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Bell Labs Innovations

4ESS™-2000 Switch

LEC Feature Handbook

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Acknowledgements

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INTRODUCTION

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INTRODUCTION

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This document summarizes the *4ESS*™ Switch features (up to and including generic 4E23) that are available to the Local Exchange Carrier (LEC) marketplace.

Features currently planned for generic 4E23 are included in Chapter 10. This information is current as of the date of publication.

Since changes may occur as new features are developed, please contact your Lucent Technologies Representative for the latest feature information.

This document is designed as an information reference, and describes 4ESS Switch features in general. It neither modifies nor supplements existing or future specifications, contracts, proposals, or warranties to Lucent Technologies products or services.

The remaining sections of this introductory chapter present the purpose, scope, content, and arrangement of this book in question and answer format.

Why This Book?

Historically, all *4ESS* Switch customers were internal to Lucent Technologies and were very familiar with the switch. As new features are developed, and with more aggressive marketing of the switch to customers outside of Lucent Technologies, there is a need for comprehensive user documentation. The purpose of this book is to describe the feature content of the *4ESS* Switch.

Who Needs It?

The primary audience for this document are LEC planners, potential customers, and consultants who make inquiries through their Lucent Technologies Account Representatives.

This document also serves as a useful reference tool for those Lucent Technologies employees who work with the *4ESS* Switch.

What Kind Of Information Is Included?

This document contains high-level descriptions of the current features in the *4ESS* Switch that are available to the LEC marketplace. The feature descriptions are intended to answer some basic questions about what the features do.

Following each feature title, the generic in which it is introduced is referenced in brackets. If the feature was enhanced in later generics, the enhancements are described separately and the appropriate generic is indicated in brackets.

Chapter 11 contains tables that list Core and Optional features, respectively.

Chapter 12 lists abbreviations and acronyms used in this document. An index is also included at the end of this document for quick reference.

What Other 4ESS Switch Documentation Is Available?

Other documentation available for this audience is listed below.

- *Network Planning Letter* (NPL) — is released quarterly and provides LEC planners with advanced information on features. The planners can then determine the combination of available features most appropriate for their needs.
- *Product Release Document* (PRD) — is issued with each generic release, and provides specific information on feature descriptions and implementation.

How Is The Material In This Book Arranged?

The organization of this book is based on the capabilities of the features. The features are grouped and arranged in logical order according to their function. Since related features are grouped together, you may need to read several descriptions in order to learn the current status of a feature developed in one generic, and modified in later generics.

How Can I Locate The Information I Want In This Book?

That depends on what type of information you are looking for. For example, if you wanted to see all the features related to trunk testing, you could begin by looking up in Chapter 5, Operations, Administration, and Maintenance (OA&M) Features.

Then, turning to the beginning of the OA&M chapter, you will find a listing of subchapters within that chapter. One of those is entitled ''Trunk Testing.'' You would then turn to that section for descriptions of all features associated with trunk testing.

In another case, you may be looking for a description of one particular feature that you know the name of, but are not exactly sure where it fits in the functional scheme of the book. If that happens, you should refer to the index at the end of the book to find the location of that feature description.

How Can I Get Further Information About The Features Described Here?

For further information beyond the scope of this handbook, please contact your Lucent Technologies Account Representative.

Additional questions, such as pricing, feature packaging, and new feature requests, should also be addressed to your Lucent Technologies Account Representative.

Field problems should be directed to the Product Engineering Control Center (PECC), or your field support organization.

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We hope you find this document useful and informative. Suggestions for improving the content or presentation of this information in future editions should be sent to:

Lucent Technologies
2000 North Naperville Road
Naperville, Illinois 60566-7033
Attention: *4ESS*™ **Switch Product Manager**

GENERIC FRAMEWORK

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GENERIC FRAMEWORK

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The generic framework of the *4ESS* Switch provides the core functionality for the switch to receive, route, and switch calls successfully.

The features in this category are grouped as follows:

- *Offices* — supports the roles that the *4ESS* Switch can fulfill in a network.
- *Basic* — provides basic functionality.
- *Routing* — determines the appropriate outgoing path of a call based on the incoming digits and knowledge of the state of the network.
- *Reliability* — provides the ability to maintain operation of the *4ESS* Switch in the event of failures.
- *Processor Items* — supports hardware items at the core of the *4ESS* Switch.
- *Trunk Interfaces* — provides trunk termination abilities.
- *Echo Suppression/Canceling* — provides the prevention/removal of echos.

- *Trunk Hunt* — provides the selection of an appropriate outgoing trunk.
- *Announcements* — provides the standard and special announcements available with the *4ESS* Switch.
- *Input/Output* — provides the ability to transfer data to and from the *4ESS* Switch.

Feature Descriptions

Offices

Access Tandem (AT) [4E9] allows the *4ESS* Switch to serve as a LEC Tandem Access office using Multifrequency (MF) signaling to Interexchange Carriers (IECs). Access Tandem signaling is used to support only the ''conforming'' Equal Access End Offices (EAEOs). The billing capability for Access Tandem node is also provided.

Exchange Network Facilities for Interstate Access (ENFIA-C) [4E9] provides the trunk connection from a LEC tandem office (ENFIA-C interface) to an Interexchange Carrier (IEC), thus extending the capabilities provided for in the Access Tandem feature.

Basic

Network Clock Synchronization Unit (NCSU) Upgrade [4E13] is a firmware development that improves the Network Clock by upgrading the NCSU to comply with both CCITT and American National Standards Institute (ANSI) timing requirements.

Disciplined Rubidium Oscillator (DRO) (060) [4E17] is an improved replacement oscillator for the Network Clock 39B Oscillator, which uses state-of-the-art rubidium oscillator technology. A key benefit of the upgrade to the DRO is improved robustness and reliability.

Previously, 39B oscillator control range allowed for the potential of 14 slips per hour on all DS1s terminating on the *4ESS* Switch. With this feature, the DRO control range is a factor of 80 times tighter, resulting in a worse-case slip rate of 14 per day. Critical service applications such as CCS7 signaling benefits from this new technology.

DRO also improves operations by reducing maintenance activity on the network clock. In addition, the time and labor required to replace an oscillator is greatly reduced. The warm up time for the DRO is 30 minutes, compared to 24 hours for the 39B. Improved long-term stability permits longer intervals to repair a Network Clock Synchronization Unit (NSCU), if necessary.

DRO is an optional upgrade. If chosen, each office must replace all four 39B oscillators (at the same time) with four DROs, since 39B and DROs cannot be intermixed.

4ESS Switch Year 2000 (476) [4E23] utilizes a 2-digit solution using a 100 year window and works as long as all systems date data spans a period of not greater than 100 years. This system has the advantage that it requires program only changes. With this method, a 100 year logic window is assigned and a bus system determines the century or decade of a given year by comparing the value in a 2-digit field against an application window.

The reasons for choosing this option are:

- It covers the years 1970 to 2069 which covers the expected *4ESS* Switch life span.
- It meets the requirement for the Bellcore Core Switching Compliant Telecommunications Industry Standard Year 2000 specification of January 1, 1980 to December 31, 2036.
- It does not impact existing user interfaces.
- It is consistent with other Lucent Technologies products.

This Feature defines the *4ESS* Switch Year 2000 compliance as:

- A 2-digit year-date representation that does not result in any software errors in arithmetic, comparison, sorting, and input/output to databases or files when manipulating year date data.
- All leap year software algorithms correctly handle all leap year conditions.
- No software compliant code hardcodes the first two year digits of "19" into software routines or use the 2-digit year dates "98", "99" or "00" as special reserved values or magic numbers (e.g. illegal value used to exit code, or demonstration account number).
- System date values that roll over do not cause software failures due to a storage or data register filling up and overflowing.
- There is no service interruption on critical and high risk date rollovers, e.g., 12/31/99, to 01/01/00, 01/02/00, 02/29/00, 03/01/00, and 12/31/00/ to 01/01/01.

This feature will be available in 4E23 Release 3.

Routing

Routing provides the basic intelligence for systematically processing and completing calls in a network. In conjunction with the North American Numbering Plan, Routing enables customers to reach their desired party by dialing an appropriate number.

The basic functions of Routing are to translate the incoming digits from a distant switch and based on those digits, determine the appropriate outgoing route. The *4ESS* Switch supports the North American Numbering Plan (NPA-NXX-XXXX), and access routing to Interexchange Carrier (IEC) and International Carriers.

Terminating Toll Switch Index (TTSI) Decrease (356e) [4E18] reclaims memory by reducing the number of TTSIs supported from 384 to 32.

Served Numbering Plan Area Expansion and Home Numbering Plan Area Improvements (4839) [4E22] The Served Numbering Plan Area (SNPA) Expansion and Home Numbering Plan Area (HNPA) Improvements feature impacts are the following:

- Doubles the number of domains in the switch.
- Moves and reorders the Plain Old Telephone Service (POTS) subdomains from locations 1 through 19 to locations 191 and greater.

Reliability

Reliability by defensive design is one of the primary objectives of the *4ESS* Switch. Reliability includes detection of and recovery from software malfunctions, recovery from hardware faults, use of diagnostic programs to help the technician/maintenance personnel identify and repair faults, and overall coordinated system recovery from multiple hardware and software malfunctions.

Detection of Loss of Memory Integrity [4E0] performs both explicit and implicit checks of memory. A large number of the control indicators, including status indicators for equipment and trunks, is kept in the memory units of the processor. If this information becomes degraded or inconsistent, the *4ESS* Switch cannot function properly. Therefore, provisions have been made for the state of the memory to be checked regularly to ensure that it is accurate and internally consistent, and that it matches the current state of the switch equipment.

Since the prime cause for loss of healthy software control is the mutilation of memory, extensive explicit checks are imbedded in the software system as defensive checks. These checks are performed at critical stages of processing to guarantee that the control information satisfies some broad validity checks, which are effective in limiting the spread of an error condition.

The main responsibility for detecting system problems, however, lies with the implicit memory checks. These include the auditing of system memory, the monitoring of test calls, and a series of performance checks.

Audit System [4E0] is responsible for validating the memory contained within the system. This feature checks the state of the various memory structures against a set of rules or standards for the use of memory. Memory usage that does not conform to these rules is deemed to be in error.

The checks that the audit system uses on the memory structures consist of direct comparison, comparison by association, and pattern comparison. The direct comparison checks are performed on data that resides both in call store and disk. Comparison by association is used on memory structures that have functional relationships to other structures. For instance, the information kept on a per-trunk basis corresponds to information kept on the members of the Trunk Subgroup of which it is a member. Similarly, the memory information that reflects the status of a physical entity corresponds to its actual state, as determined by interrogating the physical equipment. The pattern comparison

checks are used where memory structures have format rules that can be checked for consistency.

These audit checks are performed on the memory structures on a routinely scheduled basis, besides being called into action when other system aberrations implicate the memory structure. The frequency of the routine checking of a particular memory structure depends on the sensitivity of the operation of the system to errors in that structure.

To ensure the constant monitoring of critical memory structures, the audit system interleaves the various types of checks on memory. The net result of the interleaving is that various audits are effectively run in parallel. In this way, memory structures that require a long time to audit can be checked without locking out those audit checks performed on data structures that are extremely sensitive from a call handling point of view.

System Initialization [4E0] is the severest form of corrective action, involving the initialization of large sections or all of the system memory. When System Initialization occurs, all other system functions are suspended.

This feature is used only when the error symptoms indicate a severe crippling of the system's ability to function properly. There are four progressively more severe initialization actions, called Phase 1, 2, 3, and 4 (system reinitialization.) Any of the initialization actions can be manually requested, but only Phases 1, 2, and 3 are employed by the automatic recovery procedure. Calls in progress are maintained during the automatic recovery procedures.

Automatic Fault Recognition [4E0] continuously monitors the units that form the *4ESS* Switch. This feature quickly detects failures of equipment, and any faulty unit is switched out of service automatically so that it does not interfere with the operation of the system. Generally, a duplicate or spare unit is provided for major system components so the operation of the system can continue while the faulty unit is being repaired.

Automatic Trouble Diagnosis of Major System Components [4E0] identifies a fault that occurs in one of the major system components of the *4ESS* Switch. First, the faulty component is removed from service automatically. Then the maintenance programs related to this feature exercise the unit, using a set of diagnostic tests to identify the trouble condition. The results of such tests, printed on a Teletypewriter (TTY) output channel, provide a hard copy of test results for use by the office personnel.

Routine Testing of System Components [4E0] is a supplementary fault detection system in the *4ESS* Switch. Although the switch is equipped with automatic fault locating hardware and software, the system does not totally depend on those features for detecting faults. According to a preset schedule, the system is routinely and automatically tested to verify that no fault has gone undetected because of a failure of one of the fault detection mechanisms. The routine exercises also can be run on a demand basis by the office personnel, if a trouble condition is suspected in some unit.

Improved Fault Tolerance (IFT) [4E6] modifies the peripheral fault tolerance of the *4ESS* Switch in an effort to minimize the performance impacts of service-affecting incidents.

This feature is designed to:

- Reduce the number of duplex failure and zero start incidents resulting in lost calls, trunk outages, or downtime experienced in the field
- Reduce the amount of time spent by the *4ESS* Switch in performing fault recovery
- Improve the isolation of latent or marginal failures.

The following peripheral maintenance enhancements are included in this feature:

- *Network Configuration Exercise - Cross-Link* permits the Time Slot Interchanges (TSIs) and the Time Multiplexed Switches (TMSs) to be interconnected and exercised in all possible combinations, allowing failed or troublesome interconnections to be isolated. To achieve greater resolution of transmission problems, the Network Configuration Exercise feature provides both standard and cross-link interconnection of TSI and TMS controllers.
- *Directed Phase 1 for TMS* extends the Directed Phase 1 to include the TMSs, thereby reducing the contribution of TMS Phase 3's to system downtime. The term ''Directed Phase 1'' refers to the fault recovery sequence that involves duplex failure or zero start of TSIs and Signal Processors (SPs).
- *TMS Memory Parity Correction* rewrites TMS memory in all cases where a TMS parity failure is detected in a simplex TMS network configuration. This feature does not affect the ''remove and diagnose'' strategy for a duplex TMS configuration.
- *Improved Phase Information* provides the necessary information to diagnose duplex TMS failures as being related to software, hardware, or both. This enhancement also provides the technician and the field support groups with data required to solve phase-related service degrading failures; for example, multiple units left out of service. This phase information is not automatically printed following the phase — it is saved in the Error Analysis Program (ERAP) files, where it is available upon manual request.

Overload Detection and Control (029) [4E0] in the *4ESS* Switch regulates the work performed by the system when excessive demands are being placed on system resources.

This feature performs the following functions:

- Maintains good customer service up to machine capacity

- Maintains maximum call throughput at levels greater than rated machine capacity
- Arbitrates among requests according to the first two rules, when demands for the facilities of the system become excessive.

1A Audit Disk Throttling [4E14] prevents severe overloading of the 3B20D processor, by throttling 1A audit disk requests during 3B20D processor overload, Common Network Interface (CNI) initialization, or 3B20D recovery.

The Application Integrity Monitor (AIM) process is aware of the overload or recovery conditions on the 3B20D. The AIM sends the message to the 1A Processor audit system controller to throttle disk requests for a specific amount of time.

Processor Items

Real Time Reliable (RTR) Improvements (080) [4E16] provides a new Operating System (RTR 6.4) for the 3B Computer. RTR creates a non-Very Large Main Memory (VLMM) version of Release 6, to provide a single generic on which applications can expect more timely current engineering and feature development.

Release 1 applications benefit from performance improvements that were previously applied only to Release 6.

The application software is modified to use the RTR availability improvement related to craft Input/Output recovery, and the ability to detect and fault an insane kernel process.

3B20D Computer Upgrade From RTR Release 6.4 to RTR Release 21.7 (393) [4E20] upgrades the *4ESS* Switch 3B20D Computer from RTR Release 6.4 to RTR Release 21.7, introducing new RTR features that were developed by RTR since the 6.4 release. All Lucent Technologies switches use this new RTR release to provide the basis for the *Software Update Merge*

and *Software Update Automation* features.

This upgrade introduces the following RTR features:

- *Software Update Merge* feature and *Software Update Automation* feature
- *Maintenance Teletypewriter (MTTY)* or *Read Only Printer (ROP) Side 0/1 Removed* feature - indicates on the processor display page when a ROP or MTTY connection is not available
- *Atomic Directory Switch* - provides the ability to execute a switch of two directories and all the files beneath them (at the end of the operation, directory a contains all of b's subdirectories and files, and directory b contains all of a's)
- *RM ** - allows the customer to modify the behavior of the UNIX® ''RM *'' command to prompt before removing files. This additional prompting provides a safeguard against inadvertent file removal.

4ESS 3B APS Software Upgrade to UNIX RTR 21.17 (478) [4E23] provides a software upgrade of the *4ESS* Switch APS operating system software from RTR 21.7 to RTR 21.17. This will be included as part of the 4AP 16 Release.

4ESS Switch 3B21D Attached Processor System (APS) Upgrade (5222/528) [4E23] Currently, 3B20D processor is used as the Attached Processor System (APS) for the *4ESS* Switch. In this role it performs and provides the following capabilities:

- Call Detail Recording (CDR) and Teleprocessing.
- Disk Backup of all CDR data.
- System Disk Backup and Recovery of 1B Memory spectrum for files and data.

- Recent Change and Verify (RC&V) interface for 3B20D/CNI DLN based data structures.
- An Interface to the Operational Support Systems (OSs).
- A Pseudo 1B data channel for the OSs to interact with the 1B processors through a 3B20D I/O port.
- The interface to the CNI ring.
- An interface to the 1B processor for out of band signaling.

There are two concerns associated with the *4ESS* Switch 3B20D processor. The one concern is that the processor real-time capacity is nearing exhaust. This could impact AMA recording capacity. In addition, the 3B20D processor was Manufacture Discontinued (MD) in December of 1994.

This feature provides a Hardware upgrade to replace the 3B20D with a 3B21D processor system. From a *4ESS* Switch perspective, the 3B21D processor has the following attributes that make it desirable as a 3B20D replacement:

- Has a faster processor, and faster memory access.
- Has a larger main memory capacity (up to 128 MB of RAM memory can be accommodated on a single memory board).
- Has a reduced footprint (e.g., a single 3B21D *5ESS* Switch cabinet replaces one 3B20D processor, one growth cabinet, and one Tape drive cabinet).
- Has a compatible architecture with the 3B20D.
- Has two open expansion slots for evolution to future switch interfaces for long term processing, memory, and I/O expansion.
- Has circuit pack mounted SCSI pack disk drives.
- Upgraded Input/Output Processor (IOP) and to the Disk File Controller (DFC).

The 3B21D will use the RTR21.17 as its operating system.

The 1B Processor (139) [4E19] is the first network element in the evolution from the current *4ESS* Switch to the *4ESS-2000* Switch. The 1B Processor is a high performance upgrade of the 1A Processor in the *4ESS* Switch.

The 1B Processor provides additional memory and real-time resources to the *4ESS* Switch, while modernizing the Master Control Console (MCC) panel. When using the 1B Processor, the Busy Hour Call Attempts (BHCA) capability increases to handle a minimum of 1 million call attempts, with the current call mix.

This new processor contains a high speed Interface Bus (IFB), which serves as the Direct Memory Access (DMA) required for device-to-memory and device-to-device data transfers. The IFB is capable of supporting up to twenty-four clients, eight of which are currently dedicated to specific applications. The IFB is the path to future applications, and has the capability to connect the 1B Processor to network elements including adjunct processors, mass storage devices, auxiliary memory and databases, and new application circuit packs.

The 1B Processor also features a new color video display Master Control Console (MCC). The MCC provides a menu oriented color display that is used to access the switch and system status. The 1B MCC offers improved remote response time, user friendliness, and maintenance procedures.

The 1A Processor 4E18 to 1B Processor 4E19 retrofit basically follows the standard retrofit procedure. However, provisions are required to support the physical transition from the 1A Processor hardware to the 1B Processor hardware.

In addition, seven conversion switches are required to switch from the 1A to the 1B hardware. The 3B20D Computer Attached Processor System (APS) software that supports 4E19 (4AP13), also supports the retrofit to the 4E19 generic.

The 1B Processor is a duplexed machine contained within a two

cabinet complex. The fully equipped weight of the 1B Processor is approximately 2000 pounds (89 pounds per square foot weight load.) The total power required for the duplexed cabinet is approximately 6000 watts (266 watts per square foot.) The 1B Processor utilizes -48V DC power.

1B Processor File Expansion (3356)/File Restructuring (3356a) [4E20] features provide enhanced system backup for the 1B Processor. They expand the existing 1B Processor file on the Attached Processor System (APS) Small Computer System Interface (SCSI) System disk from 8 to 32 Megawords. These features enable deployment of the Extended Store feature (3355a).

Extended Stores (XS) (3355a) [4E20] is an optional hardware/software feature which provides additional Call Store (CS) memory. Currently, the only feature that may require XS is the *AIN Dialed Number Feature (442).*

For customers requiring additional CS memory, XS hardware (3355a) must be installed in the generic prior to the generic the XS memory is to be utilized in. The earliest XS can be utilized is in the 4E21 generic.

Customers who may require XS in the 4E21 generic must deploy hardware in the 4E20 generic, prior to retrofitting into the 4E21 generic.

The 4E21 generic feature 3355 provides the software necessary to access the data in XS memory. Feature 3355 is required in the generic (4E21) which XS is utilized.

The XS provides 1B Processor memory expansion up to 15 Megawords of CS for offices which require additional CS memory. The XS feature requires the following hardware:

- 3 packs per CC: KLW105, KLW116 and KLW117 (total of 6 packs for primary and secondary CC)
- 2 CS packs for each duplicate Megaword of CS memory: KLW1

This feature allows the growth of the hardware. Feature 3355 in the 4E21 generic allows applications to use this hardware. Consult engineering to determine if this feature is required for CS memory exhaust.

Extended Stores (XS) (3355) [4E21] is a means of adding more memory to the 1B Processor. This optional feature enables the Call Store (CS) memory to be expanded by up to 15 additional Megawords. The additional CS memory is utilized to support features requiring storage of large amounts of data.

The data typically is customer information such as authorization codes, account information, and account codes. The *4ESS* Switch Engineering Administration Tool (4ESEAT) should be used to evaluate the need for Feature 3355 for a particular office.

This optional feature requires replacement of the Fetch Index (KLW5), the Maintenance Control Complex and Utility Processor (MUP or KLW16), and the Fetch Address (KLW17) circuit packs.

The CS memory (KLW1) circuit packs are added to increase the CS memory in 1 MW increments, based on specific office needs. Feature 3355 in the 4E21 generic allows applications to utilize the hardware.

It is recommended that feature 3355a be deployed at least two weeks prior to the 4E21 generic retrofit.

Program Store Expansion (PSE) Hardware Growth (3333a) [4E21] is required for the 4E22 generic and must be grown in the 4E21 generic. The PSE feature provides an additional 1 Megaword of duplexed program store memory. The additional memory provides space for features that will be offered in future *4ESS* Switch generics.

This feature requires the replacement of the Bus Nodes Address circuit packs (KLW22) and, if the Extended Store (Feature 3355) has not been deployed, the Maintenance Control Complex and Utility Processor (MUP) circuit packs (KLW16) in addition to the Program Store circuit packs (KLW2) is also required.

Feature 3333a in the 4E21 generic allows the growth of the hardware; Feature 3333 in the 4E22 generic allows applications to use this hardware.

It is recommended that work associated with feature 3333a be completed at least two weeks prior to the 4E22 generic retrofit.

Program Store Expansion (PSE) (3333) [4E22] is required for the 4E22 generic. This feature provides an additional 1 Megaword of duplex program store memory. The additional memory provides space for features available in future *4ESS-2000* Switch generics.

The PSE feature requires the replacement of the Bus Nodes Address (KLW22). If the Extended Store feature (3355) has not been deployed, the Maintenance Control Complex and Utility Processor (MUP) circuit packs (KLW16), in addition to the Program Store circuit packs (KLW2) is also required.

Feature 3333 in the 4E22 generic requires feature 3333a in the 4E21 generic to allow growth of the hardware.
It is recommended that work associated with feature 3333a be completed at least 2 weeks prior to the 4E22 generic retrofit.

Trunk Interfaces

The *4ESS* Switch handles many types of incoming and outgoing intertoll, toll connecting, and local tandem trunks. In the original generic (4E0), the following types of trunks could be accommodated: DDD access, CAMA, TSPS, secondary intertoll, intertoll, toll completing, INWATS, rate and route operator, rate-quote operator, MF-MF intertoll, MF-MF toll connecting, DP-DP intertoll, MF-DP intertoll, CCS-CCS intertoll, tandem, tandem completing, intertandem completing, intertandem incoming, intertandem outgoing, MF-MF intertandem, and MF-MF tandem connecting. Special trunk interfaces are described in this section.

Emergency Access Trunks [4E0] permits the use of emergency access circuits in the *4ESS* Switch. No special provisions have been made for integrating emergency access circuits into the wiring arrangements for the *4ESS* Switch.

Accordingly, it is necessary to provide job-engineered specifications for the facilities involved, including any special requirements such as transmission terminal equipment, distributing frames, and associated wiring.

Emergency Operator Access Circuit [4E1] allows an operator to complete emergency calls to a distant toll switching point when normal access is not available, because of an all-trunks-busy condition. Emergency access is limited to analog trunks with conventional signaling.

Two-Way Operator Trunk Interface (053) [4E1] enables the *4ESS* Switch to interface with a 2-way operator trunk. The 2-way operator feature provides toll operator assistance to customers of a Community Digital Office (CDO). This feature is also referred to as the auxiliary outgoing trunk circuit interface.

CAMA E&M Signaling Trunk Interface (055) [4E1] enables the *4ESS* Switch to interface with remote CAMA operator positions by way of a carrier facility.

Inward And Leave Word Operator Trunk Interface [4E1] allows the interface with inward and leave word 1-way outgoing MF Wink Start (WS) operator trunks.

No. 5 ACD Interface [4E1] enables the *4ESS* Switch to interface with the No. 5 ACD (Automatic Call Distributor) trunk. The No. 5 ACD trunk is a directory assistance operator trunk used in centralized toll directory assistance bureaus.

Direct Inward Dialing to a Private Branch Exchange (PBX) [4E2] allows traffic to be connected directly from a *4ESS* Switch to a PBX. Calls are completed from the *4ESS* Switch as though they were being completed to a class 5 office.

Direct PBX Interface [4E9] allows analog PBXs to be directly connected to the *4ESS* Switch for voice communication.

The following capabilities are developed to accommodate the maximum number of PBX types:

- Ground start
- E&M lead supervision
- Loop-reverse battery
- A-bit (DS-1 format) supervision
- Incoming address signaling for both dial-pulse and Dual-Tone Multi-Frequency (DTMF)
- Outgoing address signaling for both dial pulse and DTMF
- Attendant interface.

Digital Interface Frame (DIF) (098) [4E5] is a *4ESS* Switch digital transmission facility peripheral frame. The DIF provides an economical arrangement for terminating digital trunk facilities, and by incorporating a microprocessor based controller, provides a standard peripheral/processor interface not previously available with the DT/SP2.

A fully-equipped DIF frame contains a duplex controller, duplex Peripheral Unit Bus (PUB) interface, 32 working Digital Interface Units (DIUs), and two switchable spare DIUs.

Domestic Digital Interface Frame (DIF-D) [4E8] provides a foundation on which to build another DIF equipped with Multifrequency (MF) service circuits, identified as the DIF-E1 (MF). The DIF-D is a product of firmware modifications to the export DIF-E1.

The DIF-D contains three firmware complexes, each modified to be compatible with the North American generic software and dial-pulse signaling types. The Executive Store (EXEC) is a ROM-based controller that oversees the operations of the DIF-D frame. The remaining processors — the Signal Processor (SP) and Maintenance Processor (MP) — have RAM-based program store. The SP firmware provides the signaling capability for the DIF-D, and the MP firmware performs maintenance functions.

Digital Interface Frame with MF Signaling (DIF-E1 [MF]) [4E9] can contain a maximum of 64 digital MF Trans/Rec circuits in four of its DIUs.

The DIF-E1 (MF) provides multifrequency signaling at about half the cost of using analog MF service circuits housed in a Multifrequency Signaling (MFS) frame and controlled by a Signal Processor (SP) frame.

The elimination of the controlling SP allows more SP/DIF member numbers to be allocated to trunk terminations rather than service circuits, thus increasing the trunk termination capacity of a typically engineered toll office.

Digital Interface Frame with DTMF Signaling (DIF-E1 [DTMF]) (154) [4E10] allows the *4ESS* Switching System to interface directly with Private Branch Exchange (PBX) and end-office customers. For Dual-Tone MultiFrequency (DTMF) capabilities, the DIF-E1 frame is required.

Type of Digital Interface Unit (TDIU) Redefinition (4099) [4E21] reduces the provisioning and capital costs associated with DIF circuit assignments. It restructures the current TDIU assignment scheme, allowing hardware type to be separated from service/function type.

Instead of a single TDIU per DIU, each DIU is assigned two new DIU parameters: Type of Hardware (THW) and Type of Di-Group (TDG) (5 TDGs per DIU). The THW value specifies the type of hardware used in the DIU and the TDG specifies the service/function associated with an individual Di-Group.

This new structure provides greater flexibility in the overall facility provisioning process on the *4ESS* Switch and reduces capital costs associated with DIF circuit assignments.

The CONNECTVU-Trunk Release 4.0 is required to support the TDIU feature.

LEC XTSI

Expanded Time Slot Interchange (XTSI) Release 1 (4754) [4E21] is an enhancement to the *4ESS* Switch fabric. The XTSI performs the transmission and switching functions previously performed by the Digital Interface (DIF) and TSI-B frames, but in a more reliable, more compact, less expensive package. The XTSI conforms to the same switch interfaces as the TSI-B, including A-links, Peripheral Unit Bus (PUB), and the Network Clock.

The first Release of XTSI will provide a Digital Signal Level-3 (DS3) interface into the *4ESS* Switch, supporting 4032 trunks per frame.

CONNECTVU-Trunk Release 5 and Total Network Management (TNM) upgrade are required to support the XTSI.

The XTSI has significant advantages over the current equipment used for network termination growth as follows:

- Overall *4ESS* Switch termination expansion from 107,520 to 129,024 terminations. Each XTSI terminates 20 percent more trunks than current TSI-B without increasing the size of the Time Multiplexed Switch (TMS). XTSI is also fully compatible with the *4ESS-2000* Switch evolution plan.
- A significant reduction in capital cost for *4ESS* Switch termination growth, as compared to the current DIF/TSI-B.
- A direct DS3 interface into the *4ESS* Switch. Each XTSI supports up to six DS3 facilities (28 DS1s). It can accommodate 6 active/2 standby DS3 packs in each XTSI frame. This eliminates the need for DS1 to DS3 multiplexing/demultiplexing equipment in a wire center.
- Intra-SPC (Stored Program Control) switching. Enables calls that originate and terminate on the same XTSI to be switched within that XTSI. This eliminates the need to go through the TMS, and improves overall switch efficiency by improving blocking characteristics.
- DS1 performance monitoring similar to that performed by the DIF. Support of DS1/DS3 loopback testing for testing and maintenance purposes.
- Standard 6 foot switch cabinet which is connectorized and compatible with top/bottom cable access. This cabinet is fully Network Equipment Building Standards (NEBS) compliant and conforms to the *4ESS-2000* Switch concept.
- Space and power savings as compared to DIF/TSI-B. Also reliability improvements associated with use of newer technology.

XTSI Static A/B Bit Option (487) [4E22] Some offices which support out-of-band supervisory signaling are highly sensitive to in-band supervisory A/B bit state changes. The Expanded Time Slot Interchange (XTSI) currently provides 64 Kb/s clear channel which causes the A/B bits to vary according to normal voice/data usage. Trunks connecting to these A/B bit sensitive offices are not currently compatible with XTSI.

The static A/B bit option provides compatibility on XTSI for facilities utilizing out-of-band supervisory signaling. For trunks identified as connecting sensitive offices terminating on an XTSI, the A and B supervisory signaling bits are always set to 1 so that offices sensitive to in-band signaling state changes on out-of-band facilities will not see any A/B state changes.

This feature is also available via Software Change Package (SCP) to the 4E21 generic.

Benefits

This feature provides the interface capabilities on the XTSI which currently exist in the Digital Interface Frame/Time Slot Interchange (DIF/TSI).

XTSI DS1 Performance Monitoring Enhancements (PM) (452) [4E22] This feature enhances the DS1 PM beyond that of XTSI Release 1. This feature provides DS1 PM enhancements necessary to monitor and maintain all the DS1s contained within the DS3s terminated within XTSI. **Caution:** Do not turn on this feature until you are on Release 5.1 of CONNECTVU and Release 4.2 of TNM. Activation of this feature is non-reversible. Customers must review their network to determine if this feature is appropriate.

Once the feature is activated XTSI Release 2 type PM is the only type PM supported. This feature is activated via Recent Change of a PM type indicator provided in the 4E22 release.

Benefits

- Provisioning 15 minute and 24 hour thresholds.
- Real-Time reporting of threshold crossing via Threshold Crossing Alerts (TCAs).
- Dumping history registers and resetting via an I/O command from CONNECTVU.
- Conforming to American National Standards for Telecommunication (ANST) standards.

XTSI Input/Output Message Specification (5111) [4E22] This feature eliminates potential confusion between Time Slot Interchange (TSI) and Expanded Time Slot Interchange (XTSI) Input/Output messages, warnings, and alarms.

This feature changes the input and output messages relating to the Expanded Time Slot Interchange (XTSI). From a technician's perspective, the XTSI is completely different from both the Digital Interface Frame (DIF) and the Time Slot Interchange (TSI), so input and output messages relating to the XTSI should refer to it as XTSI, not TSI.

Input messages provided by the *4ESS* Switch for manual control of the XTSI accept only the keyword *XTSI*.

This feature also provides a new poke command on Master Control Console (MCC) page 108 to request XTSI out-of-service list.

Output messages provided by the *4ESS* Switch in response to input messages relating to manual control on the XTSI use the keyword *XTSI*. The output messages provided by the switch for autonomous conditions relating to the XTSI use the keyword *XTSI*.

Benefits

This feature clearly distinguishes the XTSI from the Digital Interface Frame (DIF) and TSI-B with respect to input and output messages.

XTSI Software Update Tool (5113) [4E22] This feature gives maintenance personnel the capability to log onto a 1B and 3B maintenance channel, and input a short 3B command to execute the nine steps required to update a single *4ESS* Switch XTSI frame.

This feature improves the current software update method by reducing manual intervention. The tool also notifies the user of failures, including the point of failure.

Benefits

- Eliminating manual input of a significant number of commands.
- Decreasing the time needed for maintenance personnel to perform XTSI software updates.
- Decreasing the chance of error by maintenance personnel who perform XSTI software updates.

XTSI Select for Service (5131) [4E22] This feature is referred to as *select for service* capability. The XTSI is highly reliable with D3U protection switching. Currently, if a second DS3 circuit pack fails before replacement of the first failed circuit pack in the same protection group, the second failed circuit pack will lose service. This feature gives the switch owner the capability to choose which DS3 will continue to provide service, and which DS3 will remain out-of-service.

Benefits

Allows the switch owners to prioritize their customers needs.

XTSI Rapid Restore (5505) [4E22] This feature expands the rapid restore capability to include the XTSI, thereby providing an indication of which XTSI components are *down* and the root cause. It also provides a simple command to restore all eligible out-of-service components unconditionally.

Benefits

- Tells maintenance personnel which components are down and shows the root cause.
- Provides a command to restore all eligible out of service components unconditionally.
- Enables maintenance personnel to recover the switch quickly and simply.

Echo Suppression/Canceling

Improved Echo Canceler Treatment [4E10] includes an indicator to identify the presence of Echo Canceler (EC) for a group of trunks. When new trunks are added to a subgroup, trunks with an EC code and trunks with an Echo Suppressor (ES) code cannot be stored in the same trunk block.

Trunk Hunt

Glare Detection and Resolution [4E0] handles the problem posed when ''glare'' exists; that is, when a 2-way trunk is seized at the same time by the two switching systems that it interconnects. In the *4ESS* Switch, timing is used to detect a glare situation on Multifrequency (MF) or Dial Pulse (DP) trunks.

The *4ESS* Switch making the outgoing call can handle the glare situation in one of two ways:

- By seizing another trunk for its own use, allowing the other trunk to complete its call into the system
- By maintaining its trunk seizure and forcing the distant office to resolve the glare situation.

The 2-way trunks in the *4ESS* Switch can use either strategy, based on a preset control indicator associated with the individual trunks.

Trunk Hunt with Memory [4E10] solves several problems with the process the *4ESS* Switch used (in prior generics) to hunt outgoing trunks.

Previously, hunting always began at the first trunk (trunk 0) of the first choice trunk block. If that trunk was busy, the hunt proceeded to block 1, and if that was also busy, to block 2, and so on, until an idle trunk was found.

When the next hunt in that trunk block group began, it would also begin with block 0, even if the previous search had been conducted only seconds earlier.

Trunk Hunt with Memory avoids the duplication of effort involved with the above process. After each successful hunt, this feature remembers which trunk of the trunk block was selected to complete the call.

The next time a trunk is hunted in this trunk block, the hunt begins at ''1 plus'' the last used number. When the hunt reaches the last trunk of the block, it wraps around and continues the hunt with block 0. If no idle trunk is found, the hunt proceeds to the next trunk block of the trunk subgroup.

Announcements

Emergency Announcements [4E1] enables the *4ESS* Switch to connect incoming Common Channel Signaling (CCS) call attempts to an emergency or special announcement.

When calls are routed over CCS trunks, the voice paths at preceding offices may not be completed until routing is confirmed by receipt of an Address Complete (ADC) message. For most announcements (for example, the no circuit announcement and vacant code announcement), this treatment presents no problem because the failure message is returned toward the originator on the signaling link.

This treatment results in the proper announcement being applied at the first non-CCS link encountered. This procedure is unacceptable for an emergency or special announcement that pertains only to local conditions.

Therefore, the emergency or special announcement must be returned toward the originator via the voice path from the affected office. To accomplish this routing, the *4ESS* Switch call processing returns an ADC message on the signaling link to force cross-country voice circuit connections at preceding offices. The emergency or special announcement can then be connected to the trunk at the failing *4ESS* Switch.

This feature is under the control of the network manager, who may direct incoming call attempts to an emergency or special announcement rather, than to the no circuits available announcement. In addition, the recent change system may be used to implement this treatment for selected ineffective attempts.

Increased Announcement Capacity [4E10] adds a 12A recorded announcement sideframe to all *4ESS* Switch offices to provide needed announcements to the switch for various features. The 12A sideframe adds 11 new announcements in both domestic and gateway offices, for a total of 20 announcement channels.

Flexible Assignment of Announcements [4E14] allows the addition of further emergency announcements required for International Switching Center (ISC) offices.

Every *4ESS* Switch has a maximum of 20 phased announcements. Of these 20 announcements, 11 are designated as generically fixed, meaning they cannot be changed. These announcements have standard wording and are the same in every *4ESS* Switch. The remaining nine, designated as emergency or special announcements, are used by switch administration and network management personnel to inform customers about local problems or short-term outages.

To allow greater flexibility in the use of the 20 messages, the generically fixed announcements can now be used by switch administrators and network managers as local emergency announcements.

This is possible since not all of the 11 fixed announcements are needed as generic announcements in an ISC office. This same capability can then be offered to LEC Access Tandem (AT) and Service Switching Point (SSP) *4ESS* Switch Offices. Since each *4ESS* Switch application has a subset of the eleven fixed announcements that are not required for that application, this feature allows those announcements to be used as emergency or special announcements.

Input/Output

Input/Output (I/O) Facilities [4E0] enables the *4ESS* Switch to handle up to 96 I/O channels for the 1A Processor. The I/O equipment available on these channels includes low-speed (10 characters per second) teletype (TTY), high-speed (120 characters per second) TTY, and interactive Cathode Ray Tube (CRT) devices.

Certain operational areas of the *4ESS* Switch, in particular those involving recent change and network management, employ one or more CRT devices.

The rerouting of output messages under the technician control feature is available as part of the I/O system. An additional capability is the conversion from special-purpose alphanumeric to internal machine language, providing more convenient technician interpretation and identification of machine equipment.

High-Speed I/O [4E5] enables the *4ESS* Switch to communicate with ''off-site'' clients at data rates of 4800 bps rather than the 1200 bps. Both the Circuit Maintenance System (CMS) and Engineering and Administrative Data Acquisition System/Network Management (EADAS/NM) use this capability.

Communication between the *4ESS* Switch and off-site clients uses four levels of protocol.

To ensure data integrity on the links, Digital Data Communication Message Protocol (DDCMP), and Bell Administrative Network Communications System (BANCS) message protocol are used for these applications.

Improved I/O Interface Feature [4E11] allows external users to communicate with the *4ESS* Switch via a BX.25 interface. This feature enables access to 1A Processor I/O messages, and to the Attached Processor System (APS) I/O messages for some channels.

PERFORMANCE AND CAPACITY

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PERFORMANCE AND CAPACITY

3

Lucent Technologies strives to improve the performance and capacity of the *4ESS* Switch by restructuring parts of the software to run faster and/or use less memory.

Feature Descriptions

Miscellaneous Restructuring [4E12] makes general software modifications that are necessary to accommodate the continuing addition of features and capabilities. This restructuring consists of the following:

- Growing the allowable number of final handling codes from 1024 to 2048
- Growing the number of select indices
- Restructuring of program code
- Standardizing the form layout of Office Data Administration and Recent Change code grouping input forms
- Adding an Acceptable Digit Count item to the call type word entries.

Performance and Capacity Improvements [4E13] modifies the following areas:

- 1A Audit System, to accommodate up to 255 numbered audits
- The interject scheduler, uses direct transfer to task programs, thereby recovering 500 cycles/second of real time and freeing up system vector table slots
- The Phase 3 Software Initialization (SINT), to yield an estimated 10 percent increase in execution speed.

Adjunct to Trunk Subgroup (TSG) Headcell [4E12] reduces the volume of data handled by NetMinder, by eliminating the practice of filling certain records with zeros.

Previously, the *4ESS* Switch sent data on TSGs to NetMinder without regard to the adjunct head cell assignment. This data was sent on all adjuncts up to the specified (engineered) maximum count. For unassigned adjunct head cells, the data block was filled with zeros and sent to NetMinder.

This feature enables the switch to keep records of the highest adjunct head cell currently assigned to a TSG, and transmits only data for adjuncts up to this highest adjunct head cell.

Performance and Capacity Improvements (901) [4E16] are made by enhancing the architecture and capacity of the *4ESS* Switch. This capability enables new features to be added to the generic.

As more features are requested by Local Exchange Carriers (LEC) customers, the improvements allow Lucent Technologies to be responsive to LEC demands.

Call Register Restructure (444) [4E22] This feature is an internal restructure feature that provides additional space in the Call Register (CR) by moving the CR Integrated Services Digital Network User Part (ISUP) data Call Register Information Block (CRIB) to a separate data structure. The new structure will be 96 words. There will be one CRIB structure per Call Register.

This feature also creates a new data structure for AIN SSP/800 test queries. There will be 16 test query structures, each containing 256 words.

Benefits

Supports future feature needs.

Grow Trunk Subgroup Block (466) [4E22] The feature increases the number of words in the Trunk Subgroup (TSG) translator from 16 to 32 words. This feature enables the *4ESS* Switch to allow for future features that require new per TSG data.

This feature also adds six new Trunk Subgroup (TSG) words that are copied into the Call Register (CR) for Incoming Trunks (ICT) and six new words that are copied into the call register for Outgoing Trunks (OGT).

Benefits

Allows for features that require per Trunk Subgroup data.

Code Group Restructure (5898/497) [4E23] This feature increases the number of call type indicators allowed on Recent Change (RC) forms which are input in the AD3 field and increases the number of manual subsequent digit types. This is achieved by creating a new four-word call type for all manual sdtypes. The current SD1, SD2, and SD3 call types are now used for the automatic sdtype only, and the new SDIGM call type is used for all manual sdtypes. The number of call type indicators allowed on Code Group Recent Change forms in the AD3 field is increased from eight to twelve. The number of manual subsequent digit types is also increased by decoupling manual subsequent digit

types from automatic subsequent digit types and making manual subsequent digit types a new internal call type that is not provisioned on Code Group Recent Change Forms.

Benefits

Allows for the future introduction of new call processing features.

Trunk Maintenance (TM) Restructure (490) [4E23] increases the number of assigned states by restructuring Trunk Maintenance structures.

Feature 490 is available in 4E23 Release 1.

Benefits

This positions the *4ESS* Switch to allow future TM enhancements.

Use of 340-Megabyte Disks [4E9] equips the Attached Processor System (APS) with a 340-megabyte hard disk, replacing the 300 or 160-megabyte disks used in earlier generics.

The disks are used for storage of the following information:

- Traffic Measurement data
- Network Management pages and data
- Automatic Message Accounting (AMA) billing data
- Backup for translation data.

3B Small Computer System Interface (SCSI) Disk (219a) [4E16] replaces the four 340 Mbyte Single Moving Disk (SMD) pairs with two 600 Mbyte disk pairs that are used for system and Automatic Message Accounting (AMA) storage.

This increased disk capacity provides additional system disk files required to develop feature software and data. The higher disk capacity is required in 4E17 to back up program software

therefore, the disks need to be deployed during 4E16 in order to support the 4E17 retrofit.

SCSI and SMD disk systems require separate controllers, and cannot be intermixed due to cabinet space and physical floor space required to support both disk controllers. Additional duplexed disks are available for AMA storage, if they are required.

3B Small Computer System Interface (SCSI) Disk-Software Feature (219b) [4E17] is the software phase of the SCSI disk conversion.

The 3B SCSI Disk Feature (219a) activates the SCSI disk drives, but does not impact the capacity of the disks, due to no changes to the Volume Table of Contents (VTOC). The same VTOC that is used for the Storage Module Drive (SMD) disks is also used for the SCSI disks.

However, this new software feature changes the VTOC to utilize the full capacity of the SCSI disk drives. The VTOC for both the system disk and the Automatic Message Accounting (AMA) disks change when the 4AP11 retrofit occurs.

On the system disk, VTOC changes to increase the size of the existing partitions on the disk. The system data is then copied to the larger partitions. On the AMA disks, the VTOC changes to add four more partitions per disk, with each SCSI having a storage capacity of 600 MBytes. ***Backward Code Group Translator (495) [4E23]*** adds backward pointers to the domestic code grouping translators resulting in faster searches. When a program needs to know what code(s) use a particular treatment, a linear search through HT4DISGUPP is done and the backwards pointer immediately identifies the code. The benefactors of this feature are RC/V and NGODA.

This feature will be available in 4E23 Release 1.

Benefits

The Backwards pointers facilitate the speed up of RC 300 series forms processing and the VER:CODELIST messages. Having the data also allows more thorough error checking capabilities in NG-ODA.

3B20 Conversion to SCSI Disks (385) [4E18] replaces the existing 3B20D computer 600 MB Small Computer System Interface (SCSI) disk drives with 3-1/2 inch 1 GB SCSI disk drives, while providing the same physical appearance and functionality. This feature requires no software changes, with the exception of the 1 GB disk driver software, that is included in the 4AP12 load.

3B20D 1Gbyte Disk Replacement (457) [4E21] replaces the current *4ESS* and *5ESS* 1.0 GB SCSI disk drive used in 3B20D and 3B21D systems with a 2.0 GB SCSI disk drive unit. The new disk drive is a replacement only, and no new additional capabilities are provided with it. A minor software change is provided so that the disk driver recognizes the new disk when it is installed.

Small Computer Systems Interface (SCSI) Firmware Download (374) [4E17] provides the capability to update Seagate® Small Computer Systems Interface (SCSI) disk drive firmware in the field. Although it is unlikely that a field update is required, this feature minimizes the need to change disk drive memory chips or to download new firmware from a Personal Computer (PC) to replace existing firmware.

If a SCSI disk drive has a firmware failure, *4ESS* Switch Real Time Reliable (RTR) development can modify the disk drive firmware via a software update. Firmware is sent to offices using a Broadcast Warning Message (BWM) procedure, and is loaded on a 3B20D computer.

NOTE:
This feature only applies to Seagate-supplied SCSI disk drives. Hewlett-Packard disk drive firmware must still be replaced by physically changing the memory chip, or the board containing the chip.

D-Channel Capacity Increase (189) [4E17] increases both memory and real-time capacities, as well as call capacity, to meet the expected growth of the D-Channel Node (DCN).

The increase in call capacity and real-time are achieved by replacing the current DCN node processor with the Intel 80386 microprocessor based Integrated Ring Node No. 2 (IRN2) board.

The IRN2 board expands DCN capability and flexibility, providing a greater number of simultaneous calls and Temporary Signaling Connections (TSCs), including support for new applications and new features such as OA&M upgrades.

The time-frame to upgrade the DCN with the IRN2 board is 4AP10 or 4AP11 (4E16 or 4E17). The 4AP11 generic is the latest that the IRN2 must be installed, since the 4AP12 generic (4E18) requires this upgrade.

Due to the number of features and capabilities added to the DCN over the course of generics, the DCN memory has been exhausted. Therefore, this feature gives customer's the following capabilities:

- A platform for adding new D-Channel features. Previously, the D-Channel Node did not have spare memory for new features.
- Increased capacity of the D-Channel Node by increasing the number of simultaneous calls to 671 per D-Channel.
- Increase message throughput of the node to support larger customers.

Attached Processor System (APS) [4E7] expands the 1A Processor file store from 15 megabytes to 300 megabytes, by replacing the Burroughs file stores with a 3B20D Model 1 processor, and an Attached Processor Interface (API).

Disk Independent Operation (DIOP) [4E14] reduces the amount of downtime, which result from system disk failures. This feature provides a maintenance environment to clear duplex failed disks, while retaining uninterrupted call processing, Automatic Message Accounting (AMA) billing, and an environment for initializing the disk system from tape when the essential system disks fail.

DIOP builds on the UNIX® RTR Disk Limp Mode feature, allowing the system to run without disk access. Technician access is severely restricted in DIOP however, this feature does allow the initialization and verification of the system disks.

Enhanced 3B20D APS Recovery [4E12] modifies the procedures for installing new generics, and for performing AMA audits.

- *APS Update Enhancements* modifies the following application programs:
  - — *applhook* — specifies files that must be copied from the old generic to the new generic, was modified to copy the dynamic files for the CNI ring - /database/CNI
  - — *retro* — maps Equipment Configuration Database (ECD) information from the old generic release to the new generic release, was rewritten to provide data table driven operation.

3B20D Congestion Control [4E15] reduces the amount of 3B20D real time consumed by the Common Network Interface (CNI).

Fault Recovery Improvements [4E15] enhances both the 1A Processor and the 3B20D computer recovery sequences to allow faster completion of fault recovery sequences.

1B Processor Tape Unit Elimination (5013) [4E22] The 1B Data Unit Selector (DUS) Tape Unit Controller (TUC) provided secondary emergency backups, accessed the Trouble Locating Procedures (TLP) database, performed secondary emergency System Reinitialization (SR), secondary emergency diagnostics, miscellaneous tape generations, and system database administration. With the 4E22 generic, the functions provided on the 1B Processor DUS/TUC are moved to the 3B Attached Processor System (APS) with the exception of secondary emergency diagnostics, and secondary emergency system reinitialization which are eliminated completely. This removal is necessary because the tape unit has been manufactured discontinued.

Benefits

Reduces the maintenance costs of the discontinued hardware.

Attached Processor Interface Capacity Improvement (5003) [4E22] The Attached Processor Interface (API) feature (in conjunction with feature 4694) supports an overall increase in the *4ESS* Switch call handling capacity by reducing the size of header-fields used to direct all domestic ISDN User Part (ISUP) messages (inter-processor and intra-office).

This improvement enhances the throughput capacity of the API by minimizing the impact of Signaling System 7 (SS7) ISUP messages.

Benefits

- Increases overall call handling capacity.
- Enhances throughput capacity of the API.

NETWORK MANAGEMENT

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NETWORK MANAGEMENT

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The *4ESS* Switch provides features for efficient managing of the network. The goal is to complete a maximum number of calls during periods of high traffic stress. This goal is accomplished by features in the following categories:

- *Basic Capabilities* — basic detection, investigation, and control of network resources affecting the *4ESS* Switch
- *Network Management Centers* — interfaces that support systems that collect and control network management data from many switches within the network
- *Hard-to-Reach* — identification of NPA-NXX calls that are failing to complete and placing controls on calls requesting to terminate in those areas
- *Dynamic Overload Controls* — controls to limit traffic to a far switch undergoing some form of congestion
- *Other Controls* — limiting and rerouting calls
- *Miscellaneous* — various network features.

Feature Descriptions

Basic Capabilities

Network Manager Machine Interface [4E0] fulfills the network manager's need for surveillance capabilities and the ability to effect controls. The surveillance function provided in the *4ESS* Switch is based on information that the processor maintains in its memory. Besides some specialized network management data, the network manager can obtain an extensive set of traffic and plant measurement data.

The following is a typical surveillance sequence:

1. Detect an exception that indicates a potential problem
2. Investigate the problem by interrogating the system via display pages
3. Decide to initiate (or remove) a control via control pages.

Network Management Exception Panel [4E0] continually monitors the state of the *4ESS* Switch system and that portion of the Direct Distance Dialing (DDD) network to which it is sensitive. When unusual conditions are detected, the appropriate indicators are activated to call the network manager's attention to the anomaly. A teletype (TTY) message and/or an audible alarm may also be triggered, depending on the severity of the condition.

The indicators are divided into four classes according to how frequently they are updated. The update intervals are 30 seconds, 5 minutes, 15 minutes, and instantaneously (that is, immediately upon detection of some events, an indicator is modified to reflect the new status.)

The Network Management Exception Panel involves the following areas:

- Four study classes
- No Circuit (NC) numeric displays (one for each study class)
- Network controls subpanel
- Machine status subpanel.

Problem Investigation [4E0] enables the network manager to perform problem investigations by using a set of cathode ray tube (CRT) displays that allow an analysis of system problems. These CRT displays are designed to provide the information needed for an orderly and thorough investigation of the problems indicated by the exception panel.

Network Management Exception Panel Improvement [4E1] makes the following enhancements to the Network Management Exception Panel:

- Addition of a fifth study class
- Addition of features to the network control subpanel
- Additions to the machine status panel.

No-Circuit Indications [4E2] output a No-Circuit (NC) condition for selected Trunk Subgroups (TSGs) on an optional 1200-baud TTY channel. The TTY channel, when used, is remoted to a Network Management Center.

For an NC condition on a TSG to be monitored, the TSG must be assigned to a Network Management study class. A maximum of 1023 TSGs may be assigned. Once this has been done, the network management software checks each TSG on a 30-second basis for an NC condition. The numbers of all TSGs found in an NC condition are saved in a buffer and later output. The TTY channel is used on a 30-second basis in blocks containing up to 32 entries.

Control Activation [4E0] involves the network manager initiating (or removing) a control by using the CRT terminal in the same manner as during problem investigation.

The network manager requests a page on the CRT containing a blank form to be completed with the specifics of the control action. After the intended control action has been specified, the system supplies a status report on the CRT, pertinent to the control action. At this point, the system is ready to accept an execution command.

Although the external interaction for control and display pages is identical, the internal handling is different. Since controls modify the operation of the system, the design approach emphasizes minimizing the likelihood of erroneous or unintentional control actions. Consequently, the set of control pages, like the set of controls made available, is generic. With this approach, a more nearly fail-safe operation is realized in two ways. First, the control pages are carefully designed from a human factors viewpoint. Second, the explicit knowledge of the control page structure allows an extensive set of built-in software checks on the validity of control requests.

Selective Trunk Reservation (STR) [4E0] dynamically observes the occupancy of a Trunk Subgroup (TSG), and applies one of two filters to the offered traffic at high levels of TSG occupancy.

As the number of idle trunks in a TSG falls below a first threshold, all Hard-to-Reach (HTR) traffic that uses this TSG as an alternate route and most HTR traffic that uses this TSG as a first route are not permitted access. As a second threshold is passed, only first-routed traffic not destined for HTR points is allowed access.

Traffic that is not permitted access to a TSG normally skips to the next route, but may be optionally canceled.

Manual Controls [4E0] give the network manager, who is afforded a global view of the performance of the network, an extensive set of controls over the routing of calls. The manual capabilities encompass the control of traffic on a TSG and code basis, as well as the ability to modify and override the automatic system.

Network Management Centers

Engineering and Administrative Data Acquisition System for Network Management (EADAS/NM) [4E2] reduces the need for on-site network management at the *4ESS* Switch by providing for centralized network management at EADAS/NM supported Network Management Centers (NMCs), as well as by providing for more global views at EADAS/NM supported Regional Operations Centers (ROCs) and at the Network Operations Center (NOC).

EADAS/NM collects network management data from a number of switching systems. Some of this data is used to drive the EADAS/NM display board, which enables the network managers to view the status of a large portion of the network. The degree of detail available for this ''network view'' can be expanded by accessing additional data through EADAS/NM cathode ray tubes (CRTs).

EADAS/NM can also implement network management controls in the various switching systems. As a result, with EADAS/NM fully deployed, the network management functions of surveillance and control are both accomplished via centralized network management systems.

The data is obtained from the *4ESS* Switch by a request transmitted over the data link from EADAS/NM to the *4ESS* Switch.

The output data consists of the following:

- 30-second on-off status discretes that are displayed on the *4ESS* Switch network management display panel
- 5-minute Trunk Subgroup (TSG) data
- 5-minute Hard-to-Reach (HTR) code statistics
- 5-minute machine performance data
- Network management control status data
- TSG register assignment data.

Improved I/O to EADAS/NM [4E5] is an upgrade to the transmission link between the *4ESS* Switch and EADAS/NM. This improved data link makes the 5-minute network management data from the *4ESS* Switch to the Network Management Center (NMC) available within 90 seconds after the switch is polled. This link provides for 4800 bps full-duplex synchronous data transmission.

Two separate high-speed ports are provided to allow surveillance by both the Regional Operations Center (ROC) EADAS/NM and the EADAS/NM that supports the Network Management Center (NMC). Polling and reverse control requests from either EADAS/NM result in identical data being sent over both links. Polling and reverse control requests are normally handled by NMC EADAS/NM; however, it is possible for the ROC EADAS/NM to poll for data and implement reverse controls as a backup capability if the NMC EADAS/NM is down.

In addition to the improved I/O for EADAS/NM, the remoted *4ESS* Switch network management display terminals are upgraded to 4800 bps operation using isochronous data transmission.

NetMinder [4E14] is a Network Traffic Management Operations System that provides surveillance and control by monitoring the status of trunk groups and switches.

NetMinder maintains and enhances the capabilities of the Engineering and Administration Data Acquisition System for Network Management (EADAS/TDMS/NM) while offering greater capacity to store and manipulate data.

NetMinder is concerned with managing traffic once it gets into the network, so loop related features (such as ISDN) do not generally affect NetMinder. NetMinder features include:

- User-adjustable multiple exception levels that automatically establishes priorities for network problems
- High-resolution color graphic and alphanumeric displays
- Easy-to-understand wall displays
- Sub-network monitoring
- Historical data access
- Simultaneous access to several operations systems through peripheral integration
- Clear diagnosis of data availability problems
- Flexible administrative reports system
- On-line control log
- On-line help, input prompting, and error messages
- On-line trend data.

Hard-To-Reach

Hard-to-Reach (HTR) Codes [4E0] enable the *4ESS* Switch to identify HTR destinations.

In order to allow the automatic determination of codes that are HTR, three statistics are kept on each Numbering Plan Area (NPA) on the NXXs within the home NPA, and on the NXXs in a maximum of six other NPAs.

There are three counts concerning a code:

- Attempts that fail to find an outgoing route
- Attempts forwarded to other offices
- Attempts that fail to receive an answer.

Modification of Automatic Hard-To-Reach System [4E0] enables the network manager to modify the automatic HTR determination and the selective trunk reservation thresholds. The latter specifies new threshold values, and the former specifies codes as HTR.

Besides explicitly intervening in the HTR process, the network manager can ''tune'' the automatic determination of HTR by modifying the criteria that the automatic system uses in judging codes to be HTR. The criteria for HTR are concerned with the volume of traffic toward a code, and the deviation of the traffic from a satisfactory completion value.

Network Management—Hard-To-Reach/Call Gapping [4E7] enhances the HTR code identification and call gapping capabilities.

The HTR enhancement consists of the following HTR lists to be maintained for domestic codes:

- A source list of codes that the *4ESS* Switch identifies as HTR by internal calculation
- A control list of codes found to be HTR when an attempt to advance a call to the code has resulted in an HTR message being received from a contiguous office.

The call gapping enhancement meters the rate at which calls for selected codes are allowed to advance to the next office in the routing chain. Calls that are not advanced are terminated to an appropriate announcement (for example, No Circuit Announcement [NCA]).

International Hard-To-Reach Improvements [4E14] make the following improvements to international HTR in the area of manual HTR:

- An increase from 63 to 127 in the maximum number of codes on the manual international HTR list
- The capability to add (or remove) up to 60 codes to (or from) the manual international HTR list
- Ineffective Network Attempt (INA) counts for codes on the manual international HTR list.

On days with special calling patterns (for example, Christmas and Mother's Day), international network managers need the capability to declare a large number of codes as manually HTR. With this feature, the number of international codes that can be manually declared as HTR is increased from 63 to 127, more than doubling the previous capacity of the manual international HTR list.

Since manually declaring up to 127 international codes as HTR is very time consuming, this feature makes it possible to add multiple codes to the manual international HTR list in the Network Management Display System (NMDS). For the NMDS, up to 60 codes may be added or deleted.

The ability to place codes on the international HTR list allows network managers to use ''selective'' Trunk Subgroup (TSG) controls to keep the international trunking network filled with revenue-producing calls. Since a TSG control in not normally used to block all calls to an international code, it is important for international network managers to know the success rate of the calls to a given international code that are not controlled. Therefore, this feature provides an Ineffective Network Attempts (INA) count for all codes on the manual international HTR list. The INA data is available from the NetMinder and the NMDS. This data is useful for international network managers to ''fine tune'' TSG controls.

TSG Control Enhancements [4E14] add a new option to the code parameter and the routing parameter for the Cancel-From (CF), Cancel-To (CT), and Skip (SK) controls. Previously, the routing parameter had only two options; alternate routed (ALT) traffic only, or all traffic. This feature adds the Direct (DIR) traffic only option to the routing parameter. Also, the code parameter previously had only two options; traffic to HTR codes only, or all traffic. This feature adds the Non-Hard-to-Reach (NHR) only option to the code parameter. As a result of these changes, network managers can now implement other controls (for example, SK control) that would only affect DIR calls to codes that are NHR.

Hard-to-Reach Control List Administration [4E14] enables network managers to use NetMinder to add and delete codes in the Domestic Hard-To-Reach (HTR) control list. Previously, the capability to perform these functions was available to network managers only, via remote Network Management (NM) support systems.

The LEC network managers usually add codes to the Domestic HTR control list one at a time. However, they now have the capability to add large numbers of codes to the HTR control list for days with special calling patterns, such as Christmas.

Dynamic Overload Controls

Selective Dynamic Overload Control (SDOC) [4E0] provides relief for congested switching machines. In response to a Dynamic Overload Control (DOC) signal from another office, the *4ESS* Switch filters the traffic presented to that office according to the received DOC level.

Upon receipt of the low-level DOC signal, called MC1, the *4ESS* Switch restricts sending traffic to destinations that the office is finding HTR, and optionally restricts some alternate routed traffic.

For the middle level (MC2) DOC signal, the *4ESS* Switch stops sending HTR traffic in addition to optionally restricting non-HTR traffic.

The highest level (MC3) DOC signal stops all traffic from being sent, since this signal indicates a far office outage. The traffic affected by the DOC control can either be skipped to the next route or canceled as a Trunk Subgroup (TSG) option.

Selective Dynamic Overload Control (SDOC) and Selective Trunk Reservation Control (STR) [4E2] modify the automatic SDOC and STR controls in the *4ESS* Switch so that a Trunk Subgroup (TSG) may be assigned to one of six response categories for SDOC, and to one of four response categories for STR.

In addition, the application of STR and SDOC is modified, allowing both controls to be applied on a per-call basis. STR is applied first, followed by SDOC. These modifications give the network manager flexibility when using SDOC and STR, since they allow greater selectivity in assigning a TSG to a response category. A control page allows the network manager to assign the response categories on a real-time basis.

Dynamic Overload Control Time Out Relief (DOCTOR) [4E10] detects congestion to non-CCS offices by examining the congestion level ratio of timeouts on MF transmitters to outgoing seizures on a per TSG basis. Three congestion levels are defined, similar to those described for Selective Dynamic Overload Control (SDOC) in the Dynamic Overload Controls section.

DOCTOR Improvements [4E14] enhance the performance of the DOCTOR capability by reducing the interval between tests, and by changing the percentage of traffic controlled.

Prior to the introduction of this feature, there were two major problems with the DOCTOR capability:

- Network managers considered the analysis interval (30 seconds) too long to detect congestion or failure at connecting switches in a timely fashion. With this feature, the analysis interval is changed from 30 seconds to 10 seconds. This change greatly increases the speed in detecting the onset of switch congestion or failure and also allows the control to be more quickly deactivated.
- For switch failure scenarios, the control was cycled on and off every 30 seconds because 100 percent of the traffic was controlled. This feature changes the percent of traffic controlled for switch failure from 100 percent to 87.5 percent. By allowing a small percentage (12.5) of the traffic to attempt to use the outgoing Trunk Subgroup (TSG), enough timeouts are measured to keep the control active for the length of the switch failure.

Other Controls

Network Management (NM) Call Gapping Control (CGC) [4E5] limits by code (up to 12 digits), the rate at which calls are forwarded out of a switching office. This metering effect, referred to as call gapping, employs a generic table of prespecified call rates together with a timer to meter the calls that are to be forwarded to the called destination.

The activation of the CGC involves the setting of the timer to the present time plus a time interval (gap). The first call to arrive after the end of the time interval is forwarded, and then the timer is reset to the present time plus the gap.

Calls that arrive prior to the end of the time interval are terminated to a No Circuit Announcement (NCA) or equivalent announcement at the switching office. This call-handling treatment continues until the CGC is deactivated.

Spray Reroute (SPRR) [4E8] allows 256 simultaneous manual reroutes with a maximum of seven specified via offices per reroute. Traffic is offered to the designated via offices by a circular hunt method.

SPRR gives the network managers an improved instrument to direct traffic through the *4ESS* Switch network during peak congestion periods.

The SPRR feature incorporates the advantages of both the manual rerouted and Automatic Out of Chain Routing (AOOCR) capabilities to provide a new control that is administered via the NM human-machine interfaces (HMIs). SPRR entails three types of reroutes: regular, code specific, and Routing Data Block (RDB) specific.

Time Activated Reroute (TARR) [4E13] allows Network Management (NM) personnel to define a schedule for Spray Reroute (SPRR) once, so the SPRR is automatically activated and deactivated as needed. This capability was developed primarily for international NM, where the necessity for the same reroutes regularly occurs several days a week (often in the early morning hours). For example, if SPRR is needed every Monday, Wednesday, and Friday from 0200 hours to 0700 hours, the TARR capability allows NM personnel to set up an appropriate TARR. Thereafter, the SPRR is activated and deactivated at the proper times without the action of NM personnel.

TARR is available to any NM personnel with access to a Network Management Display Terminal (NMDT).

Busy Tone for Automatic Call Gapping (ACG) [4E10] modifies ACG controls for 800 service to allow a busy tone rather than a No Circuit Available (NCA) announcement as the disposition on many calls controlled by call gapping.

Network Management Enhancement [4E11] adds an enhancement called Rate Based Reroute (RBRR) to the Trunk Subgroup (TSG) SPRR capability.

RBRR allows Network Management (NM) personnel to reroute one call per unit of time, as opposed to controlling a fixed percentage of calls offered to a TSG.

Network Management Improvements [4E12] give network management personnel more sophisticated and flexible control capabilities for Network Management (NM) Manual Call Gapping Control (CGC) and NM Trunk Subgroup (TSG) control.

- *Manual CGC Improvements* include two modifications. The first increases the number of Gap Interval Indices from 16 to 32, allowing NM personnel more flexibility in using manual CGC.

  The second adds a Carrier Identity (CI) parameter to the manual CGC parameters. As a result, NM personnel at a LEC Service Switching Point (LEC SSP) can specify three variations of the manual CGC:

  — Control digits plus CI

  — Control digits only

  — Control CI only.

- *NM TSG Control Improvements* affect both manual and automatic TSG controls. The manual control option allows NM personnel to select a rate rather than a percentage for the application or nonapplication of certain controls. Thus, one call every so many seconds (rather than a percentage of calls) can be specified as exempt from Skip controls. The manual control option also allows NM personnel a preference option for Spray Reroute (SPRR) control.

  The automatic option allows NM personnel to override the automatic TSG controls that give preferred treatment to certain incoming calls, such as international calls.

Manual Call Gapping Control (CGC) Improvements [4E13] change CGC from a domain parameter to a type parameter to reduce the amount of entries in the manual CGC table, and save per-call real time. For example, to control all digital data calls to one destination required several controls with the domain parameter, but only one control with the type parameter. The same is true of international originating calls.

The Far End Country Code (FECC) and Incoming TSG Number (ITSGN) options make the control more selective. Using either option, it is possible to control calls to a destination from a single origin.

The FECC option also allows international NM personnel to limit all traffic from a country that historically sends junk calls to this country. This capability prevents valuable international switching resources from being tied up needlessly.

NetMinder Interface Improvements [4E15] allows NetMinder to collect five minute data using bigger subblock size, which in turn shortens the five minute data collection time. This procedure timely updates the wallboard display, which is especially important in case of Network Emergencies.

Time-out Counts [4E16] provides additional surveillance counts on several timeout failure situations during call setup. This allows analysis of additional Network element failure problems that were not provided prior to this feature.

Trunk Subgroup Interest List for NetMinder (213) [4E17] allows users to designate trunk subgroup for NetMinder data collection, instead of using study class assignment through the Network Management Display System (NMDS). This feature reduces administrative overhead and error.

Network Traffic Management Support of Alternate Only Overflow Reroute (435) [4E18] removes a "block" within the *4ESS* Switch to prevent an alternate only overflow reroute request that is received through the NetMinder/NTM interface.

This feature standardizes the NetMinder/NTM product by giving local display terminals the capability to reroute to a different subgroup.

CCS7/SS7 Discrete and Count (134a) [4E17] provides additional Surveillance data on the CCS7/SS7 link. This capability distinguishes SS7 failures from other types of failures to the customer, which helps to monitor the SS7 signaling Network more efficiently.

Call Gapping Enhancements for International [4E18] allows International calls to expand to 15 digits.

Trunk Subgroup (TSG) Adjunct-Head-Cell (AHC) Removal via Recent Change (RC) gives users the ability to delete a TSG via RC, even when the Network Management (NM) TSG Head Cell still exists for the trunk subgroup. This makes the process of deleting unused TSGs a lot easier, thus recovering memory resources.

Explicit 4-Digit Carrier Identification Code (CIC) Indication for NetMinder (417) [4E20] enhances the *4ESS* Switch-to-NetMinder/NTM (Network Traffic Management) system interface, by allowing explicit identification in the 5-minute surveillance data of those active Manual Call Gap Controls that include a 4-digit CIC.

The NTM system sets one bit in data blocks 44 and 46 in the interface to the NetMinder/NTM, to indicate that a specific word in these blocks contains a 4-digit CIC.

This feature enables Network Traffic Managers to know which streams of traffic are being affected by control actions taken through the Network Management Display System (NMDS). Prior to this feature, there was no way for the NetMinder/NTM system to indicate if a given Manual Call Gapping Control was active on digits that included a 4-digit CIC.

Miscellaneous

Miscellaneous Routing Changes (RC/V) [4E13] are described in Chapter 5, OA&M.

Five Minute Usage Data [4E14] allows the Percentage of Outgoing Call Completions (%OCC) and Hard-To-Reach (HTR) measurements reports to be produced in ^5- minute increments, as well for the Network Management Display System (NMDS). Previously, these reports were generated in 15 minute increments.

Providing these measurements in ^5- minute increments for the NMDS allows LEC network managers to totally monitor TSGs on a ^5- minute basis using NMDS.

Network Management Display System (NMDS) Page Transfers [4E14] improve NMDS response time for pages CN02, CN16, CN17, CN18, and TG9, which are some of the most commonly used pages in NMDS. This improvement is achieved by allowing interpage transfers of the Circuit Identification Number (CIN) between these pages.

Basic 800 Service Improvements [4E14] change Final Handling Code (FHC) 310 to handle calls blocked by a 10-digit Inward Wide Area Telecommunication Service (INWATS) Control Code (IWCC), without affecting calls blocked by a 6-digit IWCC with FHC 297. New counters were added for these FHCs.

OPERATIONS, ADMINISTRATION, AND MAINTENANCE

5

Contents

OPERATIONS, ADMINISTRATION, AND MAINTENANCE

5

The *4ESS* Switch provides operational ease in the areas of Administration, Provisioning, and Maintenance.

The features in this category fall into the following groupings:

- *Traffic Measurement* — surveys traffic switched by the *4ESS* Switch
- *Carrier Group Alarm* — determines whether a carrier facility is operating properly
- *Trunk Testing* — tests trunks terminating at the switch
- *Operations Support* — reports operational information both on-site and to remote operational support systems
- *Nail-Up* — provisions for semipermanent connections
- *Miscellaneous* — includes various operational features
- *Administration* — modifies data by providing the ability to enter, change, and verify administrative data.

Feature Descriptions

Traffic Measurement

Traffic Measurements System [4E0] measures the effects of the telephone traffic presented to the switching system. For engineering purposes, these measurements are required to predict future demand, to determine the quantity of equipment needed to meet that demand, and to verify that the present equipment can meet the demands.

For network management, these measurements are used to determine what control actions are necessary to use various control strategies efficiently.

For plant management, they are used to locate and evaluate occurrences of equipment irregularity, and to evaluate the effectiveness of the office maintenance procedures.

These measurements include:

- *Trunk Subgroup Measurements* — maintain measurements of incoming attempts, outgoing attempts, overflows, and usage for all Trunk Subgroups (TSGs). In addition, measurements pertaining to network management controls may be maintained on a specified subset of the TSGs. These include measurements of calls affected by network management controls such as reroutes, cancels, skips, dynamic overload controls, or selective trunk reservation.
- *Traffic Separations Measurements* — maintain 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* — maintain 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 (intertoll versus toll connecting).

  In addition, measurements are maintained for plant management purposes on interrupts by type, reinitialization phases, and equipment outages.

- *Ineffective Attempt Measurements* — identify and maintain a count of the reasons for failure in the case of every origination attempt in the office that fails to reach the waiting-for-answer state.

For a detailed description of specific measurements, please see the current Translation Guide (TG-4) for the *4ESS* Switch.

Modified Trunk Subgroup (TSG) Data (211) [4E17] provides NetMinder with a near real-time monitor mechanism for traffic on the selected TSG. Currently, the number of TSG Adjunct Head Cells (AHC) that can be monitored for near real-time TSG data collection is 1,023.

The 1,023 is a switch limit that takes into account all TSGs at a switch. Due to the increase of end-users in demand for near real-time network management data, the amount of TSGs that can be monitored has been increased.

Using this feature, NetMinder can designate an additional 255 TSGs to collect data. The TSG data collected by NetMinder can be transmitted to direct access customers who need an on-line ''picture'' of their traffic.

A new 5-minute Data Block is added in the *4ESS*/NetMinder Switch interface, to collect and transmit measurements for all designated TSGs.

The following list contains measurements in the Data Block areas:

- Call Attempts Peg Count
- Call Overflow Peg Count
- Incoming Seizures Peg Count
- Occupancy Peg Count
- Calls Rejected by Customer Premises Equipment Peg Count
- Maintenance Busy Count.

Schedule Capabilities [4E0] for the Traffic Measurements System provide a schedule structure that can administer up to 24 schedules for the purpose of outputting traffic measurements. The schedules are processed serially by number, but otherwise each is independent of all the others.

Enhanced Traffic and Plant Measurements [4E2] improve the original Traffic and Plant Measurements feature. Specific areas of improvement include measurements for Centralized Automatic Message Accounting (CAMA), service observing, Inward Wide Area Telecommunication Service (INWATS), system performance, machine performance, network management, system test calls, and improved categorization of lost calls.

The support of the *4ESS* Switch On-Site Operational Support System with new and improved measurements is also included.

Network Switching Performance Measurement Plan [4E3], also referred to as the Index Plan, is an on-site operations report designed to identify actual or potential trouble conditions before they can adversely affect network switching performance.

The component measurements provide a composite view of how maintenance, administrative, and engineering personnel are performing. The principal parts of the plan include a Switching Service Index, a CAMA Billing Service Index, Administrative Performance Indicators, and Machine Performance Indicators.

Plant Measurements [4E0] collect and record information associated with the status of the *4ESS* Switch equipment, and with irregularities that could cause traffic to be switched improperly by the system.

A summary of this information is printed periodically on an output TTY channel, allowing the operating personnel to determine the status and effectiveness of the system for processing traffic.

For a detailed description of specific measurements, please see the current Translation Guide (TG-4) for the *4ESS* Switch.

Maintenance Usage Measurement Capability [4E13] provides on-line traffic data including attempts, overflows, usage, and maintenance usage to the Virtual Private Network (VPN) and 800 Services customers.

New Ineffective Machine Attempt (IMA) Code [4E13] defines a new office trap index in the final handling code trap. This index, used for Q.931 Protocol Errors, is called QPE.

Trunk Status [4E0] enables office personnel to obtain the state of individual trunks (that is, busy or idle), and to obtain a list of all trunks in a specific state, such as high and wet.

Expanded Traffic Separations [4E8] measure the volume and the conversation time of predefined classes of traffic being carried by the *4ESS* Switch. The classes are defined by using a matrix with two dimensions.

One dimension is an attribute of the incoming trunk, called incoming separation (INSEP).

The second dimension is an attribute of the dialed digits, called destination separation (DESEP). Volume is the number of incoming attempts using an intersection of the matrix, while conversation time is the duration in 100 call seconds (CCS) of all calls using a matrix intersection.

Prior to the introduction of this feature, the matrix size was 32 INSEPs and 64 DESEPs. This feature raises those numbers to 256 INSEPs and 256 DESEPs. This added capacity provides better resolution of predefined traffic mixes, but a 256 by 256 matrix that is sparsely populated requires excessive amounts of memory. As a solution to that problem, a new translator, called INSEP-DESEP Addressing Matrix (IDAM), has been added to reduce the amount of memory required. IDAM is a 256 by 256 matrix with each cell containing a number between 0 and 1023. The number is called a Cell Group (CG). The system supports 1024 CGs, with CG 0 reserved for audits while CG 1 through 1023 can be used operationally. Measurements are provided for all operational CGs.

New Traffic and Plant Counts [4E5] furnish the following traffic and plant counts required, due to the addition of other features to the *4ESS* Switch:

- International Signal Transfer Point (STP)
- Mass Announcement System (MAS) Recording Channel Queue
- MAS Disk Sectors Duplication Queue
- MAS Sectors Activated While on Queue
- Dedicated Time Slot Interchange (TSI) Usage
- Calls Originating and Terminating on the *4ESS* Switch
- MAS Update, Callback, and Irregularities
- MAS Disk Usage

- MAS Per Announcement Counts
- Calls Cut-Through
- Televote Master Dialed Number
- Televote Slave Dialed Number
- Geographic Seizure Count Matrix.

Retain Measurement Reports Schedule Across 1A Processor Retrofit (879) [4E15] allows retention of measurement report schedules through a generic retrofit, thus eliminating the need to reinstall schedules later after the retrofit. Note that only the schedules are preserved; not the data accumulated in the reports.

Operations, Administration, and Maintenance Measurement Enhancements (086) [4E16] include new measurements and Recent Change (RC) indicators that support ISDN User Part (ISUP), and alert operations personnel to trouble conditions involving the protocol. Among conditions detected are loss of Access Transport Parameter (ATP) and/or UUI (User-to-User Information), Confusion Messages, and messages related to protocol errors. These measurements provide the only means for maintenance personnel to be alerted to trouble conditions.

This feature also provides a new count of ISUP messages received from Interexchange Carriers (IECs) containing an ATP. The count is on a per Trunk Subgroup (TSG) basis for TSGs to an IEC. This feature is compatible with Bellcore requirement TR-TSY-000444.

CNI Performance Measurements (082) [4E17] provide additional Signaling System 7 (SS7) link node measurements. These measurements monitor the link node buffer and real-time usage to allow the links to be better engineered.

Additionally, these measurements indicate node resources that reach exhaust points, and permit advance planning and engineering of additional nodes.

Examples of these new measurements include the following:

- Cumulative duration of Node Processor congested state
- Cumulative duration of Node Processor outage
- Link transmitter buffer average occupancy.

CNI Software/Hardware Inhibits (267) [4E17] provide the means to limit Common Network Interface (CNI) and Interprocess Message Switch (IMS) recovery actions in the 3B20D computer, when hardware or software problems occur.
This feature can be used to quiet down a system that is rolling in recoveries, thus allowing craft personnel to take manual control.

This feature uses system inhibits to prevent thrashing of error conditions that would otherwise adversely affect system operation. The switch automatically detects system trouble, and attempts to restore system operations to normal.

The following types of system inhibits exist:

- **Software:** Prevents escalation of software recovery actions where the higher action is taken arbitrarily (for example, based upon threshold counts). Low level actions are permitted.
- **Hardware:** Disables hardware check circuits to blind the software to a recovery stimulus. This inhibit is effective for false (defective) error detectors (for example, parity errors).

When inhibits are enabled, the system has limited automatic recovery resources. Therefore, the system must be closely monitored by craft personnel, since subsequent system errors require manual action.

The following four areas have the potential to thrash the system, while recovering from IMS functionalities:

- CNI Initialization

- IMS Initialization
- Ring Error Analysis and Recovery
- Automatic Ring Node Recovery.

Address Completion Message Time-Out for Study Classes (376) [4E17] adds the Address Complete (ADC) Final Handling Code (FHC) 877 to the Trunk Subgroup (TSG) study class. Prior to this feature, Network Management Study Classes included performance measurements of TSG activity Out-of-Service (OOS), Off-Line (OFL), Attempts per Circuit Per Hour (ACH), Continuity Check Indicator (CCH), and No Start Dial (NSD)].

In the MultiFrequency (MF) signaling environment, the NSD is a good indicator of far end problems. However, in the Signaling System No. 7 (SS7) network, the ADC failures (FHC 877) are the equivalent indication of the far end office's inability to process a call.

This feature pegs the existing NSD TSG count for ISDN User Part (ISUP) ADC message time-out that is FHC 877. This measurement provides the LEC customer's with an indication of the far end office's inability to process a call.

Carrier Group Alarms

Carrier Group Alarm [4E0] is a monitoring arrangement that determines whether a carrier facility is operating properly. Carrier systems are often employed by transmission facilities that interconnect switching systems.

The *4ESS* Switch can examine the state of carrier group alarm indicators for associated sets of 12 analog or 24 digital trunks, and provide an alarm signal when a carrier failure occurs. Teletype (TTY) printouts identify which carrier group has failed, and the Circuit Maintenance System (CMS-1A) is notified of the carrier group failure.

Software Carrier Group Alarm for CCS Trunks [4E2] responds when a Common Channel Signaling (CCS) voice path continuity check failure is detected. In this situation, the trouble may be an individual trunk failure or a carrier failure. For CCS trunks, a special software feature, called Software Carrier Group Alarm (SCGA), attempts to resolve the trouble and take action to protect customer service. The goal is to detect carrier failures quickly, thereby preventing incoming and outgoing traffic from using failed facilities, as well as to avoid switch congestion caused by carrier systems that have failed.

Analog Carrier Group Failure Treatment for E&M Trunks [4E4] provides a software carrier group alarm analysis routine for trunks on analog carrier facilities that employ E&M signaling. Failures on the analog carrier facility can be either Transmit Path Failure (TPF) or Receive Path Failure (RPF). Two separate algorithms are provided to detect these failures.

Software Carrier Group Alarm (SCGA) Enhancements [4E6] provide enhanced administrative tools for the SCGA capability in the *4ESS* Switch.

These enhancements, along with existing capabilities, give the technicians complete control in selecting or rejecting SCGA treatment for all eligible trunks on an analog group basis (that is, 12 consecutive Trunk Appearance Numbers (TANs) or trunks). This feature also allows them to direct the Office Data Assembler (ODA) program, to consider SCGA eligibility for trunks associated with analog carrier facilities located beyond the *4ESS* Switch maintenance boundary.

In earlier generics, absolute word overwrites were required to provide SCGA treatment on these trunks, since analog carrier definition was not detectable through normal ODA source data, such as Trunk Assignment Generation System (TAGS), Circuit Assignment Records Transfer System (CARTS), or input forms.

These enhancements also provide more control of SCGA treatment after the initial ODA installation via recent change procedures. A new VERIFY capability is also provided to verify the current SCGA treatment type (that is, E&M, MIX, HDWR, UNEQ) to the technicians.

Trunk Testing

Switched Access Trunk Testing [4E0] establishes a path through the network from a trunk to a test position. In addition to the automatic tests provided for trunks, this feature allows further tests to be made on a particular trunk to determine the quality of the service it provides.

Code Line Tests [4E0] consist of automatic and manual tests for trunks in the *4ESS* Switch. These tests can be activated both from the *4ESS* Switch, and from the connecting offices. Faulty trunks are removed from service automatically when the tests are originated by the *4ESS* Switch.

Remote Office Test Line (ROTL) [4E0] enables the *4ESS* Switch to test trunks at a remote location with controlled transmission tests.

Automatic Trunk Measurements System (ATMS) [4E0] uses the Remote Office Test Line—Centralized Automatic Reporting on Trunks (ROTL-CAROT) 3 system installed in the *4ESS* Switch to perform both routine and demand trunk testing.

Trunk Maintenance Improvements [4E2] make several modifications to improve the original trunk maintenance capabilities.

Whenever an analog Multifrequency (MF) transmitter or an analog MF receiver is implicated as the possible source of a call failure, it is tested using either an MF transmitter test circuit or an MF receiver test circuit, and is no longer subjected to trunk error analysis. This change eliminates the creation of error analysis reports on these units as a result of transmission fades or other similar anomalies.

When trunks are reported to trunk error analysis procedures, they are timed on a 3- or 15-day basis. At the end of this period, an attempt is made to test the circuit. If a test cannot be run, a teletype (TTY) output message directed to the TTY channel in the responsible trunk control area is printed.

104 Test Line [4E4] allows ''1-person'' two- way transmission loss and one-way noise measurements on message trunks [Multifrequency (MF) or Dial Pulse (DP)] connected to the *4ESS* Switch.

The test line may also be used in conjunction with the Automatic Transmission Measuring System (ATMS) to automate such tests.

108 Test Line Termination Duration (262) [4E16] increases the 108 test line timer, which times out from 20 minutes to 24 hours. The Local Exchange Carriers (LECs) can perform bit error rate testing between the *4ESS* and *5ESS*® switches, without experiencing a call drop due to timeout.

This feature allows a test call to stay up for 24 hours, or until it is explicitly taken down within 24 hours. Prior to this feature, a test call placed over a 108 test line was dropped after 20 minutes.

CMS/ESS Trunk Status Audit [4E4] enables the Circuit Maintenance System (CMS) to request, from the *4ESS* Switch, the trunk status data residing in the *4ESS* Switch database, in order to update its own database (for example, the trouble ticket log).

Discrepancies between the two databases can arise due to communication failures between the CMS and the *4ESS* Switch.

Thus, a condition where trunks are out-of-service in the *4ESS* Switch database, but are in-service to CMS could continue indefinitely. Furthermore, trunks which have been restored to service in the *4ESS* Switch database, but fail to be reported to CMS will have unnecessary downtime logged against them.

CMS/ESS trunk status audits can be initiated on a demand basis. They can also be performed by the CMS on a routine basis, as well as automatically in response to a message from a trunk maintenance program. In the latter two cases, group audit is run first to determine trouble ticket/no trouble ticket status. Thereafter, a detailed audit is obtained on a per trunk basis for each group where discrepancies have been found.

Two types of messages have been provided for the CMS/ESS trunk status audit feature, one for individual trunks and one for large groups of trunks.

All trunks in the *4ESS* Switch office are audited by the CMS on a routine basis using group trunk status audit requests. If a discrepancy is found between the CMS and ESS databases, a series of individual trunk status audit requests is issued for each trunk identified in the initial group request as having a discrepancy. The detailed trunk status data returned to the CMS is used to resolve any trouble ticket discrepancies in the CMS.

Improved I/O to Circuit Maintenance System (CMS) [4E5] uses the capabilities provided by the high-speed I/O protocol feature to facilitate high speed (4800 bps) and relatively error-free data link communication between the *4ESS* Switch and the CMS system. This feature applies only to CMS. It does not apply to CONNECTVU which replaces CMS.

Remote Maintenance System-D2 (RMS-D2) [4E10] supplies a digital replacement for the following analog test facilities:

- 51A trunk test position
- Remote Office Test Lines (ROTLs)
- Digital Test Access Trunk (DTAT)
- 104, 105, 109, and 606 test lines
- 0dB and -10dB office milliwatt tone sources.

The RMS-D2 test lines, test positions, and ROTLs are installed to be compatible with, yet independent of, the analog testing facilities. Therefore, it is possible for an office to have both analog and RMS-D2 test lines, test positions, and ROTLs in service at the same time.

Noninverting Digital Loopback Test Line [4E11] is used to test 64K digital data services in the domestic market, and provide an adequate test vehicle for foreign administrations to terminate incoming digital tests on CCITT No. 5, CCITT No. 6, and CCITT No. 7 trunks.

The noninverting digital test line, accessed via the 108 test line codes (108, 959-108, 958-108), can make up to 32 connections simultaneously. The identity of the looped trunks is maintained within a 32-word table. The loopback remains in effect for 20 minutes unless the incoming trunk is abandoned earlier.

Intranet Signaling Connection Control Part (SCCP) Routing Verification Test (SRVT) (126) [4E16] tests the ability of SCCP messages to traverse the network. The main use of SCCP is for database queries to Service Control Points (SCPs) that are critical for high-margin services like 800 and Private Virtual Network (PVN).

SRVT tests the network's ability to properly transport SCCP messages, as well as the Global Title Translation to ensure that the correct database is actually accessed. This version of SRVT only tests message delivery within the same network.

The ''routing test'' capability of SRVT provides needed procedures for testing of routing tables used to transport SS7 messages within the network of *4ESS* Switches, Service Control Points (SCPs) and STPs. It reduces the time to detect problems in the network. This feature is also available in 4E15 generic.

Tan-to-Tan with Supervision Enhancement (250) [4E16] improves the ability to perform manual and automatic testing of network inband signaling trunks. This feature allows the trunk test equipment to be remotely located, and uses an inband signaling trunk to access the *4ESS* Switch for applying signaling tests to the network inband signaling trunks terminating on the switch.

Previously, trunk test equipment used to test and maintain network inband signaling trunks terminating on a *4ESS* Switch was required to be located at the Local Exchange Carrier (LEC) Access Tandem. Applying signaling tests to these trunks also required a special type trunk [Test Access Trunk (TAT)] to access the *4ESS* Switch.

Operations Support

On-Site Operations Report (OSOR) [4E1] allows scheduling of hard copy reports of operational data accumulated over extended time intervals.

The on-site operations reports are summaries of counts available from traffic and plant measurements. The reports enable machine and administration personnel to recognize machine irregularities and evaluate the quality of service provided by the *4ESS* Switch. The reports also provide a data source for engineering the office.

The following reports are included in the OSOR feature:

- Machine Service Report (MSR)
- Machine Performance Report (MPR)
- Machine Load and Service Summary (MLSS)
- Load Service Report (LSR)
- Load Distribution Report (LDR).

On-Site Operations Report (OSOR) [4E2] enhances the original OSOR feature, by allowing new reports or changes to existing reports to be made independently of the issuance of a new generic program, if new data retrieval is not required. This capability is known as ''generic independence.''

Combined Maintenance Operations Center (CMOC) [4E2] allows the Maintenance Operations Center (MOC) functions for one to four *4ESS* Switch offices to be remoted to a CMOC location. The CMOC is collocated with the MOC of one of the offices that it serves. In this way, a single MOC can direct the maintenance activities of more than one office.

Switching Control Center (SCC) Interface [4E4] is a central location for physically and operationally remoting the Maintenance Operations Centers (MOCs) of up to six *4ESS* Switches. The physical aspect of the SCC arrangement requires remoting the Maintenance Control Console (MCC), alarms, and several key I/O channels, and providing special voice communications.

The operational aspect involves placing ultimate responsibility for the maintenance of several *4ESS* switches with a pool of personnel at a remote location who direct the activities of personnel who are on-site in the various offices.

This feature, by using a centralized facility shared among several offices, offers a higher level of expertise for switch maintenance at a significant savings.

No. 2 SCCS F-Level Analysis [4E6] is a maintenance tool available to all *4ESS* Switches that are connected to a Switching Control Center (SCC). This feature is a part of the No. 2 Switching Control Center System (SCCS) generic SC6. The *4ESS* Switch only provides the input data to the SCCS. In turn, the SCCS records this data in its logging file for the particular *4ESS* switch.

Then, either manually or through a scheduled program, this logging file may be searched for all types of maintenance reports (such as, interrupts, interjects, and base level). After locating these reports, the analysis feature can provide either a listing of all frames that have generated excessive maintenance reports over a specified period of time, or a detailed analysis of any single F-Level interrupt.

Centralized Work Centers [4E6] enhance the centralization of the *4ESS* Switch Operations, Administration, and Maintenance (OA&M) functions. A single location provides work centers for up to six *4ESS* Switch offices.

By providing a highly-skilled work/management force in one location to perform trouble analysis and control for switching maintenance, trunk service improvement, and growth support, this arrangement provides a significant work force reduction while making better use of personnel.

The centralized work center, which consists of an Switching Control Center (SCC) and a Machine Administration Center (MAC), can also incorporate some functions of the Trunk Operations Centers (TOC).

Digital Test Access (DTA) for Testing, Operations, Provisioning, and Maintenance System [4E14] enables the commands for controlling and reporting on the Direct Test Access feature on the CONNECTVU/Circuit Maintenance System (CMS)-1C channels.

CONNECTVU Low Speed Interface [4E16] provides trunk testing administration for the *4ESS* Switch. CONNECTVU interfaces with the *4ESS* 1A Processor via a Datakit® Virtual Network. Software version CONNECTVU.1, communicates with the *4ESS* Switch via Datakit to the two asynchronous, 4800 baud, full-duplex I/O channels: CMS2 and CMS4.

Functionally, CONNECTVU comprises the Network Support Tier (NST) and the Equipment Interface Tier (EIT). All 2-way communications between the CONNECTVU and the *4ESS* Switch occur via a number of autonomous messages over independent transmission paths.

The messages perform the following functions:

- *4ESS* messages report changes in trunks and facilities
- *4ESS* reports on the status of the requests received and the test results
- CONNECTVU solicits information from the *4ESS* regarding data, test details and status
- CONNECTVU also requests reports on multiple trunks.

This feature is also available in the 4E14 and 4E15 generics.

Call Irregularity Report to CONNECTVU [4E16] enables CONNECTVU to request and receive various call irregularity reports over its interface to the *4ESS* Switch. The same set of Input/Output messages that are available on the TCA channel are available on CMS2 and CMS4 with this feature. These messages are associated with setting traps and receiving the resulting Ineffective Machine Attempts (IMA) messages.

This feature is used by craftspersons at CONNECTVU terminals to diagnose troubles on remote switches that impact the services. The capability is critical, especially to Testing and Provisioning functions.

CONNECTVU Access to Verify Commands [4E16] provides CONNECTVU with a remote access to *4ESS* Verify Messages on its interface to *4ESS*-1A. A subset of *4ESS* Input/Output messages associated with verify commands are made available to CONNECTVU on CMS2 and CMS4 channels. This capability allows the *4ESS* trunk and routing-related databases to be checked for consistency with CONNECTVU databases. This feature also is essential to the Testing and Provisioning functions.

CONNECTVU/4ESS Switch Echo-back Interface (451) [4E21] maintains the integrity of the shadow Data Base (DB) on CONNECTVU/Automatic Trunk Provisioning (CVU-ATP), by informing CVU-ATP whenever Recent Change (RC) changes originate from either terminals or other Operating Systems (OSs), which bypass the CVU-ATP control environment.

The shadow DB is a repository of the "forms/views/tables" which mirrors the switch translations. The mirroring is valid only for the forms supported by ATP.

Having a shadow DB allows the user to perform queries on CVU-ATP instead of having to do verifies on the switch when building/modifying translations. This speeds up the operation and eliminates the verify traffic which otherwise would be generated by going directly on the switch.

In order to ensure that the shadow DB is synchronous with the switch, it is important that CVU ATP be informed of all RCs which are performed outside the CVU-ATP environment. The echo-back interface serves this purpose. CVU-ATP filters the RC echo-back messages associated with translations it does not support, and uses all other candidate messages to insert/update/delete the forms mirrored in the CVU-ATP shadow DB.

This feature provides the following benefits:

- Maintains integrity of the CVU Shadow Data Base (DB).
- Without this feature, the shadow Data Base (DB) will be out of synch and thus not reliable as a source which mirrors the ATP-supported switch translations.

NOTE:
CONNECTVU/Automatic Trunk Provisioning (CVU-ATP) supports the *4ESS* Switch RC interface in release R2.2.

Command-Initiated Link Fault Sectionalization (CI-LFS) (136) [4E17] is a new troubleshooting capability available with the DS0A link node. CI-LFS allows for easier and faster troubleshooting of link problems. When link problems are detected (that is, total failure or high bit error rates), the craft can initiate an Link Fault Sectionalization (LFS) to locate the faulty element.

The LFS procedure steps through each active element on the link between the *4ESS* Switch and the Signal Transfer Point (STP), and instructs that element to ‘‘loop back’’ the signal to the originating element. A test pattern is sent out, and errors in the returned pattern, allowing the *4ESS* Switch to determine the faulty element.

Forced Link Node Removal (090) [4E16] offers the customer improved maintenance control of the CNI ring. It allows manual (either local or remote) removal of an active SS7 link node from service. This capability enhances the current ''Remove'' command, by allowing the removal of the last link node in a link set when the normal link node remove command does not work. The removal of such nodes is necessary because of occasional link state mismatches.

Forced Link Node Restart (198) [4E16] offers the customer improved maintenance control of the CNI ring. It allows the craft personnel to manually restart a link node without affecting other in-service nodes. The ''Restart'' command should increase availability, as it allows a link node to be restored without being repumped. Previously, the only method to restart a link node (either manually or locally) was through a CNI level 1 initialization.

Generic Update Capability (372) [4E17] significantly reduces the time required to retrofit and process late and new start offices. This feature provides a faster method to process retrofit updates for the 1A Processor and the 3B20D computer released after the base generic. This capability allows updates to be placed on a single tape to be applied the night of the retrofit. These tapes are updated quarterly, carrying the most current information for the switch. A current version of the 3B20D computer generic is also available on tape.

The Generic Update Capability feature also significantly decreases the amount to time required to update 1A Processor and 3B20D computer software, by eliminating the need to manually apply every Broadcast Warning Message (BWM) Software Change Package (SCP) and BIG GULP issued after the base generic. Since the quantity of BIG GULPs and BWMs normally required is reduced dramatically, the occurrence for potential errors is also decreased.

This feature allows users to turn over a new *4ESS* Switch office with the latest generic installed, and retrofit an office with an up-to-date version of the generic.

This feature is strictly a convenient packaging of quarterly update releases, which contain new features and/or fixes. There is no additional charge for this feature, and the most current release tape is sent out with the normal retrofit procedures.

Threshold Alerting/Machine Service Report-2 (MSR-2) (378) [4E18] is used by the *4ESS* Switch operations group to monitor the overall functions of the switch. Thresholding various counts on the report gives technicians information that can be used to identify and correct problem areas within the switch and the network. These "exception thresholds" are indicated on the MSR-2 (when printed) with an asterisk (*) for each item that exceeds the threshold, along with the failure count for that item.

A summary page report is generated after the MSR-2 to list only the items that exceed their threshold value. The summary page makes it easier for a technician to identify problem areas and reduce the repair interval for "exceeded thresholds".

Scheduling the "summary page" report is done by completing the Entry Form -1 (EF01) On-Site Operating Report (OSOR) scheduling page. It should be noted that the procedures used to schedule the MSR-2 and to indicate thresholds is the same as in previous generics. This feature does not impact the EF01 page.

This report can be used in the following two ways:

- MSR-2 normal printout followed by the "summary". The summary page prints only if a threshold is exceeded; otherwise, it does not print.
- Summary report only (MSR-2 not scheduled by thresholds exceeded). This report is scheduled the same way as the current MSR-2, with the THRLD parameter selected on the EF01 page. This new feature produces only a summary page, and not a 3-page MSR-2 report when the MSR-2 threshold report is scheduled.

This stand-alone summary report is generated on the next half-hour boundary, after the threshold time is exceeded. This procedure allows the user to see exceptions, even if the MSR-2 was not scheduled for output.

Ring Node Version Number (395) [4E18] enables the craft to determine the version of software a Ring Node is executing. The craft uses this information to improve troubleshooting and Broadcast Warning Messages (BWM) installation procedures. This capability works with DLNs, CCS7, CCITT7, and D-Channel nodes.

XTSI DS1/DS3 Alarms/Maintenance Channel (5041) [4E21] enhances reporting of Digital Signal Level 1 (DS1) and DS3 alarms in XTSI. The *4ESS* Switch is now able to print DS1 and DS3 alarm events to the maintenance channel. (This feature only works on DS1s on an XTSI and does not apply on DIFs.)

The benefits of this feature include:

- Enables the *4ESS* Switch to properly handle exception conditions generated by DS1 or DS3 alarms.
- DS3 alarm activity is reported immediately.
- DS1 alarm activity is reported up to every 5 minutes in a compact block of data.
- Output designed to be consistent with existing transmission alarm messages.
- Technicians can inhibit and allow DS1 and DS3 alarms for the entire office, for a specific XTSI, or a specific DS3 line.
- When alarms are inhibited, a reminder is printed every 15 minutes.

Nail-Up

Trunk Appearance Number (TAN)-to-TAN Connection [4E5] allows the establishment of a nailed-up connection. This feature uses two ordinary message trunks, via a path through the *4ESS* Switch switching network, by entry of a command at an input/output (I/O) device.

These connections are referred to as ''nailed up'' through the *4ESS* Switch, because the transmission path is always connected and signaling information is not subject to normal call-processing functions.

This feature has two applications: making temporary radio program hookups and, ''private line make good.''

A TAN-to-TAN connection is established when a technician enters the necessary information into an I/O device to ''nail up'' the desired connection of any two message trunks via the Time Division Network.

Large Scale Nail-up Capability (LSNC) [4E9] establishes semi-permanent connections between trunks on a switching system. Nailed-up connections are established and changed by means of the Recent Change (RC) system. The development of LSNC greatly increased the possible number of nailed-up connections, allowing the *4ESS* Switch to have up to 50,000 nailed-up trunks.

A/B Bit Signaling Transparency for Nailed-up Connections [4E10] enhances Large Scale Nail-up Capability (LSNC), the capability whereby semi-permanent connections are made between trunks on a switching system by means of the Recent Change (RC) system.

This enhancement provides the following three types of connections to maximize use of customer direct access T1 lines:

- Conventional switched trunks using A-bit or out-of-band signaling, is currently used for Plain Old Telephone Service (POTS), voice, and Message Telecommunications Service (MTS) traffic
- Nailed-Up trunks without any signaling, passes 64-kbps restricted data transparently.
- Nailed-Up trunks with A and B Bit signaling transparency, passes A and B bit signaling information across the switch and transmits it to the correct frames of the T1 superframe unit. The data provided in this mode is 56 kbps only.

Miscellaneous

Call Tracing [4E0] enables office personnel and the Circuit Maintenance System 1A (CMS-1A) to trace calls existing in the system, and calls that originate from or terminate to prespecified trunks.

Service Evaluation System Interface (SES1) [4E1] allows the monitoring of incoming calls to determine the completion performance of subtending offices. Internal *4ESS* Switch screening selects only those calls on incoming trunks from equal or higher level offices as candidates for service observing.

This method of selection insures that a high percentage of call attempts from higher level to lower level offices is selected. Additional screening is performed to eliminate Centralized Automatic Message Accounting (CAMA) calls, non-Plain Old Telephone Service (POTS) calls, and test calls from the evaluation process.

This feature allows the *4ESS* Switch to furnish one call at a time to the remotely located Service Evaluation System (SES1) for analysis. Because call selection is a random process, no capability is provided to monitor calls on a preselected trunk.

Load Balancing [4E0], by assigning new trunks to termination ports, is not necessary with the *4ESS* Time Division Switch network. Any available termination may be used when new trunks are added to the system.

DIAL-UP Port [4E4] enables a polling computer to access *4ESS* Switch system data by means of a data link established over a Direct Distance Dialing (DDD) connection. The polling computer starts a dial-up conversation with the *4ESS* Switch by making a telephone call using an Automatic Calling Unit (ACU).

The call, to a data set that resides on a local line, is connected to an input/output channel on an I/O Processor (IOP) in the *4ESS* Switch. When the connection is established, the *4ESS* Switch begins sending traffic data to the polling computer.

Office Dependent Alarms [4E3] provide the *4ESS* Switch office with alarms that do not relate to the operation of the switch. This feature provides for 128 office engineered alarm points that interface via Signal Processor (SP) scan points.

Vacant Code Analysis [4E2] records routing-related call handling failures, some of which go to vacant code announcement. Failures that repeat often enough to indicate a possible systemic problem are reported via teletype (TTY) output messages.

The analysis function is provided for vacant codes, misrouted Centralized Automatic Message Accounting (CAMA), unauthorized CAMA, originating INWATS not allowed, INWATS band exceeded, and incorrect number of digits dialed.

Call Irregularity Trap Enhancement [4E13] controls the use of call irregularity traps to troubleshoot network problems. With this feature, the removal of a trap may only be performed from the maintenance channels, or from the channel where it was entered.

Increase Number of Final Handling Codes (FHCs) (384h) [4E20] provides the capability to continue to assign unique FHCs for call irregularities by increasing the number of FHCs from 2048 to 4096.

This capability helps identify failures more accurately and in a timely manner, thus contributing to faster failure recovery.

New Machine Service Report (MSR) II Count for ANI Failures [4E13] provides a new office measurement count for Equal Access Signaling (EAS) calls that are routed in an Interexchange Carrier (IEC) with Automatic Number Identification (ANI) or Billing Number (BN) failures.

Previously, only switched access calls that had denied BN failures were included in the measurement counts. This feature provides an accurate measurement of Equal Access Signaling (EAS) calls that encounter ANI failures.

TEST:DSIG Parameter Addition (354) [4E17] allows the Local Exchange Carriers (LECs) to test the CCS7 direct signaling network by including the 10-digit caller number in the Input Message "TEST:DSIG". The LECs can diagnose the Service Switching Point for Basic 800 Service (SSP/800) database problems more accurately.

The current input message "TEST-DSIG" for Number Service 800 (NS800) cannot diagnose SSP/800 database problems that require screening of more than the caller's Numbering Plan Area (NPA) (three digits). The SSP/800 database makes routing decisions based on all ten digits of the originator's number, instead of only a parameter for the providers originating NPA.

Enhanced TM Messages (496) [4E23] This feature provides enhancements to three trunk maintenance messages. This includes the following:

VER:TRKNAME The purpose of this message is to output all variations of the input trunk qualifier as well as a host of other trunk related information. The enhancement to this message consists of providing as much trunk related information as possible when the input trunk is unassigned and the Trunk Scanner Number (TSN) is non-zero.

CLR:TRKSTAT The purpose of this message is to provide a means of removing trunk conditions from a single trunk or a group of trunks. The enhancement consists of allowing a Test Control Area (TCA) as an input option.

OP:TSGHC The purpose of this message is to output contents of the Trunk Subgroup Headcell and associated adjunct and, if the LINK keyword is input, it outputs to Trunk Hunt Trunk Block Linkages for this TSG. The enhancement allows TSN, TAN, and OTAN as input options.

This feature is available in 4E23 Release 1.

Benefits

This feature will aid maintenance and field support.

4ESS I/O Naming Standardization (5427) [4E23] This feature creates a data file in the 3B20D/3B21D into which new Synchronous Data Link (SDL) port names can be loaded. These new or changed names can be loaded using a new TTY message. Currently, the SDL port names are hardcoded in the 3B20D. In support of future updates, this feature allows for any name to be entered for any SDL port. The message used to update the SDL names requires a security code.

This feature will be available in 4E23 Release 2.

Benefits

Provides for greater flexibility and aids maintenance operations.

Administration

Office Data Administration [4E0] generates, modifies, and verifies Office Dependent Data (ODD) for the *4ESS* Switch. ODD consists of parameter data and translation data. Parameter data includes such information as the transient range of call store, as well as the specification of various office threshold values.

Translation data includes the characteristics, interrelationships, and specific assignments of trunk subgroups, trunks, routing, basic hardware equipage, and miscellaneous equipment points.

The parameter data is small in quantity and quite stable, while the amount of translation data is abundant and it changes every day.

Off-Line Data Generation [4E0] is used to set up an office database for a new office, and also to make major updates to the office dependent data when a new generic of the *4ESS* Switch is introduced.

The office database for a new office is initially generated via an off-line assembler called the Office Data Assembler (ODA). After cutover, daily changes are normally made by means of the Recent Change (RC) system, but major growth changes such as generic updates are normally accomplished via a partial ODA run.

On-Line Data Changes [4E0] generate changes required in the office database of an operational office via the Recent Change (RC) system. This feature is used to accomplish such changes as the addition or deletion of trunks, new routing, and growth activation. In general, RC messages are provided to operate on all translation data that must be changed on a day-to-day basis.

The capability is available of either rolling back to the original state or rolling back a specified number of RC messages.

Data Verification [4E0] responds to a set of input messages that request specified subsets of the office database to be displayed or printed. The data verification program system processes these messages, retrieves the requested data, and formats it for output.

Recent Change and Verify (RC/V) [4E2] is used to modify and make additions to translation data originally generated by the Office Data Assembler (ODA). The verification system, an on-line system for retrieving information from the *4ESS* Switch memory, gives real-time access to the office translation data, and checks new data that has been input to the *4ESS* Switch. All recent changes for ODA are available in the current Translation Guide (TG-4) for the *4ESS* Switch.

Miscellaneous Routing Changes [4E13] provide Recent Change and Verify (RC/V) capabilities in support of several new features. This feature adds new messages to define routing that can be selected based on routing information, in addition to the address digits.

The routing selection can be based on the service, the Multiple Treatment Screening (MTS) class, or the digit count of the incoming call.

The new route selection mechanism replaces the previous MTS function, and increases the number of screening classes from 16 to 64.

Verification Network [4E4] provides a universal method of busy line verification that affects not only the *4ESS* Switch, but other types of offices as well.

A busy line verification call allows an operator, at the request of a customer who has tried repeatedly and does not successfully reach a subscriber, to determine whether a telephone is busy.

In addition to verifying busy lines, the Traffic Service Position System (TSPS) operator can break in on an existing call to make an emergency announcement, if the situation warrants.

4ESS Switch toll offices provide a link to an outgoing intertoll trunk on a dedicated network to another toll office or an outgoing miscellaneous trunk on a dedicated network, to an incoming no test trunk at a local office. In these cases, the request for a verification call is initiated by a TSPS operator.

Single Trunk Customer Translator [4E11] reduces the amount of storage required for the assignment of calls. This method of defining circuit connections allows a significant reduction in the number of words of call store usage.

Previously, the *4ESS* Switch could interconnect to a maximum of 4095 different point locations.

However with the new method, connections to over 10,000 trunk customers can be specified, with 4085 Trunk Subgroups still available for toll connecting or intertoll usage.

Change Trunk Subgroup (TSG) Without Rebuilding (878) [4E15] allows changes to the following formerly restricted characteristics, without deleting and completely rebuilding the TSG:

- Change direction from 1-way to 2-way
- Change domain from one non-POTS domain to another
- Change the far-end building subdivision of the common language code for a TSG
- Change a whole traffic number block from one range of numbers to another

Routing Global Title Translations Based on Service [4E13] are described in Chapter 8, Services, in the Direct Services Dialing section.

Universal Treatment Code (UTC) Population for Served Numbering Planning Areas (SNPAs) [4E16] overcomes the problems encountered when UTC codes are not properly opened as UTCs in the SNPA. The requirement for this capability is made more urgent as more SNPAs are opened in switches, due to Nodal services such as Megacom.

This feature eliminates the need for an absolute overwrite that was previously required to open the code as UTC in the SNPA, after opening the code as UTC in the Home Numbering Plan Area (HNPA). This feature is also available in the 4E14 and 4E15 generics.

Ten Worst Vacant Code Occurring Enhancement [4E16] feature is a cost-effective means of alerting appropriate personnel to administrative errors that would otherwise result in thousands of incomplete calls.

Using this alerting mechanism, administrative errors can be detected and corrected at an early stage, thereby saving thousands of calls from being terminated by the switch.

These saved calls increase revenue for the Local Exchange Carriers (LECs), and allow them to provide a superior quality of service to their customers.

The ten codes that characterize failing calls within the previous 24-hour period are identified in the Vacant Code Occurrence Report. This report can be printed automatically or on demand, and allows certain administrative errors to be detected and corrected hours in advance before maximizing call completions. This feature is also available in the 4E14 and 4E15 generics.

Software Update Merge (387) [4E20] combines the *5ESS* US Program Update, *5ESS* INTL Program Update and *UNIX* Real-Time Reliable (RTR) Field Update (used by *4ESS* Switch) Software Update capabilities into a single software update mechanism for use across all of the RTR based switching platforms.

The existing *4ESS* Switch 109 Display page (which is currently used to apply software updates) invokes the following Program Update display pages:

- 1960 - Software Update Installation page
- 1950 - Software Update Maintenance page
- 1940 - Easy Software Update Installation page.

These pages are currently used in the 5ESS®-2000 Switch. Beginning with the 4E20 generic time frame, all RTR based switches are to use the same display pages.

This feature includes the following benefits:

- Consistency in the office, since all RTR based switches use the same Software Update procedures
- Cost reduction since the same craft training and expertise is used to apply Software Updates to all RTR based switches
- Ability to backout up to the last three official Software Updates/Broadcast Warning Messages (SUs/BWMs)
- Performance improvements which decrease the time required to install a Software Update
- Improved backout procedures through the 1950 page, which minimize the impact of Software Update installation errors.

Software Update Automation (394) [4E20] provides the following new Display pages for Software Update Automation in the *4ESS* switch:

- 1941 - SU/BWM Automation Scheduling
- 1942 - SU/BWM Automation Office Profile
- 1943 - SU/BWM Automation Health Check.

With this feature, the Software Update can be prescheduled several days ahead of time to start automatically at a designated date and time as specified on the 1941 page. The craft does not have to be present to start the Software Update. luc045aWhen the time comes to start as specified in the 1941 page, the 1943 page is used by the switch to do a self Health Check to ensure system sanity. If all the 1943 page conditions pass, the Software Update process/pokes begin their execution in sequence. The craft does not have to be present to enter the poke commands or wait for the results as is currently being done.

With automation, once the activity of one poke command is finished, the next poke command activity starts in the appropriate sequence.

If the switch is not in a sane state, it checks itself every half hour up to three times. After the third time, it stops the Software Update.

The 1942 page (Office Profile Page) provides the capability for an office to set specific parameters such as customized/preset alarms in a particular office or a required soak period before making the SU/BWM official.

This feature improves cost effectiveness by allowing Software Updates to be prescheduled to execute automatically without craft intervention.

1A Processor Software Change Package (SCP) Status Message [4E16] enables a Switch Administrator to determine which updates have been applied to the current generic of the 1A Attached Processor System (APS) and when these updates applied.

This information can be output daily or on demand on the APS report. The report lists the SCPs applied to the 1A APS, and the date and time the SCPs were detected.

When implemented, this feature outputs a listing of all SCP numbers assigned by *4ESS* Field Support that have been applied and are currently active on the 1A generic.

1B Processor ORD;MCCKEY (440) [4E20] feature provides a new input message which replaces the Master Control Complex (MCC) functionality that was lost with the introduction of the *4ESS* Switch 1B Processor in the 4E19 generic.

Previously, the ORD:MCCKEY input message required entering the physical location of a control point to toggle a MCC key.

The new MCC eliminates the individual hardware connections between the MCC key and the Peripheral Processor Interface connection points. Thus, the communication between the two units is now performed via command messages.

MUP Firmware Update (469) [4E22] This feature has been created to provide a method to implement a new KLW216 version of the Maintenance Control Complex and Utility Processor (MUP) to replace the current KLW116 version. This change impacts the MUP's on-board Firmware (FW).

Benefits

- Coordinates the implementation of features 474, 5013, and 5111.
- Provides appropriate Master Control Console (MCC) displays for them.

LEC Master Control Console Alarm Enhancement (474) [4E22]
When the 1B processor replaced the 1A processor in the *4ESS* Switch, the Master Control Console (MCC) was replaced with a video display terminal and keyboard. This new MCC controls the 1B processor and components, and displays various processor and switch attributes on the video display terminal rather than turning individual lamp indicators on/off like the old 1A Processor MCC.

This enhancement feature supports Local Exchange Carrier (LEC) requirements, and reinstates two system alarm indicators to the 1B MCC: RB AREA CAPACITY WARNING and MEMORY RECOVERY PHASE. These system alarm indicators will be added to Page 108 - System Status Page. This feature will be delivered as part of feature 469.

Benefits

Reinstates the RB AREA CAPACITY WARNING and MEMORY RECOVERY PHASE system alarm indicators.

Buffered Recent Change Transition (437) [4E21] preserves *4ESS* Switch Buffered Recent Change (RC) messages across a 1B Processor generic quarterly release. This feature is required because RC form changes to support new features in the new quarterly release may invalidate the RC messages that were put in the Recent Change Buffer in a prior *4ESS* Switch generic release.

This feature is available via Software Change Packages (SCPs) to the 4E20 generic.

Increase In GULP Buffer Size (414) [4E21] increases the Generic Utility Program (GULP) buffer size from 1024 words to 2048 words.

The benefits of this feature include:

- More IN:OWBUF messages can be entered before a COPY:OWBUF is necessary.
- Reduces the probability for having an unscheduled big GULP.
- Reduces the probability for multi-buffer loading errors.

Routing Data Block List Verify Tool (4866) [4E21] creates a new verify to easily identify Routing Data Blocks (RDBs) based on specified prefix digits or a specified Final Handling Treatment (FHT).

The RDB List Verify Tool feature provides the capability to input Numbering Plan Area (NPA) digits and have the RDBs which use the code identified. This tool also allows an RDB FHT code to be input and have the RDBs which use this code identified.

Checksum Macro (473) [4E22] adds a checksum verification to copy commands: copy:tsifile, copy:tsi, and copy:xtsi. Both the actual checksum and expected checksum are displayed, and if the two do not match an error is displayed.

Prior to this feature, the above copy commands did not verify that a file was copied successfully.

Benefits

The primary benefit of this feature is its enhancement to the efficiency of the new application that must use the copy command.

LEC ODA Manager (482) [4E22] This feature provides the capability to interface with the ODAMANager which is a SUN based Platform designed to streamline the Office Data Administration (ODA) deployment process. The following capabilities are associated with the optional platform:

- Data Linking - Data-link files from a *4ESS* Switch to the ODAMANager.
- Data Collector - Collect the 1BFile and 3BFiles (that is, Traffic Data Administration System [TDAS]) manually or automatically.
- 1BFile Archival - Archive 1BFile on a 4mm tape format or on a file system in a compressed form.
- 1BFile Data Validation - Validate integrity of data.

The DataViewer can also be loaded onto this platform.

Benefits

This feature, in conjunction with the optional platform, provides the following benefits:

- Electronic 1BFile transfer.
- Electronic TDAS file transfer.
- Quiet time and retrofit interval reduction by one week.
- Centralized storage of 1BFile.
- 1BFile backup in case of 1BFile corruption.
- Reduction in operational costs.
- Ability to use tape drive as backup in case of lost data-link.

SIGNALING/NETWORK INTERCONNECT

6

Contents

SIGNALING/NETWORK INTERCONNECT

6

Signaling is the process of transferring information between two parts of the communication network to control the establishment of connections and related operations.

The *4ESS* Switch accepts the following types of signaling:

- *Inband* — where signaling and voice/data travel on the same channel
- *ISDN* — signaling for an end-to-end public digital network. The *4ESS* Switch provides AT&T's version of a Q.931 Primary Rate Interface (PRI). **After the 4E18 Generic Release, this capability is no longer covered.**
- *SS7* — out-of-band standardized signaling, including Message Transfer Part (MTP), ISDN User Part (ISUP), Signaling Connection Control Part (SCCP), and Transaction Capability Application Part (TCAP). Network Interconnect uses SS7 signaling.

Feature Descriptions

Inband

MultiFrequency (MF) and Dial Pulse (DP) [4E0] enables both of these types of signals to be handled by the *4ESS* Switch. The switch can handle a maximum of 14 MF or 10 DP digits to and from another office.

Digital Interface Frame (DIF) [4E5] and several enhancements in later generics are described in Chapter 2, Generic Framework, under Trunk Interfaces.

ISDN Enhancements

Integrated Services Digital Network (ISDN) [4E11] is based on AT&T's version of CCITT Recommendations Q.921 and Q.931, which define the ISDN Primary Rate Interface (PRI) between a Private Branch Exchange (PBX) and the network. This version of the ISDN PRI does not support carrier selection.

ISDN offers many advantages and capabilities. The following are several of the ISDN features:

- *Q.931 Out of Band Signaling* — allows more information to be exchanged between the PBX and the *4ESS* Switch
- *64 kbps clear/restricted* — allows 64 kbps transmission through the network

- *Station Identification (SID) to the Network* — makes new network features feasible by passing SID to the network during call setup
- *SID/Automatic Number Identification (ANI) to the Terminating End* — allows a terminating user to subscribe to SID and/or ANI for calls received
- *Message Associated User-to-User Information (MA-UUI)* — passes the following user-provided information in the call control messages:
  - — Called Party Subaddress
  - — Redirecting Address
  - — Connected Address
  - — Low-Layer Compatibility
  - — UUI
  - — Codeset 7.

Common Network Interface (CNI) Ring/D-Channel Node [4E11] features an enhanced, direct-connect Private Branch Exchange (PBX) interface to the Switch. Line interfaces are provided by a PBX or its equivalent. This feature is based on AT&T's version of the CCITT standard PRI for ISDN services.

With the D-Channel node, the customer can use Q.931 protocol for out-of-band signaling over the D-Channel, allowing 64 kbps restricted or clear transmission on the B-Channels. Also over the D-Channel, the customer can pass the SID and/or ANI to the network, and/or to the terminating end user. By using Q.931 protocol and the network, a customer can send User-to-User Information (UUI) between Customer Premise Equipment (CPE). This procedure can only be used during the setup or clearing of a circuit-switched call.

Channel Negotiation [4E13] allows the egress Private Branch Exchange (PBX) to choose an alternate B- Channel on calls it receives. A new indicator in the trunk block is set when channel negotiation is allowed on the outgoing trunk. Overload can set an indicator in memory to turn off channel negotiation. Call processing checks these two indicators to determine whether channel negotiation is allowed on a particular call.

D-Channel Backup [4E13] provides a standby D-Channel node. When a D-Channel or node failure occurs, the standby D-Channel becomes active.

Fraud Prevention Feature [4E13] keeps the network path open on 56 kbps and 64R calls until answer for Q.931 outgoing calls (that is, until the CONNect message is received).

OA&M Improvements [4E13] provide for the Common Network Interface (CNI) ring maintenance counts for the Testing, Operations, Provisioning, and Administration System. These improvements also include call trap enhancements to identify ISDN call failures in office traps.

Q.931 Protocol Upgrade [4E13] consists of changes to the Q.931 protocol because of standards changes and enhancements. The changes include the identification of Station Identification (SID or Automatic Number Identification (ANI) in the Calling Party Number, the expansion of Message Associated User-to-User Information (MA-UUI) to 128 octets, and the addition of Codeset 6 as a new type of MA-UUI.

Calling Party Number/Billing Number (CPN/BN) Improvements [4E14] add the ability to control, on a subscription or per-call basis, the presentation of the Calling Party Number (CPN)/Billing Number (BN) to the terminating end on Q.931 direct access calls.

For international services, the *4ESS* Switch handles up to 12 digits of a CPN. The switch no longer ''pads'' the CPN digits with zeros as in previous generics. The number of CPN digits received is passed through the network to the terminating end.

For Q.931 direct egress calls, the subscription options for sending CPN/BNs are not changed with this feature. However, a check of the presentation indicator passed through the network to the terminating switch is added. If the presentation is restricted for either the CPN or BN, it is not sent to the terminating user.

The recording for CPN/BN delivery to the terminating user is done as an aggregate record at the terminating switch for most services. Two aggregate counts are kept, one for the number of times CPN/BN was delivered to the terminating user and one for the number of times the CPN/BN could not be delivered (both counts on a per service basis.) An aggregate record per Trunk Subgroup (TSG) is generated every hour on the hour.

Protocol Upgrades [4E14] introduces the following protocol enhancements:

- *Delivery of Dialed Number* — enables direct-connect Primary Rate Interface (PRI) customers to receive the original called party address digits that were delivered to the network. This feature relies on the ISUP capability (also introduced in this generic) to pass the Dialed Number parameter through the network.

  A direct-connect customer must subscribe to receive the Dialed Number. The Q.931 direct egress TSG can be set to either ''dialed number preferred'' or ''routing number exclusive.''

- *New Cause Values* — adds three new cause values to the cause list. A short description of each and when they are used is given below:
  - — Cause 6, Channel Unacceptable, is sent to the user in a RELease message if the user attempts to do channel negotiation, and selects a channel in the CALL PROCeeding message that is unacceptable to the *4ESS* Switch.
  - — Cause 44, Requested Channel is Not Available, is sent to the user in a RELease COMplete message if a SETUP message is received on an Out of Service trunk.
  - — Cause 102, Recovery on Timer Expire, is used when a timer waiting for a message has expired, usually resulting in call clearing. The diagnostics specify which timer has expired.

- *Message Associated User-to-User Information (MA-UUI) Upgrades* — increase the allowable maximum length of MA-UUI to 131 bytes. The length restriction is checked for MA-UUI being passed in the SETUP, CONNect, and DISConnect messages.

  Two new Information Elements (IEs), the High Layer Compatibility IE and the Calling Party Subaddress, have been included in the MA-UUI that can be passed in the SETUP message.

Access Charge Verification (ACV)-Calling Party Number/Billing Number (CPN/BN) (880) [4E15] modifies the study indicator to reflect CPN reception/forwarding in the ACV records.

Enhancements and Protocol Upgrades [4E15] ISDN Phase 4 improves the existing ISDN interface developed before the 4E15 generics by adding the following enhancements and protocol upgrades:

- *MA-UUI Upgrades* — includes checking individual user data Information Element (IE) lengths and decoupling UUI from the remaining user data IEs
- *Q.931 to ISUP Cause Mapping and Screening* — defines the mapping of cause values between Q.931 and ISUP
- *ISUP Preference Indicator Setting and Routing* — requires the originating Q.931 trunks to always set the ISUP preference indicator to ‘‘preferred’’
- Recognizes the nonlocking shift Information Element (IE).
- Restricts delivery of the Calling Party Number (CPN) subaddress to the terminating user if the CPN is restricted
- Allows transport and delivery of a network-provided or user-provided connected number to originating users who subscribe to the Connected Number feature.

ISDN Expanded MA-UUI Length (911) [4E16] increases the amount of user-provided data that can be conveyed by the network between ISDN users. The Message Associated User-to-User Information (MA-UUI) contained in the SETUP, ALERTing, CONNect, DISConnect and RELease COMplete (with conditions) messages provide a maximum of 131 octets of user IEs, a maximum of 131 octets of User-to-User IEs, with a combined total length of 198 octets.

These include calling and called party subaddresses, high and low layer compatibility, user-to-user IE, locking shift to codeset 6 and IEs, locking shift to codeset 7 and IEs, and Redirecting Number.

The MA-UUI enhances the amount of information that end-users can exchange during call setup. This capability can be very beneficial in matters of end-user security, identification, or any information determined specifically by the end-user.

Calling Party Number (CPN) Delivery (4659) [4E18] enforces CPN privacy and ANI delivery rules at a terminating PRI interface, as specified in FCC Docket 91 -281.

For commercial ISDN traffic, this feature does not deliver the Calling Party Number if the the CPN is marked presentation restricted. Privacy is honored for all services for which terminating traffic egresses the network via a commercial ISDN PRI. When using this feature, the following is applicable:

- Common Carriers using Signaling System 7 and subscribing to or offering any service based on SS7 functionality must transmit the CPN parameter and its associated privacy indicator to connecting carriers on an interstate call.
- Common Carriers are prohibited from modifying or overriding the privacy indicator on an interstate call.

Switched Digital Screening By Bandwidth (4364) [4E21] ensures that only those calls for which the bearer capability (or User Service Information) is 56kb/s are allowed to egress over facilities limited to 56kb/s digital transmission, as defined in Bellcore Technical References (TR-TSY-00268).

This eliminates the previous problem of completing calls with bearer capability (USI) greater than 56kb/s (that is, 64kb/s Clear/Restricted) over facilities limited to 56kb/s digital transmission.

In addition, 384kb/s Restricted and 1536kb/s Restricted calls are blocked at the originating switch. This feature prevents the originating customer for unsuccessful data transfer.

SS7

SS7 ISDN-UP (ISUP) [4E11], the Integrated Services Digital Network User Part (ISUP), is a flexible Out-of-Band Signaling System 7 (SS7) protocol for signaling between switches.

ISUP supports the same features that Common Channel Interoffice Signaling (CCIS) supports, such as Dynamic Overload Control (DOC), Hard-to-Reach (HTR), and the transfer of User-to-User Information (UUI).

Access to ISDN via SS7 Network Interconnect [4E14] gives ISDN customers switched access/egress to and from an InterExchange Carrier (IEC) network, in addition to the direct connection currently available.

SS7 Call Associated Network Interconnect [4E14] expands the ability of the *4ESS* Switch to access other carriers. Network Interconnect allows ISUP signaling to cross network boundaries and also provides the interworking of MultiFrequency (MF) to ISUP, and ISUP to MF at the Access Tandem (AT) offices.

This capability replaces MF and Equal Access MF signaling previously used for communication between carriers. It also provides the signaling required for inter-LATA ISDN, and for switched access to international ISDN.

SS7 ISDN-UP (ISUP) Protocol Upgrade Issue 3 [4E14] changes the ISDN-UP protocol to further align with Bellcore technical recommendations. With this feature, the *4ESS* Switch passes fields, such as forward call indicators, backward call indicators, and cause and location in backward releases. Also, new parameters and fields such as Charge Number and Automatic Congestion Control are generated or passed in the Routing Information Indicator (RII) parameter.

ISUP Transition Items [4E13] encompasses the following changes needed for a smooth transition from the 4E13 generic of the *4ESS* Switch to the 4E14 generic:

- Transition to Automatic Congestion Control (ACC) System
- Recognize the Cause Parameter in the Facility Reject Message (FRJ)
- Recognize the Backward Call Indicator Parameter (BCIP) for an alerting indication.

All of these changes involve formatting of ISUP messages in the Direct Link Node (DLN).

User-to-User Information (UUI)/Access Transport Parameter (ATP) Enhancements (861) [4E15] allow decoupling of the UUI and ATP parameters, with a maximum size of 133 octets for UUI + ATP parameters.

Call Progress Message (856) [4E15] includes information in the Address Complete Message indicating user-network interaction.

It also adds information, passes the Backward Call Indicator, handles the Call Progress Message type, and passes all parameters received in the Address Complete Message (ACM), Answer Message (ANM), and Call Progress (CPG) messages.

The ACM is returned backward to the originating exchange with information about the user-network interaction, which prevents premature release of the call.

Address Complete Message, Call Progress With Cause (863) [4E15] allows the cause parameter to be accepted as an optional parameter in the Address Complete Message (ACM) and Call Progress (CPG) messages in trouble conditions, such as congestion or invalid address.

Recording of Cause Location (857) [4E15] The Access Tandem (AT) records the cause location value of a Call Progress (CPG) message, and passes it back to the end-office without further action.

Excessive ISDN Call Setup Delay (858) [4E15] detects and counts excessive delays in Address Complete Message (ACM) and Call Progress (CPG) messages. A new office-wide count is pegged when excessive delay is detected. The Backward Call Indicator contains the ''Excessive Delay'' at terminating ISDN access indicator.

Elimination of Four TR-394 Exceptions [4E15] aligns the *4ESS* Switch with Bellcore Technical Recommendations by removing the following exceptions:

- *Optional Release Versus Tone/Announcement* — For voice call failures at a terminating Access Tandem (AT), an option is provided of sending a Release (REL) message with appropriate cause and location, or sending an Address Complete Message (ACM) backwards to set up the network path for playing the appropriate tone or announcement.
- *Count of Initial Address Messages (IAMs)* — In this case, the terminating AT provides a per-office count if IAMs are received from an Inter-Exchange Carrier (IEC) with a message priority other than 01.
- *Carrier Selection Information (CSI) Parameter* — When selecting an outgoing circuit to a Inter-Exchange Carrier (IEC), the originating Access Tandem (AT) passes any received CSI parameter to the IEC. If the AT is a Service Switching Point (SSP) for a call, any CSI received is discarded and excluded from the Initial Address Message (IAM) sent to the IEC.

- *Exit Message Timer* — After sending an IAM to an interexchange switch, a timer is set to delay sending an EXIT message to the end office to ensure that glare, blocking, ect., are not encountered on the outgoing circuit.
- *Called Party Address Parameter* — The nature of Address Indicator in the IAM sent to an IEC is coded as 950+, only if 950+ was received as the Nature of Address Indicator in the incoming IAM.

Release Treatment for Calls Received from an IXC with a Transit Network Selection (TNS) Parameter in the Initial Address Message (159) [4E18] allows the TNS parameter to contain carrier ID and routing information (such as, NX digits for international and XX digits for domestic long distance calls) for routing calls to a specified Interexchange Carrier (IXC).

The TNS parameter is sent in the Initial Address Message (IAM), which is used by the Access Tandem (AT) to route calls. The AT (which is directly connected to the IXC on egress) should not receive a TNS from an IXC. Calls received with the TNS parameter in this manner are released, regardless of the code values in the TNS parameter.

Prior to this feature, if a TNS parameter was sent in an IAM to the directly connected AT from the IXC, the TNS parameter was dropped and call processing continued. With the new release treatment, the call is released at the AT switch. A call is released with a RELEASE message or tone/announcement.

The release cause is given as "service/option not available" (63), and the location is coded as "local local network" (0010). This treatment prevents the possible routing of calls back to the IXC, as a result of the received TNS parameter.

ISDN User Part (ISUP) Preference Handling [4E15] allows selection of call routing based on the setting of the ISUP Preference Indicator in the ISUP initial address message, plus the setting/transporting of the indicator to one of the following states:

- ISUP required
- ISUP preferred
- ISUP not required.

Multiple Point Code LATA Routing [4E15] provides interim Local Access and Transport Area (LATA) routing by the *4ESS* Switch to route calls from the network to different LATA in a LEC using unique link sets and unique point codes per LATA.

Handling of Confusion Message (157) [4E17] allows Network Switching Elements to notify each other when unrecognized ISUP messages are received. When the *4ESS* Switch receives an unrecognized message on a call, it immediately sends a confusion message back to the switch that sent the message. Counts are kept by the *4ESS* Switch on the number of confusion messages sent and received.

This feature provides better troubleshooting capabilities by alerting traffic engineers that the *4ESS* Switch is receiving/sending confusion messages, indicating that something is wrong with a local or remote switch.

This feature provides compatibility with Bellcore TR-TSY-444, Issue 1.

Passing Local Area Signaling Services (LASS) Parameters [4E12] allows the *4ESS* Switch to pass three ISDN-User Part (ISUP) optional parameters.

The switch supports some LASS features at a tandem office by having the following parameters included in the Initial Address Message (IAM):

- Supplementary Line Information (that is, Line Descriptor)
- Redirecting Number
- Redirection Indicator.

With this feature, the ISUP incoming trunk handler parses the IAM. If the calling party address parameter is included, it is stored in a Stable Call Accumulation Register (SCAR).

If User-to-User Information (UUI) or Access Transport Parameter (ATP) is present, then the Supplementary Line Information, Redirecting Number, and Redirection Indicator are discarded.

When the ISUP outgoing trunk handler is generating an IAM, it retrieves the LASS information stored in the SCAR and CR annex, and generates the appropriate ISUP optional parameters.

Uniqueness Indicator in ISUP CPN Nature of Address [4E12] passes the Uniqueness Indicator in the Calling Party Number (CPN) Nature of Address field.

Optional Inclusion of the Routing Information Indicator (RII) Parameter [4E14] allows passing of the RII parameter, a private parameter normally not passed by the Local Exchange Carrier (LEC) access tandem switches.

Since some carrier switches support Virtual Private Network (VPN) service which requires the RII parameters on calls routed via Dedicated Egress, LEC switches supporting Dedicated Egress Routing must pass the RII parameter.

Service Identity Indicator (SII) to Originating Line Identity (OLI) [4E15] allows identification of the service associated with a call via the Routing Information Indicators parameter. This information is passed to the terminating Local Exchange Carrier (LEC) on a Trunk Subgroup (TSG) basis in the OLI parameter.

Dual Direct Link Node (DLN) [4E13] increases signaling message throughput between the 1A Processor and the Interprocessor Message Switch (IMS)/CNI ring. Previously, two DLNs were configured as active/standby, with the active DLN handling messages to and from the ring. The current feature provides the following options:

- *Use of two DLNs* — If an office has two DLNs equipped, one is configured to handle messages from the ring, and the other to send messages to the ring. In fault scenarios or a manual remove request, the single remaining DLN is configured two-way.
- *Use of four DLNs* — This higher capacity configuration provides greater reliability by offering redundancy of the equipment used in the two DLN configuration. Two DLNs are configured one-way, and the two spare DLNs are configured standby. The removal of two DLNs can retain the higher capacity of all one-way DLN configuration. If the third DLN faults or is removed, the fourth is configured two-way, to maintain full functionality although operating at reduced throughput capability.

The throughput of the new configuration is estimated at about 2000 messages per second. The additional throughput modifies data layouts in the DLN, allowing additional Common Channel Signaling (CCS) trunks to be maintained in the DLN translation space.

Direct Link Node (DLN) Capacity [4E15] replaces the DLN with the Direct Link Node Enhanced (DLNE), which increases the SS7/Q.931 signaling capacity.

Direct Link Node Enhanced (DLNE) Memory Increase (239) [4E18] is an optional feature that allows users to expand the memory of the DLNE from 16 Megabytes (MB) to 80 MB.

This feature gives customers the capability to change the administration of databases on the Direct Link Node (DLN), allowing offices to be engineered on a per-office basis.

Use of this feature requires additional hardware (two new boards.) It reduces the time-to-market for features requiring large DLN memory.

Direct Link Node (DLN) Throughput Increase (4133) [4E20] improves Direct Link Node - Node Processor (DLN-NP) message throughput to accommodate the constantly increasing CCS7 traffic (ISUP, Q931 and TCAP) in the network. It allows the DLN, when operating in one-way mode, to use the buffers for the traffic in the direction that it is not handling. This allows the DLN that is handling the outgoing messages to use its own outgoing buffers, as well as those that are dedicated for incoming messages. Prior to this feature, when the DLN was operating in one-way mode, only one of its buffers was used.

This feature provides a 30 percent throughput improvement when the DLN is operating in one-way mode. When the DLN is operating in two-way mode the DLN performance is the same as current operation.

4ESS Switch DLN IRN2 Upgrade (4694) [4E22] This feature upgrades the Direct Link Node (DLN) Node Processor (NP) from an Integrated Ring Node (IRN) processor to an IRN2 processor. Engineering rules are available in the current version 5 of the 4ESEAT tool to determine if individual *4ESS* Switching offices will need this DLN upgrade.

The DLN is a node type on the Common Network Interface (CNI) ring-based switching office architectures. In a switching office, the CNI ring interfaces with the Signaling System No. 7 (SS7) network. The DLN sends and receives SS7 signaling messages to/from the *4ESS* Switch Central Control (1B Processor via Direct Memory Access [DMA]) transfers. The IRN2 board replaces the current IRN as the DLN-NP. The IRN2 is a complete redesign of the IRN board, and it provides better performance and higher throughput.

Benefits

- Increasing the SS7 message processing capacity of the *4ESS* Switch DLN operating in the two-way mode from 1200 to 1800 messages/sec per DLN.
- Increasing the amount of usable memory in the Dual Port RAM to 384 Kbytes, which allows more efficient message/data exchange between the DLN-NP and the DLN-Attached Processor (AP).

Increased Maximum Link Sets [4E15] enables the number of Signaling System 7 (SS7) link sets to be tunable at compile time, allowing for more efficient use of memory. This feature increases the maximum number of link sets from 255 to 511.

Header Validation and Circulation Message Removal (505) [4E23] removes circulating messages and validates headers of IMS messages on the CNI ring. It provides integrity checks on hardware command messages. The software uses the IRN2 (Integrated Ring Node Version 2 board) and ULN packs. This feature also provides the error handling software in all IRN2 and ULN based ring nodes in the 3B. The associated software considerably increases the IRN2 ring robustness, and it:

- Detects any message that fails a 3-bit check code, either being written by or passing by the IRN2 on the ring.
- Detects any broadcast or take message that fails an 8 bit checksum, either being written or passing by the IRN2 on the ring.
- Does a hardware command message write check on all messages written to the ring.
- Does a virtual source address check.
- Does a virtual command message destination address check on non-broadcast hardware command messages. Since the *4ESS* Switch does not have IRN2 based RPCNs, this feature does NOT detect any hardware command message that has passed a monitor IRN2 RPC more than once.

Feature 505 is available in 4E23 Release 1.

Benefits

Increase the robustness of the CNI Ring for those nodes that contain an IRN2.

Increased Number of Links in Link Set (3433) [4E17] increases the maximum number of A-links in a direct A-link set between a *4ESS* Switch and a No. 2 Signal Transfer Point (STP) from 8 to 16.

This feature also increases the maximum number of links in a combined A-link set between a *4ESS* Switch and a mated pair of No. 2 STPs from 16 to 32. This feature does not increase the memory in the *4ESS* Switch. Therefore, to compensate for doubling the number of A-links in a set, the maximum number of A-links sets has been reduced from 256 to 128.

Increased Maximum Number of Populated Clusters [4E15] allows the number of populated clusters with one or more exceptional members to be tunable at compile time. This feature increases the maximum number of populated clusters from 32 to 128.

Message Trap for Outgoing Messages [4E15] allows sampling of outgoing messages as they leave a link node, in order to verify correct processing and routing of messages.

Completion of Transmission Path (156) [4E17] eliminates possible fraudulent use of the network by delaying the completion of the transmission path until the answer indication is received. Prior to this feature, the possibility existed that users could make data calls and pass data between the receipt of the Address Complete Message (ACM) and the Answer Message (ANM). By disconnecting the call prior to receiving Answer, users could pass small amounts of data through the network and not be billed for the call. (The AMA record is generated when ANM is received.)

By waiting until ANM is received to complete the transmission path on data calls, this possible fraudulent use of the network is eliminated. This feature provides compatibility with Bellcore TR-TSY-000444, Issue 1.

Preventive Cyclic Retransmission (PCR) (083) [4E17] capability is available for long delay (satellite) links, providing increased throughput, as compared to Basic Error Correction (BEC). Previously, the *4ESS* Switch used BEC for all links.

At the Signaling System 7 (SS7) Message Transfer Part (MTP) Level 2, there are two options to ensure message delivery:

- Basic Error Correction (BEC)
- Preventive Cyclic Retransmission (PCR).

The PCR feature provides compatibility with American National Standards Institute (ANSI) Standard T1.111-1988.

Processor Outage (PRO)-Phase 2 (151d) [4E17] recovers Signaling System 7 (SS7) links following a PRO condition, without requiring the breakage of the link. The recovery from a PRO condition is based on the duration of the actual processor outage.

The PRO durations are classified as either a short PRO or a long PRO. A short PRO is a condition that exists for a time less than T1 seconds (before timer T1 expires).

A long PRO is a condition that exists for a time greater than T1 seconds (after timer T1 expires). T1 is the level 3 T1 timer value, which is defined as the delay to avoid message mis-sequencing on changeover.

T1 is a variable administered via recent change. The procedure used prior to PRO-Phase 2 required the breakage of the link on recovery from a PRO condition, regardless of the outage duration. This method required a substantial amount of time to realign the link.

Frequency Reduction of Voice Path Assurance (VPA) Tests [4E12] reduces the frequency of VPA tests on calls using Signaling System 7 (SS7). VPA tests detect a loss of connectivity on the talking path, and ensure that customers are not cut-through and billed for a call without voice-grade integrity.

The *4ESS* Switch originally reduced the level of VPA testing from 100% to 50% when real-time overload level 1 was reached. With this feature, the level of testing is reduced to 12.5% before the switch reaches an overload condition. However, the testing resumes at 100% when a significant increase in VPA failures are detected.

Intra-Network MTP Routing Verification Test (MRVT) [4E14] verifies the Message Transfer Part (MTP) routing data in Signaling System 7 (SS7) networks. Intra-network MRVT only tests routing data within the same network.

Fast Connect (084) [4E16] changes ISDN-User Part (ISUP) handling at a tandem switch to support ''Fast Connect'' for ISDN-called parties. If a tandem switch receives an Answer Message (ANM) for an outgoing ISUP circuit before an Address Complete (ACM) message has been received, no ACM is generated. However, if the incoming circuit is ISUP, the tandem formulates and sends an ANM for the incoming circuit.

This feature provides compatibility with Bellcore TR-TSY-000444, Issue 1, and supports correct end-to-end ISDN (Q.931) message and Information Element mapping. This includes interactions with Bellcore TR-TSY-000845, Issue 1, for the transport of User Information in ISUP Answer Message.

In previous generics, if an ANM was received at a tandem or access tandem without receiving an ACM, both the ACM and an ANM were sent to the preceding exchange, with parameters from the received ANM mapped to the ACM.

Passing of Generic Address Parameter (GAP) (085) [4E16] allows Tandem and Access Tandem switches to pass without modifying the GAP parameter in the ISUP Initial Address Message (IAM).

The GAP is used to transport user-provided Calling Party Numbers (CPNs) that either failed screening or were not screened. This feature also provides the coupling of GAP, with the Calling Party Number on a per-Interexchange Carrier (IEC)-indicator basis for calls that have completed Service Switching Point processing. In prior features the GAP parameter was ignored.

This feature ensures compatibility with Bellcore TR-TSY-000444, Issue 1, for tandem applications, and supports the ISDN Calling Line Identification (CLI) service defined in Bellcore TR-TSY-000860.

Handling Additional TR-394 Exceptions (121) [4E16] provides compliance with Bellcore TR-TSY-000394 for handling ISDN-User Part (ISUP) calls at an Access Tandem (AT), and supports consistent protocol handling in Local Exchange Carrier (LEC) networks. Compliance is provided for the following items:

- At an AT, where interworking from MultiFrequency (MF) to ISUP signaling occurs, the Calling Party Category of the outgoing Initial Address Message (IAM) is coded to ''unknown.''
- At an AT, where interworking from MF to ISUP signaling occurs, the cause value in a forward REL message sent by the AT is set to ''interworking unspecified.''
- At a Tandem or an AT, if an incoming test call on an ISUP circuit terminates at the *4ESS* Switch, and an Address Complete Message (ACM) is sent on the incoming circuit, the Backward Call Indicator (BCI) parameter coding is appropriately set.

Coding Standard Field in Cause Parameter (122) [4E16] improves handling at a Tandem or Access Tandem switch for ''non-CCITT standard'' values of the Coding Standard field of ISUP Cause Parameter.

In order for the calling party to receive an appropriate indication of the reason for call failure (tone/announcement or Q931 cause), the *4ESS* Switch passes the value of the Coding Standard unchanged, or provides default treatment if an announcement is to be played at the *4ESS* Switch.

This feature provides compatibility with American National Standards Institute (ANSI) T1S1 standards, and supports Bellcore TA-TSY-000868 for multi-Switch Business Groups and other Local Exchange Carrier (LEC) services.

Optional Inclusion of Routing Information Indicator (RII) Parameter [4E16] allows an Access Tandem (AT) to include the RII parameter in the Initial Address Message (IAM), within Local Exchange Carrier (LEC) networks that request this feature. This feature allows use of other subfields within the RII parameter besides the Routing Category Indicator, and provides Office Data Assembler (ODA) control for sending the RII parameter to LEC *4ESS* Switches. This feature is available in the 4E14 and 4E15 generics.

Handling 10XXX # Cut-through Calls [4E14] provides 10XXX # cut-through call handling at the *4ESS* Access Tandem (AT) switch for ISUP to ISUP calls.

This feature provides partial compliance with Bellcore TR-TSY-000394, by supporting 10XXX # cut-through calls through the *4ESS* AT for ISUP-to-ISUP calls, and is available in the 4E14 and 4E15 generics.

Handling of 3.1 kHz Audio Bearer Capability (158) [4E17] allows customers to effectively and economically use their trunks by distinguishing voice calls from data calls. When setting up calls though the Signaling System 7 (SS7) network, the Universal Services Indicator (USI) parameter in the ISDN-User Part (ISUP) Initial Address Message (IAM) populates the information transfer capability with ''speech'' or ''3.1 kHz audio'', based on the type of call: speech or data.

The ''speech'' category allows calls (not requiring bit stream integrity) to receive Time Assignment Speech Interpolation (TASI) and Low Bit Rate Voice (LBRV) encoding. For calls carrying voiceband data (for example, facsimile and modems), the ''3.1 kHz audio'' indicates that TASI and LBRV encoding is not used, to assure the integrity of the bit stream.

Incoming ISUP calls designated as ''3.1 kHz audio'' and MultiFrequency (MF) calls are routed over 3.1 kHz audio, 56 or 64 kbps trunks. Incoming ISUP calls designated as ''speech'' are routed on speech trunks. This feature provides compliance with Bellcore TR-448, Issue 1.

3.1 kHz Audio Enhancements: Switch/Trunk Subgroup Option (408) [4E18] gives the *4ESS* LEC Switch the capability to determine whether "3.1kHz audio" or "speech" should be used when the incoming trunk is MultiFrequency (MF), and the outgoing trunk is ISDN User Part (ISUP). This feature minimizes the amount of provisioning needed on a per Trunk Subgroup (TSG) basis.

The TSG indicator uses the opposite of what is provisioned in the office indicator, and has precedence over the office indicator. For example, if an office indicator is set to "3.1kHz," then only those TSGs that need to use speech are provisioned to use "speech."

Resize Number of Switches Count (3213) [4E17] decreases the size of the number of switches count field, and adds a new spare field in the ISUP Initial Address Message (IAM).

To prevent the condition known as "shuttle routing", a maximum of ten switches should be involved in setting up a call. To ensure this limit is not exceeded, a count is kept of the number of switches involved in the call. This information is in the IAM Routing Information Indicator (RII) parameter.

Each switch involved in the call, increments the number of switches count field before the IAM is passed on to the next switch. A *4ESS* Switch that receives an IAM with a count of ten or more in the number of switches count field, terminates the call.

Prior to this feature, the number of switches count field was five bits long (MLKJI). However, this feature reduces the number of switches count field from five bits to four bits (LKJI), with bit M becoming a spare.

Unsuccessful Call Setup Procedures (919) [4E16] specify additional procedures at a tandem switch for handling call setup failures on ISDN-User Part (ISUP) trunks. Two Recent Changeable switch options provide the capability to control whether an ISUP release message (REL) is sent to the preceding switch, or an Address Complete Message (ACM) is sent and the appropriate tone/announcement is played at the *4ESS* tandem switch. Precedence rules relative to existing TR-TSY-000394 procedures are supported.

This feature ensures compliance for call failure handling with Bellcore TR-TSY-000317, Issues 1 and 2 and TR-TSY-000444, Issue 1. It allows consistency in LEC networks for call failure treatment.

Passing Unrecognized ISUP Parameters and Parameter Values (920) [4E16] allows unrecognized (unimplemented) ISUP parameters and parameter values to be passed unchanged at a tandem or Access Tandem switch within existing recognized message types. At the exchange that terminates the message, the information may be discarded, or treated as some default value.

This feature provides compliance with Bellcore TR-TSY-000317 and TR-TSY-000394. It allows passing new information through the *4ESS* Tandem to support new End Office services, without requiring specific feature development at the tandem switch.

Q.931 Information Element (IE) Transport Capability (921) [4E16] allows the *4ESS* Tandem and Access Tandem capability to pass user data in ISDN-User Part (ISUP) call control messages between ISDN users connected to Local Exchange Carrier (LEC) end offices.

The ISUP Access Transport Parameter (ATP) is used to carry selected Q.931 User-to-User Information Elements (UUI IE). The ISUP User-to-User (UUI) parameter is mapped from Q.931 UUI IE. The allowed length of each of these parameters is expanded to 131 octets, including the parameter name and length.

Use of the ISUP Facility Reject to notify the dropping of UUI and or ATP is discontinued. If ISUP message size limitations are exceeded, precedence procedures are provided for the ATP, UUI and unrecognized parameters.

This feature complies with Bellcore TR-TSY-000444 Issue 1 and TR-TSY-000845 Issue 1.

Recent Change of Protocol Timers and Parameters (094) [4E17] gives recommended ranges and/or values for a number of timers and thresholds. Prior to this feature, these timers and thresholds could only be changed via the network file, which required a Common Network Interface (CNI) initialization to install the changes.

Customer environments tend to be different, and require ‘‘tuning’’ of these timers and thresholds. This feature allows customers to change protocol timers and thresholds via 3B Computer Recent Changes, easier and more efficiently. Advantages of this feature over the network file include the following:

- *Changing of values without requiring CNI initialization* — With the network file, a CNI initialization was needed to activate any changes made to the values causing unnecessary downtime.
- *Range checking of timer values* — The 3B Computer Recent Change provides range checks to ensure that timer values are within recommended ranges.
- *Easier change mechanisms* — With the network file, it was necessary to know the location and the format of the file to make proper changes. This feature eliminates the possibility of corrupting the network file and thus increases CNI availability.

Message Transfer Part User Flow Control Via Processor Outage [4E17] allows the *4ESS* Switch to use the Message Transfer Part (MTP) method, which is recognized by other vendor products. The MTP User Flow Control (UFC) processor outage is recommended by AT&T/Bellcore Common Channel Signaling (CCS) Network Management Technical Group as an interim method of UFC, until American National Standards Institute (ANSI) T1S1 and International Telephone and Telegraph Consultative Committee No. 11 (CCITT11) establish standard procedures for MTP UFC.

The MTP method is the default UFC setting for the LEC switches.

Customers have the option of setting a desired method on a switch basis via the 3B Computer Broadcast Warning Messages (BWMs), to ensure compatibility in multi-vendor environments.

Capabilities prior to this feature enabled the *4ESS* Switch to use the Signaling Connection Control Part (SCCP) to inform remote switches of ISDN-User Part (ISUP) unavailability. SCCP is not standard, and may not be recognized by non-AT&T products.

Message Transfer Part (MTP) Routing Verification Test (MRVT) Enhancements (278) [4E17] allows the MRVT to test the validity and accuracy of MTP routing in the Signaling System 7 (SS7) network. This feature helps to ensure that all routes are correctly and completely provisioned, and provides the following enhancements:

- A test to detect if a Signaling End Point (SEP) has been incorrectly identified as a Signal Transfer Point (STP) in the MRVT message.
- An optional test to detect an asymmetrical route error — routing from the test initiator to the test destination is different from the route in the reverse direction.
- A modification that allows the MRVT test to operate with the Alternate Link Set Routing (ALSR) feature by testing alternate routes. In addition, this modification prevents the MRVT test from failing unnecessarily, when a correctly provisioned circular route is detected.

Procedures For Message Transfer Part (MTP) Restart (400) [4E21] enables the MTP at a signaling point that has just become available, to bring sufficient signaling links into the available state to handle the expected traffic and to stabilize its routing before user traffic is restarted to the point. It uses the Traffic Restart Allowed (TRA) and Traffic Restart Waiting (TRW) messages.

The MTP Restart procedures may not only be performed at a restarting signaling point, but also at signaling points adjacent to the signaling point which are restarting (as defined in Bellcore TR-NWT-00606 and TR-NWT-000082).

ISUP Operations, Administration, and Maintenance Enhancements (160) [4E17] provide new measurements to alert operations personnel of trouble conditions which involve the ISUP protocol. Specifically, this feature enables customers to measure the effectiveness of User-to-User Information (UUI) transport and Access Transport Parameter (ATP) services. Counts for UUI/ATP trouble conditions are included as office-wide counts (hourly or 24 hour plant reports). Counts relating to ISUP messages generated with cause values equal to ''protocol error'' are also reported.

Digital Signal Zero-A Link Interface (DS0-A) (081) [4E17] provides a new link interface board for Signaling System 7 (SS7) links, and can replace the existing LINE board. This feature offers customers the following advantages over the existing interface board:

- *Lower capital costs* — Previously, the signal from the LINE interface board required conversion by a Data Signaling Unit (DSU)/Channel Signaling Unit (CSU). The new interface board eliminates the need for a DSU/CSU.
- *Reduces operating costs* — DS0-A provides a platform for additional maintenance capabilities that allow easier and faster troubleshooting of link level problems.
- *Faster and easier updating of firmware* — Previously, firmware changes were expensive and time-consuming, and required the LINE board to be replaced.

With DS0-A, the LINE board contains flash Erasable Programmable Read-Only Memory (EPROM) memory chips that eliminate the need for physical ROM replacement in order to change firmware.

DS0-A software is included as part of the 4E17 Generic program. DS0-A hardware can be optionally installed.

Extended Access Links (E-Links) (344) [4E18] increases the survivability and fault tolerance of the SS7 network, by providing additional routes to the destination, and serving as an alternate route in the event of failed A-Links.

The E-Links are SS7 links that connect the *4ESS* Switch to additional Signal Transfer Point (STP) pairs (the normal connection uses A-Links). When E-Links are deployed, they enable the *4ESS* Switch to continue processing calls on trunks using SS7 ISUP signaling, even if all the A-Links are unavailable or the STPs that are connected to the A-Links have failed. When no A-Links are available, the SS7 ISUP messages use the E-Links instead of A-Links to reach STPs that forward the messages to the destination switch.

In addition to SS7 messages, SCPs can also use the E-Links, to enhance the reliability of IN-based services. E-Links allow traffic to be directly routed to destination STPs. This speeds up call processing and improves network performance.

Along with reliability gains due to E-Links, this feature [in conjunction with the Full Point Code Routing (FPCR)] feature allows for a simple method of reconfiguring the SS7 network to more evenly balance signaling loads across STP pairs. Changing the preferred link set from the A-Links to the E-Links is made easier. The *4ESS* Switch sends the signaling message to another (alternate) STP pair. E-Links comply with Bellcore TR-NWT-001204, Issue 1.

Full Point Code Routing (FPCR) (247) [4E18] works in conjunction with the E-Link feature to improve the routing efficiency of the SS7 network, by allowing messages to be routed using the full point code. The FPCR feature allows the network administrator to administer the most efficient path through the SS7 network.

This pin point routing results in better utilization of the SS7 network (potentially requiring fewer Signaling Transfer Points [STPs]), and a reduction in call setup time due to fewer STPs traversed.

Feature Group D (FGD) Carrier Identification Code (CIC) Expansion (161) [4E18] is a Local Exchange Carrier (LEC) only feature. Feature Group D (FGD) dialing is specifically used to override a presubscribed carrier (long distance telephone service provider); however, the carrier specified can be the same as the presubscribed carrier. CICs indicate the Interexchange Carrier (IXC) and services to be used for a call.

This feature enhances the existing capabilities of *4ESS* switching offices, by allowing the expansion of FGD CICs from 3 digits to 4 digits, while maintaining the capability to receive 3-digit carriers.

When this feature is provisioned, Trunk Subgroup (TSG) characteristics are used to determine the number of digits allowed on a call.

Feature Group-D (FG-D) Carrier Identification Code (CIC) Expansion Cause Transparency (405) [4E18] transparently changes the Integrated Services Digital Network User Part (ISUP) cause value sent by the *4ESS* Access Tandem Switch to the Local Exchange Carrier (LEC) end office, if the expected number of digits are not received.

This feature is used when:

- The incoming Trunk Subgroup (TSG) only allows three digits, and a 4-digit CIC is received, and
- The incoming TSG only allows four digits, and a 3-digit CIC is received.

This feature is an enhancement to the *FG-D CIC Expansion* Feature 161.

Carrier Identification Code Parameter (406) [4E18] provides the capability to consolidate trunk groups from Local Exchange Carrier (LEC) Switches to Interexchange Carrier (IXC) switches, by delivering Carrier Identification Code (CIC) information associated with individual calls/services to the IXC.

Previously, if an IXC was assigned multiple CICs, separate trunk groups were provided for each assigned CIC.

This feature provides the following enhancements:

- Allows CIC information to be delivered for each call
- Eliminates the trunk group restriction of requiring a dedicated trunk group for each CIC
- Allows trunking facilities to be used between the LECs and IXCs more efficiently.

Carrier Identification Parameter Trunk Subgroup Increase (480) [4E22] This feature will increase the number of Carrier Identification Code (CIC) values which can be passed via the Carrier Identification Parameter (CIP) to an Inter-Exchange Carrier (IXC) from 16 to 63 per Trunk Subgroup (TSG).

Currently, the *Carrier Identification Parameter Feature (406)* provides the ability to pass the CIC associated with a call originating from a LEC *4ESS* Switch Access Tandem (AT) to an IXC via the Signaling System 7 (SS7) CIP, by allowing up to 16 unique CIC values to be passed to an IXC for a given TSG.

Feature 406, Carrier Identification Parameter, which is available in the 4E12 generic, is required to use this feature.

Benefits

This feature will allow growth of IXC network resale by accommodating more carriers.

Local Exchange Carrier (LEC) Multiple Trunk Group (TG) Assignment (089) [4E17] allows the assignment of multiple Trunk Groups (TGs) between two offices to a single Destination Point Code (DPC). Up to eight TGs can be assigned to a DPC. A TG consists of one or more Trunk Subgroups (TSGs), and each TSG can contain up to 1008 trunks with similar traffic characteristics.

This new TG assignment capability allows Local Exchange Carrier (LEC) operations and maintenance personnel to easily identify trunk usage. Each of the TGs represent a particular traffic usage, and consists of a group of trunk connections to an Interexchange Carrier (IXC) switch, to a Remote Switch Module (RMS), or to an end office (EO).

Within multiple TGs between two offices, the same Base Traffic Number (BTFN), Traffic Number (TFN), and Circuit Identification Code continues to be unique for each trunk. The TOWN, State (ST), Building (BL), and Far Building Subdivision (FBS) fields of a TG code can be used administratively to assign and identify the traffic usage associated with a group of trunks.

Example applications of the Multiple TG Assignment capability are as follows:

- CCS7 ISUP connection from the LEC AT to multiple Points of Presence (POPs) for an Interexchange Carrier (IXC), each connected to the same IXC switch (Each POP has its own CLLI code).
- CCS7 ISUP connection from the LEC *4ESS* Switch to a *5ESS* switch with multiple Remote Switch Modules (RSMs). Each RSM has its own CLLI code, but shares the DPC with the hose switch.
- CCS7 ISUP connection from the *4ESS* Switch AT to a LEC end office via multiple TGs, where TG is dedicated to a connecting IXC at the AT.

Trunk Group Control of Signaling Bits (430) [4E18] gives users of a *4ESS* Switch Access Tandem (AT) the capability to control the state of unused signaling bits (AB) on a T1 trunk. The signaling bits controlled by this feature are referred to as AB bits, which are associated with Robbed Bit Signaling.

Control may be desired when the far-end switch does not ignore these bits on Integrated Services Digital Network-User Part (ISUP) Signaling System 7 (SS7) trunks, because they are being operated in clear data mode. Use of this feature prevents false supervisory information from being passed on to a connecting switch.

This feature is available via Software Change Packages (SCPs) to 4E18, 4E19, and 4E20 generics.

15-Digit International Numbering Plan-LEC (402) [4E21] feature aligns the LEC *4ESS* Tandem Switch with CCITT recommendation E.164 supporting 15-digit international dialing plans.

As the demand for telecommunications services increases, countries around the world are experiencing a shortage of available telephone numbers. To address this problem the international standards body, International Telephone and Telegraph Consultative Committee (CCITT), has recommended an expansion of the allowed maximum length of international numbers from 12 to 15 digits.

The expansion of any country's numbering plan is left to that country; however, CCITT has identified a time after which all networks should be able to accommodate the expanded number length. That time, known as *Time-T* is set in *CCITT Recommendation E.165* as December 31, 1996 Universal Coordinated Time (UCT)+.

An international telephone number consists of a Country Code (CC) and a National Significant Number (NSN), also referred to as the National Number (NN). The international number does not include dialing prefixes, such as 01 or 011, nor does it include Carrier Access Codes (CACs), such as 10288 or 1010288. Country codes have been defined to be either 1, 2, or 3 digits in length and will remain so even after *Time-T*.

Currently, the CC+NN combination is recommended to be no longer than 12 digits in length; so that a country with a 1-digit CC may use an NN of up to 11 digits, and a country with a 3-digit CC may use an NN of up to 9 digits.

Following *Time-T*, the CC+NN combination may be expanded to a maximum of 15 digits, allowing for growth in the NN of up to 3 digits. The complete CCITT requirements for the expansion of international numbers may be found in *CCITT Recommendation E.164* and *CCITT Recommendation E.165*.

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* Some locations in Germany have already been assigned 13-digit numbers ahead of *Time-T*.

This feature aligns the LEC *4ESS* Tandem Switch with CCITT recommendation E.164 supporting 15-digit international dialing plans. The expansion applies to international numbers used during dialing, administration, and signaling; and to all external interfaces and feature interactions that use international telephone numbers.

This feature does not introduce any changes to dialing plans used to make an international call. Neither does it introduce any change to the North American Numbering Plan (NANP). The NANP will retain a 10-digit numbering plan (NN) for all countries in World Zone 1 (WZ1).

All LEC network elements and operations systems (OSs) that handle international numbers must be able to support the expansion of international numbers to 15 digits.

LEC market products which are impacted by the expansion of international numbers include: *5ESS-2000* Switch, *1A ESS* Switch, *4ESS*™ Switch, *2B ESS*™ Switch, Operator Services Position System (OSPS), Service Control Point/Network Control Point (SCP/NCP), Attached Processor (AP), SCCS, NetMinder, RMAS, MACSTAR, SES (2SES), and BILLDATS™.

The *1 ESS*™ Switch will not be upgraded to support this feature as it is anticipated that all *1 ESS* Switches will be replaced on or before *Time-T*.

This feature specifically modifies LEC *4ESS* Switch Automatic Machine Accounting (AMA) so that *4ESS* Switch billing records can be generated reporting full 15-digit dialed numbers. LEC *4ESS* Tandem Switches which support CAMA, SSP-800, AINet®, and other call types requiring billing records will require this feature so that recording of 15-digit dialed numbers for international calls can be performed. Without this feature, the international number recorded in the billing record is truncated.

With CCITT's new recommendation, LECs must prepare the network to accommodate international numbers up to 15 digits in length. This is required to provide continued support for international services.

Number Services Routing (NSR) Domain Data Enhancements (416) [4E21] provides a *4ESS* Access Tandem (AT) Switch with the capability to route Integrated Services Digital Network - User Part (ISUP) Service Switching Point for basic 800 Service (SSP/800) voice and data calls (56kb, 64kb Clear) to InterLata Carriers (ICs) differently, based on the carrier identification and the User Service Information (USI) parameter in ISUP Initial Address Messages (IAMs).

This feature gives SSP/800 vendors the capability to complete data calls that use the *4ESS* AT Switch as an SSP to route the call to the correct Trunk Group that is used for data calls.

This feature is available via a Software Change Package (SCP) to the 4E20 generic.

Address Complete Message Timer Extension (461) [4E22] The current Address Complete Message (ACM) timer value used by the *4ESS* Switch is 20 seconds. This feature allows the value for the ACM used by the *4ESS* Switch to be either 20 seconds or 25 seconds, depending on the value provisioned for the switch.

Benefits

Increases call completion.

AUTOMATIC MESSAGE ACCOUNTING

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AUTOMATIC MESSAGE ACCOUNTING

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Automatic Message Accounting (AMA) makes it possible to create records of completed calls at the *4ESS* Switch and transport those records to a remote location for processing. With this information, the LEC or Interexchange Carrier (IEC) can properly bill the customer and check the validity of access charges.

Feature Descriptions

Centralized Automatic Message Accounting

Centralized Automatic Message Accounting (CAMA) [4E0] service is provided for interfacing with class 5 offices where local AMA is not economically justified.

The data recorded includes the calling number (either Automatic Number Identification [ANI] or Operator Number Identification [ONI]), the called number, the answer and disconnect times (accurate to 0.1 second), and any other information needed to bill the call correctly.

Centralized Automatic Message Accounting (CAMA) for the LECs (422) [4E19] provides feedback when the CAMA (CAMA) operator is unavailable, to make the user aware of the condition, since revenues can be lost until the condition is cleared. It also provides the capability to enable CAMA recording via Recent Change (RC).

The visual indicators ''ONI CAMA SUSPENDED'' and ''SPECIAL CAMA RECORD,'' were removed when the new 1B Processor Master Control Center (MCC) was developed, even though the 1B Processor software supports the functionality.

For the first function, if CAMA recording is suspended, a minor alarm sounds and is printed on the maintenance channel every 15 minutes, until the condition is cleared. For the second function, RC Form 617 should be used to enable and disable AMA recording of calls for CAMA trunks to information operators.

Automatic Message Accounting

Automatic Message Accounting (AMA) Improvements [4E8] add a new format for the recording of accounting data for the billing of calls through the *4ESS* Switch. This feature also improves the handling of long duration calls, tracer records, and teleprocessing to the host collector at the Revenue Accounting Office (RAO).

AMA transfers information about charged calls from the switching system responsible for recording the call to the RAO, where it is processed so it will appear on the customer's bill. AMA also allows for the detailed recording of calls for other purposes, such as service evaluation. Among the details recorded on an AMA record are calling number, called number, answer time, elapsed time, and call type.

The new format defines ''structure codes'' which consist of a fixed set of fields. The layout of these structures depends on whether the call is answered or unanswered, and whether optional information is recorded.

A structure code may be unique to a given call type, or it may be used by more than one call type if it contains the appropriate fields. Several types of *4ESS* Switch call records must be converted to the new format.

These include station paid, directory assistance, Inward Wide Area Telecommunication Service (INWATS) to an Automatic Call Distributor (ACD), INWATS time of day, INWATS overflow counts, Direct Services Dialing Capability (DSDC), and Teleconferencing (TC) bridge and leg records.

Tracer records supply counts of the AMA records that are generated to account for missing or partially charged AMA records.

The AMA records are stored on disks until they are either written to tape or teleprocessed to the RAO. Two to five day disk storage is provided, depending on the number of disks engineered on a per-office basis.

Access Charge Recording [4E9] allows an access tandem switch office to generate terminating access charge records for the following:

- Access Tandem terminating access
- Circuit Switched Digital Capabilities (CSDC) terminating access
- Inbound International Carrier terminating access
- Feature Group B terminating access.

Automatic Message Accounting (AMA) Recording Enhancements [4E10] allow an Interexchange Carrier (IEC) to allocate the billing for inter-LATA calls between the Local Exchange Carriers (LECs) and the IEC. This feature produces two streams of AMA records: LEC designated and IEC designated.

This feature produces AMA records for the following:

- Calls entering an IEC network via Equal Access signaling protocol
- Calls to another International Carrier via the IEC's network
- Answered/unanswered calls with carrier connect information
- Test calls
- Centralized Automatic Message Accounting (CAMA) calls (two records produced — one for the operating company and one for the IEC)
- Each manual time of day clock change.

Access Charge Recording [4E15] allows the recording of the delivery/receipt of the Calling Party Number (CPN) and the Billing Number (CPN/BN) to or from an IEC in access charge Automatic Message Accounting (AMA) records.

Change Under Minimum Billable Call Duration (UMCD) Threshold (3448) [4E17] allows the threshold value to be changed to a value of less than 2 seconds. This feature modifies the *4ESS* Switch, allowing it to generate Automatic Message Accounting (AMA) records for all answered calls, regardless of the elapsed time. The downstream billing system then determines if the call should be billed.

Previously, the UMCD threshold was set for 2 seconds, for most types of services. If the call was answered and the connection lasted less than 2 seconds, no AMA records were generated. The call was treated as unanswered and unbillable.

Enhancement to AMA Audit [4E12] reduces the recording register block time by partitioning the recording registers. The auditing of the registers is done on a partition by partition basis, with each partition blocked to data transfer only for the time required to complete the audit of that partition. This process leaves all the other partitions free for data transfer.

Populating the Terminating Numbering Plan Area (TNPA) [4E12] records the home Numbering Plan Area (NPA) of the *4ESS* Switch in the TNPA field of the AMA record when the dialed number digit count equals seven for the POTS domain. This feature ensures accurate billing via downstream billing systems.

Access Charge Capability for Cellular Mobile Carrier (CMC) [4E13] provides Phase-1 access charge Automatic Message Accounting (AMA) for calls on Type 2A connections between a *4ESS* Switch acting as an Access Tandem (AT) and CMCs.

This capability gives the CMC AMA records and Originating Access AMA records to the LECs for use in billing Cellular Mobile Carriers, Inter-LATA Carriers (ICs), and International Carriers (INCs) for access charges. This feature requires the *4ESS* Switch to create two billing records for these calls.

This feature was developed according to Bellcore TR-TSY-000064, with modification by agreements with the LECs.

Common Channel Signaling 7 Trunk Interface/Cellular Type 2A (401) [4E18] allows Signaling System 7 (SS7) signaling over a Type 2A interconnection, as well as MultiFrequency (MF) signaling.

Prior to this feature, only MF signaling was allowed over a Type 2A connection between a *4ESS* Access Tandem (AT) switch and a Cellular Mobile Carrier (CMC).

Far End Network (FEN) Positive Indicator [4E15] uses a positive value rather than a blank to indicate ‘‘no action required’’ for service categories within a FEN Block.

Near Real-Time Reporting of Automatic Message Accounting (AMA) Test Call Records—Optional Package [4E15] provide near real-time reporting of test call AMA records for recording validation of up to 128 AMA records.

Network Interconnect [4E15] is used to record data, if ANI or Calling Party Number (CPN) were received or sent over the interlata carrier.

New Tracer Records [4E15] provides three new hourly Service Count Tracer records containing AMA record counts by service category. The counts accumulate from midnight to the next midnight, and are as follows:

a. "Lost/Discarded" Service Count Tracer

b. "Full Charge" Service Count Tracer

c. "Partial Charge" Service Count Tracer.

Service Count Tracer Records for Unanswered Calls and Mutilated AMA Records (4317) [4E20] adds two new Service Count Tracer records; Unanswered and Mutilated.

Tracer records are AMA records inserted at hourly intervals in the stream of AMA records, to provide aggregate counts of the number of AMA records transmitted between successive markers. These records are used primarily to audit a network elements Call Detail Recording (CDR) process.

The Unanswered Service Count Tracer contains the count of the number of unanswered calls for which recording was triggered, but an AMA record was not made. For specific classes of calls, the 3B20D computer does not make an AMA record if it determines that the call was not answered.

The Mutilated Service Count Tracer record contains the count of the number of mutilated AMA records created by the *4ESS* Switch. A mutilated AMA record is a record that the 3B20D computer produces in which the Hexadecimal Identifier is set to "AB," signifying that call detail data is missing or corrupted in the AMA record.

Deferred Formatting [4E17] defers the formatting of records during busy hours, when the 3B is busy. Records for calls which the formatting may not be deferred, are formatted using the existing processing flow.

AMA Functional Program Replacement Feature (384d) [4E18] allows formatter process updates, without killing the existing formatter. This new functionality requires less time for the formatter process to load, thereby reducing the possibility of revenue loss.

The Automatic Message Accounting (AMA) formatter is an essential part of the process which performs the following routines:

- Collects recording information on calls from the 1A Processor
- Formats the AMA records
- Stores the records on disk.

Combine AMA Receiver and Formatter (384c) [4E20] merges two 3B20D Computer AMA processes, the Receiver and the Formatter. This merge frees processor resources that result in 3B20D Computer real time savings, which in turn enables increased volume of billing records processing.

This feature provides the following:

- Simplifies the code, thus improving time-to-market for new features requiring AMA changes
- Saves 3B20D Computer real-time, by deleting some of the code that accesses shared memory
- Allows the formatter to process data from the 1B Processor as soon as it is received, reducing the latency of the AMA data.

CMC SSP/800 and AIN AMA Enhancement (502) [4E22] *4ESS* Switch Type 2A (access tandem) MF interconnection to Cellular Mobile Carriers (CMCs) was introduced in the 4E13 generic. SS7 signaling was added to the *4ESS* Switch interface to CMCs by Feature 401 in 4E18R3.

This feature provides the capability to populate the Originating Numbering Plan Area (NPA) and Number fields of SSP/800 and Advanced Intelligent Network (AIN) Automatic Message Accounting (AMA) records generated for calls received by the *4ESS* Switch Access Tandem from CMCs with the CMC billing number assigned to the incoming Trunk Subgroup (TSG).

Prior to this feature, the SSP/800 and AIN AMA records were populated with the ANI which was received via signaling or from the SCP.

Benefits

- Allows SSP/800 and AIN AMA records to be associated with the CMC which originated the call for bill back purposes.
- Provides consistent population of the Originating NPA and Number fields in all AMA records for CMC originated calls.

SERVICES

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Contents

SERVICES

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The *4ESS* Switch can be used as a base to provide various services for the end customer. Some of these services require the use of a Service Control Point data base.

The features in this category are grouped as follows:

- *Service Switching Point (SSP)* — instructs the *4ESS* Switch on what actions to perform based on the dialed number. The *4ESS* Switch supports both SSP/800 functionality based on TR24 and a subset of Advanced Intelligent Network (AIN) triggers based on 0.1 functionality (TR1284 and TR1285.)
- *The Advanced Intelligent Network (AIN)-Optional Packages* — is a set of service-independent capabilities which provides advanced customer services.
- *Number Portability* — provides the network infrastructure to give subscribers the ability to move physically from one switch to another, while retaining their original Directory Number (DN).
- *DATA Services* — pass end-to-end customer data.
- *Miscellaneous*— various service features.

Feature Descriptions

Service Switching Point - SSP/800

Local Exchange Carrier Service Switching Point (LEC SSP) [4E12] enables the LEC switches to provide Number Services (NS) calls to LEC customers. NS calls, triggered by the dialed number, provide inward call management capabilities, and normally require access to a Service Control Point (SCP) in order to complete the call. The database controls the carrier selected and the routing of the call.

The LEC SSP feature, which can reside at either a Tandem or Access Tandem *4ESS* Switch, enables the LEC switches to handle most NS call types. It enables the switch to recognize the special dialed numbers to indicate a request for an NS call, generate a database query at the SSP, and use the information returned from the database to complete the call correctly.

Another facet of the SSP feature is the provision of LEC 800 service. As the call is recognized by the dialed 800 digits, the SSP office queries the Service Control Point (SCP), a LEC-owned database accessed through the Common Channel Signaling network.

NOTE:
The SCP referenced for this feature works with SSP/800. This database is based on a different protocol than the Advanced Intelligent Network (AIN).

Routing Global Title Translations Based on Service [4E13] enable the Common Network Interface (CNI) to send global title routed messages to different pairs of STPs, depending on the service being requested by the message. The previous method used by CNI was to send all global title routed messages to the same pair of STPs for translation.

Intra-LATA Seven-Digit Free Calling (918) [4E16] allows the LECs to offer a 7-digit Intra-LATA free dialing service that their customers can provide to callers in a manner similar to 800-number calls. The 7-digit number can be reused in each LATA, so nationwide number administration is not required. However, a business may request the same number in multiple LATAs so callers can dial only one number for all locations of that business in the LATA.

LECs can assign 7-digit telephone numbers to their business customers. It allows end-users to place calls to one LATA-free, 7-digit number and be connected to the business customer's nearest location.

Intelligent Network (IN) Toll-Free Treatment for NPA 888 (432) [4E21] feature expands Toll-Free Number capacity, by using the Number Service 800 feature for new Service Activation Codes (SAC) 888 and 877. The 888 and 877 SACs are treated as a toll-free call, similar to the current 800 SAC.

This feature is available via Software Change Packages (SCPs) to the 4E18, 4E19, and 4E20 generics.

ADVANCED INTELLIGENT NETWORK (AIN) - OPTIONAL PACKAGES

AIN-Optional Packages is a set of service independent capabilities which provide advanced customer services. These capabilities allow the Local Exchange Carrier (LEC) *4ESS* Switch, known as Service Switching Point (SSP), to recognize calls that require advanced treatment and to obtain instructions for processing the call from a centralized data base, known as a Service Control Point (SCP), instead of from logic contained in the switch.

With this architecture, the LECs can develop new services by modifying the logic in the SCP instead of the switch vendor developing new logic in the switch.

The SSP knows which calls require AIN services based on characteristics of the call, such as the carrier identification code, service/circuit code, and II/OLI value. The process of identifying calls that require AIN processing is known as "triggering," since a particular characteristic of the call suspends call processing and sends a query message to the SCP requesting instructions.

Based on information contained in the query message, the SCP determines which service is being requested and provides appropriate information, such as routing and billing instructions that the SSP then executes to complete the call.

The *4ESS* Switch provides Dialed Number and Shared Interoffice Trunk Triggers which interact with a Service Control Point (SCP) to provide customized features. The triggers serve as a platform from which a customer can develop a number of unique services such as the following:

- Single Number Calling
- Dialed Number Survivability
- Personal Communications Services
- Computer Security
- Network Call Distributor
- Custom Intercept
- Televoting
- Interactive Call Services
- Advanced 800 Services.

The most important benefit of using AIN is rapid time-to-market. This allows the customer to customize features to specific markets, without dependency on new feature development.

This is extremely important since the market is segmented, and requires different features for different customers. AIN meets these needs.

The AIN feature offers customized interactive and terminating announcements. Also, the *4ESS* Switch supports the Bellcore AIN 0.1 specifications, enabling customers to offer ubiquitous AIN service on multi-vendor equipment. The following are optional AIN features:

Advanced Intelligent Network (AIN) Dialed Number Triggers (375) [4E18] is based on the feature logic and data located at a centralized node in the network, rather than in each individual switching node.

Particular characteristics of a call, such as dialed digits, triggers the Service Switching Point (SSP) to provide AIN treatment. Once a trigger occurs, a query message is sent to the Service Control Point (SCP) to seek instructions. Based on the information contained in the query message, the SCP determines which service is being requested, and provides appropriate information (for example, routing and billing instructions) which the SSP then executes to complete the call. After a query has been sent, the SCP can also request that an announcement be played and/or digits be collected by the SSP.

This capability is provided by the Service Circuit System (SCS) on the *4ESS* Switch, and is used in compliance with the *Terminating and Interactive Announcements Feature (379)*.

In order to support AIN interactive and customized final announcements, each *4ESS* Switch must be equipped with an SCS.

The following are several interrelated capabilities that affect the interactions between the SSP and SCP in an AIN network:

- Recognize and process shared interoffice trunk triggers
- Recognize and process dialed number triggers (3 through 10 digits)

- SCP interface via AIN 0.1 TCAP protocol (TR1285)
- Announcements and digit collection via SCS (The Terminating and Interactive Announcements Feature—379)
- Serial Triggering
- Standard Equal Access Multifrequency (EAMF) and CCS7-ISUP interfaces to other switches
- Operations, Administration, and Maintenance (OA&M), including test queries, network load control (automatic code gapping), and new traffic measurements
- Billing under control of the SCP with modular extended Bellcore Automatic Message Accounting (AMA) Format (EBAF).

NOTE:
The *4ESS* Switch AIN 0.1 compliancy matrix, available from your Lucent Technologies Account Representative, provides information about which messages and parameter are supported by the *4ESS* Switch.

Terminating and Interactive Announcements (379) [4E18] are described in Chapter 9, Announcement Systems, in the Service Circuit System section.

Advanced Intelligent Network (AIN) Trunk Group Routing (410) [4E18] provides the capability to route AIN calls by trunk group. The trunk group is generally used to specify private facilities however, it can also be used to specify public facilities.

The Service Control Point (SCP) data base can request an AIN call to be routed based on the called number, routing number, carrier identification or trunk group.

The trunk group returned by the SCP is the Routing Data Block Index (RDBI), which specifies a trunk subgroup. The *AIN Dialed Number Trigger Feature (375)* must be loaded prior to using this feature.

NOTE:
Refer to the *AIN Dialed Number Trigger Feature (375)* for information regarding AIN routing for called number, routing number, and carrier identification.

AIN Global Default Routing-Phase 1 (411) [4E18] allows AIN Dialed Number Trigger (DNT) calls to be routed to the original dialed number when the Service Control Point (SCP) is unavailable.

This feature provides default routing to be turned on or off on an office wide basis (that is, all DNTs use default routing or none of them use it). The call is only default routed to the original dialed number.

Global Default Routing is invoked under the following SCP conditions:

- The Service Switching Point (SSP) receives a message requesting return on error (Signaling Connection Control Part [SCCP] returns an error message)
- No response to the INFO_ANALYZED message is received at the SSP before timer T1 expires
- Dialed Number Trigger (3/6/10) query attempt is blocked by Automatic Call Gapping (ACG).

NOTE:
The *AIN Dialed Number Trigger Feature (375)* must be loaded prior to using this feature.

AIN Specific Default Routing (415) [4E20] enhances the *Global Default Routing* feature 411, and is based on AIN 0.2 specifications. This feature allows a service provider to route to the original dialed number or a specific number stored in the *4ESS* Switch, when the Service Control Point (SCP) is unavailable for AIN Dialed Number Trigger (DNT) calls. Specific default routing can be activated on a per DNT, as well as on an office wide basis.

This enhancement addresses cases where the dialed number is a virtual phone number, such as an 800 or 500 number. In addition, an announcement can be played on the Service Circuit System (SCS) prior to routing the AIN call. There is also an option to route to a terminating announcement on the SCS.

Specific Default Routing is invoked under the following conditions:

- The Service Switching Point (SSP) receives a message requesting return on error (Signaling Connection Control Part [SCCP] returns an error message)
- No response to the INFO_ANALYZED message is received at the SSP before timer T1 expires
- Dialed Number Trigger (3/6/10) query attempt is blocked by Automatic Call Gapping (ACG).

NOTE:
The *AIN Dialed Number Trigger Feature (375)* must be loaded prior to using this feature. If using announcements, the following features are required: *Terminating and Interactive Announcements (379), Announcement System Manager-Plus (386), and Service Circuit System (3082).*

AIN Operator Routing (421) [4E18] provides AIN treatment for operator type calls. This feature allows the *4ESS* Switch to support AIN operator requested calls received on Integrated Services Digital Network User Part (ISUP) and Equal Access Multifrequency (EAMF) interfaces, and routed over ISUP and EAMF interfaces.

AIN operator requested calls routed over other types of trunks are not treated as operator requested calls.

This feature allows AIN treatment for EAMF 0+ calls. The *4ESS* Switch Service Switching Point (SSP) detects that the call requires AIN treatment [Analyze Called Party Number (ACPN) from the 0ZZ-XXX(X)]. The SSP deletes the 0 (zero) from the CPN and sets the operator indicator in the message to the data base during third stage digit collection. The SSP translation results in a Dialed Number Trigger (DNT) and an Info Analyzed query is sent to the Service Control Point (SCP).

In addition, the capability of accepting an operator Nature of Number (NON) from the SCP is provided by this feature. When the *4ESS* Switch receives an operator NON from the SCP, the switch uses the indicator to determine routing, and prefixes a leading 0 for EAMF outpulsing.

SS7-ISUP calls require this feature to handle the operator NON indicator sent from the SCP in the Analyze Route message.

AIN operator requested calls can be routed differently than non-operator requested calls by using the Network Services Routing (NSR) domain. AIN operator requested calls translated in the Plain Old Telephone Service (POTS) domain receive final handling treatment.

The LECs have to provision for the new operator routing capability provided by this feature prior to having the SCP return dialed numbers with an operator requested indication. Provisioning of the *4ESS* Switch may also be required, depending on how the calls will be routed.

NOTE:
This feature is an extension of the *AIN Dialed Number Triggers Feature (375)*, which must be loaded prior to using this feature. The feature requirements are based on Bellcore AIN Specification 0.1 (TR-NWT-001285).

AIN Capabilities For Data Calls (419) [4E21] feature enhances AIN by allowing 56 and 64C Kbps data calls to activate AIN triggers to provide AIN data services, similar to the services currently available for voice calls.

This feature allows the customer to provide AIN revenue producing data services, which can be used to transport video, bulk data, Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) images, medical images, and high speed facsimile.

NOTE:
The *AIN Dialed Number Trigger Feature (375)* must be loaded prior to using this feature.

AIN Dialed Number Triggers (DNT) Expansion (442) [4E21] increases the number of 10-digit AIN DNTs supported on the *4ESS* Switch, by providing an additional 262,000 10-digit DNTs. Prior to this feature, the maximum number of 3/6/10 DNTs was 8191.

This feature does not support: *Specific Default Routing (Feature 415)*, Selective Triggering by Call type capability, or more than 15 different Numbering Plan Areas (NPAs).

This feature is available via Software Change Packages (SCPs) to the 4E19 and 4E20 generics.

NOTE:
The *AIN Dialed Number Trigger Feature (375)* must be loaded prior to using this feature.

AIN 800/Toll-free Capability (443) [4E21] provides enhancements to AIN to support toll-free service in a manner transparent to the existing Service Switching Point (SSP)/800 capability.

To provide toll-free service via AIN, an AIN Dialed Number Trigger (DNT) must be assigned to a Service Activation Code(s) (SAC) defined for toll-free calling, or to selected office codes within a toll-free SAC (SAC-NXX).

AIN triggering mechanisms are used to detect DNTs. Once the DNT is detected, the SSP formulates an Info-Analyzed Query and launches it over the SS7 network. This Query is routed to the AIN Toll-Free Service Control Point (SCP) by way of Global Title Translation at a Signal Transfer Point (STP).

The Toll-Free SCP's service logic determines how the call should be routed and replies to the SSP with routing instructions. The SSP completes the call either within the LEC network to a Plain Old Telephone Service (POTS) number provided by the SCP, or completes the call call via the Interexchange Carrier (IXC) specified by the SCP.

This feature also supports AIN DNTs for calls over Centralized Automatic Message Accounting (CAMA) trunks, and provides the following capabilities:

- AIN capability for toll-free calls instead of SSP 800.
- Ability to define any code as a Service Activation Code (SAC), not necessarily 8XX, thus increasing the number of available toll-free numbers, eliminating the current 800 exhaust problem.
- Consistency, by consolidating the SCP data bases to the same type of AIN SCP data base.
- Service Circuit System (SCS) interworking for customized announcements, if the SCS is purchased.

NOTE:
The *AIN Dialed Number Trigger Feature (375)* must be loaded prior to using this feature.

AIN Call Code Provisioning (467) [4E21] gives billing systems the capability to differentiate inter-lata and intra-lata calls for downstream billing.

For intra-network AIN calls, this feature allows the switch owner to assign any number from 001 to 999 to be used as the Call Code for these AIN AMA records. For inter-lata calls, the switch automatically assigns 110 to the Call Code, thereby identifying AIN carrier-routed calls.

Previously, the *4ESS* Switch used Call Code 047 (Default AIN value) to populate the Call Type field of the AIN AMA record.

This feature is available via Software Change Packages to the 4E20 generic.

NOTE:
The *AIN Dialed Number Trigger Feature (375)* must be loaded prior to using this feature.

AIN Carrier Access Module Setting (468) [4E21] provides information in the AIN AMA record to allow a vendor to bill different charges for operator versus non-operator carrier-routed AIN calls.

This feature provides the capability to populate the operator involvement indicator in the Carrier Access Module based on (the Nature of Number value in the Called Party Number) information returned by the Service Control Point (SCP). As a result, the fifth digit of the carrier ID indicates a (0) for Operator or a (1) for Non-Operator assisted calls.

The *4ESS* Switch currently sets the operator involvement indicator in the Carrier Access Module to the value 2 (indicating unknown).

This feature is available via Software Change Packages (SCPs) to the 4E20 generic.

NOTE:
The *AIN Dialed Number Trigger Feature (375)* must be loaded prior to using this feature.

AIN 6 Digit DNT Expansion (516) [4E23] implemented in 4E18, allows the *4ESS* Switch acting as an AIN Service Switching Point (SSP), to identify calls requiring AIN call treatment and to query a centralized database, known as an Service Control Point (SCP), to obtain call handling instructions. AIN Dialed Number Triggers (DNTs) are detected as part of digit analysis through a DNT designation associated with the trigger digits in the digit translators. DNTs can be associated with 3- through 10-digits of the called number. A DNT designation is required in each domain for which the DNT is to apply. The total number of DNTs initially supported by the *4ESS* Switch AIN implementation was 8191. In 4E21, the number of 10-digit DNTs supported was increased to 262,000 by Feature 442, which introduced a new 10-digit trigger table for 10-digit DNT detection, in addition to the digit analysis detection method.

The addition of LNP DNTs by Feature 450, which are expected to be provisioned on a 6-digit basis for both voice (POTS domains) and data calls (56K and 64C domains), coupled with the increasing numbers of NPAs to be supported by a single switch due to NPA splits, has lead to the potential exhaust of AIN 6-digit DNTs for *4ESS* Switch offices in metropolitan areas.

This feature increases the number of 6-digit AIN DNTs which can be provisioned on the *4ESS* Switch to at least 50,000, subject to memory constraints. The new 6-digit triggers can be designated as either Local Number Portability (LNP) or AIN or both and will be associated with a set of translation domains for which the triggers apply. This means that each new 6-digit trigger is encountered in

all the specified domains, and receives either AIN and/or LNP treatment according to the designation associated with the trigger (i.e. treatment is the same in all domains). Traditional AIN DNT detection via digit translation continues to be supported on a 3- through 10-digit basis as well, with the existing 8191 limit. Traditional 6-digit DNTs have precedence over the new 6-digit DNTs. The LNP DNT defined by Feature 450 is supported by the new 6-digit DNTs. New office-wide Type of Service (TOS) values are defined for use with the new DNTs - one for DNTs designated for AIN treatment, and one for DNTs designated for LNP treatment.

The new DNTs support AIN Global Default Routing Feature 411 (default routing to the original called number), but will not support AIN Selective Default Routing Feature 415 (default routing to a specific new number associated with the DNT). The option of defining a separate set of domains associated with the expanded 10-digit DNTs provided by Feature 442 is also included as part of this feature.

This feature requires the purchase of either Feature 375 or Feature 450.

Feature 516 will be available in 4E23 Release 3.

Benefits

- Provides an additional 50,000 6-digit triggers.
- Provides the new 6-digit triggers to support LNP, data calls, and other expanding AIN services.
- Allows provisioning of the domains for the expanded 10-digit triggers which Feature 442 provides.

AIN/LNP Domain Option (534) [4E23] The LNP query introduced by LNP Feature 450 is an extension of AIN DNT capabilities. The number returned by the SCP after an LNP query is translated in the POTS (or appropriate data) domain, this is the current translation provided for numbers returned by an AIN SCP.

Feature 534 allows the 4ESS Switch to perform special domain determination logic when preparing to translate the called number received from either an AIN or LNP SCP. If this feature is active, the 4ESS translates the called number returned by the SCP in the same domain in which the original called number was translated. If the called number received in incoming signaling was not translated, then the 4ESS defaults to the appropriate data or voice domain. The special domain determination only applies when local routing is used (i.e. the SCP does not request carrier routing, or the carrier id returned is the 'local' carrier e.g. 0110).

The domain originally used to translate the called numbers is typically the domain associated with the incoming trunk in local (i.e. non-FGD) routing. For AIN serial triggering, the domain used is the one used to translate the number causing this query to be launched. Note, the domain could be a footprint domain if Feature 488 has been purchased, or could be an EADOM domain if the query was generated under the AIN SIT Analyzed Called Party Number scenario. This domain will also be used for AIN default routing to the original called number, if invoked.

Call handling capabilities associated with Feature 534 will not apply unless this feature is activated. This feature depends on AIN Feature 375 and LEC LNP Feature 450.

Feature 534 is available in 4E23 Release 1 and also as a 4E22 SCP.

Benefits

Minimizes network provisioning required to introduce LNP for service providers utilizing non-POTS domain routing.

Number Portability

LEC Number Portability (450) [4E22] Number Portability (NP) provides the network infrastructure to give subscribers the ability to move physically from one switch to another, while retaining their original Directory Number (DN). This ability is known as *porting*. Industry consensus has limited the initial implementation of NP to the porting of subscribers within existing rate center boundaries (typically a zone a few miles in radius surrounding the switch), while the implications and requirements for porting beyond the rate center boundaries are being defined.

NP is built on the Advanced Intelligent Network (AIN) platform *(AIN Dialed Number Triggers and Interactive Announcements-Feature 375)* and is based on the Illinois Generic Requirements for Number Portability. NP introduces a new AIN Number Portability (NP) trigger and the concept of a Location Routing Number (LRN).

The LRN is a ten-digit number (NPA-NXX-XXXX) that uniquely identifies an end-office or rate center within the end-office, and is used as a virtual address for the switch serving ported subscribers. When a DN is defined as portable via provisioning of the new NP trigger, checks are made to determine whether a query should be launched to the Service Control Point (SCP). When a query is launched, service logic in the SCP determines whether the DN has been ported, and returns either a LRN (if the number is ported) or the original DN (if the number is not ported). Calls to ported numbers are routed using the LRN returned from the SCP. Calls to non-ported numbers are routed using the DN as usual.

NP also introduces new requirements for Automatic Message Accounting (AMA) in order to support accurate billing and cost recovery. Whenever a NP query is launched, a Bellcore AMA Format (BAF) module is appended to existing AMA records being generated by the switch. This module will contain the LRN returned by the SCP for a ported terminating DN.

Because NP breaks the traditional relationship between wire center and Calling/Called NPA-XXX used to perform mileage calculations for access charges, this NP module will also be appended to Inter-Exchange Carrier (IXC) Terminating Access records generated for calls to ported subscribers independent of launching a NP query. A NP BAF module containing the LRN of the originating EO will be appended to IXC Originating Access AMA records, including applicable AIN records, generated by the switch, again independent of launching the NP query.

To provide AMA recording for calls crossing network boundaries between two local service providers, a new type of AMA record may be produced at the option of the Service Provider. This new record is known as a Connecting Network Access Record and will be available either for all calls received from the connecting network, or only for those calls resulting in a NP query.

NOTE:
The *AIN Dialed Number Trigger Feature (375)* must be loaded prior to using this feature.

Benefits

The benefits of deploying NP capability at the tandem switch to avoid billing errors and lost calls include:

- The tandem switch is in a natural position to perform NP queries for calls received not queried from either IXC or local carrier networks connecting to it for the most efficient routing of ported calls and accurate capture of AMA information.
- NP introduces new ISUP information, including the LRN, transporting of the original DN, and an indication that an NP query has been performed. NP provided processing of this information by the tandem is critical to correct call routing when interworking ISUP-to-inband signaling.
- Population of Originating and Terminating Access AMA records generated at the tandem with NP information so that accurate mileage calculations can be made by downstream billing systems.
- Generation of new Connecting Network Access records to allow AMA records to be generated for local network interconnections.

LEC LNP OA&M Enhancements (517/517A) [4E23] offers additional LNP (Local Number Portability) measurements to those initially defined for LEC LNP Feature 450. It also sends both existing and new NP measurement data to NetMinder, so that network managers can identify and monitor NP effects on local networks.

In addition, this feature makes changes to rules governing CNA (Connected Network Access)AMA record generation for calls encountering both AIN and LNP triggers, to align with the latest version of the Illinois GR. The AMA portion of this feature is available in 517A.

Feature 517/517A is available in 4E23 Release 3 and 517A is also available as a 4E22 SCP. These features depend on LEC LNP Feature 450.

Benefits

Provides additional AMA and Network Management enhancements for LNP.

Additional LNP OA&M Enhancements (538)[4E23] provides the following OA&M enhancements to LNP Feature 450:

- Restricts Network Management Call Gap/Call Trap to six digits or less when the control is applied to a LRN.
- Modifies the default population handling for the IC/INC and Dialing Indicator fields in the CNA AMA record.
- Appends the appropriate NPA to a seven-digit LRN prior to using the LRN to populate the terminating party LNP BAF AMA module.

Feature 538 is available in 4E23 Release 4. This feature depends on LNP Feature 450.

Benefits

Provides additional AMA and Network Management enhancements for LNP.

Analyze Ported Number Gap for AIN DNTs (515) [4E23] allows the *4ESS* Switch to act as an intermediate exchange (local tandem or terminating access tandem) in local networks implementing Number Portability (NP) using the Local Routing Number (LRN) method. NP provides the network infrastructure to give subscribers the ability to physically move from one switch to another while retaining their original Directory Number (DN). This ability is known as 'porting'. LNP Feature 450 is built on the Advanced Intelligent Network (AIN) platform (Feature 375) and is

based on the Illinois Generic Requirements for Number Portability. NP introduced a new AIN LNP trigger and the concept of a Location Routing Number (LRN). The LRN is a 10-digit number (NPA-NXX-XXXX) that uniquely identifies an end-office or rate center within the end-office, and is used as a virtual address for the switch serving ported subscribers. Calls to ported numbers are routed using the LRN which is returned from the SCP in response to an LNP query. Calls to non-ported numbers are routed using the DN which is returned by the SCP.

For LNP calls to ported subscribers, the ISUP IAM CdPN parameter contains the LRN, while the original DN is carried in the Ported Number GAP (PNG). AIN DNTs defined at tandem switches for the original DN are not currently encountered for LNP calls which are ported into the LEC network (i.e. received at a network interconnection point - the terminating access tandem for calls received from IXCs, or the terminating local tandem for calls received from another local carrier).

If an AIN Dialed Number Trigger (DNT) on the Ported Number GAP (PNG) is encountered and an AIN query is performed, the switch uses the contents of the GAP to populate the Dialed Party ID parameter in the AIN query. Analysis of the ported number GAP is done in addition to analysis of the CdPN (containing the LRN) performed to determine call routing. Any routing information associated with the ported number GAP analysis is ignored. If the SCP response to the AIN query for the PNG contains a different Dialed Party ID than was sent in the query, this new called party number will be used to determine call routing, and the LNP indications (FCI bit M and ported number GAP) originally associated with the call are dropped.

This feature requires the purchase of Feature 450 (LEC LNP).

Feature 515 will be available in 4E23 Release 3.

Benefits

Allows AIN services based on the called number to be provided at the tandem switch, rather than at the terminating EO, for calls to subscribers ported into the LEC network.

Orginating LNP Module AMA Enhancements (537) [4E23] NP Feature 450 introduced new requirements for AMA needed in order to support accurate billing and cost recovery, since NP breaks the traditional relationship between wire center and NPA-NXX used to perform mileage calculations. A LNP Bellcore AMA Format (BAF) module containing the LRN associated with a ported DN is appended to existing AMA records being generated by the switch to provide the ability to identify the terminating wire center for calls made to ported subscribers. A LNP BAF module containing the LRN of the originating end-office is appended to IXC Originating Access AMA records, including applicable AIN records, generated by the switch, to provide the ability to identify the originating wire center for calls made by ported subscribers.

In order to extend the ability to provide originating wire center identification for calls received from ported subscribers, Feature 537 appends a LNP BAF module containing the LRN of the originating end-office to all terminating AMA records generated by the switch, when the LRN of the originating end-office is known at the 4ESS Switch. The terminating AMA records currently generated by the 4ESS Switch are: CSDC Terminating Access CC 121, FG-B CC 135, FG-D CC 119, CNA CC 720, and CMC CC 66.

The LRN of the originating Switch is obtained from the Jurisdiction Information Parameter (JIP) of the incoming ISUP IAM, or, if the JIP is not available via signaling, from the JIP/LRN provisioned on the incoming TSG. If neither an ISUP JIP nor incoming TSG JIP/LRN is available, the originating party LNP BAF module is not recorded. This feature must be activated via Recent Change subsequent to being purchased.

This feature is available in 4E23 Release 4 and depends on LNP Feature 450.

Benefits

Allows accurate cost recovery for calls terminated within the LEC network which are originated by ported subscribers.

DATA Services

Full Rate Data/Public Switched Data Capability (PSDC) [4E6] allows the transparent switching of 64 kbps bandwidth signals through the *4ESS* Switch over a dedicated network of digital trunks.

Public Switched Data Capability (PSDC) allows high-speed digital communications through portions of the public telephone network.

In order to provide the Full Rate Data/PSDC feature, the following are defined in the *4ESS* Switch software:

- The PSDC trunks and their routing network
- A new test access trunk and the network connections required to test the PSDC trunks
- A new test line which provides a digital loopback complement for use when testing PSDC trunks.

PSDC trunks, 2-way dedicated trunks that terminate exclusively on Digital Interface Frames (DIFs) at *4ESS* Switch locations, use Common Channel Signaling (CCS) for addressing and supervision. PSDC trunks are dedicated to the PSDC network but are shared among PSDC users.

Circuit Switched Digital Capability (CSDC) Improved Access [4E10] allows CSDC calls to be made on trunks other than Common Channel Signaling (CCS) trunks, such as Multifrequency trunks.

This method of signaling was developed because of uncertainty over whether local Common Channel Interoffice Signaling (CCIS) would be available after divestiture.

Intra-LATA Switched 384/1536 Kbps (917) [4E16] allows customers to select bandwidths of 64 kbps, 384 kbps, or 1536 kbps on a per-call basis. Customers utilizing the higher bandwidths have the capability to offer data services that are flexible and cost-efficient.

Examples of data applications that utilize the 384/1536 kbps capability are:

- Full motion video
- Bulk file transfer
- Backup of private line
- Video teleconferencing
- High resolution graphics or interactive Computer Aided Design/Computer Aided Manufacturing (CAD/CAM)
- High speed facsimile.

Previously, these high-speed data applications required private line connectivity point-to-point, which limits the customers' flexibility for where or when a particular application could be used.

With switched 384/1536 kbps, these services are ''on-demand'' and can be set up at any time by the customer. In the case of video, the large business customer can increase productivity and reduce expenses by having video teleconferencing with locations other than those on a private network.

Essential hardware includes a Primary Rate Interface (PRI) supported by the Common Network Interface (CNI) Ring and a D-Channel node to terminate the Q.931 D-Channel.

The DIF-E1 frame must be equipped with the SM9 packs to support the 64 kbps clear-channel bandwidth. In addition, the Time Slot Interchange-B (TSI-B) frames must be equipped with the FA1816 and FA1817 circuit packs to ensure proper time-slot correlation.

Inter-LATA Switched Data Service/Network Interconnect for Primary Rate Interfaces-Phase 1 (373) [4E17] provides Local Exchange Carrier (LEC) Primary Rate Interface (PRI) customers with data services at rates of 56 kbps, 64 kbps, 384 kbps, and 1536 kbps over dedicated domains.

This feature enables the PRI capability to support per-call carrier selection, and the Network Interconnect (NI) capability to support data calls.

This feature allows LEC PRI customers to set up data calls "between" Local Access and Transport Areas (LATAs), and to select the carrier (on a per-call basis) which transports the call. Prior to this feature, the PRI supplied to the LECs did not support carrier ID. Inter-LATA Switched Digital Service requires a Q.931 to be directly or indirectly connected to a LEC *4ESS* Switch.

When the PRI is not directly connected, the Signaling System No. 7 (SS7) Integrated Services Digital Network User Part (ISUP) network transports the data call from the PRI to the switch. When the LEC switch has a direct route to the inter-LATA carrier, the Common Channel Signaling System 7 (CCS7) NI protocol is used. In order to support data calls, this feature requires a directly connected PRI interface to be setup in a dedicated domain.

Inter-LATA Switched Data Services Phase 2 (333) [4E18] provides the capabilities for Primary Rate Interface (PRI) customers to set up data calls to a selected carrier without having to provide the carrier identification code during call setup (presubscribed carrier selection).

This feature expands the capabilities provided in the *Inter-LATA Switched Data Services Phase 1 Feature (373)*. Phase 1 provides LEC *4ESS* Switch PRI customers with Inter-LATA Switched Data Service, but requires carrier designation on every call (per-call carrier selection).

When using this feature, the *4ESS* Switch screens dialed numbers for PRI customers, and determines whether an inter-LATA or intra-LATA call is being made.

The switch then routes the call to a presubscribed carrier or a customer provided carrier. PRI customers have the ability to override carrier presubscription on a call by call basis by providing a carrier identification code during call setup.

This feature also enhances the 4E17 generic per-call carrier selection as follows:

- Validating 3- and 4-digit carrier codes
- Verifying whether the requested carrier can handle the call (inter-LATA, international, or LEC)
- Determining whether an inter-LATA carrier can route an originating intra-LATA switched data call (intra-LATA competition allowed)
- Determining whether a LEC can route an originating inter-LATA switched data call (corridor/privileged traffic)
- Determining whether a carrier supports the bearer capability requested (64, 384 or 1536 kbps).

Miscellaneous

Emergency Alternate Routing (165) [4E17] enables the Local Exchange Carriers (LECs) to provide their end customers with emergency alternate routing strategies to cover contingencies. This feature is used when the primary business location is either isolated from the network, or is unable to process calls due to natural disasters, fires, bomb threats, etc.

Emergency Alternate Routing is initiated by customer request. This capability enables end customers to create their own contingency plans, by specifying where calls should be alternately routed when the primary location cannot process calls.

A *4ESS* Switch Recent Change updates the 1A Processor memory, allowing the alternate customer number to be substituted for the customer's primary number.

This service satisfies a federal mandate that requires banks to have the capability to alternately route calls from a primary location to a secondary location, in case of an emergency such as a terrorist threat or natural disaster.

Access Tandem (AT) Trunk Trigger and Equal Access AMA Enhancements (455) [4E21] gives non-LEC owned EOs the capability to generate AMA records and perform Network Call Denial (NCD) type screening functions at the *4ESS* AT Switch for calls received from EO switches that they do not own. In addition, this feature provides the capability to enter the long distance market with a small investment.

Prior AT requirements, based on Bellcore GRs, have been based on the assumption that all local network switches were owned by the same LEC entity. However, with increasing local competition, this assumption is no longer valid.

As the interrelationships between competing entities grow more complex, the ability to screen and record calls at AT Switches needs to be provided for calls originating from non-LEC owned EOs. In support of this growing marketing need, this feature

provides the option of designating either or both of the following options on a Trunk Subgroup (TSG) basis:

- The ability to generate AMA records equivalent to those generated by EAEOs at the *4ESS* AT Switch for calls received from/destined for non-LEC owned EOs.
- The ability to provide SCP-based NCD screening for calls received from non-owned EOs via a new AIN Trunk Subgroup (TSG) trigger.

NOTE:
The *AIN Dialed Number Trigger Feature (375)* must be loaded, prior to using the SCP-Trunk Trigger capability.

AT Routing Enhancement (488) [4E22] This feature allows LECs to leverage their embedded base in-region networks by offering in-region inter-lata transport to Interexchange Carrier (IXCs). The region in which the LEC currently owns and operates local network switches/services is referred to as the LEC footprint, and the NPA-NXXs within that footprint for which an IXC subscribes to LEC provided transport is referred to as the IXC's subscribed footprint area.

The *4ESS* Switch Access Tandem (AT) determines, based on the Carrier ID received from the EO via Feature Group D (FGD) signaling (either EAMF or ISUP-NI), whether that carrier is subscribed to LEC transport service, and if so, determines the IXC's subscribed footprint area. Calls to non-subscribed IXCs are routed to the carrier using existing AT capabilities. For calls to subscribed IXCs, the *4ESS* Switch AT translates the called number to determine whether the call terminates in-or-out of the IXC's subscribed footprint area, and completes the call via the LEC network (for in-subscribed-footprint calls), or route the call to the carrier for completion (for out-of-subscribed footprint area calls). Initially, seven unique subscribed footprint areas are supported by this feature, increasing up to a total of forty

subscribed footprint areas in the 4E23 generic.

Benefits

- Allows the LECs to offer in-region inter-lata transport service to IXCs, adding potential new revenues.
- Requires no modification to existing EO Feature Group D (FGD) capabilities, feature functionality is localized at the *4ESS* Switch Access Tandem (AT) switch.
- Works in conjunction with Feature 455 allowing Equal Access Automatic Message Accounting (AMA) records to be made at the *4ESS* Switch AT, if desired.

Enhancement to AT Routing Feature 488 (488i) [4E23]
enhances the Access Tandem Routing Enhancement feature (488) by increasing the number of subscribed footprint areas from 7 to 40. This feature is included with the purchase of 488 which is available in 4E22.

Benefits

It allows the LEC to offer in region interlata transport service to IXCs, adding potential new revenues.

ANNOUNCEMENT SYSTEMS

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ANNOUNCEMENT SYSTEMS

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Feature Descriptions

Service Announcements/Digit Collection are important elements of many telephone network services. Previously, the *4ESS* Switch's announcement capabilities consisted of a tone generation frame, Recorded Announcement Frame (RAF) (synchronized announcements), and Public Announcement System (PAS) (barge in and synchronized announcements.)

However, as the market for announcement and collection-related services continues to grow, it is expected that the present cost to provide these services will drastically increase. The following announcement-related and input collection-related services feature groups are developed to meet the expected demand:

- *Service Circuit System (SCS)* — is a hardware and software enhancement of the *4ESS* Switch that allows an almost unlimited number of customized tones and announcements to support new services. The SCS is essential for many of the sophisticated services that are possible with the powerful *4ESS* Switch Advanced Intelligent Network (AIN) offering.

- *Announcement System Manager (ASM) Plus*— initiates announcement updates to the Service Circuit System.

Service Circuit System

Service Circuit System (SCS) Feature (3082) [4E17] provides functions such as announcement, tone, and music storage; announcement, tone, and music playback; and digit collection capabilities, including:

- Increased announcement capability allowing customized announcement sets giving detailed direction to callers
- Flexibility for growth and evolution of future service requirements
- Fast update capability allowing customers to custom-tune their applications quickly to meet specific operational objectives
- Standard interactive announcements (announcement wording as a function of the feature, followed by collection of customer digits)
- Custom interactive announcements (announcement wording as a function of both the featured and customer-specified input of calling number)
- Interactive information collection through Dual-Tone Multi-Frequency (DTMF) or automatic speech recognition hardware.

The hardware consists of three basic elements, Service Circuit Units (SCUs), disks, and SCS controllers. The actual service circuits that are used on calls to provide tones and announcements are in the SCUs. Each SCU has 120 service circuits, each of which can provide a tone or announcement during an individual call. Each service circuit is also capable of receiving Dual Tone Multifrequency (DTMF) digits for interpretation by *4ESS* Switch call processing logic. Each SCU is connected to a Time Slot Interchange (TSI) by a DS120, to allow calls to have access to the service circuits.

The SCS controller interconnects the 1A/1B Processor with the SCUs for call processing control messages and Operations, Administration, Maintenance and Provisioning (OAM&P) functions. The SCS is fully integrated into the *4ESS* Switch OAM&P plan.

SCS equipment is packaged in two frames: SCS main frame and SCS growth frame. The SCS main frame contains two SCS controllers, one SCU, and up to four disk pairs. The SCS growth frame contains four SCUs and four disk pairs. A fully configured SCS consists of one SCS main frame, and four growth frames.

Terminating and Interactive Announcements (379) [4E18] allows the *4ESS* Switch via the Service Circuit System (SCS) to support terminating and interactive announcements associated with AIN services. This feature allows customers to redirect their AIN calls using the announcement and digit collection functionality. The SCS is used to provide these announcement capabilities on the *4ESS* switch.

The Service Control Point (SCP) logic determines when to direct calls to announcements. The SCP may request an interactive announcement, which generally prompts the caller to input additional Dual Tone Multifrequency (DTMF) information.

The *4ESS* Switch returns any caller-entered digits to the SCP, from which the SCP makes service logic decisions.

The SCP may also request that the switch play a customized announcement to the caller, then disconnect the call. This capability can be used if the SCP determines the caller has made a fatal error (input an invalid dialed number), or if the service logic indicates the call is being attempted outside of business hours.

NOTE:
The AIN Dialed Number Trigger Feature (375) must be loaded, prior to using this feature.

Expanded Final Handling (FH) Announcements (3091) [4E17] makes use of the Service Circuit System (SCS) platform. The Expanded Final Handling Announcement adds the capability for 96 new Final Handling announcements, that include both network emergency announcements (invoked via network management controls) and generic network announcements (triggered by call failures).

This enhanced Final Handling announcement capability allows more specific announcements, and can support up to 4.5 minutes of announcement playback.

Final Handling Announcement names and uses are not currently defined for Local Exchange Carrier (LEC) applications. Specific requirements need to be defined to implement Final Handling Announcement to LEC applications.

Automatic Speech Recognition on the Service Circuit System (4183) [4E21] allows the *4ESS* Switch to recognize end customer service requests during a call. The Service Circuit System (SCS) platform enables the switch to prompt the customer for account codes, authorization codes, or routing codes ("dial 1 for hardware.")

With the addition of Automatic Speech Recognition (ASR), customers have the capability to speak responses to switch prompts, allowing them hands free access to services. This adds new convenience to existing services, and allows customers to interact with services when they do not have access to touch tone equipment.

NOTE:
The SCS/ASR platform can easily be adapted to support service ideas either for service trials or full service offerings. This feature requires switch application development.

4ESS Switch SCS Automatic Speech Recognition-Phase 2 (4801) [4E22] This upgrade reduces the quantity of equipment necessary to provide Automatic Speech Recognition (ASR) on the Service Circuit System (SCS). This is accomplished by using a new speech recognition circuit pack and new support packs in the existing Custom Data Services Unit (CDSU).

The existing speech recognition circuit pack can provide two channels of the following types of recognition: isolated digits, isolated words, connected digits and TDD recognition. The new circuit pack provides 12 channels of the same recognition, and allows for future services as well. This new CDSU supports up to 60 channels of recognition in a single unit.

NOTE:
The SCS/ASR platform can easily be adapted to support service ideas either for service trials or full service offerings. This feature requires switch application development.

Benefits

Reduces the quantity of equipment needed to provide ASR on the SCS system.

Service Circuit System (SCS) 4GB Disk Drive (404) [4E18] provides 4GB of announcement storage capacity for Service Circuit Units other than SCU 0, and a disk unit of 4GB capacity on SCU 0.

This feature is implemented through use of a new disk unit that contains two disk drives of 2GB each.

Multiple 4E Network Announcements (4232) [4E18] enables the Service Circuit System (SCS) to support Multiple Network Announcements for Final Handling Treatments (FHTs) in different languages. Network announcements refer to the base platform, and are generic announcements.

A specific bilingual network announcement or the sequence of the different languages is determined based on the location/Numbering Plan Area (NPA) of the caller.

For example, this feature can support the following four network announcements: English Only, Spanish Only, English and Spanish, and Spanish and English.

Service Circuit System (SCS) UN351 Circuit Pack Replacement (456) [4E21] replaces circuit pack UN351 with UN591. A component on the UN351 circuit pack is discontinued, with no replacement parts available. Therefore, new hardware is needed for use by Local Exchange Carriers (LECs).

The only software changes are for the SCS to recognize which circuit pack is present, and to output appropriate Trouble Locating Procedure (TLP) data on diagnostic failures.

NOTE:
This feature requires a new Unit Software load for SCS, which resides on the 3B disk in the SCS file structure.

SCS Software Update Tool (5563) [4E22] This feature enhances the software update engine and 3B display page interface for the automated method of updating software on the XTSI frame provided in Feature 5113 to include update capabilities for SCS frames.

This feature uses the base built in the XTSI features, with the additional capability of updating SCS frames, by selecting and supplying the required data to the software update interface on the 3B.

The SCS Software Update tool is similar to the current 3B Broadcast Warning Message/Software Update (BWM/SU) interface, using a menu driven page on the 3B terminal. It includes automatic verifications and dump analysis, back-outs, perms (make permanent), etc. If a timeout occurs during tool execution, the tool can be interrupted manually, similar to the current BWM/SU interface.

Benefits

The SCS Software Update tool does the following:

- Automates the Software Update procedure.
- Reduces the risk of error.
- Requires substantial intervention ONLY when a failure occurs.

Announcement System Manager

Announcement System Manager (ASM)—Plus Interface to Service Circuit Units (ASM-Plus) (386) [4E18] initiates announcement updates to the Service Circuit System (SCS), and consists of two main hardware components: The ASM-Plus Administrator and the ASM-Plus Controller.

The ASM-Plus Administrator, a PC-based system, is where end-users administer announcement activities. This function interfaces with the ASM-Plus Controller, by using high speed modems and an analog line. A single ASM-Plus Administrator can manage multiple SCSs in different offices.

The ASM-Plus Controller has a high speed Local Area Network (LAN) interface to the Service Circuit Unit of the SCS, which links announcement updates, maintains status, and reports error conditions to the ASM-Plus Administrator. For a *4ESS* office that has a SCS, an ASM-Plus Controller is required.

The current ASM-Plus is enhanced with several features which significantly increase the speed of the Administrator-Controller interface. There are also several enhancements to the user interface.

This feature provides the following benefits:

- Ability for the customer to incorporate the fastest available modem technology without ASM application updates.
- Navigation between screens is greatly facilitated by allowing the use of a mouse with the UNIX OpenLook environment.

FUTURE ENHANCEMENTS - GENERIC 4E24

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FUTURE ENHANCEMENTS - GENERIC 4E24

10

Core

Recent Change (RC) Form Metrics Reports (523) [4E24] provides new input and output messages to verify the total processing time per RC form/message, the number of times each RC form/message was activated and the longest single activation per RC form/message.

Benefit

This feature will provide additional metrics to gage the performance of the Recent Change function.

Recent Change (RC) Trunk Sub-Group (TSG) Engineered Limit (529) [4E24] adds a new one word ODA structure which counts the number of assigned TSG's currently in the office and checks against the engineered limit for the office. This will be incremented or decremented whenever a TSG is created or deleted. Whenever a TSG is added, this counter will be checked against the engineered limit. The form will fail if 4ESS is over the limit engineered for the office. Note that NG-ODA will initialize this counter during retrofit.

Benefit

Will eliminate a potential problem where the memory limit for TSG's will now be looked at via this RC check. RC then cannot create more TSG's than the engineered memory supports.

ISUP Digit Storage (530) [4E24] provides a real time enhancement by changing the digit storage algorithm in the IAM for the Called Party Number.

Benefits

This new algorithm is estimated to save about 200 (1B) cycles per call in real time.

Additional Input to the CRIB (Call Register ISDN Block) (533) [4E24] provides an aditional input to the CRIBPRIM. This input with 24 bits is needed as an indication to what parameters can be stored in the CRIB.

Benefits

This will add one more spare bit in the CRIBPRIM.

Service Control Point (DSC SCP) Interface Modification for LNP (540) [4E24] allows the 4ESS Switch to support the reception of an additional Service Connection Control Part (SCCP) header format with Called Party Address. Specifically, it will include Point Code and Subsystem Number, and the Calling Party Address including Subsystem Number.

This feature is provided as a BWM to 4E22R4 and is in 4E23R3.

Benefit

This will allow the 4ESS to recognize and process the particular SCCP header format utilized by the DSC STP/SCP. It does not allow for all possible combinations of SCCP Called/Calling Party Address fields.

AIN/LNP SCCP Header Validation Reduction (542) [4E24] allows the *4ESS* to accept all combinations of SCCP Called/Calling Party Address Fields, with the exception of the Called/Party Address Global Title (GT). The 4ESS does not provide Global Title Translation (GTT) functionality and therefore any AIN/LNP message received in GT format by the 4ESS switch will be dropped.

Benefit

This will allow the 4ESS to recognize all combinations of SCCP header formats with the one exception of GT.

SCS Cache Change to 128 Milliseconds (6881) [4E24] This applies only to customers with SCS.

This feature will change the current cache boundaries to one eight of a second (128 msc). It will allow for better sounding short duration announcements. When announcements are concatenated together, with the current cache duration of 512 msc, the overall announcement can sound "choppy".

Benefit

Provides reduced latency to "playback" since announcements in cache are not "read" from the disk. Also, playback from cache is 100 to 200 msc faster than from disk and there is less "wear and tear" on the disk heads. Additionally, it provides quality and performance improvements on short duration announcements and better sounding announcements when concatenated together.

UNIX REAL TIME RELIABLE OPERATING SYSTEM

The Real Time Reliable (RTR) Operating System is the basic operating system required to run the 3B20D and 3B21D computer. The RTR Operating System monitors and controls operations in various switching and processing applications. The application software detects faulty processes and equipment, reconfigures or reinitializes the system, and diagnoses and identifies faulty equipment.

The application software is designed for high-reliability and real-time responsive applications (for example, telecommunications, military, and transaction processing systems).

OPTIONAL FEATURES

Tandem Flexible ANI/II Digit Restriction (539) [4E24] provides the mechanism to restrict or allow forwarding of Flexible ANI/II values subsequent to SSP/800 or AIN queries performed at the 4ESS tandem. A Flex ANI/II subscription indication (Yes/No) on a per carrier basis will be provided. After performing an SSP/800 or AIN query for which the SCP has returned a carrier ID, the switch will check the carrier's Flexible ANI/II subscription. If Yes, the ANI/II value is forwarded as received from the EO (or as modified by the SCP for AIN). If No, the II digit value received from the EO (or SCP) would be checked to determine whether that II value or one of three "Default II" values shall be forwarded to the IXC.

Benefit

This feature meets the requirements that are part of the FCC Docket for Payphone Compensation (FCC 96i-128). This docket mandates nationwide deployment of Flexible ANI/II functionally to identify calls from certain coin lines for carries requesting this service.

Enhanced ASM-PLUS (541) [4E24] applies only to selective customers who have SCS and ASM-Plus. A detailed feature description and requirements will be provided under separate cover.

CNAR TSG Billing Number Option (547) [4E24] LEC LNP Feature 450 is built on the AIN platform (Feature 375) and is based on the Illinois Generic Requirements for Number Portability. NP introduced a new AIN LNP trigger, and the concept of a Location Routing Number (LRN). The LRN is a ten-digit number (NPA-NXX-XXXX) that uniquely identifies an end-office or rate center within the end office, and is used as a virtual address for the switch serving ported subscribers. LEC LNP also introduced new requirements for AMA in order to support accurate billing and cost recovery. Whenever an LNP query is launched, a Bellcore AMA Format (BAF) module containing the LRN returned by the

SCP is appended to existing AMA records being generated by the switch. This module is also appended to Terminating Access AMA records. For calls crossing network boundaries between two local service providers, a new type of AMA record may be produced at the option of the Service Provider. This new record is know as a Connecting Network Access Record (CNAR) and will be available either for all calls received from the connecting network, or only for those calls resulting in an LNP query. Current rules for population of Originating NPA and Number fields of the CNA record always use ANI if it is available.

This feature will provide a total office CNAR Option to control what information is recorded in the Originating NPA & Originating Number fields of the CAN record as follows:

With the CNAR Option turned on, the Originating NPA & Originating Number will contain:

1. Billing number assigned to the incoming TSG
2. ANI if received and TSG billing number is not available
3. Filled with zeros if neither ANI nor TSG billing number is available.

With the CNAR Option turned off, the existing population rules will apply. The Originating NPA & Originating Number will contain:

1. ANI if received
2. Billing number assigned to incoming TSG if ANI is not available
3. Filled with zeros if neither ANI nor TSG billing number is available.

BENEFIT

Allows the option of recording the billing number associated with the originating carrier vs. the billing number (ANI) of the originating caller, similar to the way Cellular AMA Originating Number is recorded.

TABLES

11

The following tables list available *4ESS* Switch core and optional features, respectively.

The core feature list is arranged by generic, and includes *UNIX*® Real Time Reliable (RTR) Operating System Features.

The optional feature list is arranged by capability, by generic. Optional features typically have a associated Right-To-Use Fee.

In addition, if a Local Exchange Carrier (LEC) feature is included in a Product Release Document (PRD), the PRD generic release number that contains the respective feature is also listed in the tables.

NOTE:
Feature numbers are not applicable to features released in earlier generics.

Core Features

TABLE 11.1 Core Features

GENERIC	FEATURE NAME	PRD REL	FEATURE#
4E0	Audit System		
4E0	Automatic Fault Recognition		
4E0	Automatic Trouble Diagnosis of Major System Components		
4E0	Automatic Trunk Measurements System		
4E0	Call Tracing		
4E0	Carrier Group Alarm		
4E0	Centralized AMA (CAMA)		
4E0	Code Line Tests		
4E0	Control Activation		
4E0	Data Verification		
4E0	Detection of Loss of Memory Integrity		
4E0	Emergency Access Trunks		
4E0	Glare Detection and Resolution		
4E0	Hard-to-Reach Codes		
4E0	Input/Output Facilities		
4E0	Load Balancing		
4E0	Manual Controls		
4E0	Modification of Auto HTR System		
4E0	MultiFrequency and Dial Pulse		
4E0	Network Management Exception Panel		
4E0	Network Manager Machine Interface		
4E0	Off-Line Data Generation		
4E0	Office Data Administration		
4E0	On-Line Data Changes		
4E0	Overload Detection and Control		
4E0	Plant Measurements		
4E0	Problem Investigation		
4E0	Remote Office Test Line		
4E0	Routine Testing of System Components		
4E0	Selective Dynamic Overload Control		

TABLE 11.1 Core Features Continued

GENERIC	FEATURE NAME	PRD REL	FEATURE#
4E0	Selective Trunk Reservation		
4E0	Schedule Capabilities		
4E0	Switched Access Trunk Testing		
4E0	System Initialization		
4E0	Traffic Measurements System		
4E0	Trunk Status		
4E1	CAMA E&M Signaling Trunk Interface		
4E1	Emergency Announcements		
4E1	Emergency Operator Access Circuit		
4E1	Inward and Leave Word Operator Trunk Interface		
4E1	Network Management Exception Panel Improvement		
4E1	No.5 ACD Interface		
4E1	On-Site Operations Report		
4E1	Service Evaluation System Interface		
4E1	Two-Way Operator Trunk Interface		
4E2	Combined Maint Operations Center		
4E2	Direct Inward Dialing to a PBX		
4E2	EADAS/NM		
4E2	Enhanced Traffic & Plant Measurements		
4E2	No-Circuit Indications		
4E2	On-Site Operations Report		
4E2	Recent Change and Verify (RC/V)		
4E2	SDOC and STR Control		
4E2	Software Carrier Group Alarm for CCS Trunks		
4E2	Trunk Maintenance Improvements		
4E2	Vacant Code Analysis		
4E3	Network Switching Performance Measurement Plan		
4E3	Office Dependent Alarms		
4E4	104 Test Line		

TABLE 11.1 Core Features Continued

GENERIC	FEATURE NAME	PRD REL	FEATURE#
4E4	Analog Carrier Group Failure Treatment for E&M Trunks		
4E4	CMS/ESS Trunk Status Audit		
4E4	Dial-Up Port		
4E4	Switching Control Center Interface		
4E4	Verification Network		
4E5	Digital Interface Frame		
4E5	High-Speed I/O		
4E5	Improved I/O to CMS		
4E5	Improved I/O to EADAS/NM		
4E5	Network Management CGC		
4E5	New Traffic and Plant Counts		
4E5	TAN-to-TAN Connection		
4E6	Centralized Work Centers		
4E6	Full Rate Data/PSDC		
4E6	Improved Fault Tolerance		
4E6	No.2 SCCS F-Level Analysis		
4E6	Software Carrier Group Alarm		
4E7	Attached Processor System (APS)		
4E7	Network Management—HTR/ Call Gapping		
4E7	TASI-E Dynamic Load Control		
4E8	AMA Improvements:		
4E8	Domestic Digital Interface Frame		
4E8	Expanded Traffic Separations		
4E8	Spray Reroute		
4E9	Access Charge Recording		
4E9	Digital Interface Frame with MF Signaling		
4E9	Exchange Network Facilities for Interstate Access		
4E9	Large Scale Nail-Up Capability		
4E9	Direct PBX Interface		
4E9	Use of 340-Megabyte Disks [4E9]		
4E10	A/B Bit Signaling Transparency for Nailed-Up Connections		

TABLE 11.1 Core Features Continued

GENERIC	FEATURE NAME	PRD REL	FEATURE#
4E10	AMA Recording Enhancements		
4E10	Busy Tone for Automatic Call Gapping		
4E10	Circuit Switched Digital Capability Improved Access		
4E10	Digital Interface Frame with DTMF Signaling		
4E10	Dynamic Overload Control Time Out Relief (DOCTOR)		
4E10	Fully Coded International Addressing		
4E10	Improved Echo Canceler Treatment		
4E10	Increased Announcement Capacity		
4E10	Remote Maintenance System-D2		
4E10	Trunk Hunt with Memory		
4E11	Improved I/O Interface Feature		
4E11	Network Management Enhancement		
4E11	Noninverting Digital Loopback Test Line		
4E11	Single Trunk Customer Translator		
4E12	Adjunct to Trunk Subgroup Headcell		
4E12	Enhanced 3B20D APS Recovery		
4E12	Enhancement to AMA Audit		
4E12	Frequency Reduction of VPA Tests		
4E12	Miscellaneous Restructuring		
4E12	Network Management Improvements		
4E12	Passing LASS Parameters		
4E12	Populating The TNPA		
4E12	Uniqueness Indicator in ISUP CPN Nature of Address		
4E13	Access Charge Capability for Cellular Mobile Carrier (CMC)		
4E13	Call Irregularity Trap Enhancement		
4E13	Channel Negotiation		
4E13	Dual Direct Link Node (DLN)		
4E13	Fraud Prevention Feature		
4E13	ISUP Transition Items		

TABLE 11.1 Core Features Continued

GENERIC	FEATURE NAME	PRD REL	FEATURE#
4E13	Maintenance Usage Measurement Capability		
4E13	Miscellaneous Routing Changes		
4E13	Network Clock Synchronization Unit Upgrade		
4E13	New Ineffective Machine Attempt Code		
4E13	New Machine Service Report II Count for ANI Failures		
4E13	OA&M Improvements		
4E13	Performance and Capacity Improvements		
4E13	Routing Global Title Translations Based on Service		
4E14	1A Audit Disk Throttling		
4E14	Calling Party Number/ Billing Number Improvements		
4E14	CPN/BN Improvements		
4E14	Digital Test Access for Testing, Operations Provisioning, and Maintenance System		
4E14	Disk Independent Operation		
4E14	DOCTOR Improvements		
4E14	Flexible Assignment of Announcements		
4E14	Handling 10XXX # Cut-through Calls		
4E14	Intra-Network MTP Routing Verification Test (MRVT)		
4E14	Hard-To-Reach Control List Admin		
4E14	International HTR Improvements		
4E14	NetMinder		
4E14	Optional Inclusion of the Routing Indicator Parameter		
4E14	Protocol Upgrades		
4E14	TSG Control Enhancements		
4E15	3B20D Congestion Control		

TABLE 11.1 Core Features Continued

GENERIC	FEATURE NAME	PRD REL	FEATURE#
4E15	Access Charge Verification-(CPN/BN)		880
4E15	ACM with Call Progress w/cause		863
4E15	Call Progress Message		856
4E15	Change Trunk Subgroup W/O Rebuilding		878
4E15	Direct Link Node (DLN) Capacity		
4E15	Eliminaton of Four TR-394 Exceptions		
4E15	Fault Recovery Improvements		
4E15	Message Trap for Outgoing Messages		
4E15	Multiple Point Code LATA Routing		
4E15	NetMinder Interface Improvements		
4E15	Recording of Cause Location		857
4E15	Service Identity Indicator to Originating Line Identity		
4E15	User-to-User Information/ATP		861
4E16	1A Processor Software Change Package Status Message		
4E16	3B SCSI Disk	16R2	219a
4E16	Call Irregularity Report to CONNECTVU		
4E16	Coding Standard Field in Cause Parameter	16R1	122
4E16	CONNECTVU Access to Verify Commands		
4E16	CONNECTVU Low Speed Interface		
4E16	Fast Connect	16R1	084
4E16	Handling Additional TR-394 Exceptions	16R1	121
4E16	Intranet SCCP Routing Verification Test	16R1	126
4E16	OA&M Measurement Enhancements	16R1	086
4E16	Optional Inclusion of RII Parameter		
4E16	Passing of Generic Address Parameter	16R1	085
4E16	Performance/Capacity Improvements	16R1	901
4E16	Real Time Reliable Improvements	16R1	080
4E16	Ten Worst Vacant Code Occurring		
4E16	Time-Out Counts		

TABLE 11.1 Core Features Continued

GENERIC	FEATURE NAME	PRD REL	FEATURE#
4E16	Universal Treatment Code Population for SNPAs		
4E16	Unsuccessful Call Setup Procedures	16R1	919
4E17	3B SCSI Disk-Software Feature	17R1	219b
4E17	Address Complete Message Timeout		376
4E17	Change Under Minimum Billable Call Duration Threshold	17R1	3448
4E17	CNI Software/Hardware Inhibits	17R1	267
4E17	Command-Initiated Link Fault Sectionalization	17R1	136
4E17	Completion of Transmission Path	17R1	156
4E17	Deferred Formatting		
4E17	Digital Signal Zero-A Link Interface	17R1	081
4E17	Disciplined Rubidium Oscillator	16R1	060
4E17	Handling of Confusion Message	17R1	157
4E17	Modified Trunk Subgroup		211
4E17	Preventive Cyclic Retransmission	17R1	083
4E17	SCSI Firmware Download	17R2	374
4E17	TEST:DSIG Parameter Addition	17R2	354
4E17	Trunk Subgroup Interest List for NetMinder	17R2	213
4E18	Machine Service Report2 (MSR-2)	18R1	378
4E18	AMA Functional Program Replacement Feature	18R2	384d
4E18	Call Gapping Enhancements for International		
4E18	Network Traffic Management Support of Alternate Only Overflow Reroute		435
4E18	Terminating Toll Switch Index Decrease	18R1	356e
4E18	Trunk Group of Signaling Bits		430
4E19	CAMA for the LECs	20R3	422

TABLE 11.1 Core Features Continued

GENERIC	FEATURE NAME	PRD REL	FEATURE#
4E19	1B Processor	18R1	139
4E20	1B Processor File Expansion	20R1	3356
4E20	1B Processor File Restructuring	20R1	3356a
4E20	1B Processor ORD:MCCKEY	20R4	440
4E20	3B20D Computer Upgrade From RTR 6.4 Release to RTR 21.7 Rel	20R1	393
4E21	Buffered Recent Change Transition	20R4	437
4E20	Combined AMA Receiver and Formatter	20R1	384c
4E20	Direct Link Node Throughput Increase	20R1	4133
4E20	Explicit 4-Digit CIC Indication for Network Traffic Management	20R2	417
4E20	Increase Number of Final Handling Codes	20R1	384h
4E20	Non-Obtrusive D-Channel Node Pump	20R1	4243
4E20	Software Update Merge	20R1	387
4E21	XTSI, Release 1	21R3	4754
4E21	Increase Gulp Buffer Size		414
4E21	NSR Domain Data Enhancements	21R3	416
4E21	Procedures For MTP Restart	21R1	400
4E21	Program Store Expansion Hardware Growth	21R1	3333a
4E21	RDB List Verify Tool	21R3	4866
4E21	Switched Digital Screening	21R3	4364
4E21	Type of Digital Interface Redefinition	21R1	4099
4E22	XTSI in I/O Messages	22R1	5111
4E22	1B Processor Tape Unit Elimination	22R1	5013
4E22	4ESS Switch DLN IRN2 Upgrade	22R1	4694
4E22	Address Complete Message Timer Extension	22R1	461
4E22	API Capacity Improvements	22R1	5003
4E22	Call Register Restructure		444
4E22	Checksum Macro	22R1	473
4E22	Grow Trunk Subgroup Block		466

TABLE 11.1 Core Features Continued

GENERIC	FEATURE NAME	PRD REL	FEATURE#
4E22	MUP Firmware Upgrade	22R2	469
4E22	Program Store Expansion	22R1	3333
4E22	XTSI Select for Service	22R1	5131
4E22	XTSI Software Update Tool	22R1	5113
4E22	XTSI Rapid Restore	22R3	5505
4E22	XTSI DS1 Performance Monitoring Enhancements	22R2	452
4E22	SCS Software Update Tool	22R4	5563
4E22	SNPA Expansion and HNPA Improvements	22R1	4839
4E22	LEC ODAMANager	22R2	482
4E22	LEC Master Control Console Alarm Enhancement	22R2	474
4E22	XTSI Static A/B Bit Option	22R2	487
4E23	4ESS Switch Year 2000	23R3	476
4E23	Trunk Maintenance (TM) Restructure		490
4E23	Header Validation and Circulation Message Removal	23R1	505
4E23	LEC LNP OA&M Enhancements	23R3	517
4E23	Code Group Restructure	23R1	5898
4E23	4ESS 3B APS Software Upgrade to UNIX RTR 21.17	23R1	478
4E23	Additional LNP OA&M Enhancements	23R3	538
4E23	Backward Code Group Translator	23R3	495
4E23	Enhanced TM Messages	23R3	496
4E23	4ESS I/O Naming Standardization	23R3	5427
4E24	Recent Change Form Metrics Reports	24R1	523
4E24	Recent Change TSG Engineered Limit	24R1	529
4E24	ISUP Digit Storage	24R1	530
4E24	Additional Input to the CRIB	24R1	533
4E24	Service Control Point Interface Modification	24R1	540
4E24	AIN/LNP SCCP Header Validation Reduction	24R1	542
4E24	SCS Cache Change to 128 Milliseconds	24R1	6881

Optional Features

Table 11.2 Optional Features

GENERIC	FEATURE NAME	PRD REL	FEATURE#
	GENERIC FRAMEWORK		
4E17	Disciplined Rubidium Oscillator	17R2	207
4E20	Extended Stores	20R1	3355a
4E21	Extended Stores	21R1	3355
4E23	4ESS Switch 3B21D Attached Processor System Upgrade	23R1	5222
	PERFORMANCE/CAPACITY		
4E17	D-Channel Capacity Increase	17R1	189
4E18	3B20 Conversion to SCSI Disks	18R2	385
4E21	3B20D 2 Gbyte Disk Certification	21R4	457
	NETWORK MGMT		
4E13	Manual CGC Improvements		
4E13	Time Activated Reroute (TARR)		
4E14	Basic 800 Service Improvements		
4E14	Five Minute Usage Data		
4E14	NMDS Page Transfers		
	OA&M		
4E15	Retain Measurement Reports Schedule Across 1A PROC Retrofit		879
4E16	108 Test Line Termination Duration	16R2	262
4E16	Forced Link Node Removal	16R2	090
4E16	Forced Link Node Restart	16R2	198
4E16	Tan-To-Tan with Supervision	16R2	250
4E17	Generic Update Capability	17R2	372
4E18	Ring Node Version Number	18R2	395
4E20	Software Update Automation	20R1	394
4E21	CONNECTVU/4ESS Echoback Interface	21R4	451
4E21	XTSI DS1/DS3 Alarms/MTC Channel	21R4	5041

Table 11.2 Optional Features Continued

GENERIC	FEATURE NAME	PRD REL	FEATURE#
	SIGNALING/NETWORK INTERCONNECT (NI)		
4E9	Access Tandem		
4E11	CNI Ring/D-Channel Node		
4E11	Integrated Services Digital Network		
4E11	SS7 ISDN-UP (ISUP)		
4E13	D-Channel Backup		
4E13	Q.931 Protocol Upgrade ISDN PH 2		
4E14	Access to ISDN via SS7 Network Interconnect		
4E14	Additional Procedures for CPN/BN Delivery at ISC		
4E14	SS7 Call Assoc Network Interconnect		
4E14	SS7 ISUP Protocol Upgrade Issue 3		
4E15	Enhancements and Protocol Upgrades ISDN Ph 4		
4E15	Excessive ISDN Call Setup Delay		858
4E15	Increased Maximum Link Sets		
4E15	Increased Maximum Number of Populated Clusters		
4E15	ISUP Preference Handling		
4E16	ISDN Expanded MA-UUI Length	16R1	911
4E16	Passing Unrecognized ISUP Parameters and Parameter Values	16R1	920
4E16	Q.931 IE Transport Capability	16R1	921
4E17	CCS7/SS7 Discrete and Count		134a
4E17	CNI Performance Measurements		082
4E17	Handling of 3.1 kHz Audio Bearer	17R1	158
4E17	Increased Number of Links in Link Set	17R2	3433
4E17	ISUP OA&M Enhancements	17R1	160
4E17	LEC Multiple Trunk Group Assign	17R2	089
4E17	MTP User Flow Control via Processor Outage		
4E17	MTP Routing Verification Test		278
4E17	Processor Outage (PRO)—Phase 2	17R1	151d

Table 11.2 Optional Features Continued

GENERIC	FEATURE NAME	PRD REL	FEATURE#
	SIGNALING/NI Continued		
4E17	RC of Protocol Timers and Parameters	17R1	094
4E17	Resize Number of Switches Count	17R1	3213
4E17	UCIC Message	17R2	3214
4E18	3.1 kHz Audio Enhancements:Switch/ Trunk Subgroup Option	18R3	408
4E18	Calling Party Number Delivery	20R3	4659
4E18	Carrier Identification Parameter	18R4	406
4E18	DLNE Memory Increase	18R1	239
4E18	Extended Access Links (E-Links)	18R2	344
4E18	FG-D CIC Expansion	18R1	161
4E18	FG-D CIC Exp Cause Transparency	18R2	405
4E18	Full Point Code Routing (FPCR)	18R2	247
4E18	Release Treatment for Calls Received from an IXC with TNS Parameter	18R1	159
4E21	15-Digit International Numbering Plan	21R1	402
4E22	LEC Local Number Portability	22R2	450
4E22	Carrier Identification Parameter Trunk Subgoup Increase	22R3	480
	AUTOMATIC MESSAGE ACCOUNTING		
4E15	Access Charge Recording Enhancement		
4E15	Far End Network Positive Indicator		
4E15	Near RTR of AMA Test Call Records		
4E15	Network Interconnect		
4E15	New Tracer Records		
4E18	SS7 Trunk Interface/Cellular Type 2A	18R3	401
4E20	Svc Count Tracer Records-Unanswered Calls and Mutilated AMA Records	20R2	4317
4E22	CMC SSP/800 and AIN AMA Enhancements	22R4	502

Table 11.2 Optional Features Continued

GENERIC	FEATURE NAME	PRD REL	FEATURE#
	SERVICES		
4E12	LEC Service Switching Point		
4E13	Routing Global Title Translations Based on Service		
4E16	Intra-LATA Seven-Digit Free Calling	16R1	918
4E16	Intra-LATA Switched 384/1536 Kbps	16R1	917
4E17	Emergency Alternate Routing	17R1	165
4E17	Inter-LATA Switched Data Service/ Network Interconnect for PRIs—PH 1	17R3	373
4E18	AIN Default Routing-Phase I	20R1	411
4E18	AIN Dialed Number Triggers and Interactive Announcements	18R2	375
4E18	AIN Trunk Group Routing	18R4	410
4E18	AIN Operator Routing	20R3	421
4E18	Inter-LATA Switched Data Services-PH 2	18R3	333
4E18	Terminating and Interactive Announcements		379
4E18	Toll-Free Treatment for NPA 888	21R1	432
4E19	AIN Dialed Number Trigger Expansion	21R1	442
4E20	AIN Default Routing-Phase II	20R2	415
4E21	AIN 800 Toll Free Capability	21R3	443
4E21	AIN Call Code Provisioning	21R4	467
4E21	AIN Carrier Access Module Setting	21R4	468
4E21	AIN Data Calls	21R4	419
4E21	AT Trunk Trigger and EA AMA Enhancement	21R4	455
4E22	Access Tandem Routing Enhancement	22R4	488
4E23	Enhancement to Feature 488	23R1	488i
4E23	Analyze Ported Number GAP for AIN DNTs	23R3	515
4E23	AIN 6 Digit DNT Expansion	23R3	516
4E23	AIN/LNP Domain Option	23R3	534
4E23	Originating LNP Module AMA Enhancements	23R3	537

Table 11.2 Optional Features Continued

GENERIC	FEATURE NAME	PRD REL	FEATURE#
	ANNOUNCEMENT SYSTEMS		
4E13	Barge-In Revenue Sharing Connect Time		
4E13	Direct Services Dialing Mass Announce		
4E17	Expanded Final Handling Announcements	17R3	3091
4E17	Service Circuit System Core Feature	17R3	3082
4E17	Service Announcements/Digit Collection		
4E18	ASM—Plus	18R2	386
4E18	Multiple 4E Network Announcements	18R3	4232
4E18	Service Circuit System 4GB Disk Drive	18R3	404
4E21	Automatic Speech Recognition on the Service Circuit System		4183
4E21	SCS UN351 Board Redesign	21R3	456
4E22	Automatic Speech Recognition on the Service Circuit System-Phase 2	21R4	4801

Abbreviations and Acronyms

A

ACC
Automatic Congestion Control

ACD
Automatic Call Distributor

ACG
Automatic Call Gapping

ACH
Attempts Per Circuit Hour

ACM
Address Complete Message

ACP
Action Control Point

ACPN
Analyze Called Party Number

ACU
Automatic Calling Unit

ACV
Access Charge Verification

ADC
Address Complete

ADG
Automatic Distribution Group

AHC
Adjunct Head Cells

AIM
Application Integrity Monitor

AIN
Advanced Intelligent Network

ALSR
Alternate Link Set Routing

ALT
Alternate Routed

AMA
Automatic Message Accounting

ANI
Automatic Number Identification

ANM
Answer Message

ANSI
American National Standards Institute

AOC
Abbreviated Order Code

AOOCR
Automatic Out of Chain Routing

AP
Attached Processor

API
Attached Processor Interface

APS
Attached Processor System

ASM
Announcement Systems Manager

ASR
Automatic Speech Recognition

AT
Access Tandem

ATME
Automatic Test Maintenance Equipment

ATMS
Automatic Transmission Measuring System

ATMS
Automatic Trunk Measurements System

ATP
Access Transport Parameter

B

BANCS
Bell Administrative Network Communication System

BCI
Backward Call Indicator

BCIP
Backward Call Indicator Parameter

BEC
Basic Error Correction

BN
Billing Number

BOS
Bit Oriented Signaling

BTFN
Basic Traffic Number

BWM
Broadcast Warning Message

C

CA-TSC
Call-Associated Temporary Signaling Connection

CAMA
Centralized Automatic Message Accounting

CAROT
Centralized Automatic Reporting on Trunks

CARTS
Circuit Assignment Records Transfer System

CCH
Continuity Check Indicator

CCIS
Common Channel Interoffice Signaling

CCITT
The International Telegraph and Telephone Consultative Committee

CCPAS
Customer Calls to Public Announcement Systems

CCR
Continuity Check Request

CCS
Common Channel Signaling

CCS
Hundred Call Seconds

CCS7
Common Channel Signaling No. 7

CDO
Community Digital Office

CdPN
Called Party Number

CDR
Call Detail Recording

CDSU
Custom Data Services Unit

CF
Cancel-From

CG
Cell Group

CGC
Call Gapping Control

CGC
Circuit Group Congestion

CHI
Call Handling Instructions

CI
Carrier Identity

CI
Carrier Interconnect

CI-LFS
Command-Initiated Link Fault Sectionalization

CIC
Customer Information Center

CID
Customer Identification

CIN
Circuit Identification Number

CINMAP
Circuit Identification Name Map

CIP
Carrier Identification Parameter

CLB
Clear Backward

CLF
Clear Forward

CLI
Calling Line Identification

CMC
Cellular Mobile Carrier

CMOC
Combined Maintenance Operations Ctr

CMS
Circuit Maintenance System

CMS-1A
Circuit Maintenance System 1A

CNI
Common Network Interface

COLP/R
Connected Line Identification Presentation/Restriction

CPE
Customer Premise Equipment

CPG
Call Progress

CPN
Calling Party Number

CPR
Common Program Release

CR
Call Register

CRM
Circuit Reservation Message

CRT
Cathode Ray Tube

CS
Call Store

CSDC
Circuit Switched Digital Capabilities

CSI
Carrier Selection Information

CSU
Call Store Unit

CSU
Channel Signaling Unit

CT
Cancel-To

D

D-STR
DNHR Selective Trunk Reservation

DCN
D-Channel Node

DDCMP
Digital Data Communication Message Protocol

DDD
Direct Distance Dialing

DESEP
Destination Separation

DIF
Digital Interface Frame

DIF-D
Domestic Digital Interface Frame

DIF-E1 [DTMF]
Digital Interface Frame with DTMF Signaling

DIF-E1 [MF]
Digital Interface Frame with MF Signaling

DIOP
Disk Independent Operation

DIR
Direct

DIU
Digital Interface Unit

DLC
Dynamic Load Control

DLN
Direct Link Node

DLNE
Direct Link Node Enhanced

DMA
Direct Memory Access

DNHR
Dynamic Non-Hierarchical Routing

DNT
Dialed Number Trigger

DOC
Dynamic Overload Control

DOCTOR
Dynamic Overload Control Time Out Relief

DP
Dial Pulse

DPC
Destination Point Code

DRO
Disciplined Rubidium Oscillator

DS0A
Digital Signal Zero-A Link

DSC
Digital Services Control

DSD
Direct Services Dialing

DSDC
Direct Services Dialing Capability

DSDMA
Direct Services Dialing Mass Announcement

DSU
Data Store Unit

DT
Digroup Terminal

DTA
Digital Test Access

DTAT
Digital Test Access Trunk

DTMF
Dual-Tone MultiFrequency

E

EADAS/NM
Engineering and Administrative Data Acquisition System/Network Management

EAEO
Equal Access End Office

EAMF
Equal Access MultiFrequency

EAS
Equal Access Signaling

EB
Extended Bus

EBAF
Extended Bellcore AMA Format

EC
Echo Canceler

ECD
Equipment Configuration Database

ECS
Extended Call Store

EIB
Extended Internal Bus

EIT
Equipment Interface Tier

ENFIA-C
Exchange Network Facilities for Interstate Access

EO
End-Office

EPROM
Erasable Programmable Read-Only Memory

ERAP
Error Analysis Program

ES
Echo Suppressor

EST
Echo Suppressor Terminal

EXEC
Executive Store

F

FAR
Far Building Subdivision

FCI
Forward Call Indicator

FECC
Far End Country Code

FEN
Far End Network

FENCLASS
Far End Network Class

FG
Feature Group

FGC
Feature Group C

FGD
Feature Group D

FH
Final Handling

FHC
Final Handling Code

FHT
Final Handling Treatments

FPCR
Full Point Code Routing

FRJ
Facility Reject Message

G

GAP
Generic Address Parameter

GB
Gigabit

H

HDRN
High Density Ring Node

HMI
Human-Machine Interface

HNPA
Home Numbering Plan Area

HTR
Hard-to-Reach

I

I/O
Input/Output

IAM
Initial Address Message

IAT
Integrated Access Terminal

IC
Inter-LATA Carrier

ICDR
International Call Detail Recording

IDAM
INSEP-DESEP Addressing Matrix

IDDD
International Direct Distance Dialing

IDDD-TC
International Direct Distance Dialing Teleconferencing

IE
Information Element

IEC
Interexchange Carrier

IFB
Interface Bus

IFT
Improved Fault Tolerance

ILDS
International Long Distance Service

IMA
Ineffective Machine Attempts

IMS
Interprocessor Message Switch

INA
Ineffective Network Attempt

INC
International Carrier

INF
Information

INR
Information Request

INSEP
Incoming Separation

INUP
International ISDN-User Part

INWATS
Inward Wide Area Telecommunication Svc

IOC
International Operating Center

IOP
Input/Output Processor

IOTC
International Originating Toll Center

IRN2
Integrated Ring Node No.2

IRO
International Reorder

ISAIC
Improved Service Announcements and Information Collection

ISC
International Switching Center

ISDN
Integrated Services Digital Network

ISDS
International Switched Digital Services

ISS
Improved Switch Surveillance

ISTS
International Switched Transit Service

ISUP
ISDN User Part

ITAMAC
International Traffic and Maintenance Analysis of Calls

ITSGN
Incoming TSG Number

IUC
International Unauthorized Code

IVC
International Vacant Code

IWCC
INWATS Control Code

IXC
Interexchange Carrier

K

KW
KiloWords

L

LAN
Local Area Network

LASS
Local Area Signaling Services

LATA
Local Access and Transport Area

LBRV
Low Bit Rate Voice

LDIG
Language Digit

LDR
Load Distribution Report

LEC
Local Exchange Carrier

LEC SSP
LEC Service Switching Point

LFS
Link Fault Sectionalization

LNP
Local Number Portability

LRN
Location Routing Number

LSNC
Large Scale Nail-up Capability

LSP
Load Set Period

LSR
Load Service Report

M

MA-UUI
Message Associated User-to-User Information

MAC
Machine Administration Center

MAS
Mass Announcement Service

MB
Megabyte

MC1
Low Level DOC System Congestion Signal

MC2
Middle Level DOC System Congestion Signal

MC3
Highest Level DOC System Congestion Signal

MCC
Maintenance Control Console

MCS
Message Command System

MF
MultiFrequency

MFS
MultiFrequency Signaling

MLSS
Machine Load and Service Summary

MOC
Maintenance Operations Center

MP
Maintenance Processor

MPR
Machine Performance Report

MRVT
MTP Routing Verification Test

MSN
Miscellaneous Scan

MSR
Machine Service Report

MTP
Message Transfer Part

MTS
Message Telecommunications Service

MTS
Multiple Treatment Screening

MTTY
Maintenance Teletyprwriter

N

NANPA
North American Numbering Plan Area

NC
No Circuit

NCA
No Circuit Announcement

NCA-TSC
Non-Call-Associated Temporary Signaling Connection

NCAT
Non-Call Associated Trunks

NCP
Network Control Point

NCSU
Network Clock Synchronization Unit

NDMI
Network Digital Multiplexed Interface

NEBS
Network Equipment Building Standard

NHR
Non-Hard-to-Reach

NI
Network Interconnect

NM
Network Management

NMC
Network Management Center

NMDS
Network Management Display System

NMDT
Network Management Display Terminal

NN
National Number

NNC
National Network Congestion

NOC
Network Operations Center

NPA
Numbering Plan Area

NPL
Network Planning Letter

NS
Number Services

NSCS
Network Service Center System

NSCU
Network Clock Synchronization Unit

NSCX
Network Services Complex

NSD
No Start Dial

NSN
National Significant Number

NSR
Network Services Routing

NST
Network Support Tier

NTM
Network Traffic Management

O

OA&M
Operations, Administration, and Maintenance

OBAT
Operator Bridged Access Trunk

OCC
Outgoing Call Completions

ODA
Office Data Assembler

ODD
Office Dependent Data

OFL
Off-Line

OGT
Outgoing Trunk

OLI
Originating Line Identity

ONI
Operator Number Identification

OOS
Out-of-Service

OSO
Originating Screening Office

OSOR
On-Site Operations Report

OSPS
Operator Services Position System

OTS
Originating Toll Switch

OUTWATS
Outward Wide Area Telecommunications Service

P

PAS
Public Announcement System

PBX
Private Branch Exchange

PCC
Per Call Control

PCIS
Per Channel Inhibit Signaling

PCM
Pulse Code Modulation

PCR
Preventive Cyclic Retransmission

PECC
Product Engineering Control Center

PNG
Ported Number GAP

POP
Point-of-Presence

POTS
Plain Old Telephone Service

PRD
Product Release Document

PRI
Primary Rate Interface

PRT
Proportional Routing

PS
Program Store

PSDC
Public Switched Data Capability

PSE
Program Store Expansion

PSN
Public Switched Network

PTS
Proceed To Send

PUB
Peripheral Unit Bus

PUBB
Peripheral Unit Bus Branching

PUC
Peripheral Unit Control

PVN
Private Virtual Network

Q

QPE
Q.931 Protocol Errors

R

RAF
Recorded Announcement Frame

RAO
Revenue Accounting Office

RBRR
Rate Based Reroute

RC
Recent Change

RC/V
Recent Change/Verify

RDB
Routing Data Block

RDBI
Routing Data Block Index

REL
Release

RII
Routing Information Indicator

RMAS
Remote Memory Access System

RNMS
Regional Network Management System

ROA
Reorder Announcement

ROC
Regional Operations Center

ROP
Read Only Printer

ROTL
Remote Office Test Line

RPF
Receive Path Failure

RSC
Reset Circuit

RSM
Remote Switch Modules

RTR
Real Time Reliable

S

SAC
Service Access Codes

SAPN
Slave Application Number

SCAR
Stable Call Accumulation Register

SCC
Service Circuit Controller

SCC
Switching Control Center

SCCP
Signaling Connection Control Part

SCCS
Switching Control Center System

SCGA
Software Carrier Group Alarm

SCP
Service Control Point

SCP
Software Change Package

SCS
Service Circuit System

SCSI
Small Computer System Interface

SCU
Service Circuit Unit

SDOC
Selective Dynamic Overload Control

SEP
Signaling End Point

SES1
Service Evaluation System Interface

SID
Station Identification

SIF
Signaling Information Failure

SII
Service Identity Indicator

SINT
Software Initialization

SK
Skip

SLS
Signaling Link Selection

SMD
Single Moving Disk

SNPA
Served Numbering Plan Area

SP
Signal Processor

SPC
Stored Program Control

SPC
Switching and Permuting Circuits

SPRR
Spray Reroute

SRVT
SCCP Routing Verification Test

SS7
Signaling System 7

SSP
Service Switching Point

STC
Single Trunk Customer

STP
Signal Transfer Point

STR
Selective Trunk Reservation

SU
Software Update

SWATS
Switched OUTWATS

T

TAGS
Trunk Assignment Generation System

TAN
Trunk Appearance Number

TARR
Time Activated Reroute

TASI
Time Assignment Speech Interpolation

TAT
Test Access Trunk

TC
Teleconferencing

TCAP
Transaction Capability Application Part

TCM
Traveling Class Mark

TDG
Type of Di-Group

TDIU
Type of Digital Interface Unit

TDN
Time Division Network

TFN
Traffic Number

TG
Translation Guide

THW
Type of Hardware

TLP
Trouble Locating Procedures

TMS
Time Multiplexed Switch

TNPA
Terminating Number Plan Area

TNS
Transit Network Selection

TOC
Trunk Operations Center

TOSS
Teleconferencing Operator Support System

TPF
Transmit Path Failure

TR
Tone Receiver

TSC
Temporary Signaling Connection

TSG
Trunk Subgroup

TSI
Time Slot Interchange

TSI-B
Time Slot Interchange-B

TSPS
Traffic Service Position System

TTSI
Terminating Toll Service Indices

TTY
Teletypewriter

TUC
Tape Unit Controller

TUP
Telephone User Part

U

UCIC
Use and Handling of Unequipped Circuit Identification Code

UCT
Universal Coordinated Time

UFC
User Flow Control

UMCD
Under Minimum Billable Call Duration

USI
Universal Services Indicator

UTC
Universal Treatment Code

UUI
User-to-User Information

UUS
User-to-User Signaling

V

VIF
Voiceband Interface Frame

VIU
Voiceband Interface Unit

VLMM
Very Large Main Memory

VPA
Voice Path Assurance

VPN
Virtual Private Network

VTOC
Volume Table of Contents

VTS
Via Toll Switch

W

WATS
Wide Area Telephone Service

WCS
Windowed Call Store

WS
Wink Start

WZ1
World Zone 1

X

XM
Extended Memory

XS
Extended Store

XTSI
Expanded Time Slot Interchange

Index

#

A

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