555-4001-106

Meridian SuperNode

Meridian SL-100

ISDN Primary Rate Interface Reference Manual

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NORTEL NETWORKS™

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Contents

About this document

When to use this document

This document describes the applications that can be provided and engineered for the Primary Rate Interface (PRI) connection between a Meridian SuperNode switch and a wide variety of other systems, including Local Exchanges and other Private Branch Exchanges (PBX). Specifically, this document discusses how to provide service for PRI, that is, how to apply PRI to a network.

This document also provides the additional information needed to engineer PRI on an ISDN digital trunk controller (DTCI) or ISDN line trunk controller (LTCI), as well as enhancements offered by DTCI and LTCI, notably the Integrated Trunk Access (ITA) feature. (The ITA feature allows both PRI and non-PRI trunks to be configured on a single DS-1 of the DTCI.)

The purpose of this document is to describe how two Meridian SuperNode switches work together to provide the following:

- end-to-end service for the user
- engineering information for PRI between Meridian SuperNode switches
- provisioning information of DS-1 options on the PRI Interface
- performance analysis of PRI

How to check the version and issue of this document

The version and issue of the document are indicated by numbers, for example, 01.01.

The first two digits indicate the version. The version number increases each time the document is updated to support a new software release. For example, the first release of a document is 01.01. In the *next* software release cycle, the first release of the same document is 02.01.

The second two digits indicate the issue. The issue number increases each time the document is revised but rereleased in the *same* software release cycle. For example, the second release of a document in the same software release cycle is 01.02.

To determine which version of this document applies to the software in your office and how documentation for your product is organized, check the release information in *Master Index of Publications*.

References in this document

The following documents are referred to in this document:

- *Automatic Message Accounting-Northern Telecom Format*, 297-1001-119,
- *Network Management System Reference Manual*, 297-1001-453
- *Bellcore Format Automatic Message Accounting (AMA) Maintenance Guide*, 297-1001-570
- *Trunks Maintenance Guide*, 297-1001-595
- *Menu Commands Reference Manual*, 297-1001-821
- *Commands Reference Manual*, 297-1001-822
- *Bellcore Format Automatic Message Accounting Reference Guide*, 297-1001-830
- *Integrated Services Digital Network Basic Rate Interface Maintenance Guide*, 297-2401-501
- *Integrated Services Digital Network Primary Rate Interface Maintenance Guide*, 297-2401-502
- *M5317T and CustomNet ISDN Telephone Installation Guide Appendices*, 297-2451-211A
- *Digital Trunk Interface/Computer-to-PBX Interface Maintenance Guide*, 553-2811-500
- *ISDN PRI Description and Administration*, 553-2901-100
- *Customer Data Schema*
- *Log Report Reference Manual*
- *Operational Measurements Reference Manual*
- *Translations Guide*
- *NT-NI Primary Rate User-Network Interface Specification*, NIS-A233-1

The following International Telecommunication Union-Telecommunication Standardization Sector (ITU-T) recommendations are referred to in this document:

- I.411 “ISDN User-Network Interfaces-Reference Configurations", 1984
- I.430 “Basic User-Network Interfaces-Layer 1 Specification", March 1993
- Q.920 “Digital Subscriber Signalling System No. 1 (DSS 1)-ISDN User-Network Interface Data Link Layer-General Aspects", 1993
- Q.921 “ISDN User-Network Interface-Data Link Layer Specifications", March 1993

- Q.930 “Digital Subscriber Signalling System No. 1 (DSS 1)-ISDN User-Network Interface Layer 3-General Aspects", March 1993
- Q.931 “Digital Subscriber Signalling System No. 1 (DSS 1)-ISDN User-Network Interface Layer 3-Specifications for Basic Call Control", March 1993
- X.200 “Reference Model for Open Systems Interconnection for CCITT Applications"

The following Bellcore publications are referred to in this document:

- TR-NWT-001268, “ISDN Primary Rate Interface Call Control Switching and Signaling Generic Requirements for Class II Equipment", Issue 1, revision 4, March 1998
- TR-NWT-001270, “Generic Requirements for ISDN PRI Call-By-Call Service Selection for Non-ISDN Foreign Exchange Facilities, Non-ISDN Tie Trunks, OUTWATS, and INWATS", Issue 1, May 1998; Bulletin 1, December 1993; and Bulletin 2, January 1995
- SR-3887, “1997 Version of National ISDN Primary Rate Interface Customer Premises Equipment Generic Guidelines", Issue 1, Revision 1, June 1997

The following Nortel Networks publications are referred to in this document:

- NIS A211-1, “ISDN Primary Rate User-Network Interface Specification", Release 6, March 1994
- NIS A233-2, “ISDN Primary Rate User-Network Interface Specification", Standard 02.01, May 1997

What precautionary messages mean

The types of precautionary messages used in Nortel Networks documents include attention boxes and danger, warning, and caution messages.

An attention box identifies information that is necessary for the proper performance of a procedure or task or the correct interpretation of information or data. Danger, warning, and caution messages indicate possible risks.

Examples of the precautionary messages follow.

ATTENTION Information needed to perform a task

ATTENTION

If the unused DS-3 ports are not deprovisioned before a DS-1/VT Mapper is installed, the DS-1 traffic will not be carried through the DS-1/VT Mapper, even though the DS-1/VT Mapper is properly provisioned.

DANGER Possibility of personal injury

DANGER

Risk of electrocution

Do not open the front panel of the inverter unless fuses F1, F2, and F3 have been removed. The inverter contains high-voltage lines. Until the fuses are removed, the high-voltage lines are active, and you risk being electrocuted.

WARNING Possibility of equipment damage

DANGER

Damage to the backplane connector pins

Align the card before seating it, to avoid bending the backplane connector pins. Use light thumb pressure to align the card with the connectors. Next, use the levers on the card to seat the card into the connectors.

CAUTION Possibility of service interruption or degradation

CAUTION

Possible loss of service

Before continuing, confirm that you are removing the card from the inactive unit of the peripheral module. Subscriber service will be lost if you remove a card from the active unit.

How commands, parameters, and responses are represented

Commands, parameters, and responses in this document conform to the following conventions.

Input prompt (>)

An input prompt (>) indicates that the information that follows is a command:

```
>BSY
```

Commands and fixed parameters

Commands and fixed parameters that are entered at a MAP terminal are shown in uppercase letters:

```
>BSY CTRL
```

Variables

Variables are shown in lowercase letters:

```
>BSY  CTRL  ctrl_no
```

The letters or numbers that the variable represents must be entered. Each variable is explained in a list that follows the command string.

Responses

Responses correspond to the MAP display and are shown in a different type:

```
FP 3 Busy CTRL 0: Command request has been submitted.

FP 3 Busy CTRL 0: Command passed.
```

The following excerpt from a procedure shows the command syntax used in this document:

Manually busy the CTRL on the inactive plane by typing

>BSY CTRL ctrl_no

and pressing the Enter key.

where

ctrl_nois the number of the CTRL (0 or 1)

Example of a MAP response:

FP 3 Busy CTRL 0: Command request has been submitted.

FP 3 Busy CTRL 0: Command passed.

1 Introduction

This document is a Primary Rate Interface (PRI) applications handbook for PBX telecommunications. It provides a mixture of references and procedures for PRI specifics built on the existing DMS product family, as well as detailed information introduced on the Meridian SuperNode system for PRI.

Primary rate interface

ISDN PRI is a standardized architecture for the interface between a customer's equipment and the public network. PRI is composed of two elements:

- PRI protocol
  - — Layer 1 (DS-1)—electrical, synchronization, and framing
  - — Layer 2 (LAPD)—packetization, error detection, and flow control
  - — Layer 3 (Q.931)—protocol messages used in call control
- services provided over a PRI facility; for example, integrated service access (ISA) trunk selection

PRI supports B-channels for circuit-switched voice and data calls. It supports out-of-band call control over a 56 or 64 kbit/s D-channel. PRI also provides the interface within a corporate network for basic call and networked business services.

The logical capabilities of PRI provide an architecture for continued evolution in networked business services, operations, and maintenance.

The physical characteristics of PRI provide a standardized, all-digital interface that supports a powerful message-oriented, out-of-band signaling protocol, Q.931. Q.931 is capable of providing telephony, data, and supplementary services.

Figure 1-1 shows the connectivity provided by ISDN PRI. Figure 1-2 shows how a PBX, such as a Meridian SuperNode switch, connects to the telecommunications network by means of an ISDN PRI.

Figure 1 PRI between Meridian SuperNode switches

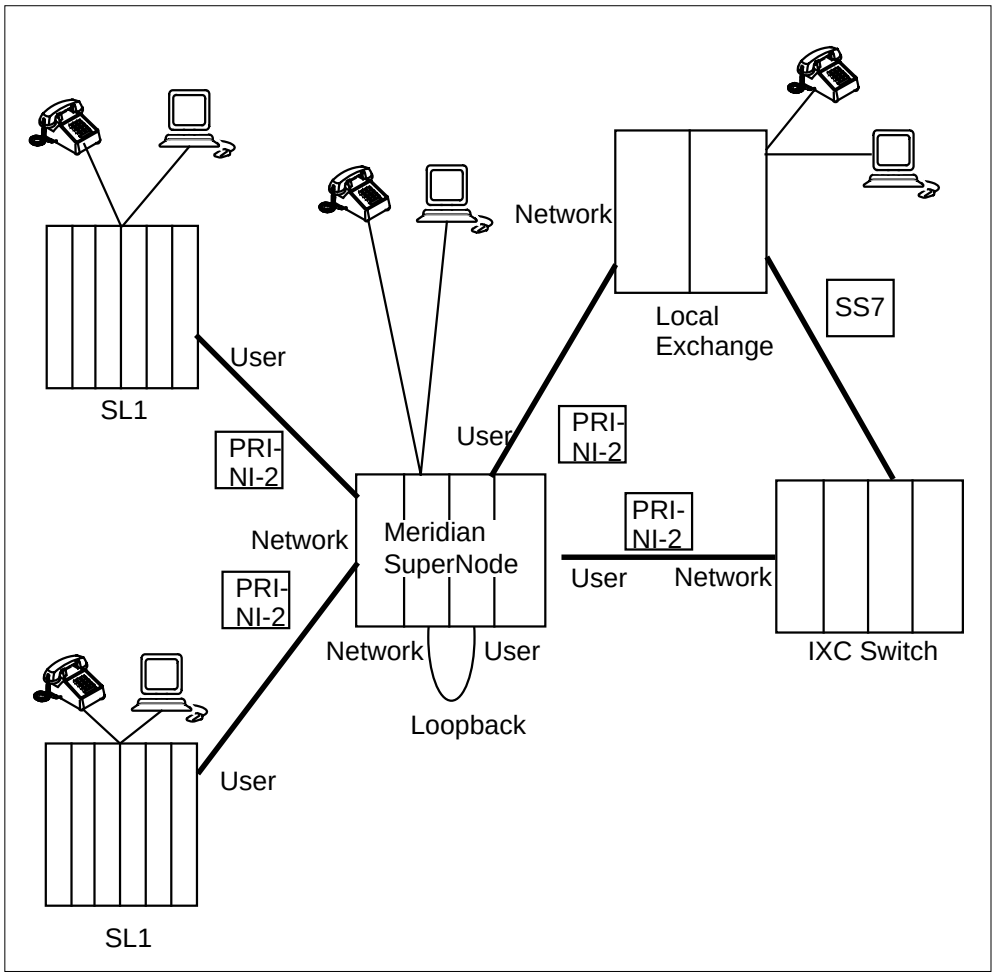
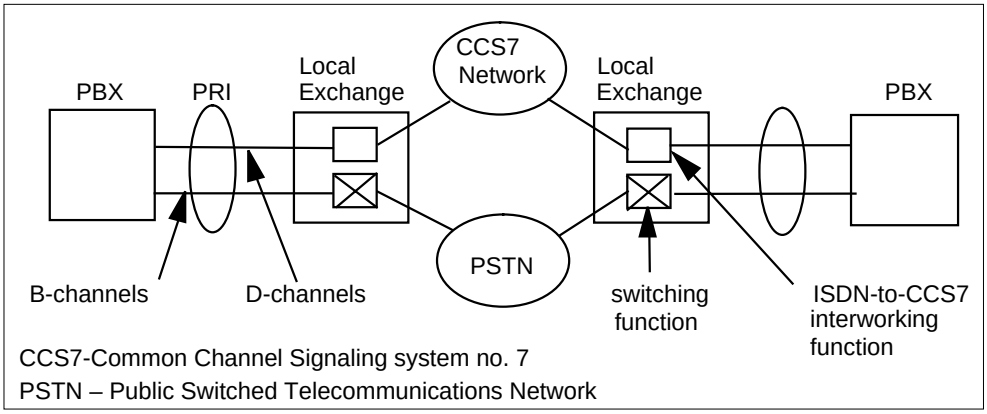


Figure 2 PRI between PBX and PSTN

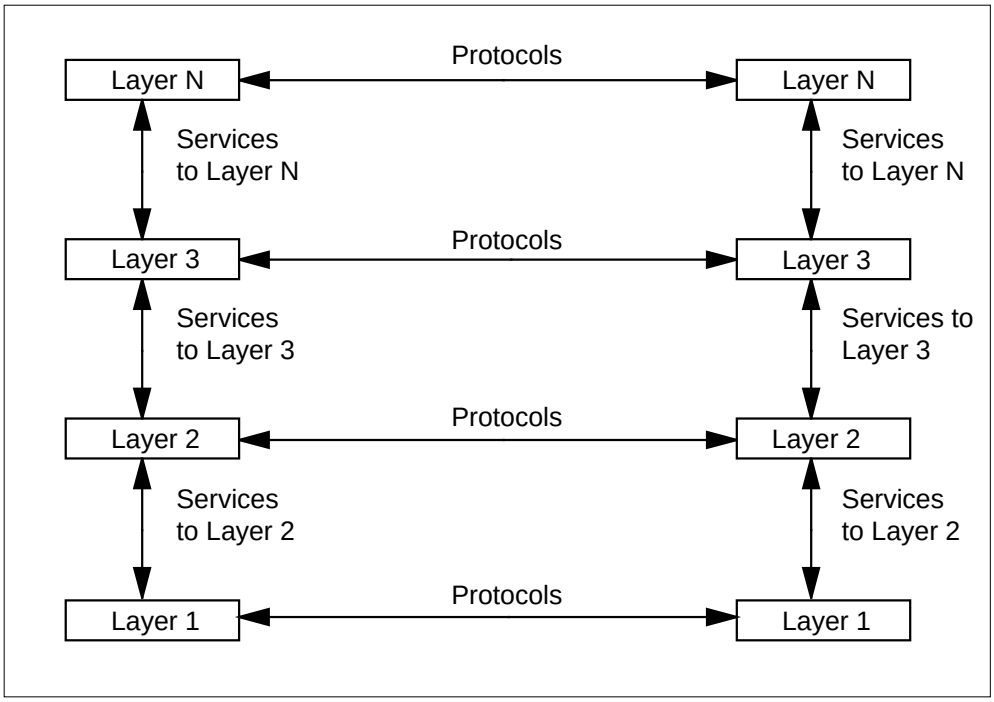


Protocol view

A set of protocols govern the format, timing, sequencing, and control for the exchange of data and control information between two terminal stations that are connected through an ISDN network or communications channel.

These protocols are based on a model containing seven layers of protocols developed by the International Standards Organization (ISO). This seven-layer model, called the Open Systems Interconnection (OSI) model, was adopted by the International Telecommunication Union-Telecommunication Standardization Sector (ITU-T) and is used as the basis for building protocol structures for ISDN service. See the following figure.

Figure 3 Structure of layered protocols



Each protocol layer uses a series of services provided by a lower-numbered layer. Each layer uses the lower layer services to perform a communications function and to provide a series of services for the layer above it. This layered approach to structure splits the complex protocols into a series of easily managed blocks, each of which can be modified without affecting protocols in another layer. The following lists the seven layers of protocols and their associated functions:

- Layer 1 (physical)—concerned with the transmission of unstructured bit stream over physical medium; deals with the mechanical, electrical, functional, and procedural characteristics to access the physical medium.
- Layer 2 (link)—provides for the transfer of information across the physical link; sends blocks (frames) with the necessary synchronization, flow control, and error control
- Layer 3 (network)—provides upper layers with independence from the data transmission and switching technologies used to connect systems; responsible for establishing, maintaining, and terminating connections
- Layer 4 (transport)—provides transparent transfer of data between end points; provides end-to-end error recovery and flow control
- Layer 5 (session)—provides the control structure for communication between applications; establishes, manages, and terminates connections (sessions) between cooperating applications

- Layer 6 (presentation)—provides independence to the application processes from differences in data representation (syntax)
- Layer 7 (application)—provides access to the OSI environment for users and also provides distributed information services

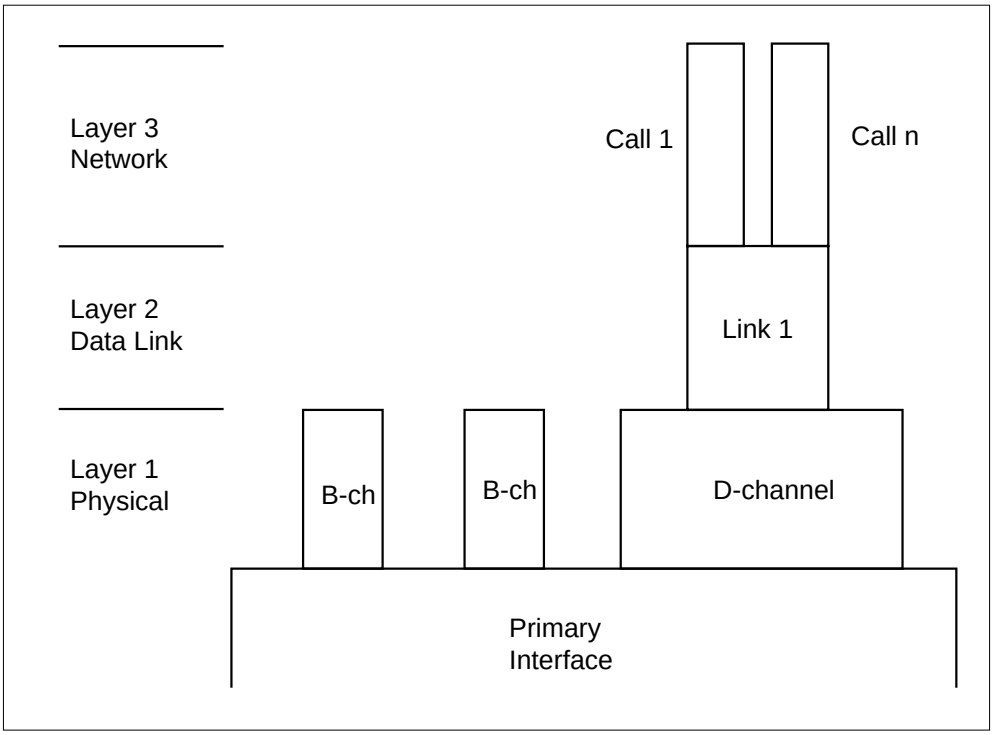
Layers 1 through 3 govern connection setup and the transmission of information between terminals on a loop and the packet-switched and circuit-switched networks. (ISDN protocol implements only the lowest three layers.) Protocols in these three layers can be thought of as a series of pipes, as shown in the following figure.

Layer 1 provides the physical pipe for primary access, which contains the multiple B-channels and one D-channel used for transmitting information.

Layer 2 provides pipes on the D-channel in the form of logical data links. These links join terminals on the loop to points that provide access to packet-switched service or circuit switched service.

Layer 3 provides protocols that are used to establish, maintain, and clear one or more calls over one or more B-channels. For PRI, one data link between the terminal and the network handles multiple calls at Layer 3.

Figure 4 Layers of ISDN protocols

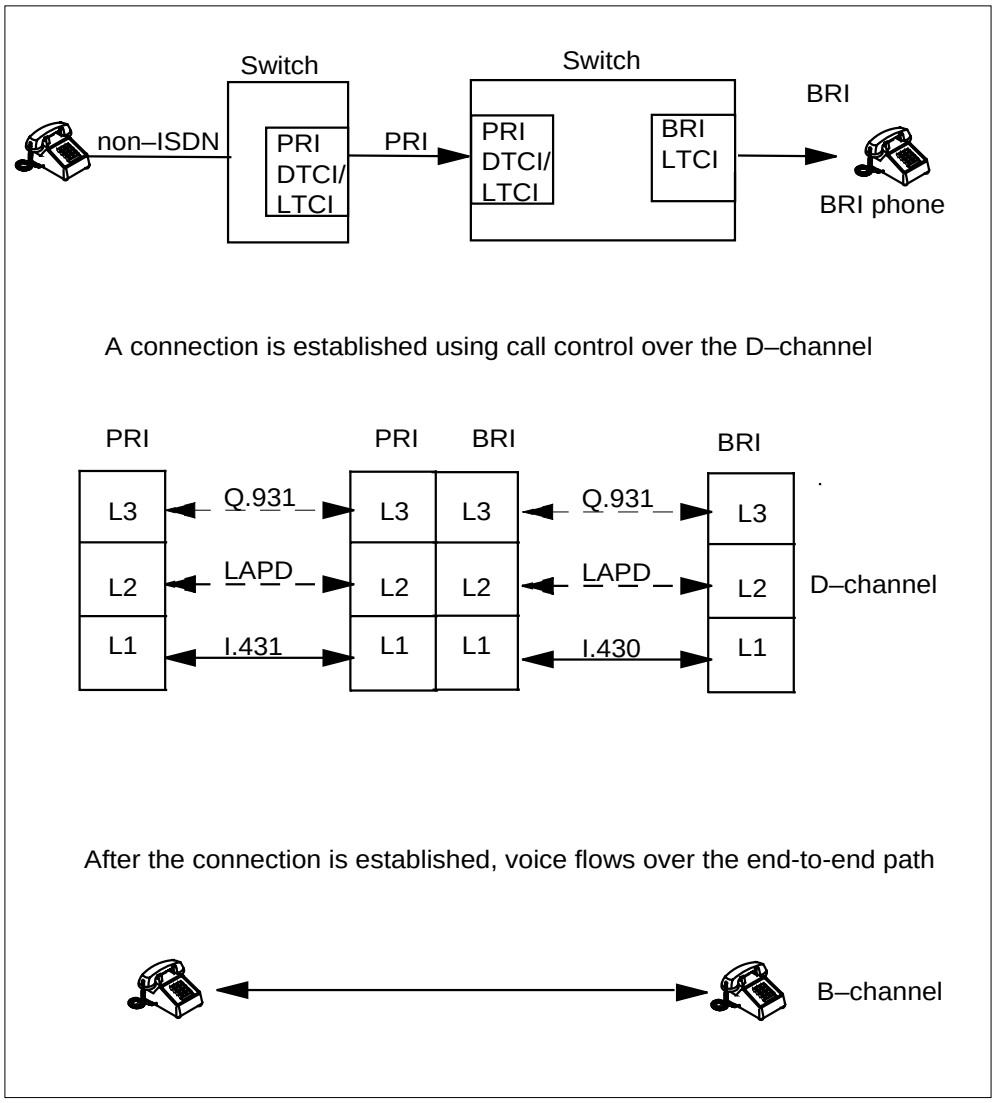


Note: Data transfer between two ISDN terminals on the B-channel may involve Layer 2 and higher layer protocols. Such protocols are transparent to the network.

Different types of protocols are used on B-channels. The X.25 network layer protocol is used on B-channels only for transmission of packet data. Speech and circuit-switched data on a B-channel do not require a network layer protocol. These types of data are considered to be raw information operating at the physical layer.

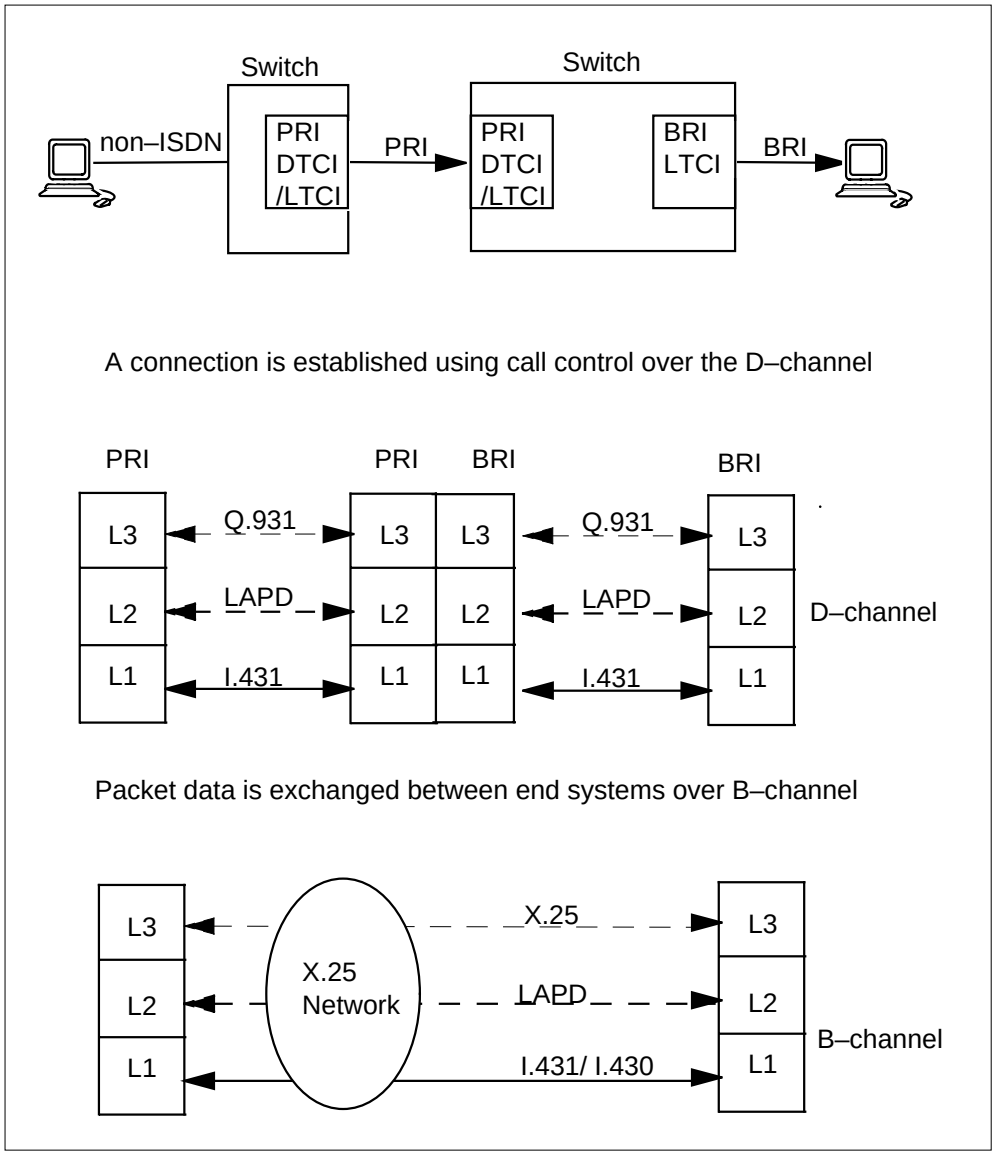
The following figure shows the data flow in voice communication.

Figure 5 Data flow in voice communication



The following figure shows the data flow in data communication.

Figure 6 Data flow in data communication



Layers 4 through 7 govern the transmission of signaling information that occurs between two terminals on ISDN loops after connections through the network have been set up. For information on these four layers, refer to ITU-T X.200, “Reference Model for Open systems Interconnection for CCITT Applications".

An ISDN network is described in ITU-T Recommendation I.411 in terms of functional groups and reference points. Functional groups specify the type of function that is implemented by a particular piece of equipment. These

descriptions apply to arrangements of equipment on the customer's premises that are used to provide ISDN access.

Functional groups

There are six functional groups. They are as follows:

- Terminal equipment, type 1 (TE1)
- Terminal equipment, type 2 (TE2)
- Terminal adapter (TA)
- Network Termination, type 1 (NT1)
- Network Termination, type 2 (NT2)
- Exchange Termination (ET)

The following paragraphs describes each of these functional groups

Terminal equipment, type 1 (TE1)

Terminal equipment, type 1 (TE1) is an ISDN-compatible device used to perform a communication function. This could be a telephone (for voice communication, a computer (for data communication), or an integrated device providing both voice and data functions. This type of device operates at Layer 1 (physical), Layer 2 (data link), and Layer 3 (call control) of the ISDN protocol.

Terminal equipment, type 2 (TE2)

Terminal equipment, type 2 (TE2) is a device that performs functions identical to those of TE1 devices except the TE2 device does not communicate by means of the ISDN protocol. Examples of TE2 devices include terminals that communicate using RS-232, X.25, analog or proprietary signaling methods.

Terminal adapter (TA)

Terminal adapter (TA) is a device that adapts a non-ISDN TE (TE2) to an ISDN interface. A TA converts the communication protocol that the TE2 uses on its transmit side to ISDN for transmission toward the ISDN network and converts ISDN from the network to the communication protocol received by the TE2. This type of device operates at Layer 1 (physical), Layer 2 (data link), and Layer 3 (call control) of the ISDN protocol.

Network Termination, type 1 (NT1)

Network Termination, type 1 (NT1) is a device that provides termination and conversion of the signaling format used between the Exchange Termination and the equipment on the customer's premises. This type of device operates at the physical layer only.

Network Termination, type 2 (NT2)

Network Termination, type 2 (NT2) is a device that performs multiplexing and switching of information streams to and from different TEs and protocol handling at Layer 2 (data link), and Layer 3 (call control). Examples of devices with NT2 functionality include PBXs, LAN devices (bridges and routers, cluster terminal controllers, and time-division multiplexers.

Exchange Termination (ET)

The functions provided by the physical attachment to the Local Exchange. This includes signal generation, frame alignment, alarm generation and detection, and maintenance functions.

Reference Points

The R reference point is the demarcation point between non-ISDN TE2 and their TAs.

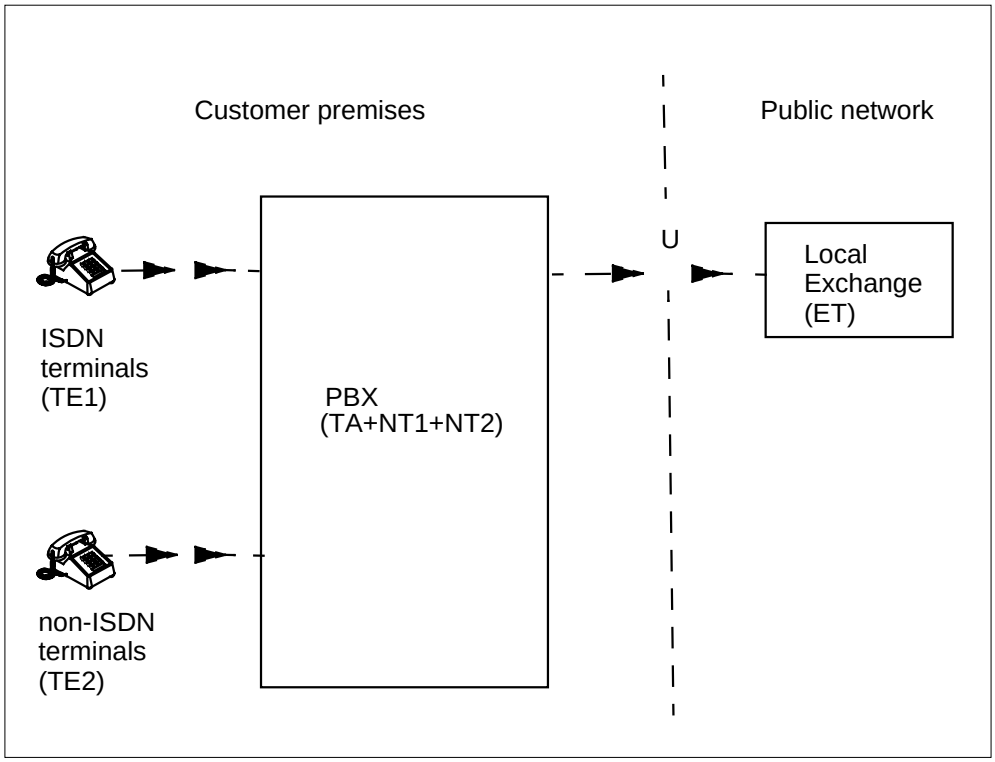
The S reference point is the demarcation point between ISDN-compatible TE1 or TAs and the NT2.

The T reference point marks the interface between NT1 and NT2 when these functions are provided by different entities. In the case where there is no device providing NT2 functionality on the customer's premises, the S and T reference points coincide. In the case where a device (such as a PBX) combines both the NT1 and NT2 functions, the T reference point can be considered internal to that device.

The U reference point marks the boundary between the NT1 and the Exchange Termination. This type of interface at the U reference point is not specified by the ITU but left to the network service provider. In North America, there are two physical layer interfaces used at the U reference point: one for Basic Rate access and one for Primary Rate access.

There is a wide variety of possible arrangements of functional blocks and reference points, depending on the type of equipment in use on the customer's premises. These arrangements are described in detail in ITU-T Recommendation I.411. The following figure shows the arrangement that best represents the role of the Meridian SuperNode switch in an ISDN network.

Figure 7 Role of an Meridian SuperNode switch in an ISDN network



In its role as an ISDN PBX, the Meridian SuperNode switch combines the functions of the NT1, NT2, and TA functional blocks.

As an NT1 device, the Meridian SuperNode switch interfaces to the ET at the Local Exchange by way of the T1 interface standard, which is the physical layer interface standard for ISDN Primary rate Interfaces in North America. The Meridian SuperNode switch also contains line cards with integrated NT1 functionality; the line cards allow ISDN BRI terminals to connect directly to the PBX.

As an NT2 device the Meridian SuperNode switch performs switching of voice and data between TEs on the customer's premises and switching of voice and data between the customer's premises and the central office.

As a TA, the Meridian SuperNode switch provides interfaces to a variety of non-ISDN terminal types, including analog telephones, proprietary digital telephones, LANs, X.25 terminals, and low-speed (for example, RS-232) data communication devices.

Layer 1 (physical) protocols

The physical layer for the DS-1 interface is described in ITU-T Recommendation I.431, which defines physical characteristics of the physical transmission medium.

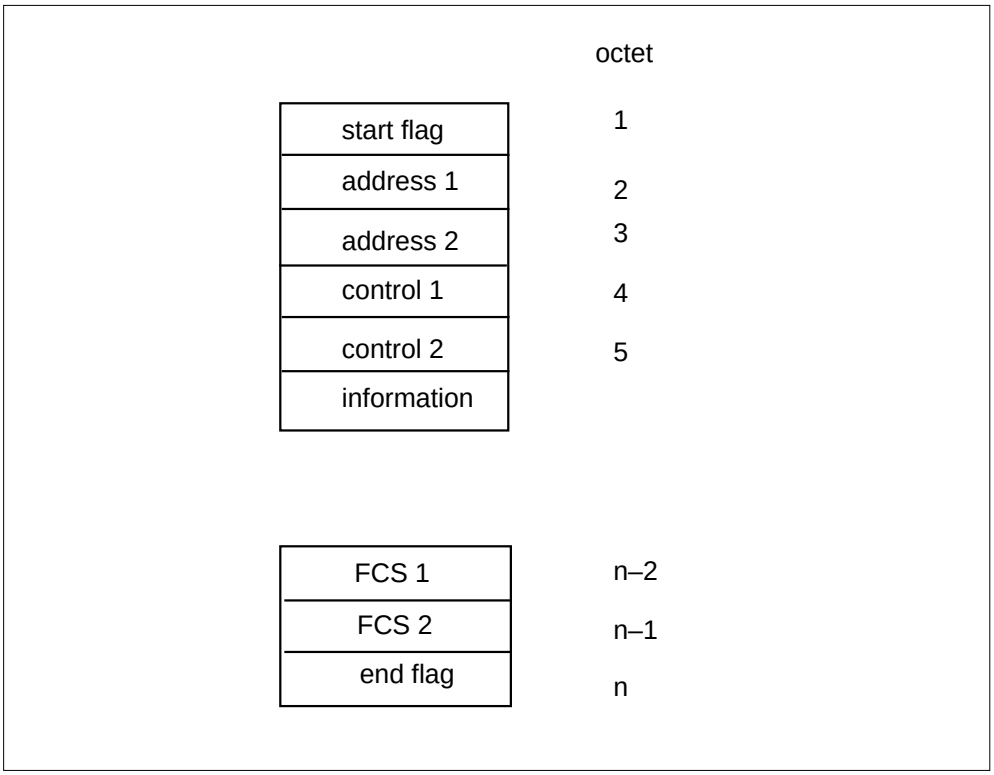
Layer 2 (link) protocols

Link Access Procedure on the D-channel (LAPD)/Q.921 is a protocol that is used for carrying signaling on D-channels of ISDN access interfaces. The following sections briefly describe their functions.

LAPD

The protocol that is used at Layer 2 in ISDN is the Link Access Procedure on the D-channel (LAPD). This protocol is specified in ITU-T Recommendation Q.921 (I.441). The LAPD protocol provides a structure for the exchange of data between systems. This structure consists of packets or frames. Each packet is a sequence of 8-bit data called octets. Each octet has a different function depending on its location within the packet. The following figure shows the general format of the packet structure.

Figure 8 LAPD frame format



The start flag and the end flag are a special bit pattern (01111110) that identifies the beginning or end of a packet. When a data link is idle (no packets are being sent,), only flags are transmitted.

The address octets consists of the following three parts:

- Terminal Endpoint Identifier (TEI)
- Service Access Point Identifier (SAPI)
- the command/response (C/R flag)

The TEI provides a means for addressing individual terminals on a multi-station link. This is used on BRI interfaces only. PRI does not support multiple stations per link. Therefore this field is always set to 0.

The SAPI provides access to individual Layer 3 protocol service access points; that is, it identifies the particular protocol to which the octets in the information field are being communicated. Only a few service points are defined. PRI only supports the Q.931 Layer 3 call control protocol (SAPI 0); therefore this part of the address field is always set to 0.

The C/R flag identifies the direction of the message (user-to-network or network-to-user).

The control octets consist of a command/response field that identifies different data link operations, and send and receive sequence number fields for performing flow control. The data link operations specified by the command/response field are

- SABME (set asynchronous balanced mode extended). This command is used to establish the data link.
- DISC (disconnect). This command is used to released the data link
- UA (unnumbered acknowledge). This response is used to acknowledged a request to establish or release a data link
- DM (disconnected mode). This response is used to inform the other side of the data link that information frames cannot be accepted. In order to exchange information frames, a link establishment operation must be performed
- RR (received ready). This command/response is used to indicate that the link is capable of receiving frames. RR frames are typically exchanged during periods of idleness after the link has been established.
- RNR (receive not ready). This command/response indicates that the link is temporarily not able to receive information frames

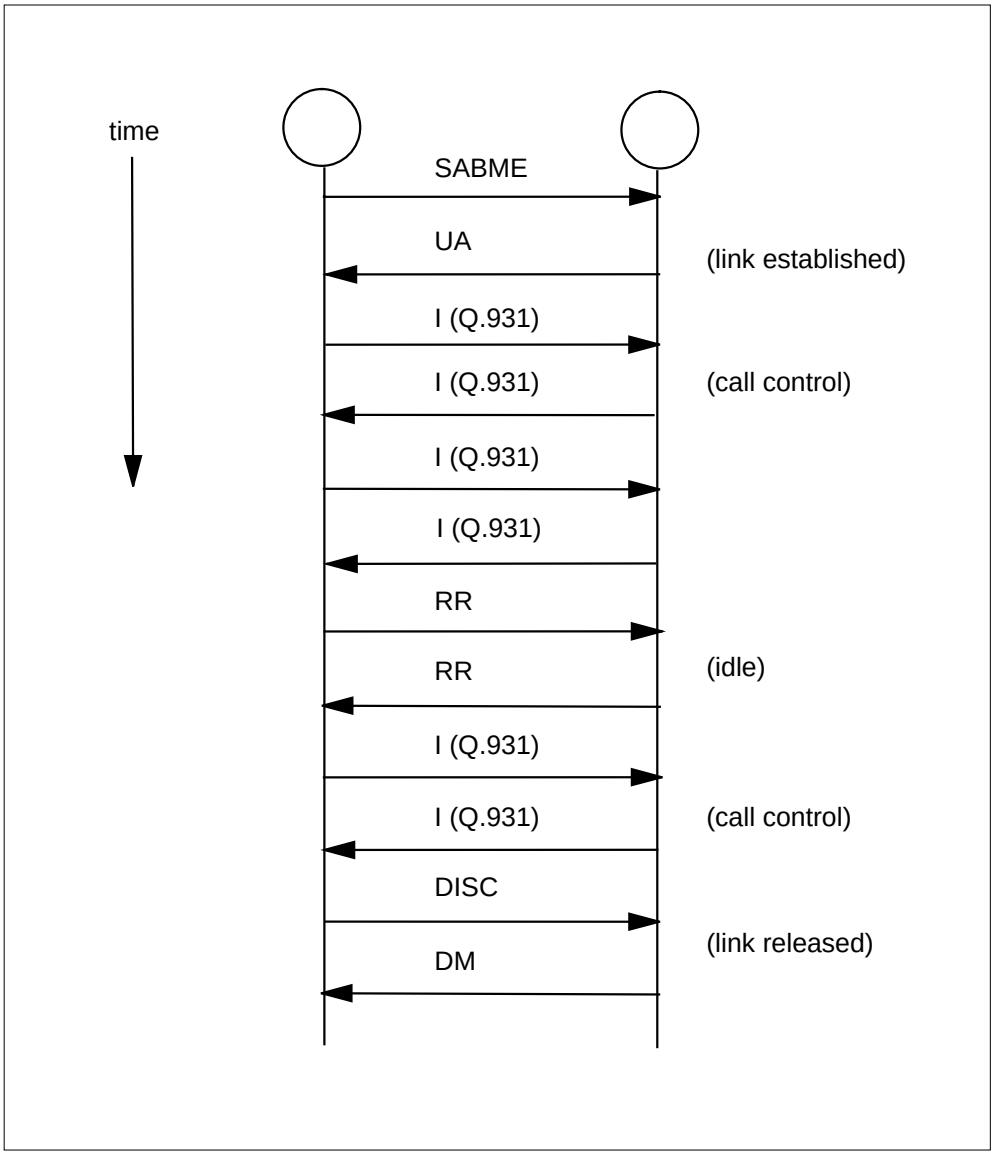
- REJ (reject). This command/response is used to request that the other side of the data link retransmit one or more frames.
- I (information). This command indicates that an information field containing Layer 3 data is present in the data link message

The information field contains the Layer 3 message octets. This field is not present in data link frames that are used for establishing or releasing the data link.

The FCS is used for error detection and correction. When a data link entity transmits a message, it calculates a cyclic redundancy check on the contents of the message that results in a 2-octet value. This value is placed in the FCS field. When a data link entity receives a message it performs the same check and compares its FCS value to the FCS contained in the message. If the two are not identical, one or more bit errors has occurred on the data link. Typically, this error is corrected on the receiving side by using a REJ frame to request the retransmission of all frames that have been sent, beginning with the frame in error. In this manner, the data link layer provides a reliable message transmission capability for Layer 3 messages.

The following figure shows the typical operation of a data link on the D-channel. First the data link is established, then mostly information frames containing Layer 3 call control messages are exchanged. During periods of inactivity, RR frames are exchanged. Once established, the data link tends to remain in this state. The only reason a DISC-DM sequence would occur is in response to a manual command to deactivate the link, such as occurs during a D-channel SWACT.

Figure 9 Typical operation of a data link on a D-channel



PRI uses only point-to-point logical links and supports the following functions:

- establishing a logical link
- transferring information
- releasing a logical link
- establishing and clearing a logical link used for transmitting call control messages
- establishing and clearing logical links for transmitting high-speed packet data over a B-channel
- controlling the sequence of messages transmitted over a channel
- detecting errors occurring on transmission media (Layer 1) and recovery from these errors

B-channel, packet data

A link is only established on a B-channel for the transmission of packet data between a terminal on a loop and the packet-switched network. From the ET's point of view, B-channel packet data is treated as raw information because it is transferred directly to the packet handler (PH) through permanent connections in the time switch in the ISDN digital trunk controller (DTCI) or ISDN line trunk controller (LTCI).

For links established on the B-channel, the type of protocol used is called Link Access Procedure Balanced (LAPB).

B-channel, circuit-switched data or speech

No link is established on a B-channel by a link access procedure for transmitting circuit-switched speech/data. The bits carried on the B-channel contain raw pulse code modulated (PCM) or user data information.

For circuit-switched data on a B-channel, the Meridian SuperNode switch provides a clear 64-kbit/s channel only if Bipolar 8 Zero Substitution (B8ZS) signaling is used. Otherwise, if Alternate Mark Inversion (AMI)/2B1Q/Zero Code Suppression (ZCS) signaling is used, the maximum data rate is 56 kbit/s. The use of a link layer protocol on the B-channel is dependent on the two ISDN terminals connected.

Layer 3 (network) protocols

Layer 3 of the ISDN protocol suite is the call control protocol. The call control protocol is used for establishing and clearing calls and performing various subsidiary functions. It is specified in ITU-T Recommendations Q.930 (general aspects) and Q.931 (detailed specifications). The call control protocol

consists of a set of messages and a set of procedures. The messages are transmitted in the information field of data link layer (LAPD) frames. Each message specifies a unique function. Each Q.931 message is composed of information elements (IE). The number, type, and content of the IEs vary from message to message. The following is a list of messages in the Q.931 protocol that are used on Primary Rate Interfaces. A partial list of IEs follows this list.

SETUP

This Q.931 message is sent from the originating switch to request the establishment of a call. It includes IEs such as Bearer Capability and Called Party Number that completely specify the location of the terminating party and type of service.

CALL PROCeeding

This Q.931 message is sent to the originating switch in response to a SETUP message in order to provide confirmation that the SETUP message has been received and that facilities are available to complete the call.

ALERTing

This Q.931 message is sent to the originating switch to indicate that ringing is occurring at the Called Party

CONNect

This Q.931 message is sent to the originating switch to indicate that the Called Party has answered and an end-to-end connection has been established

CONNect ACKnowledge

This Q.931 message is sent from the originating switch to acknowledge the receipt of the CONNect message

PROGress

This Q.931 message is sent in response to a SETUP to indicate delay in establishing the call. Typically, this message is sent when a switch encounters interworking with non-ISDN facilities (for example, analog or PTS trunks, which require a greater amount of time to outpulse dialed digits than ISDN trunks do).

DISConnect

This Q.931 message is sent to request clearing (termination) of a call.

RELease

This Q.931 message is sent in response to a DISConnect message to acknowledge that call clearing has occurred.

RELease COMplete

This Q.931 message is sent in response to a RELease message to indicate the completion of call clearing.

RESTart

This Q.931 message is used to request the re-initialization of a physical facility. An individual trunk (B-channel), all trunks on a DS-1, or the entire PRI can be specified. If there is an active call on the specified facility of the switch receiving a RESTart message, the call is terminated.

RESTart ACKnowledge

This Q.931 message is sent in response to a RESTart message to indicate that the requested facility has been re-initialized.

STATus ENQuiry

This Q.931 message is sent to request the status of a particular item at the remote side. Typically, it is used to request the state of a call (active or inactive) after a maintenance event, such as the switching of a backup D-channel into service.

STATus

This Q.931 message is sent in response to a STATus ENQuiry message in order to provide the requested information.

SERVice

This maintenance message is sent to inform the remote switch of the current state (in-service or out-of-service of a particular facility [trunk or D-channel]).

SERVice ACKnowledge

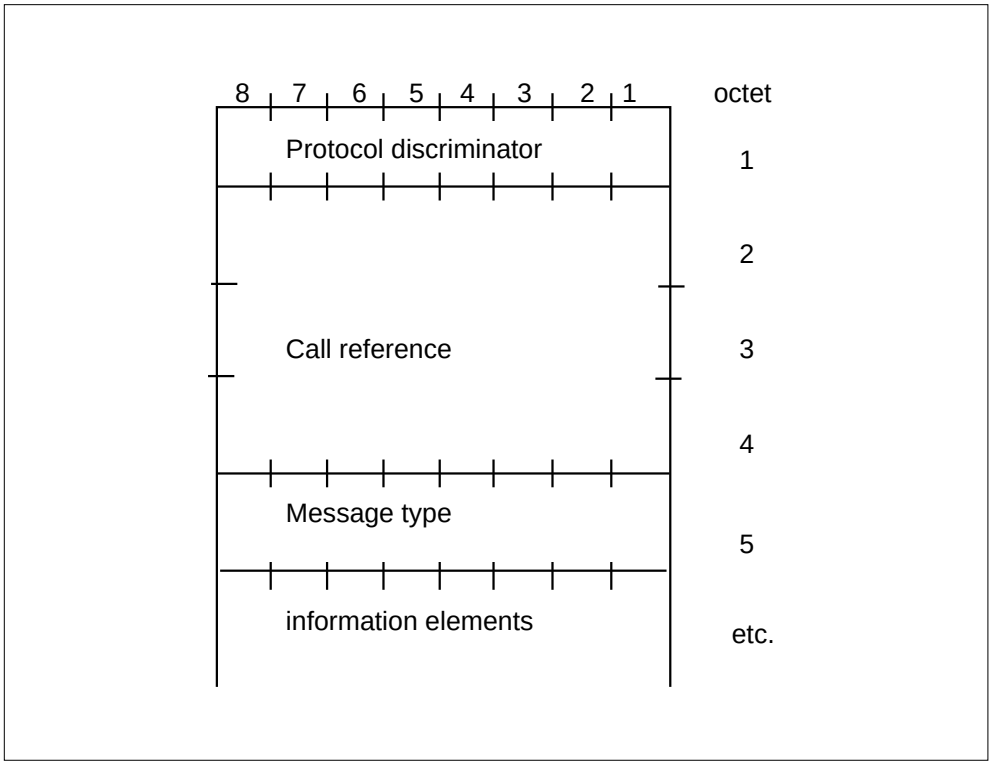
This maintenance message is used both to acknowledge the receipt of a SERVice message and to report the state of the same facility on the side sending the SERVice ACKnowledge.

ISDN Layer 3 Message Structure

Messages are composed of a Protocol Discriminator field, a Call Reference field, a message type field, and a set of Information Elements (IE). The number and type of IEs that are included in a particular message varies from message to message with some IEs being mandatory and some optional. In turn, IEs are sequences of octets.

The following figure shows the general information of Q.931 messages.

Figure 10 General format of Q.931 messages



Mandatory fields in all ISDN layer 3 messages

Protocol discriminator

The protocol discriminator is always the first octet of any ISDN Layer 3 message. It identifies the type of Layer 3 message. There are two Protocol Discriminators used in ISDN Layer 3 messages. The binary values and their meaning are

- 00001000-Q.931 call control message
- 01000011-maintenance message

Call reference (CR)

Each time a call is initiated over an ISDN facility, a unique random number (Call Reference) is allocated by the originating switch and assigned to that call. The Call Reference is included in all call control messages that are exchanged between switches and is used by both ends of the ISDN facility to identify the particular call to which a given message applies. The Call Reference is deallocated when the call is completed. For maintenance messages and restart messages that do not pertain to a particular call, the Global Call Reference (0) is used.

Message type

The message type identifies the particular message (SETUP, RESTart, etc.).

Mandatory information in Q.931 SETUP messages

Type of number and Numbering Plan Identifier (TON/NPI)

The TON/NPI field is part of the Called Party Number and Calling Party Number information elements. It identifies the format of the digits contained in those information elements.

There are four permissible combinations for the TON/NPI field in the

NIPRI (NI-2) protocol. They are

- local directory number/E.164 (7 digits)
- national number/E.164 (10 digits)
- international number/E.164 (up to 15 digits)
- unknown number/unknown numbering plan

The NTNA protocol provides for a fifth TON/NPI that is not allowed in NIPRI: subscriber number/private numbering plan.

Bearer capability (BC)

Bearer capability enables telephone switches to restrict communication between terminals. Depending on the BC associated with a terminal and how compatibility is set up, terminals may or may not be allowed to talk to each other.

Five BCs are supported on the Meridian SuperNode switch: speech, 64-kbits per second unrestricted, 64-kbits per second restricted, 56-kbits per second unrestricted, and 3.1 kHz audio.

Channel identification (CID)

The channel identification consists of the interface number and B-channel selected. The interface number defines which DS-1 link is used, and the B-channel number is the channel number within the DS-1 link.

Optional information in Q.931 SETUP message

Calling party number (CPN)

The CPN is the 10-digit public address of the calling party. The CPN is used to identify the calling party to the destination switch.

Progress indicator (PI)

The progress indicator describes events that may affect the handling of a call:

- Call is not end-to-end ISDN—The connection from source to destination includes a non-ISDN per trunk signaling (PTS) trunk.
- In-band information is now available—An event has occurred that must be retold to the originator of the call. When this information cannot be sent out of band on the D-channel, the information is sent as a treatment on a B-channel.

Network-Specific Facilities (NSF)

The NSF information element is used to identify or request a variety of services beyond those provided by a basic call. These include access to tie trunk and foreign exchange (FX) facilities, INWATS and OUTWATS service, interexchange carriers (IXC), and competitive local exchange carriers (CLEC).

Cause

Cause IE is included in some messages to identify the cause of the event. For example, a DISConnect message might contain a cause ID indicating “Normal Call Clearing".

DTCI overview

The DTCI is an enhanced version of the existing DTC peripheral. The DTCI and the DTC have the same hardware configuration, except that the DTCI must be equipped with an ISDN signaling preprocessor (ISP) card and the DTCI does not support the special tone receiver (STR) card. The DTCI, like the DTC, can accommodate up to 20 DS-1s. The DTCI also supports the Warm switch activity (SWACT) capability. (Note that the ISP also goes through a Warm SWACT along with the other processors resident on the DTCI.)

The DTCI does not support SS7 (that is, CCS7 ISUP) trunks.

Integrated trunk access

The DTCI supports provisioning of both PRI and non-PRI (that is, AB-bit) trunks. This type of access arrangement is termed Integrated Trunk Access (ITA). It means that a single DS-1 is provisioned with both PRI and non-PRI trunk types, with alterations to tables LTCINV and TRKSGRP.

LTCI overview

The LTCI is a peripheral module that combines the services of the line group controller (LGC) and the digital trunk controller (DTC). The LTCI connects DS30 links from the network to Line Concentrating Modules (LCMs). It also connects DS30 links from the network to digital trunk circuits.

The LTCI supports ISDN signaling.

2 DS-1 (Layer 1) configuration

This section provides an overview of DS-1 engineering between two Meridian SuperNode switches.

For the purposes of PRI, the DS-1 can be thought of as a collection of 24

DS-0s. Each DS-0 is used as one of the following:

- PRI B-channel
- PRI D-channel
- provisioned (nailed-up) channel

On NTNA-PRI, the D-channel can be in any DS-0 channel. However, by convention it is assigned to channel 24.

On NI-2 PRI (NIPRI), the D-channel can be placed on DS0 channel 24 of the DS-1.

DS-1 hardware configuration

Figure 2-1 shows the ISDN digital trunk controller (DTCI) and ISDN line trunk controller (LTCI) frame layout and Table 2-1 gives a detailed view of the DCTI and LTCI configuration. Both the DTCI and the LTCI support up to 10 NT6X50AB (or NT6X50AA) DS-1 cards, which are equivalent to 20 DS-1 links (480 DS-0s). It is recommended that the DTCI and the LTCI be equipped with NT6X50AB cards, as these cards can support both 56-kbit/s and 64-kbit/s (clear and restricted) data rates.

When NTNA provisioning is used, the D-channel can be in any DS-0 channel. However, by convention it is assigned to channel 24.

When NI-2 provisioning is used, only one D-channel can be assigned to a DS-1 and it may be assigned to DS0 channel 24 only.

Figure 2-1 DTCI and LTCI shelf configuration (front view)

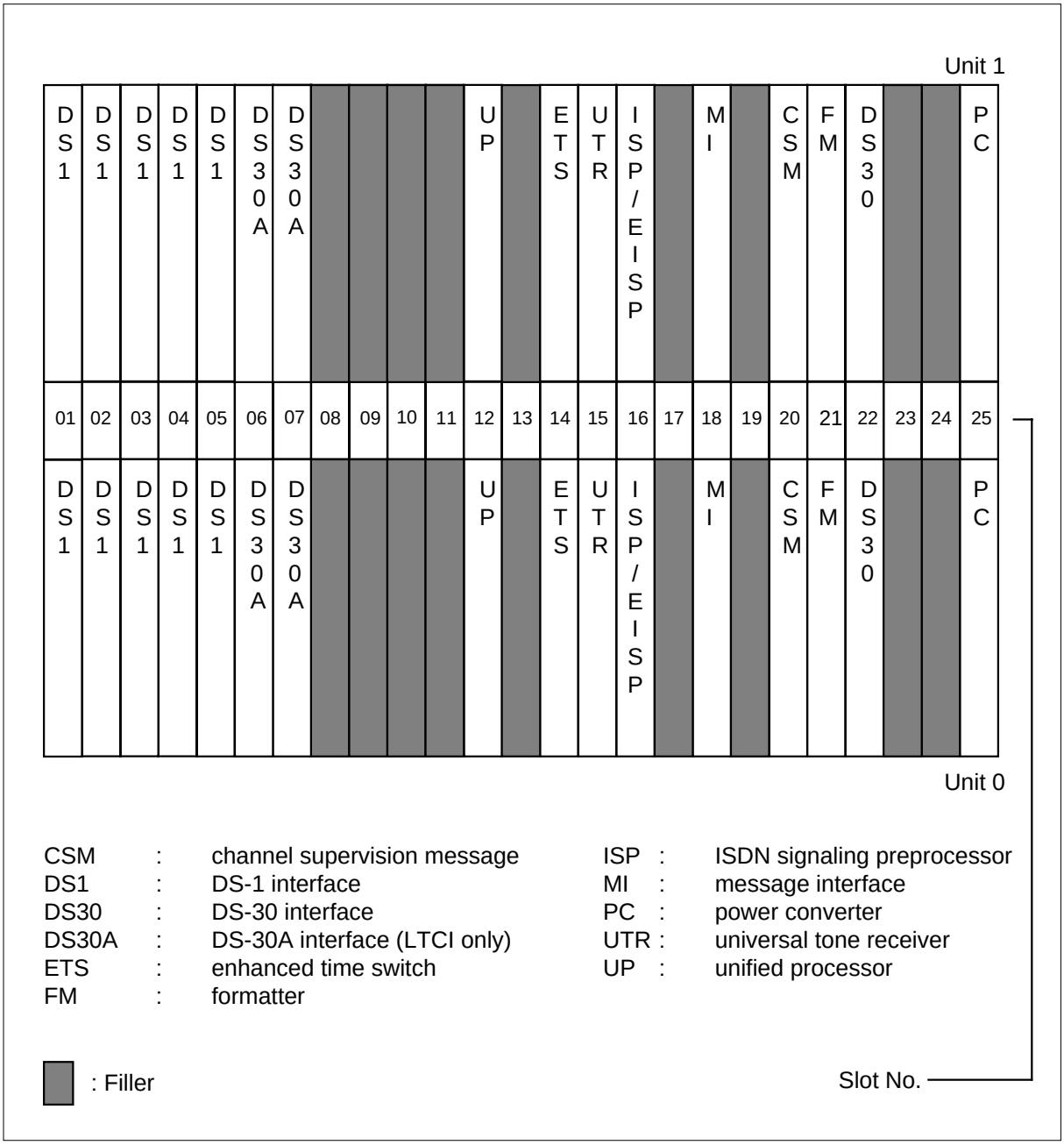


Table 2-1 DTCI and LTCI card description

Slot	Abbreviation	NT PEC	Remarks
01-05	DS1	6X50AA or 6X50AB	DS-1 Interface. Each shelf supports up to 5 DS-1 cards (up to 10 per DTCI). Each shelf requires a minimum of 1 card.
06-07	---	DS30A	DS30A interface (LTCI only)
08	---	0X50AA	filler panel
09	---	0X50AA	filler panel
10	---	0X50AA	filler panel
11	---	0X50AA	filler panel
12	UP	MX77AA	unified processor
13	---	0X50AA	filler panel
14	ETS	AX78AA	enhanced time switch
15	UTR	6X92BC	universal tone receiver
16	ISP	BX01AB	ISDN signaling preprocessor
17	---	0X50AA	filler panel
18	MI	6X69MA	message interface
19	---	0X50AA	filler panel
20	CSM	6X42AA	channel supervision message card
21	FM	6X41AA	formatter
22-23	DS30	6X40FA	DS-30 interface (8-port)
22	---	0X50AA	filler panel
24	---	0X50AA	filler panel
25	PCONV	2X70AE	power converter

DS-1 commissioning

Frame formats

The DS-1 basic format consists of twenty-four 8-bit bytes (1 byte per channel) and 1 framing bit (F-bit) for a total of 193 bits per frame. In addition

- The nominal bit rate of the DS-1 signal is 1.544 Mbits per second.
- The sampling rate for each channel is 8000 Hz.
- The twenty-four 8-bit bytes are identified consecutively from the frame bit as time slots 1 through 24.
- A pattern is placed in the framing bit to identify the location of the signaling frame.
- Channel framing identifies the location of time slot one. The signaling frame identifies those frames in which two signaling states, A and B, are transmitted on a time-shared basis. The assignments of the F-bit and the A and B bits are shown in Table 2-2.
- A superframe format (SF) consists of 12 DS-1 frames; an extended superframe format (ESF) consists of 24 frames. SF and ESF are datafilled in table CARRMTC.
- Bit error rate (BER) monitoring is accomplished using two indicators, bipolar violations and cyclic redundancy check (CRC):
  - — Bipolar violations indicate coding errors in the received bit stream and performance on the local span.
  - — CRC, applicable only with ESF, is an indication of one or more bit errors in a block of bits from the received bit stream. CRC indicates performance on an end-to-end span.

Superframe format

A Superframe is consistent with channel bank formats D2, D3, and D4. The signaling bit is time-shared to identify both the channel and the signaling frame. The framing pattern is the repeated sequence 100011011100. Superframe is supported on both 6X50AA and 6X50AB DS-1 cards.

Extended superframe format

ESF consists of 24 frames and is only supported on DS-1 card 6X50AB. The 8-kbit/s, F-bit channel is divided into three separate channels:

- Framing pattern sequence (FPS)—Beginning with frame four (ESF bit 579), the framing bit of every fourth frame forms FPS 001011, which is

used to determine the mainframe and Superframe synchronization. This sequence is a 2-kbit/s channel.

- Facility data link (FDL)—FDL is a 4-kbit/s channel. Its intended use is not yet well defined. The 6X50AB uses FDL to convey remote alarm information or to transmit all ones, as selected in service change.
- Cyclic redundancy check (CRC)—The CRC sequence is a 2-kbit/s channel that carries the CRC-6 code. CRC indicates one or more bit errors in a block, or bits from the received bit stream. CRC can be used as an end-to-end BER indicator.

Table 2 Superframe format

Frame number	F-Bit Terminal Framing	F-Bit Signaling Framing	PCM Coding Bits	Signaling Bit	Signal Channel
1	1	---	1-8	---	---
2	---	0	1-8	---	---
3	0	---	1-8	---	---
4	---	0	1-8	---	---
5	1	---	1-8	---	---
6	---	1	1-7	8	A
7	0	---	1-8	---	---
8	---	1	1-8	---	---
9	1	---	1-8	---	---
10	---	1	1-8	---	---
11	0	---	1-8	---	---
12	---	0	1-7	8	B

Note: The most significant bit is defined as bit 1 and the least significant bit as bit 8.

Channel ordering sequence

The following figure shows the channel ordering sequence.

Figure 2 Channel ordering sequence

Time Slot	1	2	3	4	5	6	7	8	9	10	11	12
D3/D4/ESF	1	2	3	4	5	6	7	8	9	10	11	12
D2	12	13	1	17	5	21	9	15	3	19	13	23

Time Slot	13	14	15	16	17	18	19	20	21	22	23	24
D3/D4/ESF	13	14	15	16	17	18	19	20	21	22	23	24
D2	11	14	2	18	6	22	10	16	4	20	8	24

Line coding

Line coding for DS-1 is bipolar, Alternate Mark Inversion (AMI) or 2B1Q. Both Bipolar 8 Zero Substitution (B8ZS) and Zero Code Suppression (ZCS) are provisionable. The 6X50AA DS-1 cards ZCS supports line coding; the 6X50AB DS-1 card supports B8ZS or ZCS. In addition:

- The B8ZS coding format provides 64 kbit/s clear channel.
- The ZCS coding format requires the B-channels to a maximum data transmission rate of 56 kbit/s.

Zero code suppression

General requirements for

DS-1 code suppression are as follows:

- a maximum of 15 consecutive zero binary bits
- a minimum average of 12.5-percent density of one binary bit over any 192 consecutive bits

To meet the maximum and minimum requirements,

DS-1 uses the following ZCS schemes:

- ZCS or AMI/2B1Q coding for 64 kbit/s restricted — When all eight pulse code modulation (PCM) bits in a channel are zero, and if the eighth bit is not a signaling bit of state one, the seventh bit is substituted by a one. This means ZCS is done on a per-byte basis.

  Note: Invoking seventh-bit substitution when digital data is being transmitted causes data corruption.

- B8ZS for 64 kbit/s unrestricted — When eight consecutive zeros appear on a channel, and the last one transmitted in the preceding word was positive (+1), the eight zeros are substituted by the following pattern:

```
Original 8 bits:   0  0  0  0  0  0  0  0
Substituted word:  0  0  0 +1 –1  0 –1 +1
```

  When eight consecutive zeros appear on a channel, and the last one transmitted in the preceding word was negative (-1), the eight zeros are substituted by the following pattern:

```
Original 8 bits:   0  0  0  0  0  0  0  0
Substituted word:  0  0  0 –1 +1  0 +1 –1
```

Bipolar violations occur in the fourth and seventh bit positions of the inserted code. Therefore, B8ZS coding is used only when the receiving end is capable of recognizing that these are not bipolar violations or bit errors.

Network customer terminating equipment and cross-connect point

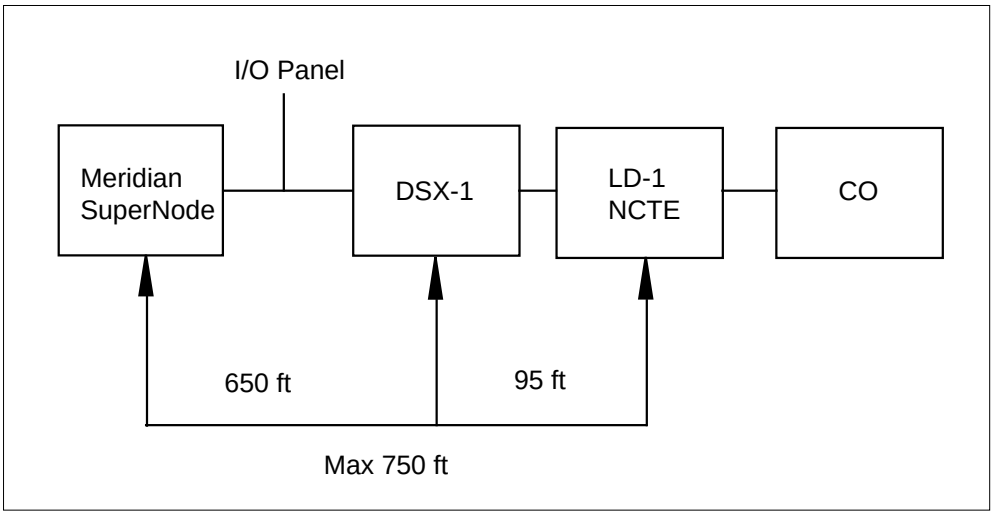
Network customer terminating equipment (NCTE) is generally located at the central office repeater bay. An

LD-1 type repeater bay, NCTE, and a DSX-1 cross-connect point are represented in Figure 3. In addition:

- The LD-1 is the demarcation point between customer premises equipment (CPE) and the public network.
- The DSX-1 point is the standard signal quality reference point.

Note: In the United States, NCTE is part of CPE; in Canada, it is part of the public network.

Figure 3 PBX-to-CO physical connection



The following conditions apply to the

cabling distance from the front panel of the DS-1 to the LD-1:

- Cabling distance is limited to approximately 750 ft on shielded 22-gauge cable (NT-ABAY, WECO-ABAM, or equivalent).
- Cabling consists of approximately 655 ft of the same cable to a DSX-1.

The following conditions apply to the

cabling distance from the DSX-1 to the LD-1:

- Cabling varies within a 95-ft range depending on the manufacturer of the NCTE or whether the NCTE is equipped with a transmit equalizer.
- Cabling distance should be reduced to the LD-1 or DSX-1 by about 27 ft (exact length to be determined) when measured from the input/output (I/O) filter assembly, PN P0643763, located at the bulkhead (I/O panel) of the Meridian SuperNode cabinet.

6X50AB DS-1 card equalization switch settings

The following three tables describe the equalization switch settings based on distance to the DSX and the DS-1 card release code.

Note: Switches closed refers to the DIP switch being placed in the ON position.

Table 3 6X50AB DS-1 card switch setting for DS-1 release code 39

Distance to Cross-Connect	Switches Closed
0 to 91 m	SW1
91 to 137 m	SW2, SW5, SW7
137 to 200 m	SW3, SW6, SW8

Table 2-4 6X50AB DS-1 card switch setting for DS-1 release codes 40-49

Distance to Cross-Connect	Switches Closed
0 to 91 m	SW2, SW4
91 to 137 m	SW3, SW6, SW8
137 to 200 m	SW1, SW5, SW7

Table 5 6X50AB DS-1 card switch setting for DS-1 release codes 60 and above

Distance to Cross-Connect	Switches Closed
0 to 133 ft	SW1
133 to 266 ft	SW2, SW3
266 to 399 ft	SW2
299 to 533 ft	SW3
533 to 655 ft	none (all open)

DS-1 performance and maintenance

The CARRIER level of the MAP display contains alarms and display fields that are indicators of the DS-1's performance.

Alarms and display fields

The alarms applicable to the DS-1 are as follows:

- remote carrier group alarm (RCGA)—yellow alarm
- local carrier group alarm (LCGA)—red alarm
- alarm indication signal (AIS)
- DATA—data not downloaded correctly to XMS-based peripheral module (XPM)
- SCAN—scan path enable failure

The display fields applicable to the DS-1 are as follows:

- slip
- frame errors (FRME)
- approximated bit error rate (BER)
- errored seconds (ES)
- severe errored seconds (SES)
- state

RCGA—yellow alarm

When a remote alarm is detected, it is verified through a filtering process. The filtering process meets requirements as defined by Bell Publication 43801 (United States) and CS03 (Canada).

The filtering process operates as follows:

- To enter the remote alarm mode, a counter integrates the detected remote alarm from the digital carrier in increments of 10 ms.
- For each time period with a detected remote alarm, the counter is incremented by one. When a detected remote alarm is no longer present, the counter is decremented by 16.
- A remote alarm is considered significant when the counter reaches 34 (340 ms of continuous remote alarm). Once the alarm is significant, the counter is no longer incremented.
- To exit the remote alarm mode, the counter is decremented until it reaches 0. (This takes approximately 30 ms when the remote alarm is absent.)
- If any frame alarm is present, all processing of yellow alarms is temporarily suspended and the contents of the yellow alarm counter remain unchanged.

LCGA—red alarm

If the switch determines the DS-1 should be removed from service, it raises a local alarm. As part of this operation, the DS-1 transmits a remote alarm pattern to inform the far end of its local alarm condition. The local alarm timing meets the requirements outlined by Bell Publications 43801 and CS03.

If the DS-1 sends a remote alarm, it transmits the following pattern:

- When the DS-1 is commanded to enter the local alarm mode, a remote alarm pattern is transmitted after a 2.5 +/-0.5 second delay from the receipt of the message from the Meridian SuperNode switch.
- When the DS-1 is commanded to exit the local alarm mode, it stops sending the remote alarm pattern after a 10.5 +/-0.5 second delay from the receipt of the message from the Meridian SuperNode switch. The DS-1 informs the Meridian SuperNode switch when the remote alarm pattern ends.

Slip

A frame slip occurs when the transmit clock and receive clock on the DS-1 link are not synchronized. When this occurs, a frame must be inserted or deleted. A counter is used to keep the total number of frame slips. To prevent frame slips, the clock is synchronized to the external clock.

Frame errors

The DS-1 frame format consists of a frame bit followed by twenty-four 8-bit words, representing the 24 channels. If 2-out-of-4 to 2-out-of-5 framing bits are received erroneously, receive framing is considered lost. This means the receiving side cannot determine which data belongs to which channel.

Frame loss is considered significant when it lasts for 3 s, after which the trunk is taken out of service. The trunk is restored to service automatically when frame synchronization is received continuously for 15 s.

Approximated bit error rate

BER is accomplished using two indicators:

- bipolar violation
- cyclic redundancy checking (CRC)

In a bipolar pulse stream, pulses alternate in polarity. If after transmission, two pulses of the same polarity are received in succession, a bipolar violation has occurred. Each bipolar violation implies that a data transmission error has occurred. A count is maintained, in increments of 1024, for the number of occurrences per day.

There are four classes of bipolar violations rates:

- Class 1—10-*3* error rate (10 240 bipolar violation in 6.6 s)
- Class 2—10-*4* error rate (10 240 bipolar violation in 65.96 s)
- Class 3—10-*5* error rate (10 240 bipolar violation in 659.6 s)
- Class 4—10-*6* error rate (10 240 bipolar violation in 6596 s)

CRC, applicable only with ESF, is an indication of one or more bit errors in a block of bits from the received bit stream. CRC indicates performance on an end-to-end span, while bipolar violation indicates performance on only the local span.

With ESF, both bipolar violation and CRC are reported to software. If framing is not ESF, only bipolar violations are reported.

The alarm settings mentioned above are defaults, which can be altered in table CARRMTC.

The carrier options for the a given posted circuit are displayed by using the DispOpt command. The card code, options, and alarm thresholds are displayed. A carrier can be looped towards the near (l) or far (r) end by using the Loop n <l / r / c > command. The loop is cleared using the (c) option.

Slips and out-of-frame conditions are monitored for maintenance purposes as well as carrier group alarms and an approximated BER, which is based on coding violations.

The quality of service on a given DS-1 link is reflected in the ES, SES, and unavailable seconds (UAS) data parameters.

All performance data parameters have user-defined alarm points associated with them on a per-carrier basis. In some cases, two alarm points are appropriate, specifying a maintenance level and an out-of-service level.

> ***Note:*** Default values to performance group alarms are adequate for normal maintenance procedures.

The carrier group alarms also have user-defined alarm points associated with them on a per-carrier basis. These alarm points signify the filter period used to time the alarm. Two filter periods are required: one to define entry into the alarm, and one to define the exit from the alarm.

DS-1 performance

DS-1 operational measurements

The following operational measurement (OM) pegs are accumulated for each DS-1 carrier over 24 hours and reset when DS-1LOF and DS-1SLP are reset:

- DS1OMINF—key to digital carrier equipment table
- DS1LCGA—DS-1 local carrier group alarm
- DS1RCGA—DS-1 remote carrier group alarm
- DS1LOF—DS-1 framing lost on the incoming side
- DS1SLP—DS-1 slip
- DS1SBU—DS-1 carriers busied out by system originated commands
- DS1MBU—DS-1 carriers busied out by commands from the MAP terminal
- DS1CBU—DS-1 carriers in CSBY state
- DS1PBU—DS-1 carriers in PSBY state
- DS1BER—DS-1 bit error ratio (replaces DS-1BPV)
- DS1ES—DS-1 error second
- DS1SES—DS-1 severe error second
- DS1UAS—DS-1 unavailable second

DS-1 carrier logs

The following Meridian SuperNode logs are output in relation to events on DS-1 carriers.

- The following report is generated by the peripheral module (PM) subsystem when a carrier link is made system busy by loss of sync, remote alarms, or the carrier card is removed.

```
PM109 NC SYSB CARRIER pmtype pmnbr CARRIER_NO: line_nbr,
REASON: char_string
```

- The following report is generated by the PM subsystem when bipolar violation (BPV), slip (SLIP), maintenance (MTCE), or out of service (OOS) limits are set or cleared; when the carrier card fails maintenance; or when the carrier card is replaced.

```
PM110 NOALARM INFO CARRIER pmtype pmnbr
CARRIER_NO:line_nbr,REASON: char_string
```

- The following report is generated by the PM subsystem when a system-busy carrier is returned to service.

```
PM111 NOALARM INFO CARRIER pmtype pmnbr
CARRIER_NO:line_nbr,REASON: char_string
```

- The following report is generated by the PM subsystem when a carrier slip counter is initialized.

```
PM112 NOALARM INFO CARRIER_SLIP_INIT pmtype pmnbr
```

- The following report is generated by the PM subsystem as a general information log for carriers.

```
PM186 NOALARM INFO CARRIER pmtype pmnbr
CARRIER_NO:line_nbr
REASON: char_string optional char_string
```

Note: For more information, refer to the *Log Reports Reference Manual*.

Test equipment requirements

This section describes equipment useful for commissioning DS-1s.

DS-1 line simulator

A DS-1 line simulator/monitor is used to verify the integrity of the DS-1 links between the two PBXs. The line simulator is used in a number of useful ways. For example, it performs the following tasks:

- monitors on a single path without being part of the primary path
- operates in either a transparent mode or provides its own stimulus to the link in the path between the two systems
- monitors the status of the link
- monitors the information in the channels
- simulates information in a given channel or an idle code in all channels
- simulates alarms

Error counter

An error counter detects bipolar violations or no-signal periods for DS-1.

An operational fault on a DS-1 message link connecting an LTC, LTCI, or LGC to an RCC generates a PM181 log report. The log report provides information on whether the fault occurred on the P-side or the C-side and provides the messaging error counters at the time the fault occurs. If the fault is P-side, the P-side counters are shown. If the fault is C-side, the C-side counters are shown. The message counts are totals for all the links on the

appropriate side rather than per link. The message error counters are cleared on the RTS of the peripheral.

Steps for using an error counter are described in *Digital Trunk Interface/Computer-to-PBX Interface Maintenance Guide*, 553-2811-500.

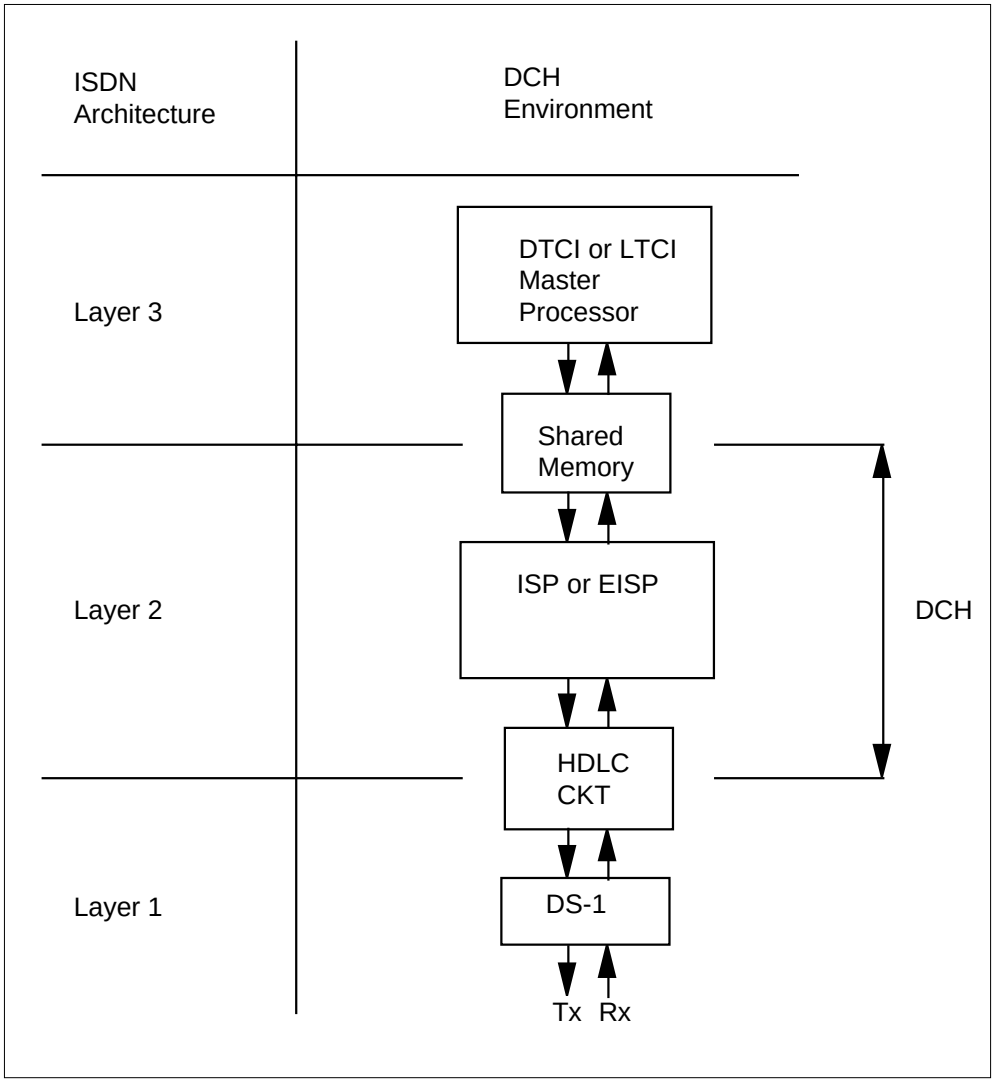
3 Datalink engineering

D-channel handler hardware configuration

The ISDN trunk controller uses the ISDN signaling preprocessor (ISP) or enhanced ISP (EISP) card for D-channel signaling. The ISP and EISP cards eliminate the need to provision signaling terminal (ST) cards for D-channel signaling and support up to 32 D-channels on a single ISDN trunk controller. The ISDN trunk controller unified processor (UP) communicates with the ISP or EISP through shared memory. The ISP and EISP package Layer 3 messages destined for the Meridian SuperNode switch into Layer 2 frames. The High-level Data Link Control (HDLC) circuitry resident in the ISP and EISP transmits these frames onto a channel on a DS-1. The following figure illustrates data flow among components in ISDN Layers 1 through 3.

The DS-1 is a 24-channel carrier that interconnects switching systems. Frames are transmitted and received by both switches using the same path in forward and reverse directions.

Figure 1 DCH environment and OSI equivalents



DCH hardware

The DCH consists of two processors:

- unified processor (UP)—performs high-level processing for the D-channel, such as Link Access Protocol on the D-channel (LAPD)
- ISDN signaling preprocessor (ISP)—controls the transmission and reception of HDLC frames or Enhanced ISP (EISP)—provides same control as ISP with 4 Mbytes of memory, a 20 MHz clock rates, and an improved 32 bit bus

The ISP or EISP card, provisioned in slot 16, provides the capability to do ISDN-specific front-end processing for PRI applications. The ISP and EISP

contain a host processor (68020), HDLC circuitry, and a LAPD state machine. These entities provide Layer 1 and Layer 2 protocol handling for ISDN PRI.

The HDLC circuitry is used to send and receive ISDN LAPD frames. The circuitry terminates up to 32 data channels and each channel supports up to 64 kbit/s. (This gives the ISDN trunk controller the capability to support up to 32 D-channels.)

The ISDN line trunk controller (LTCI) or ISDN digital trunk controller (DTCI) peripheral is the same configuration as a line trunk controller (LTC) or digital trunk controller (DTC), except that the ISDN trunk controller requires an ISP card in each unit. (However, note that the DTCI and LTCI do not support the special tone receiver [STR] card.) Having an ISP or EISP card in each unit of the DTCI or LTCI provides complete hardware redundancy.

D-channel handler installation

This section describes the steps to install a DCH. D-channel must first be datafilled by means of tables CLLI, TRKGRP, TRKSGRP, CARRMTC, and LTCPSINV. For more information on datafill, see Chapter 5, Database information.

The PRADCH level of the MAP display is used to post and maintain the DCH in the ISDN trunk controller. To reach the PRADCH level from the command interpreter level of the MAP display, type the following:

```
MAPCI;MTC;TRKS;TTP;PRADCH
```

The DCH is loaded when the ISDN trunk controller is loaded.

To return the DCH(s) to service, use the following procedure:

- Go to the PRADCH level of the MAP display.
- Use the **POST GD <clli>** or **POST AD <deqnm>** command to identify the DCH you wish to return to service (RTS).
- Use the **RTS** command to return the posted DCH to service. (In the event that the DCH is INB, ensure that a BSY command is issued to put the DCH in MB state before issuing the RTS command.)

Checking the load name does not apply, as the DCHs are loaded when the ISDN trunk controller is loaded.

D-channel handler verification

Use the following procedure to run internal continuity tests:

- Go to the PRADCH level of the MAP display by typing the following:

  ```
  MAPCI;MTC;TRKS;TTP;PRADCH
  ```

- Use the **POST GD <clli>** or **POST AD <deqnm>** command to identify the DCH(s) to test.
- Enter the continuity (CONT) command with the internal (INT) option to run the internal continuity test.

Note: Read-only memory tests to not apply to the ISDN trunk controller DCH.

The external continuity test checks the end-to-end continuity of the D-channel from the home Meridian SuperNode DCH over the DS-1 to the far-end Meridian SuperNode DCH. The loopback at the far end must be set by commands at the far end.

The steps taken to run are as follows:

- Go to the PRADCH level of the Meridian SuperNode MAP display.
- Use the **POST GD <clli>** or **POST AD <deqnm>** command to post the DCH(s) associated with the DS-1 to test.
- Ensure the D-channel is looped back at the far end. This can be done using the LOOPBACK SET command at the far-end switch.
- Enter the CONT command with the external (EXT) option to run the external continuity test.
- At the far end, remove the loopback by using the LOOPBACK TAKEDOWN command.

Troubleshooting

This section gives some suggestions on what to do in the event of problems. For problems that are not mentioned below, refer to the “Restoring Service to the DCH" section in Chapter 7, “Service Verification."

If the DCH is lockout (LO), there are a number of reasons why this condition occurs. The following are some suggestions:

- Verify that the baud rate datafilled in table TRKSGRP matches that of the far-end DCH.
- Verify the entry for IFCLASS in table TRKSGRP. It must complement the provisioning of the remote switch. If the remote switch is USER, the IFCLASS field must be set to NETWORK and vice versa. Typically, the equipment that is closest to the user is provisioned as USER and the

equipment that is closest to the public network is provisioned as NETWORK.

- Verify that the appropriate NT6X50 card is in the DS-1.
- Check whether Layer 1 is set up correctly. For example, check that both sides are set to the same frame format; that is, either standard (SF) or extended superframe (ESF). The DCH does not send any messages to the far end unless it has frame synchronization with the far end. Use the protocol analyzer to verify frame synchronization.

Test equipment requirements

This section describes equipment required for commissioning DCHs.

A protocol analyzer is used to monitor the DS-1. It is normally used to check Layer 1; however, it can be used to check whether Layer 2 HDLC flags are being transmitted, from both sides, on the DS-1 (when operating at 64 kbit/s). This does not need to be checked unless a connection problem arises. This check must be made after the DCHs are ready for service.

To monitor ISDN PRI messages on the D-channel, the protocol analyzer must have software that can monitor or decode ITU-T LAPD and Q.931 messages.

4 PRI applications

Drop-in replacement for PBX to central office connectivity

The Primary Rate Interface (PRI) uses existing integrated business network two-way trunks (IBNT2) that connect two PBXs. The trunks are distinguished as integrated business network (IBN) PRI trunks by datafilling the subgroup data signaling type as ISDN.

Meridian SuperNode call setup

This section describes how the Meridian SuperNode switch selects a PRI B-channel to make an outgoing call.

In any PRI connection, one end of the interface functions as the user, the other as the network. The Meridian SuperNode switch functions either as the user or network in a PRI connection.

Once a route is determined, and a PRI trunk group is selected within that route, the call is treated as a PRI termination. The next idle member (B-channel) in the trunk group is chosen according to the SELSEQ field in table TRKGRP. The B-channel is reserved and the Q.931 setup message is built. All digits must be present before sending the setup message.

If all B-channels belonging to the PRI are busy, the call is routed to the next trunk group in the route list.

Call progress signals

This section describes the correlation of Q.931 messages with the process of establishing and releasing a call. The following paragraphs describe the messages used in call processing.

SETUP

A user initiates a call request by sending a SETUP message to the network. All of the digits dialed are included in the message.

CALL PROCeeding (CALL PROC)

CALL PROC is sent to the originator of the call after successful translation and routing.

PROGress (PROG)

A PROG message is sent to the originator after the CALL PROC message. If the call uses a PRI to non-ISDN trunk, the PROG message indicates that the call is not end-to-end ISDN.

ALERTing (ALERT)

An ALERT message is sent to the originator to indicate that the called party has been alerted.

An ALERT message is sent for the following calls:

- PRI to PRI
- PRI to non-ISDN line (such as 500/2500, ETS, IVD)
- PRI to ISDN Stimulus line (BRI)

When the called party must be accessed over a non-ISDN trunk, the terminating exchange will not send an ALERTing message back to the originating switch because the terminating exchange has on way of verifying that ringing is taking place at the called station.

CONNect (CONN)

A CONN message is generated by the terminating side of the call when the call is answered. This message is sent from the terminator to the network. The network subsequently sends a connect message back to the originator. Billing begins at this time.

For line-to-trunk or trunk-to-trunk calls, B-channel cut-through occurs between CALL PROC and CONN. For trunk-to-line calls, B-channel cut-through occurs after the call is answered.

CONNect ACKnowledge (CONN ACK)

After the originator receives the CONN message, it responds to the network with a CONN ACK message.

DISConnect (DISC)

A DISC message is generated when one of the subscribers involved in the call hangs up. This message is equivalent to detecting an on-hook signal on a PTS trunk. This is the first step in the call takedown message sequence. Billing ends at this time.

RELease (REL)

A REL message is generated and sent by the subscriber that sent the DISC message. This is the second step in the call takedown message sequence.

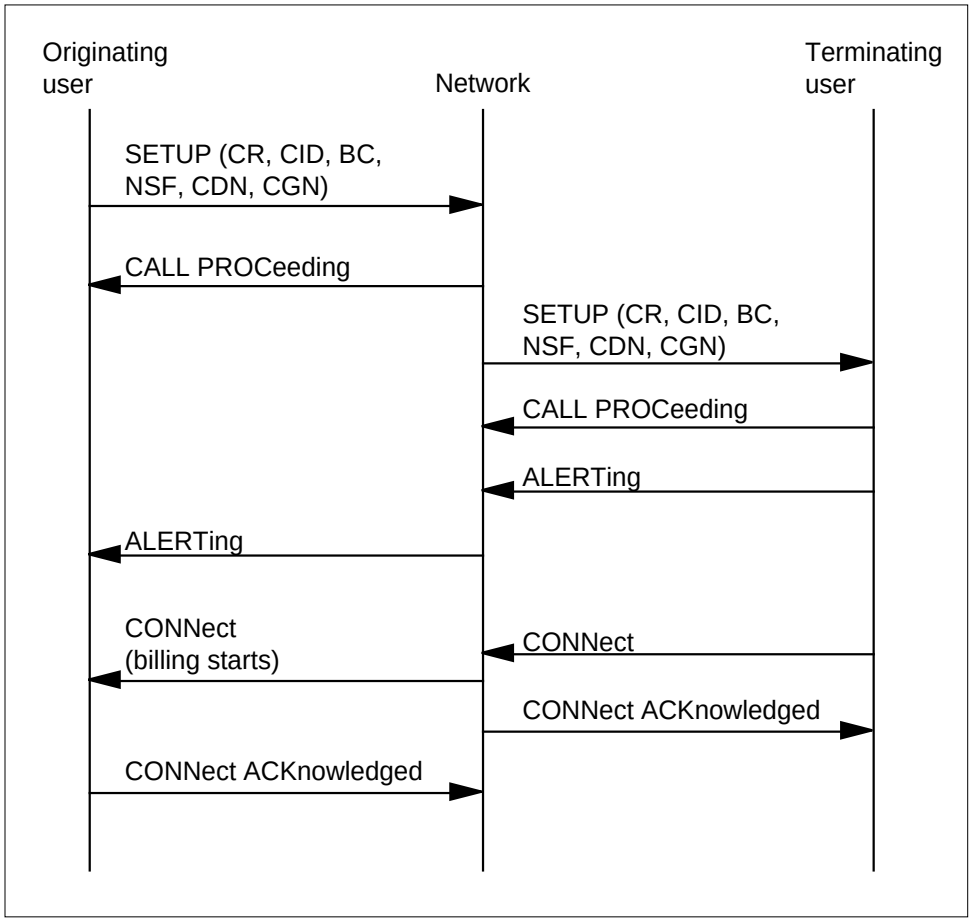
RELease COMplete (REL COM)

A REL COM message is generated after the subscriber receives the REL message. This is the third and final step in the call takedown message sequence.

Call setup diagrams

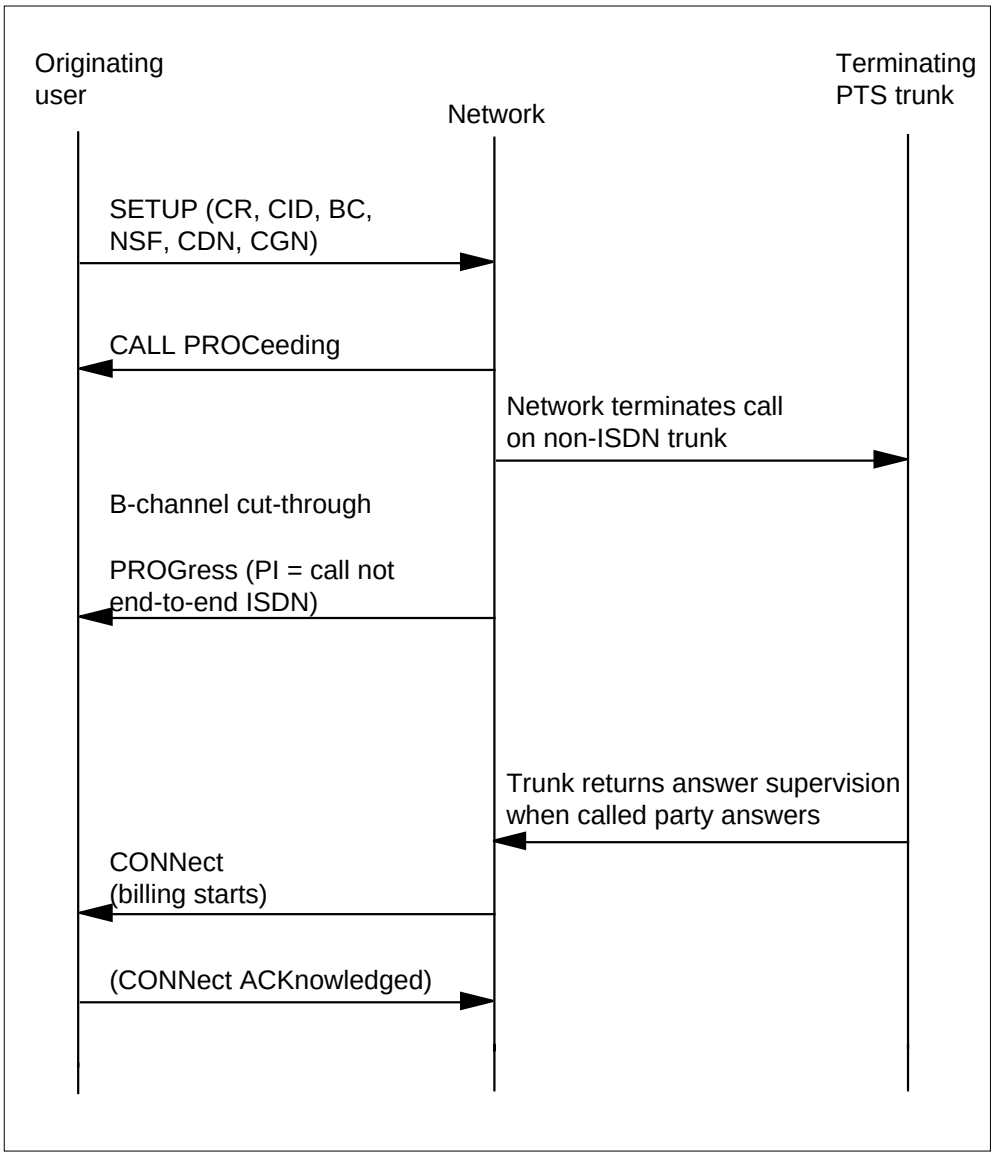
The following figure is a time-sequence diagram of a PRI-to-PRI trunk call setup. This figure shows the message sequence between the network and the two users on a PRI-to-PRI trunk call. The CALL PROC, ALERT, and CONN ACK are optional.

Figure 1 PRI-to-PRI call setup



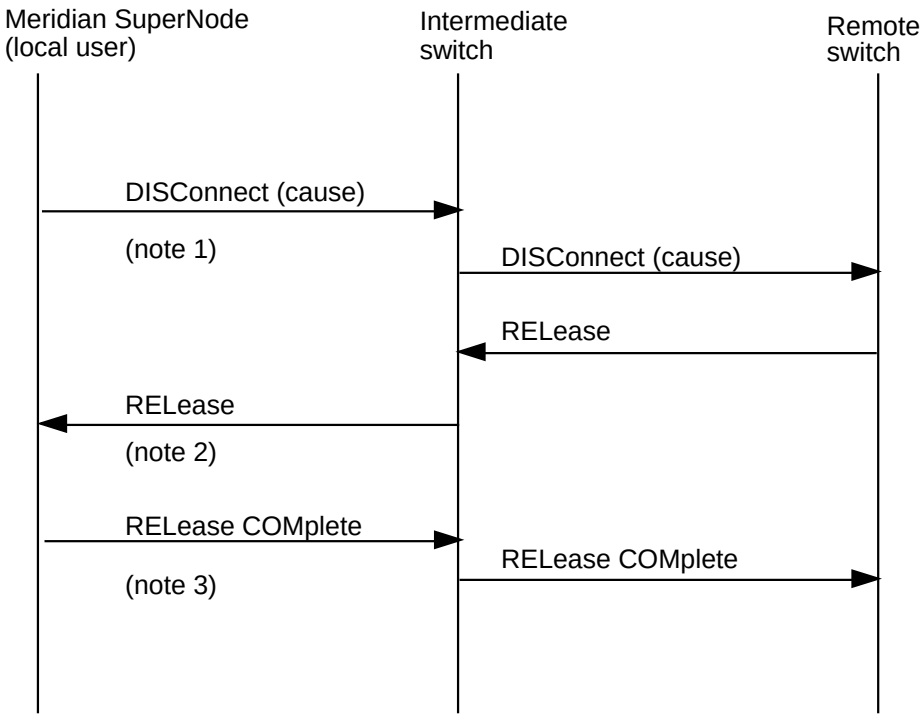
The following figure is a time-sequence diagram of a PRI to non-ISDN trunk call setup. This figure shows the message sequence between the network and the originating PRI interface when the terminator is a non-ISDN trunk. Since interworking has occurred, a PI “call not end-to-end ISDN" indicator is sent in a PROG message over the originating PRI.

Figure 2 PRI to non-ISDN trunk



The following figure shows a time-sequence diagram of a PRI-to-PRI trunk disconnect with one PRI trunk as the network and the second PRI trunk as the user. The local user initiates call clearing.

Figure 3 Normal call clearing initiated by local user



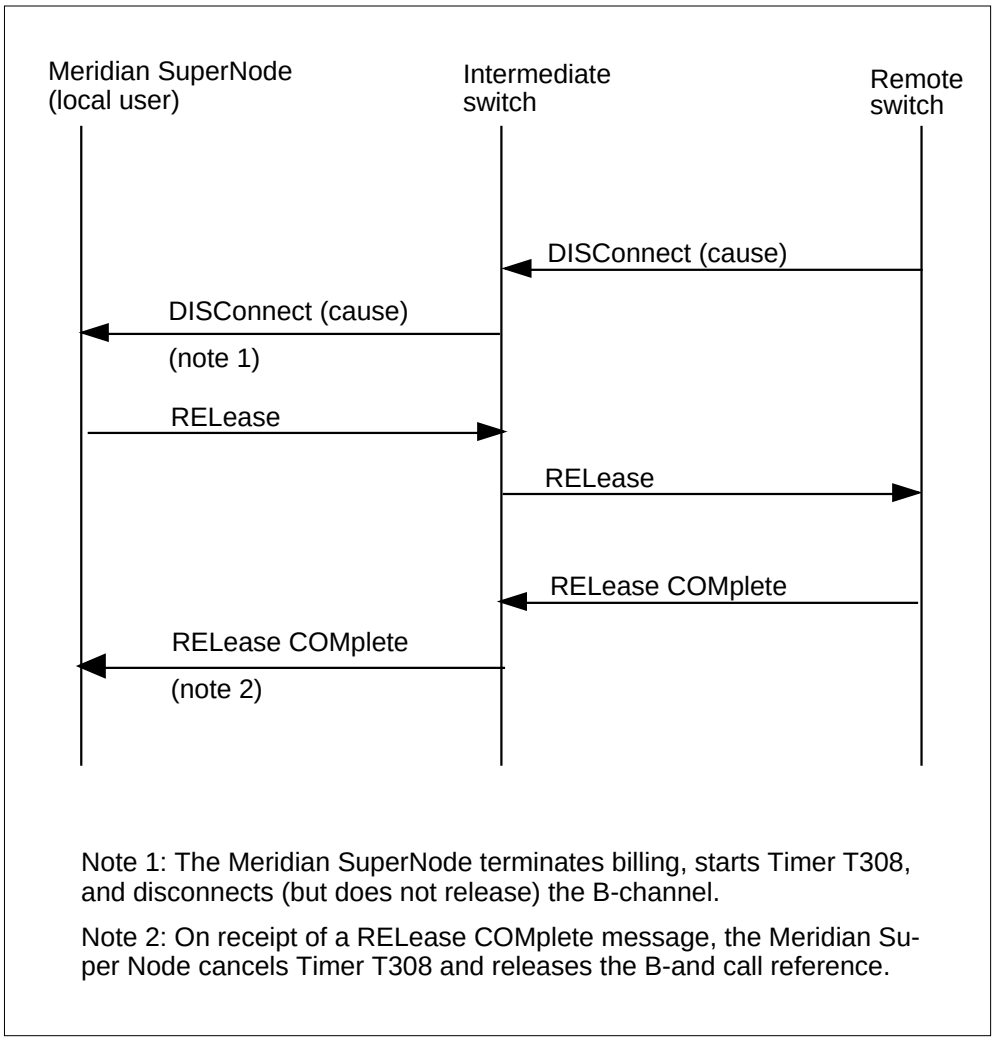
Note 1: The Meridian SuperNode terminates billing, starts Timer T305 in anticipation of receiving a RELease message, and disconnect (but does not release the B-channel. Typically, the cause sent in the DISConnect message is #16, normal clearing.

Note 2: On receipt of a RELease message, the Meridian SuperNode cancels Timer T305 and releases the B-channel and call reference.

Note 3: This confirms call clearing to the remote switch.

The following figure shows a time-sequence diagram of a PRI-to-PRI trunk disconnect with one PRI trunk as the network and the second PRI trunk as the user. The remote user initiates call clearing.

Figure 4 Normal call clearing initiated by remote user



Multiple call types per trunk group

Integrated services access

Integrated services access (ISA) supports multiple call types on a single trunk group. The following call types are included:

- public
- private

- outward wide area telecommunications service (OUTWATS)
- inward wide area telecommunications service (INWATS)
- foreign exchange (FX)
- tie trunk

Public

Public calls connect the PBX to the central office (CO) for direct outward dialing (DOD), or CO to PBX for direct inward dialing (DID). The digits dialed conform to E.164 standards.

Private

Private incoming and outgoing calls connect the PBX to a virtual private network (VPN). The dialed digits may not conform to E.164 standards. Private network overflow to the public network can also be provisioned.

Note: NI-2 does not support private networking

OUTWATS

OUTWATS is a service provided by telephone companies that permits a customer to originate calls to telephones in a specific geographical area called a zone or band. A flat monthly charge is provided for such services. A PBX can request a specific OUTWATS zone/banding number (range: 0-9, A, B, C) or auto-banding to be done by the CO.

INWATS

INWATS is a long distance service that allows a subscriber to receive telephone calls originating within specified service areas without a charge to the caller. A 1-800 number is assigned to a certain PBX to allow for free calls.

FX

FX service connects a customer's location to a remote exchange. FX also provides the equivalent of local service to the distant exchange.

Tie trunk

Tie trunks (TIE) are private incoming and outgoing trunks between PBXs.

Call-by-call

Integrated Service Access is a term that applies to the NTNA PRI protocol variant. The NI-2 PRI variant uses a different term, Call-By-Call service selection (CBC) to refer to the support of multiple call types over a single trunk group. In addition, CBC differs functionally from ISA in the following areas:

- There is no direct support for private numbering plans, so the Private (PVT) call type is not allowed. Private networking can still be performed

using private dialing plans with translations that are set up either to produce Called party Numbers that conform to the ITU-T E.164 recommendation or to code the Type of Number and Numbering Plan Identifier (TON/NPI) field to UNKNOWN/UNKNOWN. (See table PRIPROF in the chapter on database information.)

- There is a new call type, InterLATA OUTWATS that allows the Meridian SuperNode switch to obtain OUTWATS service from a service provider other than the Interexchange Carrier (IXC) or a Competitive Local Exchange Carrier (CLEC).

For more information about Call-by-call, refer to the *Customer Data Schema* and the *Translations Guide*.

Figure 4-5 shows how in the absence of Call-By-Call (CBC), each call type requires a separate dedicated (in some cases, non-ISDN) facility between the Customer Premise Equipment (CPE) and the Stored Program Controlled Switching (SPCS) system.

Figure 4-6 shows the alternative in which Call-By-Call allows calls with various service attributes to share a single PRI facility between CPE and SCPS systems.

Figure 5 Without ISA/Call-By-Call

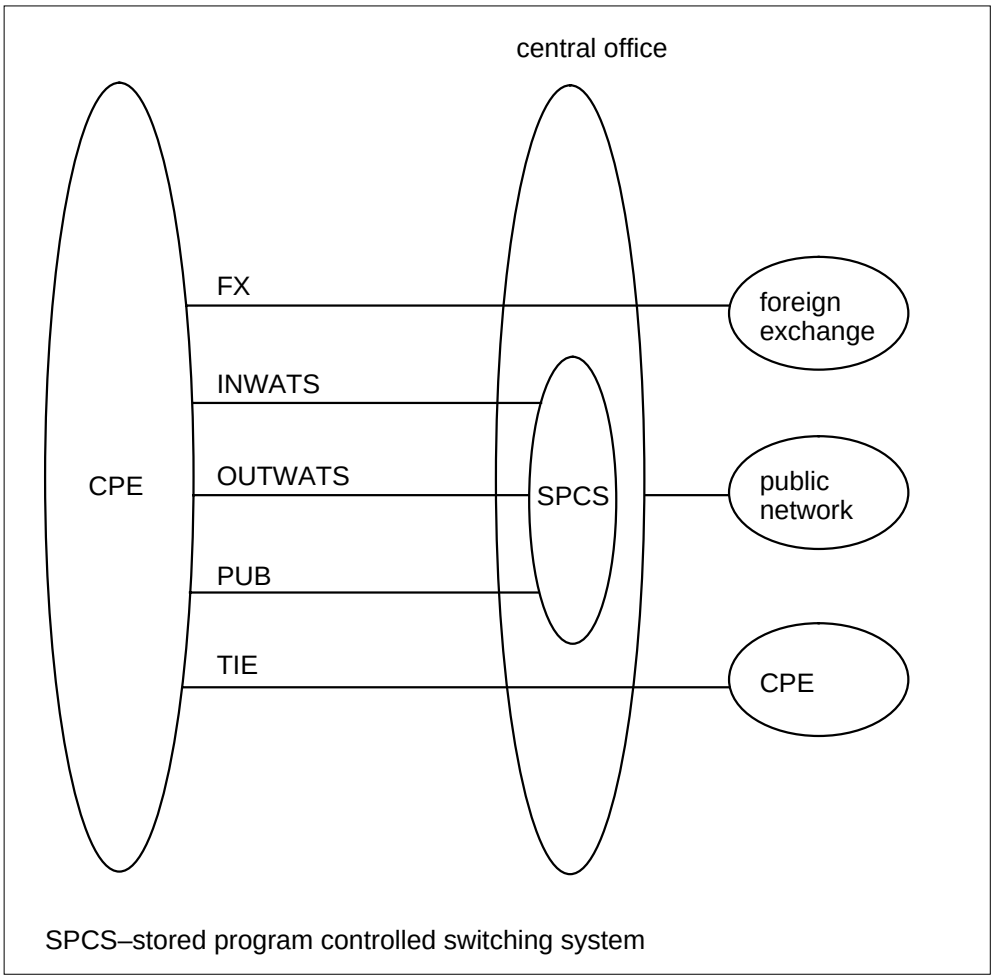
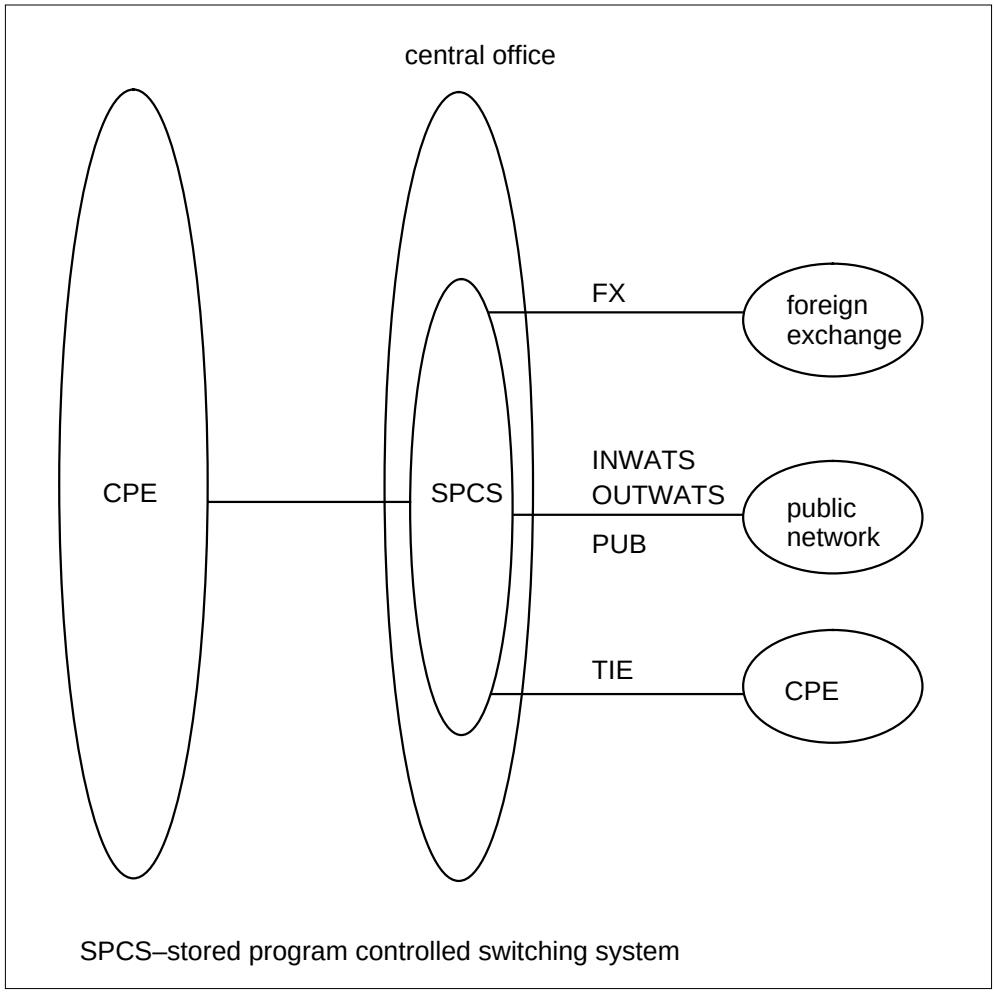


Figure 6 With ISA/Call-By-Call



Access to the public network

Meridian SuperNode switch (B) users dial access codes to the public DOD route. For instance, dialing 9 accesses the public network; where 9 is the access code to the DOD route, which can step to an ISA route, or the automatic route selection (ARS) access code to public network.

The following list describes valid numbers in the public dialing plan:

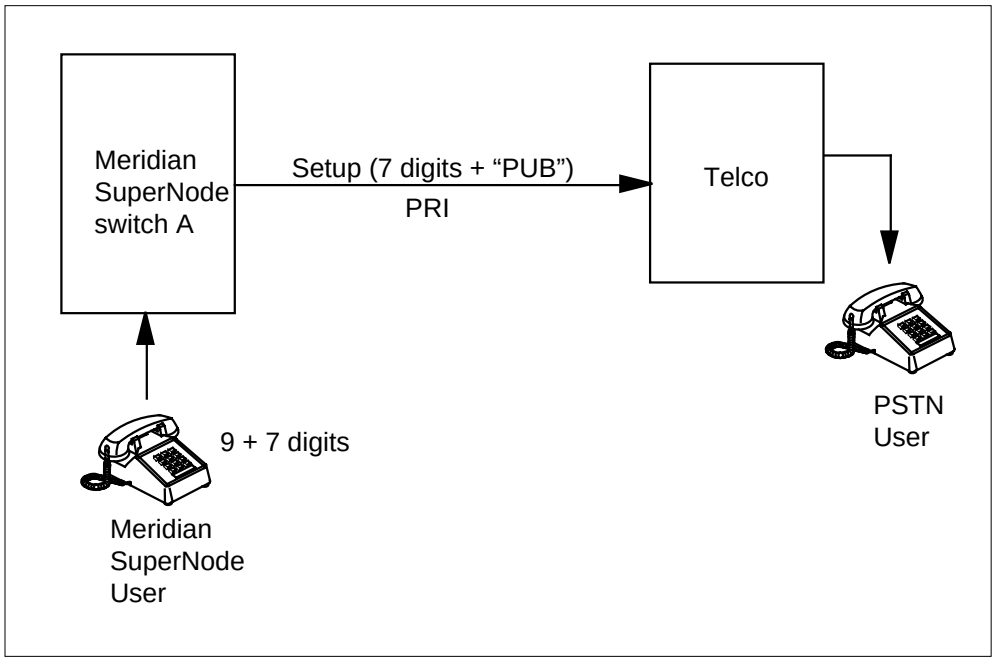
- 7-digit number
- 10-digit number
- 7- or 10-digit number with prefixes 0, 1
- 0 or 00

- 01 or 011, followed by international number
- special numbers, such as 411, 611, and 911
- 10 + XXX + 7- or 10-digit number
- (1) + 800 + 7-digit number
- (1) + 900 + 7-digit number

Sample public dialing plan

A sample public dialing plan is shown in the following figure. A Meridian SuperNode user dials a public network access code, 9, plus a 7-digit number in the public network. The PRI carries the seven-digit number, and identifies the call type as public. The Meridian SuperNode switch routes the call to a PSTN user in the public network over a PTS trunk.

Figure 7 Call to public network



In the following example, the call comes in on a PRI trunk (B2APRI) that connects Meridian SuperNode switch (A) and Meridian SuperNode switch (B). The B2APRI entry in table TRKGRP describes some of the attributes, such as the logical terminal identifier (LTID) associated with this trunk group. ISDN 900 is the LTID that indexes table LTCALLS.

Table LTCALLS supplies the necessary information to begin translation of the CDN when indexed by LTID and call type. In this case, the CALLTYPE is public (PUB).

The LINEATTR (600) indexes table LINEATTR which contains translation information. In table LINEATTR, AABB specifies a pretranslator used by the PRI link, and the serving translation scheme (416) is the NPA of the PRI link. The translation of these digits follow standard IBN digit analysis.

```
TABLE TRKGRPB2APRI IBNT2 0 PRIP NCRT  BNRRCH 0 ... (LTID ISDN)
900 $TABLE LTCALLSISDN 900  PUB  XLAIBN  600 CENTRAL 0 25 $TABLE
LINEATTR600  IBN  ...  416  AABB  L416 ... $
```

5 NI-2 database information

The Primary Rate Interface (PRI) subscription parameters allow customers to support PRI and-6 fashion it to their own particular needs. The Meridian SuperNode switch assigns the parameters by datafilling a set of software tables. The Meridian SuperNode table descriptions that follow are presented in the order of datafill.

Database correlation

A number of database items have to be correlated in the Meridian SuperNode database. Some of these items must be carefully coordinated to ensure a properly functioning PRI. This section attempts to highlight these parameters and provide the equivalent (and recommended) parameters to be used for provisioning the Meridian SuperNode switch.

Configuration data correlation

No correlation in hardware-related database.

Layer 1 data correlation

The correlation of Layer 1 data is described in Table 5-1.

Table 5-1 Layer 1 database correlation (Sheet 1 of 2)

Description		Table	Field	Value
Card Type		CARRMTC	CARD	NT6X50AA, NT6X50AB
Frame Format:		CARRMTC	FF	
	SuperFrame			SF
	Extended SuperFrame			ESF
Line Encoding:		CARRMTC	ZLG	
	Zero Code Suppress (ZCS)			

Table 5-1 Layer 1 database correlation (Sheet 2 of 2)

Description		Table	Field	Value
	Bipolar 8 Zero Substitution (B8ZS)			
Bit Error Ratio Base:		CARRMTC	BERB	
	Bipolar Violations			BPV
	CRC Errors			CRC
Data Link:		CARRMTC	DLK	
	No Data Link			
	FDL—source ts 1			
	FDL—source ext			
Inhibit Alarm Transmit		CARRMTC	IAT	Y, N
Bit Error Ratio Maintenance Limit		CARRMTC	BERML	6 (exponent)
Bit Error Ratio Out of Service Limit		CARRMTC	BEROL	3 (exponent)
Errored Second Threshold		CARRMTC	ES	864
Frame Bit Error Maintenance Limit		CARRMTC	FRAMEML	17
Frame Bit Error Out of Service Limit		CARRMTC	FRAMEOL	511
Slip Count Maintenance Limit		CARRMTC	SLIPML	4
Slip Count Out of Service Limit		CARRMTC	SLIPOL	255

Layer 2 data correlation

The correlation of Layer 2 data is described in Table 5-2

Table 5-2 Layer 2 database correlation

Description	Table	Field	Value
Associate D-channel with PRI	TRKSGRP	DCHNL	Same as DS1 endpoint in table SPECCONN
Data Rate of D-channel	STINV	CONTYPE	PRABAUD
		BAUD	64 kbit/s, 56 kbit/s
Note: Table STINV is not used with DTCI or LTCI peripherals.			

Layer 3 service data

The Layer 3 service-related database correlation ensures that certain service-related parameters are aligned with their equivalents in the other switch, as shown in Table 5-3.

Note: For the interface identifier (field IID) of table LTCPSINV, the recommended value for datafilling a single DS-1 is 0 (zero). When datafilling multiple DS-1s per trunk group, a different IID is required for each DS-1. The IID must match with the IID of the connecting switch.

Table 5-3 Layer 3 facility data correlation

Description	Table	Field	Value
Q.931 Interface Identifier (used in CID I.E.)	LTCPSINV	IID	0 (recommended)
Q.931 Call Reference value length	TRKSGRP	CRLENGTH	2
B-channel Selection	TRKGRP	SELSEQ	ASEQ, DSEQ
Billing at PRI I/F recommend using CGN in SETUP	TRKGRP	BILLDN	N
Loss & Level	TRKGRP	PADGRP	PRIC
User-Network Interface	TRKSGRP	IFCLASS	NETWORK
Q.931 Progress Indicator location	TRKSGRP	LOCATION	Network
B-channels defined	TRKMEM	PMTYPE	DTCI

Timer values

Table 5-4 shows the default timer values for the user side as described in SR-3887.

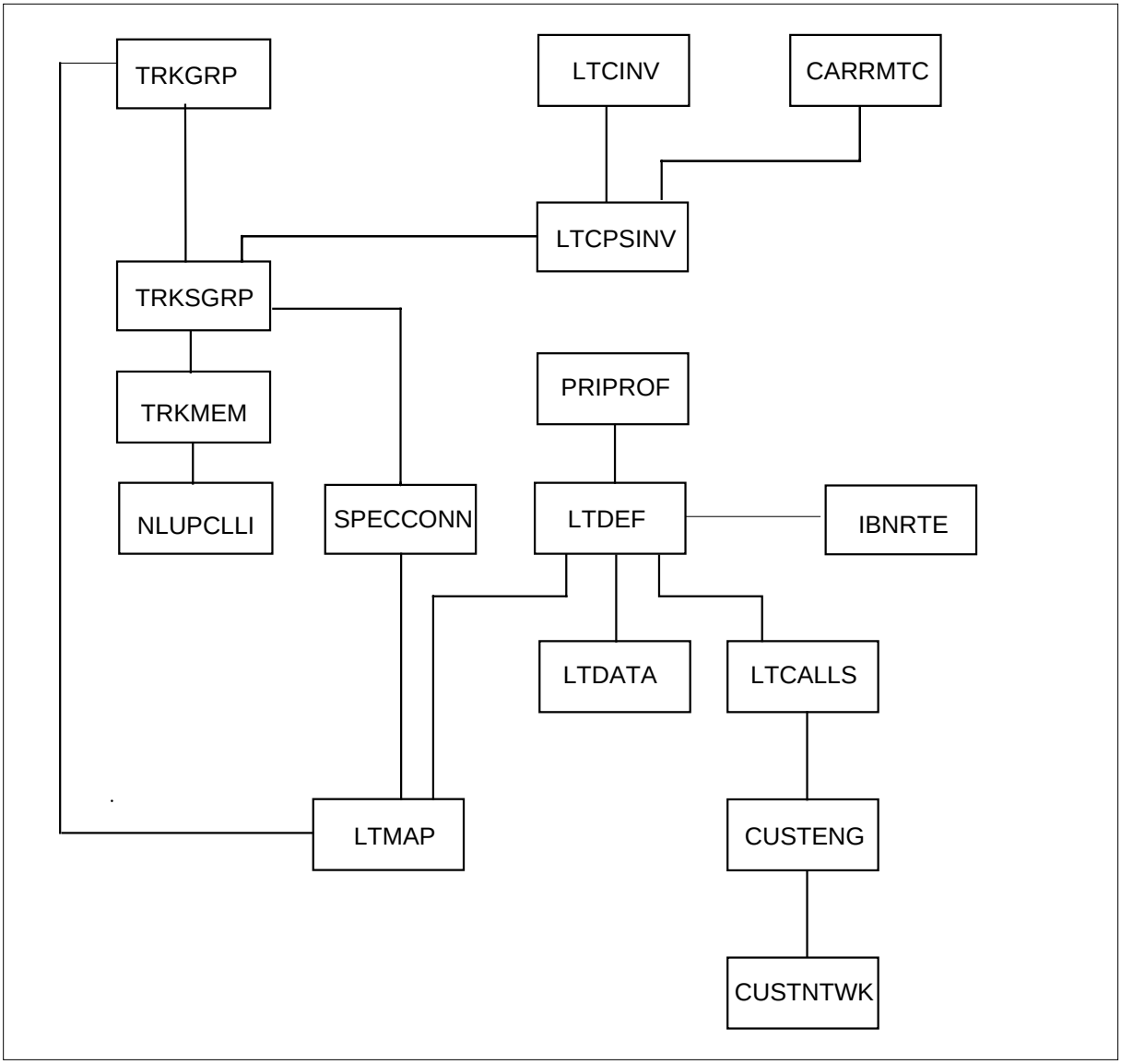
Table 5-4 Default timer values for user side

Timer	Default value
T301	5 minutes
T303	4 seconds
T305	30 seconds
T308	4 seconds
T309	90 seconds
T310	30 seconds
T313	4 seconds
T316	30 seconds
T317	20 seconds
T321	40 seconds
T322	4 seconds
T323	120 seconds
T-init	not implemented
T-ds1	not implemented

Datafill order

Figure 5-1 shows the interdependencies of tables within the Meridian SuperNode database and the resulting datafill order. Tables should be datafilled from top to bottom. Tables at the same vertical position (in figure) can be datafilled in parallel.

Figure 5-1 Datafill order for ISDN PRI tables



Configuration data

The following sections describe the tables that need to be datafilled for PRI to function. These tables must be completed to define PRI facilities for basic call processing.

Table PRIPROF (PRI Profile)

Table PRIPROF contains information about the function switches defining a specific issue of a variant. Default values are automatically added when table PRIPROF is initialized.

The following is an example tuple:

```
NI2PROFL NIPRI NI2V1 (UNTONNPI) $
```

The following PRIPROF fields are important to PRI setup.

- PROFNAME—an eight character, user defined string (default is NIL).
- VARIANT—specifies the switch protocol for the profile. Value is NIPRI for NI-2.
- ISSUE—specifies the release issue of the variant. Value is NI2V1 for NI-2.
- SWITCH—a vector of up to 64 function switch names (default is NIL). The only switch supported for NI-2 is UNTONNPI. This is the switch that allows the user to set the type of number/number plan identifier for all outgoing calls over PRI trunks to “unknown/unknown."

Table OFCENG (Office Engineering)

Table OFCENG defines engineering parameters for the Meridian SuperNode switch.

The following OFCENG fields are important to PRI setup:

- PARMNAME—office parameter
- PARMVAL—defines the office parameter value. NO_OF_HIS_CONTROL_BLKS and NO_OF_HIS_DATA_BLKS are the parameters that control the number of history control blocks (HCBs) and history data blocks (HDBs) PRI. Recommended value is one HCB and one HDB per trunk member.

Table LTCINV (LTC Inventory)

Table LTCINV is used to maintain a list of line and trunk controller-based peripherals (for example, LTC, LGC, DTCI, and LTCI) that are datafilled in the Meridian SuperNode system. The table identifies where the ISDN digital trunk controller (DTCI) is located, the load and exec lineups required, and also the network link connections.

The following LTCINV fields are important in the TERMTYPEs vector:

- TERMTYPE—PRAB must be datafilled.
- EXEC—should be datafilled as DTCEX.

An additional important field is OPTCARD. This vector must include ISP16.

The following is an example of datafill for table LTCINV.

```
TABLE LTCINV

LTCNAME ADNUM FRTYPE FRNO SHPOS FLOOR ROW FRPOS EQPEC LOAD

EXECTAB CSLNKTAB OPTCARD TONESET PECS6X45 E2LOAD OPTATTR

PEC6X40 EXTINFO
-------------------------------------------------------------
DTCI 10 5 MCTMI5 33 1 D 2 6X02NA ELI06BH (POTS POTSEX)

(KEYSET KSETEX) (PRAB DTCEX) (AVPRATRK ADTCIX) $ (0 12 0 0)

(0 12 0 1) (0 12 0 2) (0 12 0 3) (0 12 0 4) (0 12 0 5)

(0 12 0 6) (0 12 0 7) (0 12 0 8) (0 12 0 9) (0 12 0 10)

(0 12 0 11) (0 12 0 12) (0 12 0 13) (0 12 0 14) (0 12 0 15) $

(UTR15) (MSG6X69) (CMR13 CMR03A) (ISP16) $ NORTHAM MX77A

AMX77AA MX77NB03 $ 6X40FA N
```

Table LTCPSINV (LTC P-Side Inventory)

An entry in the LTCPSINV table is added automatically when a DTCI is added in the LTCINV table.

The following LTCPSINV fields are important in the P-side links vector:

- AREASELECT—must be DS1PRA.
- CARRIDX—as defined in table CARRMTC.
- IID—Recommended value for a single DS-1 is 0 (zero). When datafilling multiple DS-1s per trunk group, a different IID is required for each DS-1.

The following is an example tuple for table LTCPSINV.

```
TABLE LTCPSINV

LTCNAME PSLNKTAB

-----------------

DTCI 10 N (0 DS1PRA PRADEF N 0 NIL) (1 DS1PRA PRADEF N 0 NIL)

(2 DS1PRA PRADEF N 0 NIL) (3 NILTYPE) (4 DS30A) (5 DS30A)

(6 DS30A) (7 DS30A) (8 NILTYPE) (9 NILTYPE) (10 NILTYPE)
```

```
(11 DS1PRA PRIESF N 0 NIL) (12 DS30A) (13 DS30A) (14 DS30A)

(15 DS30A) (16 NILTYPE) (17 DCH) (18 NILTYPE) (19 DCH) $
```

Table CARRMTC (Carrier Maintenance)

The attributes of DS-1 carriers are datafilled in the CARRMTC table and referenced from the DTCI P-side inventory table, LTCPSINV.

The following is the recommended tuple for 56 kbit/s and 64 kbit/s rest:

```
DTCI ZCS 255 255 DTCI NT6X50AB SF ZCS BPV NILDL N 250 1000 50

50 150 1000 3 6 864 100 17 511 4 255 $
```

The following is the recommended tuple for 64 kbit/s clear:

```
DTCI DEFAULT NT6X50AB SF B8ZS BPV NILDL N 250 1000 50 50 150

1000 6 3 864 100 17 511 5 255 $
```

Note: For 56 kbit/s/ZCS, the NT6X50AA is valid.

Any difficulty bringing the carriers into service with these CARRMTC tuples may be a result of a timing inconsistency between the DS-1s with respect to alarm filtering at Layer 1.

This problem is alleviated by creating two new entries in table CARRMTC for the carriers. These tuples are similar to the DTCI DEFAULT and DTCI ZCS entries, respectively, except the Remote Carrier Group Alarm (RCGA) filter times have been increased to 10 seconds. The overall effect of these changes is to ease the task of returning the carriers to service.

The following is the recommended tuple for 64 kbit/s clear:

```
DTCI B8ZSSL1 255 255 DTCI NT6X50AB SF B8ZS BPV NILDL N 250

1000 1000 1000 150 1000 3 6 864 100 17 511 4 255 $
```

The following is the recommended tuple for 56 kbit/s:

```
DTCI ZCSSL1 255 255 DTCI NT6X50AB SF ZCS BPV NILDL N 250 1000

 1000 1000 150 1000 3 6 864 100 17 511 4 255 $
```

ZLG
This is the line coding scheme used for this DS-1. The choices include the following:

- ZCS—This is used if the repeaters cannot handle the bipolar violations inherent in the B8ZS line encoding scheme.
- B8ZS—This allows for the capability of 64 kbit/s clear communication.

FF
This is the frame format used. The choices include the following:

- SF—Superframe
- ESF (Extended Superframe Format)—With ESF, the bit error base can be cyclic redundancy check (CRC) or bipolar violations (BPVs) and the facility data link (FDL) is used for transmitting yellow alarm. Further use of the FDL is not currently supported. For more details on this table, refer to *Customer Data Schema*.

The DS-1 link can be configured in four basic operational modes with various levels for performance parameters. The card type for all four modes is NT6X50AB. The four basic modes are as follows:

- SF/ZCS—SF format and ZCS line encoding result in a maximum transfer capability of 64 kbit/s restricted information. (No all-zero bytes/octets are passed.)
- SF/B8ZS—SF format and B8ZS line encoding allows the passing of 64 kbit/s unrestricted information. (All bytes/octets are passed transparently.)
- ESF/ZCS—ESF format and ZCS line encoding is like SF/ZCS except that the yellow alarm is sent through the FDL and CRC information can be used as the bit error ratio base.
- ESF/B8ZS—ESF format and B8ZS line encoding offer the same transfer capability as SF/B8ZS.

The following are other carrier options that can be specified; the defaults are shown in parentheses:

- bit error ratio base—BPV or CRC
- data link (NILDL)
- inhibit alarm transmit (N)
- local carrier group alarm set threshold (250) specified in units of 10 ms
- local carrier group alarm clear threshold (1000) specified in units of 10 ms

- remote carrier group alarm set threshold (50) specified in units of 10 ms
- remote carrier group alarm clear threshold (50) specified in units of 10 ms
- alarm indication signal set threshold (150) specified in units of 10 ms
- alarm indication signal clear threshold (1000) specified in units of 10 ms
- bit error rate maintenance limit threshold expressed as a negative exponent of 10 (6 x 10-*6*)
- bit error rate out-of-service limit threshold expressed as a negative exponent of 10 (3 x 10-*3*)
- errored second limit (864)
- severe errored second limit (100)

The DS-1 attributes for a given carrier are changed as follows:

- Make sure the associated carriers are either manual busy (MANB) or offline (OFFL).
- Create a new tuple, if necessary, in table CARRMTC with the required attributes.
- In the P-side inventory table, LTCPSINV, assign the new tuple to the desired DS-1 carriers.
- Busy and return the carrier to service.

PRI facility-related tables

These tables describe characteristics of the physical interface and B-channel allocation rather than the service being provided on the interface.

These parameters are datafilled in tables TRKGRP, TRKSGRP, and TRKMEM.

Table TRKGRP (trunk group)

For all applications (both PRI and non-PRI), the TRKGRP table is used to define data associated with each trunk group interface.

The following is an example tuple:

```
K2KPRI64CLLP1 IBNT2 ... ASEQ ... (LTID ISDN 555) $
```

The following TRKGRP fields are important to PRI setup:

- GRPTYP—This is the group type used for call processing. For PRI, IBNT2 is used, as shown in the preceding example.
- SELSEQ—For PRI, only ASEQ or DSEQ should be used. The other end of the trunk should then use the opposite value to reduce B-channel glare.
- LTID—It is broken down into LTGRP (ISDN) and LTNUM (555) and is a read-only field. Upon making an entry in table LTMAP, this field is automatically updated. Table 5-5 is an example of TRKGRP datafill using IBNT2 GRPTYP.

Table 5-5 Example of TRKGRP datafill using IBNT2 GRPTYP (Sheet 1 of 2)

Field	Datafill
CLLI	K2CPR64CL
GRPTYP	IBNT2
TRAFSNO	0
PADGRP	NPDGP
NCCLS	NCRT
CUSTNAME	BNRRCH
SUBGRPN	0
SELSEQ	ASEQ
NCOS	60
BILLDN	N (see note 1)
SUPV	ANSDISC *
DISCTSEL	0 *
INTRAGRP	Y
DIGIT0	N *
DIGIT1	N *
DTI	N *

Note 1: Table LTDATA must be datafilled with a default CGN (calling number).

Note 2: The fields marked with an asterisk (*) are controlled for ISDN signaling type trunks through table TRKSGRP. These values are mandatory for a PRI interface.

Table 5-5 Example of TRKGRP datafill using IBNT2 GRPTYP (Sheet 2 of 2)

Field	Datafill
TES	N *
CDR	N
SMDR	N
TRC	0
ALTNCOS	0
TRKDSR	N
LSCFN	0
ALTLSCFN	0
LSCINCPT	0
ALSCINCP	0
IGA	N *
FDN	N *
FDV	N *
FLASH	N *
DPX	N *
PREEMPT_INFO	N
AIOD	N *
REORIG	N
OFFNET	Y
COFFTYP	NATL
OPTIONS	LTID (ISDN 99) $

Note 1: Table LTDATA must be datafilled with a default CGN (calling number).

Note 2: The fields marked with an asterisk (*) are controlled for ISDN signaling type trunks through table TRKSGRP. These values are mandatory for a PRI interface.

Table TRKSGRP (trunk subgroup)

Table TRKSGRP lists the supplementary information for each subgroup assigned to one of the trunk group interfaces listed in table TRKGRP. For PRI applications, it is in this table that the signaling channel (the primary and backup channels) is defined for each trunk group.

On the ISDN trunk controller, subfield DCHRATE of the DCHNL field indicates the data rate of the D-channel; the valid values are 64 kbit/s and 56 kbit/s.

The following is an example tuple that is datafilled for the network side of the user/network interface with a single D-channel:

```
K2KPRI64CLLP1 0 DS1SIG ISDN 10 20 87Q931 2 N YIELD +

NETWORK PT_PT USER Y Y 30 DTCI 10 0 24 $
```

The following is an example tuple that is datafilled for the network side of the network/user interface with primary and backup D-channels:

```
MSL2LECNI2 0 DS1SIG ISDN 15 15 87Q931 2 N YIELD USER PT_PT

USER N UNEQ 16 N TEST DTCI 3 8 24 64K HDLC (DTCI 3 9 24 64K

HDLC) $ $
```

The following TRKSGRP fields are important to PRI setup.

- CARDCODE—DS1SIG is the card code used for ISDN PRI.
- SIGDATA—The protocol used for call processing. ISDN is the only valid field for a PRI trunk.
- IFCLASS—This field describes whether this end of the PRI trunk is to be considered the network end or the user end of the protocol.
- TRKGRDTM—Recommended value for trunk guard timing for PRI is 30.
- DCHNL—The D-channel to be used for this PRI interface. It is made up of subfields DTCINO, DTCICKTNO, DTCICKTTS, and DCHRATE. The field DCHNL can be datafilled twice: once for the primary D-channel and once for the backup D-channel.
- DCHBCKUP—The backup D-channel (if any) is specified by datafilling this field. It has the same subfields as the DCHNL field.

ITA configuration

In order to configure ITA on the trunk controller, the non-PRI trunk groups are datafilled in table TRKSGRP along with PRI trunk groups.

Table TRKMEM (trunk member)

Table TRKMEM lists the data associated with each analog or digital trunk. Specifically for PRI, it defines the B-channels in each trunk group.

The following are example tuples:

```
K2KPRI64CLLP1 1 0 DTCI 10 0 1 $

K2KPRI64CLLP1 2 0 DTCI 10 0 2 $

K2KPRI64CLLP1 3 0 DTCI 10 0 3 $
```

The following TRKMEM fields are important to PRI setup:

- EXTRKNM—This is the first digit of the key of this tuple and should be the same as the DTCI or LTCI circuit time slot number to ensure that trunk selection is done in the correct order.
- PMTYPE—The Peripheral Module (PM) type used for PRI is DTCI or LTCI.

ITA configuration

Non-PRI trunk members are datafilled in table TRKMEM along with PRI B-channels. The following example presents an ITA configuration.

The following are example tuples:

- `K2KPRI64CL 1 0 DTCI 10 0 1 $`
- `K2KPRI64CL 2 0 DTCI 10 0 2 $`
- `K2KPRI64CL 3 0 DTCI 10 0 3 $`
- `K2KABTRK1 1 0 DTCI 10 0 4  ABTRK GRP 1 $`
- `K2KABTRK2 1 0 DTCI 10 0 5  ABTRK GRP 2 $`

Note that the AREASELECT field in P-side links vector of the DTCI or LTCI tuple in table LTCPSINV is DS1PRI for ITA.

PRI service-related tables

The parameters in the following tables describe the type and level of services to be provided on the PRI interface. The three tables used to describe these logical characteristics of the interface are tables LTDEF, LTDATA, and LTCALLS. The mapping of these logical attributes to the physical interface is accomplished through table LTMAP datafill.

Table LTDEF (logical terminal definition)

Table LTDEF is used to define logical terminals along with their access privileges. For PRI, the only allowable access privilege is B.

The following is an example tuple:

```
ISDN 15 B PRA 25 25 4 4

     NIPRI NI2V1 NIL (NOPMD) $
```

The following LTDEF fields are important to PRI setup.

- LTAP—The access privilege of the LT; must be B for PRI.
- LTCLASS—Must be PRA.
- VARIANT—Specifies the vendor-specific switch protocols for the profile. Must be NIPPRI.
- ISSUE—Must be NI2VI.
- OPTIONS—The options NOVOICE, NOVBD, and NOCMD control the use of BCs on the PRI as follows:
  - NOVOICE—Prevents calls with BC of SPEECH from terminating or originating on this PRI.
  - NOVBD—Prevents calls with BC of 3.1 KHz audio (also known as voice-band data).
  - NOCMD—Prevents calls with BC of 64 kbit/s (clear or restricted) and 56 kbit/s (also known as circuit-mode data).
  - NOPMD—Prevents calls with packet mode data. This is the default.

Table LTCALLS (logical terminal calls)

Table LTCALLS defines service-related data associated with the Call type. Call types supported by this table include public (PUBLIC), private (PRIVATE), wide area telecommunications service (WATS), inward WATS (INWATS), foreign exchange (FX), and tie trunk (TIE).

The following is an example tuple (CALLTYPE = PUB):

```
ISDN 555 PUB XLAIBN 52 MTLL  1  250 $
```

Fields are varied depending on the call type selected.

Table LTDATA (logical terminal data)

Table LTDATA stores additional service-related data associated with the LTID. This table is used to enter data related to directory numbers (DNs), such as the

default Calling Party Number or billing number. Initially, only one 10-digit number is supported.

The following is an example tuple:

```
ISDN 555 DN DN 6137221234 $
```

Field DFLTCGN is the default calling number to be used if none is supplied in the SETUP message. It is also used for billing in the BILLDN field if table TRKGRP is N.

Datafill a default CGN (calling number) if the CGN is suppressed. If the CGN is suppressed and a default CGN is not datafilled, a DFIL617 log generates.

Table LTMAP (logical terminal mapping)

Table LTMAP maps LTIDs to common language location identifiers (CLLIs). Once an entry is made in LTMAP, an update to table TRKGRP is automatically performed. The TRKGRP field, LTID, is changed from $ to LTGRP and LTNUM entered in LTMAP.

The following is an example tuple:

```
ISDN 555 CLLI K2KPRI64CLLP1 TEI 0 $
```

The following LTMAP fields are important to PRI setup:

- MAPTYPE—This field should always be CLLI for PRI.
- CLLI—The name of the PRI trunk datafilled in table TRKGRP.
- OPTIONS—This field's only valid entry is TEI 0.

Table CUSTNTWK (customer networking)

Table CUSTNTWK controls customer networking features; for PRI, it controls the display on Meridian SuperNode telephones when interworking with PRI.

The following is an example tuple:

```
CUSTNAME PUBLIC 1 CLID OFFNET $
```

The following CUSTNTWK fields are important to PRI setup.

- CUSTNAME—The customer group of the line being called.
- NETNAME—Use the value PUBLIC.

- NETCGID—Use the value 1.
- DNREVXLA—Use the value $.
- OPTIONS—This field is prompted for repeatedly. The value CLID (with ONNET or OFFNET) should be entered at one of the prompts.

Table DNGRPS (DN group)

Table DNGRPS may alter the display of groups of DNs (such as all numbers from 7262000 to 7262999 will not be displayed). It is also used to set privacy bit in the calling party number information element in the Q.931 SETUP message.

Table DNATTRS (DN attributes)

Table DNATTRS alters the display of specific DNs. For example, 613 726 7860 is displayed as 613 737 1111.

Table SPECCONN

Table SPECCONN is used to datafill special connections needed in the switch. It contains one tuple for each special connection. Each special connection contains two valid endpoints that are connected together with a permanent nailed up connection. The connection can involve one or more extended multiprocessor system (XMS)-based peripheral module (XPM), one or more ISDN line concentrating device (LCD) and the DMS network, depending on the type and location of the endpoints. The utility is not restricted for ISDN use only. For more information about table SPECCONN refer to the *Customer Data Schema* NTP.

The following is an example tuple:

```
RCLU RCU0 01 2 00 00 VN 1010 0 ON DS0T SNU2 3 2 17 VN 0010

CAB ACTIVE
```

Table NLUPCLLI

Table NLUPCLLI can be provided in a switching unit that has feature package NTX802AA (Toll Features II), or feature package NTX902AA (Local Features II).

A hard-wired supervision (off-hook) does not have to be available at the incoming side of the nailed-up connection pair. Both in-band and standard supervision signals in both directions are supported.

Trunks assigned to the nailed-up connection trunk group are assigned trunk group type NU in table TRKGRP.

There can be a maximum of 801 nailed-up connections (0 to 800). For each of the connections, the common language location identifier (CLLI) and external

trunk number of the incoming and outgoing trunks that are to be connected must be datafilled, and the value of field CONNECT must be specified. For more information about table NLUPCLLI, refer to the *Customer Data Schema* NTP.

The following is an example tuple:

```
10 OTWAON52CG02 15  HULLPQ1077X0 17  Y
```

Calling Name Display (CND) on an outgoing NI2 PRI network trunk

For CND to be passed over NI2 PRI network-side trunks and user-side trunks, the following datafill is required.

Table TRKSGRP (trunk subgroup)

Table TRKSGRP lists the supplementary information for each subgroup assigned to one of the trunk group interfaces listed in table TRKGRP. For PRI applications, it is in this table that the signaling channel (the primary and backup channels) is defined for each trunk group.

The entry that is datafilled in the field PARMNAME is part of the key to get into table ISDNPARM.

The following is an example of the tuple for table TRKSGRP for the user-side trunk (note that TEST is specified for field PARMNAME in this example):

```
MSL2LECNI2 0 DS1SIG ISDN 15 15 87Q931 2 N YIELD USER PT_PT

USER N UNEQ 16 N TEST DTCI 3 8 24 64K HDLC (DTCI 3 9 24 64K

HDLC) $ $
```

The following is an example of the tuple for table TRKSGRP for the network-side trunk (note that TEST is specified for field PARMNAME in this example):

```
MSL2LECNI2 0 DS1SIG ISDN 15 15 87Q931 2 N YIELD NETWORK PT_PT

USER N UNEQ 16 N TEST DTCI 3 8 24 64K HDLC (DTCI 3 9 24 64K

HDLC) $ $
```

Table LTDATA (logical terminal data)

Table LTDATA stores additional service-related data associated with the LTID. This table is used to enter data related to directory numbers (DNs), such as the default Calling Party Number or billing number. Initially, only one 10-digit number is supported.

A TCAP_CNAM service option is located in table LTDATA for datatype SERV. This option is associated with the logical terminal (LTID) of the trunk. It is checked by a network-side PRI terminating agent to determine whether to deliver the calling user's name. If the TCAP_CNAM option does not appear on the PRI interface, calling name is not delivered.

The field CNAM_SUSP is associated with TCAP_CNAM.

- CNAM_SUSP—enables and disables SUSP billing for PRILTID. Set refinement CNAM_SUSP as follows:
  - — Y—to enable billing.
  - — N—to disable billing. The default value is N.

The following is an example of the SERV tuple for table LTDATA. Note that the option TCAP_CNAM is specified in order to allow the calling name to be sent over the associated PRI trunk. Also note that CNAME_SUSP is set to N to disabled billing.

```
ISDN 381 SERV SERV Y Y ALWAYS ALWAYS (TCAP_CNAM N) $
```

Table CUSTNTWK (customer networking)

Table CUSTNTWK controls customer networking features. For PRI, table CUSTNTWK controls the display on Meridian SuperNode telephones when interworking with PRI_SUSP.

The following fields and entries are important to setup.

- OPTION—the required entry is TCAPNM.
- TCAPNM—this field has two possible entries:
  - — LOCAL—the Meridian SuperNode looks in its own database for the name.
  - — NONLOCAL—the Meridian SuperNode does a TCAP query in an attempt to get the calling party (originator) name from the public network.

The following is an example tuple for table CUSTNTWK with the TCAPNM field set to LOCAL:

```
CUSTNAME PUBLIC 1 $ CLID ONNET TCAPNM LOCAL $
```

Table NETNAMES

Table NETNAMES defines internal logical network names. These names are used in tables storing DN attributes corresponding to the network

The following fields are important to setup.

- NETOPTS—Set this field to NMDSP.
- NMDSP—This field has two possible entries:
  - — SETUP—causes calling name to go across PRI trunks in the setup message.
  - — QUERY—sends back a query asking for the calling name.

The following is an example tuple for table NETNAMES with the NETOPTS field set to NMDSP:

```
BNRRCH 0 0 NMDSP SETUP
```

Table ISDNPARM

Table ISDNPARM specifies the optional information element handling routine for each primary rate interface (PRI) for certain Q931 messages.

For the SETUP message type, it is important to specify the following in the field DFLTACT:

- MAP—use this entry. This entry allow the sending of the name information in the SETUP message.
- BLK—This entry blocks the sending of the name information in the SETUP message.

The ISDN parameter message direction is set in field MSGDIR. There are three possible entries:

- IN—Incoming
- OUT—Outgoing
- BOTH—Incoming and outgoing

The following is an example tuple for table ISDNPARM with the DFLTACT field set to MAP. Remember that the key to this table is datafilled as the PARMNAME of the corresponding type in table TRKSGRP. Refer to the "Table TRKSGRP (trunk subgroup)" section in this chapter.

```
TEST SETUP BOTH MAP $
```

Table OFCVAR

The TCAPNM_INTERLATA_QUERY office parameter in table OFCVAR is important when setting up calling name delivery. Possible entries are as follows:

- Y—indicates both intraLATA and interLATA calls perform TCAP queries when necessary.
- N—indicates only intraLATA calls perform TCAP queries when necessary. The default is N.

The TCAP timer is assigned per customer group basis. The PRI TCAP_CNAM option in table LTDATA is assigned per LTID. The corresponding LTID in table LTCALLS must have the respective customer group provisioned in order to set the timer. A customer group is only allowed for a LTID with an IGN translation route. The attributes if the customer group control the TCAP timer in table CUSTHEAD.

The TCAP timer option (NDTIMOUT) has the range of one to six seconds. The default time for the TCAP interface is three seconds.

Table OFCENG

The IAM_USE_NAME_CHARS office parameter in table OFCENG is important when setting up calling name delivery. Possible entries are as follows:

- Y—indicates that when the Meridian SuperNode NI2 PRI user or SS7 trunk receives a name from the network, it allows routing of the name through the Meridian SuperNode to an outgoing NI2 PRI network trunk.
- N—indicates that when the Meridian SuperNode NI2 PRI user or SS7 trunk receives a name from the network, it does not allow that name to be used when routing to an outgoing NI2 PRI network trunk. The default is N.

Note: Incoming PRI to outgoing SS7 calling names are not supported.

6 NTNA database information

The Primary Rate Interface (PRI) subscription parameters allow customers to support PRI and fashion it to their own particular needs. The Meridian SuperNode switch assigns the parameters by datafilling a set of software tables. The Meridian SuperNode table descriptions that follow are presented in the order of datafill.

Database correlation

A number of database items have to be correlated in the Meridian SuperNode database. Some of these items must be carefully coordinated to ensure a properly functioning PRI. This section attempts to highlight these parameters and provide the equivalent (and recommended) parameters to be used for provisioning the Meridian SuperNode switch.

Configuration data correlation

No correlation in hardware-related database.

Layer 1 data correlation

The correlation of Layer 1 data is described in Table 6-1.

Table 6-1 Layer 1 database correlation (Sheet 1 of 2)

Description	Table	Field	Value
Card Type	CARRMTC	CARD	NT6X50AA, NT6X50AB
Frame Format:	CARRMTC	FF	
SuperFrame			SF
Extended SuperFrame			ESF
Line Encoding:	CARRMTC	ZLG	
Zero Code Suppress (ZCS)			

Table 6-1 Layer 1 database correlation (Sheet 2 of 2)

Description		Table	Field	Value
	Bipolar 8 Zero Substitution (B8ZS)			
Bit Error Ratio Base:		CARRMTC	BERB	
	Bipolar Violations			BPV
	CRC Errors			CRC
Data Link:		CARRMTC	DLK	
	No Data Link			
	FDL—source ts 1			
	FDL—source ext			
Inhibit Alarm Transmit		CARRMTC	IAT	Y, N
Bit Error Ratio Maintenance Limit		CARRMTC	BERML	6 (exponent)
Bit Error Ratio Out of Service Limit		CARRMTC	BEROL	3 (exponent)
Errored Second Threshold		CARRMTC	ES	864
Frame Bit Error Maintenance Limit		CARRMTC	FRAMEML	17
Frame Bit Error Out of Service Limit		CARRMTC	FRAMEOL	511
Slip Count Maintenance Limit		CARRMTC	SLIPML	4
Slip Count Out of Service Limit		CARRMTC	SLIPOL	255

Layer 2 data correlation

The correlation of Layer 2 data is described in Table 6-2.

Table 6-2 Layer 2 database correlation

Description	Table	Field	Value
Associate D-channel with PRI	TRKSGRP	DCHNL	Same as DS1 endpoint in table SPECCONN
Data Rate of D-channel	STINV	CONTYPE	PRABAUD
		BAUD	64 kbit/s, 56 kbit/s

Layer 3 service data

The Layer 3 service-related database correlation ensures that certain service-related parameters are aligned with their equivalents in the other switch, as shown in Table 6-3.

Note: For the interface identifier (field IID) of table LTCPSINV, the recommended value for datafilling a single DS-1 is 0 (zero). When datafilling multiple DS-1s per trunk group, a different IID is required for each DS-1. The IID must match with the IID of the connecting switch.

Candidates include the translation information associated with PRI, the call types subscribed to, and the bearer capabilities (BCs) enabled.

Table 6-3 Layer 3 facility data correlation (Sheet 1 of 2)

Description	Table	Field	Value
Q.931 Interface Identifier (used in CID I.E.)	LTCPSINV	IID	0 (recommended)
Q.931 Call Reference value length	TRKSGRP	CRLENGTH	2
B-channel Selection	TRKGRP	SELSEQ	ASEQ, DSEQ
Billing at PRI I/F recommend using CGN in SETUP	TRKGRP	BILLDN	N
Loss & Level	TRKGRP	PADGRP	PRIC
User-Network Interface	TRKSGRP	IFCLASS	NETWORK

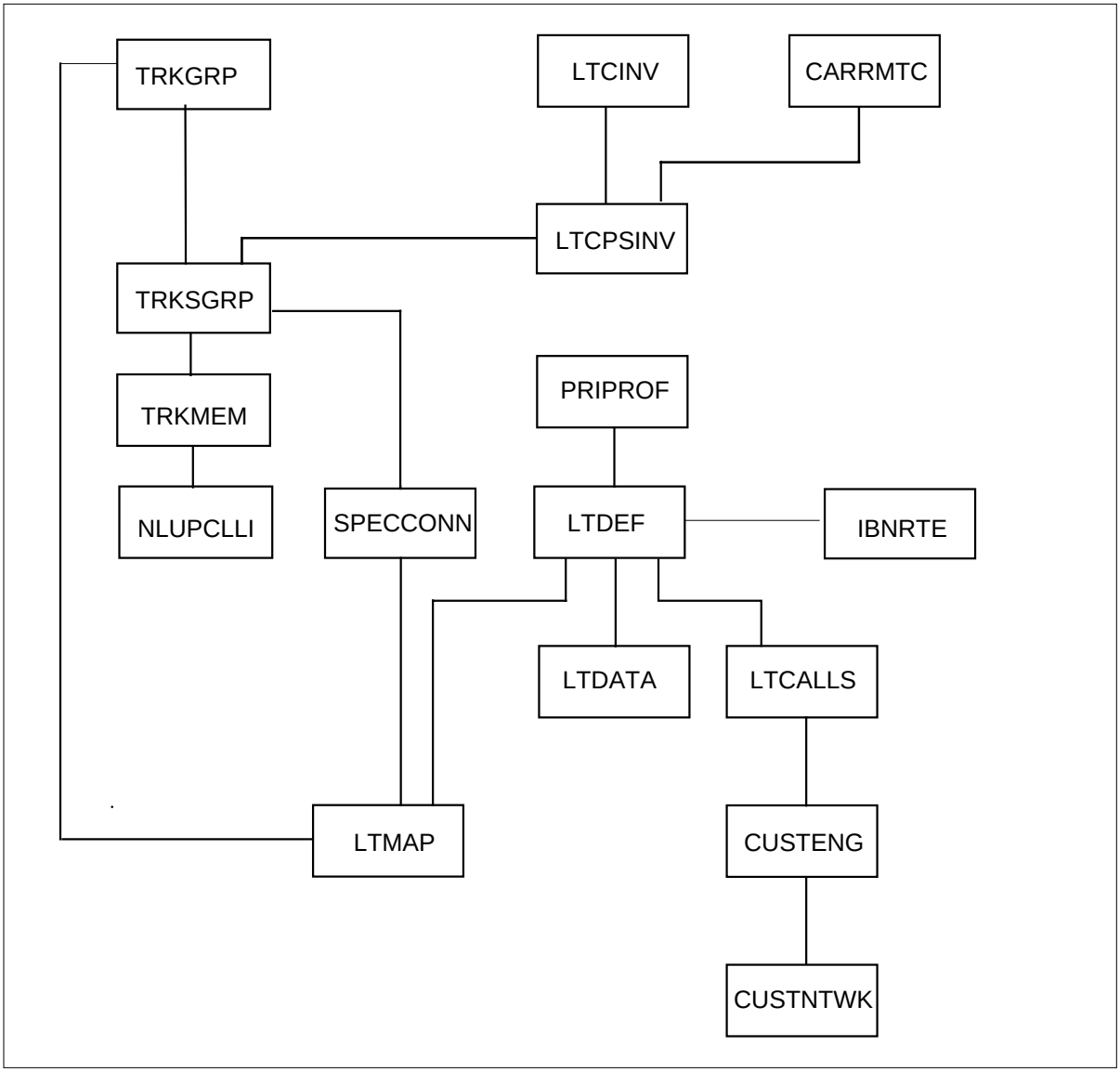
Table 6-3 Layer 3 facility data correlation (Sheet 2 of 2)

Description	Table	Field	Value
Q.931 Progress Indicator location	TRKSGRP	LOCATION	Network
B-channels defined	TRKMEM	PMTYPE	DTCI

Datafill order

Figure 6-1 shows the interdependencies of tables within the Meridian SuperNode database and the resulting datafill order. Tables should be datafilled from top to bottom. Tables at the same vertical position (in figure) can be datafilled in parallel.

Figure 6-1 Datafill order for ISDN PRI tables



Configuration data

The following sections describe the tables that need to be datafilled for PRI to function. These tables must be completed to define PRI facilities for basic call processing.

Table PRIPROF (PRI Profile)

Table PRIPROF contains information about the function switches defining a specific issue of a variant. Default values are automatically added when table PRIPROF is initialized.

The following PRIPROF fields are important to PRI setup:

- PROFNAME—an eight character, user defined string (default is NIL)
- VARIANT—specifies one of four vendor-specific switch protocols for the profile. Values are NTNAPRI, N449PRI, U449PRI, and U459PRI. The default is NTNAPRI.
- ISSUE—specifies the release issue of the variant. Values are V1 or MCIV1. The default is V1.
- SWITCH—a vector of up to 64 function switch names (default is NIL)

Table OFCENG (Office Engineering)

Table OFCENG defines engineering parameters for the Meridian SuperNode switch.

The following OFCENG fields are important to PRI setup:

- PARMNAME—office parameter
- PARMVAL—defines the office parameter value. NO_OF_HIS_CONTROL_BLKS and NO_OF_HIS_DATA_BLKS are the parameters that control the number of history control blocks (HCB) and history data blocks (HDB) PRI. Recommended value is one HCB and one HDB per trunk member.

Table LTCINV (LTC Inventory)

Table LTCINV is used to maintain a list of line trunk controller (LTC) based peripherals that are datafilled in the Meridian SuperNode system. It identifies where the ISDN digital trunk controller (DTCI) is located, the load and exec lineups required, and also the network link connections.

The following LTCINV fields are important in the TERMTYPEs vector:

- TERMTYPE—PRAB must be datafilled.
- EXEC—should be datafilled as DTCEX.

An additional important field is OPTCARD. This vector must include ISP16.

The following is an example of datafill for table LTCINV.

```
TABLE LTCINV

LTCNAME ADNUM FRTYPE FRNO SHPOS FLOOR ROW FRPOS EQPEC LOAD

EXECTAB CSLNKTAB OPTCARD TONESET PECS6X45 E2LOAD OPTATTR

PEC6X40 EXTINFO

------------------------------------------------------------
DTCI 10 5 MCTMI5 33 1 D 2 6X02NA ELI06BH (POTS POTSEX)

(KEYSET KSETEX) (PRAB DTCEX) (AVPRATRK ADTCIX) $ (0 12 0 0)

(0 12 0 1) (0 12 0 2) (0 12 0 3) (0 12 0 4) (0 12 0 5)

(0 12 0 6) (0 12 0 7) (0 12 0 8) (0 12 0 9) (0 12 0 10)

(0 12 0 11) (0 12 0 12) (0 12 0 13) (0 12 0 14) (0 12 0 15)$

(UTR15) (MSG6X69) (CMR13 CMR03A) (ISP16) $ NORTHAM MX77AA

MX77AA MX77NB03 $ 6X40FA N
```

Table LTCPSINV (LTC P-Side Inventory)

An entry in the LTCPSINV table is added automatically when a DTCI is added in the LTCINV table.

The following LTCPSINV fields are important in the P-side links vector:

- AREASELECT—must be DS1PRA.
- CARRIDX—as defined in table CARRMTC.
- IID—Recommended value for a single DS-1 is 0 (zero). When datafilling multiple DS-1s per trunk group, a different IID is required for each DS-1.

The following is an example tuple for table LTCPSINV.

```
TABLE LTCPSINV

LTCNAME PSLNKTAB

-----------------

DTCI 10 N (0 DS1PRA PRADEF N 0 NIL) (1 DS1PRA PRADEF N 0 NIL)

(2 DS1PRA PRADEF N 0 NIL) (3 NILTYPE) (4 DS30A) (5 DS30A)
```

```
(6 DS30A) (7 DS30A) (8 NILTYPE) (9 NILTYPE) (10 NILTYPE)

(11 DS1PRA PRIESF N 0 NIL) (12 DS30A) (13 DS30A) (14 DS30A)

(15 DS30A) (16 NILTYPE) (17 DCH) (18 NILTYPE) (19 DCH) $
```

Table CARRMTC (Carrier Maintenance)

The attributes of DS-1 carriers are datafilled in the table CARRMTC and referenced from the DTCI P-side inventory table, LTCPSINV.

The following is the recommended tuple for 56 kbit/s and 64 kbit/s rest:

```
DTCI ZCS 255 255 DTCI NT6X50AB SF ZCS BPV NILDL N 250 1000 50

 50 150 1000 3 6 864 100 17 511 4 255 $
```

The following is the recommended tuple for 64 kbit/s clear:

```
DTCI DEFAULT NT6X50AB SF B8ZS BPV NILDL N 250 1000 50 50 150

 1000 6 3 864 100 17 511 5 255 $
```

Note: For 56 kbit/s/ZCS, the NT6X50AA is valid.

Any difficulty bringing the carriers into service with these CARRMTC tuples may be a result of a timing inconsistency between the DS-1s with respect to alarm filtering at Layer 1.

This problem is alleviated by creating two new entries in table CARRMTC for the carriers. These tuples are similar to the DTCI DEFAULT and DTCI ZCS entries, respectively, except the Remote Carrier Group Alarm (RCGA) filter times have been increased to 10 seconds. The overall effect of these changes is to ease the task of returning the carriers to service.

The following is the recommended tuple for 64 kbit/s clear:

```
DTCI B8ZSSL1 255 255 DTCI NT6X50AB SF B8ZS BPV NILDL N 250

1000 1000 1000 150 1000 3 6 864 100 17 511 4 255 $
```

The following is the recommended tuple for 56 kbit/s:

```
DTCI ZCSSL1 255 255 DTCI NT6X50AB SF ZCS BPV NILDL N 250 1000

1000 1000 150 1000 3 6 864 100 17 511 4 255 $
```

ZLG
This is the line coding scheme used for this DS-1. The choices include the following:

- ZCS—This is used if the repeaters cannot handle the bipolar violations inherent in the B8ZS line encoding scheme.
- B8ZS—This allows for the capability of 64 kbit/s clear communication.

FF
This is the frame format used. The choices include the following:

- SF—Superframe
- ESF (Extended Superframe Format)—With ESF, the bit error base can be cyclic redundancy check (CRC) or bipolar violations (BPVs) and the facility data link (FDL) is used for transmitting yellow alarm. Further use of the FDL is not currently supported. For more details on this table, refer to *Customer Data Schema*.

The DS-1 link can be configured in four basic operational modes with various levels for performance parameters. The card type for all four modes is NT6X50AB. The four basic modes are as follows:

- SF/ZCS—SF format and ZCS line encoding result in a maximum transfer capability of 64 kbit/s restricted information. (No all-zero bytes/octets are passed.)
- SF/B8ZS—SF format and B8ZS line encoding allows the passing of 64 kbit/s unrestricted information. (All bytes/octets are passed transparently.)
- ESF/ZCS—ESF format and ZCS line encoding is like SF/ZCS except that the yellow alarm is sent through the FDL and CRC information can be used as the bit error ratio base.
- ESF/B8ZS—ESF format and B8ZS line encoding offer the same transfer capability as SF/B8ZS.

The following are other carrier options that can be specified; the defaults are shown in parentheses:

- bit error ratio base—BPV or CRC
- data link (NILDL)
- inhibit alarm transmit (N)
- local carrier group alarm set threshold (250) specified in units of 10 ms
- local carrier group alarm clear threshold (1000) specified in units of 10 ms

- remote carrier group alarm set threshold (50) specified in units of 10 ms
- remote carrier group alarm clear threshold (50) specified in units of 10 ms
- alarm indication signal set threshold (150) specified in units of 10 ms
- alarm indication signal clear threshold (1000) specified in units of 10 ms
- bit error rate maintenance limit threshold expressed as a negative exponent of 10 (6×10^{-6})
- bit error rate out-of-service limit threshold expressed as a negative exponent of 10 (3×10^{-3})
- errored second limit (864)
- severe errored second limit (100)

The DS-1 attributes for a given carrier are changed as follows:

- Make sure the associated carriers are either manual busy (MANB) or offline (OFFL).
- Create a new tuple, if necessary, in table CARRMTC with the required attributes.
- In the P-side inventory table, LTCPSINV, assign the new tuple to the desired DS-1 carriers.
- Busy and return the carrier to service.

PRI facility-related tables

These tables describe characteristics of the physical interface and B-channel allocation rather than the service being provided on the interface.

These parameters are datafilled in tables TRKGRP, TRKSGRP, and TRKMEM.

Table TRKGRP (trunk group)

For all applications (both PRI and non-PRI), the TRKGRP table is used to define data associated with each trunk group interface.

The following is an example tuple:

```
K2KPRI64CLLP1 IBNT2 ... ASEQ ... (LTID ISDN 555) $
```

The following TRKGRP fields are important to PRI setup:

- GRPTYP—This is the group type used for call processing. For PRI, IBNT2 is used, as shown in the preceding example.
- SELSEQ—For PRI, only ASEQ or DSEQ should be used. The other end of the trunk should then use the opposite value to reduce B-channel glare.
- LTID—It is broken down into LTGRP (ISDN) and LTNUM (555) and is a read-only field. Upon making an entry in table LTMAP, this field is automatically updated. Table 6-4 is an example of TRKGRP datafill using IBNT2 GRPTYP.

Table 6-4 Example of TRKGRP datafill using IBNT2 GRPTYP (Sheet 1 of 2)

Field	Datafill
CLLI	K2CPR64CL
GRPTYP	IBNT2
TRAFSNO	0
PADGRP	NPDGP
NCCLS	NCRT
CUSTNAME	BNRRCH
SUBGRPN	0
SELSEQ	ASEQ
NCOS	60
BILLDN	N
SUPV	ANSDISC *
DISCTSEL	0 *
INTRAGRP	Y
DIGIT0	N *
DIGIT1	N *
DTI	N *
TES	N *

Note: The fields marked with an asterisk (*) are controlled for ISDN signaling type trunks through table TRKSGRP. These values are mandatory for a PRI interface.

Table 6-4 Example of TRKGRP datafill using IBNT2 GRPTYP (Sheet 2 of 2)

Field	Datafill
CDR	N
SMDR	N
TRC	0
ALTNCOS	0
TRKDSR	N
LSCFN	0
ALTLSCFN	0
LSCINCPT	0
ALSCINCP	0
IGA	N *
FDN	N *
FDV	N *
FLASH	N *
DPX	N *
PREEMPT_INFO	N
AIOD	N *
REORIG	N
OFFNET	Y
COFFTYP	NATL
OPTIONS	LTID (ISDN 99) $
Note: The fields marked with an asterisk (*) are controlled for ISDN signaling type trunks through table TRKSGRP. These values are mandatory for a PRI interface.	

Table TRKSGRP (trunk subgroup)

Table TRKSGRP lists the supplementary information for each subgroup assigned to one of the trunk group interfaces listed in table TRKGRP. For PRI applications, it is in this table that the signaling channel (the D-channel) is defined for each trunk group.

A new subfield, DCHRATE, as part of the DCHNL field, is introduced on the ISDN trunk controller. This field indicates the data rate of the D-channel; the valid values are 64 kbit/s and 56 kbit/s.

The following is an example tuple:

```
K2KPRI64CLLP1 0 DS1SIG ISDN 10 20 87Q931 2 N YIELD +

NETWORK PT_PT USER Y Y 30 DTCI 10 0 24 $
```

The following TRKSGRP fields are important to PRI setup:

- CARDCODE—DS1SIG is the card code used for ISDN PRI.
- SIGDATA—The protocol used for call processing. ISDN is the only valid field for a PRI trunk.
- IFCLASS—This field describes whether this end of the PRI trunk is to be considered the network end or the user end of the protocol.
- TRKGRDTM—Recommended value for trunk guard timing for PRI is 30.
- DCHNL—The main D-channel to be used for this PRI interface. It is made up of subfields DTCINO, DTCICKTNO, DTCICKTTS, and DCHRATE.

ITA configuration

In order to configure ITA on the trunk controller, the non-PRI trunk groups are datafilled in table TRKSGRP along with PRI trunk groups.

Table TRKMEM (trunk member)

Table TRKMEM lists the data associated with each analog or digital trunk. Specifically for PRI, it defines the B-channels in each trunk group.

The following are example tuples:

```
K2KPRI64CLLP1 1 0 DTCI 10 0 1 $

K2KPRI64CLLP1 2 0 DTCI 10 0 2 $

K2KPRI64CLLP1 3 0 DTCI 10 0 3 $
```

The following TRKMEM fields are important to PRI setup:

- EXTRKNM—This is the first digit of the key of this tuple and should be the same as the DTCI or LTCI circuit time slot number to ensure that trunk selection is done in the correct order.
- PMTYPE—The Peripheral Module (PM) type used for PRI is DTCI or LTCI.

ITA configuration

Non-PRI trunk members are datafilled in table TRKMEM along with PRI B-channels. The following example presents an ITA configuration:

The following are example tuples:

- `K2KPRI64CL 1 0 DTCI 10 0 1 $`
- `K2KPRI64CL 2 0 DTCI 10 0 2 $`
- `K2KPRI64CL 3 0 DTCI 10 0 3 $`
- `K2KABTRK1 1 0 DTCI 10 0 4  ABTRK GRP 1 $`
- `K2KABTRK2 1 0 DTCI 10 0 5  ABTRK GRP 2 $`

Note that the AREASELECT field in P-side links vector of the DTCI or LTCI tuple in table LTCPSINV is DS1PRI for ITA.

PRI service-related tables

The parameters in the following tables describe the type and level of services to be provided on the PRI interface. The three tables used to describe these logical characteristics of the interface are tables LTDEF, LTDATA, and LTCALLS. The mapping of these logical attributes to the physical interface is accomplished through table LTMAP datafill.

Table LTDEF (logical terminal definition)

Table LTDEF is used to define logical terminals along with their access privileges. For PRI, the only allowable access privilege is B.

The following is an example tuple:

```
ISDN 555 I B PRA 23 23 12 11

     NTNAPRI VI NIL (NOPMD) $
```

The following LTDEF fields are important to PRI setup:

- LTAP—The access privilege of the LT; must be B for PRI.
- LTCLASS—Must be PRI.

- VARIANT—specifies one of four vendor-specific switch protocols for the profile. Values are NTNAPRI, N449PRI, U449PRI, and U459PRI. The default is NTNAPRI.
- OPTIONS—The options NOVOICE, NOVBD, and NOCMD control the use of BCs on the PRI as follows:
  - — NOVOICE—Prevents calls with BC of SPEECH from terminating or originating on this PRI.
  - — NOVBD—Prevents calls with BC of 3.1 KHz audio (also known as voice-band data).
  - — NOCMD—Prevents calls with BC of 64 kbit/s (clear or restricted) and 56 kbit/s (also known as circuit-mode data).
  - — NOPMD—Prevents calls with packet mode data. This is the default.

Table LTCALLS (logical terminal calls)

Table LTCALLS defines service-related data associated with the Call type. Call types supported by this table include public (PUBLIC), private (PRIVATE), wide area telecommunications service (WATS), inward WATS (INWATS), foreign exchange (FX), and tie trunk (TIE).

The following is an example tuple (CALLTYPE = PUB):

```
ISDN 555 PUB XLAIBN 52 MTLL  1  250 $
```

Fields are varied depending on the call type selected.

Table LTDATA (logical terminal data)

This table stores additional service-related data associated with the LTID. This table is used to enter data related to directory numbers (DNs), such as the default Calling Party Number or billing number. Initially, only one 10-digit number is supported.

The following is an example tuple:

```
ISDN 555 DN DN 6137221234 $
```

Important fields include DFLTCGN. The default calling number to be used if none is supplied in the SETUP message. It is also used for billing in the BILLDN field if table TRKGRP is N.

Table LTMAP (logical terminal mapping)

Table LTMAP maps LTIDs to common language location identifiers (CLLIs). Once an entry is made in LTMAP, an update to table TRKGRP is automatically performed. The TRKGRP field, LTID, is changed from $ to LTGRP and LTNUM entered in LTMAP.

The following is an example tuple:

```
ISDN 555 CLLI K2KPRI64CLLP1 TEI 0 $
```

The following LTMAP fields are important to PRI setup:

- MAPTYPE—This field should always be CLLI for PRI.
- CLLI—The name of the PRI trunk datafilled in table TRKGRP.
- OPTIONS—This field's only valid entry is TEI 0.

Table CUSTNTWK (customer networking)

Table CUSTNTWK controls customer networking features; for PRI, it controls the display on Meridian SuperNode telephones when interworking with PRI.

The following is an example tuple:

```
CUSTNAME PUBLIC 1 CLID OFFNET $
```

The following CUSTNTWK fields are important to PRI setup:

- CUSTNAME—The customer group of the line being called.
- NETNAME—Use the value PUBLIC.
- NETCGID—Use the value 1.
- DNREVXLA—Use the value $.
- OPTIONS—This field is prompted for repeatedly. The value CLID (with ONNET or OFFNET) should be entered at one of the prompts.

Table DNGRPS (DN group)

Table DNGRPS may alter the display of groups of DNs (such as all numbers from 7262000 to 7262999 will not be displayed). It is also used to set privacy bit in the calling party number information element in the Q.931 SETUP message.

Table DNATTRS (DN attributes)

Table DNGRPS alters the display of specific DNs. For example, 613 726 7860 is displayed as 613 737 1111.

Table SPECCONN

Table SPECCONN is used to datafill special connections needed in the switch. It contains one tuple for each special connection. Each special connection

contains two valid endpoints that are connected together with a permanent nailed up connection. The connection can involve one or more extended multiprocessor system (XMS)-based peripheral module (XPM), one or more ISDN line concentrating device (LCD) and the DMS network, depending on the type and location of the endpoints. The utility is not restricted for ISDN use only. For more information about table SPECCONN refer to the *Customer Data Schema* NTP.

The following is an example tuple:

```
RCLU RCU0 01 2 00 00 VN 1010 0 ON DS0T SNU2 3 2 17 VN 0010 CAB
ACTIVE
```

Table NLUPCLLI

Table NLUPCLLI can be provided in a switching unit that has feature package NTX802AA (Toll Features II), or feature package NTX902AA (Local Features II).

A hard-wired supervision (off-hook) does not have to be available at the incoming side of the nailed-up connection pair. Both in-band and standard supervision signals in both directions are supported.

Trunks assigned to the nailed-up connection trunk group are assigned trunk group type NU in table TRKGRP.

There can be a maximum of 801 nailed-up connections (0 to 800). For each of the connections, the common language location identifier (CLLI) and external trunk number of the incoming and outgoing trunks that are to be connected must be datafilled, and the value of field CONNECT must be specified. For more information about table NLUPCLLI, refer to the *Customer Data Schema* NTP.

The following is an example tuple:

```
10 OTWAON52CG02 15  HULLPQ1077X0 17  Y
```

7 System performance

This section describes how to monitor the performance of the respective systems with respect to the performance of the Primary Rate Interface (PRI) links.

Meridian SuperNode performance monitoring tools

The Meridian SuperNode operational measurement (OM) system acquires, maintains, and displays operating data that indicates the performance of various parts of the Meridian SuperNode switch. OM data is acquired from both hardware and software sources in the switch.

OM information is gathered through equipment component and activity scans. Data is collected, stored and output according to a series of parameters defined by operating company administrators. The information appears in two different forms.

- Event or peg counts, where registers are incremented individually every time an event occurs.
- Usage counts, where equipment items are scanned (sampled) at regular intervals and registers incremented when the scan detects a busy state.

OM information can be displayed at a terminal or printer, or transmitted to a recording device for further processing. The display of data can either be requested or scheduled in advance to appear at a specified output device.

For Meridian SuperNode PRI, OMs can be used to monitor performance in the following areas:

- Level 1—DS-1 performance
- Level 2—LAPD performance
- Level 3—Call processing performance

DS-1 operational measurements

The DS1CARR OMs are used to monitor the performance of DS-1 lines. This OM group has replaced the CARR OM group. Provisioning for the registers in the DS1CARR group is per DS-1 line.

The following is a list of currently existing registers, along with a brief description for their use. Refer to *Operational Measurements Reference Manual* for more detailed information.

DS1CARR OM registers include the following:

- DS1OMINFO—This field identifies the DS-1 line.
- DS1LCGA—This field counts the number of times that a local carrier group alarm is received from the peripheral module.
- DS1RCGA—This field counts the number of times that a remote carrier group alarm is received from the peripheral module.
- DS1BER—This field, the DS-1 bit error ratio, counts the number of times the out-of-service or maintenance limits for bit errors (counted as defined in CARRMTC) have been exceeded.
- DS1LOF—This field counts the occurrences of loss of frame on the incoming side of the associated digital carrier.
- DS1SLP—This field counts the occurrences of frame slip on the associated digital carrier resulting from overrun/underrun of the incoming bit stream.
- DS1SBU—This field is a usage count of the amount of time during which the carrier was in a SYSTEM_BUSY state.
- DS1MBU—This field is a usage count of the amount of time during which the carrier was in a MAN_BUSY state.
- DS1PBU—This field is a usage count of the amount of time during which the carrier was in a PBSY state because its P-side (remote) peripheral was not in service.
- DS1CBU—This field is a usage count of the amount of time during which the carrier was in a CBSY state because its C-side peripheral (in this case, the ISDN trunk controller) was not in service.
- DS1ES—The number of errored seconds encountered on the DS-1 in this reporting period.
- DS1SES—The number of severely errored seconds encountered on the DS-1 in this reporting period.
- DS1UAS—The number of unavailable seconds encountered on the DS-1 in this reporting period.

Level two operational measurements

No Layer 2 OMs are supported for this release of DTCI or LTCI PRI.

Call processing performance monitoring tools

Layer 3 PRI call processing performance can be monitored from two main OM groups: TRK and treatment. For any PRI interface, the best source of trunk performance is the TRK OM group.

Trunk group OMs

The TRK OMs are used to monitor the performance of individual trunk groups. Provisioning for the registers in the TRK group is per trunk group.

The following is a list of currently existing registers, along with a brief description for their use. Refer to *Operational Measurements Reference Manual* for more detailed information.

TRK OM Registers include the following:

- OM2TRKINFO—Information fields: trunk direction, number of total circuits in the group, and number of working trunk circuits.
- INCATOT—This field counts the number of incoming seizures recognized on this trunk group.
- PRERTEAB—This field counts the number of incoming attempts that abandoned before routing can be completed.
- INFAIL—This field counts the number of events on a trunk that appeared to have originated a call; however, the call went down and there may be need for maintenance action. Causes include permanent signal, partial dial time-out, and bad digits.
- NATTMPT—This field counts the number of times routing directed an outgoing call to this trunk group.
- NOVFLATB—This field counts the number of times call processing overflows this trunk group because there are no idle trunks.
- GLARE—This field counts the number of times a previously selected trunk has to be dropped because the peripheral module detected an origination before it could seize the trunk.
- OUTFAIL—This field counts the number of times that an error is detected when attempting to seize this outgoing trunk group.
- DEFLDCA—This field counts the number of calls prevented from accessing this trunk group although they were routed to it, because of the action of network management.
- DREU—This field is a usage count of the amount of time during which Directional Reservation is activated for this two-way trunk group. Refer to 297-1001-453, *Network Management System Reference Manual*, for information on Network Management.

- PREU—This field is a usage count of the amount of time during which Protective Reservation is activated for this two-way trunk group. Refer to 297-1001-453, *Network Management System Reference Manual*, for information on Network Management.
- TRU—This field is a usage count of the number of trunks found to be in the following states:
  - TK_CP_BUSY
  - TK_CP_BUSY_DELOAD
  - TK_LOCKOUT
- SBU—This field is a usage count of the number of trunks found to be in the following states:
  - TK_REMOTE_BUSY
  - TK_PM_BUSY
  - TK_SYSTEM_BUSY
  - TK_CARRIER_FAIL
  - TK_DELOADED
- MBU—This field is a usage count of the number of trunks found to be in the following states:
  - TK_MAN_BUSY
  - TK_SEIZED
  - TK_NWM_BUSY
- OUTMTCHF—This field count the number of attempts to get a network path from an incoming agent to a selected trunk of this group that failed because of network blockage.
- CONNECT—This field counts the number of outgoing seizure attempts on this trunk group that appear to have resulted in successful connections.
- TANDEM—This field counts the number of calls incoming on this trunk group that are initially routed to an outgoing trunk group.
- AOF—This field counts the number of incoming calls where ANI failure has been detected. This is not applicable to PRI trunks.
- ANF—This field counts the number of incoming CAMA or TOPS calls where ANI failure has been detected. This is not applicable to PRI trunks.
- TOTU—This field is a usage count that is the sum of TRU, SBU, and MBU.

Abnormal call processing conditions

If a call originated by a PRI interface cannot be completed by the Meridian SuperNode switch (for example, the terminator is busy, no circuits are available to route the call), one of two things can happen.

- If the Meridian SuperNode treatment maps to a Q.931 cause value, that cause value is sent to the originating PRI in a DISC message. The originating PRI trunk member is deallocated and idled.
- If the treatment cannot be mapped to a corresponding Q.931 cause value, the network routes the call to treatment. A Progress (PROG) message is sent to the originating PRI containing the PI = inband tones and announcements and CSE = cause unknown.

Call treatments

The OM groups for treatments are described in the following list.

- Customer unauthorized (CU)—These treatments notify customers that their actions are inappropriate for reasons of authorization. Usually, this indicates that the customer has dialed an invalid sequence of digits or has followed improper procedure for the action to be performed.
- Customer miscellaneous (CM)—These treatments explain call situations that are attributable to customer action but do not relate to authorization. This does not include treatments used to mark the progress or completion of call features.
- Equipment related (ER)—These treatments handle failures resulting from switching equipment malfunction. This does not include treatments used to handle software or hardware resource shortages.
- Feature related (FR)—These treatments explain call situations that are attributable to a certain call feature, whether plain old telephone service (POTS), integrated business network (IBN), or other. This does not include treatments that deny access to features for reasons of authorization.
- Resource shortage (RS)—These treatments handle failures that result from a shortage of software or hardware resources, indicating an inadequate capacity to handle the presented load. This does not include treatments that handle switching equipment malfunction.

The current call treatments defined in the Meridian SuperNode switch have been divided among the five categories listed in Table 7-1. Refer to *Customer Data Schema* for more information.

Table 1 Call treatment categories (Sheet 1 of 2)

Customer Unauth (CU)	Customer Misc (CM)	Equipment Related (ER)	Feature Related (FR)	Resource Shortage (RS)
INAC	UNDT	SYFL	BUSY	NOSC
CNDT	PDIL	SSTO	MANL	NBLH
MSCA	PSIG	RODR	ORMC	NBLN
MSLC	VACT	PNOH	CONF	EMR1
UNCA	UNDN	PTOF	RRPA	EMR2
HNPI	BLDN	NMZN	ORAF	CQOV
UNOW	OPRT	ERDS	TRRF	NCRT
TDND	TRBL	STOB	ORAC	NECG
UNIN	ANCT	STOC	ORMF	FECG
ORSS	DISC	INOC	SRRR	TOVD
TESS	BLPR	AIFL	PMPT	EMR3
DNTR	ATBS	FDER	PRSC	EMR4
UNPR	TDBR	CONP	MHLD	SORD
NOCN	VACS	NCFL	PGTO	GNCT
INAU	ANTO	NONT	CCTO	EMR5
TINV	CFWV	NCUN	NINT	EMR6
CNOT	VCCT		NCIX	NOSR
DCFC	ATDT		NCII	CGRO
DODT			NCTF	
RSDT				
FNAL				
UMOB				

Table 1 Call treatment categories (Sheet 2 of 2)

Customer Unauth (CU)	Customer Misc (CM)	Equipment Related (ER)	Feature Related (FR)	Resource Shortage (RS)
ANIA				
NACK				
CACE				
D950				
N950				
ILRS				
NACD				
DACD				
ADBF				
FDNZ				
CCNV				
CCNA				
LCAB				
INCC				
ANBB				
IVCC				

Other performance monitoring tools

OM groups include CP, CPU, OFZ, IBN, VFG, plus various IBN feature-specific OM groups.

OM thresholds and alarms

The capability of associating an EXT alarm with OM registers is provided in tables ALARMTAB and OMTHRESH. Each tuple in the table provides a duplicate register of a specific OM register. Each duplicate register has an alarm level and threshold specified. The threshold represents the amount by which the duplicate register needs to be incremented in a given time period to activate the associated alarm. Four alarm levels are provided, associated with log OM2200. The alarm levels are OMNOALARM, OMMINOR,

OMMAJOR, and OMCRITICAL and are displayed at the EXT level of the MAP terminal.

Switch performance monitoring system

The switch performance monitoring system (SPMS) is an optional feature. It provides on-demand reports of index values that describe how well the switch is operating, at various levels of detail. The indexes are computed from switch-generated OMs.

8 Service verification

This section deals with the verification of the various services that have been provisioned. This section outlines the following:

- the steps to be performed to guarantee that the service functions properly
- the steps to be taken to localize problems when they occur

Call setup service over PRI

The following steps must be taken to make sure that calls over Primary Rate Interface (PRI) can be placed successfully:

- PRI-related facilities must be put in service:
  - The carrier must be In Service (INS).
  - The D-channel must be INS.
  - The PRI trunk must be in service and Idle (IDL).
  - The calling and called lines must be IDL. Make a call (not over a PRI trunk) from a terminal to another terminal to ensure that the loops are in service.
- The PRI-related tables must be properly datafilled.

Call over a PRI

From an Integrated Services Digital Network (ISDN) Stimulus terminal or an ETS with display, make a call to another set over a PRI trunk. Then, verify that the

- call is terminated correctly.
- calling party number is displayed on the terminating set.
- called party number is displayed on the ISDN Stimulus terminal or ETS with display.
- call can be released properly from either end.

Verify data connectivity

Make basic data calls from one type of data module to another through PRI trunks. After a connection is established, perform the BERT test. It is recommended to allow a minimum of 10 minutes per test.

The following Meridian SuperNode products are supported: AIM, AILU, LSDU, and HSDU.

Customer questionnaires

Two customer questionnaire forms are provided.

Form 1 is filled in by the PBX telecommunications manager when reporting problems to the telephone company (TELCO). (See Figures 8-1 and 8-2.) It emphasizes the problems possibly visible to the telecom manager.

Form 2 is filled in as a result of trouble reports filed by end-users of the switch (see Figure 8-3). It emphasizes the problems possibly visible to the end-user with space for comments.

Figure 8-1 PBX telecom manager trouble report form (page 1)

PBX Telecom Manager Trouble Report Form

TIME hrs. m DATE / /19 PROBLEM NO. ;

CUSTOMER NAME ; CONTACT NAME ;

RELEASE MSL ; DTCI or LTCI ; DCH ;

PROBLEM

dead audring no_i/c ctoff 1wayxmit noise xtalk sldt

hi+dry alwzbsy gtann tonelvl dod did esn pvt tie

display cpi bpv sync_loss data cid watts

other:

DS-1 Attributes

LTID= ISDN_____ DTCI or LTCI____ ____ CLLI _____

D-Channel IAC ____ ____ ____ ____ Number of B-Channels _____

Call Attributes

CDN _____ NPI _____ CGN _____

Meridian SuperNode Solution/Action Taken

no_fault found_ok miss_operate no_response mb/rts

unable_to_reproduce database_table frls clear_when_tested

CSR _____ clear_after_diagn

Figure 8-2 PBX telecom manager trouble report form (page 2)

Outside Plant Solution/Action Taken

FORWARDED TIME hrs m DATE / /19
CLEARED TIME hrs m DATE / /19

WORK DONE

SWITCH PROBLEM = DMS PM CPU NET CMC LCM DTCI LTCI DS1

TERMINAL PROBLEM = CPE

OTHER

HARDWARE
PEC: ; SERIAL #: ; LOCATION: ;

DIAGNOSTIC FAILURE ON SUSPECT HARDWARE YES / NO

OTHER DETAILS:

RELEASE

DS-1 6X50AB _____
DCH _____
ST _____

PRINTOUTS

Attach any relevant printouts or files in SFDEV associated with identifying the fault

Figure 8-3 PBX end-user trouble report form

PBX End-User Trouble Report Form

TIME __ HRS ___MIN DATE ___/___/19 __ PROBLEM NO. _____
NAME _____ TELEPHONE NO. _____

APPLICATION:

VOICE DATA

DATA MODULE USED:

ASDM ASIM AILU ADO OTHER BAUD RATE _____

PROBLEM DESCRIPTION:

ORIGINATION DN _____ NUMBER DIALED _____
CALL TRANSFER/CONFERENCE DN _____

CUTOFF NOISY CROSSTALK FASTBUSY HI&DRY WRONG-TERMINATION
1WAY-CONVERSATION DIGIT-DISPLAY DATA-CORRUPTION

OTHER _____

SUPPLEMENTARY INFORMATION _____
_____

SYSTEM _____ LOC _____
S/W RELEASE+ISSUE _____

FREQUENCY _____
IMPACT _____
WORKAROUND _____

FORWARD TO _____ FORECAST FIX _____

Verification of PRI facility on the Meridian SuperNode switch

This section defines the various states that each component of the PRI facility may incur. The section is divided into the following PRI components:

- PRI trunk
- carrier
- ISDN digital trunk controller (DTCI)
- ISDN line trunk controller (LTCI)
- D-channel handler (DCH)

PRI datafill verification

The PRI-related tables are categorized into two categories: facility-related tables and service-related tables.

The PRI service-related tables consist of the following:

- table LTGRP
- table LTDEF
- table LTCALLS
- table LTDATA
- table LTMAP
- table PRIPROF

PRI trunk on the Meridian SuperNode switch

B-channel availability control

B-channel Availability Control was introduced in conjunction with National ISDN-2. With this function, two switches that are connected by means of a PRI can use SERVice and SERVice ACKnowledge messages to exchange information about the state of trunks on either side of the PRI.

The two ends of the PRI are termed the near end (NE) and the far end (FE). There are one IS state and two OOS states: OOS/NE and OOS/FE. By means of the MAP terminal, the Meridian SuperNode switch reports a B-channel that is OOS/NE as maintenance busy (MB) and a B-channel that is OOS/FE as remote maintenance busy (RMB). A B-channel can be IS only if it is in-service on both ends, and only channels that are IS can be used in establishing calls.

When a switch that supports B-channel Availability Control detects an event that causes the NE state of one or more B-channels to change, the switch sends a SERVice message for each affected B-channel to the FE indicating the B-channel and its new state. If possible, the FE switch aligns its B-channel

state and responds to the SERVice message with a SERVice ACKnowledge message containing the same B-channel and a Change Status information element indicating the state of the B-channel on its end. The following are specific examples.

Example: B-channel that is in-service on both ends is made maintenance busy on the near end. A SERVice (OOS/NE) message is sent to the remote switch that marks that B-channel as OOS/FE. The remote responds with a SERVice ACKnowledge (OOS)

Example: One of the carriers in a multiple DS-1 PRI is made maintenance busy. Multiple SERVice (OOS/NE) messages, one for each affected B-channel, are sent. Each B-channel is set to OOS/FE on the remote side, and each SERVice message is acknowledged.

Example: A B-channel that is OOS/NE (OOS/FE on the remote side) is restored to service. A SERVice (IS) message is sent to the remote end of the PRI. The remote determines that the current state is OOS/FE, meaning that it can be placed in-service by a request from the other side. It changes the B-channel state to IS and sends a SERVice ACKnowledge (IS). On receipt of the SERVice ACKnowledge (IS), the near-end switch can place its B-channel in-service.

Example: A B-channel that is OOS/NE (OOS/FE on the remote side) is restored to service. A SERVice (IS) message is sent to the remote end of the PRI. If no SERVice ACKnowledge (IS) message is received or if a SERVice ACKnowledge (OOS) is received in response, the near end cannot place the B-channel in-service but must change its state to OOS/FE.

Note: B-channel Availability Control is a subscription parameter; that is, it must be supported by explicit agreement of both parties (the owner of the Meridian SuperNode switch and the local service provider). On the Meridian SuperNode switch, B-channel Service Messaging is ENABLED by default. On some central office equipment, Service Messaging is DISABLED by default. This can cause problems when trunks or carriers are made busy. If B-channel Availability Control is enabled on one end but not the other, the end on which it is not enabled has no way to recognize when B-channels have changed to the OOS state. The far end may attempt to use channels that it thinks are in-service (but the near end has marked as OOS/NE) to establish calls. These call attempts may be rejected by the near end even though there are other in-service B-channels available to complete the call. There are two ways to resolve this: B-channel Availability Control can be enabled at the local exchange or it can be disabled at the Meridian SuperNode switch. B-channel Availability Control is disabled at the Meridian SuperNode switch by datafilling the SERV_OPTIONS field in table LTDATA with NO_BCH_SERV option.

Interpretation of PRI trunk states

The PRI trunk states and its interpretation are as follows:

- Idle (IDL)—The trunk member is in service and not busy.
- Call processing busy (CPB)—The facility or member is currently carrying traffic, thus the facility is busy.
- Peripheral maintenance busy (PMB)—The circuit is not available because the associated peripheral (the PRI DTCI or LTCI) is out of service.
- D-channel maintenance busy (DMB)—This is the state an ISDN PRI trunk member is in when the local D-channel (DCH) is out of service, the DS-1 is out of service, or the far-end DCH is out of service (Layer 2 failure). Every member in the trunk group associated with the out-of-service returns to service.
- Remote maintenance busy (RMB)—A circuit has the state RMB when the far end of the B-channel is removed from service. As a result, the B-channel cannot be used for placing calls.
- Lock out (LO)—The D-channel associated with the facility is in service. However, Layer 3 cannot communicate with the far end because there is no synchronization over Layer 2, there is synchronization but no logical link is established, or Layer 3 is not responding to a restart or release.
- Carrier fail (CFL)—The circuit is removed from service because of a failure associated with the DS-1.
- Call processing deload (CPD)—The circuit is currently carrying traffic, however, another entity has requested to be informed when the circuit is released. Usually maintenance on the circuit is pending.
- Maintenance busy (MB)—The circuit is removed from service by a maintenance person.
- Installation busy (INB)—The circuit is installed but has not been placed in service thus far.
- System busy (SB)—The circuit is removed from service by system maintenance, which performs periodic tests.

Note: Refer to NTP 297-1001-595, *Trunks Maintenance Guide* for more information.

Restoring service to the PRI trunk

The following table lists the various actions to be taken based on trunk states shown at the Meridian SuperNode MAP terminal.

If the problem is due to DCH (that is, B-channel states in DMB, DFL, and LO), refer to the “Restoring service to the DCH" section for troubleshooting information.

Table 1 Meridian SuperNode PRI trunk states and actions

PRI trunk states	Resource out of service	Actions to take
PMB	The PRI DTCI or LTCI is out of service.	Enter PM level of the MAP display. Post the DTCI or LTCI. Isolate the fault.
DMB	The DCH is out of service.	Enter PRADCH level of the MAP display. Post the DCH. Isolate the fault.
RMB	The remote end of the PRI trunk is out of service.	Enter TTP level of the MAP display. Post the PRI trunk group. Isolate the fault.
LO	DCH cannot communicate with Layer 3.	Enter PRADCH level of the MAP display. Post the associated DCH. Isolate the fault.
CFL	The carrier is out of service.	Enter CARRIER level of the MAP display. Post the carrier. Isolate the fault.
MB	The PRI is Maintenance Busy.	Enter TTP level of the MAP display. Post the PRI trunk group. Return the circuits to service.
INB	The PRI is installation busy.	Enter TTP level of the MAP display. Post the PRI trunk group. Busy and return the trunk group to service.
SB	The PRI circuit is system busy.	The system will return the member to service after test is completed.

DS-1 carrier states

The following list explains the carrier states on the Meridian SuperNode switch:

- In Service (INSV)—The DS-1 is in service and can be used to service a trunk. No alarms are present.
- Maintenance Busy (MANB)—The DS-1 is out of service because of a command issued by maintenance personnel.
- System busy (SYSB)—The DS-1 is system busy because of a local or remote alarm.
- Unequipped (UNEQ)—A P-side port for the PRI DTCI is unequipped when no datafill exists in table LTCPSINV to define that port. Any trunks that may be datafilled for that facility will be offline.
- Offline (OFFL)—The DS-1 is offline.

Note: Refer to NTP 297-1001-595, *Trunks Maintenance Guide*, for more information.

Restoring service to the carrier

The following table lists DS-1 carrier states and actions.

Table 2 Meridian SuperNode DS-1 carrier states and actions

DS-1 carrier states	Resource out of service	Actions to take
OFFL	Carrier is offline.	From carrier level of the MAP display, BUSY and return the carrier to service
MANB	Carrier is maintenance busy.	From carrier level of the MAP display, return the carrier to service. Note the new carrier state.
SYSB	Carrier is system busy.	From carrier level of the MAP display, diagnose the fault. Note the new carrier state.

DTCI and LTCI states

The following list explains DTCI and LTCI states on the Meridian SuperNode switch:

- In service (INSV)—The DTCI or LTCI is in service, no action is required.
- In service trouble (ISTB)—A fault does exist in the DTCI or LTCI; however, services are not impacted.

- Offline (OFFL)—The DTCI or LTCI is offline and possibly pending office data modifications (ODMs).
- Maintenance busy (MANB)—The DTCI or LTCI has been busied by maintenance personnel. Maintenance may be in progress.
- C-side busy (CBSY)—This implies there is no in-service message connection between the DTCI or LTCI and the network, or that the network is out of service.
- System busy (SYSB)—The system has detected a fault and taken the DTCI or LTCI out of service.

Note: Refer to NTP 297-2401-502, *Integrated Services Digital Network Primary Rate Interface Maintenance Guide*, for more information.

Restoring service to the DTCI and LTCI

The following table lists DTCI and LTCI states and actions.

Table 3 Meridian SuperNode DTCI and LTCI states and actions

DTCI and LTCI states	Resource out of service	Actions to take
MANB	DTCI or LTCI is maintenance busy.	From the PM level of the MAP display: • Post the DTCI or LTCI. • RTS the DTCI or LTCI.
ISTB	The DTCI or LTCI is in service trouble.	From the PM level of the MAP display: • Post the DTCI or LTCI. • Enter QUERYPM FLT. • Diagnose the fault.
CBSY	The DTCI or LTCI is C-side busy.	From the PM level of the MAP display: • Post the DTCI or LTCI. • Enter TRNSL C. • Diagnose the C-side links that are not in service.
SYSB	The DTCI or LTCI is system busy because of a problem the system detected.	A system log is generated, showing the fault that occurred. Diagnose the problem. The system returns the DTCI or LTCI to service if no fault is found

D-channel states

The following list explains D-channel states on the Meridian SuperNode switch:

- In service (INSV)—The D-channel is in service.
- Maintenance busy (MANB)—Maintenance personnel have maintenance busied the ST to perform maintenance actions.
- Installation busy (INB) —The D-channel is installed but has not been put into service thus far.
- Peripheral MANB (PMB)—Peripheral is taken out of service by maintenance personnel.
- Initializing (INI)—The D-channel is being initialized by the system. The system brings up the D-channel once the other facilities are brought into service.
- Carrier fail (CFL)—The carrier on which the D-channel is provisioned failed.
- Lockout (LO)—This state indicates a failure at the logical link level or the hardware (not the carrier).
- Remote not responding (RNR)—This state indicates that the Layer 3 at the far end is not responding, although Layer 2 is established and ready.
- Standby (STB)—A backup D-channel has been provisioned, equipped, or both; and is in the STB state

Note: Refer to NTP 297-2401-502, *Integrated Services Digital Network Primary Rate Interface Maintenance Guide*, for more information.

Restoring service to the D-channel

When the D-channel state is LO or RNR, refer to “Troubleshooting" in Section 3, Datalink Engineering, for additional information on troubleshooting.

The following table lists the D-channel states and actions.

Table 4 Meridian SuperNode D-channel states and actions

DCH ST states	Resource out of service	Actions to take
MANB	The DCH is maintenance busy.	From CI level of the MAP display, enter: **MAPCI;MTC;TRKS;TTP; PRADCH** Then: Post the DCH. RTS the DCH.
INB	D-channel is installation busy.	Enter the PRADCH level of the MAP terminal. Post, BSY, and RTS the DCH.
INI	The DCH is being initialized.	Post, BSY, and RTS the DCH.
PMB	The DTCI or LTCI is busy.	Enter the PM level from the MAP display. Post the DTCI or LTCI. Isolate the fault.
CFL	The carrier failed.	No action is required if DTCI or LTCI is going through a RESTART. Otherwise: Enter the Carrier level of the MAP display. BSY and RTS the carrier.
LO	Logical link failed.	Refer to the “Troubleshooting" section in chapter 3, “Datalink engineering".
RNR	The far-end Layer 3 is not responding.	Ensure that the far-end DCH is engineered properly. Ensure that the far-end DCH is in service.

Semi-permanent connection

A semi-permanent connection is nailed up connection over a permanently reserved B-channel that does not use call control messages. Semi-permanent

connections are created by datafilling entries in tables SPECCONN and NLUPCLLI. The following conditions must exist for the semi-permanent connection to function properly:

- The PRI service must function correctly.
- The data unit (DU) must function and be set up correctly.

Establishing semi-permanent connection

The DU establishes the connection automatically only if all the facilities are in service.

Localizing the cause of the problem

When the DU cannot establish the semi-permanent connection, verify that calls over the same PRI trunk can be made from a set on the Meridian SuperNode switch. If calls cannot be made, follow the steps in the previous section. If calls can be made, perform the following procedures:

- Check the DU setup. Post DU in LTP and verify that it connects to PRI and stays CPB.
- Follow the normal steps to verify a line.

Note: Joint effort is required when both the preceding actions fail to resolve the problem.

9 Engineering recommendations

This section provides recommendations to simplify Primary Rate Interface (PRI) configuration and engineering.

PRI configurations

Multiple DS-1s per PRI

The Meridian SuperNode switch allows a D-channel to control multiple B-channels across DS-1s. For NI-2, one D-channel controls up to 20 DS-1s, depending on the amount of traffic.

Note: Nortel recommends the site perform traffic analyses before provisioning the maximum number of DS-1s to a D-channel.

Multiple DCH per DS-1

The NTNA-PRI variant supports multiple D-channels and PRIs within the same DS-1. For NI-2, only one D-channel per DS-1 is supported, and the D-channel must be on channel 24.

Use of non-PRI channels in DS-1

Any channels within the DS-1 that are not to be used as B-channels (that is, controlled by the D-channel for circuit-switched calls) need not be left idle (that is, containing IDLE code, hex 7F). The ISDN digital trunk controller (DTCI) and ISDN line trunk controller (LTCI) allows these non-PRI channels to be provisioned as a PTS trunk. In other words, any AB-trunk supported by the Meridian SuperNode switch can be datafilled on the non-PRI channels.

Optimal DS-1/DCH card assignments on the DTCI and LTCI

DS-1/DCH card assignments are not applicable to PRI. ST cards are not used on the DTCI or LTCI.

DTCI port allocation

For trunk call processing, C-side channels are pre-allocated for each trunk member. The members on the first five P-side ports (0 to 4) are scattered over the channels on the first four C-side ports (0 to 3). The next five P-side ports use the next four C-side ports, and so on. The scattering of channels was

chosen to minimize transit delays through the DTCI or LTCI timeswitch; it also reduces the chances of an entire DS-1 being taken out of service by a C-side link failure. (C-side ports can only be datafilled in ascending order in table LTCINV.)

Tthe following table summarizes the mapping of groups of P-side ports to C-side ports. The number of ports usable as DS-1 ports per grouping is also indicated.

Table 1 PRI DTCI P-side to C-side port mapping

Port Group (Config)	P-side Port	C-side Port	Min DS-1 ports	Max DS-1 ports
A	0-4	0-3	3	4
B	5-9	4-7	3	5
C	10-14	8-11	5	5
D	15-19	12-15	5	5

Reliability considerations

Backup trunk group

To reduce the impact of PRI failures or degradations, non-PRI trunk groups should be used as a backup. (These trunks could be on an LTC or DTC, but would provide the most reliability if they were not on the same peripheral module as the PRI being backed up.)

Route selection should be set up to select the PRI trunk first, with rerouting to the non-PRI trunk(s) if the PRI is completely busy or out of service. The Meridian SuperNode route/trunk databases have to be set up to accomplish this.

The overflow from PRI could result in calls being offered in both directions through a single 2-way trunk group, or two 1-way trunk groups. See the following example of Meridian SL-100 routing data for backup trunk group from table IBNRTE.

```
99 (ISA N N N MSLTOLECPRI PUB NONE N N 0)      (N N N N N
MSLTOLECPRI 99) $
```

In the previous example, the call is routed using route IBNRTE 99 when a user dials the access code (or ESN code) to reach the PRI trunk. Calls are first offered through the PRI group MSLTOLECPRI. If this is 100% busy, out of service, or experiences protocol failure during call setup, routing continues to

the next entry in IBNRTE 99 MSLTOLECPTS, which would be a non-PRI (PTS) facility.

Note: Multiple PRI links do not apply.

Backup D-channel

Both the NTNA and NI-2 PRI protocol variant (NIPRI) address the issue of reliability on PRI interfaces by means of the backup D-channel. The backup D-channel can be used with NTNA PRI and NIPRI trunk groups that consist of multiple DS-1 spans. The term used to describe these types of interfaces is Non-Facility Associated Signaling (NFAS). The term NFAS simply means that the B-channels on one or more of the DS-1 facilities in a multi-DS-1 PRI trunk group are controlled by a D-channel that is physically located on a different DS-1 in the same trunk group.

A backup D-channel is created by datafilling the DCHBCKUP field in table TRKSGRP. The backup D-channel, like the primary D-channel, must be placed on the 24th channel of a carrier. When the D-channel is restored to service, the status of both primary and backup D-channels is displayed automatically. The status is typically shown as INS/STB which means that the primary is in-service and the backup is in standby mode. If an unrecoverable error occurs on the primary D-channel, the backup is switched automatically from standby mode to in-service. The states of primary and backup D-channel can also be changed manually by using a SWACT command.

The backup D-channel allows the PRI trunk group to continue operation if there is a failure of the DS-1 facility containing the primary D-channel. To minimize the likelihood that both DS-1s containing D-channels are disrupted by the same event (such as a cable cut), the two DS-1s should be routed to the local exchange over physically separate paths. When a backup D-channel is brought into service as a result of a failure on the primary (or manual SWACT), all calls that are in an active (talking) state should remain in that state. Exceptions are calls over B-channels, which are affected by the same event (such as a total failure of the DS-1), that cause the failure of the primary D-channel.

Meridian SuperNode loss and level datafill

PRI requires the addition of some new tuples in table PADDATA. The following table shows the recommended datafill for the Meridian SuperNode switch to support the ISDN PRI loss and level plan.

Table 2 Recommended loss and level datafill

Key Port 1	Key Port 2	Data PAD1T02	Data PAD2T01
PRIP	ONS	6	3
PRIP	OPS	3	0
PRIP	PONS	3	3
PRIP	POPS	0	0
PRIP	DONS	6	0
PRIP	ATT	3	0
PRIP	DTT	0	0
PRIP	ACO	3	0
PRIP	DCO	0	0
PRIP	PRIP	0	0
PRIP	BRI	0	0
PRIP	CONF	0	0

Note: PRIP is the PAD group associated with the PRI interface on the PBX.

10 PRI functionality

This section provides a list and brief descriptions of Primary Rate Interface (PRI) functionality.

PRI functional groups

The following table is a list of the PRI functional groups arranged by functional group number. This list shows the functional group number, functional group name, and the functionality of each group.

Note: In this chapter, NI-1 refers to NTNA.

Table 10-1 PRI functional groups

Functional group number	Functional group name	Functionality
PRI functional groups		
MDC00006	MBG standard	Multilocation business group standard
NIO00014	NI-1 tandem	National ISDN-1 PRI tandem
NIO00033	PRI NI-1 base	Primary rate interface NI-1 base
NIO00043	PRI NI-2 base	Primary rate interface NI-2 base
Note: NIO00033 replaces NIO00011, NIO00012, NIO00013, and NIO00022 which are manufacturer discontinued.		

PRI functional group descriptions

The remainder of this chapter provides brief descriptions of the PRI functional groups listed by functional group number.

MDC00006

Multilocation business group (MBG) standard

This functional group extends a a number of station and attendant features across multiple switches of a business group. MDC00006 enables full networking capabilities to MBG subscribers without requiring tie trunks between switches.

The MBG standard functional group includes the following station and attendant features:

- Network number display
- Network ring again
- Network attendant service
- Network message service
- Network name display
- Virtual access to private networks (FGD)
- Virtual communication network (VCN) 1A billing
- VCN 1A operational measurements
- MBG per line feature control

The following functional groups are required for MBG standard operation.

- MDC00001—Meridian digital centrex minimum
- MDC00005—Multilocation business group minimum
- SS700001—CCS7 trunk signaling

NIO00014

NI-1 PRI tandem

This functional group provides NI-1 compliance through the toll network. It also supports routing and ISDN User Part (ISUP) interworking of NI-1 voice and data calls through the Meridian SuperNode switch.

The NI-1 PRI tandem functional group allows network-wide service by mapping ISDN Q.931 loop signaling to ISUP signaling. It provides end-to-end communication of bearer capability, high layer capability, low layer capability,

call progress information, cause and signal information, and calling number over the SS7 network.

The NI-1 PRI tandem functional group includes the following features.

- ISDN routing
- ISDN/ISUP interworking

The following functional groups are required for NI-1 PRI tandem operation.

- MDC00001—Meridian digital centrex minimum
- NI000007—ISDN base
- NI000008—NI-1 basic rate interface
- SS700001—CCS7 trunk signaling

NIO00022

NI0 ISDN PRI base

This functional group provides the ISDN PRI base code to support NI-1 PRI services.

In addition to supporting functional group NI000014, the NI-1 PRI base functional group provides the following features and capabilities.

- NI0 AMA for PRI
- NI0 XPM+ for DTCI
- PRI static downloading
- Table control for ISDN BRI calls
- Table control to support subscription parameters
- Layer 3 call control for IBN attendant console and IVD sets
- Signaling terminal control module 0 usage
- DS1 and DS0 maintenance for ISDN
- B/D channel correlation and maintenance tests
- Basic ISDN PRI maintenance
- Calling line identification
- Redirected number delivery

- Enhanced electronic business set (EBS) reason display
- Connectivity to the Meridian SuperNode switch from various vendors

The following functional groups are required for ISDN PRI base operation.

- MDC00001—Meridian digital centrex minimum
- NI000007—ISDN base

NIO00024

NIO on NI-1 PRI

This functional group provides the following:

- NIO RLT on NTNAPRI (network side only)

NIO00033

PRI NI-1 base

This functional group provides the following:

- the PRI base code to support NI-1 PRI services
- compliance with Bellcore NI-1 protocol for functional call control signaling and supplementary services
- basic call interworking connectivity between the Meridian SuperNode switch and the AT&T #4ESS and #5ESS switches over PRI trunk
- information about the calling, called, and connected parties across PRI networks
- features for hybrid configurations that span both private and public switching networks
- support for functional group NI000014

The PRI NI-1 base functional group provides the following features and capabilities:

- re-architect PRI
- 4ESS interworking
- 5ESS interworking
- automatic message accounting for PRI
- D-channel backup
- PRI base
- CCS7 interworking

- enhanced number del
- integrated services access
- message waiting interface
- network display
- networking
- dialable wideband service DTA
- XPM+ for ISDN digital trunk controller

The following functional groups are required for PRI NI-1 base operation:

- MDC00001—Meridian digital centrex minimum
- NI000007—ISDN base

Note 1: NI-1 PRI includes all the NI-2 services required by Bellcore.

Note 2: For more information about NI-1 PRI interworking with 4E/5ESS, refer to chapter 12, “Connectivity to other vendors."

Note 3: For more information about NI-1 PRI networking, refer to chapter 11, “Network services."

NIO00043

PRI NI-2 base

This functional group provides the ISDN PRI base code to support NI-2 PRI services. NI-2 supports the following:

- up to 20 DS-1s per D-channel, depending on traffic
- basic call
- Calling line identification
- 2B-channel transfer (network side only)
- Call-By-Call (CBC)
- D-channel backup
- NI-2 PRI basic maintenance
- NI-2 CC
- PRI screening
- NI-2 variant
- TR1268 D-channel backup

- B- and D-channel maintenance
- PRI NI-2 to ISUP

11 Network services

Network ring again

Ring again (RAG) allows a user to queue against a busy directory number (DN). The system recalls the subscriber when the DN becomes idle and sets up the call again, if requested.

Network ring again (NRAG) on PRI extends RAG to DNs on different switches that are linked by PRI trunks and T1S1 Transactions Capabilities Applications Part (TCAP).

Feature operation

NRAG is used in the following sequence:

- The user dials a DN on another switch over a PRI trunk and encounters a busy tone.
- The user activates the RAG key or dials the RAG access code.
- The originating switch requests the terminating switch to notify it when the DN is free.
- When the busy station is idle, the original station is recalled.
- The user presses the DN key and RAG key to complete the call.

Meridian SuperNode configuration data for network ring again

This section lists the tables that must be completed to define NRAG.

Table TCAPTRID (TCAP transaction ID)

This table defines the number of simultaneous transactions used. One transaction ID is required for one NRAG attempt, which could be an originating or terminating request.

```
NRAG 32 10
```

An important field is NUMTRIDS, which defines the number of transaction IDs for a particular office.

Table TCAPTRID is defaulted to 32 entries. If usage is greater than 32 simultaneous NRAGs, the table must be increased. A cold restart is required to activate the change.

Table NETNAMES (network name)

This table associates logical network names with the external global network identifier.

The following is an example tuple:

```
CUSTNAME 3 0 $
```

An important field is EXTNETID. This field entry must be the same between switches.

Table CUSTNTWK (network name)

This table controls customer networking features. For PRI, it controls the display on Meridian SuperNode telephones when interworking with PRI.

The following is an example tuple:

```
CUSTNAME PUBLIC 1 N $ NTWKRAG (10) CLID OFFNET $ $
```

The following CUSTNTWK fields are important to PRI setup:

- CUSTNAME—The customer group of the line being called.
- NETNAME—Uses the value PUBLIC.
- NETCGID—This field entry must be the same between all switches.
- DNREVXLA—Uses the value $.
- OPTIONS—NTWKRAG must be entered to activate the NRAG feature. Also, enter the timeout value, ranging from 10 to 60 seconds. In addition, enter the value CLID for OFFNET or ONNET access.

Table MSGRTE (message route)

This table routes PRI facility messages through the switch.

The following is an example tuple:

```
RCHNET 109427 109427 PRA RICHPRI 3 $ $
```

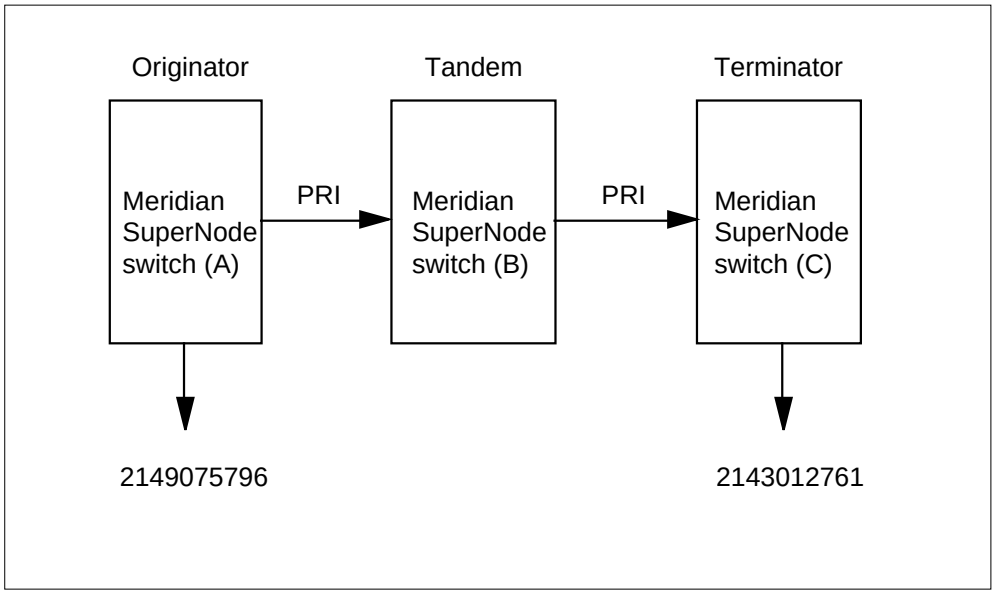
The following MSGRTE fields are important to PRI setup:

- NETID—This field is the network identifier, which must be datafilled in table NETNAMES before being used in this table.
- FROMDIGS—This field is a digit string, from 1 to 10 digits. It is the lower bound of the digit range to which the route list applies.
- TODIGS—This field is a digit string, from 1 to 10 digits. It is the upper bound of the digit range to which the route list applies.
- MSGRTSEL—This is the type of route in the route list. The possible values are LOCAL, PRI, and SS7. LOCAL indicates that the message is to terminate on this switch. PRI indicates that the message is to be routed out on a specified PRI D-channel. SS7 indicates that the message is to be routed through an SS7 trunk. There may be at most one SS7 selector per tuple, and it must be the last selector in the list.
- TRKCLLI—The PRI trunk containing the D-channel on which messages are to be transmitted (datafilled only if PRI selector is chosen).
- DPC—The SS7 destination point code of the switch that the message is to be sent through an SS7 signaling link (datafilled only if the SS7 selector is chosen).
- DELDIGS—The number of digits to be deleted from the destination address in the message routing information.
- PREDIGS—The digit string to be prefixed to the destination address in the message routing information.

Network ring again datafill example

This example includes three switches, illustrated in Figure 11-1.

Figure 1 NRAG over PRI



Datafill at switch A

The following example shows the datafill at switch A.

```
TABLE NETNAMES

RCHNET 3 0 $

TABLE CUSTNTWK

BNRRCH RCHNET 1 N $ NTWKRAG (10) CLID OFFNET $ $

TABLE MSGRTE

RCHNET 109427 109427 PRA RICHPRI 3 $ $

RCHNET 446 446 LOCAL 3 214907 $ $
```

Datafill at switch B

The following example shows the datafill at switch B.

```
TABLE NETNAMES

NTI 3 0 $

TABLE CUSTNTWK

NTICORP NTI 1 N $ NTWKRAG (10) CLID OFFNET $ $

TABLE MSGRTE
```

```
NTI 427 427 PRI PALPRI 0 $ $

RCHNET 446 446 BNRPRI 0 N $ $
```

Datafill at switch C

The following example shows the datafill at switch C.

```
TABLE NETNAMES

NTI 3 0 $

TABLE CUSTNTWK

EXEC1 NTI 1 N $ NTWKRAG (10) CLID OFFNET $ $

TABLE MSGRTE

NTI 427 427 LOCAL 13 214301 $ $

NTI 446 446 PRA RICHPRI 3 $ $
```

Network name display

Network name display (NND) displays the names of the calling party, the connected party, and the originally called party (if redirection occurs) across an ISDN PRI network. NND across a PRI interface is limited to display names on electronic telephone sets with displays (ETSDs), integrated voice and data (IVD) sets, and attendant consoles (ACs). For an AC, only basic calls to and from the console and console-extended calls over a PRI interface are supported.

Note: Network name display is not supported for NI-2.

Figure 11-2 illustrates NND's operation. In this figure, User A and User B have either ETSDs or IVD sets.

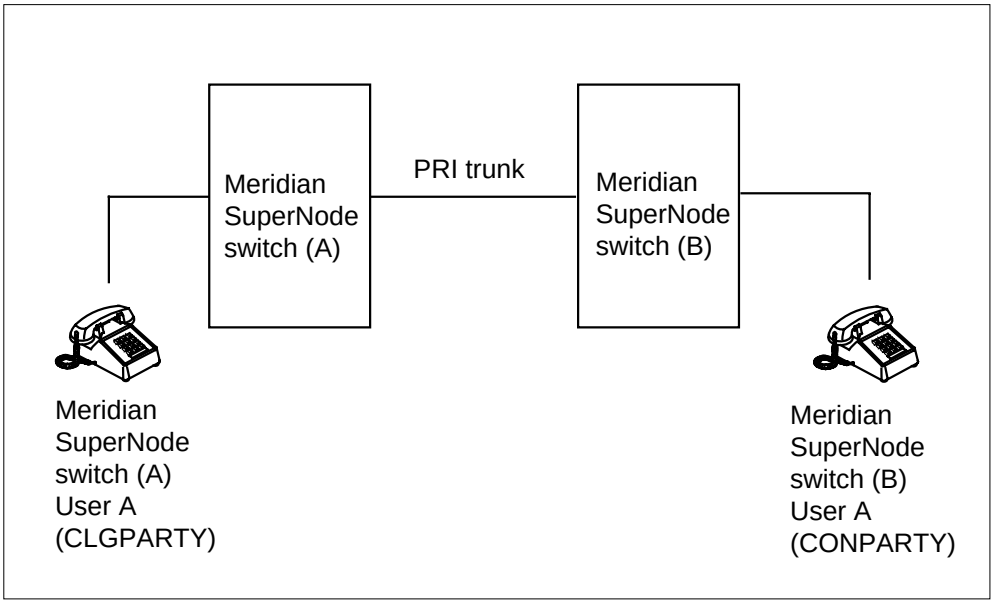
1. User A with name CLGPARTY calls User B with name CONPARTY on another switch over a Primary Rate Interface (PRI) trunk.
2. User B gets ringing.
3. User A's set displays the following on the top line:

   ```
   CONPARTY
   ```

4. User B's set displays the following on the top line:

   ```
   CLGPARTY
   ```

Figure 2 Dual-node configuration for NND



To activate NND, the following tables must be datafilled:

- NETNAMES
- CUSTNTWK
- CUSTSTN
- DNATTRS
- FNMAP (for ACs)

Table NETNAMES (network name)

This table associates logical network names with the external global network identifier.

Option NMDSP and name exchange method QUERY must be added to the network that supports NND.

The following is an example tuple:

```
PUBLIC 0 0 NMDSP QUERY $
```

Important fields include the following:

- OPTIONS—Enter NMDSP.
- NMXCHG—This field is a refinement for NMDSP, which specifies the name exchange method. Only the second method of NND, which sends the name of the connected party if the request is received, is supported for PRI. Name exchange method QUERY must be datafilled.

Table CUSTNTWK (customer networking)

This table controls customer networking features. For PRI, it controls the display on Meridian SuperNode telephones when interworking with PRI.

The following is an example tuple:

```
CUSTNAME PUBLIC 1 $ CLID OFFNET $
```

An important field is OPTIONS. For NND, enter values CLID with OFFNET.

Table CUSTSTN (customer station options)

This table list the station options assigned to each customer group.

To indicate that a customer supports NND, see the following example tuple:

```
COMKODAK NAMEDISP NAMEDISP
```

The following CUSTSTN fields are important to PRI setup:

- OPTNAME—Enter NAMEDISP.
- OPTIONS—Enter NAMEDISP.

Table DNATTRS (DN attributes)

This table contains DN attributes for specific DNs, such as assigning a name to DN 214 301 2401.

To add a name associated with a DN, see the following example tuple:

```
214 301 2401 PUBLIC NAME CLGPARTY $
```

An important field is DATA. The name attribute list NAME CLGPARTY must be datafilled for each logical network.

Table FNMAP (attendant console functional key)

This table lists all the features to which each of the AC keys, 2 through 43, are assigned.

To assign key 42 the NAME function, see the following example tuple:

```
ISDKOD 42 SPECL <name>
```

The following FNMAP fields are important to PRI setup:

- KEYSEL—Enter SPECL.
- SPFN—Enter NAME for NND.

Network automatic call distribution

Automatic call distribution (ACD) provides equal distribution of incoming calls to a predesignated set, or group, of answering positions (ACD agent positions). Networked ACD (NACD) determines which ACD group a call is to be presented by providing a means of communication, or networking, between ACD groups.

The information communicated between the NACD groups provides the intelligence for routing overflowed calls. This network load status information determines the best group for routing immediate overflow calls and time overflow calls. Time overflow calls are calls that have waited in the group's call queue for longer than a predesignated time. In this case, an overflowed call is placed in the overflow out queue of the original group. Also, the call is logically queued in another call's overflow in queue, which allows the call to be answered by either group.

The following data tables are used to define NACD groups:

- NACDGRP (network ACD group)—designates ACD groups as network ACD groups
- REMNACD (remote networked ACD)—provides the routing information associated with NACD groups on remote switches

- OFCENG (office engineering)—contains information on office parameters used for engineering the switch
- ACDGRP (ACD group)—provides information on the ACD group

Network load status information

NACD allows each NACD group to broadcast status information about its own load traffic and store load status information about the rest of the network. This load status information, known as Resource Index (RI), is the intelligence of NACD. RI reflects a group's ability to answer calls, and is used when determining where to route an overflowed call. RI is sent in call processing messages for immediate (physical) overflow calls and broadcast in a status update message. It also sent in the TCAP messaging for logical calls.

In addition to the RI, each group in the network has a customer-defined preference weighting factor (PWF). When a group receives an RI value from another group, it combines the RI with its PWF to form a value used to determine where to route a call. This new value, the desirability measure (DM), is calculated on a per-group basis each time an RI is received, either in a call processing message or a status update message.

A customer may use the PWF to give preference for routing calls to groups on the same switch, instead of using trunk facilities. Or, a customer may use the PWF to give preference to NACD groups that are routed to over less expensive trunks.

For Signaling System #7, status information (RI) for the originating NACD group is sent in the IAM and the ACM for the terminating NACD group.

For PRI, RI for originating NACD group is sent the SETUP message and the ALERT message for the terminating NACD group.

By sending status information in these existing call processing messages, the amount of signaling required to keep all NACD groups updated is minimized.

Status information is also broadcast (on an audit basis) to each group in the network though TCAP messages. Each NACD group maintains a table of the RI that was last sent to every other group in the network. This RI could have been sent in a call processing message or in a previous status update message. Before sending a broadcast message to another group, a check is made to determine whether the change between the current RI and the previously sent RI is less than the delta value. If not, a status update message is sent to that group.

Network message waiting indicator

Message waiting indicator—PRI

Message waiting allows messages for busy or unavailable subscribers to be stored and retrieved at a convenient time. When a message is left through a Simplified Message Desk Interface (SMDI), the message waiting indicator (MWI) is activated at the subscriber's set. When subscribers see the message waiting lamp is lit or hear a stuttered dial tone, they realize a message has been left for them and dial the SMDI and retrieve the message. Once the message is retrieved, MWI is deactivated.

Currently with NI-2, the SMDI has to be located on the same switch as the subscriber. The SMDI switch and the subscriber's switch must be connected by a pure CCS7 network that supports Transaction Capability Application Part (TCAP) messages. The connection can be made over PRI or ISDN User Part (ISUP) trunks.

This feature routes the TCAP message through the use of table MSGRTE. This table is datafilled with entries based on the destination DN and the destination network name. The advantage to routing through this table is that the transport of the TCAP message over PRI or PRI/CCS7 networks is supported. This allows the SMDI switch to be connected to the subscriber's switch over a PRI, CCS7, or PRI/CCS7 network.

This activity has no effect on the basic operation of message waiting. The feature simply alters the way network message waiting sends TCAP messages.

Feature interactions

This feature interacts with the following features:

- Network message service
- CCS7/PRI interworking
- Network executive message waiting
- Network ring again
- Network automatic call distribution

Restrictions and limitations

Because the network MWI does not know the name of the destination directory number (DN), the network name is sent as PUBLIC.

TCAP messages received by the network message service subsystem route no further, regardless of the value of option NMSTBRTE in table NETNAMES.

An originating switch with the NMSTBRTE option set may consider the initial attempt at feature activation unsuccessful if the far end switch cannot return a confirmation message.

Datafill

Option NMSTBRTE in table NETNAMES added to the range of values for field OPTION to datafill TCAP message routing options.

This feature increases program store by 2 kbytes.

12 Connectivity to other vendors

#4ESS connectivity

The Meridian SuperNode switch provides connectivity to interwork with the AT&T #4ESS switch over a Primary Rate Interface (PRI) trunk. The connectivity provided is for basic calls.

Feature operation

To connect to a #4ESS interface, existing procedures should be followed for the initial installation of the PRI interface. Datafill remains the same except that table PRIPROF and table LTDEF should be set to U449PRI to identify the vendor and switch type, and the L1FLAGS field in table TRKSGRP should be set to Y to identify the far end switching node to be a non-Nortel Networks switch.

The following are example tuples:

```
TABLE PRIPROF

NAPBX U449PRI V1 NOPIALERT $

TABLE LTDEF

ISDN 1008 B PRA 10 10 5 5 U449PRI V1 NAPBX NOPMD $

TABLE TRKSGRP

K2KPRI64CLLP1 0 DS1SIG ISDN 10 20 87Q931 2 N YIELD +

USER PT_PT USER Y Y 30 Y DTCI 10 0 24 64K HDLC$
```

#5ESS connectivity

The Meridian SuperNode switch can provide connectivity to interwork with the AT&T #5ESS switch over a PRI trunk. The connectivity provided is for basic calls.

Feature operation

To connect to a #5ESS interface, existing procedures should be followed for the initial installation of the PRI interface. Datafill remains the same except

that table PRIPROF and table LTDEF should be set to U459PRI to identify the vendor and switch type, and the L1FLAGS field in table TRKSGRP should be set to Y to identify the far end switching node to be a non-Nortel Networks switch.

The following are example tuples:

```
TABLE PRIPROF

NAPBX U459PRI V1 NOPIALERT $

TABLE LTDEF

ISDN 1008 B PRA 10 10 5 5 U459PRI V1 NAPBX NOPMD $

TABLE TRKSGRP

K2KPRI64CLLP1 0 DS1SIG ISDN 10 20 87Q931 2 N YIELD +

USER PT_PT USER Y Y 30 Y DTCI 10 0 24 64K HDLC$
```

Connectivity to NI-2 compliant vendors

National ISDN-2 (NI-2) is an attempt to provide a standardized approach to ISDN protocol and services. By providing a uniform standard for ISDN protocol message formats, NI-2 eliminates the semi-proprietary variations that were used by various equipment manufacturers in previous versions of ISDN. Thus NI-2 prevents many of the interoperability problems that were caused by these variations

There is only one protocol variant associated with NI-2, which is NIPRI, and only one issue of this protocol variant, which is NI2V1. No vendor-specific variants are provided. This is reflected in the following example datafill for NI-2 in the table LTDEF:

```
TABLE LTDEF

ISDN 15 B PRA 25 25 4 4 NIPRI NI2V1 NIL (NOPMD) $
```

There is presently only one switch for modifying the behavior of NI-2 PRI facilities in table PRIPROF, which is UNTONNPI. Other switches in PRIPROF that can be used with other ISDN protocol variants are not allowed with the NI-2 (NIPRI) variant.

The UNTONNPI switch allows the TON/NPI field of the Called Party Number information element for all outgoing SETUP messages from any logical terminals using this profile to be set to UNKNOWN/UNKNOWN. One case where this switch is required is when sending SETUP messages with digits in the Called Part Number that do not conform to the E.164 numbering plan. For

example, some IXCs require that the leading 1 in a 1+ call be included with the dialed digits. This does not comply with E.164. To prevent any switching systems between the Meridian SuperNode switch and the IXC from rejecting the call because of an invalid number format, the TON/NPI must be set to UNKNOWN/UNKNOWN. The following is an example of how tables PRIPROF and LTDEF would be datafilled.

```
TABLE PRIPROF

IXCPROFL NIPRI NI2V1 (UNTONNPI) $

TABLE LTDEF

ISDN 10085 B PRA 25 25 4 4 NIPRI NI2V1 IXCPROFL (NOPMD) $
```

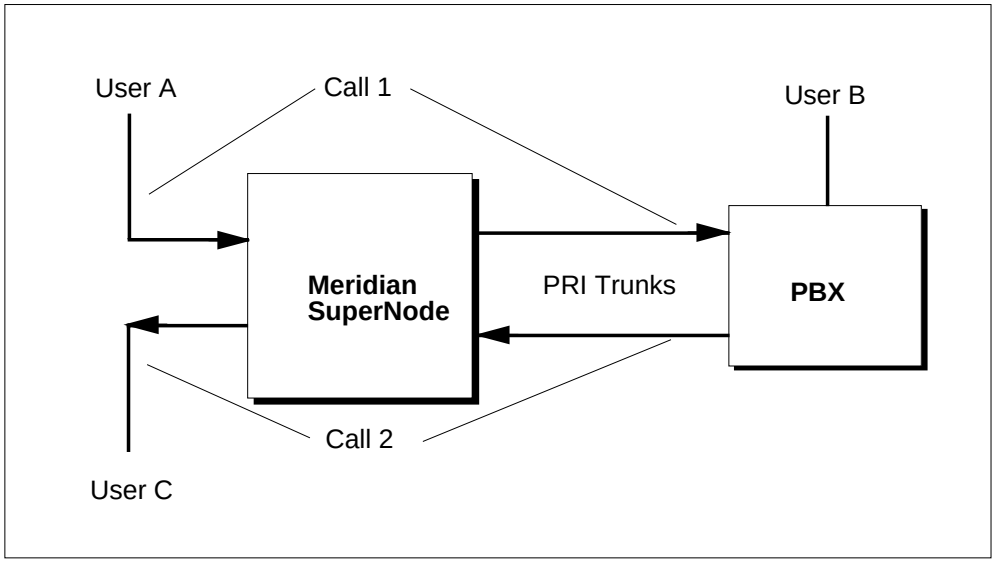
13 Release link trunk

A Primary Rate Interface (PRI) trunk with release link trunk (RLT) functionality connects a Meridian SuperNode switch to customer premises equipment (CPE), such as a Meridian 1 PBX.

RLT functionality allows a Meridian SuperNode switch to release a pair of PRI trunks while it bridges the originator of one call to the terminator of a second call. After relaease link trunking, the trunks are available for other calls. RLT functionality increases the traffic handling capacity of the Meridian SuperNode switch and saves resources during call routing by optimizing PRI trunk use. Without release link trunking, the CPE and trunks involved must maintain at least one call connection until a call is over.

This functionality provides only network-side RLT capability on PRI trunks for Meridian SuperNode offices (NTNA PRI variant only). The following figure shows a typical usage for RLT. Note that many other scenarios are possible.

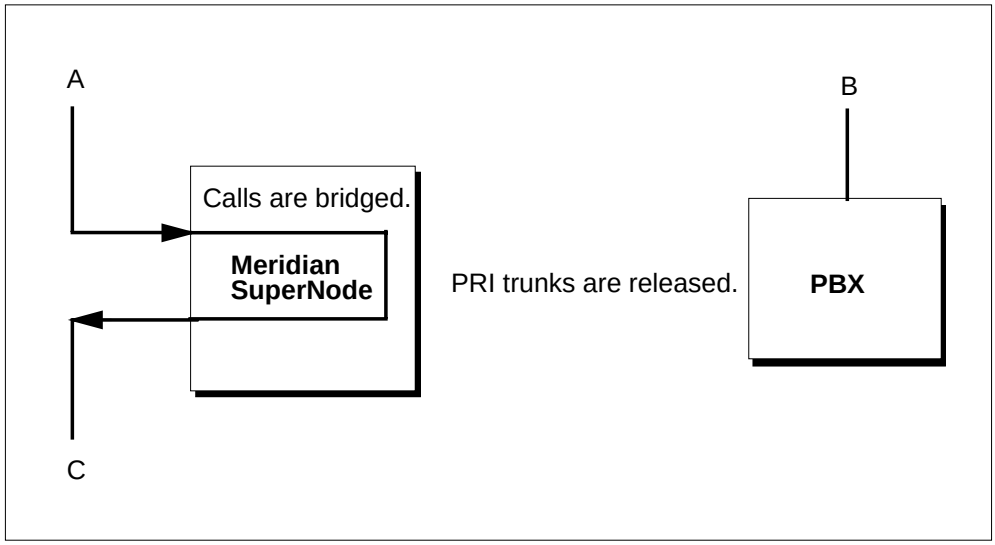
Figure 1 Typical RLT usage



In the scenario shown in Figure 13-1, user A calls user B. This call is referred to as call 1. Call 1 routes through the Meridian SuperNode switch to another PBX. User B then forwards or transfers the call to user C, and the system requests RLT. This call (call 2) routes through the same Meridian SuperNode office. Note that calls 1 and 2 can be on the same or different trunk groups.

When the call to user C connects, the system invokes RLT. In the example shown in Figure 13-2 the call is bridged at the Meridian SuperNode office and the PRI trunks to the other PBX are released.

Figure 2 Result of invoking RLT



In a standard RLT scenario, a PRI link is set up between two offices. As shown in Figures 13-1 and 13-2, the two offices are a Meridian SuperNode switch on one side and another PBX on the other side. For the ISDN PRI protocol to work, one side must act as the network side, and the other side must act as the user side. In the configuration described here, the Meridian SuperNode office acts as the network side, and the other PBX acts as the user side.

In the RLT protocol, the user side (the other PBX) requests RLT, and the network side (the Meridian SuperNode office) bridges the calls and releases the trunks. This functionality applies to the network side of RLT only. This functionality does not apply to user-side RLT on the Meridian SuperNode office. Although the Meridian SuperNode switch is a PBX, it supports network-side PRI links. The network-side links can be used for RLT in the case where the Meridian SuperNode office is connected to a PBX or other such RLT-capable device. The user side links on the Meridian SuperNode switch cannot be used for RLT.

RLT functionality is available on an optional basis through two methods. The first method is through datafill on the individual trunk groups. If a trunk group is not datafilled for RLT, it cannot use RLT.

The second method is password protection, which is controlled through the software optionality control (SOC) utility. In its delivered state, RLT is disabled on the entire switch, regardless of how the trunk groups have been datafilled. By entering a password, switch maintenance or administration personnel can enable RLT in the trunk groups for which it is datafilled. Subsequent to enabling RLT, the functionality can be disabled on a switch-wide basis again using the same password protection interface.

The prime target for this functionality is the Meridian 1 PBX. Other devices can be used with this functionality, if they follow the user-side RLT protocol described in *ISDN Primary Rate User-Network Interface Specification*, NIS A211-1.

Protocols that support RLT capabilities

The Meridian SuperNode switch uses the Q.932 FACILITY message and Facility IE (Information Element) to provide RLT capability.

Explanations for RLT terms

The following subsections define important RLT terms used frequently in this chapter.

Meridian SuperNode and network side

Throughout this document the terms “Meridian SuperNode" and “network side" are used synonymously. These terms refer to the equipment that is running the code that implements the RLT functionality. (Refer to Figure 13-4.)

PBX and user side

The terms “PBX" and “user side" are used synonymously and refer to the equipment that implements the user portion of RLT. It is important to remember that even though the term “PBX" is used, any device capable of running the user portion of RLT may be substituted.

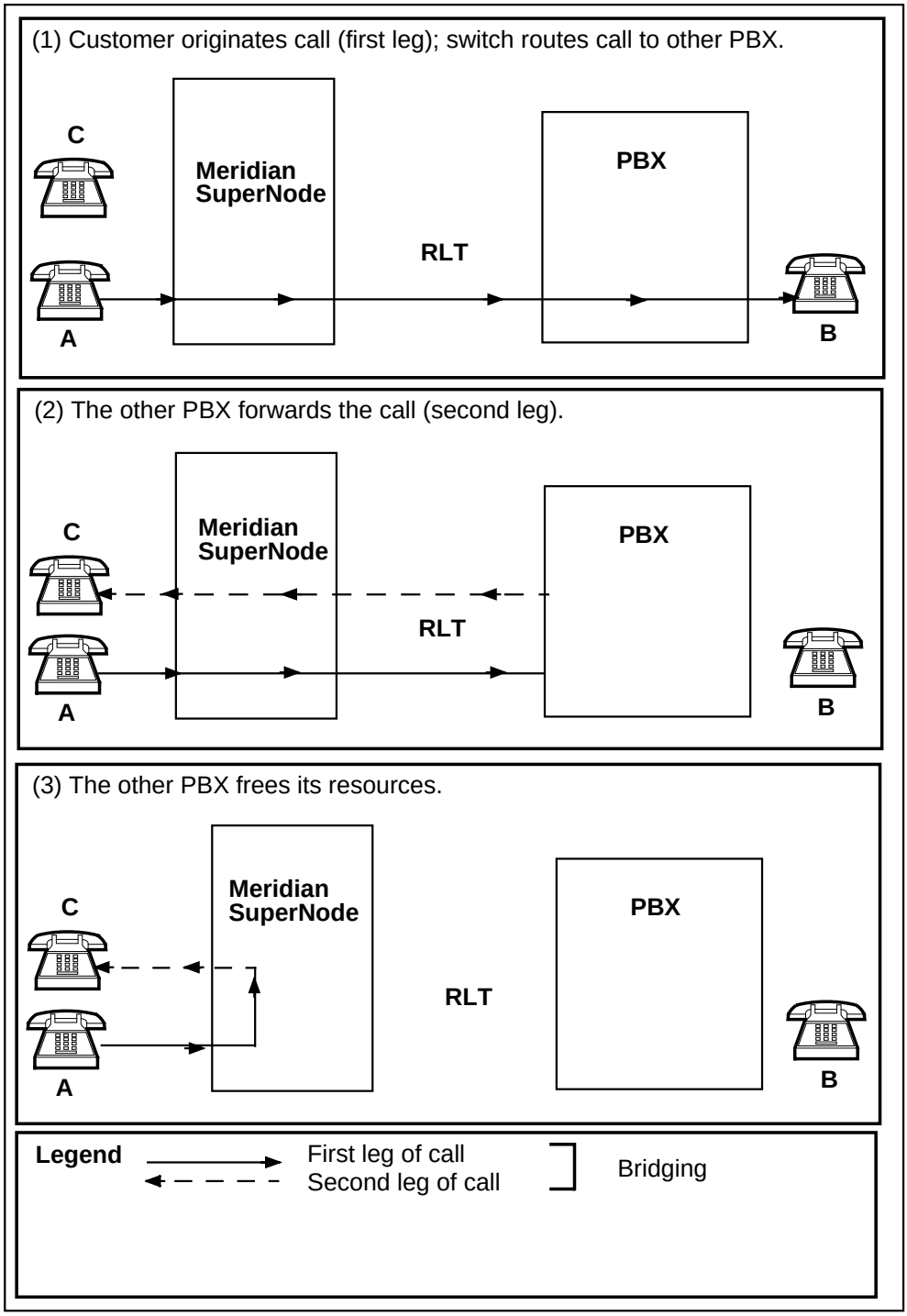
Bridging and the bridging switch

When a switch bridges a call for RLT functionality, it connects the originating or terminating trunk of one call to the terminating trunk of a second call. The *bridging* Meridian SuperNode switch is the switch that bridges the call and maintains the call connection. A switch only bridges calls when it cannot remove itself from the call connection by passing the bridge request to another switch. To bridge calls, a switch between the bridging and host switches must have RLT capability.

Originating switch, terminating switch, and call legs

A switch that connects to the calling party is an *originating* switch. A switch that connects to the called party is a *terminating* switch. A call's first leg connects to the originating switch. A call's second leg connects to the terminating switch. The bridging switch makes a call to the terminating switch before it connects a call to the originating switch, establishing the second call leg before the first call leg. A call's point of connection, not the order in which the network establishes a call, defines it as a first or second leg. Figure 13-3 shows an example of call legs in an RLT scenario.

Figure 3 Example of call legs between the bridging Meridian SuperNode switch and another PBX



Common PRI RLT call scenarios

The following scenarios summarize the most common call scenarios that involve RLT functionality. For details about these call scenarios, refer to the “Functional overview" section in this chapter.

Call forwarding scenario

In this scenario, the Meridian SuperNode switch routes a call to the CPE over PRI trunks. The CPE then redirects the call to the same Meridian SuperNode switch. When the parties are in conference, the CPE invokes release link trunking. The release link trunking capability frees the CPE resources.

Call transfer scenario

In this scenario, the call originates from the Meridian SuperNode switch to the CPE. The subscriber off the CPE then transfers the callback to another subscriber off the Meridian SuperNode switch. After the CPE subscriber drops off the call, RLT is invoked, the call is bridged, and CPE resources are freed.

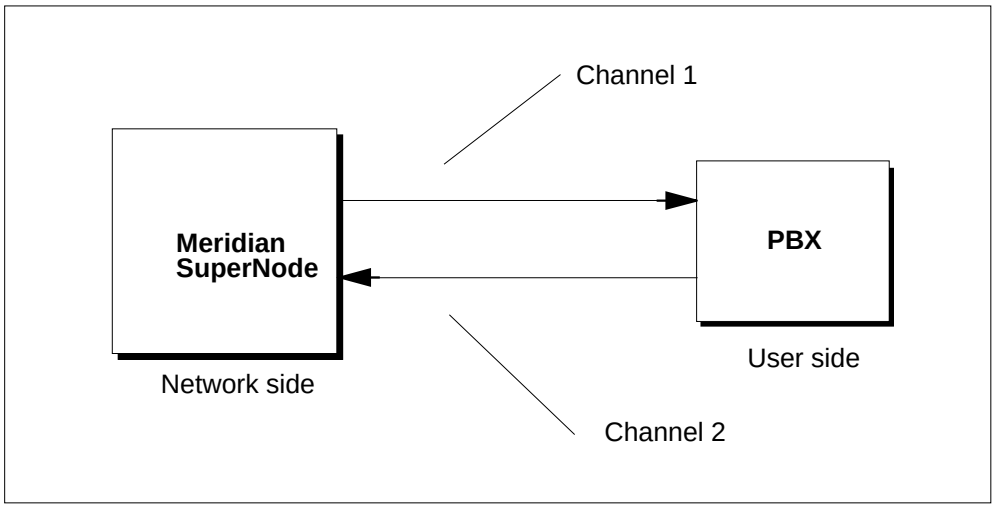
Functional overview

This functionality implements the network side of RLT on a Meridian SuperNode office over PRI. This functionality has been designed to work with the Meridian 1 PBX, but can work with other devices that follow the user-side RLT protocol described in *ISDN Primary Rate User-Network Interface Specification*, NIS A211-1.

In all cases, RLT involves exactly two B-channels that run between the network side (at the Meridian SuperNode office) and the user side (at the other PBX) as illustrated in Figure 13-4. These B-channels can be on the same PRI trunk group or on different PRI trunk groups. If the B-channels are on different PRI trunk groups, they must connect to the same Meridian SuperNode office and PBX. One B-channel carries a call that originates from the network side and terminates on the user side. This channel is referred to as channel 1. The call that is carried over channel 1 is referred to as call 1.

The other B-channel carries a call that originates from the user side and terminates on the network side. This channel is referred to as channel 2. The call that is carried over channel 2 is referred to as call 2.

Figure 4 RLT overview



For RLT to be invoked, datafill must be entered for all trunks that may handle RLT traffic and for the system itself as being capable of RLT functionality. Refer to the “Enabling the RLT option" section in this chapter.

Messaging sequences

Figures 13-5, 13-6, and 13-7 detail messaging sequences that describe ways in which RLT is typically used. In these figures, a dashed line indicates a message associated with call 1, and a solid line indicates a message associated with call 2. The messages that are in bold type have Facility Information Elements relating to RLT included in them. Refer to the “RLT and PRI Layer 3 messages" section in this chapter for a description of the function of these Facility Information Elements.

Note that there are many other ways in which RLT could be invoked. These three examples describe the most common ways in which the Meridian 1 PBX uses RLT with the trunk anti-tromboning (TAT) feature. Apart from the RLT specific messaging, which is in bold type, the messaging sequence is the same as it would be if RLT were not invoked. Also note that these scenarios are dependent on the PBX.

Figure 13-5 shows the messaging sequence for RLT with call forward. In this example, user A calls user B. This call is automatically forwarded to user C. The phone for user B does not ring. Instead, the phone for user C rings, and the Q.931 signaling for the call is propagated through the PBX to user A. When user C answers the phone, the PBX invokes RLT, and the call is bridged at the Meridian SuperNode office. The PRI lines to the PBX are taken down, and user B is no longer involved with the call.

Figure 13-6 shows the messaging sequence for RLT with call forward no answer. This scenario is very similar to call forward, but has one major difference. When user A calls user B, the phone on user B rings. After a certain period of time (provided that user B does not answer the phone), the call is forwarded to user C. The PBX does not propagate the Q.931 ALERTING message from user C to user A because it was already informed that the call was alerting user B.

Figure 13-7 shows the messaging sequence for RLT with call transfer. In this example, user A calls user B. User B answers the phone and then transfers the call to user C. Because user A and user B are already connected, no Q.931 messages are propagated from user B to user A. Sometime after user C answers the phone, user B drops out of the call, and the PBX invokes RLT. The call is bridged at the Meridian SuperNode office, and the PRI lines to the PBX are taken down. User B is no longer involved with the call.

Figure 13-5 RLT with call forward

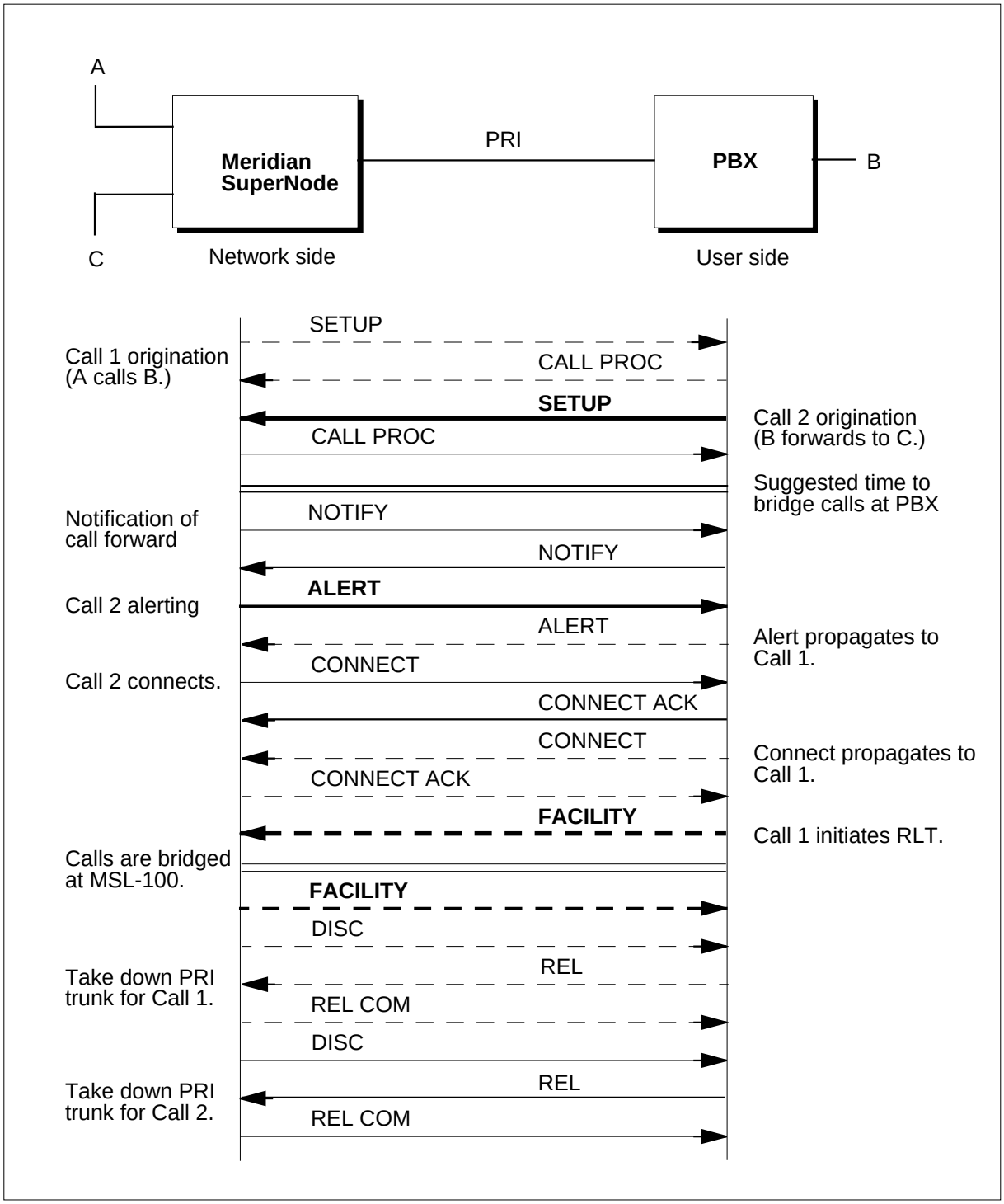


Figure 13-6 RLT with call forward no answer

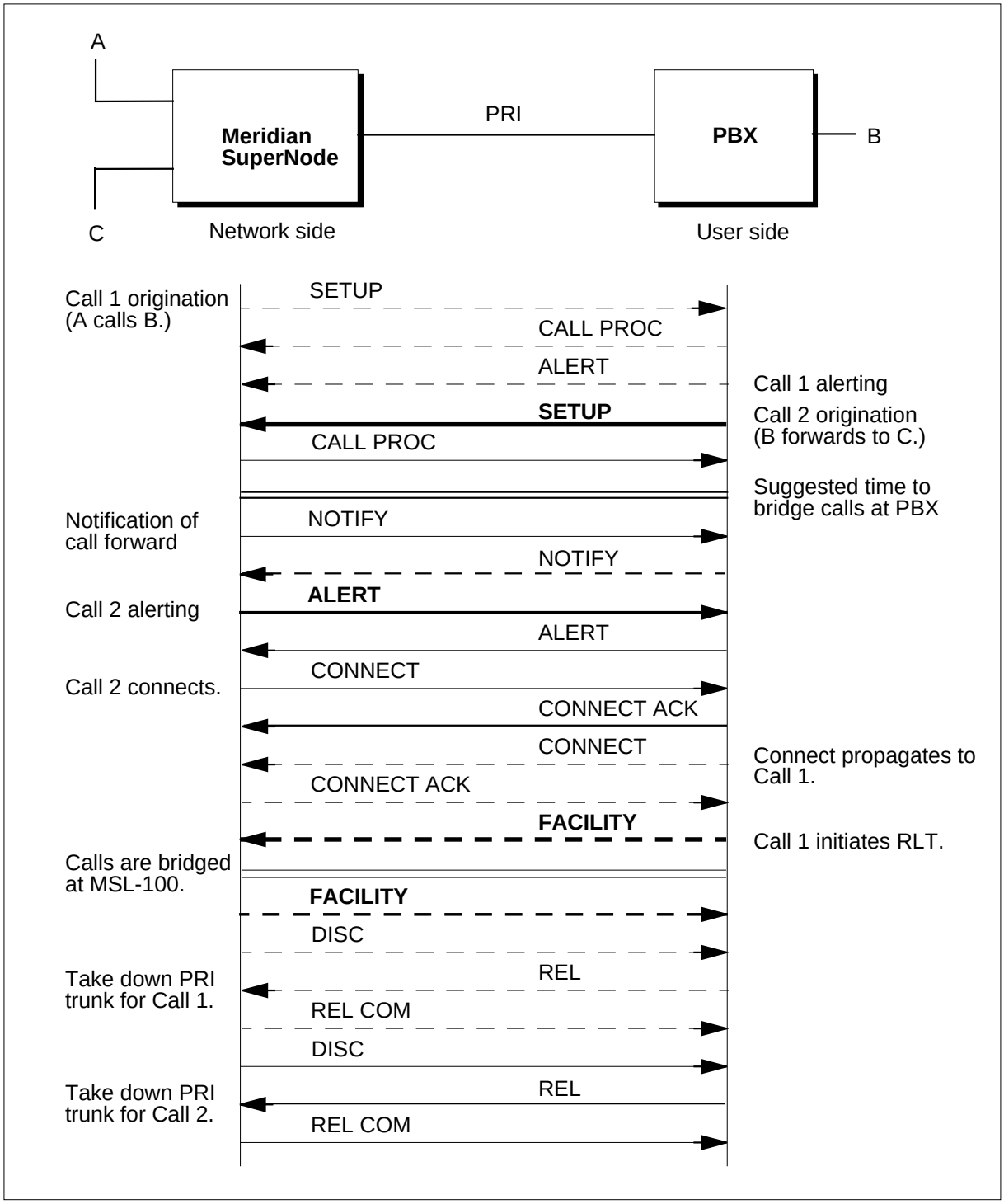
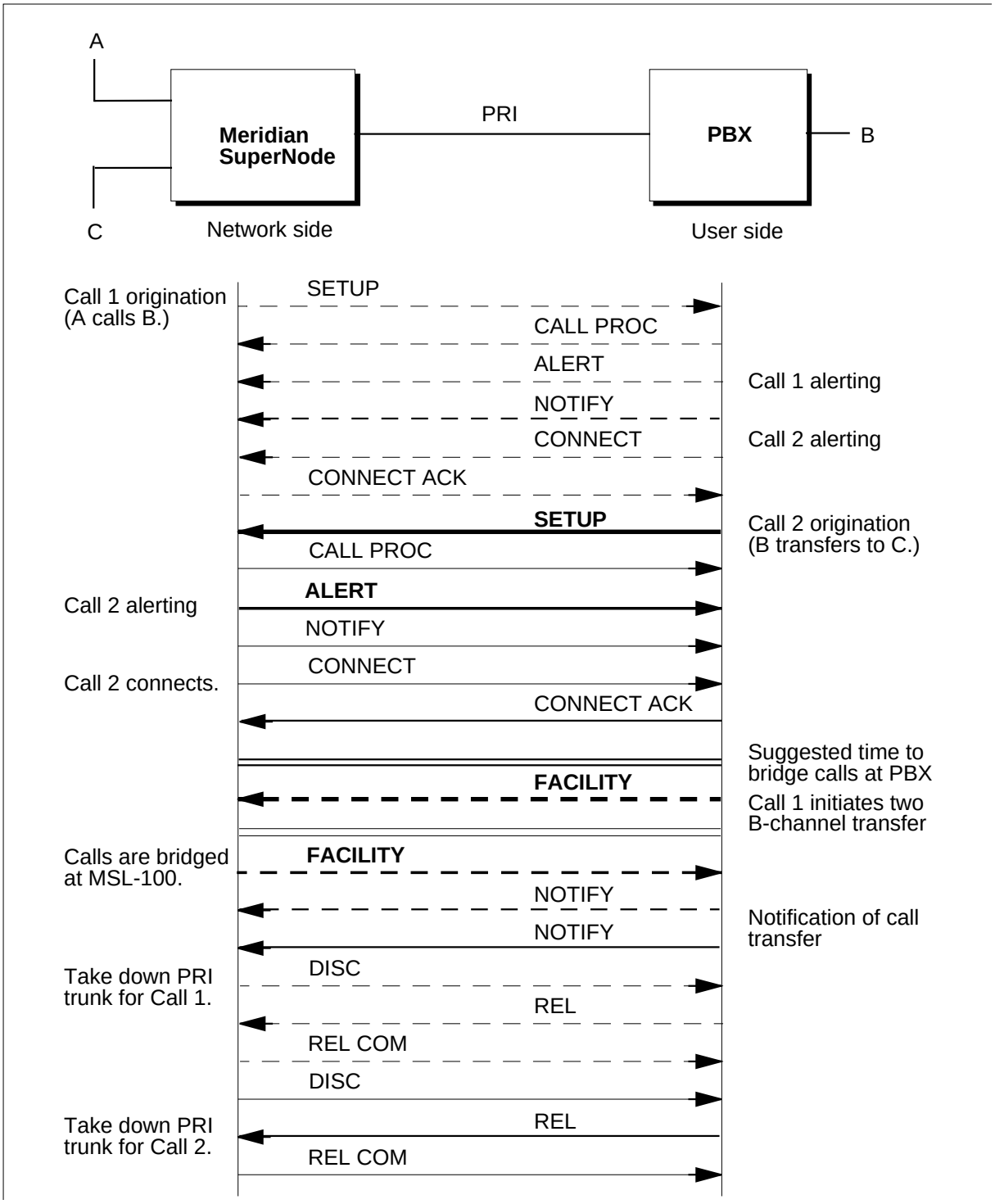


Figure 13-7 RLT with call transfer



Despite the previous two examples, it is important to note that it doesn't matter whether call 1 is originated before or after call 2. It is possible for call 2 to be

set up for RLT before call 1 arrives, if the PBX predicts a need for a future transfer.

When RLT is invoked, calls 1 and 2 must both be connected. The calls must also be bridged at the PBX. This ensures that user A receives the appropriate tones and announcements from call 2. In the previous examples, suggestions are made as to the appropriate time to bridge the calls at the PBX. In both call forward scenarios, the call should be bridged immediately after call 2 has received a CALL PROCEEDING message. This allows user A to hear the tones and announcements for the call. In the call transfer scenario, the bridging may wait until just before RLT is invoked. This ensures that the call stays up even if RLT fails. Note that no user may be associated with the call at the PBX when RLT is being invoked. Otherwise, the user would be disconnected from the call when RLT takes down the two PRI trunks.

There are two separate phases of messaging required to invoke RLT. The first phase occurs when call 2 is originated. If the PBX wants to involve call 2 in RLT, it must include a Facility IE (Information Element) in the SETUP message when originating call 2.

When the network side receives a SETUP message with a Facility IE requesting RLT, it will respond by adding its own Facility IE to the ALERTING or PROGRESS message associated with call 2. This Facility IE contains the call ID of call 2.

Any time after call 2 is originated and before RLT is invoked, the user side must bridge calls 1 and 2. It must also disconnect any of the users at the user side who are involved in either call.

When the above criteria have been met, and provided that call 2 is connected, the user side may invoke RLT. The user side may send a FACILITY message associated with call 1 to the network side. This FACILITY message must contain a Facility IE with the call ID that was sent back from the network side previously. (The exact contents of the FACILITY message are described in the *ISDN Primary Rate User-Network Interface Specification*, NIS A211-1.)

Upon receiving this FACILITY message, the network side bridges the two calls. It then sends DISCONNECT messages associated with each call to the user side. The user and network sides then proceed to release the two channels in the usual way.

The end result of this action is that the two calls are bridged at the network side. No B- or D-channels between the network side and the user side are involved in either call. The user side is not involved in either call at this point.

Error conditions

Error conditions can occur and are described in the “RLT and PRI Layer 3 messages" section. These error conditions do not, however, interfere with call processing. The system merely disallows RLT. Because the calls are already bridged at the PBX, the call stays up. In general, there are two places where an error condition occurs: after receiving the SETUP message or after receiving the FACILITY message.

Enabling the RLT option

RLT is available to PRI trunks on a Meridian SuperNode office when the MRLT option is datafilled in table TRKGRP. This option can only be datafilled on the network side of a PRI trunk group.

Datafill

The following table lists the datafill for table TRKGRP type PRA that applies specifically to RLT functionality. Refer to the *Customer Data Schema* for information on other fields in table TRKGRP.

Table 1 TRKGRP type PRA field descriptions

Field	Subfield or refinement	Entry	Explanation and action
	OPTIONS	See subfield.	*Options* *This field consists of subfield OPTION and refinement.*
	OPTION	MRLT	*Option* Enter MRLT to specify RLT for PRI trunks.

The MRLT option allows the RLT functionality to be enabled on that trunk group. RLT, however, is only activated if it is turned on using software optionality control (SOC). Datafill is still possible with the RLT SOC state set to IDLE; however RLT is not activated on any of the trunk groups datafilled with the MRLT option.

For more information on the SOC interface and how to activate a feature, refer to the *Software Optionality Control User Manual*, 297-8991-901.

Datafill example

The following example shows sample datafill for table TRKGRP type PRA. This example is datafilled as follows:

- The code in the CLLI table for the trunk group is 64K1DT0.
- The trunk group type is PRA.
- A traffic separation number is not required.
- The pad group assigned to this trunk group is PRAC.
- NCRT is the no-circuit class for incoming trunks where datafill is not required for this field.
- The selection sequence is ASEQ (ascending sequential selection).
- No billing directory number is required.
- The logical terminal group is ISDN, and the logical terminal number within the group is 3.
- RLT functionality is enabled.

Figure 13-8 MAP display example for table TRKGRP type PRA

```
GRPKEY          GRPINFO
_____________________________________________________________________

64K1DT0         PRA 0 PRAC NCRT ASEQ N (ISDN 3) (MRLT) $
```

RLT and PRI Layer 3 messages

This section outlines the PRI Layer 3 messaging that occurs when RLT functionality is invoked.

FACILITY messages and FACILITY information elements

RLT uses the Q.932 FACILITY message and FACILITY Information Element (IE) to provide RLT capability. The FACILITY message is a Q.932 message that is used to transfer higher layer protocols. Two of these protocols are Transactions Capabilities Application Part (TCAP) and Remote Operations Service Element (ROSE).

All FACILITY messages contain a FACILITY IE. This element may also be contained in other Q.931 messages. For the purposes of RLT functionality, the FACILITY IE is used as part of Q.931 ALERTING, PROGRESS, and SETUP messages. (The format of these messages is documented in the *ISDN Primary Rate User-Network Interface Specification*, NIS A211-1.)

All FACILITY IEs have the same general format. Table 13-2 shows the format common to all FACILITY IEs. The most important parameters shown here are the Service Identifier (octet 3a) and the Service Discriminator (octet 3). Note that the Length of Information Element parameter (octet 2) contains the length of the entire IE minus two. The FACILITY IE Identifier (octet 1) and the Length parameter (octet 2) are not counted.

Table 13-2 FACILITY IE common format

Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Octet
0	0	0	1	1	1	0	0	1
Length of Information Element								2
0/1	Spare		Service Discriminator					3
1	Service Identifier							3a
User Data (component)								4 ... n

The Service Identifier (octet 3a) specifies to which service this IE relates as shown in Table 13-2. For this feature, it contains the identifier for RLT. A FACILITY IE that contains this Service Identifier contains information pertinent to an RLT service.

Table 13-3 Service identifier

7	6	5	4	3	2	1	
1	1	1	0	0	0	0	Network Message Service
1	1	1	1	1	1	0	Network Automatic Call Distribution
1	1	1	1	1	1	1	Network Ring Again
0	1	1	1	1	1	0	*Release Link Trunk*

The User Data, which is stored in octets 4 and beyond, are encoded into the FACILITY IE according to a particular protocol. This protocol is specified by the Service Discriminator (octet 3). Currently, there are only two supported protocols: ROSE and TCAP. FACILITY IEs that contain RLT information must be encoded using a subset of the ROSE protocol.

ROSE components

The User Data encoded in octets 4 and beyond are contained in a ROSE component. There are four different ROSE components used by RLT: Invoke, Return Result, Return Error, and Reject. Each RLT-related FACILITY IE has

a single ROSE component in its User Data octets. Octet 4 (the first of the User Data octets) contains the Component Tag. This tag identifies the kind of component in the FACILITY IE.

The Component Length follows the Component Tag. This octet (octet 5) contains the length of the IE past octet five. It contains the number of octets in the component (not counting octets 4 and 5).

The next three octets (octets 6-8) contain the Invoke Identifier. Octet 6 contains a value that indicates that this is an Invoke Identifier. Octet 7 contains the length of the Invoke Identifier. The last mandatory octet (octet 8) contains the Invoke Identifier. This contains the Operation Value of the RLT Invoke component that caused this IE to be generated. In the case where the IE is not sent in response to anything, the Invoke ID is set to the Operation Value. The description of each component, given below, indicates the value to which the Invoke Identifier is set.

Invoke component

The Invoke component indicates that an RLT action is desired. The user side sends a FACILITY IE containing an Invoke component to setup and invoke RLT. There are two kinds of Invoke components: RLT Operation Indication and RLT Third Party. The RLT Operation Indication component is used in a SETUP message to indicate that the call is eventually involved in RLT. The RLT Third Party component is used in a FACILITY message to invoke RLT.

Return result component

The Return Result component is returned on the successful completion of the requested operation. This component is sent by the network side after it has completed the operation requested by a preceding FACILITY IE with an Invoke component.

There are two types of Return Result components created by RLT functionality. The simplest is sent on successful completion of processing an RLT Third Party Invoke component (after the network side has successfully bridged the two calls). In this case, no additional information is added to the IE. The Invoke ID indicates that this is a response to an RLT Third Party Invoke component.

The other type of Return Result component created by RLT functionality is sent on successful completion of processing an RLT Operation Indication Invoke component. (The Invoke component is sent in the SETUP message indicating that RLT is desired. The Return Result component is sent back in the PROGRESS or ALERTING message and contains the Call ID of that call.) The Invoke ID indicates that this is a response to an RLT Operation Indication Invoke component.

Return error component

The Return Error component is generated when the network side is unable to complete the request of the previous Invoke component. This component is only used in response to a properly formatted request.

The Invoke ID of this component is set to the value of the Operation Value in the Invoke component that initiated this message. This indicates which operation could not be completed.

Reject component

The Reject component is sent when a protocol error occurs. The Reject component is returned if the Meridian SuperNode switch is unable to parse the data in an RLT FACILITY IE.

Message protocols

There are two phases of messaging. The first phase, RLT setup, occurs when the user side is attempting to originate call 2. The second phase, RLT invocation, occurs when the user side actually invokes RLT.

RLT setup

When the user side attempts to originate call 2, it must announce its intention to involve this B-channel in RLT. It does this by adding a FACILITY IE with an RLT Operation Indication Invoke component to the outgoing SETUP message.

Upon receipt of this SETUP message, the network side tries to originate the call. If it is unsuccessful, the network side takes down the call as usual, and no further RLT-specific messaging is associated with this call.

If, however, the network side is successful in originating the call, it will send the appropriate messages as usual. Eventually the network side indicates to the user side that the call is alerting. It does this by sending either an ALERTING message or, in the case of a call that is not end-to-end ISDN, a PROGRESS message.

Before sending the ALERTING or PROGRESS message, the network side checks to ensure that the trunk to which the second B-channel belongs is subscribed to RLT. It does this by checking the datafill in table TRKGRP. If that trunk belongs to a subscribed trunk group, the network side checks to ensure that the RLT feature is activated. If RLT is activated, the network side adds a FACILITY IE with a Return Result component. This component contains the Call ID of call 2.

If the trunk group in question is not datafilled for RLT or if the RLT feature has not been activated, the ALERTING or PROGRESS message contains a

FACILITY IE with a Return Error component. This error indicates that RLT is not available. No further RLT messaging is done involving this call.

RLT invocation

To invoke RLT, the following criteria must be met:

- Call 1 must have been originated and connected.
- Call 2 must have been originated, sending an RLT FACILITY IE in the SETUP message.
- The user side must have received and recorded the Call ID of call 2 from the Return Result component in the RLT FACILITY IE of the ALERTING or PROGRESS message of call 2.
- Call 2 must be connected.
- Calls 1 and 2 must be bridged at the user side.
- There must be no users connected to either call 1 or call 2 at the user side.

The conditions that calls 1 and 2 must be connected and bridged at the user side before invoking RLT ensures that announcements and tones are properly sent to the initiator of call 1.

When these criteria are met, the user side may send a FACILITY message, containing a FACILITY IE with an RLT Third Party Invoke component to the network side. This message must be associated with call 1 (B-channel 1). The Invoke component must contain the Call ID of call 2.

When the network side receives a FACILITY IE with an RLT Third Party Invoke component, it checks the trunk group of the B-channel on which it has received the message (B-channel 1). It does this by ensuring that the trunk group is datafilled for RLT in table TRKGRP. It then ensures that the RLT feature is activated on the switch. If these conditions are satisfied, it attempts to bridge the call.

Call bridging

In this stage, the Meridian SuperNode switch attempts to bridge the calls. If the call is bridged successfully, the network side sends a FACILITY message containing a FACILITY IE with a Return Result component.

If the call is not bridged successfully or if RLT is not allowed, the system returns a FACILITY message containing a FACILITY IE with a Return Error component. The error component contains an error value of 1 (RLT Call ID Not Found) if the bridging failed because the network side did not recognize the call ID in the Invoke component. An error value of 2 (RLT Not Allowed) indicates that the trunk group is not datafilled for RLT or that the RLT feature is not activated. An error value of 0 (RLT Bridge Fail) indicates that the bridging failed for any other reason.

B-channel release

After the call is bridged at the network side and the FACILITY message containing the FACILITY IE with the Return Result component has been sent to the user side, the network side takes down both calls 1 and 2. This is done by sending DISCONNECT messages to the user side. The calls are then taken down in the normal manner.

Feature impact

Interactions

There are no feature interactions that cause bridging to fail.

If the PBX sends NOTIFY messages after it has invoked RLT, these may not be propagated to their intended recipients. The PBX must send all NOTIFY messages before invoking RLT.

Restrictions and limitations

The following restrictions limit the scope of this feature:

- The feature is implemented only for North America PRI (NTNA PRI variant).
- The feature specifically works with the Meridian 1 PBX. Other devices that implement RLT must use the user-side RLT protocol described in the *ISDN Primary Rate User-Network Interface Specification*, NIS A211-1.
- Only the network side of RLT is implemented by this feature.
- This feature is not generally available. RLT use is controlled by the software optionality control (SOC) utility.
- Interaction with ISDN user part (ISUP) call completion with trunk optimization (CCTO) (or any other trunk optimizing scheme) is not supported. This feature only optimizes PRI trunks between the Meridian SuperNode and another PBX that are directly connected.

14 Trunk anti-tromboning

The Trunk Anti-Tromboning (TAT) feature optimizes tromboned ISDN Primary Rate Interface (PRI), ISDN Signaling Link (ISL), Virtual Network Services (VNS), and analog trunks within an ISDN PRI network. The system performs anti-tromboning only after the third party answers provided that the tromboned trunks are associated with the same primary D-channel (with or without a backup D-channel) and the trunks are associated with the same customer.

ATTENTION

TAT functionality is a Meridian 1 feature that works in conjunction with the Meridian SuperNode release link trunk (RLT) feature.

Note that TAT also applies to a call entering a Meridian SuperNode network over a central office (CO) trunk. TAT eliminates the tromboning of private network trunks that may occur if the call is redirected or modified.

The term tromboning defines a situation in which two trunks, associated with the same D-channel, are being used in parallel. Basically one trunk (B-channel) is established to handle an incoming call from a calling set at the originating node to a called set at the terminating node. A second trunk (B-channel) is then established to handle the loop-back of the same call that is redirected from the called station back to a different set at the originating node.

The loop-back may result from a call being treated by Network Message Services—Meridian Mail, Network Call Redirection (such as Network Call Forward All Calls, Network Call Forward No Answer, Network Call Forward Busy, and Network Hunting), or Call Modification (such as a call transfer). These tromboned trunks are redundant. The TAT feature eliminates these redundant trunks *after* the call is answered.

TAT functions with a Meridian 1 (M1) switch interworking with another M1 switch or with an M1-to-Meridian SuperNode interworking scenario. In an M1-to-M1 interworking scenario, each switch must be equipped with TAT. In the M1-to-Meridian SuperNode interworking scenario, the Meridian

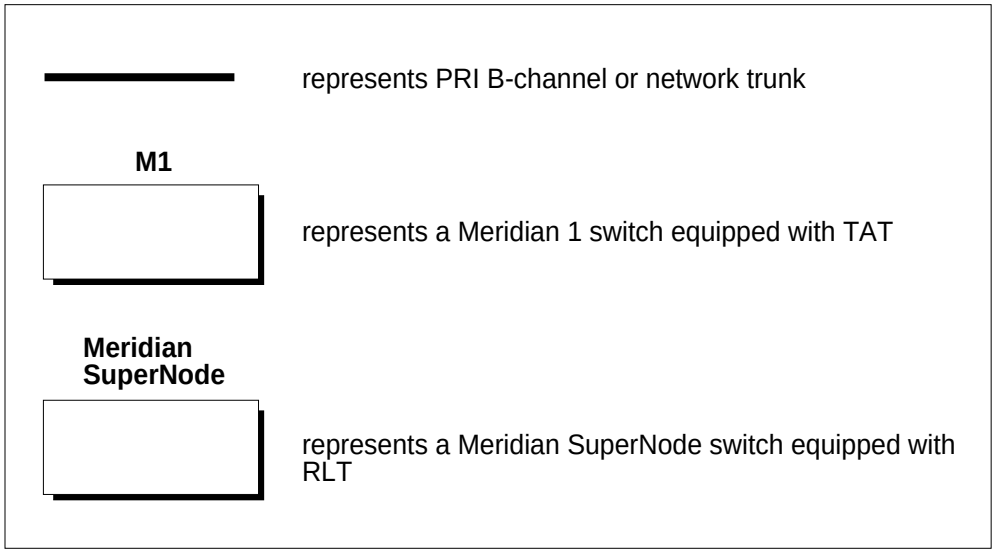
SuperNode switch must be equipped with the Release Link Trunk (RLT) feature.

Note: For detailed information on TAT functionality in an M1-to-M1 interworking scenario, refer to *ISDN PRI Description and Installation*, 553-2901-100.

Anti-tromboning scenarios

The following information provides examples of various anti-tromboning scenarios as applied with M1-to-Meridian SuperNode interworking with the Meridian SuperNode switch equipped with RLT functionality.

Note that the following legend describes the connectivity depicted in the following figures.



Anti-tromboning operation for network call redirection (example 1)

In Figure 14-1, TAT is applied to a network call redirection scenario (using call forward) with two M1 switches interworking with a Meridian SuperNode switch:

1. Station A is located at an originating switch (public CO or PBX) node and makes an internodal call through the Meridian SuperNode switch and a tandem M1 node to Station B located at the terminating M1 node. This is represented in Figure 14-1 as the first call.
2. Station B, which is located at the terminating M1 node, is call-forwarded through the tandem M1 node and the Meridian SuperNode switch to Station C, which is located at the originating switch. This is represented in Figure 14-1 as the redirected call.
3. Station C answers.
4. Station A connects to Station C.

Figure 14-1 Anti-tromboning for network call redirection (example 1)

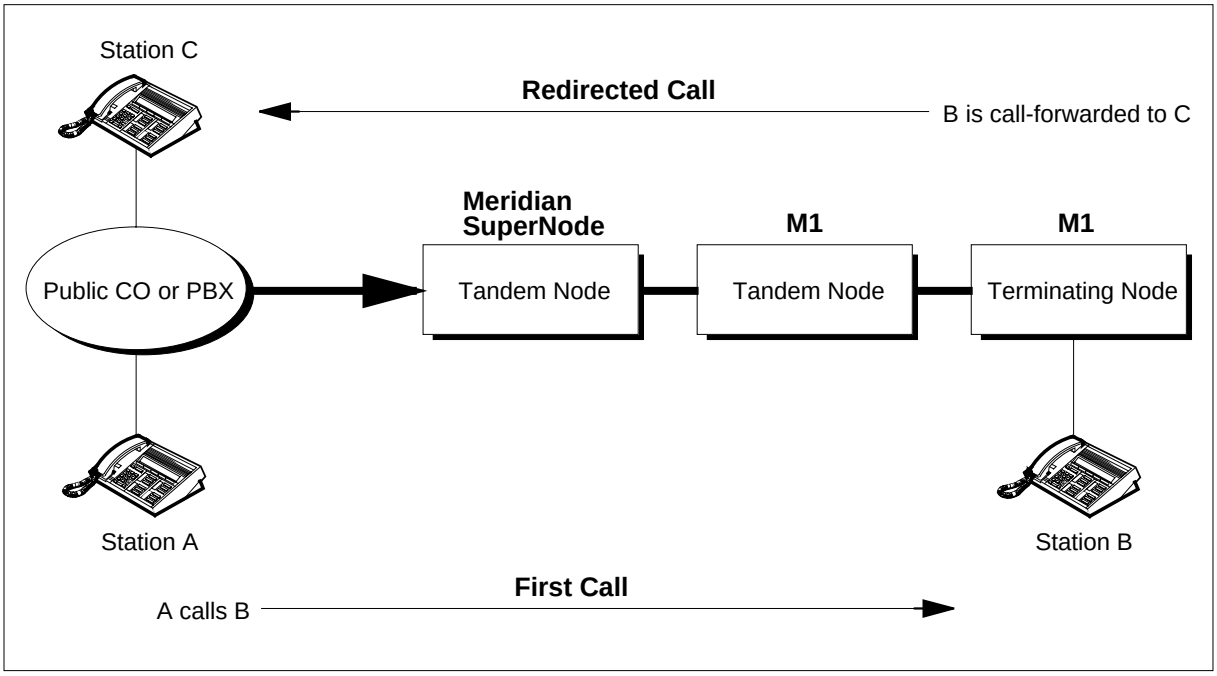
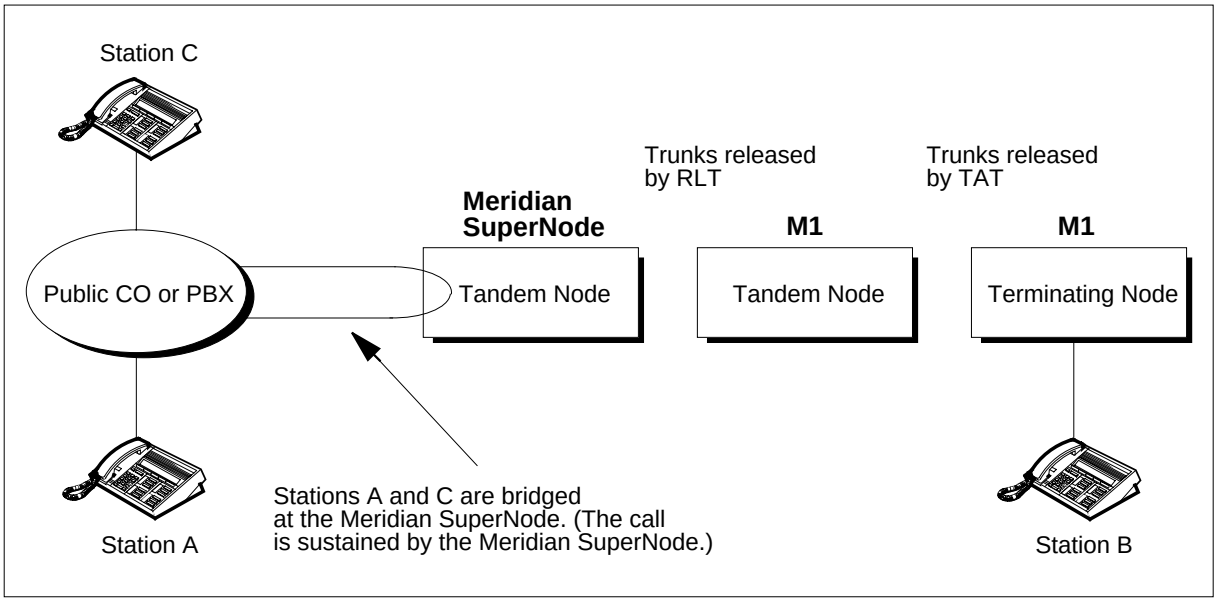


Figure 14-2 shows the results of anti-tromboning *after Station C answers the call*.

1. The call is bridged at the Meridian SuperNode tandem node between Stations A and C.
2. TAT releases the trunks between the terminating M1 node and the tandem M1 node.
3. RLT releases the trunks between the tandem M1 and Meridian SuperNode nodes.

Figure 14-2 Results of anti-tromboning for network call redirection (example 1)



Anti-tromboning operation for network call redirection (example 2)

Figure 14-3 provides another example of TAT optimizing redundant trunks due to call forwarding. In this example, the trunks between a terminating M1 node and a tandem M1 node are optimized. The Meridian SuperNode switch acts as the originating node, and Station C is a centralized attendant or a Meridian Mail position.

1. Station A is located at an originating switch (public CO or PBX) and makes an internodal call through tandem Meridian SuperNode and M1 nodes to Station B, which is located at a terminating M1 node. This is represented in Figure 14-3 as the first call.
2. Station B, which is located at the terminating M1 node, is call-forwarded to Station C at the tandem M1 node. Station C is either a centralized attendant or Meridian Mail position. This is represented in Figure 14-3 as the redirected call.
3. Station C answers.
4. Station A connects to Station C.

Figure 14-3 Anti-tromboning for network call redirection (example 2)

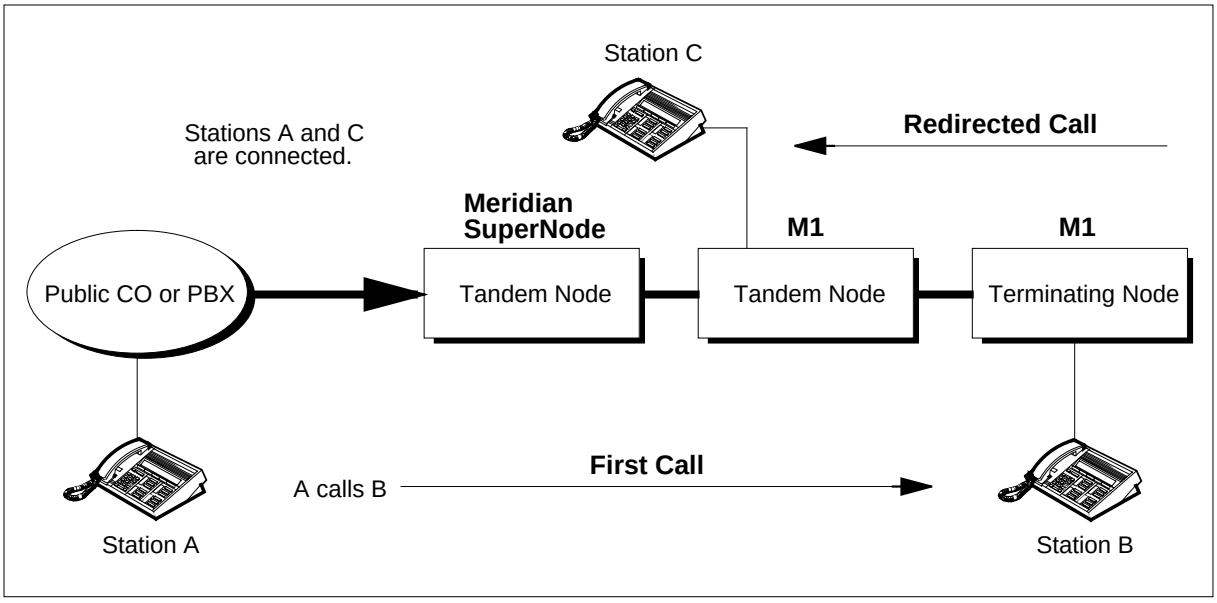
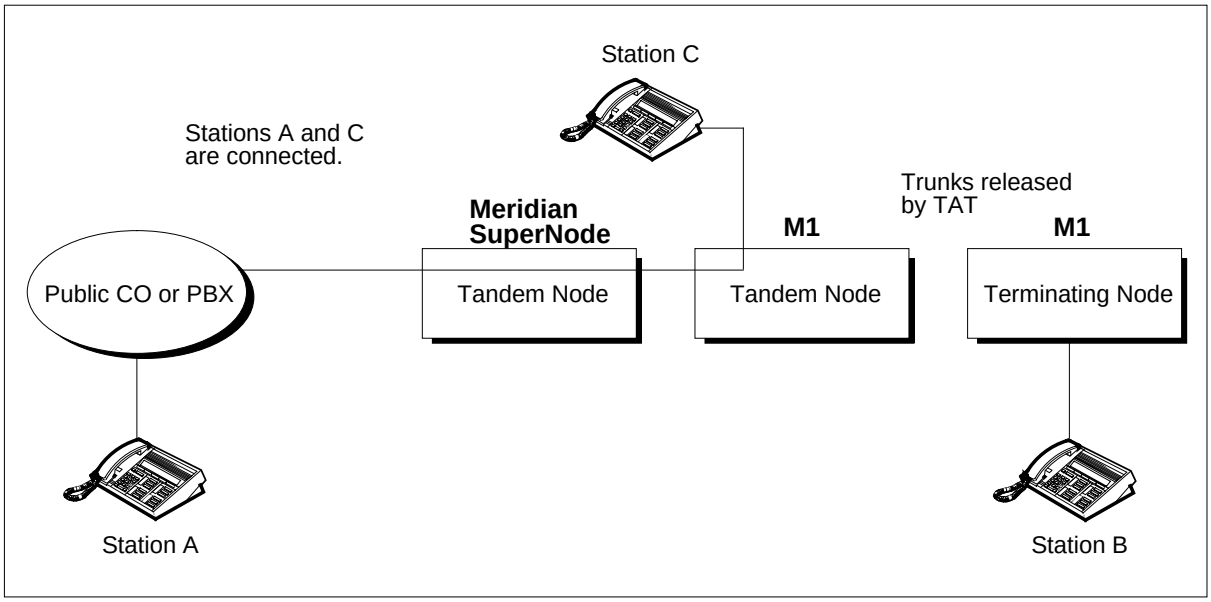


Figure 14-4 shows the results of anti-tromboning *after Station C answers the call*.

1. TAT releases the trunks between the terminating M1 node and the tandem M1 node.
2. Stations A and C remain connected.

Figure 14-4 Results of anti-tromboning for network call redirection (example 2)



Anti-tromboning operation for call modification

Figure 14-5 shows TAT as applied to a call modification scenario with a Meridian SuperNode switch interworking with an M1 switch (using call transfer). Note that the same effect would occur if Station B conferences Station C into the call then drops out. This would still leave Stations A and C connected.

1. Station A is located at an originating M1 node and makes an internodal call through a tandem Meridian SuperNode node to Station B, which is located at a terminating M1 node. This is represented in Figure 14-5 as the first call.
2. Station B, which is located at a terminating M1 node, answers the call and initiates a call transfer, through the tandem Meridian SuperNode node, to Station C, which is located at the originating M1 node. This is represented in Figure 14-5 as the second call.
3. Station C answers.
4. Station B completes the call transfer.

Figure 14-5 Anti-tromboning for call modification

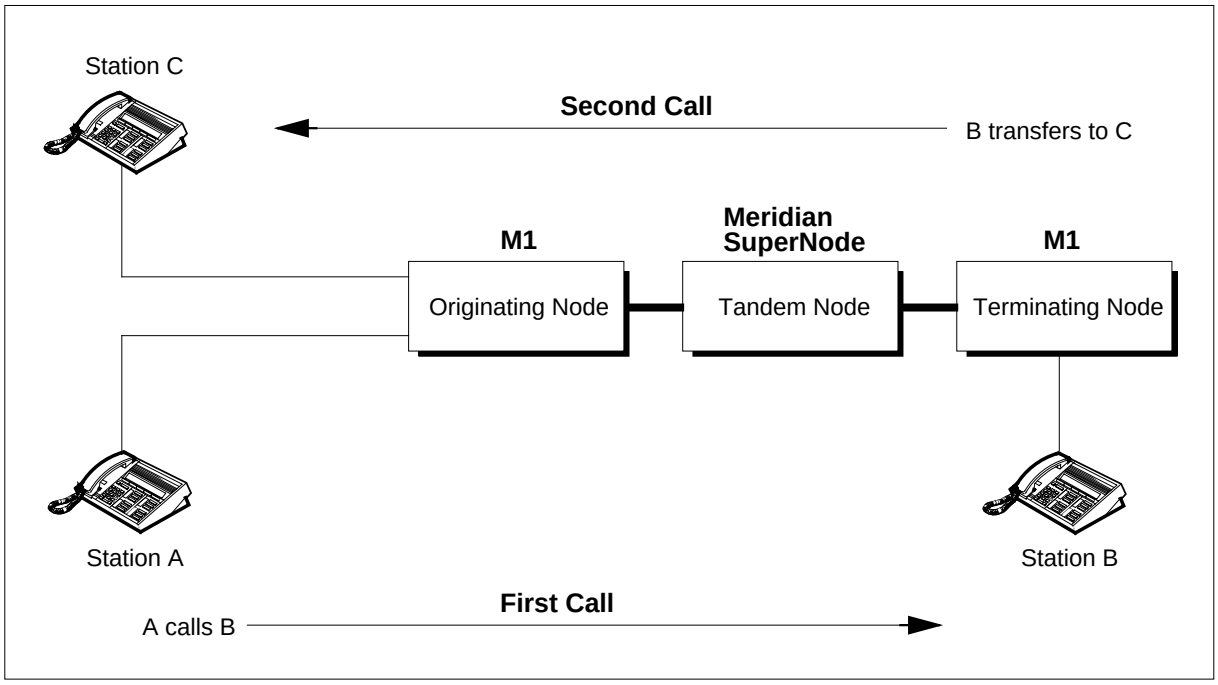
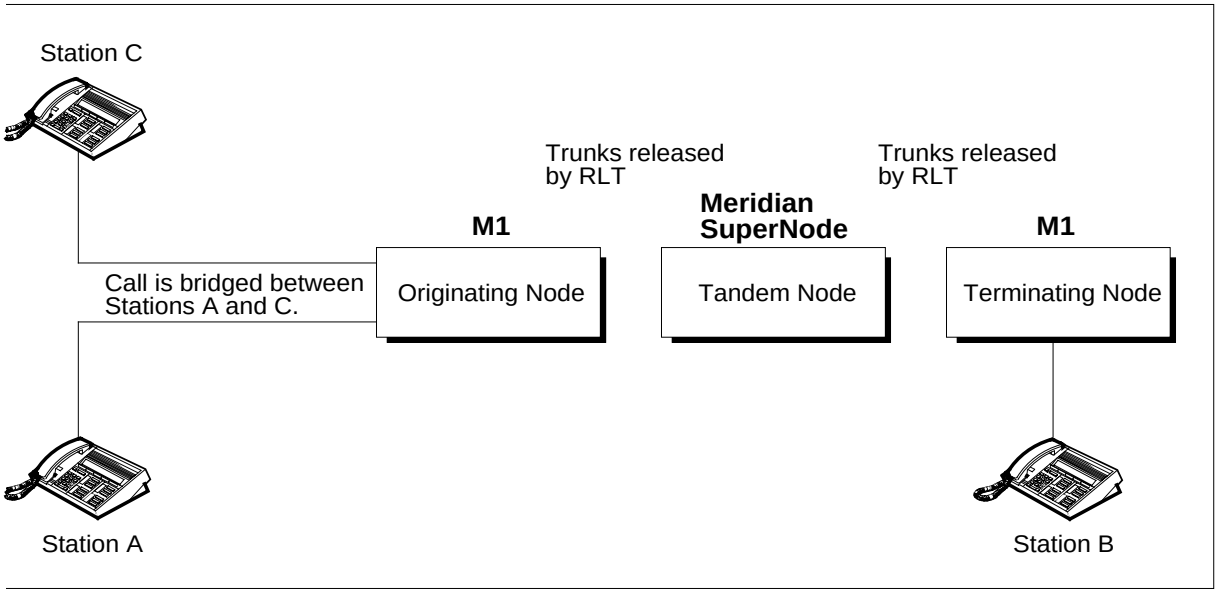


Figure 14-6 shows the results of anti-tromboning *after Station C answers the call*.

1. The call is bridged at the M1 originating node between Stations A and C.
2. RLT releases the trunks between the M1 terminating node and the Meridian SuperNode node and between the Meridian SuperNode node and the M1 originating node.

Figure 14-6 Results of anti-tromboning for network call transfer



Operating parameters

The system performs anti-tromboning only after the third party answers provided that the tromboned trunks are associated with the same primary D-channel (with or without a backup D-channel) and the trunks are associated with the same customer.

The system does not perform anti-tromboning for a tromboned call between two attendants on the same node.

There are two types of protocols used for TAT operations depending on the interface type. One protocol is for the M1-to-M1 interface, and the other protocol is for an M1-to-Meridian SuperNode interface in which the Meridian SuperNode office is equipped with the RLT feature.

If non-ISDN trunks are involved in a call transfer call, ISDN signaling messages cannot be sent, and anti-tromboning is not performed.

The system does not perform anti-tromboning for tromboned trunks associated with a call originated on a set that is routed back to the same set.

TAT can cause a momentary interruption in data transmission during optimization. When TAT operations are performed at multiple tandem nodes, this effect is cumulative (in the milliseconds range). Therefore the impact of this loss is dependent on the terminals on each end of the transmission and may be recovered through re-transmission.

Feature interactions

Attendant

If an attendant has activated Busy Verify or Barge-in at the time that a message to invoke TAT is received, the anti-tromboning operation is aborted.

Automatic call distribution (ACD)

The TAT feature performs anti-tromboning operations to eliminate the PRI trunks associated with the same D-channel due to the following ACD operations: Enhanced Network Call Forward, Network ACD, Interflow Options, and Enhanced Interflow.

If an ACD agent is being observed at the time that a message to invoke TAT is received, the anti-tromboning operation is aborted.

If an incoming PRI call that is in the ACD queue is answered by a recorded announcement, then the anti-tromboning operation is performed only after an ACD agent answers the call.

Call park network wide

The TAT feature is invoked if programmed at all interim PBXs involved in the call.

Conference

If the Conference feature is activated, the TAT feature performs the anti-tromboning operations only when there are two parties remaining in the call and the two parties are using PRI trunks associated with the same D-channel.

External recorded announcement

If an attendant originates a call that, through call modification or call redirection, creates tromboned trunks and eventually terminates on recorded announcement equipment, TAT does not optimize the trunks. (TAT does not release tromboned trunks resulting from an attendant initiating an outgoing call.)

Meridian mail

The TAT feature does not release tromboned trunks arising from the application of Auto Attendant, Thru-Dialing, and Operator Revert capabilities of Meridian Mail. If Network Message Services is activated, the associated

Call Sender capability does not create an additional trunk when it is activated. Therefore, TAT is not applied.

Network attendant service (NAS)

If both TAT and NAS are equipped in the network, the NAS feature takes precedence over TAT, if NAS is equipped end-to-end. (There is no interworking between NAS and TAT.)

Network call pickup

The TAT feature optimizes tromboned trunks arising from the operation of the Network Call Pickup feature.

Network call redirection

The TAT features eliminates tromboned trunks resulting from the operation of any of the following Network Call Redirection features:

- Network Call Forward Unconditional
- Network Call Forward No Answer
- Network Call Forward Busy
- Network Call Forward by Call Type
- Network Hunt
- Internal Call Forward

Radio paging system

If an attendant originates a call that, through call modification or call redirection, creates tromboned trunks and eventually terminates on radio paging equipment, TAT does not optimize the trunks. (TAT does not release tromboned trunks resulting from an attendant initiating an outgoing trunk call.)

Virtual network services (VNS)

The TAT feature performs anti-tromboning operations to eliminate tromboned trunks (physical B-channels) associated with the same VNS D-channel.

List of terms

64C
64 kbits per second clear (unrestricted)

64R
64 kbits per second restricted

AC
Attendant console

ACD
Automatic Call Distribution

ACEES
Attendant console end-to-end signaling

ADM
asynchronous data module

AIM
asynchronous interface module

AIS
alarm indication signal

AMI
Alternate Mark Inversion

ANI
Automatic Number Identification

ARS
Automatic Route Selection

ASIM
asynchronous synchronous interface module

B8ZS
Bipolar 8 Zero Substitution

BC
bearer capability

BER
bit error rate

BPV
bipolar violation

BRI
Basic Rate Interface

CARRMTC
carrier maintenance

CBC
Call-By-Call

CBSY
C-side busy

CC
central controller

CCTO
call completion with trunk optimization

CDN
called party number

CID
channel identifier

CLEC
competitive local exchange carrier

CLID
calling line identifier

CLLI
common language location identifier

CNAC
call not accepted

CND
Calling Number Delivery

CO
central office

CPB
call processing busy

CPE
customer premises equipment

CPU
central processing unit

CPV
command protocol violation

CR
call reference

C/R
command/response

CRC
cyclic redundancy check

DCH
D-channel handler.

DID
direct inward dialing

DISC
disconnect

DLP
data link processor

DM
desirability measure or disconnect mode

DN
directory number

DCH
D-channel handler

DNATTRS
directory number attributes

DNGRPS
directory number groups

DOD
direct outward dialing

DPN
digital packet network

DTCI
ISDN digital trunk controller

DTI
digital trunk interface

DTMF
dual tone multifrequency

DU
data unit

DWA
dialable wideband service

EA
equal access

EAEO
equal access end office

EISP
enhanced ISDN signaling processor

ES
errored seconds

ESF
extended superframe format

ESN
electronic switching network

ET
exchange termination

ETN
electronic tandem network

ETS
electronic telephone set

ETSD
electronic telephone set with display

EXT
external

FDL
facility data link

FSP
frame pattern sequence

FRME
frame pattern sequence

FE
far end

FX
foreign exchange

HCB
history control block

HDB
history data block

HDLC
High-level Data Link Control

IBN
integrated business network

IBNRTE
IBN routing table

IBNT2
IBN trunk 2-way

IBNTI
IBN trunk incoming

IBNTO
IBN trunk outgoing

IBNXLA
IBN translation table

IDL
idle

IE
information element

IEC
interexchange carrier

IFC
interface type

INB
installation busy

INS
in service (indication on PRI D-channel)

INSV
in service

ISA
integrated services access

ISDN
Integrated Services Digital Network

ISL
ISDN Signaling Link

ISTB
in service trouble

ISO
International Standards Organization

ISP
ISDN signaling preprocessor

ISUP
ISDN user part

ITA
integrated trunk access

ITU-T
International Telecommunication Union-Telecommunication Standardization Sector

IVD
integrated voice and data

IXC
interexchange carrier

KSETLINE
keyset line table

LAPB
Link Access Procedure B-channel

LAPD
Link Access Procedure D-channel

LC
line card

LCG
local carrier group

LCGA
local carrier group alarm

LCM
line concentrating module

LDN
listed directory number

LGC
line group controller

LINEATTR
line attributes table

LO
lockout

LOC
location code

LTCI
line trunk controller

LTID
logical terminal identifier

LTP
line test position

MANB, MB
manual busy

MAP
maintenance and administration position

MARS
Meridian Automatic Route Selection

MDC
Meridian Digital Centrex

MNT & OS
maintenance and out-of-service

MWI
message waiting indicator

NA
North American

NARS
Network Alternate Route Selection

NACD
Networked ACD (automatic call distribution)

NAS
network attendant service

NCOS
network class of service

NCTE
network customer terminating equipment

NE
near end

NFAS
Non-Facility Associated Signaling

NSF
Network-Specific Facility

NND
network name display

NP
no prefix

NPI
numbering plan identification

NRAG
Network Ring Again

NT1
network termination 1

NT2
network termination, type 2

OAM
operations, administration, and maintenance

ODM
office data modification

OFFL
offline

OM
operational measurement

OSI
Open Systems Interconnection

OSS
out of service

PBX
Private Branch Exchange

PCM
pulse code modulated

PCTA
personal computer terminal adaptor

PDN
private directory number

PH
packet handler

PI
presentation indicator

PIC
Preferred Inter-LATA Carrier

PC
peripheral module

PRI
Primary Rate Interface

PSTN
public switched telephone network

PTS
Per Trunk Signaling

PUB
public (call type)

PVT
private (call type)

PWF
preference weighting factor

PX
PBX trunk

RAG
resource shortage

REJ
reject

RCGA
remote carrier group alarm

RI
resource index

RLT
release link trunk

RNR
receive not ready

RODR
reorder

ROSE
Remote Operations Service Element

RR
receiver ready

RS
resource shortage

RTS
return to service

SABME
set asynchronous balanced mode extended

SADN
synchronous data module

SAPI
service access point identifier

SELSEQ
selection sequence

SES
severe errored seconds

SF
superframe

SID
station identification number

SMDI
Simplified Message Desk Interface

SOC
software optionality control

SPCS
Stored Program Controlled Switching system

SPMS
Switch Performance Monitoring System

SPN
special number

ST
signaling terminal

STR
special tone receiver

STS
serving translation scheme

SWACT
warm switch activity

SWERR
software error

SYSB
system busy

TA
terminal adapter

TAT
Trunk Anti-tromboning

TCAP
Transactions Capabilities Applications Part

TCOS
traveling class of service

TE1
terminal equipment, type 1

TE2
terminal equipment, type 2

TON
type of number

UAS
unavailable seconds

UP
unified processor

VFG
virtual facility group

VNS
Virtual Network Services

VPN
virtual private network

WATS
Wide-Area Telecommunications Service

XMS
extended multiprocessor system

XPM
XMS-based peripheral module

ZCS
Zero Code Suppression

Meridian SuperNode

Meridian SL-100

ISDN Primary Rate Interface Reference Manual

This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules, and the radio interference regulations of the Canadian Department of Communications. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at the user's own expense. Allowing this equipment to be operated in such a manner as to not provide for proper answer supervision is a violation of Part 68 of the FCC Rules, Docket No. 89-114, 55FR46066.

The MSL-100 system is certified by the Canadian Standards Association (CSA) with the Nationally Recognized Testing Laboratory (NRTL).

This equipment is capable of providing users with access to interstate providers of operator services through the use of equal access codes. Modifications by aggregators to alter these capabilities is a violation of the Telephone Operator Consumer Service Improvement Act of 1990 and Part 68 of the FCC Rules.

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numerique de la classe A respecte toutes les exigences du Reglement sur le materiel brouilleur du Canada.

YEAR 2000 READINESS DISCLOSURE

This information was originally published prior to October 19,1998. The foregoing legend applies retroactively in accordance with the U.S. Year 2000 Information and Readiness Act and on an ongoing basis.

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