6-38  
    Display Page 1108, 6-37  
    Ring Node (1106), 6-35  
    Specific High-Speed Link T1 Test Request Page, 6-39  
    Summary Page (1105), 6-34  
Subsystem, 1-5, 1-6  
    Components, 1-4  
    Initialization, 6-56  
Summary Page (1105), 6-34  
System Description, 1-10

---

- System Diagnostics, 6-62
- System Initializations, 5-104
- System Integrity, 1-2
  - Monitor, 6-82
- System Operation, 1-18
  - Common Network Interface, 1-18
  - Multiple Node Isolation, 1-22
  - Node OOS-Quarantined, 1-22
  - Ring Down, 1-22
  - Single Node Isolation, 1-22
  - Unexplained Loss of Token, 1-22
- System Reliability Features, 1-23
  - Critical Node Restore, 1-24
  - Full Process Initialization, 1-23
  - Node Initialization, 1-23
  - Protected Application Segment, 1-25

## T

- T1 Facility Access (T1FA), 2-26, 6-26
  - Circuit Pack, 2-26
- T1 Measurement Descriptions, CNI 11.4 and Later, 5-76
  - Maintenance, 6-26
- Tables:
  - All-Test-Passed (ATP) Status Page Commands, 6-38
  - Alphabetical Index of Measurements (CNI, IMS, PBX, T1, HSA, and ESF), 5-10
  - AT&T 2556 Digital Service Unit Options, 3-13
  - AT&T 500B Digital Service Unit Options, 3-11
  - Audit Abort Codes, 6-89
  - Audit Execution Sequence, 6-84
  - Automatic Ring Recovery Response to Isolation and CP Maintenance States, 6-20
  - CCIS 6 to CCS7 Measurement Correspondence, 5-9
  - CCS7 Common Network Interface (CNI) Measurement Descriptions, 5-40
  - Central Processor Functions, 1-8
  - Channel Service Unit Options, 3-13
  - Common Channel Signaling (CCS) Network Critical Event (CNCE) Descriptions, 5-117
  - Common Channel Signaling 7 Protocol Layer Identification, 4-7
  - Common Channel Signaling 7 Protocol Layers Equivalency to Open Systems
    - Interconnection Model Layers, 4-7
  - Common Network Interface Trouble Indicators and Analysis — Audible Alarms, 6-32
  - Common Network Interface Trouble Indicators and Analysis — Output Messages, 6-30
  - Common Network Interface Trouble Indicators and Analysis — Visual Alarms, 6-31
  - Critical Event, 5-130
  - DATATEL\* Digital Service Unit Options, 3-12
  - DGN Message Input Variations, 6-63
  - DLN Capacity Figures 4E19/22 Generics, 2-20
  - Environmental Limits, 2-5
  - Extended Super Frame (ESF) Error Count Description, CNI 11.4 and Later, 5-79
  - High Speed Link (1.544) Measurement Descriptions, CNI 11.4 and Later, 5-77
  - Initial Critical Event Table, 5-132
  - Initial Exception Table, 5-143

---

Tables: (Continued)

- Initial History File Descriptor Table, 5-149
- Initial Scheduler Table (Notes 1 through 4), 5-154
- Interprocess Message Switch (IMS) Measurement Descriptions, 5-16
- Node Processor Functions, 1-9
- OP:RING** Input Message Variations, 6-63
- Open Systems Interconnection (OSI) Model Layer Identification, 4-5
- Parameter Values for 56 Kbps Links in a Linkset, 3-38, 3-39
- Physical Node Address (Hexadecimal Representation), 6-77
- Physical Node Addresses (Decimal Representation), 6-69
- Physical Node Identification (Decimal Representation), 6-65
- Physical Node Identification (Hexadecimal Representation), 6-73
- Private Branch Exchange (PBX) Measurement Descriptions, 5-68
- Report Generators, 5-150
- Signaling Link State Transitions, 3-7, 3-20, 3-28
- T1 Measurement Descriptions, CNI 11.4 and Later, 5-76
- TF5 Digital Service Adapter Options, 3-14

Temperature, 2-4

- Environmental, 2-4

Tests:, 3-24

- Ethernet Interface Node Signaling Link, 3-36
- International Link Node Signaling Link, 3-29
- Link Check, 3-24, 3-29
- Link Check Internal, 3-21, 3-29
- Loopback, 3-24, 3-30
- Small Computer System Interface Node Signaling Link, 3-33
- Special Access Data Channel Signaling Link, 3-21

TF5 Digital Service Adapter Options, 3-14

Thirty-Minute Marginal Performance Report, 5-109

TN1803, 2-26

TN915/TN1506/TN1509, 2-26

TN918/TN1508, 2-26

Total Office, 5-5

- Measurements, 5-5

Transaction Capabilities, 4-8

Transport Layer, 4-6

Trouble Conditions, 6-44, 6-45, 6-55

- D-Channel, 6-55
- Link Set Failure, 6-44
- Signaling Link Failure, 6-44
- Signaling Point Isolation, 6-44
- Special Access Data Channel, 6-55

Trouble Detection Mechanisms, 6-41

- Signaling Link, 6-41

Trouble Indicators, 6-24, 6-28

- Audible Alarms, 6-28
- Display Pages, 6-28
- Office Alarms Indications, 6-24
- Output Messages, 6-29
- Trouble Indications, 6-24
- Visual Alarms, 6-28

---

Typical Ring Node Cabinet Layouts, 2-7  
Typical Signaling Transport Frame (STF), 2-41

---

## U

- Unexplained Loss of Token, 1-22
- Unit (AC), 2-38
- Unit Processing,
  - No Message Signal, 5-105
- Universal Link Nodes, 2-25, 6-46, 6-50, 6-54
  - Circuit Packs, 2-24
  - Feature Capabilities, 6-50
  - Maintenance, 6-54
  - Maintenance Philosophy, 6-48
  - Philosophy, 6-48
- User View Descriptor Table, 5-135

## V

- Visual, 6-28
  - Alarms, 6-28
  - Indicators, 6-15