LEC 4ESS™ Switch PRI Services and Implementation Manual

234-090-115
Issue 2, June 1993

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Chapter 1
Introduction

Overview

Organization of This Chapter

This chapter gives a brief description of the Integrated Services Digital Network (ISDN) and how it relates to the Local Exchange Company (LEC) 4ESS™ switch capability. This chapter previews the contents of this document, explains conventions used in this manual, how to get support for possible ISDN problems, and how to make comments about this document.

About This Document

Contents

The *LEC 4ESS™ Switch PRI Services and Implementation Manual* includes the following:

- Gives an overview of the LEC 4ESS™ switch ISDN capability.
- Describes the base capability of the ISDN feature set; explaining what each feature is, how each feature works, and how the features interact.
- Describes the Primary Rate Interface (PRI) architecture and its components, for example, channels, nodes, connections, and processors.
- Provides a description for setting up hardware components and configuring software at the LEC 4ESS switch locations.
- Provides Operations System (OS) impacts that explain how each site can do maintenance and testing once the ISDN service is in place.
- Provides testing and troubleshooting information.
- Provides billing information.

Intended Audiences

The primary audience for the *LEC 4ESS™ Switch PRI Services and Implementation Manual* is ISDN support personnel at the LEC sites. The secondary audience for the document is the managerial or supervisory personnel making planning decisions for the LEC sites as to which ISDN features are most appropriate for their needs.

Prerequisite Skills and Knowledge

To use this document effectively, you should have a familiarity with the following:

- 4ESS switching concepts and practices
- general ISDN concepts

Document Description

Overview	This section briefly describes each chapter in the document.
Chapter 1	**"Introduction"** This chapter provides an overview of the contents of the document, explains conventions used in the document, lists related documentation, and explains how to get customer support and how to make comments about the document.
Chapter 2	**"Overview of the LEC 4ESS Switch ISDN Capability"** This chapter explains the ISDN features specific to the LEC 4ESS switch. The chapter will be a high-level overview of what the features are, how they relate to one another, and how the ISDN capabilities benefit the customer.
Chapter 3	**"LEC 4ESS PRI Architecture"** This chapter explains what the 4ESS PRI architecture is and how it works. It provides information on the physical characteristics of the 4ESS switch, and explains in greater detail the purpose of the various features of the PRI architecture and how they interrelate.
Chapter 4	**"Implementation"** This chapter describes how to provision the various ISDN features and components, both hardware and software, to design and set up your network or database, and to add customer channels. It provides a general representation of how to provision the LEC 4ESS switch ISDN features.
Chapter 5	**"Maintenance and Testing"** This chapter explains the types of maintenance and testing that needs to be done on the D-Channels and B-Channels to ensure that protocols are working correctly and that bits are being carried without errors. Monitored and simulated testing from the 4ESS switch and from the customer site are described. Hardware necessary to perform the testing is listed, and troubleshooting examples are provided.

Chapter 6 **"AMA/Billing"**

This chapter explains general billing information and defines data fields, structures, and modules. It tells how to build an AMA record, and gives AMA call recording formats for originating and terminating calls. The seven AMA tables for both Inter-LATA and Intra-LATA calls are shown.

Conventions Used in This Document

Overview

Type is a combination of typeface (for example, Palatino or Helvetica) and font (for example, regular, **bold**, *italic*). This section explains type conventions used in this document.

Headings Type

Helvetica Bold type is used for all levels of headings, including chapter titles, headings at the top left of a page (for example, "Conventions Used in This Document"), headings in the left-hand margin of each page (for example, "Headings Type"), and headings within blocks of information on the right-hand side of a page.

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Palatino Regular type is used for the text of this document.

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The three kinds of type you will see used in this document are as follows:

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- **`Constant Width Bold`** type is used for user input when that input is set off in a display or in a sequence of steps (User input tells readers what to enter at the keyboard.)
- *Palatino Italic* type is used for user-specified (substitutable) elements.

Document Titles Type

Palatino Italic type is used for all document titles, for example, *LEC 4ESS™ Switch PRI Services and Implementation Manual*.

Related Documents

Overview

There are many informative documents and manuals on 4ESS switching and ISDN that you might find useful. A source for ordering such documents is the Customer Information Center (CuIC).

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4ESS switch documentation, as well as ISDN documentation, is distributed through CuIC. To place a documentation order, or to obtain a catalog listing current CuIC offerings, call the following number:

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Chapter 2
Overview of the LEC 4ESS Switch ISDN Capability

Introduction

Overview

This chapter explains what Integrated Services Digital Network (ISDN) is, the components that make it up, and the features specific to the Local Exchange Company (LEC) 4ESS switch. It gives a high-level overview of what the features are, how they relate to one another, and how the ISDN capabilities benefit the customer.

Organization of This Chapter

Topics in this chapter include the following:

What is ISDN?

Introduction

Overview

This section gives a high-level overview of ISDN, the Primary Rate Interface (PRI), and the customer channels. This is intended as an introduction for less experienced users. More detailed information can be found in the next section, "Basic PRI Capabilities," where each of the components that make up ISDN and the PRI are described separately, and in greater detail.

In This Section

Topics in this section include the following:

ISDN Defined

Definition of ISDN

The Integrated Services Digital Network (ISDN) is an overall architecture under which telecommunications services and networks will be digitized from their inception in the end-user's instrument, and then integrated. ISDN is defined as a set of standards which allows the integration of voice and data on the same facility. Whatever services are desired by the customer (voice, data, video) will come via the same connection to the network and can be used simultaneously over that connection.

The 7 Layers of Protocol

There are seven layers of protocol in the Open Systems Interconnection (OSI) architecture. The interface between layers is on a peer basis; that is, each layer only communicates with the layer above it and the one below it. The PRI provides the first three layers of protocol (physical, data link, and network) and layers four through seven are for the customer to switch interface.

The following table shows the layers of the tasks performed in data communications:

Layer	Description
(1) Physical	Concerned with transmission of unstructured bit stream over physical medium. Deals with the mechanical, electrical, functional, and procedural characteristics to access the physical medium.
(2) Data Link	Provides for the reliable transfer of information across the physical link. Sends blocks of data (frames) with the necessary synchronization, error control, and flow control.
(3) Network	Provides upper layers with independence from the data transmission and switching technologies used to connect systems. Responsible for establishing, maintaining, and terminating connections.

Continued on the next page

Layer	Description
(4) Transport	Provides reliable, transparent transfer of data between end points. Provides end-to-end error recovery and flow control.
(5) Session	Provides the control structure for communication between applications. Establishes, manages, and terminates connections (sessions) between cooperating applications.
(6) Presentation	Provides independence to the application processes from differences in data representation (syntax).
(7) Application	Provides access to the Open Systems Interconnection (OSI) environment for users. Provides distributed information services.

Characteristics of ISDN

The essential characteristic of ISDN is to present an integrated services interface to the end-user.

ISDN is a network providing end-to-end digital connectivity to support a wide range of telecommunications services. The characterization of ISDN centers on three main areas

- The standardization of services offered to users to enable services to be internationally compatible.
- The standardization of user-network interfaces to enable terminal equipment to be portable.
- The standardization of ISDN capabilities to the degree necessary to allow user-to-network and network-to-network interworking.

What Makes ISDN So Advanced?

ISDN builds on major new technological capabilities that are already available or being deployed in our telecommunication network: digital links (including lightwave) and stored program machines, and also capitalizes on our emerging intelligent networks. In signaling, it is important because it defines open standard interfaces, whereby machine intelligence under the customer's control can interact at machine speeds with the intelligence in and across the public networks. ISDN is a very flexible tool for serving customer needs as and when they develop. It allows customers to adopt various products and services to customize their own network.

Primary Rate Interface Defined

Introduction

The two most important customer interfaces are the Basic Rate Interface (BRI) and the Primary Rate Interface (PRI).

Definition of BRI

The BRI consists of a multiplexed combination of 2 B-Channels and 1 D-Channel, and is known as the "2B+D" interface. In BRI, the B-Channels may carry digitized voice or data. The D-Channel is used for signaling (in support of the B-Channels) and for packet switching.

Definition of PRI

The PRI is the interface between the user and the network to access ISDN. The PRI consists of 23 B-Channels and 1 D-Channel. The B-Channels transport end user information, and the D-Channel is the signaling channel that controls the B-Channels.

NOTE: Only the PRI is available on the 4ESS switch.

Channels Defined

Introduction

Customer information is carried over several different types of digital channels. The Consultative Committee for International Telephone and Telegraph (CCITT) standardizes and defines ISDN interfaces (such as BRI and PRI), the channels they carry, and the way in which the channels are multiplexed.

Channels and the Purpose of Each

The following channels are most significant to ISDN:

Channel	Purpose
B-Channel (64 Kbps)	• Carries user information (defined as information intended for transfer from one end-user to another, and not analyzed by the transport mechanism). • Carries circuit switched or packet switched data.
D-Channel (64 Kbps)	Carries signaling to support circuit switched calls as well as packet switched packets.
H0-Channel (384 Kbps)	• Intended for video, fast data, high-quality audio, and similar applications. • Defined as a multiplexed combination of six information streams at 64 Kbps each.
H11-Channel (1536 Kbps)	• Intended for applications similar to those of the H0-Channel. • Defined as a multiplexed combination of 24 information streams at 64 Kbps each.

Basic PRI Capabilities

Introduction

Overview

The AT&T 4ESS switch PRI is a special access interface to ISDN services off the 4ESS switch. Figure 2-1 illustrates the AT&T 4ESS switch ISDN Network Architecture.

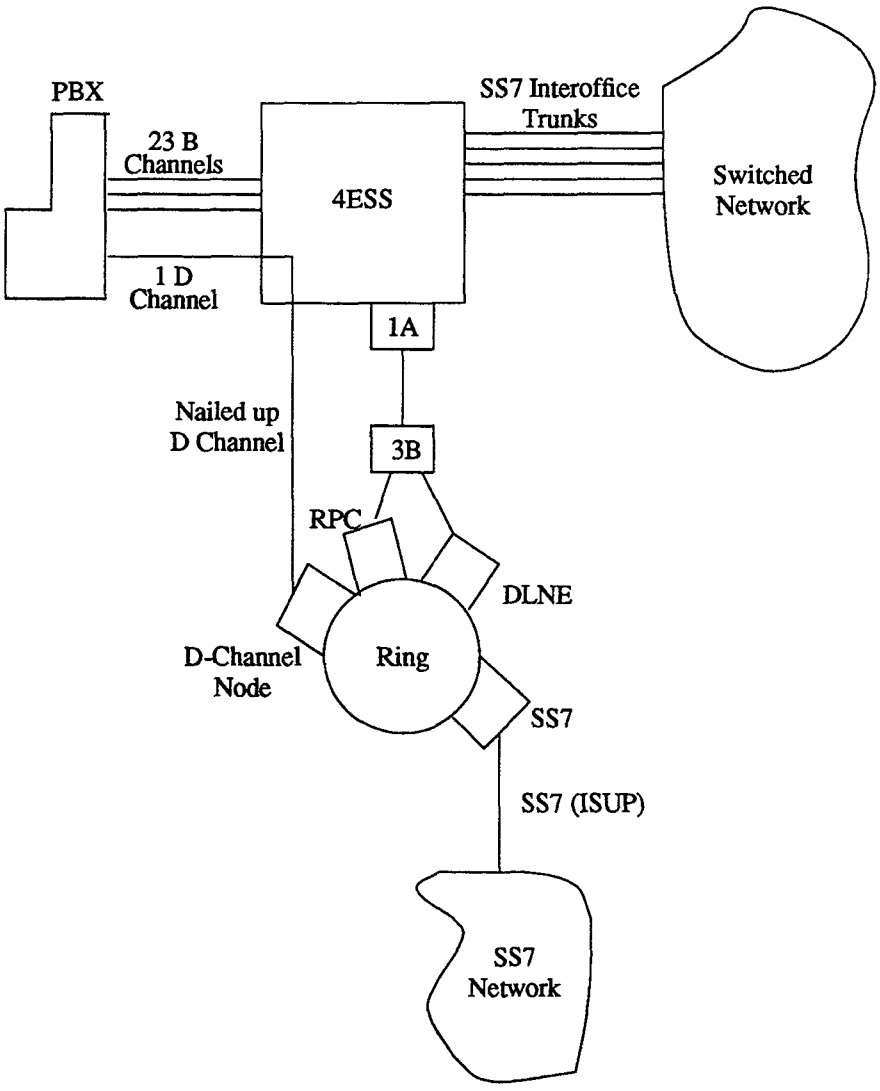


Figure 2-1. 4ESS Switch ISDN Network Architecture

Primary Rate Interface

ISDN capabilities allow for access to multiple services using shared, rather than dedicated, facilities.

The ISDN Primary Rate Interface (PRI) is a 1.544 Mbps Digital Interface consisting of the following:

- Bearer (B) Channels for the transport of end-user information (for example, voice and data).
- A Signaling (D) Channel for the control of the B-Channels and transport of end-user information.

What the PRI Consists of

The AT&T 4ESS switch ISDN customer PRI includes 23 B-Channels that provide for the transport of voice and data services, and one customer-to-network communications channel called the D-Channel. This configuration is known as 23B+D. A customer's access configuration may include multiple PRIs (23B+D) and/or multiple DS-1 facilities (24B) supported by one or more D-Channels.

B-Channels provide 64 Kbps Clear (C) capability. D-Channels contain B-Channel signaling information and customer and network data messages. A single D-Channel may support more than 23 B-Channels.

D-Channels are nailed up from the CPE through the 4ESS switch to the T1 Facility Access (T1FA)/D-Channel node termination on the Common Network Interface (CNI) Ring. The CNI Ring routes messages to their appropriate destinations for processing.

In This Section

Topics in this section include the following:

D-Channel OOB Signaling

Introduction

D-Channel Out-Of-Band (OOB) signaling provides a signaling interface between the 4ESS switch and the Customer Premise Equipment (CPE). This interface supports the CCITT Standard Q.931 Layer 3 signaling protocol. OOB signaling is a major feature of ISDN. It transmits address, supervisory, and other control signals of the information transport channel over a separate transmission channel in message format.

OOB signaling employs data links, distinct from voice paths, to transfer information from switch to switch.

Advantages of OOB Signaling

The following are some advantages of OOB signaling:

- OOB signaling is much faster than in-band signaling. Trunks are used more efficiently.
- A single, common data channel is used for the signaling for many different trunks. Trunks are no longer tied up.
- Security is enhanced since network signaling is done over a separate channel.
- Since the signaling message is in the form of a computer data message, the information can be put in memory and processed directly.

Q.931 Protocol

The Q.931 protocol is a CCITT recommendation describing D-Channel user-network messages for basic call control. Basic message types include the following:

- `SETUP`
- `ALERTING`
- `CONNECT`
- `CONNECT ACKNOWLEDGE`
- `DISCONNECT`

This protocol, used over the D-Channel, does the OOB signaling and controls other trunks on the network.

NFAS

Definition of NFAS

Prior to ISDN, all customer-to-network signaling was inband, meaning each access channel carried its own signaling.

With ISDN, the interface bandwidth between the customer premise and the AT&T 4ESS Switch Network Service Node is one or more DS-1 at 1544 Kbps, (commonly referred to as the PRI). The PRI is divided into B and D Channels. Signaling for more than one T1 with one D-Channel is referred to as Non-Facility Associated Signaling (NFAS). The D-Channel carries OOB signaling for B-Channels as well as embedded user information.

The NFAS arrangement exists to better serve ISDN wideband customers. It is a signaling arrangement that allows 1 D-Channel to signal for multiple T1s. You can select the signaling arrangement for your NFAS T1 access between any D-Channel.

How NFAS Works

The basic concept behind NFAS is that you can now select the signaling arrangement for your NFAS T1 access between any D-Channel. The inclusion of this signaling arrangement is for you to better utilize the T1 channels for multiple applications, for example, six channels associated with wideband are signaled for by one D-Channel and the remaining 17 channels are utilized by another application being signaled for by a different D-Channel.

Example: How to Arrange NFAS

Based on the above scenario, one example of how to arrange NFAS follows:

There are three PRIs and two D-Channels. The first PRI has only voice service, the second has wideband and voice service, and the third has data services. The D-Channels exist on the first and third PRIs.

Under the NFAS arrangement, the B-Channels on the second PRI can be signaled for between these two D-Channels. The wideband B-Channels can utilize the D-Channel on the third PRI and the voice services can utilize the D-Channel on the first PRI.

64 Kbps C Circuit Switch Capability

Introduction

The 4ESS switch has a 64 Kbps Clear (C) circuit capability.

With 64 Kbps Clear, you can send any combination of bits over the network that you want. End-user equipment does not have to ensure against specific bit combinations (for example, eight consecutive 0s).

Zero Code Suppression Formats

Pulse density constraints apply to all DS-1 signals, regardless of the framing format used. The pulse density constraints are:

- no more than 15 consecutive zeros allowed
- for every time window of $8x(n+1)$, where n can be 1 - 23, there should be as many "ones" pulses as there are n channels.

This means that there must be at least 23 ones for each block of 192 bits. Failure of the customers data equipment to conform to this pulse density constraint will result in the Network equipment adding occasional ones to the customers bit stream. This will appear as errors or synchronization problems to the far end Customer Premise Equipment (CPE). Zero Code Suppression (ZCS) or the ones pulse density rule is enforced by requiring the customer to have at least 1 one in every 8 bit word transmitted. This will only permit the customer to transmit data at the 64 Kbps Restricted rate.

B8ZS

Clear channel capability will be obtained on DS-1 systems designed for transmission over a bipolar medium using Bipolar with 8 Zero Substitution (B8ZS) coding.

With B8ZS coding, each block of eight consecutive zeros is removed and the B8ZS code is inserted in their place. If the pulse preceding the inserted code is transmitted as a positive pulse (+), the inserted code is (000+-0-+). Bipolar violations occur in the fourth and seventh bit position of the inserted code. If the pulse preceding the inserted code is a negative pulse (-), the inserted code is (000-+0+-).

To decode B8ZS coded signals, equipment receiving DS-1 signals should continuously monitor the incoming DS-1 level for B8ZS coded words. When a B8ZS word is detected, it should be replaced with eight zeros.

NOTE: ZCS and B8ZS are supported by the SM9 circuit packs.

Advantages of 64 C

ISDN customers have the capability to transmit up to 64 Kbps of data, rather than the 56 Kbps possible with all other service configurations. The increase in capacity is the result of greater network utilization available with ISDN technology.

A 64 C arrangement permits an additional 8 Kbps of data to flow over the channels in a T1 pipe. Either transmission speed (56 or 64 Kbps) is possible with this arrangement. You can control the transmission speed through terminal equipment.

D-Channel Backup

Introduction

The D-Channel Backup feature provides network reliability to customers by controlling B-Channel signaling in the event that one (the primary) D-Channel fails. Multiple links can increase the availability of a working connection.

How D-Channel Backup Works

One of the D-Channel links is the "in-service" or "primary" link. The other link of the D-Channel pair is the "backup" or "secondary" link. A backup link is normally in the "standby" state, meaning it is established at the link layer (level 2). If an in-service D-Channel link fails, call control is switched to the backup link.

The primary and backup D-Channels should be provisioned on a separate T1 facility so that no single power failure will isolate both a primary and secondary D-Channel.

See Figure 2-2 for a simple diagram of how D-Channel Backup works.

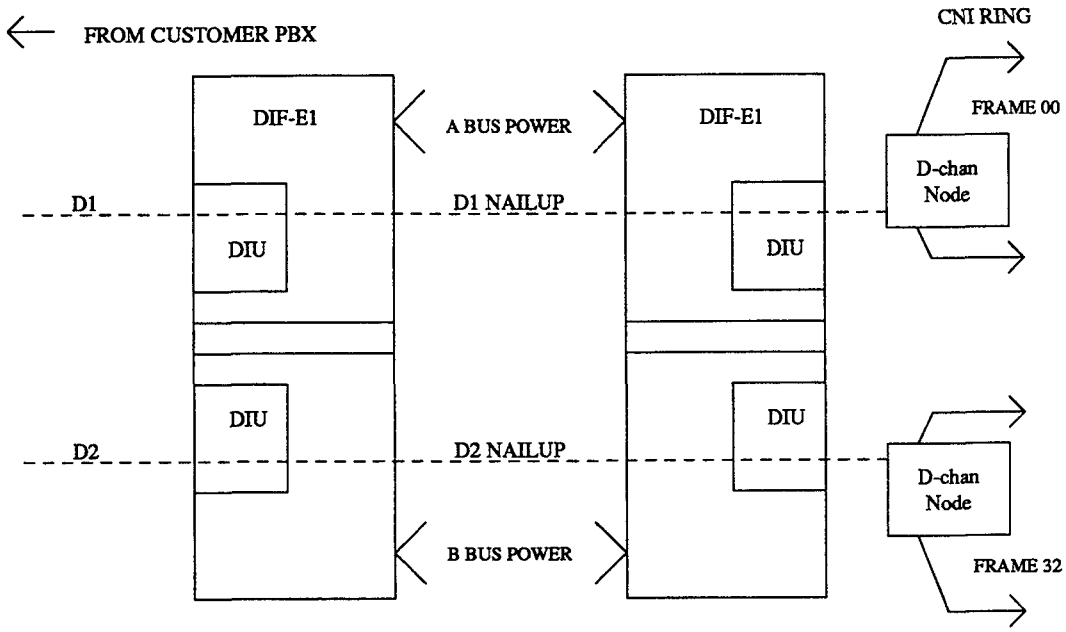


Figure 2-2. How D-Channel Backup Works

Channel Negotiation

Description

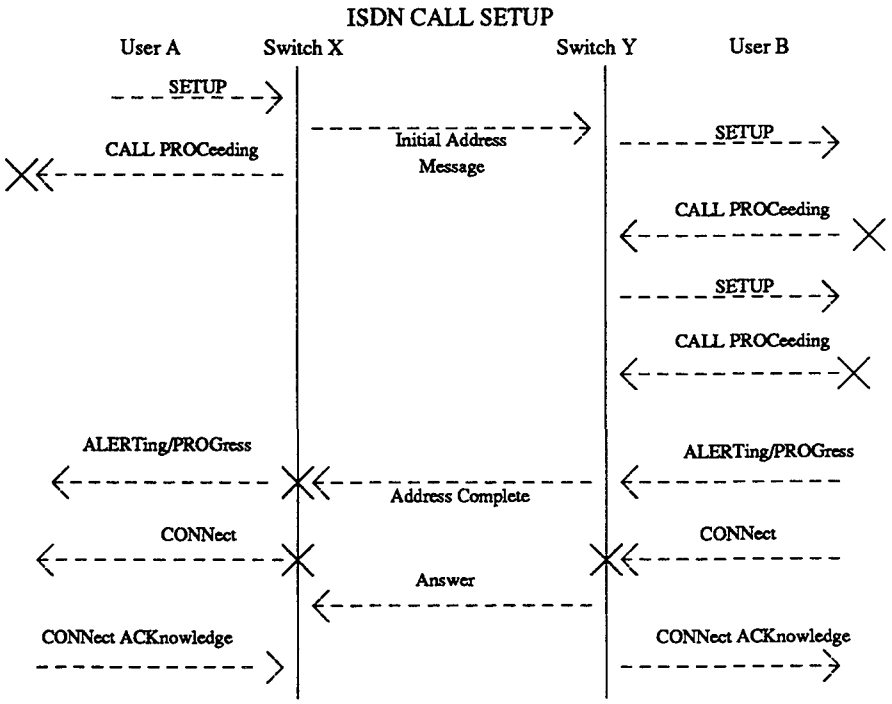
Channel negotiation allows the egress PBX to choose an alternate B-Channel on calls it receives. This allows the Customer Premise Equipment (CPE) to reserve channels for special call setups, such as H0 or H11 services.

Channel negotiation is performed by the CPE responding to an incoming Q.931 `SETUP` message with a `CALL PROCeeding` message with indication of channel negotiation and the channel on which the call will be accepted.

How Channel Negotiation Works

Channel negotiation is implemented on a per-customer D-Channel basis. It applies only to network switched B-Channels controlled by a common D-Channel. Only the CPE is allowed to suggest alternate channels. Channel negotiation can be used only to negotiate to another channel within the same Trunk SubGroup.

See Figure 2-3 for an example of channel negotiation.



NOTE: The "X"s in the figure represent B-Channel cut-through.

Figure 2-3. Channel Negotiation

Note

AT&T Definity® (System 85) Release 4 and later supports channel negotiation. The 4ESS Switch supports this, but, this does not mean that all CPEs will.

Example of Channel Negotiation

If you wanted to reserve a channel for a video-teleconference at 2:00 p.m., you could use channel negotiation to reserve an H0 channel for that particular time. All other calls would be routed to other channels.

ISDN Features

Introduction

Overview

This section will discuss some of the features and capabilities of ISDN available for the LEC 4ESS switch sites.

In This Section

Topics in this section include the following:

Calling Party Number Feature

Description of CPN Feature

The Calling Party Number (CPN) feature delivers the calling party's number to the receiving end of the transmission. It is the number that would be dialed to reach the station from which the caller is calling. The CPN is also known as the Station Identification (SID). A Billing Number (BN) is associated with a caller's line or trunk, and is also known as Automatic Number Identification (ANI).

NOTE: For a residential line or a single business line, the CPN and the BN are the same number.

How CPN and BN Work

In different scenarios, CPN, BN, or both, get delivered as a call gets completed through the network. The CPN and the BN are delivered through the network on ISDN calls. CPN or BN get delivered to the end-user under different circumstances, depending on local regulations, LEC policy, and technical capabilities. For example, if privacy is enabled on the originating call, the CPN and/or the BN is not delivered to the end-user.

CPN Applications

The following is a brief list of end-user applications of CPN. While delivery of CPN is single service under ISDN, many end-user applications are driven by this single service. The list of end-user applications is unlimited.

- Voice data applications — Incoming voice numbers can be associated with a data record. The voice call and the data record can then be sent to a waiting agent by customer equipment.
- Customer Service/Order Entry — Receipt of CPN by an ISDN business location provides automated retrieval of calling customer records prior to delivering the call to a call agent. CPN is delivered to the ISDN direct connect business via Q.931 protocol. End user equipment can use the CPN and access customer data base prior to answering call. The customer record and call can be transferred to call agent (or customer specific call agent) at the same time. This allows the agent to efficiently answer the call since the customer's information is immediately available.
- Dealer Locator Services — Provides information on the nearest dealer location in proximity to a calling customer. Prior to ISDN CPN delivery, call agents would have to ask customers where they were calling from and manually look up the nearest dealer

location to that customer. With CPN delivery, this process can be automated in a way similar to Customer Service/Order Entry, allowing more efficient handling of the call.

- Call Back Logging/Demographics —

  Call Back Logging: During peak traffic periods, business's are unable to answer all incoming calls due to busy facilities. Unanswered calls represent potential loss of business since the customer may call a competitor or never call back. With ISDN, direct connect business locations can receive and store CPN even if all call agents are busy. Logging CPNs in this manner allows the business to call back customers at a later time thereby averting a potential loss of business.

  Demographics: Logging CPN also provides business's with a demographic capability to "track" incoming calls for marketing uses.

- Work-at-Home Programs/Terminal Security — For work-at-home applications where employees dial up into company computer networks, CPN delivery can be used to provide terminal security. Employee phone numbers are stored in the company computer system and used with the CPN delivery capability to screen incoming requests for connection. This way only calls from "authorized" locations are accepted by the computer system.

Examples: How CPN Works for End-Users

- From an end-user point of view, if you are a supervisor with employees using a "work at home" application, you want your systems accessible only to authorized personnel. You can set up screening on your 4ESS switch that will route or block calls to the system based on the CPN.
- CPN can also be used for data records. If you order merchandise through a catalog, your phone number will be in that company's database. When you call to place an order, your phone number (the CPN) will register on the receiving end, and bring up a data record containing pertinent information such as your home address, credit card number, and shipping information. The salesperson taking your order will only need to verify the information with you, not re-enter it into the database.

MA-UUI Feature

Description of MA-UUI Feature

The Message-Associated User-to-User Interface (MA-UUI) feature of ISDN supports Out-Of-Band (OOB) data connections between two ISDN users. MA-UUI refers to the user-to-user information that may be placed in the User-to User Information Element (UUI IE) in the Q.931 call control messages, such as `SETUP`, `ALERTING`, `CONNECT`, or `DISCONNECT`. The IEs are transported end-to-end via SS7/Network Interconnect ISUP. MA-UUI contains user information such as Calling Party Number, Calling Party Number Sub Address, Called Party Number, High Layer Compatibility, Low Layer Compatibility, etc. This capability allows customers to send and receive up to 196 octets of user information in normal call setup and clearing messages between two ISDN locations.

MA-UUI is a part of the ISDN User Part (ISUP) signaling function required to provide voice and data services to the end user.

See the section, "D-Channel OOB Signaling," in this chapter, for descriptions of OOB Signaling and Q.931 protocols.

Support of MA-UUI on a Call

The support of MA-UUI on a call depends on the availability of appropriate network resources and the capabilities of the Terminating Equipment (TE). When the terminating user is non-ISDN, any MA-UUI in the message will be dropped, but, the network will still attempt to complete the call.

Examples: How MA-UUI is Used

- An example of how MA-UUI can be used is during a credit card transaction at a grocery store. When the customer hands a credit card to the cashier, the cashier runs the magnetic strip of the credit card through a special "reader". This machine reads the data, and transfers it to a facility on the receiving end where the data is read and analyzed. A message is then sent back to the originator, approving or disapproving the purchase, based on credit information.

- Check verification is another way that this feature is used. After an account number is entered in the cash register/terminal, the number is sent to a facility on the receiving end where the data is read. The account number is checked against a list of account numbers against which bad checks have been written. The list is checked, and the information is sent back to the originator. The check is accepted or denied, based on the information received.
- MA-UUI can help with computer terminal security. Used with Calling Party Number (CPN) and closed-user group information, it can prevent illegal access to terminals.

ISDN Services

Introduction

Overview

This section describes the Switched Data Service and the Switched 384/1.536 Data Service provided by ISDN PRI.

In This Section

The topic discussed in this section is the following:

Switched Data Service

Description

ISDN Switched Data Service (SDS) is accessible through the 4ESS PRI interface and provides per-call access to bandwidth between 56 Kbps and 1536 Kbps in the network.

Transmission Data Rates

SDS makes use of the 64 Clear capability, which allows you to set up a single circuit connection for applications requiring 64 Kbps data transmissions or less. (See the section, "64 Kbps C Circuit Switch Capability," in this chapter for further information.)

A transmission speed of 56 Kbps or 64 Kbps is possible with SDS. You can control the transmission speed through your terminal equipment.

H0/H11 (Switched 384/1.536 Data Service)

Description of Switched 384/1.536 DS

The H0/H11 (Switched 384/1.536 Data Service) provides clear, end-to-end digital transmission at 384/1.536 Kbps over the LEC 4ESS switch network. It is available, through ISDN PRI, for customers who require on-demand larger bandwidth transmission with connectivity to multiple locations.

Description of H0/H11

The H0/H11 wideband access channels are types of synchronous B-Channels which are defined for information transfer at rates of 384 Kbps (6 trunks x 64 Kbps for H0) and 1536 Kbps (24 trunks x 64 Kbps for H11).

Types of Wideband Services

There are different groups of wideband bearer services available on the PRI of ISDN, each having different options. See the section, "Wideband Signaling," in Chapter 3, *LEC 4ESS PRI Architecture* for more detailed information.

Characteristics of Wideband Signaling

During a communication session, one party will produce or send information, and the other party will receive information. The characteristics of the end-users information are the most important element. It is important to know what kind of information can be received by end-users in a channel with a bandwidth between 128 and 1536 Kbps, because certain requirements must then be met for setting up a system. Some examples follow:

- Audio
- Static Visual Information (text and image)
- Motion Picture (animated image)
- Machine Data

H0/H11 Applications

The H0/H11 service provides the bandwidth necessary to support high-speed data transmissions such as the following:

- High-Speed Data Transfer — The bandwidth capability of Switched Data Service supports many different high bandwidth applications applications such as video-conferencing, medical imagery, bulk file transfers, graphic applications (CAD/CAM), Group 4 Fax, etc.

- Backup of Private Line — Provides a way to load-share data traffic during peak busy periods for customers with dedicated private line networks.

  Switched Data Service also provides Network Managers survival contingency for failed Private Lines. By having the ability to switch traffic from private line over to circuit switch connections in times of private line failure, Network Managers can provide their customers with reliable service. End-user ISDN equipment provides the capability to monitor private line connections. Upon sensing private line failure, the end user ISDN equipment can buffer communications, initiate switched circuit connections in bandwidth ranging from 56 Kbps to 1536 Kbps on the 4ESS PRI, and reestablish communications between users until the private line facilities are restored. Traffic is then switched back to the private line and the circuit-switched connections are terminated.

- Local Area Network (LAN) Bridging/Bandwidth on Demand — Private Line is the backbone of todays computer networks. Network Managers are faced with engineering the private line capacity to meet the needs of their users. Over-engineering private line results in unused bandwidth and wasted money. Under-engineering private line results in unhappy customers. Switched Data Service provides bandwidth on demand offering network managers capacity contingency at a reasonable cost. During peak traffic periods when the private line approaches 100% capacity, additional circuit switched bandwidth can be accessed via 4ESS PRI to provide additional capacity to handle peak traffic loads. As call volumes diminish, the circuit switched connections can be release thus limiting the facility costs to time actually used.

ISUP

Description

The ISDN User Part (ISUP) feature is a flexible layer 4 Signaling System #7 (SS7) protocol used for signaling between switches. To provide a full range of ISDN services and features, the SS7 network must be completed and have all switches connected.

Purpose of ISUP

ISUP encompasses the signaling functions required to provide voice and non-voice services in an integrated services digital network. ISUP connections allow for protocol to protocol conversion within the network.

Facilities that ISUP Supports

In addition to basic telephone service, ISUP also supports the following facilities:

- closed user group
- user access to calling party address identification
- user access to called party address identification
- connect when free and waiting allowed
- completion of calls to busy subscriber
- network access to calling party address identification
- screening list entry validation

Measurements and Reports

Introduction

This section describes what the traffic measurements system is, what its purpose is, and how the information on the reports is used.

Measurement Subclass (MSC) and Output Measurement Sets (OMS) are described, and reference documents are listed.

Purpose

The 4ESS Switch traffic/plant measurement system is concerned with measuring the effects of the telephone traffic presented to the switching system, and the effects of any maintenance conditions.

Collecting measurements and reports serves a wide variety of purposes, for engineers, network managers, and plant managers.

- Engineers use measurements to verify that existing equipment is adequate for present needs, and also to predict future equipment needs.
- Network managers use measurements to determine the control actions necessary to efficiently utilize the network and to evaluate the effects of the various control strategies.
- Measurements are also used to locate equipment irregularities and evaluate the effectiveness of the office's maintenance procedures.

Types of Measurements

Some of the types of measurements available on the LEC 4ESS switch ISDN are as follows:

- Trunk SubGroup (TSG) Measurements — maintains measurements of incoming attempts, outgoing attempts, overflows, and usage for all TSGs.
- Traffic Separations Measurements — maintains measurements of calls by class. All incoming traffic is split into 32 different incoming classes, and all outgoing traffic is split into 64 different destination classes based on the destination code.
- Total Office Measurements — maintains a number of total office counts. These include network seizures, failures, and usage; total incoming calls broken down by signaling type; and total outgoing calls broken down by type of trunk (for example, intertoll versus toll connecting).

MSC/OMS Defined

Measurement Classes (the set of all traffic/plant measurements) are divided into Measurement Subclasses (MSCs). In an MSC, all of the measurements associated with a particular facility or entity are called Output Measurement Sets (OMSs).

When you need to find the output of measurements, you identify those measurements by specifying an OMS within an MSC. Or you can specify the entire MSC to gather information.

List of MSC/OMS for Wideband PRI

The following list gives the MSC number and OMSs for wideband PRI:

- MSC 5/OMS 1
  - Broadband Call 6-Trunk Incoming Seizures (BBC-6 INC SZRE)

    This counter is incremented by one for each H0 (384 Kbps) call seizure processing attempt received.
  - Broadband Call 24-Trunk Incoming Seizures (BBC-24 INC SZRE)

    This counter is incremented by one for each H11 (1536 Kbps) call seizure processing attempt received.
  - Broadband Call 6-Trunk Outgoing Seizures (BBC-6 OUT SZRE)

    This counter is incremented by one when trunk hunt determines enough trunks are available to be seized to process an H0 call.
  - Broadband Call 24-Trunk Outgoing Seizures (BBC-24 OUT SZRE)

    This counter is incremented by one when trunk hunt determines enough trunks are available to be seized to process an H11 call.
- MSC 11/OMS 4
  - Broadband Call Failure Peg Count (BROADBAND FAIL MISC IA)

    This counter is incremented by one for H0 (384 Kbps) or H11 (1536 Kbps) call attempts that fail.

Reference Documents

Translation Guide TG-4, September 1992.

Course Reference

For additional information on machine-generated reports, you may find AT&T Corporate Education and Training (CET) Course ES4010 — *4ESS Switch On-Site Operations Reports* helpful. While it is not ISDN-specific, it contains general information that is useful for creating and analyzing reports.

To register for the course, or for additional information about other courses offered, call +1 800 872 4637.

General CPE Products Compatible with the 4ESS Switch

Introduction

This section lists the Customer Premise Equipment (CPE) products that are available and compatible with the 4ESS switch.

NOTE: The lists are current as of January 1993. For the most current information, please contact your AT&T Account Representative.

CPE Products

Table 1-1 shows the data products compatible with AT&T's ISDN PRI Services, and Table 1-2 shows the products compatible with AT&T's ISDN PRI Features.

Table 1-1. Products Compatible with AT&T's ISDN PRI Services † (Data)

	VENDORS	Switched Data Service				
		56	64R	64C	384	1536
PBX	AT&T Definity® G3V2 (MIPS, 286, 386)	√	√	√		
	AT&T Definity G3i	√	√	√		
	AT&T Definity G3r	√	√	√		
	AT&T Definity G2	√	√	√		
	AT&T MERLIN Legend	√	√	√		
	Fujitsu F9600	√	√	√		
	Fujitsu STARLOG		√	√		
	Harris Corp. 2020	√	√	√		
	Intecom FLEX IM PRI	√	X			
	Intecom IU PRI	√	X			
	NEC NEAX2400 IMS			√		
	Northern Meridian-1	√	X	√		
	Northern MSL-100 (BCS 28)†	√	√	√		
	ROLM 9751	√	X			

√ – Tested compatible for the service
X or "Blank" – Not tested for the service
‡ – Preliminary test result (subject to audit)
† – Product did not undergo the full range of compatibility tests. Only remote testing was conducted

Table 1-1. Products Compatible with AT&T's ISDN PRI Services † (Data) (contd.)

	VENDORS	Switched Data Service				
		56	64R	64C	384	1536
CENTREX	AT&T 5E6	√	√	√		
MUX	Gandalf Access SDX/Starmaster	X	√	√		
	GDC TMS			√	√	
	Timeplex IGS	X	√	√	√	
OTHER	Ascend Multiband Plus	√	X	√	√	√
	Ascend Multiband T/P-1	√	X	√	√	√
	AT&T Conversant R2.1					
	DiAnaTel EasyAccess 24					
	Excel LNX-2000	√	√	√		
	INC CM-384/PRI	√	X	√	√	
	InterVoice VC/D					
	Memorex Telex 6544 MFCC	X	√	√		
	NCR Comten			√		
	Network Sciences Model 231					
	Periphonics VPS 9000/9500					
	Primary Rate, Inc. PRI-48			√	√	
	Promptus T1 Access Module	√	√	√	√	√
	Rockwell CMC, CMC-1800			√		
	Rockwell Galaxy 3000D†	√	√			
	Rockwell Spectrum†‡					
	Summa Four SDS	√	√	√		
	Teleos Network/Video Hubs	√	√	√	√	
	Teleos IRX 9000	√	√	√	√	
	TyLink SNS 400	√	X	√	√	

√ – Tested compatible for the service
X or "Blank" – Not tested for the service
‡ – Preliminary test result (subject to audit)
† – Product did not undergo the full range of compatibility tests. Only remote testing was conducted

Table 1-2. Products Compatible with AT&T's ISDN PRI Features †

	VENDORS	CPN To NETWORK/ CPN/BN to TERM-Subscription/ CPN/BN To TERM - Per call	NFAS	MAUUI	D-Chan Backup	B Chan Neg.
PBX	AT&T Definity® GV32 (MIPS, 286, 386)	√/√/√	√	√	√	√
	AT&T Definity G3i	√/√/√	√	√	√	√
	AT&T Definity G3r‡	√/√/√	√	√	√	√
	AT&T Definity G2	√/√/X	√	√	√	√
	AT&T MERLIN Legend	√/√/X				√
	Fujitsu F9600	√/√/X				
	Fujitsu STARLOG	X/√/X				
	Harris Corp. 2020	√/√/X		√		√
	Intecom FLEX IM PRI	√/√/X		√		
	Intecom IU PRI	√/√/X				
	NEC NEAX2400 IMS	√/√/√		√		
	Northern Meridian-1	√/√/X	√	√	√	
	Northern MSL-100 (BCS 28)†	√/√/X				
	ROLM 9751	X/√/X				√
CENTREX	AT&T 5E6	√/√/X				
MUX	Gandalf Access SDX/Starmaster	X/√/X				
	GDC TMS	√/√/X		√		
	Timeplex IGS	√/√/X		√		√

√ – Tested compatible for the service
X or "Blank" – Not tested for the service
‡ – Preliminary test result (subject to audit)
† – Product did not undergo the full range of compatibility tests. Only remote testing was conducted
* – CPN/BN to Terminating End on a Per Call basis is also known as ANI(BN) on request.

**Table 1-2. Products Compatible with AT&T's ISDN PRI Features †
(contd.)**

	VENDORS	CPN To NETWORK/ CPN/BN to TERM-Subscription/ CPN/BN To TERM - Per call	NFAS	MAUUI	D-Chan Backup	B Chan Neg.
OTHER	Ascend Multiband Plus	X/√/X	√			
	Ascend Multiband T/P-1	X/√/X	√			
	AT&T Conversant R2.1	X/√/√	√			
	DiAnaTel EasyAccess 24	X/√/√	√			√‡
	Excel LNX-2000	√/√/X				
	INC CM-384/PRI	√/√/X		√		
	InterVoice VC/D	√/√/X				
	Memorex Telex 6544 MFCC	X/√/X		√		
	NCR Comten	X/√/X				
	Network Sciences Model 231	X/√/X				
	Periphonics VPS 9000/9500	√/√/√	√		√	
	Primary Rate, Inc. PRI-48	X/√/X				
	Promptus T1 Access Module	√/√/√	√	√		
	Rockwell CMC, CMC-1800	√/√/X		√		
	Rockwell Galaxy 3000D†	X/√/√				
	Rockwell Spectrum†‡	√/√/√		√		
	Summa Four SDS	√/√/√	√	√	√	√
	Teleos Network/Video Hubs	√/√/X				
	Teleos IRX 9000	√/√/X				
	TyLink SNS 400	√/√/X				

√ – Tested compatible for the service
X or "Blank" – Not tested for the service
‡ – Preliminary test result (subject to audit)
† – Product did not undergo the full range of compatibility tests. Only remote testing was conducted
* – CPN/BN to Terminating End on a Per Call basis is also known as ANI(BN) on request.

Chapter 3
LEC 4ESS PRI Architecture

Introduction

Overview

This chapter explains what the LEC 4ESS PRI architecture is and how it works. It provides information on the physical characteristics of the LEC 4ESS switch and explains in greater detail the purpose of the various features of the PRI architecture and how they interrelate. Wideband signaling and its benefits to the customer is also discussed.

Organization of this Chapter

Topics in this chapter include the following:

Wideband Signaling

Description

Prior to ISDN, all customer-to-network signaling was inband. Inband means that the monitoring and control functions occur in the same channel as the user information, limiting the data transmission rate to 56 Kbps.

Wideband ISDN service is defined as a family of bearer services which transport wideband information within the channel bandwidth of 128 Kbps through 1536 Kbps in circuit or packet mode. Wideband information is basically data, static visual information (text/image), and motion image. Wideband ISDN service is accessed from the PRI H0 or H11 channels according to the attributes and protocols described by existing CCITT recommendations. PRI is the only interface for users to access the wideband services of ISDN.

Types of Wideband Services

The services commonly supported by the 4ESS switch and their attributes are as follows:

- 384 Kbps circuit mode service
  - information transfer rate: 384 Kbps
  - information transfer mode: circuit mode
  - access rate for user information: 384 Kbps H0 channel
  - access protocol for user information: none

  This service is defined as a bearer service which provides the circuit mode transfer of digital information (speech, audio, video, and unrestricted) at a rate of 384 Kbps. This service must be accessed from an H0 channel on a PRI.

- 1536 Kbps circuit mode service
  - information transfer rate: 1536 Kbps
  - information transfer mode: circuit mode
  - access rate for user information: 1536 Kbps H11 channel
  - access protocol for user information: none

  This service is defined as a bearer service which provides circuit mode transfer of digital information at a rate of 1536 Kbps. This service must be accessed from an H11 channel on a PRI. Signaling for this service must be provided on a D-Channel of a different PRI which is subscribed on the same access management.

Bearer Services of ISDN

Bearer services (B-Channels) provide information transfer services between two access points on a user-network interface with the control of lower layer protocols. Some low layer attributes are listed as follows:

- Information Transfer Attributes
  - Information Transfer Mode
  - Information Transfer Rate
  - Structure
  - Communication Configuration
- Access Attributes
  - Access Rate for User Information
  - Access Rate for Signaling Information
  - Access Signaling Protocol

Characteristics of H0

H0 is a fixed format. It is made up of six contiguous channels within a T1 circuit. Those six channels must be dedicated to circuits in the following way:

- circuits 1-6
- circuits 7-12
- circuits 13-18
- circuits 19-24

Characteristics of H11

H11 takes up an entire T1 facility, it cannot be split over different T1 facilities.

H11 starts at circuit 1 and goes through circuit 24, unlike H0, which is divided in a specific way over the 24 circuits (as above) and can start on either 1, 7, 13, or 19.

Advantages of Wideband Signaling

Some advantages to wideband signaling are as follows:

- You do not have to dedicate a facility to H0 or H11.
- You can mix data rates on a facility (depending on how you provision that facility).
- You can mix single-channel calls and H0 calls on the same facility.

Provisioning for Wideband Signaling

Facilities can be provisioned in one of seven ways:

- B-Channel only
- H0 only
- H11 only
- B-Channel and H0
- B-Channel and H11
- H0 and H11
- a combination of all of the above

See the section, "Software Configuration," in Chapter 4, "Implementation," for further information on provisioning.

B-Channel

Description

Bearer (B) Channels support the transport of customer information, voice and data. For each DS-1, there are 23 B-Channels at 64 Kbps each, which transport user voice or data for service node access to switched and non-switched ISDN services.

Purpose of the B-Channel

The purpose of the B-Channels is to transport end-user information.

The B-Channel is the basic user channel. It is used to carry digital data, PCM-encoded digital voice, or a mixture of lower rate traffic, including digital data and digitized voice encoded at a fraction of 64 Kbps. In the case of mixed traffic, all traffic must be destined to the same endpoint.

B-Channels are controlled by signaling channels, called D-Channels.

B-Channel Connection

The circuit-switched connection is the type of connection that can be set up over a B-Channel. The circuit-switched connection is one where the user places a call and a circuit-switched connection is established with another network user. Communicating users can use any protocols they wish for end-to-end equipment communication.

D-Channel

Introduction

This section describes the signaling channel (D-Channel) of the PRI which controls the B-Channels and the support of limited end-user information. Out-Of-Band (OOB) signaling provided by D-Channels between the network and the Customer Premise Equipment (CPE) will be explained, as well as the relationship of the D-Channel to the CNI Ring.

Purpose of the D-Channel

The D-Channel provides OOB signaling between the 4ESS network and Customer Premise Equipment (CPE) using the CCITT standard Q.931 protocol. The D-Channel allows for a flexible message-oriented structure consistent with the CCITT standards.

The D-Channel is used to carry OOB signaling for the B-Channels as well as the user data (such as Calling Party Number [CPN]). If the D-Channel fails, existing calls on the B-Channels will continue, but no new calls can be set up.

Out-Of-Band Signaling

OOB Signaling is a major feature of ISDN. It requires the transmission of address, supervisory, and other control signals of the information transport channel over a separate transmission channel in message format. The D-Channel is usually the 24th circuit in a T1.

D-Channel and CNI Ring

The Common Network Interface (CNI) Ring provides the customer ISDN channel packet transport capability for both signaling and data applications via the D-Channel Node. The CNI Ring terminates D-Channel packets and routes messages to their appropriate destinations for processing.

The Link Access Identifier (LACID) describes the relationship between the D-Channel and its associated B-Channels. The LACID is assigned to the primary D-Channel CNI Port TAN (PTAN) on ODA Form 402E (or Recent Change Form 207). Once the specific LACID has been defined, it must be used when assigning D-Channel and B-Channel trunks to the customer PBX. Customer trunks cannot be assigned until the LACID has been assigned.

D-Channel Node

Introduction

This section explains what the D-Channel Node is, the components that make it up, how it provides a direct digital connection from the CPE to the CNI Ring equipped 4ESS office, and how it is used as a PRI on the T1 carrier system.

Purpose of the D-Channel Node

The D-Channel Node is one of five different types of nodes currently allowed on the CNI Ring. It provides the interface to the ISDN customer's D-Channel, supporting the Q.931 protocol between a PBX and the 4ESS switch. The D-Channel Node terminates messages originating from the CPE.

4ESS Wideband NFAS gives you the ability to have a D-Channel outside of the T1 to control up to 479 trunks or B-Channels. See the section, "NFAS," in this chapter for further information.

D-Channel Node Components

A D-Channel Node consists of a Node Processor, a Ring Interface, and a Link Interface. A T1 (24 D-Channel link) Facility Interface (T1FA) will support up to 3 D-Channel Nodes.

See Figure 3-1 for a graphic representation of the D-Channel Node and its components.

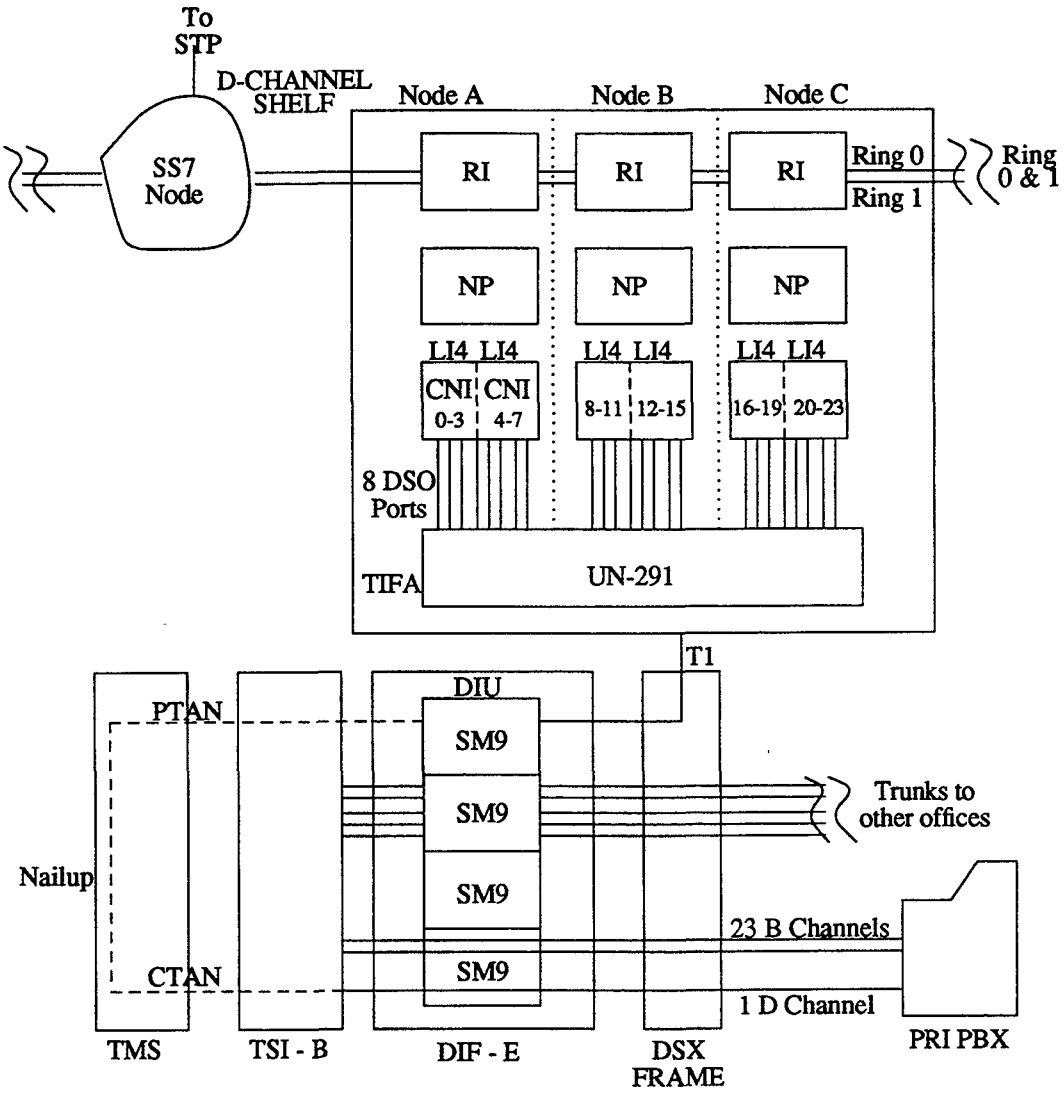


Figure 3-1. D-Channel Node and Components

CNI Ring

Introduction

This section describes the Common Network Interface (CNI) Ring, the Interprocess Message Switch (IMS), and how it and other ISDN features relate to the CNI Ring.

Description of the CNI Ring

The CNI Ring provides customer ISDN D-Channel packet transport capability for both signaling and data applications via the D-Channel Node.

Purpose of CNI Ring

CNI and IMS are components of the 4ESS switch. IMS consists of a ring-based local network connecting the application's 3B20D processor and node processors on the ring. The ring and a layer of IMS software provide packet communications between processes in the 3B20D and nodes.

CNI is an additional layer of software that converts the base capabilities of IMS into an interface to AT&T's signaling network.

CNI Ring Node Types

The CNI Ring has a number of processors (known as nodes) connected to it:

- Ring Peripheral Controller (RPC) Node — Takes care of maintenance functions, such as, checking the Ring for correct operation, reconfiguring the Ring in the event of a failure, and handling Ring status requests.
- Direct Link Node - Enhanced (DLNE) — The DLNE is a high-capacity data interface to the Ring. It can transmit large quantities of data between the Ring and the 1A processor.
- Signaling System 7 (SS7) Node — Sends and receives SS7 messages, including call routing messages, and database queries and responses.
- D-Channel Node — Similar to the SS7 Node in that it conveys OOB signaling information between the 1A processor (via the Ring) and the far end.

How The Nodes Work

On the CNI Ring, multiple processors share a communication link. At any given time, one processor has permission to transmit on the communication link. All the other processors are then able to monitor the CNI Ring for any messages addressed to them.

The CNI Ring and the ISDN Architecture

The CNI Ring is the Q.931 interface to the 4ESS switch. It is a protocol converter for Q.931 messages into the SS7 node, and a converter over ISUP to a Signaling Transfer Point (STP) and on to another PBX.

The CNI Ring strips off messages intended for the 4ESS switch and delivers them to the 1A Processor. See Figure 3-2 for an example of a CNI Ring node configuration.

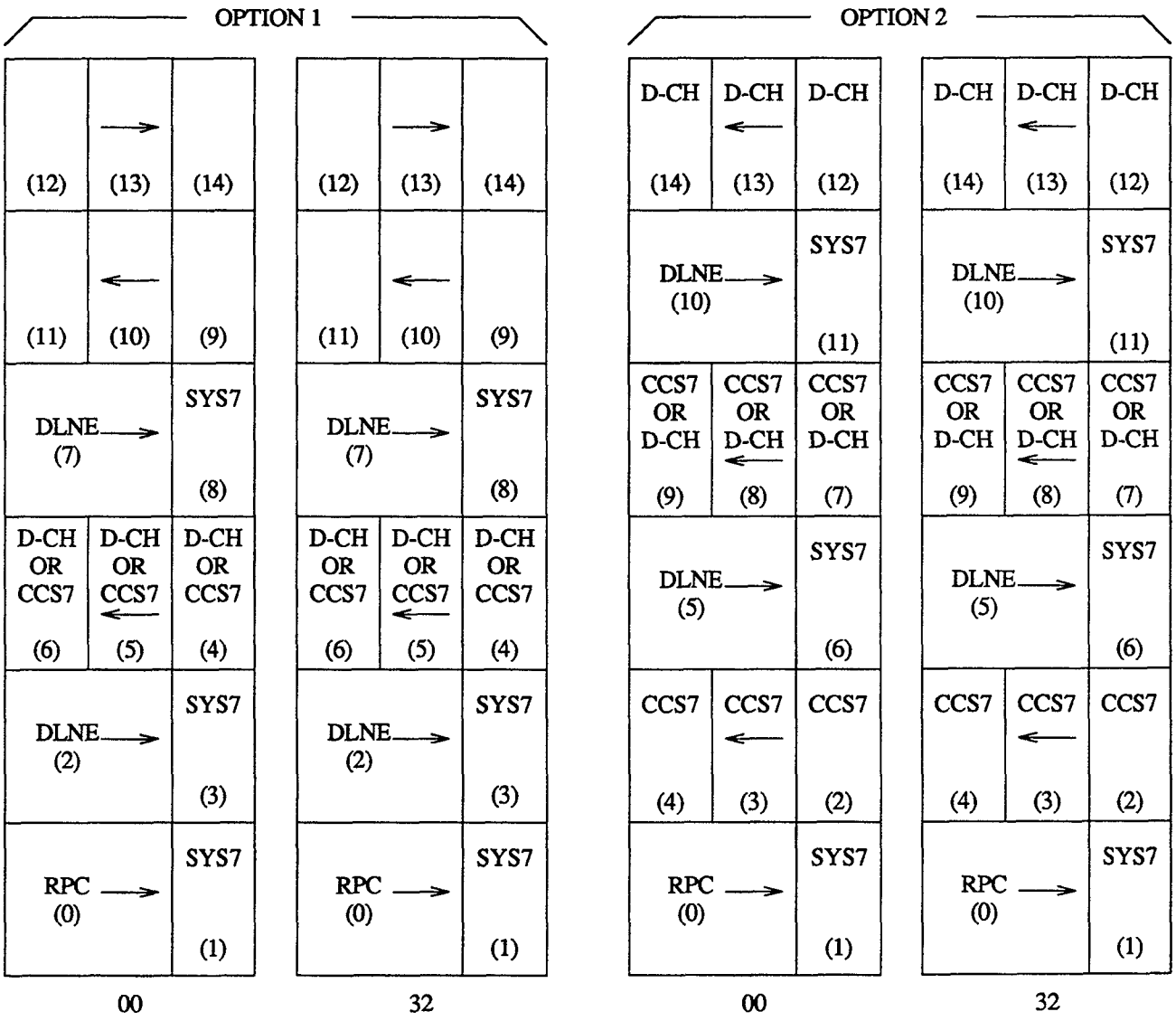


Figure 3-2. CNI Ring Node Configuration

NFAS

Introduction

This section explains how Non-Facility Associated Signaling (NFAS) is used to serve ISDN wideband customers, how special NFAS arrangements can be set up, and lists some restrictions that apply to NFAS signaling arrangements. It also gives some examples of different ways customers can arrange NFAS to better utilize T1 channels for a variety of applications.

Purpose of NFAS

Signaling for more than one DS-1 with one D-Channel is called Non-Facility Associated Signaling, or NFAS.

NFAS allows a D-Channel to signal for more than 23 B-Channels. (The theoretical limit is 671 B-Channels.) This arrangement is made possible by allowing a D-Channel to control the signaling of B-Channels located on facilities separate from the D-Channel.

NFAS will also allow each B-Channel on a single T1 to be assigned to different D-Channels which the customer selects. A customer can now select the signaling arrangement for their NFAS T1 access between any D-Channel. This allows the customer to better utilize T1 channels for multiple applications.

Restrictions to NFAS

The following restrictions apply to NFAS signaling arrangements:

- Both PRIs must be connected to the same 4ESS switch.
- Both PRIs must terminate at the same Customer Premise Equipment (CPE).
- The T1 must contain only one D-Channel per PRI, assigned to channel number 24.

TSI Modifications

Introduction	This section explains what the Time Slot Interchange (TSI-B) is, and what modifications to it consist of. The relationship between the TSI-B frame and SM9 circuit packs is also covered.
Why Modify TSI-B?	Modification of the Time Slot Interchange (TSI-B) frame is required to provide for H0 or H11 transmission over the 4ESS network.
What Constitutes a TSI-B Modification?	TSI-B modifications consist of replacing the FA1780 and FA1781 circuit packs with the new FA1816 and FA1817 circuit packs.
TSI-B and SM9 Circuit Packs	The new FA1816 and FA1817 circuit packs provide a new double buffering capability in the receive and transmit TSI. A minimum of 16 of each circuit pack is needed per office. This allows for the termination of up to 35 DS-1s. See Chapter 4, *Implementation*, for instructions on performing the actual modifications.
Advantages Gained from TSI Modifications	Provides internal synchronization of bit streams through the switch, eliminating the need for end-user equipment to synchronize bit streams for H0 and H11 calls.

D-Channel Backup

Introduction

This section explains what the D-Channel Backup feature is, and how it works to offer redundancy of signaling and control of the B-Channels from a failed D-Channel to a stand-by D-Channel when a failure is recognized.

Purpose of D-Channel Backup

ISDN customers have the option of a D-Channel backup feature. This feature allows the customer continued access to the CNI Ring in the event of one D-Channel failure.

The basic idea is that multiple D-Channel links (assuming the links are implemented with physically different paths) can increase the availability of a working connection compared to a single D-Channel link. D-Channel Backup provides improved reliability to the PRI between the CPE and the serving 4ESS switch.

Prerequisites for D-Channel Backup

This arrangement requires a minimum of two PRIs with NFAS to the CPE, and connects the CPE OOB D-Channels to the CNI Ring. The CNI Ring terminations are via two D-Channel nodes configured as diversely as possible in the T1 Facility Access (T1FA) unit(s); for example, one should terminate on Digital Interface Frame (DIF) 00, and the other on DIF 32.

To provide for this optional arrangement, you must have two or more PRI interconnections from the PBX to the 4ESS switch for ISDN services.

How D-Channel Backup Works

The customer's primary D-Channel is designated D1, with the secondary or backup D-Channel designated D2. Each D-Channel must be presented to the switch on a separate DS1 line.

When D1 is active, D2 will be in standby status, and vice versa. The active D-Channel is used to send signaling for all of the customer's multiple PRIs, including that containing the standby D-Channel. If D1 fails while active, its entire signaling path from the PBX to the D-Channel Node on the CNI Ring is replaced by the entire signaling path of D2 from the PBX to its D-Channel Node.

Restrictions to D-Channel Backup

The following restrictions apply to D-Channel Backup:

- At any given time, one of the D-Channels is in a standby role, so no load sharing is possible between the two.
- A backup D-Channel cannot function as a B-Channel while in standby.
- The two D-Channels must operate as a mated pair and provide signaling for a predefined set of B-Channels, and cannot backup any other D-Channels on a different interface.

See Chapter 4, *Implementation,* for instructions on provisioning for D-Channel Backup.

Chapter 4
Implementation

Introduction

Overview

This chapter provides a general representation of how to provision the various ISDN features and components, both hardware and software, on the 4ESS switch. This chapter is not intended as a task oriented procedure, but rather as an overview of the steps required to provision the 4ESS switch with PRI. Reference to specific TOPs documentation is given where appropriate. This document only covers ISDN provisioning on the 4ESS switch. It does not cover CPE provisioning.

Organization of This Chapter

Topics in this chapter include the following:

Office Engineering

Introduction

This section describes some general requirements for setting up ISDN at a LEC 4ESS switch site. Each of the information blocks below describes one piece of the overall ISDN customer interface to the 4ESS switch.

NOTE: Each LEC 4ESS switch site can be configured differently. This section is only an example of what is required for a typical site set-up.

Required Forms

The following is a checklist of all of the forms required for establishing the FEN Block, building trunks, assigning B-Channels and D-Channels, and so forth:

- RC 100
- RC 200
- RC 205
- RC 207
- RC 617 and RC 618
- RC 702
- ODA Form 401E
- ODA Form 402E

DIU

The foundation for equipping a 4ESS switch with ISDN service is the Digital Interface Unit (DIU) equipment on which all the related circuits will terminate. These DIU circuit packs have to be SM9s. It is best to have multiple facilities to a customer diversely assigned, in other words, at least two DIUs, each of which is installed on a different Digital Interface Frame (DIF). These DIUs have to be conditioned with the appropriate TDIU state for the planned service with the Recent Change 702 Form.

See the section, "Modify DIF Frame with SM9 Circuit Packs," in this chapter for further information and for an example of the RC 702 Form.

Non-Message TSG

A non-message Circuit Identification Number (CIN) Trunk Subgroup (TSG) is provided in the Office Data Assembler (ODA) for the TSG ACI*DCHAN. When first provisioning the 4ESS switch with PRI, ODA Form 401E has to be submitted to provide the D-Channel TSG in ODA.

FEN

A Far End Network (FEN) Block has to be prepared for the type of service to be provided using an ODA Form 406L or a Recent Change 617 Form. It will have a FENCLASS of PBX. This is required to make the appropriate billing records and perform any service category screening. This FENCLASS has to be used when building customer TSGs.

See the section, "Establish FEN Block," in this chapter for further information and an example of the RC 617 Form.

CNI D-Channel TSG

Once the D-Channel TSG is established, trunks have to be assigned in order to connect the 4ESS switch to the Common Network Interface (CNI) equipment. These trunks are built using the Recent Change 200 Form, or ODA Form 402A. (See the section, "Add Customer Trunks to TSG," in this chapter for further information and an example of the RC 200 Form.) The TANs assigned are from an SM9 DIU that is connected to the CNI equipment (T1FA Interface). These TANs may be referred to as PTANs (CNI Port TANs). A minimum of one di-group each of two different DIFs are cabled to the D-Channel node of the CNI Equipment. A node must exist on the low or high CNI frames, for example, one on frame 0 and the other on frame 32. The D-Channel shelf consists of three consecutive nodes, all of which must reside on the same shelf of the CNI frame along with the required T1FA to interface the DIF to the CNI Ring. (See Figure 3-1 in Chapter 3, "LEC 4ESS PRI Architecture," for a graphic representation of the D-Channel node and its components.) Typically, the highest numbered of the three consecutive nodes contains circuits 1 through 8, the next highest has 9 through 16, and the lowest has 17 through 24. Only the highest of the nodes has to be installed initially. The others can be installed when required for the additional D-Channel assignments. The D-Channels should be assigned alternately across the CNI cabinet to keep the working ports balanced on the CNI Ring. A Link Access Identifier (LACID) is not assigned to these trunks.

The D-Channel PTANs planned for a specific customer have to be assigned a LACID. This is accomplished with the Recent Change 207 Form. (See the section, "Define Customer LACID," for an example of the RC 207 Form.) If only one D-Channel is planned, only the primary PTAN is assigned with the appropriate LACID. If D-Channel Backup is to be used, the second PTAN is assigned the same LACID. See the section, "Establish D-Channel Signaling for D-Channel Backup (optional)," for further information and for an example of the ODA Form 402E.

Customer D-Channel

The customer D-Channels are assigned to the SM9 TANs with an ODA Form 402A or the RC 200 Form. The primary D-Channel can be assigned to the 24th TAN of the SM9 DIU to the customer. If D-Channel backup is used, the second trunk assigned on this form will be to the 24th TAN of the SM9 DIU (different DIF) to the customer's other facility. Both the primary and the backup D-Channels are the CTANs. (See the section, "Add Customer Trunks to TSG," for further information and for an example of the RC 200 Form.)

An alternate D-Channel assignment arrangement would be to define a D-Channel TSG using the Recent Change 100 Form. This TSG would be dedicated to customer D-Channels.

B-Channel TSG

The customer B-Channel TSG is built using the ODA Form 401A or the Recent Change 100 Form. The ISC/OSC is Q.931 and the TOT is PBX. (See the section, "Define New TSG for Wideband," for further information and for an example of the RC 100 Form.)

The customer B-Channels are assigned to the SM9 TANs with an ODA Form 402A or Recent Change 200 Form. B-Channels from all Facilities to the PBX should be assigned to this TSG. The LACID data from the related D-Channel node assignment is required for these trunks. (See the section, "Add Customer Trunks to TSG," for further information and for an example of the RC 200 Form.)

D-Channel Nailup

The customer D-Channel CTANs must be nailed-up across the TDNET to the CNI cabinet D-Channel node PTANs. This is accomplished with the RC 205 Form. This type of nailup must be specified as "DCH." (See the section, "Nailup of D-Channel," for further information and for an example of the RC205 Form.)

The overall D-Channel interface is now established from the customer PBX to the ISDN Signal Transfer Point (STP). The B-Channels are terminated on the 4ESS switch so they can be switched to the appropriate trunks as needed.

Miscellaneous Office Data Information

To define a number of miscellaneous office data structures, you should use ODA Form 406C. This form is used to allocate memory space for various data collection purposes. Special care must be taken to ensure sufficient space is reserved for these counts.

The Billing Count Blocks (BLCNT) field on ODA Form 406C must be filled out. The correct entries are: `blank`, or `1 to 512`. You must have 1 BLCNT per each Q.931 TSG that you build. To check whether you have enough bill count blocks, check the ODA output from Form 406C.

NOTE: This form is generally the responsibility of the Machine Administrator.

For further information on Billing, see Chapter 6, "Billing/AMA," in this manual.

Modify TSI-B Frame

Introduction

Modification of the TSI-B frame is required to provide for H0 or H11 transmission over the network. The modification consists of replacing the FA1780 and FA1781 circuit packs with the new FA1816 and FA1817 circuit packs. These circuit packs provide a double buffering capability in the receive and transmit Time Slot Interchange (TSI).

To equip one SPC for modification, 16 of each circuit pack is needed. This allows for the termination of up to 35 DS-1s.

Procedure

CAUTION: An anti-static wrist strap must be worn to prevent electrostatic discharge and possible damage to circuit packs while handling.

NOTE: No downtime is associated with these procedures because the SPC is duplicated (controller 0 and controller 1).

Use the following steps to modify the TSI-B frame:

Step	Action
1	Replace two 245A power mods with a pair of 245C power mods.
2	Change sensing resistors to each modified Signaling Point Code (SPC). The resistor values of current sensing power straps must be changed to allow for a higher current draw. NOTE: Expect controller 0 to fail Phase 23 before controller 1's SPC is changed.
3	Replace eight FA1780 circuit packs with eight FA1816 circuit packs for controller 0, per modified SPC.
4	Replace eight FA1781 circuit packs with eight FA1817 circuit packs for controller 0, per modified SPC.
5	Repeat steps 3 and 4 for controller 1.

Continued on the next page

Step	Action
6	Perform functional word change of wideband capability data. A functional word change must be made to indicate wideband capability. In the TSI unit type translator: SPC 0 - Decimal word 12 EVEN MEMBER SPC 1 - Decimal word 13 EVEN MEMBER SPC 2 - Decimal word 12 ODD MEMBER SPC 3 - Decimal word 13 ODD MEMBER This changes SL4UOWB and XL4U1WB from 0 to 1 (bit 0).

Refer to TOPS procedure 234-153-040, *MAS, PUC, TMS, TSI - Growth and Degrowth,* and DCS 4A082-11 for more detailed information.

Convert TSI to Wideband Capability

Introduction

This section details the procedures for growth and degrowth of the TSI frames and/or units. TSI-B modifications must be done to provision the 4ESS switch with wideband (H0/H11) capabilities.

Procedure

Use the following steps to convert TSI to wideband.

Step	Action
1	Perform functional word change of wideband capability. (Use the Recent Change 801 Form.)
2	Determine active trunks.
3	Set trunks to `CAD.DSA` state.
4	Verify trunks set to `CAD.DSA` state.
5	Restore TSI controller 0 to service unconditionally.
6	Verify TSI critical registers are set correctly.
7	Set trunks back to `ACT` state.

Refer to TOPS procedure 234-153-040, *MAS, PUC, TMS, TSI - Growth and Degrowth,* and DCS 4A082-11 for more detailed procedures.

Modify DIF Frame with SM9 Circuit Packs

Introduction

This section describes the Digital Interface Unit (DIU) of the Digital Interface Frame (DIF) that is used to provide for any clear channel data transmission capability from 64 Kbps and higher. These components are part of the hardware conversion that supports wideband transmission.

DIF Requirements for Wideband

The SM9 equipped DIU provides many different transmission services. For wideband, you must have SM9 which provides you with

- 64 Kbps clear channel
- multi-rate switched capability
- broadband capability

Procedure

CAUTION: An anti-static wrist strap must be worn to prevent electrostatic discharge and possible damage to circuit packs while handling.

Use the following steps to modify the DIF with SM9 circuit packs:

Step	Action
1	Modify switchable spare unit in DIF.
2	Switch service to spare DIU.
3	Modify selected DIU. Replace the SM1B with SM9 circuit packs.

Refer to TOPS procedure 234-153-030, *DIF, VIF, DT, EST, and CCIS TGR - Growth and Degrowth* for more detailed information.

Wideband Modification

Figure 4-1 shows the configuration for a wideband modification.

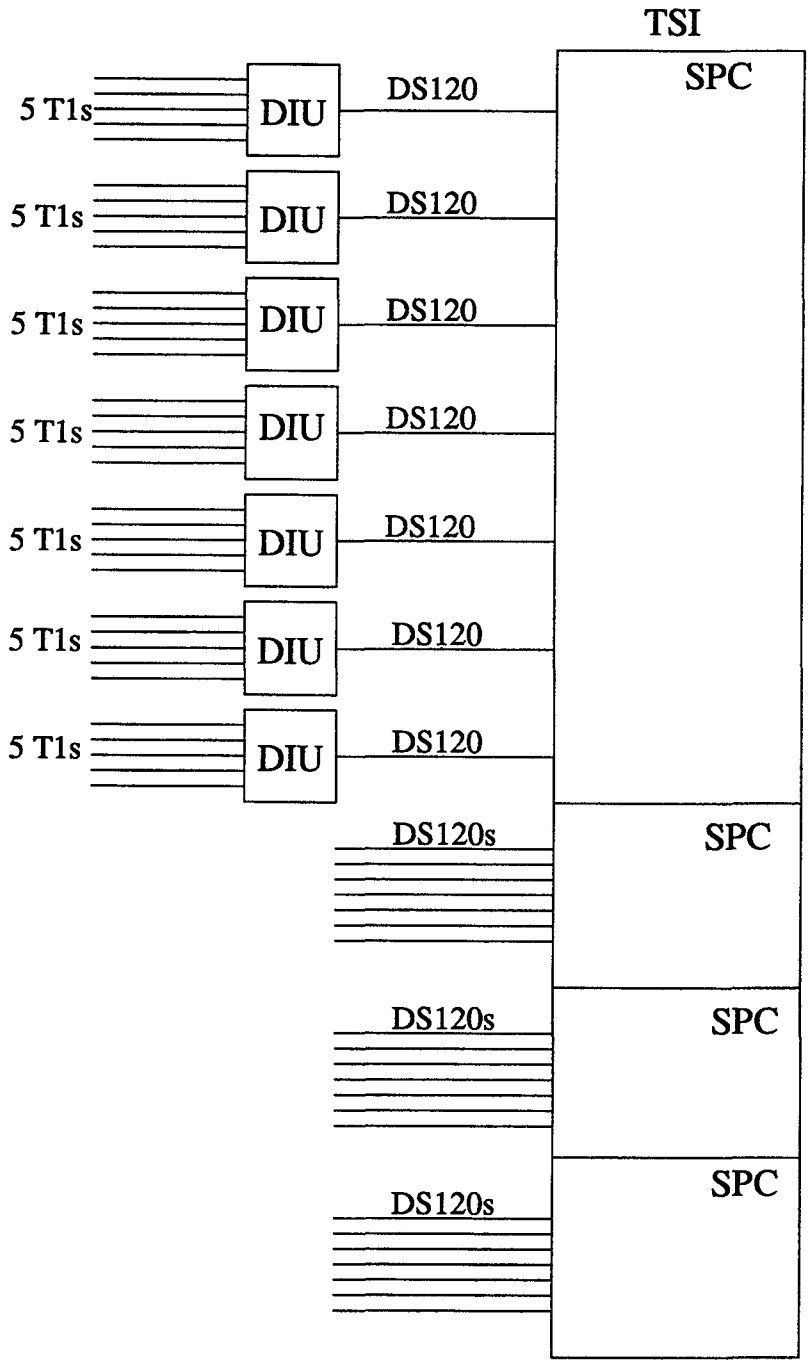


Figure 4-1. TSI Modification

NOTE: The TSI wideband modification package only modifies one SPC, therefore, one SPC will support approximately 840 B-Channels.

Provisioning SM9 Circuit Packs

Provisioning the SM9 circuit packs requires the Recent Change 702 Form. This form allows the provisioner/machine administrator to specify the desired TDIU value of the SM9 DIU. The RC702 Form also enables the office engineer to reconfigure the characteristics of the SM9 DIU to support the Special Service market without buying excessive numbers of circuit packs for every capability.

Example of the Recent Change 702 Form

An example of the Recent Change 702 Form follows:

```
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# FORM 702          CHANGE DIU FUNCTION CAPABILITY

RC:UTYPE;CHG;OPT(DIU),TST:

ORNU _____,

                                          OLD  NEW
DIF MEMN ___,      DIU MEMN ___,      TDIU ( __,  __ ),

REMARKS _____________________________________________________!

                        EQUIVALENT ODA INPUT FORM - NONE
                          ASSOCIATED VERIFY MESSAGES
                            INPUT-17a-VER:UTYPE:DIF
                            OUTPUT-7b-VER:UTMN;OPT()
```

Field Definitions

See the *4ESS Translation Guide* for definitions of the fields on the RC 702 Form.

SM9 DIU Functions

The new TDIU State Assignments of 8 and above pertain to the different transmission aspects of the SM9. Table 4-1 gives a brief description of the transmission format for each new TDIU and mentions some of their possible applications.

Table 4-1. SM9 DIU Functions

4E16 SM9 DIU FUNCTIONS		
TDIU	DESCRIPTION	APPLICATION
8	4-State Signaling (SF+RB+1ADC+ZCS)	ISC offices CCITT No. 5
9	CSDC (SF+RB+CSDC+ZCS)	CSDC[see note 1]
10	Direct Connect (SF+RB+IADC+ZCS)	IADC[see note 1], Voice
11	64kbps clear (ESF+B8ZS)	POTS, 64CC, CCITT No. 6 CCITT No. 7 ISDN (23B+D, H0 and H11)[see note 2] Common channel signaling[see note 3]
12	DMI (SF+DMI+POTS+ZCS)	N/DMI Services POTS, (Voice, 56k and 64kR)
13	DMI (ESF+DMI+POTS+B8ZS)	N/DMI Services POTS, (Voice, 56k, 64kR and 64CC)
14	SM1B Services (SF+RB+POTS+ZCS)	POTS, Voice, 64kR, CCITT No. 6 CCITT No. 7, ISDN (23B+D, H0 and H11 Restricted)[see note 2] Common channel signaling[see note 3]
15	64kbps restricted (ESF+RB+POTS+ZCS)	POTS, Voice, 64kR, CCITT No. 6 CCITT No. 7, ISDN (23B+D, H0 and H11 Restricted)[see note 2] Common channel signaling[see note 3]
16	Direct Connect (ESF+RB+IADC+ZCS)	IADC[see note 1], Voice
17	Direct Connect (ESF+RB+IADC+B8ZS)	IADC[see note 1], Voice
18	Direct Connect (SF+RB+POTS+NO ZCS)	SPECIAL APPLICATION, POTS, 64kR, Common channel signaling[see note 3]

Table 4-1. SM9 DIU Functions *continued*

4E16 SM9 DIU FUNCTIONS		
TDIU	DESCRIPTION	APPLICATION
19	SM1B Services (SF+RB+POTS+B8ZS)	POTS, Voice, ISDN (23B+D, H0 and H11)[see note 2] Common channel signaling[see note 3]
20	Direct Connect (SF+RB+IADC+B8ZS)	IADC[see note 1] Voice
21	DMI (ESF+DMI+POTS+ZCS)	N/DMI Services POTS, (Voice, 56k and 64kR)
22	4-State Signaling (SF+RB+4ST+B8ZS)	ISC offices CCITT No. 5
23	4-State Signaling (ESF+RB+4ST+B8ZS)	ISC offices CCITT No. 5
24	SM1B Services (ESF+RB+POTS+B8ZS)	POTS, Voice, SW56[see note 4] ISDN (23B+D, H0 and H11)[see note 2] Common channel signaling[see note 3]
25	CSDC (ESF+RB+CSDC+ZCS)	CSDC[see note 1]
26	CSDC (ESF+RB+CSDC+B8ZS)	CSDC[see note 1]
27	CSDC (SF+RB+CSDC+B8ZS)	CSDC[see note 1]

NOTES

1. AT&T-C has no current application planned for this service offering.
2. 23B+D = 23 voice circuits and 1 signaling channel
   H0 = 384KBPS H11 = 1.536MBPS
3. Can be used for any common channel signaling trunks [CCS6, CCS7, CCITT #6, CCITT #7 or ISDN-D]
4. SW56 service can be assigned to SM1B packs if ESF and/or B8ZS are not required for the facility involved.

In addition, the following states are recommended for PRI wideband customers:

- TDIU state 11 should be used if the DIU supports Out-Of-Band (OOB) signaling only, and if Extended SuperFrame (ESF) and B8ZS encoding is used.

- TDIU state 19 should be used if the DIU supports both OOB and in-band signaling, and if SuperFrame (SF) and B8ZS encoding is used.
- TDIU state 24 should be used if the DIU supports both OOB and in-band signaling, and if ESF and B8ZS encoding is used.

Install D-Channel Node and Shelf

Introduction

D-Channel nodes are installed on the CNI Ring with a shelf that may be equipped to provide three D-Channel nodes. This section shows how the D-Channel nodes are arranged on a shelf, and describes the basic operation of the D-Channel node.

D-Channel Node

The D-Channel nodes are provided on a shelf per the drawing J3F011DC-1. The basic components of the shelf are:

- One T1FA (T1 Facility Access)
- Three nodes, each with
  - two Link Interfaces (LI4D0 and LI4D1), each of which support four I/O ports (D-Channels).
  - one Node Processor (NP)
  - two Ring Interfaces (RI0 and RI1)

Figure 4-2 shows how a D-Channel node is set up. It is described in the following section.

IMPORTANT: Figure 4-2 is an example of a typical CNI Ring arrangement with a left-to-right configuration. If you are using a right-to-left configuration, assignments may be different.

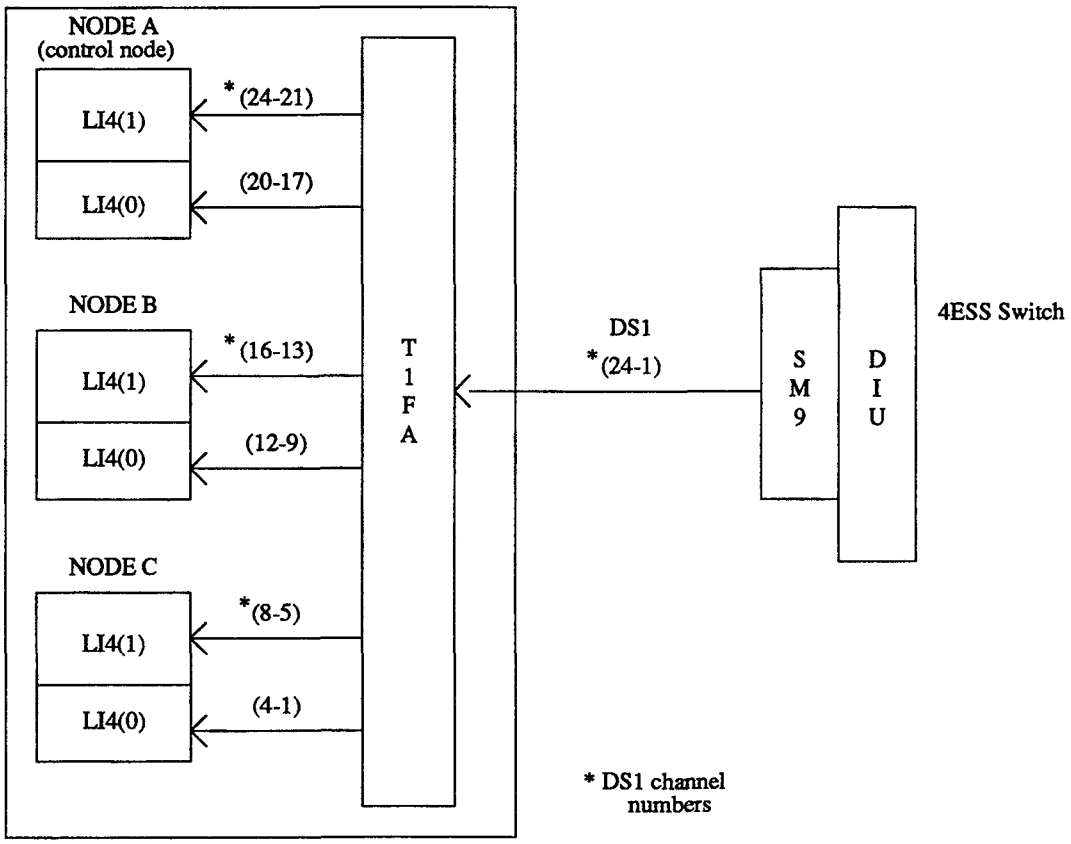

Figure 4-2. D-Channel Node

Basic Operation of the D-Channel Node

The T1FA is a multiplexer/demultiplexer device. Its input from the 4ESS is a DS1 line (1.544 Mbps) consisting of 24 64 Kbps D-Channels. The T1FA demultiplexes the DS1 line signal into 24 individual D-Channels which are then separated into three 8-channel groups. Each group is then input to a respective node. Channels 1 through 8 are input to the eight ports of node "C", channels 9 through 16 are input to the eight ports of node "B", and channels 17 through 24 are input to the eight ports of node "A". Node "A" is the control node, Nodes "B" and "C" are non-control nodes.

Each of the three nodes have eight I/O ports numbered 0 through 7. Ports (0) through (3) are associated with the first LI4. It is designated (LI4D0). Ports (4) through (7) are associated with the second LI4, which is designated (LI4D1). The channels of the DS1 line are

demultiplexed directly to the ports. Each channel is wired to its specific I/O port. This DIU time slot-node-PID relationship is given in Table 4-2.

The node output ports follow the reverse procedure. The eight output ports of each node are multiplexed into a DS1 line bit stream by the T1FA. This is then delivered to the SM9 circuit pack of the DIU.

Node-PID-Time Slot Relationship

Table 4-2 shows that the DIU Time Slot (1) is extended to the D-Channel T1FA via a DS1 line on Channel (1). At the T1FA, it is demultiplexed to Node (C) PID (0). DIU Time Slot (24) extends to the T1FA via DS1 line channel 24. It is then demultiplexed to Node (A) PID (7).

Table 4-2. Node-PID-Time Slot Relationship

NODE-PID-TIME SLOT							
NODE	PID	DS1 CHAN	DIU TIME SLOTS				
C	0	1	1	25	49	73	97
	1	2	2	26	50	74	98
	2	3	3	27	51	75	99
	3	4	4	28	52	76	100
	4	5	5	29	53	77	101
	5	6	6	30	54	78	102
	6	7	7	31	55	79	103
	7	8	8	32	56	80	104
B	0	9	9	33	57	81	105
	1	10	10	34	58	82	106
	2	11	11	35	59	83	107
	3	12	12	36	60	84	108
	4	13	13	37	61	85	109
	5	14	14	38	62	86	110
	6	15	15	39	63	87	111
	7	16	16	40	64	88	112
A	0	17	17	41	65	89	113
	1	18	18	42	66	90	114
	2	19	19	43	67	91	115
	3	20	20	44	68	92	116
	4	21	21	45	69	93	117
	5	22	22	46	70	94	118
	6	23	23	47	71	95	119
	7	24	24	48	72	96	120

NOTE:

- Node A (control node) is the HIGHEST node on the shelf and the first populated.
- Node B is the MIDDLE node on the shelf and the second populated.
- Node C is the LOWEST node on the shelf and the third populated.
- In each grouping of eight Time Slots, the lowest number always interfaces PID (0) and the highest number Time Slot interfaces PID (7).

DIU Time Slots (25) through (48) follow a similar path to similar nodes on a different ACI/CNI Ring shelf. The relationship of the 120 time slots of the DIU is given in Table 4-2.

Additional Guidelines

Some additional facts to keep in mind when equipping the D-Channel node —

- DIU Time Slots are associated with five SM9 packs in the DIU.
- If the SM9 is associated with the D-Channel link to the CNI Ring, all 24 channels would be D-Channels.
- If the SM9 is associated with individual PBX equipment, then the 24th channel would be the D-Channel.

Change IUN to D-Channel Node

Introduction

After the TSI-B Frame has been modified, the new SM9 circuit packs have been installed, and the D-Channel nodes have been installed as IMS User Nodes (IUNs) in an unassigned state, use the following procedure to grow the IUNs to active D-Channel nodes.

Procedure

CAUTION: An anti-static wrist strap must be worn to prevent electrostatic discharge and possible damage to circuit packs while handling.

NOTE: This procedure should be performed during light traffic periods.

Use the Unit Control Block (UCB) Form 199 RCV/ECD to change the IUN to a D-Channel node.

Step	Action
1	Take the node adjacent to the UNEQUIP (unequipped) D-Channel node out of service. Change the status of the UNEQUIP node to GROW in the major status field (Field 21). NOTE: Page 1 of the UCB Form 199 is mostly populated. Page 2 may require you to make some changes to some fields.
2	On page 2 of the UCB Form 199, enter PBXD (for non-controlling node) or PBXT (for controlling node) in the packcode field (Field 62) to change the IUN to a D-Channel Node. Entering PBXD or PBXT depends on the type of node that you are growing.
3	Change the major status field (Field 21) to OOS (Out Of Service).
4	Clear the adjacent node of its OOS status. (It was taken out of service in step 1 of this procedure.)
5	Change the major status field (Field 21) to ACT (Active).

For more information on this procedure, see the task, "Add Link Interface (LI) pack to link node or IUN - Support to installer," in TOPS 234-153-055, *Common Network Interface - Growth/Degrowth.*

Establish FEN Block

Introduction

This section describes how to provision for Far End Network (FEN) screening. ODA Forms and Recent Change Forms are discussed, as well as how to prepare them for the type of service needed.

Description of FEN Block

FEN screening (in conjunction with service categories) is one of the six major means for screening and call processing used in the 4ESS switch.

Screening in the network provides the routing flexibility to selectively allow or deny calls based on the following:

- the Trunk SubGroup (TSG) on which the call originated
- the validity of the dialed digits
- the customer that made the call (call authorization)

The FEN Block also provides for the recording of calls.

Provisioning the FEN

To provision the FEN Update, do the following:

- Use ODA Form 406L or Recent Change 617 Form to specify the identity and characteristics of a new FEN. These characteristics will then apply to all TSGs defined to be within this FEN.

  The CLASS **must** be PBX. This is necessary to make the appropriate billing records and perform service category screening.

  NOTE: The FENCLASS must be built before building the customer TSG.

  See the following page for an example of the RC 617 Form.

```
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# FORM 617        ESTABLISH A NEW FAR END NETWORK
4E16>

RC:FEN;NEW;___:                              CLASS _____,     FID _____,

ORNU _____,

AFA __,

RECORD SCREEN AND QUERY TREATMNT

UNSP _,   ATAP _,   CUSP _,   CARP _,   CANP _,   HAWP _,   NWZ1 _,   INW _,
DSD _,    DLT _,    TC _,     DA _,     IOP _,    TST _,    RSYS _,   MSC1 _,
MSC2 _,   MSC3 _,   MSC4 _,   INCN _,   ALAP _,   CUTP _,   INCO _,   EASC _,
ICIN _,   SC1 _,    SC2 _,    SC3 _,    SC4 _,    SC5 _,    SC6 _,    SC7 _,
SC8 _,    SC9 _,    SC10 _,   SC11 _,   SC12 _,   SC13 _,   SC14 _,   SC15 _,
SC16 _,   SC17 _,   SC18 _,   SC19 _,   SC20 _,   SC21 _,   SC22 _,   SC23 _,
SC24 _,   SC25 _,   SC26 _,   SC27 _,   SC28 _,   SC29 _,   SC30 _,   SC31 _,
SC32 _,   SC33 _,   SC34 _,   SC35 _,   SC36 _,   SDN _,    LDA _,    SSP _,
SPDI _,   MULT _,   MCPP _,   INET _,   SDND _,   QTM _,

SCREEN TREATMNT

DEF1 _,   DEF2 _,   DEF3 _,   DEF4 _,                    DFHT ___,

REMARKS _____________________________________________________!

                    EQUIVALENT ODA INPUT FORM - ESS 406L

                         ASSOCIATED VERIFY MESSAGES

                           INPUT-16m-VER:FEN:

                           OUTPUT-6s-VER:FEN:
```

Field Definitions for FEN Block

The acceptable values for the FEN Block follow:

- B — both recording and query
- R — make an AMA recording (billing)
- D — deny the call, route to Final Handling Treatment (FHT)
- N — no record

These values determine the condition at call processing when the dialed digits are translated and the service category is checked against the FEN Block for the incoming TSG.

NOTE: See the *4ESS Translation Guide* for more information about the fields on the RC 617 Form, and the possible values that can be assigned to them.

Change/Update Existing FEN

Recent Change 618 Form will be used to change/update the characteristics of an existing FEN. These characteristics then apply to all TSGs defined to be within this FEN.

NOTE: All relevant data fields must contain an entry even when some of the characteristics are not being changed.

The `CLASS` and `FEN Identification (FID)` entries that you enter on this form must match the existing FEN that is updated. See the next page for an example of RC 618 Form.

```
TRANSLATION GUIDE                                          DIV. 7, SEC. 6s
TG-4                                                       October, 1992


# FORM 618      CHANGE THE CHARACTERISTICS OF AN EXISTING FAR END NETWORK
4E16>

RC:FEN;CHG;___:                          CLASS _____,     FID _____,

ORNU _____,

AFA __,

RECORD SCREEN AND QUERY TREATMNT

UNSP _,   ATAP _,   CUSP _,   CARP _,   CANP _,   HAWP _,   NWZ1 _,   INW _,
DSD _,    DLT _,    TC _,     DA _,     IOP _,    TST _,    RSYS _,   MSC1 _,
MSC2 _,   MSC3 _,   MSC4 _,   INCN _,   ALAP _,   CUTP _,   INCO _,   EASC _,
ICIN _,   SC1 _,    SC2 _,    SC3 _,    SC4 _,    SC5 _,    SC6 _,    SC7 _,
SC8 _,    SC9 _,    SC10 _,   SC11 _,   SC12 _,   SC13 _,   SC14 _,   SC15 _,
SC16 _,   SC17 _,   SC18 _,   SC19 _,   SC20 _,   SC21 _,   SC22 _,   SC23 _,
SC24 _,   SC25 _,   SC26 _,   SC27 _,   SC28 _,   SC29 _,   SC30 _,   SC31 _,
SC32 _,   SC33 _,   SC34 _,   SC35 _,   SC36 _,   SDN _,    LDA _,    SSP _,
SPDI _,   MULT _,   MCPP _,   INET _,   SDND _,   QTM _,


SCREEN TREATMNT

DEF1 _,   DEF2 _,   DEF3 _,   DEF4 _,                    DFHT ___,

REMARKS ____________________________________________________!

                    EQUIVALENT ODA INPUT FORM - ESS 406L

                         ASSOCIATED VERIFY MESSAGES

                           INPUT-16m-VER:FEN:

                           OUTPUT-6s-VER:FEN:
```

NOTE: See the *4ESS Translation Guide* for definitions of the fields of the RC 618 Form.

Define Customer LACID

Introduction

The Link Access Identifier (LACID) describes the relationship between the D-Channel and its associated B-Channels. It is assigned to the primary D-Channel CNI Port TAN (PTAN) on the ODA Form 402E, or the Recent Change 207 Form. Once the specific LACID has been defined, it must be used when assigning D-Channel and B-Channel trunks to the customer PBX.

NOTE: Customer trunks cannot be assigned until the LACID has been assigned.

How the LACID is Assigned

The LACID is an arbitrary number that allows the 3B to share identification of the D-Channel trunk with the 1A processor.

The LACID no longer correlates to the physical address on the CNI Cabinets. A LACID is assigned by the Machine Administator. The legal ranges to choose from for the LACID assignment are as follows:

1 through 255

- and -

1024 through 1279

NOTE: There can be no dual assignments of numbers.

Recent Change 207 Form

Use the Recent Change 207 Form to assign the LACID. The LACID assigned here is a required field entry on other Recent Change forms. See the following example:

```
DIV. 7, SEC 2h                                          TRANSLATION GUIDE
November, 1991                                                    TG-4


# FORM 207        LACID TO D-CHANNEL ASSIGNMENT

RC:TRK;NEW;OPT(LACID),___:                              LACID ____,

ORNU ______,  ACTION _,

       TAN
TSI  SPC  LVL  FTS
__,   _,   _,  ___,
__,   _,   _,  ___,


REMARKS _____________________________________________________!

                        EQUIVALENT ODA INPUT FORM - ESS 402E

                             ASSOCIATED VERIFY MESSAGES

                               INPUT-12a-VER:TRK:

                               OUTPUT-2a-VER:TRK:
```

NOTE: See the *4ESS Translation Guide* for definitions of the fields on the RC 207 Form.

Define New TSG for Wideband

Introduction

Defines customer B-Channel TSGs in a particular domain to make the wideband (H0/H11) capabilities work.

Procedure

Use the Recent Change 100 Form. The following is an example:

```
TRANSLATION GUIDE                                          DIV. 7, SEC. 1a
TG-4                                                          February 1993

# FORM 100              ADD A NEW TWO WAY TRUNK SUBGROUP
4E18
RC:TSG;NEW;OPT(TWOWAY), ___:                  BTFN TOWN ST BL FBS NBS

ORNU ____                                      TSG ____ ____ __ __ ___ __,
PCF ____,   AOPC ________,                     DPC _________,

FENCLASS ____, FENID _______,                  TFG _, TSGBBC 6, VDCAP ____, DATAF _,
QTFN __,   TOT ____, SAT _,                    DOM ____, ACD _,  IT _,
FENPA ___, FEOFC __, FELATA __,                FESC6 _, IWZ1 _,  LSST __,
MEM _,     PSES _,   INSEP___,                 MTSC __, GNSC _,  GEOSEP __,

ISC _____, RFA _,    ADIG _,                     CCIS2WRE _, CBNPR ___,
OSC _____, RFMP _,   DPSTOP _,                 DELAY __, MFSPEED __, DNHR _,
XCPA _,    DNP _,                              REV _,    GLARE _,    PSOLI _,

BN _______, BRL _,   ITC _,  GSDN _,           GSDNPHSE _, EAS _,     NPARINH _,
WATSBN _____, PSBN ___, PSCPN _,               ANISID ___, WANISID ___, PSUUI _,
BNPT ___,  WBNPT ___,  CMERGE _,               SCFN _,  OVLP _, PRIT ____,
APS _ CHNEG _, PSATP _, PBXESGD _,             PBXAW _  FAR4E _, DOFP _, SBRIV _,
MEGC _, SDNA _, OWAT _, DATA _, CBC _,         DDD _, IDDD _,  FOSPS _, CCIF _,
SDNPLAN ___, BFTIS __, BFTNI __,               SKSP _, PBXNWW _, HYBRD _,
INCID _,  ITELCO _,
ONCID _,  D3DBN _,
ANCR _,

CAREA _,   CPOS _,  SINDEX __,                 CODSC _,   NEOTR _,    TRIDX __,
OTSTT ___, OTSTN _______,                      OTMTT ___, OTMTN _____,
XTSTT ___, XTSTN _______,                      XTMTT ___, XTMTN _____,

S1 _, S2 _, S3 _, S4 _, S5 _, S6 _, S7 _, S8 _, S9 _, S10 _,

REMARKS ____________________________________________________!

                          EQUIVALENT ODA INPUT FORM - ESS 401A
                              ASSOCIATED VERIFY MESSAGES
                              INPUT -11a-VER:TSG:CIN....
                              INPUT-11c-VER:TSG:TSGN....
                        OUTPUT (CHARACTERISTICS)-1a-VER:TSG,OPT(TWOWAY):
                        OUTPUT (LIST OF TRUNKS)-1d-VER:TSG,OPT(TRUNKS):
```

Field Definitions

Some fields are required and must be filled in with specific options. All other fields are optional, and can be filled in depending on the requirements at your site. Following are the required fields:

- FENCLASS — Far End Network Class

  Enter: PBX

- TSGBBC — Trunk SubGroup Broadband Capability

  Possible entries: blank, or 0 to 6

  blank, 0 = B only
  1 = H0
  2 = H11
  3 = B and H0
  4 = B and H11
  5 = H0 and H11
  6 = all

- TOT — Type of Trunk

  Enter: PBX

- DOM — Domain

  Possible entries: POTS, 20 to 83, INTL, VRFY, SDNA, DEV, IVT, I56D, I64C, N64C, N64R, APN, NH0C, NH1C

- ISC — Incoming Signaling Characteristics

  Enter: Q931

- CBNPR — Calling Party Number/Billing Number Default Presentation Restriction Indicator

  Possible entries: blank, Y (before 4e16), N (before 4e16), PA (4e17 and greater), or PR (4e17 and greater).

- OSC — Outgoing Signaling Characteristics

  Enter: Q931

- ANISID — ANI/SID Request

  Possible entries: blank, NONE, ANI, PANI, PSID, REQ, or SID.

- WANISID — WATS service ANI/SID Request

  Possible entries: blank, NONE, ANI, PANI, PSID, REQ, or SID.

- PSUUI — Prohibit Sending User-to-User Information

  Possible entries: `blank`, `Y`, or `N`.

- DATA — Data Service

  Possible entries: `blank`, `Y`, or `N`.

- BN — Billing Number

  Possible entries: `blank`, `3`, `4`, or `10 digit number`.

NOTE: See the *4ESS Translation Guide* for definitions of all the fields on the RC 100 Form.

Add Customer Trunks to TSG

Introduction

After the TSG is defined, (see the section, "Define New TSG for Wideband," in this chapter) the RC 200 Form is used to populate customer trunks inside the TSG.

Procedure

Use the Recent Change 200 Form to add customer trunks to an existing Trunk SubGroup. See the following example:

```
DIV 7, SEC. 2a                                          TRANSLATION GUIDE
October 1992                                                      TG-4

# FORM 200          ADD NEW TRUNKS, ASSIGN TANS MANUALLY
  4E16>


RC:TRK;NEW;OPT(MANUAL),FTA:                          BTFN TOWN ST BL FBS NBS

ORNU 2345__,                                    TSG 1096TCFACICNI01AAA_ ___,

ES N___,                        D1D2 __,

                    TAN
QTRK  FTFN     TSI SPC LVL FTS    FCHAN    LACID    FAC FTRID   VCR  BBC  SCGA
_4_,  1096,    29,  1,  3, 1 _,    0_,     32__,    0_,  1__,   100,  1,   _,
___,  ____,    __,  _,  _, ___,    __,     ____,    __,  ___,   ___,  _,   _,
___,  ____,    __,  _,  _, ___,    __,     ____,    __,  ___,   ___,  _,   _,
___,  ____,    __,  _,  _, ___,    __,     ____,    __,  ___,   ___,  _,   _,
___,  ____,    __,  _,  _, ___,    __,     ____,    __,  ___,   ___,  _,   _,
___,  ____,    __,  _,  _, ___,    __,     ____,    __,  ___,   ___,  _,   _,


REMARKS _____________________________________________________!

                        EQUIVALENT ODA INPUT FORM - ESS 402A
                            ASSOCIATED VERIFY MESSAGES
                                INPUT-12a-VER:TRK:
                                OUTPUT-2a-VER:TRK:
```

Field Definitions

See the *4ESS Translation Guide* for the possible values to enter in the fields of the RC 200 Form.

Establish D-Channel Link

Introduction

The `lkdata` function is used to manage the link configuration data of each link on the CNI Ring.

Procedure

Use the following steps to establish the D-Channel link:

Step	Action
1	Access the Database Management System (DMS) and call up the RCV:DMS Form which enables you to change and add link data.
2	Assign links to the ports.
3	Submit the form.
4	Call up the RCV:DMS form again. Change the Major State field to `available`.
5	Activate the form. The link is now defined.

See the section, "Activate Signaling Links on Existing Link Interface Pack," in the TOPS procedure 234-153-055 *Common Network Interface - Growth/Degrowth,* for more detailed information.

LKDATA Recent Change Screen

Figure 4-3 is an example of the Link Data Recent Change screen that you access through the Data Management System.

***** CNI DATA MANAGEMENT SYSTEM ***** DATE: 04/23/92 TIME: 13:42 *****

FUNCTION: lkdata ACTION: ver OFFICE: NPVLILIH2MD

LINK INFORMATION

GROUP - MEMBER: 00 - 04

LINK TYPE ID: dchan

LI4 EQUIPPAGE both CONTROL NODE 00 - 04

FACILITY ACCESS TYPE t1fa

	-------- li40 --------				-------- li41 --------			
	0	1	2	3	0	1	2	3
LACID	32	33	34	35	36	37	38	39
LINK SPEED	64ri/d	64ri/d	64ri/d	64ri/d	64ri/d	64ri/d	64ri/d	64ri/d
LINK TYPE	simplex	primary	second	second	second	second	second	primary
MATE NODE	32 - 04	32 - 04	32 - 04	32 - 04	32 - 04	32 - 04	32 - 04	32 - 04
MATE LINK	li40-0	li40-1	li40-2	li40-3	li40-0	li40-1	li40-2	li40-3
MAJOR STATE	avail	unav	unav	avail	unav	avail	unav	avail

Figure 4-3. LKDATA Recent Change Screen

The LKADMN Function

The `lkadmn` function is used to supplement the `lkdata` and `lkinfo` functions to provide data for D-Channel links. The data items that are changeable using the `lkadmn` function all have default values that are assigned during link growth using either the `lkdata` or the `lkinfo` functions.

Changing the defaults on the `lkadmn` form is optional for the user. For D-Channel links, the `lkadmn` function is used for billing numbers and engineering data.

Figure 4-4 is an example of the `lkadmn` screen for D-Channels.

NOTE: The only valid actions are "CHG" and "VER". To change any of the data on this form, the major state of the link must be set to unavailable. See the *4ESS Translation Guide* for more information.

```
***** CNI DATA MANAGEMENT SYSTEM ***** DATE: 04/23/90 TIME: 13:42 *****
FUNCTION: lkadmn  ACTION: chg  ORDER: 06Y000555000  OFFICE: NPVLILIH2MD

                    LINK ADMINISTRATION

                    ITEM:                          001
                    GROUP - MEMBER:                00 - 04


                    LINK TYPE ID:                  dchan
                    BILLING NUMBER:                3125551212
                    CIRCUIT CALLS:                 128
                    TEMP SIGNALLING CONNECTIONS:   0
                    FACILITY ID:                   0
                    MAJOR STATE:                   available
```

Figure 4-4. LKADMN Recent Change Screen

Nailup of D-Channel

Introduction

The D-Channel Nailup feature is accomplished with the Recent Change 205 Form. It is used to nailup the TANS across the 4ESS switch TDNET from the customer facility D-Channel (CTAN) to the CNI Equipment D-Channel Node Port (PTAN). The Type entry on this form identifies that the nailup is for the D-Channel application. (See Figure 3-1 in Chapter 3 of this document for an example of a nailed up D-Channel.)

NOTE: If the D-Channel Backup feature is used, both the Primary and Backup D-Channel must be nailed up using the Recent Change 205 Form.

There is no equivalent ODA form for this function.

Recent Change 205 Form

Use the Recent Change 205 Form for D-Channel Nailup. Following is an example:

```
# FORM 205    ADD NEW NAILUP ASSIGNMENTS
  4E11>

RC:TRK;NEW;OPT(NAILUP),____:

ORNU ______,

                  TAN                       TAN
QTRK        TSI SPC LVL FTS         TSI SPC LVL FTS      TYP      RDC

 __,        __, __, __, __,         __, __, __, __,      ____,     _,
 __,        __, __, __, __,         __, __, __, __,      ____,     _,
 __,        __, __, __, __,         __, __, __, __,      ____,     _,
 __,        __, __, __, __,         __, __, __, __,      ____,     _,
 __,        __, __, __, __,         __, __, __, __,      ____,     _,
 __,        __, __, __, __,         __, __, __, __,      ____,     _,

REMARKS ____________________________________________________!

                          EQUIVALENT ODA INPUT FORM - NONE

                            ASSOCIATED VERIFY MESSAGES

                              INPUT-12d-VER:NAILUP

                              OUTPUT-2n-VER:NAILUP
```

NOTE: There is no ODA input form equivalent to the RC 205 Form. This information is carried through the retrofit process on what is called a D6 form. The Machine Administration Center (MAC) can identify any TAN nailups carrying through the retrofit process on the D6 record line of the "Job Library."

All trunks being nailed up must be `CAD.DSA`.

Delete D-Channel Nailup

The Recent Change 206 Form can be used to delete nailups.

Field Definitions

There are two TAN assignments necessary for the RC205 Form. The first `TAN` field is the Customer TAN. The second `TAN` field is the D-Channel TAN.

The `TYP` field should contain `DCH`. The `RDC` field should contain `Y`.

See the *4ESS Translation Guide* for further information and definitions of the fields on the RC 205 and RC 206 Forms.

Establish D-Channel Signaling for D-Channel Backup (optional)

Introduction

This section provides information on provisioning the optional D-Channel Backup feature. It explains how to provision a standby D-Channel for use in controlling signaling of the B-Channel in the event of a failure of the primary D-Channel.

ODA Form 402E

A second D-Channel from the same customer location (different T1 facility) is allowed to terminate on the CNI Ring. An active D-Channel resides on one D-Channel node, and a standby D-Channel resides on another. When a D-Channel node failure occurs, the standby D-Channel will become active.

Each of the two D-Channels will be nailed-up through the 4ESS switch TDNET to a D-Channel node on the CNI Ring and from the customer facility D-Channel. Each node will be on diverse CNI equipment frames, that is, one node on frame 0, and the second on frame 32.

Both of the D-Channels will have the same LACID assignment via the ODA Form 402E (RC207). See the section, "Define Customer LACID," in this chapter for more information on LACID assignments. The TAN entry on this form is the PTAN (CNI Port TAN) assignment. The Primary D-Channel will be assigned first, and the backup D-Channel will be second. The CTANs (Customer TANs) cannot be assigned for the D-Channels or B-Channels until the LACID has been defined on this form. There is no rule as to which CNI Frame D-Channel node has to be the first or second TAN entry. Use ODA Form 402E. See the following example:

```
DIV. 6, SEC. 2e                                          TRANSLATION GUIDE
June, 1987                                                        TG-4

ESS 402E TG-4                LACID TO D-CHANNEL ASSIGNMENT
4E13>                                  4 ESS

                             ESS UNIT _____________________


FORM CODE _2E_                                      LACID _____,
          1  2                                            4    7

          TAN
 TSI     SPC  LVL   FTS                                   AD
10 11    12   13   14 16                                 80
_____,  __,  __,  _____,                                 __
_____,  __,  __,  _____,                                 __


REMARKS _____________________________________________ PAGE ____ OF ____
```

The PTANS assigned on ODA Form 402E must be defined on the D-Channel TSG, ACI*DCHAN.

Both of the D-Channels will be assigned the same LACID as the Primary D-Channel.

No more than two TANs may be entered with the same LACID.

Procedure for Establishing D-Channel Backup

Perform the following steps for D-Channel backup:

Step	Action
1	Establish D-Channel signaling links for D-Channel backup.
2	Verify Circuit Identification Number (CIN) and TAN assignments for D-Channel signaling link pair.
3	Verify nailup information for D-Channel signaling link.
4	Change secondary signaling link to UNEQ.

Continued on the next page

Step	Action
5	Change secondary signaling link to initial values.
6	Change link interface data for primary and secondary signaling links.

See TOPS 234-153-055, *Common Network Interface - Growth/Degrowth,* for more detailed information.

Guidelines for Provisioning

Provision the D-Channels, D1 and D2, according to the following guidelines:

- The D-Channels must be on a separate DS1 facility between the central office and the customer PBX location.
- Where possible, the D1 DS1 line should be diversely routed from the D2 DS1 line.
- The D-Channel should go to two separate nodes located on two separate rings.

Provisioning DIF-E1 and Digital Interface Units (DIUs)

- Multiple PRIs with D1 and D2 must terminate on separate DIF-E1s (where possible).

  NOTE: They should also terminate on separate DIUs powered by different power BUSs.

- Where separate DIF-E1s are unavailable, the multiple PRIs with D1 and D2 must terminate on separate DIUs.

  NOTE: They should not terminate on DIUs powered from the same BUS.

- The D1 channels must connect through the 4ESS switch to the D-Channel Node on the CNI Ring via DIUs powered by the same A or B BUS.
- The D2 channels must connect through the 4ESS switch to the D-Channel Node on the CNI Ring via DIUs powered by the same A or B BUS.

  NOTE: Mixtures of A and B BUS powered equipment are not recommended within the paths.

Provisioning Common Switch Equipment

- A DIU malfunction should not cause total isolation of a customer's circuits due to D-Channel failure (D1 or D2). The D-Channels must be diversified among the DIUs and DIF-E1 frames when possible.
- D1 and D2 arrive at the 4ESS switch on separate DS1s and must pass through the office using a minimum amount of common switching equipment.

Reference

Refer to TOPS procedure 234-153-055, *Common Network Interface - Growth/Degrowth* for more detailed information.

Chapter 5
Maintenance and Testing

Introduction

Overview

This chapter explains the types of maintenance and testing that needs to be done on the D-Channels and B-Channels to ensure that protocols are working correctly and that bits are being carried without errors. Monitored and simulated testing from the 4ESS switch and from the customer site are described. Hardware necessary to perform the testing is listed, and troubleshooting examples are provided.

Organization of This Chapter

Topics in this chapter include the following:

Protocol Analysis

Overview

When troubleshooting problems with ISDN applications, interaction between the 4ESS switch and the Customer Premise Equipment (CPE) is necessary to be able to interpret the signaling that occurs on the D-Channel at the time the trouble is detected. This section describes what a test set — protocol analyzer — is, and what its functions are.

Protocol Analyzer

A protocol analyzer is a test set that is placed between the 4ESS switch and the CPE. Exactly how the analyzer connects depends on the particular vendor from whom you get your equipment.

Protocol analyzers can be used as monitors and as test simulators.

As a monitor, the device monitors traffic over a link. The protocol analyzer is placed on the link between the two devices to be monitored and passively captures all transmissions on the line for later examination.

As a test simulator, the device actively communicates with another device. The tester can be connected to the Device Under Test (DUT) and sends a predetermined set of Q.931 messages, for example, and then examines the replies from the DUT to be sure that they are valid responses. The protocol analyzer does not contain an ISDN protocol implementation itself; it contains only a script of test frames and messages and the expected responses.

Functions of the Protocol Analyzer

One function of the protocol analyzer is to trap the D-Channel signaling from an ISDN interface (PRI) and decode the bits into ASCII characters for the tester. A protocol analyzer can also be used for protocol conformance testing. This is typically done prior to connecting a new device onto a live network, to assess the device's implementation of a protocol.

Protocol analysis and monitoring is essential to analyze performance of a network and is helpful for identifying potential problems, for example, protocol incompatibilities. See the section, "Troubleshooting Protocol Problems," in this chapter for more information.

Test Equipment Required

Overview

This section lists the hardware necessary to perform the testing scenarios described in the section, "Types of PRI Tests," in this chapter.

Required Equipment

NOTE: Tekelec* equipment was used for the testing scenarios in this chapter. It is not necessary that you use Tekelec equipment; test equipment from other vendors will perform the same function.

The following table lists the quantity and part number of the Tekelec equipment, and gives a description.

	QTY	PART	DESCRIPTION
SYSTEMS	1	937-1019-01	Chameleon 32-plus Dual Port System
	1	937-0004-02	CH5 BRI/PRI Protocol Analyzer with ISDN BRI & PRI
INTERFACES	1	930-2550	ISDN Single BD PRI T1 ANSI (1.544)
	1	930-2551	ISDN Single BD PRI T1 ANSI (1.544) Second Bd.
SOFTWARE	1	930-4255	NT/TE Simulator (BRI/PRI)
	1	937-0013-01	NX64 BERT Package for CH5 BRI/PRI
MANUALS	1	910-0172-02	CH5 Series User's Manual
	1	910-0189-01	CH5 PRI Supplementary Manual

* Tekelec is a registered trademark of Tekelec.

Layer Analysis

Overview

This section describes the layers of protocol; physical, data link, user-network, and CPE-dependent. It explains what the layers are and how to troubleshoot/test them.

NOTE: For a complete explanation of the seven layers of protocol in the Open Systems Interconnection (OSI) architecture, see the section, "The Seven Layers of Protocol," in Chapter 2, "Overview of the LEC 4ESS Switch ISDN Capability," in this manual.

Layer 1

Layer 1 is the "Physical Layer." It is concerned with the transmission of unstructured bit stream over physical medium. This layer can be the most difficult to troubleshoot. Without basic connectivity it is difficult to determine exactly where the problem is. Bit Error Rate Testing (BERT) can be used to determine connectivity.

Test

The Tekelec provides information, via LED indicators, where the link is *framing* properly. Framing properly means that you can distinguish between noise and data on the line, and can throw out the noise.

Using the loopback configuration, you can properly determine if a PRI link is working at the Digital Cross-Connect (DSX) frame. On-site verification can be sectionalized (broken down to known working links) to determine where the fault is. See the section, "Loopback Testing Through the DSX Frame," in this chapter for more information.

Layer 2

Layer 2 is the "Data Link Layer." It provides for the reliable transfer of information across the physical link. Layer 2 provides flow control and error checking.

Test

This layer can be tested by monitoring or by using simulation mode. After using BERT testing to check for connectivity in Layer 1, you can use BERT testing to check the quality of the test patterns in Layer 2. (See the section, "Capabilities of Tests," in this chapter for more information on BERT.)

In simulation mode, commands can be initiated by the simulator to determine what level of response the link is providing. See the section, "Monitoring the D-Channel," in this chapter for more information.

Layer 3

Layer 3 is the User-Network interface. These protocols are used between the ISDN CPE and the network access point.

Test

The Tekelec equipment is used as a simulator to test this layer.

Layers 4—7

Layers 4—7 are the "CPE-Dependent Layers" and are application dependent. Meaning that they can be used/configured depending on the needs of your site. They provide access to the OSI environment for users.

Capabilities of Tests

Overview	This section describes the different types of tests that can be done, either from the 4ESS switch, to test the 4ESS connections, or from the customer site, to verify PRI connections.
BERT Testing	Standardized Bit Error Rate Testing (BERT) provides information on the quantity of bit errors and the pattern in which they occur. Statistics such as errored bits, bit error rate, number of blocks, and errored seconds can be measured.
Simulation	Allows you to initiate a call on a B-Channel by sending messages on the D-Channel, and then to test the B-Channel with BERT tests. This can be done via test scripts or manual entry at the 4ESS switch.
Monitoring	Provides the ability to monitor the D-Channel remotely from the 4ESS switch to capture information on Q.931 protocol messages for analysis.
Multitasking	Provides the ability to simulate on one test port and monitor on the other port of the DSX frame simultaneously. All data can be stored directly to disk and then transmitted to computer files for remote analysis or printing.
Remote/On-Site Testing	These tests can be performed at the switch site (for customer turn-ups and installation), or remotely, by using the 4ESS switch to set up connections remotely to monitor/simulate.

Prerequisites for Testing

Overview

This section gives an outline of the those steps that should be completed prior to beginning PRI testing.

Before Testing...

Before beginning the PRI tests in the next section, "Types of PRI Testing," make sure that

- the TSI-B Frame has been modified
- the SM9 hardware is installed correctly
- the D-Channel node has been properly installed
- the LACID, TSG, and D-Channels are defined
- the T1 lines (Layer 1) are provisioned correctly

The above should all be in working order before you begin Tekelec testing or on-site customer testing.

3B Commands

The following commands can be used to monitor and test Layers 1 and 2, to prove that the link exists:

- `CHG:SLK` — For pre-service link maintenance of D-Channel links while the Major State on the LKDATA form is Unavailable, use the message as in the following example:

  ```
  CHG:SLK(0,4,1,3); TEST!
  ```

  This would begin testing of the growth or pre-service link.

  ```
  CHG:SLK (0,4,1,3); GROW!
  ```

  This would terminate the testing of the growth or pre-service link. This testing would be at Layer 1, 2, and part of Layer 3.

- `LKC:SLK` — This message is used specifically to test In-Service D-Channel links. **NOTE:** Please use caution when using this command. This is an intrusive test.

  Use the following command as an example:

  ```
  LKC:SLK (0,4,1,3);LCHK 300!
  ```

  This would run the link check for 300 seconds on Layers 1, 2, and 3, and would report errors, including bit errors on the D-Channel under test.

- MON:SLK — Monitors and reports immediate signal link events. This monitor will report real time events on signaling links that MAY have service impact.

  CAUTION: This message may cause large amounts of 3B ROP processor output.

  Use the following commands as examples:

  ```
  MON:SLK(0,4,1,3);ON X'cfe01!
  ```

  ```
  MON:SLK(0,4,1,3);OFF!
  ```

For further information on these commands, see the current issue of the *4ESS™/APS Input Messages Manual* and the *4ESS™/APS Output Messages Manual*. The document numbers are IM-4A001-01 and OM-4A001-01.

Types of PRI Testing

Overview

There are numerous ways to test the PRI link and connections to ensure that protocols work correctly, and that the medium is carrying bits without errors. What follows are a few examples of areas that most likely do need to be tested.

Please note that each operating company will need to develop their own procedures for testing. Use the following sections to help you get started.

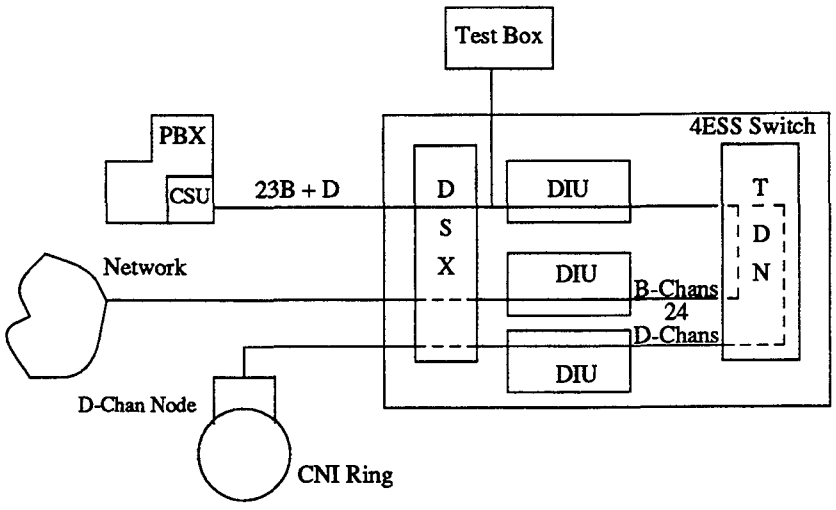
NOTE: Tekelec equipment, as well as other equipment of similar capabilities, can be used for these tests. In the following examples, "Test Box" is used as a generic term for the various types of test equipment.

Monitoring the D-Channel

Monitoring the D-Channel can be done from the 4E switch.

This test is used mostly during maintenance activities to determine the state of the PRI link. By monitoring the D-Channel (the control link) you can determine if an active call is being attempted, and how the Q.931 protocol is handling the call. This test is done on the switch site, from the DSX frame, so that it will not interrupt customer activities.

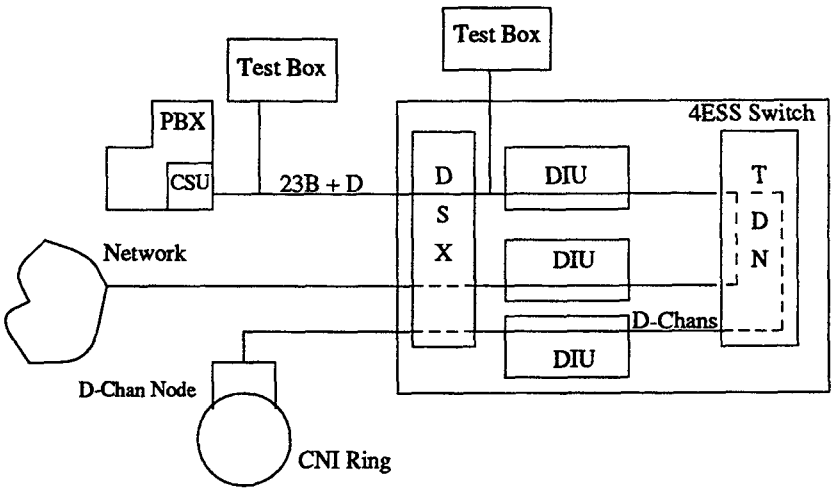
Monitoring, unlike simulating, is passive. You get information by bridging onto a circuit and watching what transpires back and forth.



Verification of PRI Link at Customer Site

Verifying the PRI link should be done at the customer site. This test is done before the PRI link is turned over to the customer. It is the final test to verify that the customer's link is ready for use.

The test equipment at the DSX Frame (4ESS office) is linked to the customer with a 2nd piece of test equipment (used to terminate or originate calls). BERT testing (pattern testing) determines Layer 1 and 2 connectivity. Simulation testing can detect Layer 3 errors.

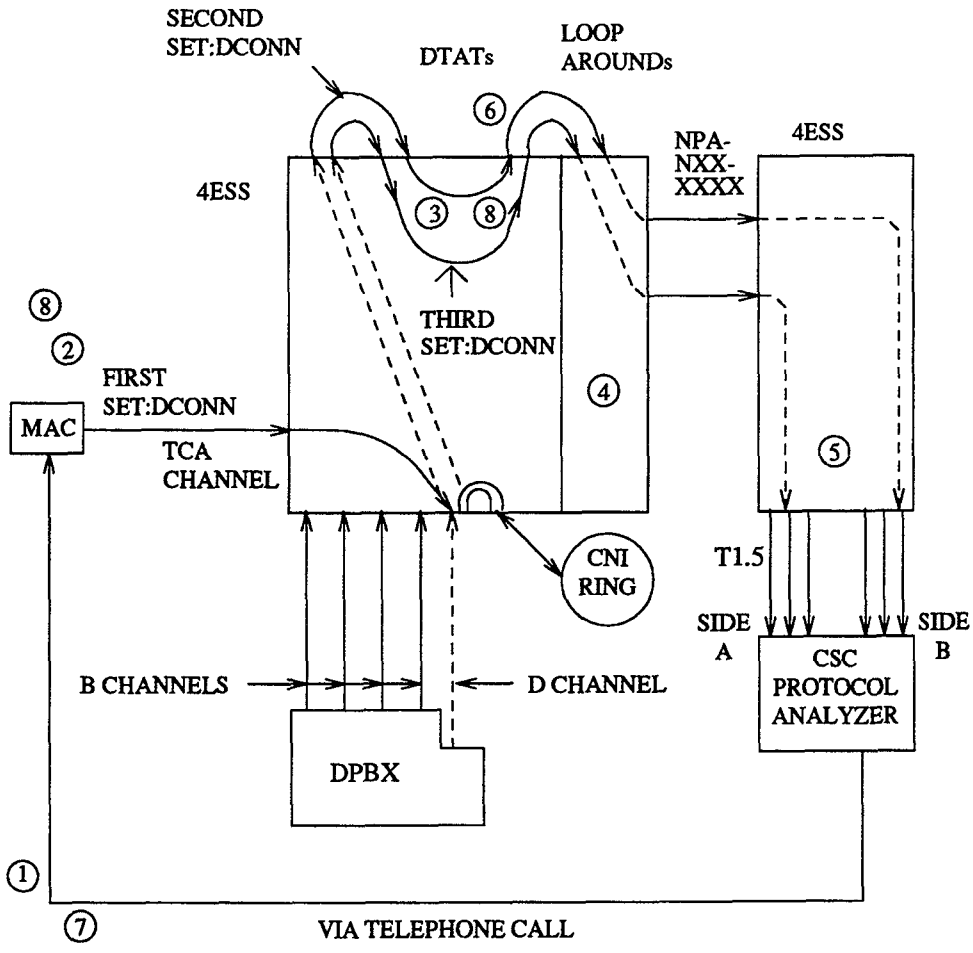


Remote Testing

Besides on-site testing, protocol analysis can be done remotely, from a centralized test center. This allows one maintenance person in one office to analyze and service several sites.

One testing scenario is as follows: At one location is a centralized test position with a dedicated PRI link to the 4ESS switch. This test arrangement provides simulation of a PBX, enables you to call a remote PRI, and enables you to monitor the remote D-Channel connection. By analyzing Q.931 messages, you can determine call set-up and failure patterns. **NOTE:** Monitoring can be set up at any time without adversely affecting the D-Channel node or the customer. (The diagram below is explained in the following section.)

ISDN D-CHANNEL
PROTOCOL TESTING



Note: Only outgoing direction of DTATs and LOOP AROUNDs are shown.

Diagram Explanation

Call Set-up (Steps 1 through 6)

- Step 1 — A request is made to inspect the customer's ISDN D-Channel protocol (Q.931). The Customer Service Center (CSC) initiates the test by calling the Machine Administration Center (MAC) to initiate 4ESS switch commands to transmit a D-Channel connection over Digital Test Access Trunks (DTATs)/Loop-Arounds to the terminating 4ESS switch and associated CSC. Caller should provide D-Channel Circuit Identification Number (CIN) and two analyzer phone numbers to be dialed.
- Step 2 — The MAC will input three `SET;DCONN` (Digital Connection) commands to send the D-Channel signal to the remote CSC. The MAC inputs first `SET:DCONN` command into the 4ESS switch via Test Control Area (TCA) channel to bridge customer's D-Channel signal onto DTATs.

  For example

  ```
  SET:DCONN24:RDC, UCL:CIN (D-Channel),
       mode 5!
  ```

  The D-Channel signal is bridged to DTATs number 24 and 25. The MAC should keep track of DTAT numbers assigned.
- Step 3 — The MAC inputs second `SET:DCONN` command to bridge one DTAT to a loop-around test trunk and outpulse Dialed Number (DNBR) digits of the test number for side A of analyzer.

  For example

  ```
  SET:DCONN 48:CIN; 1001 DATAOUT LOOP,
    mode 1, DNBR !
  ```

  The MAC inputs third `SET:DCONN` command similar to second `SET:DCONN` command to bridge other DTAT to another loop-around test trunk and outpulse dialed digits of corresponding test number for side B of protocol analyzer.

  For example

  ```
  SET:DCONN 49; 1002 DATAOUT LOOP,
          mode 1, DNBR
  ```

- Step 4 — DNBR digits are translated and routed in the proper domain (for example, N64C, NH0C, or NH1C) to the terminating 4ESS switch.
- Step 5 — The terminating 4ESS switch translates and routes to CSC on proper channel.

- Step 6 — Same routing is performed on second number dialed from third SET:DCONN command. (**NOTE**: At this point the monitor connection is up.)

Call Hang-up (Steps 7 and 8)

- Step 7 — CSC requests the MAC to terminate test access by providing D-Channel CIN. (Phone connection may or may not be torn down. Therefore, further testing of another D-Channel may be requested over the same transmission path.)
- Step 8 — The MAC gives one SET:DCONN command to tear down the test access. (Two more SET:DCONN commands are required to tear down the phone connections.)

  For example

  ```
  SET:DCONN 24; RLS,RDC! (Tear down test access)
  SET:DCONN 48; RLS! (Tear down phone connection)
  SET:DCONN 49; RLS! (Tear down phone connection)
  ```

  NOTE: The tear-down of the monitor does not adversely affect the D-Channel node or the customer.

Troubleshooting the D-Channel Node

Overview

The failure of a D-Channel link indicates a critical situation.

The following section outlines a few steps you can take to prevent trouble from occurring, or to ensure you are notified if trouble does occur.

General Procedures

1. Alarms are set up which will aid you in troubleshooting. Alarm indicators are either visual (colored lights) or audible. Alarm condition types are Major or Minor. A Major alarm is audible. If the D-Channel goes down, that is considered a Major alarm.
2. 1108 page — display page that shows status of nodes and links. This is used to determine if a D-Channel is out of service.
3. Set up monitoring at the 3B — `MON:SLK`. This command provides extra data on what is occurring on your system that doesn't normally appear on the ROP.
4. Set up logfile to collect information gathered while monitoring — `OP:LOG;LG"CNCELOG"`. This command enables you to look at the history of a particular D-Channel.

Troubleshooting Protocol Problems

Overview

One function of the protocol analyzer is to trap the D-Channel signaling from an ISDN interface (PRI) and decode the bits into ASCII characters for the tester. This enables the troubleshooter to read the Q.931 messages and the information contained within each message. The message and information can then be compared with the PRI specifications to check for any protocol violations. (See *Technical Reference 41459 AT&T Network Integrated Services Digital Network (ISDN) Primary Rate Interface and Special Application Specification, User-Network Interface Description* for more information.) The troubleshooter can then go through the call scenarios, follow the message flow, and determine whether any messages are sent at the wrong time.

When the error is determined, the tester can identify whether the message is sent by the 4ESS switch or by the CPE. In the case of PRI, the error would be identified between two switches (for example, 4ESS and a System 85 [Definity]) or between a switch and a system controller (for example, 4ESS and a 6500 controller). A protocol analyzer will label each message as either from the Network (4ESS) or the CPE (ISDN voice sets, System 85 [Definity], controllers, etc).

Troubleshooting

The first step in troubleshooting protocol problems is understanding the format of the message as it is received from the protocol analyzer. Figure 5-1 contains a message in protocol analyzer format. The message chosen for dissection is a SETUP message.

NOTE: Every vendor uses a different format, but, the variation is slight since they have to decode the signaling per the BRI and PRI specifications. (See *Technical Reference 41459 AT&T Network Integrated Services Digital Network (ISDN) Primary Rate Interface and Special Application Specification, User-Network Interface Description* for more information.) The format chosen for Figure 5-1 was collected from the protocol analyzer most widely used by AT&T personnel.

Example

Figure 5-1 is an example of a SETUP message in protocol analyzer format.

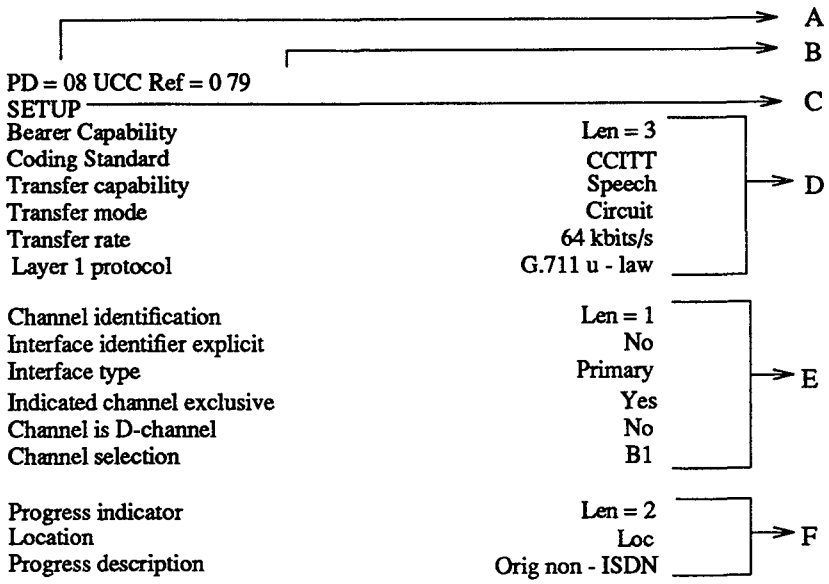


Figure 5-1. Protocol Analyzer Message Example

Explaining Figure 5-1

The various parts of the SETUP message (labeled A through F in Figure 5-1) are explained here.

Elements A through C

- A - Protocol Discriminator (PD) Element

  The PD value (Hex 08) identifies the message as a Q.931 message. Currently, 08 is the only valid PD.

- B - Call Reference (CR) Element

  The SETUP message in the example, is a call being originated by the 4ESS switch. Therefore, the CR Flag is set to 0 and is displayed here as O for origination. (If the CPE were to respond to this message, the message would be destined for the 4ESS with a CR flag set to 1 and would be displayed by the analyzer as D for destination.) The CR value for the lifetime of this call is equal to Hex 79. All messages from the 4ESS pertaining to this call will be displayed, on the protocol analyzer, as a CR of 0111 1001. All

messages from the CPE pertaining to this call will be displayed as a CR of 1111 1001. The numerical values for CR are Hex values.

- C - Message Type Element

  The Message Type element has a value of SETUP. This is a SETUP message from the 4ESS switch to the CPE. This is a request to establish an incoming call over the B-channel to the CPE.

Elements D through F

Elements D through F reference various Information Elements (IE) that are included in the SETUP message. Some of these IEs are mandatory while others are optional. Some SETUP messages are shorter than others, depending upon the various features subscribed to. These features direct the addition of optional elements. For example, if the Display field on the ISDN DSL RCV view 23.2 is populated with "N" indicating no display, no Display Field elements will be included. Whether a particular element is optional or mandatory for a particular message is specified in the PRI spec under the Network Layer section.

- D - Bearer Capability Element

  The Bearer Capability element is mandatory for all SETUP messages. It explains the transmission capabilities of the link that the call will be established on. The comment LEN = 3 refers to the length of the Bearer Capability element. It states that the next three octets of information are the parameters for the Bearer Capability element. The parameters for the Bearer Capability are within the brackets labeled D.

  The Bearer Capability parameters tell the CPE (or the tester) that the Coding Standard used for the D-Channel information is CCITT. The Transfer Capability is Speech. This means that Speech or voice will be the format that the information takes as it goes out over the B-Channel. (For Circuit Switched Data the possible values would be Unrestricted or Restricted.) The Transfer Mode is Circuit and the Transfer Rate is 64 Kbps. This indicates the voice will be Circuit Switched Voice (digital voice) and the speed of the B-Channel is 64 Kbps. The Layer 1 protocol refers to the standard used to convert the analog voice signal to a digital signal. G.711 u-law is a CCITT standard.

  This element and its parameters are setting up a Circuit Switched Voice call over a 64 Kbps link using standard analog to digital conversion.

- E - Channel Identification Element

  The Channel Identification element is mandatory for all SETUP messages sent from the 4ESS switch to the CPE. The length of the element is 1 octet (LEN = 1). Therefore, the next single octet of information will contain the parameters for the Channel Identification element. This information is within the brackets labeled E.

  The Channel Identification parameters inform the CPE of the characteristics of the channel that carries the above Bearer Capability information. Interface identifier explicit is No. This means the D-Channel signaling is contained in the same interface as the B-Channel (refer to the Channel Identification element explained earlier in the text.) The Interface Type is Basic identifying that the CPE is connected to a PRI. Indicated channel exclusive is Yes which means that only the B-Channel indicated in this element can be used for the call. For voice calls, this is the B-Channel that is translated for voice. Likewise, for Circuit Switched Data calls, it is the B-Channel translated for Circuit Switched Data. Channel is D-Channel is No meaning that the information transfer (voice) will not take place over the D- Channel. The channel that handles the voice is indicated in Channel selection equal to B1.

  This element and its parameters set up the voice connection on the B1 channel of a PRI.

- F - Progress Indicator Element

  The Progress Indicator element is only in a SETUP message from the 4ESS switch to the CPE if the incoming call is from a non-ISDN source (for example, an analog phone). The length of this element is 2 (Len = 2). The next two octets of information contain parameters for the Progress Indicator element and the decodes are within the brackets labeled F.

  The Progress Indicator element informs the CPE of the source of the call. The location of the call is Loc which refers to local network. This means the call was originated from a user off the same 4ESS switch as the CPE receiving the call. The Progress description is Orig non-ISDN which identifies the fact that the user who originated this call was not using an ISDN phone.

  This element and its parameters identify the voice call as one established from an analog phone within the same 4ESS switch as the receiver of the call.

Summary

The protocol analysis format was chosen for the example because it is the format most commonly seen within AT&T. Some information that was not included in the example is that the various Information Elements are identified by an I in front of the element. The parameters for an element always follow directly underneath the element and pertain only to that element. After troubleshooting has been performed once or twice, the tester will become very familiar with identifying Information Elements and separating these elements from their parameters .

B-Channel Testing

Overview

B-Channel Testing is done no differently than D-Channel testing. B-Channel testing is the same as other existing single circuit testing; you test B-Channels as you would test other trunks.

How to Test

You can test B-Channels by using the Remote Measurement System Digital 2 (RMSD2) test facility. The RMSD2 measures trunks.

Testing can be done in one of two ways.

- Move the RMSD2 to a DIU that has been upgraded with SM9s to support 64 Kbps testing.
- Grow SM9s into the DIU where the RMSD2 is already attached.

See the *Remote Measurement System - Digital 2 User's Manual*, Document Number 234-121-105, Issue 4, June 1992, and the RMSD2 task (NTP 025) in the TOPS procedure *GROWTH/DEGROWTH-NM, MF, ROTL, ALARMS, ABC, DRO, CCT, POWER PLANTS, 51A TPOS, RMS-D2* Issue 6, January 1992, for more information on RMSD2 testing.

Chapter 6
Billing/AMA

Introduction

Overview

This chapter explains general billing information and defines data fields, structures, and modules. It tells how to build an AMA record, and gives AMA call recording formats for originating and terminating calls. The seven AMA tables for both Inter-LATA and Intra-LATA calls are shown.

Organization of This Chapter

Topics in this chapter include the following:

Automatic Message Accounting (AMA)

Overview

Automatic Message Accounting (AMA) is the process that generates data from which customers and carriers are billed for their use of network services and capabilities.

Basic Element of an AMA Record

The basic element of an AMA record is a field of data, also known as a *table*. AMA records differ for Inter- and Intra-LATA calls.

AMA Record Defined

A record may be a simple, predefined structure of fields. Or it may be a structure to which modules of fields have been appended. The key to the network's choice of the proper structure for coding data is the call type.

The 4ESS switch puts all of the information into the tables or records, based on the type of call that is generated or received. This information is then passed to the LECs' billing system.

NOTE: The tables provided in this document conform to the Bellcore AMA Format (BAF). See the *TR-NWT-001100 BAF Requirements Document* for more information.

AMA Call Recording Formats

Overview

AMA billing records must accommodate carrier codes. A carrier code is the code that identifies a particular carrier selected by the customer to handle their local or long distance calls.

Originating Inter-LATA Calls

Originating Inter-LATA data calls (that originate at the 4ESS switch via PRI) that are recorded for AMA, shall use Call Code 117 and Structure Code 00645 or 00647 depending on call conditions.

See the section, "Tables," in this chapter for more information.

Originating Intra-LATA Calls

Originating Intra-LATA data calls (that originate at the 4ESS switch via PRI) that are recorded for AMA shall use Call Code 072 and Structure Code 00190 or 00194 (4E17 and beyond) depending on call conditions.

NOTE: The 4E16 generic uses Call Code 61 and Structure Codes 1081 and 1083.

See the section, "Tables," in this chapter for more information.

Terminating Calls

Terminating Inter-LATA ISDN data calls (terminating at the 4ESS tandem switch) that are recorded for AMA shall use Call Code 121 and Structure Code 00656 or 00657 (4E17 and beyond) depending on call conditions.

See the section, "Tables," in this chapter for more information.

ISDN AMA Module 071

The ISDN AMA module 071 (see Table 1 in the section, "Tables," in this chapter) must be appended to the AMA records generated for both originating and terminating Inter- and Intra-LATA data calls.

ISDN Core Module 071 contains Tables 410, 411, 412 (see the "Tables" section) and will be appended to presently defined structures.

- Table 410 is used to identify network interworking situations, and is delivered to the user.
- Table 411 is used to provide release cause information.
- Table 412 records the bearer capability delivered to the user.

Table 410

An ISDN call may be completed via an interworking arrangement which converts the signaling and transmission as appropriate to the connected network or access circuit. The identity of the interworking situation should be recorded because it may affect the rate charged for the call or have other tariff impacts.

The interworking value may affect how an end user is charged, especially for signaling services, where interworking provides an implicit indication that the signaling information could not be delivered.

Table 410 contains codes which identify interworking situations for calls originating from an ISDN circuit. When a call has an end-to-end ISDN connection, "0" — no interworking encountered — should be recorded. A value for each of the interworking situations is specified in Table 410.

Intra-Switch Interworking Recording

For an intra-switch circuit mode call, Character 1 of Table 410 should be coded either "0" — no interworking encountered — if the terminating user is ISDN, or "3" — called equipment is non-ISDN — if the terminating user is non-ISDN. (NOTE: The default is "0".)

Inter-Switch Interworking Recording

For an inter-switch circuit mode call, the originating switch will rely on bits K and M in the Backward Call Indicators (BCI) field, which may be included in certain ISUP (see Chapter 2, "ISUP," in this manual) messages. The meanings of bits K and M are as follows:

K = 0 if ISUP is not used all the way
K = 1 if ISUP is used all the way
M = 0 if terminating access is non-ISDN
M = 1 if terminating access is ISDN

Bits K and M are mapped into Character 1 of Table 410 as shown in the following table:

K	M	Character 1 of Table 410
0	0/1	2 = Call is not end-to-end ISDN
1	1	0 = No interworking encountered
1	0	3 = Called equipment is non-ISDN

Table 411

When a call is terminated, the cause will be sent to the user as part of a release sequence message. This cause should be included in the AMA record as part of module 071.

The "cause numbers" in Table 411 are directly related to the information elements delivered to the user on the D-Channel when a call is released. For end-to-end ISDN calls, the cause should be whatever is reported by the disconnecting terminal. For ISDN to analog calls when the analog party disconnects first, no cause is sent — so a value of 127 (interworking) should be recorded. If the ISDN originator disconnects, then the cause value should be whatever is reported by the terminal.

Table 412

Table 412 records the bearer call type and bearer capabilities delivered to the user. Each bearer call type is a category of bearer capabilities used to consolidate aggregate records.

Tables

Overview

This section shows the tables necessary for completing an AMA billing record.

Tables

Table 1. AMA Module 071

MODULE 071 - ISDN CORE MODULE		
AMA TABLE NUMBER	MEANING	BCD CHARS
88	Module Code (071)	4
412	Bearer Capabilities	4
410	Network Interworking	2
411	Release Cause Indicator	6

Table 2. AMA Table 42

TABLE 42 - CSDC DATA RATE INDICATOR	
BCD CHARS	MEANING
1-3	Module Code Number 000=This table not populated 001=1536 Kbps clear 002=1536 Kbps restricted 003=384 Kbps clear 004=384 Kbps restricted 005=64 Kbps clear 006=56 Kbps 007=64 Kbps restricted
4	SIGN (Hex C)

Indicates the data rate used on a CSDS call.

Table 3. AMA Table 88

TABLE 88 - MODULE CODES	
BCD CHARS	MEANING
1-3	Module Code Number 000=End of Module 071=ISDN Core Module
4	SIGN (Hex C)

Contains a number which uniquely identifies an AMA Module appended to an AMA structure.

Table 4. AMA Table 410

TABLE 410 - NETWORK INTERWORKING	
BCD CHARS	MEANING
1	0=No interworking encountered 1=Interworking unspecified 2=Call is not end-to-end ISDN 3=Called equipment is non-ISDN 9=Don't know
2	SIGN (Hex C)

Used to identify network interworking situations, and is delivered to the user.

Table 5. AMA Table 411

TABLE 411 - RELEASE CAUSE INDICATOR	
BCD CHARS	MEANING
1	0=Padding
2	0=CCITT Standard 3=network specific
3-5	CCITT or Network Specific Cause Value ##
6	SIGN (Hex C)

All the CCITT Standardized and Network Specific cause values will be valid for recording in this table. The AT&T PRI Network specific cause values are identified in the AT&T PRI Specifications Documents.

Table 6. AMA Table 412

TABLE 412 - BEARER CAPABILITIES	
BCD CHARS	MEANING
1	0=Padding
2-3	01=Circuit Mode Speech 02=Circuit Mode 3.1 kHz Audio 03=Circuit Mode Unrestricted 64 kbps Digital Information Transfer 04=Circuit Mode Unrestricted 64 kbps Digital Information Transfer Rate Adapted from 56 kbps 05=Packet Mode Unrestricted Digital Information Transfer 07=Circuit Mode Unrestricted Digital Information Transfer at a rate greater than 64 kbps 99=Unknown
4	SIGN (Hex C)

Records bearer capability delivered to the user.

Table 7. Call Code 072 Structures

Intra-LATA Data Call
Call Code 072

Structure Layouts for Call Code 072				
Information	Table Number	BCD Chars	Structure Codes 00190	Structure Codes 00194
Call Type	1	4	x	x
Sensor Type	2	4	x	x
Sensor Identification	3	8	x	x
Recording Office Type	4	4	x	x
Recording Office Identification	5	8	x	x
Carrier Connect Date	6	6	x	x
Timing Indicator	7	6	x	x
Study Indicator	8	8	x	x
Answer Indicator	9	2	x	x
Service Observed, Traffic Sampled	10	2	x	x
Operator Action	11	2	x	x
Service Feature	12	4	x	x
Originating NPA	13	4	x	x
Originating Number	14	8	x	x
Overseas Indicator	15	2	x	x
Terminating NPA	16	6	x	x
Terminating Number	17	8	x	x
Connect Time	18	8	x	x
Elapsed Time	19	10	x	x
Service Indicator	41	4	x	x
Data Rate Indicator	42	4	x	x
Terminating Company	56	4	x	x
Present Date	6	6	-	x
Present Time	18	8	-	x

Structure Codes

00190 Answered

00194 Long Duration

The information parameters not explicitly described in this document shall be populated using existing population rules.

Table 8. Call Code 117 Structures

Originating Inter-LATA Data Call
Call Code 117

Structure Layouts for Call Code 117				
Information	Table Number	BCD Chars	Structure Codes 00645	Structure Codes 00647
Call Type	1	4	x	x
Sensor Type	2	4	x	x
Sensor Identification	3	8	x	x
Recording Office Type	4	4	x	x
Recording Office Identification	5	8	x	x
Carrier Connect Date	6	6	x	x
Timing Indicator	7	6	x	x
Study Indicator	8	8	x	x
Answer Indicator	9	2	x	x
Service Observed, Traffic Sampled	10	2	x	x
Operator Action	11	2	x	x
Service Feature	12	4	x	x
Originating NPA	13	4	x	x
Originating Number	14	8	x	x
Overseas Indicator	15	2	x	x
Terminating NPA	16	6	x	x
Terminating Number	17	8	x	x
Connect Time	18	8	x	x
Elapsed Time	19	10	x	x
IEC/INC Prefix	57	6	x	x
Carrier Connect Date	6	6	x	x
Carrier Connect Time	18	8	x	x
Elapsed Time from Carrier Connect	19	10	x	x
IEC/INC Call Event Status	58	4	x	x
Trunk Group Number	83	6	x	x
Routing Indicator	59	2	x	x
Dialing Indicator	85	2	x	x
ANI Indicator	60	2	x	x
Service Indicator	41	4	x	x
Data Rate Indicator	42	4	x	x
Terminating Company	56	4	x	x
Present Date	6	6	-	x
Present Time	18	8	-	x

Structure Codes

00645 Answered Inter-LATA

00647 Long Duration Inter-LATA

The information parameters not explicitly described in this document shall be populated using existing population rules.

Table 9. Call Code 121 Structures

Terminating Inter-LATA Data Call
Call Code 121

Structure Layouts for Call Code 121				
Information	Table Number	BCD Chars	Structure Codes 00656	Structure Codes 00657
Call Type	1	4	x	x
Sensor Type	2	4	x	x
Sensor Identification	3	8	x	x
Recording Office Type	4	4	x	x
Recording Office Identification	5	8	x	x
Carrier Connect Date	6	6	x	x
Timing Indicator	7	6	x	x
Study Indicator	8	8	x	x
Answer Indicator	9	2	x	x
Service Observed, Traffic Sampled	10	2	x	x
Operator Action	11	2	x	x
Service Feature	12	4	x	x
Overseas Indicator	15	2	x	x
Terminating NPA	16	6	x	x
Terminating Number	17	8	x	x
Connect Time	18	8	x	x
Elapsed Time	19	10	x	x
IEC/INC Prefix	57	6	x	x
Carrier Connect Date	6	6	x	x
Carrier Connect Time	18	8	x	x
Elapsed Time from Carrier Connect	19	10	x	x
IEC/INC Call Event Status	58	4	x	x
Trunk Group Number	83	6	x	x
Routing Indicator	59	2	x	x
Service Indicator	41	4	x	x
Data Rate Indicator	42	4	x	x
Terminating Company	56	4	x	x
Present Date	6	6	-	x
Present Time	18	8	-	x

Structure Codes

00656 Answered Inter-LATA

00657 Long Duration Inter-LATA

The information parameters not explicitly described in this document shall be populated using existing population rules.

Table 10. (CSDC with ACI) Structure Code 01081

Originating Intra-LATA Data Calls on PRI (4E16)

Structure Code 01081		
Information	Table Number	No. of Characters
Record Descriptor Word	000	8
Hexadecimal Identifier	00	2
Structure Code	0	6
Call Type	1	4
Sensor Type	2	4
Sensor Identification	3	8
Recording Office Type	4	4
Recording Office Identification	5	8
Connect Date	6	6
Timing Indicator	7	6
Study Indicator	8	8
Answer Indicator	9	2
Service Observed, Traffic Sampled	10	2
Operator Action	11	2
Service Feature	12	4
Originating NPA	13	4
Originating Number	14	8
Overseas Indicator	15	2
Terminating NPA	16	6
Terminating Number	17	8
Connect Time	18	8
Elapsed Time	19	10
CSDC Service Indicator	41	4
Data Rate Indicator	42	4
ACI Features	344	4
SID Information	322	12
Count of Message Associated UUI	345	6

Call Codes Recorded
061 = CSDC

Table 11. (CSDC with ACI) Long Duration, Structure Code 01083

Originating Intra-LATA Data Calls on PRI (4E16)

Structure Code 01083		
Information	Table Number	No. of Characters
Record Descriptor Word	000	8
Hexadecimal Identifier	00	2
Structure Code	0	6
Call Type	1	4
Sensor Type	2	4
Sensor Identification	3	8
Recording Office Type	4	4
Recording Office Identification	5	8
Connect Date	6	6
Timing Indicator	7	6
Study Indicator	8	8
Answer Indicator	9	2
Service Observed, Traffic Sampled	10	2
Operator Action	11	2
Service Feature	12	4
Originating NPA	13	4
Originating Number	14	8
Overseas Indicator	15	2
Terminating NPA	16	6
Terminating Number	17	8
Connect Time	18	8
Elapsed Time	19	10
CSDC Service Indicator	41	4
Data Rate Indicator	42	4
ACI Features	344	4
SID Information	322	12
Count of Message Associated UUI	345	6
Present Date	6	6
Present Time	18	8

Call Codes Recorded
061 = CSDC

Appendix A

Acronym List

ANI	Automatic Number Identification
APS	ACCUNET® Packet Service
ASN	AT&T Switched Network
BN	Billing Number
BRI	Basic Rate Interface
CAD/CAM	Computer Aided Design/Computer Aided Manufacturing
CET	Corporate Education and Training
CCIS	Common Channel Interoffice Signaling
CCITT	Consultative Committee for International Telephone & Telegraph
CCS	Common Channel Signaling

CIN	Circuit Identification Number
CNI	Common Network Interface
CP	Customer Premise
CPE	Customer Premise Equipment
CPN	Calling Party Number
CSC	Customer Service Center
CTAN	Customer TAN
CuIC	Customer Information Center
DIF	Digital Interface Frame
DIU	Digital Interface Unit
DLN	Direct Link Node
DMS	Data Management System
DSX Frame	Digital Cross-Connect Frame

DTATs	Digital Test Access Trunks
FEN	Far End Network
FID	FEN Identification
IAD	Integrated Access Distributor
IAM	Initial Address Message
IMS	Interprocess Message Switch
IPC	ISDN Premises Controller
ISDN	Integrated Services Digital Network
ISUP	ISDN User Part
IUN	IMS User Node
IWDC	ISDN Wideband Digital Capabilities
LACID	Link Access Identifier
LAN	Local Area Network

LEC	Local Exchange Carrier
MA UUI	Message Associated User-to-User Information
NCP	Network Control Point
NFAS	Non-Facility Associated Signaling
OC	Operations Centers
ODA	Office Data Assembler
OOB	Out-of-Band signaling
OS	Operations System
OSI	Open Systems Interconnection
PBX	Private Branch Exchange
POTS	Plain Old Telephone Service
PRI	Primary Rate Interface
PTAN	CNI Port TAN

RAC	Ring Access Circuit
RMC	Remote Work Centers
RNA	Ring Node Address
RPC	Ring Peripheral Controller
RWC	Remote Work Center
SDN	Software Defined Network
SDS	Switched Digital Service (Accunet)
SID	Station Identification
SPC	Signaling Point Code
SS7	Signaling System 7
STP	Signaling Control Point
T1FA	T1 Facility Access (units)
TDIU	Type of DIU

TE	Terminating Equipment
TSG	Trunk SubGroup
TSI-B	Time Slot Interchange-B
UCB	Unit Control Block
UUI	User-to-User Information (Exchange)
ZCS	Zero Code Suppression

Appendix B

Glossary of Terms

access protocols	The set of procedures which enable a user to obtain services from a network.
application layer	Layer 7 of the OSI Reference Model; provides specific network services and applications to the user, such as message handling systems, directory services, and network management.
ASCII	American Standard Code for Information Interchange, a standard for data transmission. ASCII assigns sets of 0s and 1s to represent 128 characters, including alphabetical characters, numerals, and standard special characters, such as #, %, and &.
Automatic Message Accounting	AMA is the process that generates information from which customers and carriers are billed for their use of network services and capabilities.
B-Channel	Bearer service channel operating at 64 Kbps, carrying user voice and data.
Bellcore standards	Standards developed by the Bell Communications Research (Bellcore) organization, which is the main research and development organization for regional Bell operating companies. These standards regulate maintenance, testing, and billing among other facets of the business.

Customer Premise Equipment	Equipment located on the customers' premises that transmits and receives a voice/data/image to and from a digital switch. It is also called Terminal Equipment (TE).
D-Channel	The ISDN Out-Of-Band (OOB) signaling channel, carrying ISDN user-network signals. It operates at 64 Kbps in the PRI.
data link layer	Layer 2 of the OSI Reference Model; responsible for error-free communication between adjacent devices in the network.
frame	In ISDN, the unit of transmission at the physical layer or data link layer; physical frames are fixed-size blocks of transmitted signals and contain some sort of frame delimiters; data link frames are variable-length groups of octets, typically delimited by a special 8-bit pattern called a Flag (01111110).
Inter-LATA	Traffic handled by Inter-Exchange Carriers (IEC) across different Local Access and Transport Area (LATA) boundaries. For example, AT&T, U.S. Sprint, and MCI.
Intra-LATA	Traffic handled within the same Local Access and Transport Area (LATA) boundaries.
LAPD	Link Access Procedures on the D-Channel. The ISDN data link layer protocol specified for the D-Channel.
LEC site	Local Exchange Company site. A local telephone company; specifically, a communications carrier that can provide Intra-LATA (local) service, but not Inter-LATA (long distance) service.
octet	8-bit pattern

Open Systems Interconnection (OSI)	A seven-layer model architecture for open systems, allowing communication between computers from different vendors using different network architectures; initially proposed by ISO, adopted by CCITT and most major computer manufacturers around the world; model and protocols defined in CCITT X.200-series recommendations.
Out-of-Band Signaling (OOB)	Signaling information that is exchanged between processor-equipped switching offices, using signaling channels that are completely separate from the user's voice channel.
physical layer	Layer 1 of the OSI Reference Model; primarily responsible for the transport of bits between adjacent devices in a network, describing electrical and mechanical characteristics of the connection and media.
Primary Rate Interface	PRI is the primary ISDN subscriber access. It provides access through a 24-channel (23B+D) interface.
protocol	The set of rules that governs the exchange of information between two devices, allowing them to effectively communicate with each other.
protocol analyzer	A test set to monitor the traffic over a line and/or test implementations of a protocol.
Q.931	The Q.931 protocol is a CCITT recommendation describing D-Channel user-network messages for basic call control. Layer 3 circuit mode ISDN protocol.
Standardized Bit Error Rate Testing (BERT)	BERT testing provides information on the quantity of bit errors and the patterns in which they occur. Measures statistics for errored bits, bit error rate, number of blocks, and errored seconds.

wideband	Channels supporting rates above the primary rate (1.544 or 2.048 Mbps). In general data communications, usually refers to analog, modulated signals, and a bandwidth greater than that of the voiceband.

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