297-2621-106

Digital Switching Systems

UCS DMS-250

Integrated Services Digital Network (ISDN) Reference Manual

UCS13 Standard 07.03 August 2000

NORTEL NETWORKS™

How the world shares ideas.

Digital Switching Systems

UCS DMS-250

Integrated Services Digital Network (ISDN) Reference Manual

Publication number: 297-2621-106
Product release: UCS13
Document release: Standard 07.03
Date: August 2000

Printed in the United States of America

Publication history

August 2000

Standard release 07.03 to remove incorrect information (the Automatic number identification/all B-channels busy topic) from the D-channel interactions section of the D-channel handler chapter of UCS06 release (CSP05).

February 1997

Standard release 07.02 for software release UCS06 (CSP05).

October 1996

Preliminary release 07.01 for software release UCS06 (CSP05).

This document has been updated to include the following:

- Chapter 6 — Call control procedures
  - — added “table CSEMAP”
- Chapter 9 — Feature interaction
  - — added multiple class-of-service capability
  - — added route-based outgoing parameter modifications
- Chapter 15 — Description of UUI Information Elements and Parameters (new chapter).

Contents

About this document

When to use this document

This document serves as the primary rate interface (PRI) applications handbook for UCS DMS-250 switch telecommunications managers and coordinators. It describes the applications engineered for the PRI connection between a UCS DMS-250 switch and a private branch exchange (PBX). Specifically, this document describes how to apply PRI to a network.

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 the *DMS-10 and DMS-100 Family Product Documentation Directory,* 297-8991-001.

This document is written for all DMS-100 Family offices. More than one version of this document may exist. To determine whether you have the latest version of this document and how documentation for your product is organized, check the release information in the *DMS-10 and DMS-100 Family Product Documentation Directory,* 297-8991-001.

References in this document

The following Nortel Networks Technical Publications (NTPs) are referred to in this document:

- *DMS-100 Network Management System Reference Manual,* NTP 297-1001-453
- *DMS-100 Bit Error Rate Performance Testing,* NTP 297-1001-533
- *DMS-100 Trunks Maintenance Guide,* NTP 297-1001-595
- *Integrated Services Digital Network Product Guide,* NTP 297-2401-010
- *Integrated Services Digital Network Basic Rate Interface Maintenance Guide,* NTP 297-2401-501
- *UCS DMS-250 Master Index of Publications,* NTP 297-2621-001
- *UCS DMS-250 Feature Group D (FGD) Application Guide,* NTP 297-2621-385
- *UCS DMS-250 Data Schema Reference Manual,* NTP 297-2621-851
- *UCS DMS-250 Operational Measurements Reference Manual,* NTP 297-2621-814
- *UCS DMS-250 Commands Reference Manual,* NTP 297-2621-819
- *UCS DMS-250 Logs Reference Manual,* NTP 297-2621-840

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

WARNING
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:

1 Manually busy the CTRL on the inactive plane by typing

>BSY CTRL ctrl_no
and pressing the Enter key.

where

ctrl_no is 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.
```

Introduction

The primary rate interface (PRI) is a standardized architecture for the connection between a customer's equipment and the public telephony network. PRI also provides the interface within a corporate network for basic call and networked business services.

PRI supports the following:

- B-channels—N × 64 kbit/s channels for circuit-switched voice and data calls, and packet-switched data
- D-channels—56 or 64 kbit/s channels that provide out-of-band call control

PRI is transmitted over a DS-1 trunk. For the purposes of PRI, the DS-1 can be thought of as a collection of 24 imbedded DS-0 channels.

Each DS-0 can be used as one of the following:

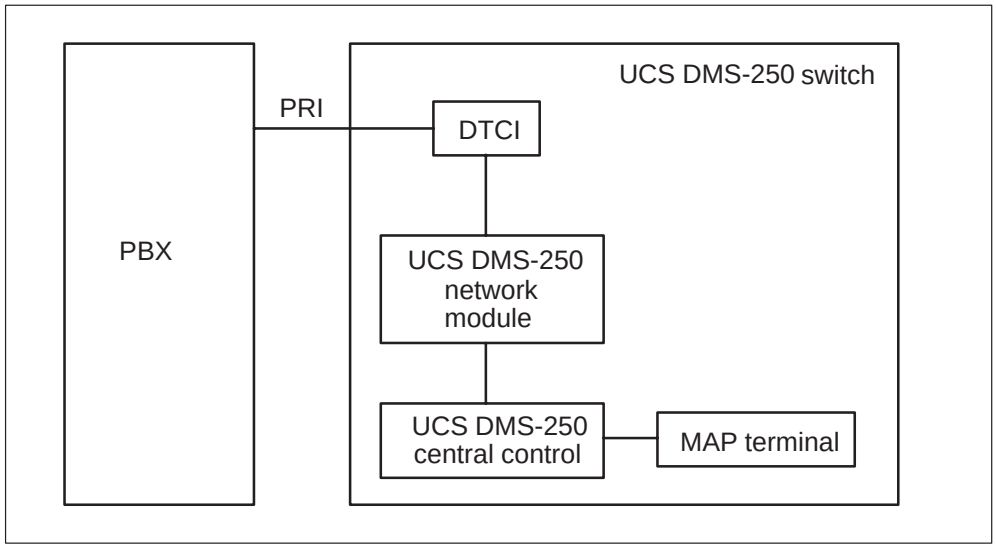
- PRI B-channel
- PRI D-channel
- provisioned channel

Any of the 24 DS-0 channels in a DS-1 trunk can be a D-channel, but convention designates the DS-0 in the 24th position as the D-channel.

The standardized, all-digital characteristics of PRI support Q.931, a message-oriented, out-of-band signaling protocol capable of providing telephony, data, and supplementary services.

Figure 1-1 shows an example of PRI connectivity between a private branch exchange (PBX) and a UCS DMS-250 switch.

Figure 1-1
Block diagram of a primary rate interface connection between a private branch exchange and a UCS DMS-250 switch



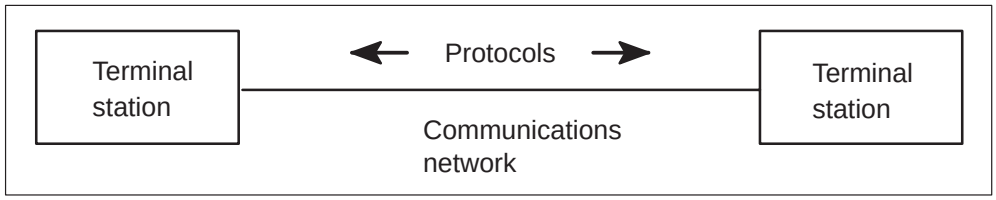
PRI applications

As defined by the International Telecommunication Union-Telecommunication Standardization Sector (ITU-T) and by the Exchange Carrier Standards Association (ECSA) T1S1 committees, the PRI consists of n × 64 kbit/s B-channels for voice and data, and at least one 64 kbit/s D-channel for signaling, where two D-channels may be used for redundancy purposes.

Protocol overview

A set of protocols governs the format, timing, and sequencing between two network terminal stations. Figure 1-2 is a simplified view of the role that protocol plays.

Figure 1-2
Protocol view



The architecture used for ISDN protocol consists of four modular levels, based on the seven-layer open systems interconnection (OSI) reference model. This model, developed by the International Standards Organization

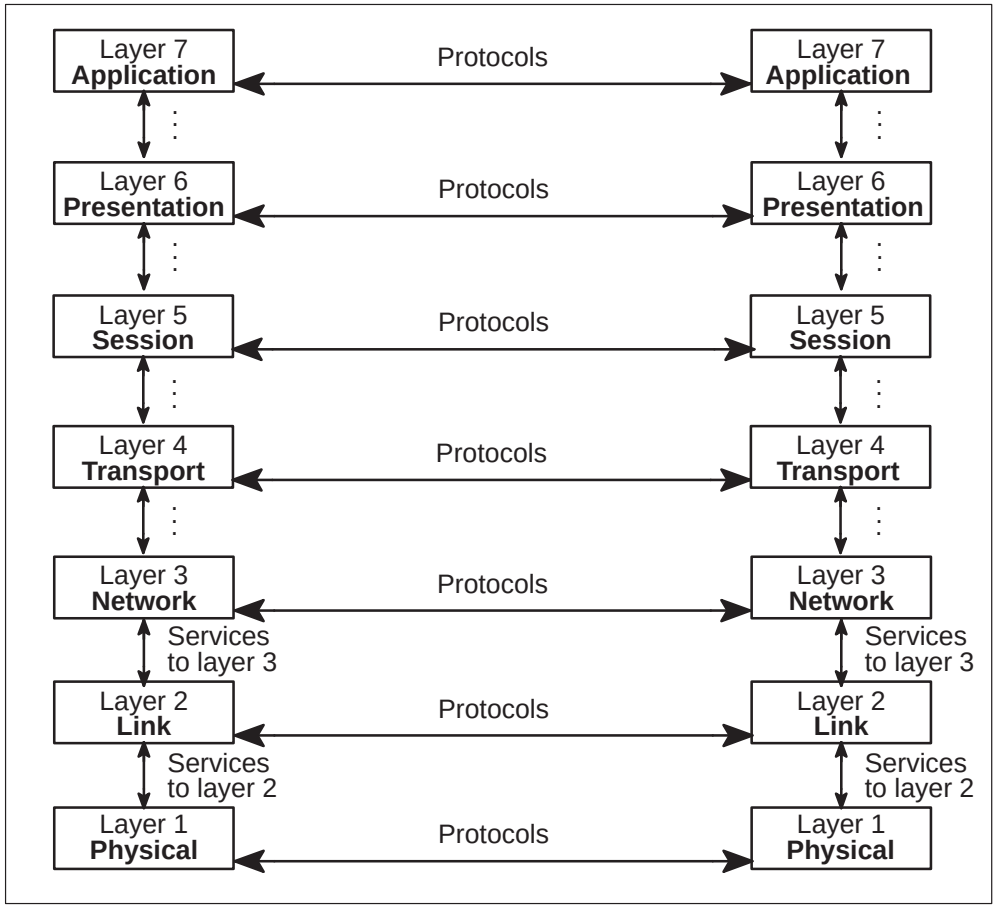
in 1983, was adopted by the International Consultative Committee on Telegraphy and Telephony (CCITT).

The OSI defines consistent languages and communication boundaries for protocols so that systems conforming to its rules are “open” to each other. Figure 1-3 illustrates the hierarchy of functional levels defined within the OSI reference model. Each successive layer represents a higher level of system supervision.

OSI layers

Each of the seven OSI layers, as shown in Figure 1-3, uses a series of services provided by the layer below it. It builds on those services to perform communication functions and furnishes a series of services to the layer above it. This layered approach splits the complex communication requirements of a wide variety of systems into a series of derivative blocks. Although connected, each block exists independently of the others.

Figure 1-3
Open systems interconnection seven-layered reference model



The following is a list of the seven OSI layers and their associated functions:

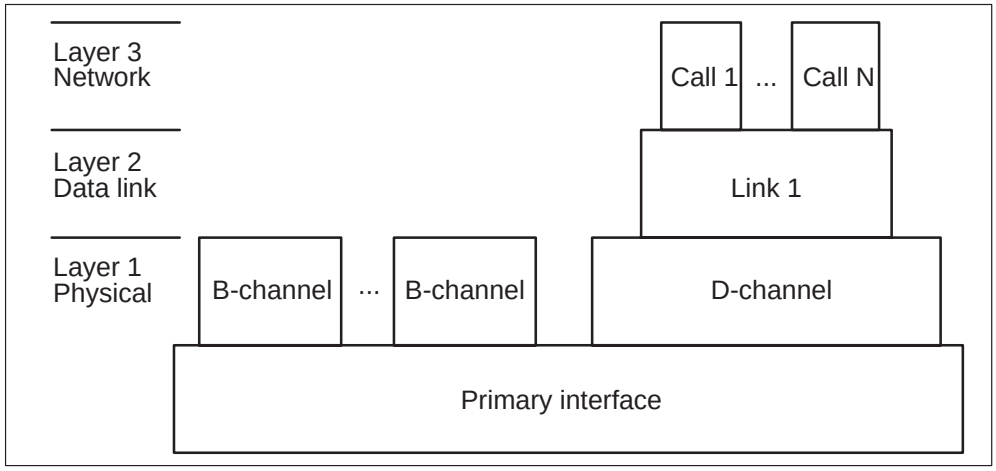
- Layer 1 (physical)—Maintains, connects, and disconnects the circuits that form the communication facility. Layer 1 handles the electrical, mechanical, and functional control of a data interface.
- Layer 2 (link)—Provides services related to the reliable interchange of data across the data link established by the physical layer. This layer manages the establishment, maintenance, and release of data link connections. Layer 2 controls the flow of data while supervising error recovery and link flow control.
- Layer 3 (network)—Provides services related to moving data through a network. Layer 3 provides and manages logical channel connections between end points of a network.
- Layer 4 (transport)—Transfers data between sessions transparently. Layer 4 handles communication between the two end systems and enhances, where necessary, the quality of services provided by layer 3.
- Layer 5 (session)—Responsible for administration services, control of data exchange, and delimiting and synchronizing data operation dialogue services. Layer 5 handles the structure of dialogue between devices.
- Layer 6 (presentation)—Interprets data and is responsible for format and code transformation. Handles the representation of information as bit patterns.
- Layer 7 (application)—Contains the protocols specific to the application or reason for communicating. Layer 7 is concerned with the application process and management functions.

Note: Layers 4 through 7 govern the transmission of signaling information between two terminals on an ISDN loop.

ISDN layers

Layers 1 through 3 govern connection, set up, and transmission of information between terminals on loops, packet-switched, and circuit-switched networks. Layer 4 provides transparent transfer of data between network entities. The protocols in layers 1 through 3 can be thought of as a series of pipes. Only message information intended for that layer or any higher layer can pass through the pipes. This is depicted in Figure 1-4.

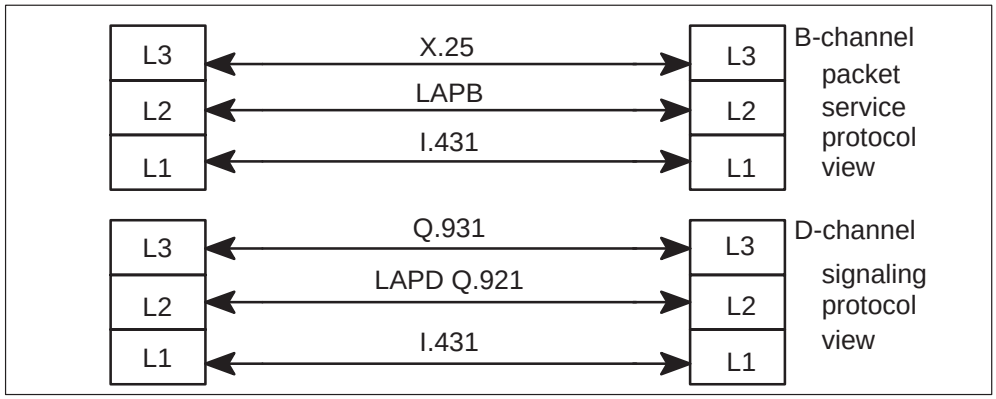
Figure 1-4
Layers 1 through 3 of the ISDN protocol



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

Layer 1 (physical) provides the physical pipe for primary access, which contains multiple B-channels and one D-channel. Layer 2 (link) 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 (network) provides protocols that are used to establish, maintain, and clear one or more calls in a logical link pipe. For the PRI, one data link exists between the terminal and the network, and between multiple calls at layer 3. Layer 4 (application) provides protocols for transport, session, presentation, and application functions. Figure 1-5 shows the ISDN layer 1, 2, and 3 protocols used by the B- and D-channels.

Figure 1-5
B- and D-channel protocols



Layer 1 (physical) protocols

The physical layer protocol is described in CCITT Recommendation I.431.

Layer 2 (link) protocols

Link Access Procedure on the B-channel (LAPB) is the protocol used to carry packet-switched data on B-channels of ISDN access interfaces.

Link Access Procedure on the D-channel (LAPD)/Q.921 is the protocol used to carry signals on D-channels of ISDN access interfaces.

The following sections briefly describe the LAPB and LAPD functions.

Link access procedure on the B-channel Layer 2 (link) protocols for the B-channel are defined in CCITT Recommendation Q.921. LAPB carries packet-switched data, speech, and circuit-switched data.

Link access procedure on the D-channel Layer 2 (link) protocols for the D-channel are defined in CCITT Recommendations I.440, Q.920, Q.441, and Q.921. LAPD carries multiple signaling and data message streams that interleave on the same D-channel, each of which forms a logical link.

There are two types of logical links:

- Broadcast is used for line (not trunk) implementation of ISDN.
- Point-to-point is used on DMS-250 switches. DMS-250 switches use only point-to-point links.

Layer 3 (network) protocols

Layer 3, described in CCITT Recommendations I.450, Q.920, I.451, and Q.931, provides the means to use the D-channel for establishing, maintaining, and completing calls on a logical link created by the link layer. The protocol used depends on the channel and the type of information carried.

D-channel On the D-channel, two types of protocols are used:

- LAPD, a packet-switching protocol based on X.25, is used for low-speed packet data on basic rate interface D-channels. LAPD is not used for the PRI D-channel.
- Q.931, a call-control protocol, is used for call control messages.

B-channel Different types of protocols are used on B-channels. The X.25 network layer protocol is used only for transmission of packet-switched data. Speech and circuit-switched data on a B-channel do not require a network layer protocol.

Q.931 protocol procedures Q.931 signaling protocol is used for call-control. The protocol procedure performs the following functions:

- setup and teardown of calls and features between the network and PBX
- address (directory number) displays and progress indicators at the PBX and the network ends
- B-channel control from the network side

In addition to these functions, Q.931 also supports basic error-handling procedures and reinitialization on recoverable errors.

Layer 4 (application) protocols

Layer 4 protocols provide transparent data transfer and application-level messages.

DTCI overview

The ISDN digital trunk controller (DTCI) is an enhanced version of the existing digital trunk controller (DTC) peripheral interface. The DTCI and the DTC share 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 card. The DTCI and DTC both accommodate up to 20 DS-1s. The DTCI also supports the warm switch of activity (SWACT) capability.

Note: The ISP also goes through a warm SWACT, along with the other processors that are resident on the DTCI.

The DTCI does not support Common Channel Signaling 7 ISDN User Part trunks.

Integrated trunk access

The DTCI supports PRI and non-PRI (AB-bit) trunk provisioning. This type of access arrangement is called integrated trunk access, and it means that a single DS-1 can be provisioned with both PRI and non-PRI trunk types, with alterations to tables LTCINV and TRKSGRP.

- MANB (maintenance busy)—During manual intervention from the MAP terminal, the channel may be set to MANB (maintenance busy) to take the channel out of service. When the peripheral is brought into service, the D-channel is initialized in this state.

  When a channel in a wideband call is set to MANB, the other channels associated with the wideband call are set to IDL. This is done with the master channel or any of the slave channels in the wideband call.

- IDL (idle)—When a channel in a wideband call is set to MANB, the other channels associated with the wideband call are set to IDL. This is done with the master channel or any of the slave channels in the wideband call.

DS-1 configuration

This chapter gives an overview of how a UCS DMS-250 switch connects a DS-1 trunk to a single-line private branch exchange (PBX).

Hardware configuration

The printed circuit board hardware for the DS-1 trunks resides on the ISDN digital trunk controller (DTCI) shelf, as shown in Figure 2-1.

Figure 2-1
DTCI shelf configuration (front view)

DSI	DSI	DSI	DSI	DSI	Filler	Filler	Filler	Filler	Filler	Filler	UP	Filler	ETS	UTR*	ISP	Filler	MI	Filler	CSM	FM	DS30	Filler	Filler	PCONV
01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
DSI	DSI	DSI	DSI	DSI	Filler	Filler	Filler	Filler	Filler	Filler	UP	Filler	ETS	UTR*	ISP	Filler	MI	Filler	CSM	FM	DS30	Filler	Filler	PCONV

* Optional

The 25 card slots in the DTCI shelf are split into upper and lower sections. This allows each populated slot to have one online module and one standby module. The DTCI supports up to 10 NT6X50AB (or NT6X50AA) DS-1 cards (slots 1 through 5, upper and lower), which are equivalent to 20 DS-1 trunks. It is recommended that the DTCI be equipped with NT6X50AB type DS-1 cards, because they can support 56 kbit/s and 64 kbit/s (clear and restricted) data rates.

Table 2-1 describes the printed circuit boards on the DTCI shelf.

Table 2-1
DTCI shelf description

Slot	Abbreviation	NT_PEC	Description
01–05	DS1	6X50AB	DS-1 interface. Up to five DS-1 cards on each unit are supported. A minimum of one card is required.
06–11	Filler	0X50AA	Filler face plate
12	UP	MX77AA	Unified processor
13	Filler	0X50AA	Filler panel
14	ETS	AX78AA	Enhanced time switch
15	UTR	6X92BB	Universal tone receiver
16	EISP	BX01AB	ISDN signaling processor
17	Filler	0X50AA	Filler panel
18	MI	6X69AC	Message interface
19 front	Filler	0X50AA	Filler face plate
19 rear		MX71AA	XPM PLUS terminator board
20	CSM	6X42AA	Channel supervision message card
21	FM	6X41AA	Formatter
22 front	DS30	6X40FA	DS-30 Interface (16-port). If this card is provisioned, slot 23 is not used.
22 rear		6X40GA	ENET fiber interface card
23–24	Filler	0X50AA	Filler face plate
25	PCONV	2X70AE	Power converter

Commissioning

Frame formats

The DS-1 basic frame format consists of one byte per channel (24 eight-bit bytes) and one framing bit (F-bit), for a total of 193 bits per frame.

- The bit rate is 1.544 Mbit/s.
- The sampling rate for each channel is 8000 Hz.
- The 24 bytes are identified as time slots 1 through 24 (numbered consecutively from the F-bit).
- A pattern is placed in the F-bit to identify the location of the signaling frame.
- A superframe format (SF) consists of 12 DS-1 frames.

- Bit error rate (BER) monitoring is accomplished using two indicators: bipolar violation (BPV) and cyclic redundancy check (CRC).
  - — BPV is an indication of a coding error in the received bit stream. BPV indicates local span performance.
  - — CRC, applicable only with extended superframe format (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.
- 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 assignment of the F-bit, A-bit, and B-bit is shown in Table 2-2. In Table 2-2, the most significant bit is defined as bit 1 and the least significant bit as bit 8.
- The SF is consistent with channel bank formats D2, D3, and D4. The signaling bit is time-shared to identify the channel and the signaling frame. The framing pattern is the repeated sequence 100011011100. SF is supported on both types of DS-1 cards (6X50AA and 6X50AB).
- The ESF consists of 24 frames. ESF is supported only on DS-1 card 6X50AB.

Table 2-2
Superframe format bit assignments

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	1–8	8	8

The 8-kbit/s F-bit channel is divided into three separate channels:

- Framing pattern sequence (FPS)—a 2-kbit/s channel. Beginning with frame 4 (ESF bit 579), the framing bit of every fourth frame forms FPS 001011, which determines the mainframe, SF, and robbed bit signaling synchronization.
- Facility data link (FDL)—a 4-kbit/s channel. The 6X50AB uses FDL to convey remote alarm information or to transmit all 1s, as selected in service change.
- CRC—a 2-kbit/s channel. CRC carries the CRC-6 code. CRC indicates one or more bit errors in a block, or bits from the received bit stream. CRC is used as an end-to-end BER indicator.

Note: The SF and ESF formats are datafilled under the frame format field found in table CARRMTC.

Channel ordering sequence

The channel ordering sequence is shown in Table 2-3.

Table 2-3
Channel ordering sequence

Timeslot	D3/D4/ESF	D2
1	1	12
2	2	13
3	3	1
4	4	17
5	5	5
6	6	21
7	7	9
8	8	15
9	9	3
10	10	19
11	11	13
12	12	23
13	13	11
14	14	14

—continued—

Table 2-3
Channel ordering sequence (continued)

Timeslot	D3/D4/ESF	D2
15	15	2
16	16	18
17	17	6
18	18	22
19	19	10
20	20	16
21	21	4
22	22	20
23	23	8
24	24	24
—end—		

Line coding

Line coding for a DS-1 is bipolar alternate mark inversion (AMI)/2B1Q. The 6X50AA DS-1 card supports zero code suppression (ZCS) line coding, and the 6X50AB DS-1 card supports bipolar eight zero substitution (B8ZS) or ZCS, with the following conditions:

- ZCS coding format requires that the B-channels be used in the 64 kbit/s restricted mode.
- The B8ZS coding format provides a 64 kbit/s clear channel.

General requirements for DS-1 ZCS are as follows:

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

To meet the maximum and minimum requirements, DS-1 uses the following schemes:

- ZCS or AMI/2B1Q coding is used for the 64 kbit/s restricted mode.
- B8ZS is used for the 64 kbit/s unrestricted mode.

ZCS or AMI/2B1Q coding for 64 kbit/s restricted

When all eight pulse code modulation bits in a channel are zero, and 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 that seventh-bit substitution should not be invoked when digital data is being transmitted, as this causes data corruption.

B8ZS for 64 kbit/s unrestricted

When eight consecutive zeroes appear on a channel and the last one transmitted is positive, they are substituted with the following pattern:

- original eight bits: 0 0 0 0 0 0 0 0
- substituted word: 0 0 0 +1 –1 0 –1 +1

If the last one was negative (so the substituted word is 0 0 0 –1 +1 0 +1 –1), the polarity is reversed.

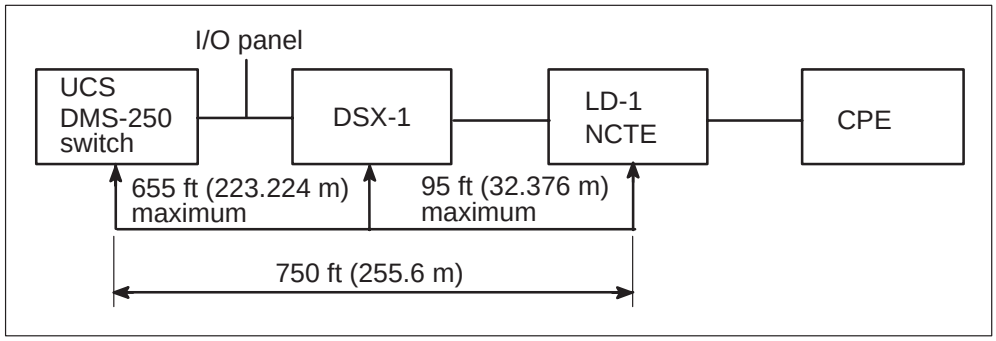
BPVs occur in the fifth and seventh bit positions of the inserted code. Therefore, B8ZS coding is used only when the receiving end is capable of recognizing that these are not BPVs or bit errors.

Network customer terminating equipment and cross-connect point

Network customer terminating equipment (NCTE) is generally located in the central office repeater bay, such as the LD-1 shown in Figure 2-2. Also shown is a UCS DMS-250 switch, customer premise equipment (CPE), and digital signal cross connect-1 (DSX-1) cross-connect point. 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 2-2
NCTE block diagram



The following conditions apply to the cabling distance from the front panel of the UCS DMS-250 switch to the LD-1:

- Cabling distance is limited to approximately 750 ft (255.6 m) on shielded 22-gauge cable (NT-ABAY, WECO-ABAM, or equivalent).
- Cabling consists of approximately 655 ft (223.2 m) 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 may vary within a 95-ft (32.4 m) range, depending on the manufacturer of the NCTE and whether the NCTE is equipped with a transmit equalizer.
- Reduce the cabling distance to the LD-1 or DSX-1 by about 27 ft (9.2 m) when measured from the input/output (I/O) filter assembly, PN P0643763, located at the bulkhead (I/O panel) of the UCS DMS-250 switch cabinet.

Table 2-4 lists the UCS DMS-250 switch settings based on distance.

Table 2-4
UCS DMS-250 switch settings

Distance to cross-connect	Switches closed
0 to 298 ft (0 to 101.6 m)	SW1
298 to 449 ft (101.6 m to 153.0 m)	SW2, SW5, SW7
449 to 656 ft (153.0 m to 223.6 m)	SW3, SW6, SW8
Note: SW4 is not used.	

Test equipment requirements

The following paragraphs describe equipment that is useful when commissioning a DS-1 trunk.

DS-1 line simulator

A DS-1 line simulator/monitor can be used to verify the integrity of the DS-1 trunks between a UCS DMS-250 switch and a PBX. The line simulator can perform the following tasks:

- monitor a single path without being part of the primary path
- be included in the path between the two systems and operate in either a transparent mode or provide its own stimulus to the trunk

- monitor the status of the trunk
- monitor the information in the channels
- simulate information in a given channel or an idle code in all channels
- simulate the alarms

Error counter

An error counter detects BPVs or no-signal periods for DS-1 trunks. The fault detection and isolation procedures are performed using a Thor portable test package, which consists of one of each of the following items:

- Thor TTT2028 Mini Error Counter with an operation instruction card
- test cable equipped with a bantam plug at one end and minihooks at the other end
- loopback plug with pin 3 shorted to pin 1 and pin 11 shorted to pin 9 (of a 15-pin D-connector)

Performance and maintenance

The carrier level of the UCS DMS-250 switch MAP terminal contains alarms and display fields that are indicators of the DS-1 trunk performance. To access the carrier level of the MAP terminal, enter the following command:

```
MAPCI;MTC;TRKS;CARRIER
```

Alarms

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

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

Yellow alarm

A yellow alarm, RCGA, indicates a remote alarm detection in the receive path.

When a remote alarm is detected in the receive path, the alarm is verified through a filtering process. The filtering process meets requirements as defined by Bell Publications 43801 (United States) and CS03 (Canada).

The filtering process operates as follows:

- When the remote alarm mode is entered, 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 increments by one. When a detected remote alarm is no longer present, the counter decrements 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 no longer increments.
- When the remote alarm mode is exited, the counter decrements until it reaches zero (this takes approximately 30 ms when the remote alarm is absent).
- If any frame alarm is present, processing of the yellow alarm is temporarily suspended and the contents of the yellow alarm counter remain unchanged.

Red alarm

A red alarm, LCGA, indicates a local alarm in the transmit path.

If the switch determines that a DS-1 trunk should be removed from service it generates a local alarm. As part of this operation, the DS-1 trunk 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.

When the DS-1 trunk sends a remote alarm, it sends alarm patterns as follows:

- When the DS-1 trunk is commanded to enter the local alarm mode, a remote alarm pattern is transmitted. This pattern transmission is delayed for 2.5 ± 0.5 s after the receipt of the message from a UCS DMS-250 switch.
- When the DS-1 trunk is commanded to exit the local alarm mode, it stops sending the remote alarm pattern. There is a 10.5 ± 0.5 s delay after the receipt of the message from the UCS DMS-250 switch. The DS-1 trunk informs the UCS DMS-250 switch when the remote alarm pattern ends.

Display fields

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

- frame slip
- frame loss
- approximated BER

- errored seconds (ES)
- severe errored seconds (SES)
- unavailable seconds (UAS)
- states

Frame slip

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

Frame loss

The DS-1 frame format consists of a frame bit followed by 24 eight-bit words that represent the 24 channels. If two-out-of-four to two-out-of-five 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 after 3 s, and the trunk is taken out of service. The trunk is restored to service automatically when frame synchronization is received continuously for 15 s.

BER monitoring

Two indicators, BPV and CRC, monitor the BER.

In a bipolar pulse stream, pulses alternate in polarity. If two pulses of the same polarity are received in succession, it is called a BPV. Each BPV 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 BPV rates:

- class 1: 10^{-3} error rate (10,240 BPVs in 6.6 s)
- class 2: 10^{-4} error rate (10,240 BPVs in 65.96 s)
- class 3: 10^{-5} error rate (10,240 BPVs in 659.6 s)
- class 4: 10^{-6} error rate (10,240 BPVs 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 BPV indicates performance on only the local span.

With ESF, BPVs and CRCs are reported. If framing is not ESF, only BPVs are reported.

ES, SES, and UAS

The quality of service on a given DS-1 trunk is reflected in the ES, SES, and UAS data parameters.

States

DS-1 trunk states are as follows:

- INSV—in-service
- MANB—manual busy
- SYSB-T—system busy
- UNEQ—unequipped (trunks are offline)

Maintenance and error thresholds are datafilled in table CARRMTC (refer to the *UCS DMS-250 Data Schema Reference Manual*).

The alarm settings mentioned in the discussion of alarms are default settings; they can be altered in table CARRMTC.

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.

The carrier options for the nth posted circuit can be displayed by using the DispOpt command. Card code, options, and alarm thresholds are displayed with this command.

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.

TRAVER enhancements

Translation verification (TRAVER) helps in debugging datafill. TRAVER displays the contents of all translation and routing tables used, and it can display each element of the route list with digits outpulsed, if any.

TRAVER reflects the additional translation tables accessed by PRA250 and ISA. The additional translation tables needed for PRA250 do not affect translations for PRA250 trunks.

Originations on PRA250 trunks

The TRAVER command line accepts data needed to make originations on PRI trunks. The TRAVER command line format is

```
traver <ORIG> |<NPI>| <DIGITS> |<OPT>| <TRACE>
```

The fields NPI and OPT are used for calls originating on a PRI trunk. These fields do not affect any other type of trunk agency. The OPT field contains the following information:

- network-specific facilities (mandatory)
- bearer capability (optional)

With this information, which is usually contained in the Q.931 SETUP message, TRAVER is able to follow the path that the translations would follow for PRI on the UCS DMS-250 switch.

Datafill trace

Figure 4-3 shows a sample TRAVER call trace. The first three tables are TRKGRP, LTCALLS, and CALLATTR.

- TRKGRP provides the LTID (in this case, ISDN 45) that TRAVER uses to perform further translation of a routed call.
- LTCALLS, which is indexed by ISDN 45 and the call type from the command line, provides the appropriate CALLATTR index or RTEREF.
- CALLATTR, which has been indexed by the CALLATTR field in table LTCALLS (in this case, 4), provides information needed to translate the call.

Figure 4-3
Sample TRAVER call trace

```
> TRAVER  TR  L2DPR64CL  2339910000  PRISM  T

STS USED FOR TRAVER IS:  815
TABLE TRKGRP
L2DPR64CL PRA250 0  NPDGP  NCIT  N  0 ASEQ  N  NIL  0  N  814
       0  (ISDN 45)
TABLE LTCALLS
ISDN 45 PRISM XLAIEC  4  $  $
TABLE CALLATTR
4  444   MCIP  0  NSCR  ZEROM  814  Y  10  8140000  NIL
TABLE STDPRTCT
MCIP      (1)  (0)
     – SUBTABLE STDPRT
     – 23 29 CT OFFNET 10 10 0
     – SUBTABLE AMAPRT
     – KEY NOT FOUND
     – DEFAULT VALUE IS:  NONE N
TABLE HNPACONT
815  20  0  (8)  (1)  (0)
– SUBTABLE HNPACODE
– 233  234  FRTE  3
–      3  S  D  D2AIMTISUP
– EXIT TABLE RTEREF
EXIT TABLE HNPACONT

+++ SUCCESSFUL CALL TRACE
```

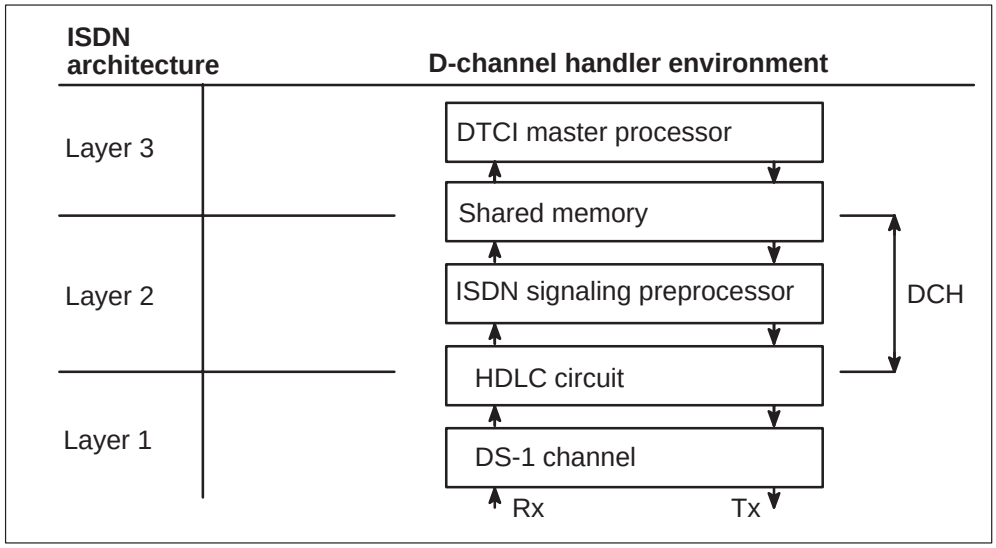
D-channel handler

Hardware configuration

The ISDN digital trunk controller (DTCI) employs the ISDN signaling preprocessor (ISP) card for D-channel signaling. The ISP card eliminates the need to provision signaling terminal cards for D-channel signaling, and it supports up to 32 D-channels on a single DTCI.

The DTCI master processor (MP) communicates with the ISP through shared memory. Layer 3 messages destined for the private branch exchange (PBX) are packaged into layer 2 frames by the ISP. These frames are transmitted by the high-level data link control (HDLC) circuitry (resident in the ISP) onto a DS-1 channel. Figure 3-1 illustrates the relationship between the D-channel handler (DCH) environment and the various ISDN layers.

Figure 3-1
D-channel handler and ISDN layer comparison



The DS-1 is a 24-channel (64 kbit/s each channel) carrier that provides the medium of communication between the UCS DMS-250 switch and the PBX.

D-channel handler hardware

The DCH consists of two processors, the MP and the ISP. The MP performs high-level processing for the D-channel such as Link Access Procedure on the D-channel (LAPD). The ISP controls the transmission and reception of HDLC frames.

The ISP card, located in slot 16 of the DTCI shelf, provides the capability to do ISDN-specific front-end processing for primary rate interface (PRI) applications. The ISP is essentially the layer 1 termination point for DTCI D-channels. The ISP contains a host processor (68020), HDLC circuitry, and a LAPD state machine. These entities provide layer 1 and layer 2 protocol handling for an ISDN PRI.

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.

The DTCI peripheral has the same configuration as a digital trunk controller (DTC), but the DTCI requires an ISP card in each unit. The special tone receiver card is not supported with a DTCI.

Installation

The PRADCH-level of the MAP terminal posts and maintains the DCH in the DTCI. To reach the PRADCH level from the command interpreter level of the MAP terminal enter the following command:

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

How to load the DCH from the MAP terminal

The ISP is loaded when the DTCI is loaded.

How to return the DCH to service

To return the DCH to service, perform the steps in the following procedure.

1. At the PRADCH level of the MAP terminal, enter the POST GD (group D-channel) or POST D <ckt #> command to identify the DCH using the common language location identifier to return to service (RTS).

2. Apply the RTS command to the POST DCH.

   Note 1: If DCH is busy, ensure that a BSY command puts the DCH in MB state before issuing the RTS command.

   Note 2: DCH goes to in-service state.

How to check the DCH load name

It is not necessary to check the DCH load name since the DCH is loaded when the DTCI is loaded.

Verification

How to run internal continuity tests

To run a continuity test, perform the steps in the following procedure.

1. Go to the PRADCH level of the MAP terminal. The full path name is MAPCI;MTC;TRKS;TTP;PRADCH
2. Enter the POST GD command to identify the DCH to test.
3. Enter the CONT command with option INT to run the internal continuity test.

Running the read-only memory tests

This does not apply to the DTCI DCH.

Running the external continuity test

The external continuity test checks the end-to-end continuity of the D-channel. The test path runs from the UCS DMS-250 switch DCH to the far-end PBX. The loopback at the far end must be set by commands at the far end.

To run the continuity test, perform the steps in the following procedure.

1. Go to the PRADCH level of the MAP terminal. The full path name is MAPCI;MTC;TRKS;TTP;PRADCH
2. Enter the POST command to post the DCH associated with the DS-1 to test.
3. Ensure that the D-channel is looped back at the far end. This can be done using the LOOPBK SET command at the far-end switch.
4. Enter the CONT command with the external (EXT) option to run the external continuity test.
5. At the far end, remove the loopback by using the LOOPBK REMOVE command.

Troubleshooting

Check the following if the DCH is in lockout (LO):

- The baud rate (field DCHRATE) datafilled at the local end, in table TRKSGRP, might not match that at the far end of the DS-1 channel.

- The UCS DMS-250 switch is considered to be the network in the layer 2 protocol. This means that entry IFCLASS in table TRKSGRP must be set to NETWORK. Other datafill could cause LO.
- If local parameter IFCLASS in table TRKSGRP is set to USER, verify the remote DS-1 channel configuration.
- The DS-1 channel might not be supervised by the appropriate NT6X50 DS-1 card type.
- Layer 1 might be set up incorrectly. Both sides of the DS-1 channel may not be set for the same frame format (either standard or extended).
- The DCH does not send any messages to the far end unless it has frame synchronization with the far end. Use a protocol analyzer to verify frame synchronization.

Also refer to "Restoring service to the DCH," in Chapter 12, "Service verification."

Test equipment

A protocol analyzer can be used to monitor a DS-1 channel. Analyzers are normally used to check layer 1; however, they can be used to check whether layer 2 HDLC flags are being transmitted. HDLC flags must be transmitted from both sides of the DS-1 channel when operating at a rate of 64 kbit/s. This check can 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 LAPD and Q.931 messages.

PRI D-channel backup (optional)

PRI D-channel backup provides a backup D-channel, in addition to the primary D-channel, to increase reliability and guarantee continuous PRI service between any switching nodes or networks using ISDN PRI.

PRI D-channel backup extends the existing MAP terminal PRADCH-level commands to handle the backup D-channel maintenance functions in the ISDN central controller and ISDN extended multiprocessor system peripheral module (XPM).

Background

A typical PRI interface supports a configuration of 23 B-channels and one D-channel in a common DS-1 facility. This is called associated signaling of the PRI interface.

When one D-channel controls a PRI interface with more than one DS-1 facility, it is called nonassociated signaling of the PRI interface. When the nonassociated PRI interface is used, D-channel backup ensures the integrity

of the interface by providing a second D-channel and a warm switch of activity (SWACT0 capability.

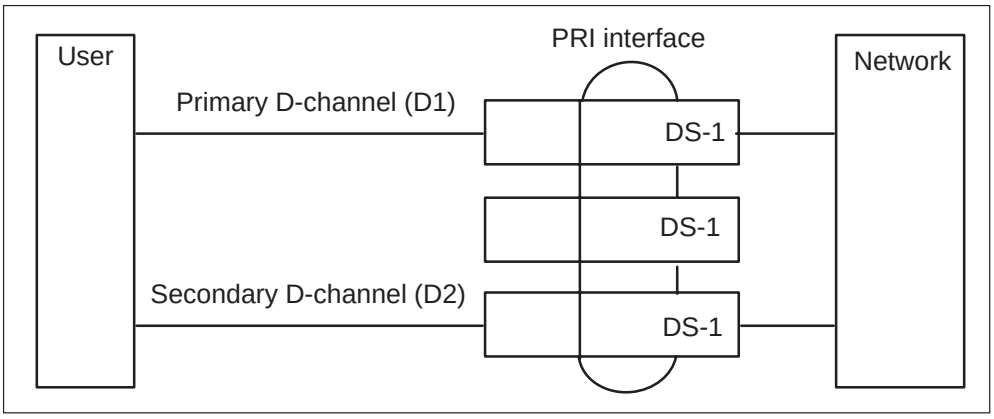
In the UCS DMS-250 switch product series, DTCI type XPMs are supported by D-channel backup. The ISDN access controller type XPM is not supported with D-channel backup.

Configuration for D-channel backup

When two or more DS-1 facilities are used with the PRI interface, a primary D-channel is always present on one DS-1 and is labeled D1. On a different DS-1 facility, a secondary D-channel, identified as D2, is also present. Both primary and secondary D-channels can send signaling information in LAPD format, but only one D-channel (either primary or secondary) can be active in layer 3 at any one time. The other D-channel is active in layer 2.

Figure 3-2 shows the basic nonassociated signaling of a PRI interface that contains three DS-1 facilities. It also shows the primary D-channel (D1) and a secondary D-channel (D2).

Figure 3-2
Nonassociated PRI interface with D-channel backup



Terminology

The terms *primary D-channel* and *D1* are used interchangeably to describe the primary D-channel for the PRI interface with a backup D-channel. The terms *secondary D-channel* and *D2* are used interchangeably to describe the secondary D-channel for the PRI interface with a backup D-channel.

The term *backup D-channel* can refer either to the D1 or D2, depending on the state of D1 and D2. For example, if D1 is in the active state, D2 is called the backup D-channel, regardless of what state D2 is in. On the other hand, if D2 is in the active state, D1 is the backup D-channel. D1 and D2 cannot be in the active state at the same time.

Backup D-channel is a logical term, but *primary D-channel* and *secondary D-channel* are terms assigned to circuits as datafilled in the trunk subgroup table.

D-channel maintenance with backup configuration

The command function under PRADCH-level handles primary and secondary D-channel maintenance. The SWACT command supports the manual switch of activity of D-channels.

D-channel interactions

The following features interact with the D-channel backup

Universal tone receiver on PRI

The calls in the digit receiving state are cleared.

Basic PRI calls

Calls not in the active state are cleared.

Q.931 information elements

Every message consists of the following information elements (IE). The first three items are common to all the messages and must always be present, while the last item is specific to each message type. The maximum message length is 256 octets.

- protocol discriminator
- call reference
- message type
- other IEs, as required

Mandatory information elements

Mandatory IEs are the protocol discriminator IE, call reference IE, and message type IE.

Protocol discriminator information element

The protocol discriminator IE distinguishes messages for call control and maintenance (service) from other messages.

Call reference information element

The call reference IE identifies the call request at the local user-network interface to which the particular message applies. The call reference does not have end-to-end significance across ISDNs. It contains two fields: call reference value and call reference flag.

Message type information element

The message type IE identifies the function of the message.

Other information elements

The following IEs are listed in alphabetical order. However, the code values of the IE identified for the variable length formats are assigned in ascending numerical order, according to the actual order of appearance of each IE in a message. This allows the receiving equipment to detect the presence or absence of a particular IE without scanning through the entire message.

Bearer capability information element

Bearer capability (BC) IE lets subscribers specify, on a per-call basis, the type of communication required for a call. BCs are further discussed in "Bearer capability for PRI" in Chapter 9, "Feature interaction." No default bearer capability may be assumed by the absence of this IE.

Call state information element

The call state IE describes the current status of a call.

Called party number information element

The called party number IE are the digits dialed to access a terminal in the public switched telephone network or the private network.

For details on how the UCS DMS-250 switch uses the called party number for routing the call, refer to "Interexchange carrier translations" in Chapter 9, "Feature interaction."

Called party subaddress information element

The called party subaddress IE allows the originating user to further identify the called user.

Calling party number information element

The calling party number IE identifies the origin of a call.

For details on how the UCS DMS-250 switch uses the calling party number, refer to "Calling number delivery" in Chapter 9, "Feature interaction."

Calling party subaddress information element

The calling party subaddress IE allows the originating user to further identify the calling user.

Cause information element

The cause IE describes the reason for generating certain messages and optionally provides diagnostic information if procedural errors occur. It also indicates the location of the cause originator.

Only a subset of the Q.931 cause values is supported on UCS DMS-250 switch. For a complete list of all the possible causes generated during primary rate interface (PRI) call processing, refer to the paragraph "Mapping of treatments to cause values," in Chapter 6, "Call control procedures."

Change status information element

The change status IE changes the current status of an interface and D-channel to one of the following states: In Service, Maintenance, Out of Service.

Channel identification information element

The channel identification (CID) IE identifies a channel within the interface controlled by signaling procedures. The IE consists of the interface number and the B-channel selected. The interface number defines the DS-1 trunk being used; the B-channel number is the channel number within the DS-1 trunk.

The CID IE identifies the B-channel on a PRI interface that is to be used for a call. If B-channel negotiation is enabled, either the originating or the terminating side can specify a B-channel and indicate whether alternatives are acceptable.

Since a PRI interface can comprise more than one DS-1 interface, the channel used for a call is identified by specifying the interface identifier (IID) of the DS-1 where the channel resides, as well as the channel number identifying the channel on that DS-1. The IID is a binary code in the range of 0 to 31 as datafilled against that DS-1 in table LTCPSINV. The channel number used to identify a particular channel on a DS-1 is a binary code in the range of 1 to 24, corresponding to the timeslot for that channel as datafilled in table TRKMEM.

The encoding of the CID IE is such that the IID field may be omitted, implying that the DS-1 interface to be used is *implicitly identified*. In the case where a PRI interface comprises a single DS-1, the interface must be identified either explicitly or implicitly.

In cases where the PRI is comprised of more than one DS-1, the interface must be identified explicitly. Otherwise, the UCS DMS-250 switch assumes that the interface requested is the interface that contains the D-channel. If the interface that contains the D-channel does not contain B-channels, a release with cause is returned specifying *channel not available*.

When formatting a CID IE, the UCS DMS-250 switch always identifies the DS-1 interface explicitly, regardless of the number of DS-1 interfaces that comprise the PRI.

Connected number information element

The connected number IE indicates which number is connected to a call. The connected number may be different from the calling or called party number(s) because of changes (call redirection) during the lifetime of the call. As a subscription option, the connected number may be passed from

user to user without network interpretation or interaction. The element is sent by the PBX only in response to an information request IE.

Display information element

The display IE supplies display information that will be visible to the user. The contents of this IE describes the type of information referenced and the action associated with the information. Optionally, this IE may be passed from user to user without network interpretation or interaction.

Facility information element

The facility IE indicates the invocation and operation of supplementary services identified by the corresponding operation value within the facility IE. The maximum length of this IE depends on the service provided.

Higher layer compatibility information element

The higher layer compatibility IE allows the originating user to identify specific requirements requested for upper layer functionality.

Lower layer compatibility information element

The lower layer compatibility IE allows the originating user to identify specific requirements requested for lower layer functionality.

Information request information element

The information request IE allows the system to request additional information and signal completion of the information requested. This IE is used by the private branch exchange (PBX) to request redirection information. If the information is restricted, or not available, this IE indicates what number type was requested (calling, connected, redirecting, and so forth). Optionally, this IE may be passed from user to user without network interpretation or interaction.

Network-specific facilities information element

The network-specific facilities IE indicates which network facilities are being invoked at the specified network.

PRI supports the following call type from the PBX to the UCS DMS-250 switch:

- PRISM—PRISM service calls translated by the in-switch data tables.

PRI supports the following call types from the UCS DMS-250 switch to the PBX:

- 800—calls designated as such by the CALLTYPE field, under LTID, in table LTCALLS

- 900—toll calls designated as such by the CALLTYPE field, under LTID, in table LTCALLS

The network-specific facilities IE provides the subscriber the ability to request specific route or network capabilities. The call is routed on the basis of the service selector in preference to other information (for example, destination number [DN], NPI, and so forth), although checks are made to ensure that the call setup information is consistent with the network facilities requested for the call.

Notification indicator information element

The notification indicator IE indicates or conveys information pertaining to a call.

Original called information element

The original called IE identifies the number from which the first redirection/diversion was invoked. Optionally, this IE may be passed from user to user without network interpretation or interaction. The original called IE is Nortel proprietary to support cross product interworking and is coded as codeset 0 to accommodate inter-vendor connectivity.

Progress indicator information element

The progress indicator IE describes an event that has occurred during the life of a call and affects the handling of a call. It is supported as a mandatory IE in the Progress message and optional in the Alerting message. For examples of use of this IE, refer to “Termination on non-ISDN trunk” and “Call routed to treatment,” in Chapter 6, “Call control procedures.**”**

The following conditions describe these events:

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

Redirecting information element

The redirecting IE indicates the source from which call redirection/diversion was invoked. Optionally, this IE may be passed from user to user without network interpretation or interaction.

Redirection information element

The redirection IE indicates the number to which call redirection/diversion should be or has been invoked. Optionally, this IE may be passed from user to user without network interpretation or interaction.

Restart indicator information element

The restart indicator IE identifies the class of the facility (channel or interface) for restart. The CID IE must be included here and indicates which channel is to be restarted.

Transit network selection information element

The transit network selection IE requests a transit network for call routing.

User-to-user information element

The user-to-user IE conveys information between users. The information is not interpreted by the network, but rather is carried transparently and delivered to the remote users.

For more information concerning the User-to-User Information (UUI) IE, see Chapter 15, ”Description of UUI Information Elements and Parameters”.

Message functions

The message definitions in this chapter include

- a brief description of the message direction and event
- a matrix describing the
  - — event
  - — information element (IE)
  - — direction
  - — inclusion factor (whether the IE's inclusion is mandatory or optional)

The following tables describe the messages that are supported for primary rate interface (PRI) call processing and the role of each message in call processing. In Table 5-1, Q.931 messages are listed in the order that they appear during regular call setup. Where applicable, the correlation of messages with traditional telephone events is also included. Table 5-2 lists Q.931 IEs and their related messages. Table 5-3 lists Q.932 messages. Table 5-4 lists Q.932 IEs.

Q.931 messages

Q.931 messages are listed in Table 5-1 as they appear during regular setup.

Table 5-1
Q.931 messages

Message	Meaning	Direction	Event information
SETUP	Setup	This message is sent by either the originator or the network to initiate call establishment.	When a call is initiated, the SETUP message is sent to the network. All digits dialed are included in the message.
CALL PROC	Call proceeding	The network sends this message to the originating PRI to indicate that call establishment has been initiated and that it will accept no more information. Also, the terminating PRI may send this message to the network. When the network receives this information, it does not send it back to the originator. This message does not have end-to-end significance—its significance is local within a single interface.	CALL PROC is sent to the originator of the call after translation and routing have been successful.
PROG	Progress	This message is sent from the network or from the originator to indicate the progress of a call during call establishment (for example, when the call has left the ISDN network or to indicate the use of in-band tones).	A PROG message is sent to the originator after a CALL PROC message is sent. Following are examples: • Call is not end-to-end ISDN. The connection from source to destination includes a 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.

—continued—

Table 5-1
Q.931 messages (continued)

Message	Meaning	Direction	Event information
ALERT	Alerting	This message is sent by the called party to the network, and by the network to the calling party to indicate that called party alerting has been initiated. Any additional information in this message, such as redirecting number or redirection number, is not sent to an originating ISDN user. Instead, the network ignores these IEs upon receipt.	An ALERT message is sent to the originator to indicate alerting of the called party. An ALERT message is sent to PRI originators only when received from a terminating PRI agent. The terminating MSL-PBX determines when the ALERT message is sent. For PRI-to-trunk calls, the B-channel cut-through occurs between call proceeding and connect.
NOTIFY	Notify	A NOTIFY message is sent by either PBX user to the network and by the network to the calling user to convey information across the PRI interface. Like the ALERT message, the NOTIFY message is sent to a PBX only when received from the opposite PBX. The MSL-PBX determines when the NOTIFY message is sent.	
CONN	Connect	This message is sent by the called party to the network, and by the network to the calling party, to indicate call acceptance by the called party.	A CONN message generates 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 CONN message back to the originator. Billing begins at this time.
CONN ACK	Connect acknowl–edge	This message is sent by the network to the called party and may, optionally, be sent by the calling party to the network in response to a CONN message.	After the originator receives the CONN message, it responds back to the network with a CONN ACK message.

—continued—

Table 5-1
Q.931 messages (continued)

Message	Meaning	Direction	Event information
DISC	Disconnect	This message is sent by either the calling party or the network as an invitation to release the channel and call reference. The channel and call reference are retained.	A DISC message generates when one member of the call hangs up. This message is equivalent to detecting an onhook signal on a per-trunk signaling (PTS) trunk. This is the first step in the call takedown message sequence. Billing is now complete.
REL	Release	This message is sent from either the calling party or the network to indicate that the equipment sending the message disconnected the channel and intends to release the call reference, and that the receiving equipment should release the channel and call reference and abort any call with that call reference in the process of being set up.	A REL message is sent to the member that sent the disconnect message. This is the second step in the call takedown message sequence. A REL message is also sent for abnormal call clearing.
REL COM	Release complete	This message is sent from either the calling party or the network; it indicates that the equipment sending the message released the channel and call reference, the channel is available for reuse, and the receiving equipment will release the channel and call reference. This is the last message sent in any disconnect sequence.This message is also sent by either the user or the network in response to a SETUP message when the requested B-channel cannot be allocated.	A REL COM message is generated after a member receives a REL message. This is the third and final step in the call takedown message sequence.

—continued—

Table 5-1
Q.931 messages (continued)

Message	Meaning	Direction	Event information
REST	Restart	This message is sent from one side of the interface to the other to request the recipient to restart (return to an idle condition) the indicated channels or interface. The REST message is of local significance. It uses the global call reference. If no channel is identified, the restart applies to all B-channels controlled by the D-channel on which the message was sent.	
REST ACK	Restart acknowl-edge	This message is sent to acknowledge receipt of the REST message and indicates that the requested restart is complete. The REST ACK message is of local significance. It uses the global call reference.	
STATUS ENQ	Status enquiry	This message is sent from either the calling party or the network at any time during a call to solicit a STATUS message from layer 3.	
STATUS	Status	This message is sent from either the calling party or the network at any time during a call when an unexpected message is received, or to report other conditions of the call. It is also sent in response to a STATUS ENQ message.	

—continued—

Table 5-1
Q.931 messages (continued)

Message	Meaning	Direction	Event information
SERVICE	Service	This message conveys PRI B-channel change of status to in-service, maintenance, or out-of-service state. The SERVICE and SERVICE ACK messages are bidirectional and can be sent by either the calling party or the network. They cannot be used for changing the status of the D-channel.	
SERVICE ACK	Service acknowl-edge	This message is used to acknowledge changes to the status of PRI B-channels. It is sent in response to a SERVICE message received and, like SERVICE, can be sent by the calling party or the network.	

—end—

Q.931/Q.932 messages and information elements

Q.931/Q.932 messages contain IEs as shown in the following tables. Each IE may be sent from the user to the network, from the network to the user, or both. IEs ignored by the UCS DMS-250 switch are acceptable if received in a Q.931 message, but are never sent by the UCS DMS-250 switch.

The supported Q.931 IEs are described in Table 5-2.

Table 5-2
Q.931 messages and information elements

Q.931 message	Information element	Direction	Type
SETUP	Protocol discriminator	Both	Mandatory
	Call reference	Both	Mandatory
	Message type	Both	Mandatory
	Bearer capability	Both	Mandatory
	Channel identification	Both	Mandatory
	Facility	Both	Optional
	Progress indicator	Both	Mandatory if in-band tones are to be provided; optional, otherwise.
	Network-specific facilities	Both	Optional. Included if facilities other than public ISDN facilities are to be used for the call.
	Display	Both	Optional. Network can provide, on a subscription basis, the ability to transfer the IE between users without network interpretation or interaction.
	Calling party number	Both	Optional
	Called party number	Both	Mandatory
	Called party subaddress	Both	Optional
	Original called number	Both	Optional
	Lower layer capability	Both	Optional
	Higher layer capability	Both	Optional
	Locking Shift Codeset 5	Both	Optional

—continued—

Table 5-2
Q.931 messages and information elements (continued)

Q.931 message	Information element	Direction	Type
	Codeset 5 IEs	Both	Optional
	Locking Shift Codeset 6	Both	Optional
	Codeset 6 IEs	Both	Optional
	Locking Shift Codeset 7	Both	Optional
	Codeset 7 IEs	Both	Optional
CALL PROC	Protocol discriminator	Both	Mandatory
	Call reference	Both	Mandatory
	Message type	Both	Mandatory
	Channel identification	Both	Mandatory
PROG	Protocol discriminator	Both	Mandatory
	Call reference	Both	Mandatory
	Message type	Both	Mandatory
	Cause	Both	Optional. CAUSE is supplied when there is in-band treatment applied to the call, and there is a cause that corresponds to that in-band treatment; otherwise, it is not included.
	Progress indicator	Both	Mandatory in the network-to-user direction. If received on an incoming ALERT message, it is treated as an unrecognized optional IE and discarded.
	User-to-user information	Network to user	Optional
ALERT	Protocol discriminator	Both	Mandatory
	Call reference	Both	Mandatory
	Message type	Both	Mandatory
	Channel identification	Both	Optional; mandatory if it is the first message in response to SETUP.
	Facility	Both	Optional

—continued—

Table 5-2
Q.931 messages and information elements (continued)

Q.931 message	Information element	Direction	Type
	Progress indicator	Network to user	Optional
CONN	Protocol discriminator	Both	Mandatory
	Call reference	Both	Mandatory
	Message type	Both	Mandatory
	Channel identification	Both	Mandatory if it is the first message in response to SETUP. Otherwise, optional.
CONN ACK	Protocol discriminator	Both	Mandatory
	Call reference	Both	Mandatory
	Message type	Both	Mandatory
DISC	Protocol discriminator	Both	Mandatory
	Call reference	Both	Mandatory
	Message type	Both	Mandatory
	Cause	Both	Optional only in the sense that if it is missing or truncated or having invalid contents, then the actions taken shall be the same as if a DISC message with cause value #31, “normal, unspecified,” were received.
REL	Protocol discriminator	Both	Mandatory
	Call reference	Both	Mandatory
	Message type	Both	Mandatory
	Cause	Both	CAUSE is mandatory if this is the first clearing message; otherwise, it is not included.
REL COMP	Protocol discriminator	Both	Mandatory
	Call reference	Both	Mandatory
	Message type	Both	Mandatory

—continued—

Table 5-2
Q.931 messages and information elements (continued)

Q.931 message	Information element	Direction	Type
	Cause	Both	CAUSE is mandatory if this is the first clearing message; otherwise, it is not included.
	User to user information	User to network	Optional
REST	Protocol discriminator	Both	Mandatory
	Call reference	Both	Mandatory
	Message type	Both	Mandatory
	Channel identification	Both	Mandatory only if a single channel or a single interface controlled by a D-channel is to be restarted. If all the channels associated with a D-channel are to be restarted, it is not included.
	Restart indicator	Both	Mandatory
RESTART ACK	Protocol discriminator	Both	Mandatory
	Call reference	Both	Mandatory
	Message type	Both	Mandatory
	Channel identification	Both	Optional, but mandatory if a single channel or a single interface controlled by a D-channel is to be restarted. If all the channels associated with a D-channel are to be restarted, it is not included.
	Restart indicator	Both	Mandatory
STATUS ENQ	Protocol discriminator	Both	Mandatory
	Call reference	Both	Mandatory
	Message type	Both	Mandatory
STATUS	Protocol discriminator	Both	Mandatory
	Call reference	Both	Mandatory
	Message type	Both	Mandatory
	Cause	Both	Mandatory

—continued—

Table 5-2
Q.931 messages and information elements (continued)

Q.931 message	Information element	Direction	Type
	Call state	Both	Mandatory
SERV	Protocol discriminator	Both	Mandatory
	Call reference	Both	Mandatory
	Message type	Both	Mandatory
	Change status	Both	Mandatory
	Channel identification	Both	Optional. Mandatory only if a single channel or a single interface controlled by a D-channel is to be restarted. If all the channels associated with a D-channel are to be restarted, it is not included.
SERV ACK	Protocol discriminator	Both	Mandatory
	Call reference	Both	Mandatory
	Message type	Both	Mandatory
	Change status	Both	Mandatory
	Channel identification	Both	Optional. Mandatory only if a single channel or a single interface controlled by a D-channel is to be restarted. If all the channels associated with a D-channel are to be restarted, it is not included.
NOTIFY	Protocol discriminator	Both	Mandatory
	Call reference	Both	Mandatory
	Message type	Both	Mandatory
	Cause	Both	Optional
	Connected number	Both	Optional. The network can provide, on a subscription basis, the ability to transfer the IE between users without network interpretation or interaction.
	Progress indicator	Both	Optional. Mandatory if in-band tones must be provided; otherwise, it is not included.

—continued—

Table 5-2
Q.931 messages and information elements (continued)

Q.931 message	Information element	Direction	Type
	Notification indicator	Both	Mandatory
	Display	Both	Optional. Included in the user-network direction if the user has display information that should be passed to the far-end user. It is included in the network-user direction if received from the remote user. As a network option, the Display IE can be passed from user to user without network interpretation or interaction.
	Information request	Both	Optional. The network can provide, on a subscription basis, the ability to transfer the IE between users without network interpretation or interaction.
	Calling party number	Both	Optional. Mandatory in the user-to-network direction if the calling party number to be used is not the default number for the interface. In the network-to-user direction, this information is made available to the called user upon subscription to the corresponding ISDN supplementary service.
	Redirecting number	Both	Optional. The network can provide, on a subscription basis, the ability to transfer the IE between users without network interpretation or interaction.
	Redirection number	Both	Optional. The network can provide, on a subscription basis, the ability to transfer the IE between users without network interpretation or interaction.

—end—

Q.932 messages

Table 5-3 lists Q.932 messages.

Table 5-3
Q.932 messages

Message	Meaning	Direction	Event information
FACILITY	Facility	This message is sent by a user to a network to request supplementary service or from the network to the user to respond to a request.	The FACILITY message is network dependent. Refer to the appropriate network profile supplement to determine what level of message is supported and what additional IEs are used.
REGISTER	Register	This message initiates a transaction.	The REGISTER message is network dependent. Refer to the appropriate network profile supplement to determine what level of message is supported and what additional IEs are used.

Q.932 messages and information elements

Table 5-4 lists Q.932 messages and IEs.

Table 5-4
Q.932 messages and information elements

Q.932 message	Information element	Direction	Type
FACILITY	Protocol discriminator	Both	Mandatory
	Call reference	Both	Mandatory
	Message type	Both	Mandatory
REGISTER	Protocol discriminator	Both	Mandatory
	Call reference	Both	Mandatory
	Message type	Both	Mandatory

Call control procedures

This chapter describes the call control procedures used to set up and take down primary rate interface (PRI) calls.

User or network parameters

In any PRI connection, one end functions as the user and the other end as the network. The IFCLASS parameter, a subfield under the field SGRPVAR, in table TRKSGRP specifies whether the UCS DMS-250 switch functions as a user or a network. The recommendation is that this parameter be set to network when operating on a UCS DMS-250 switch.

The differences between the functionality of a user and network are as follows:

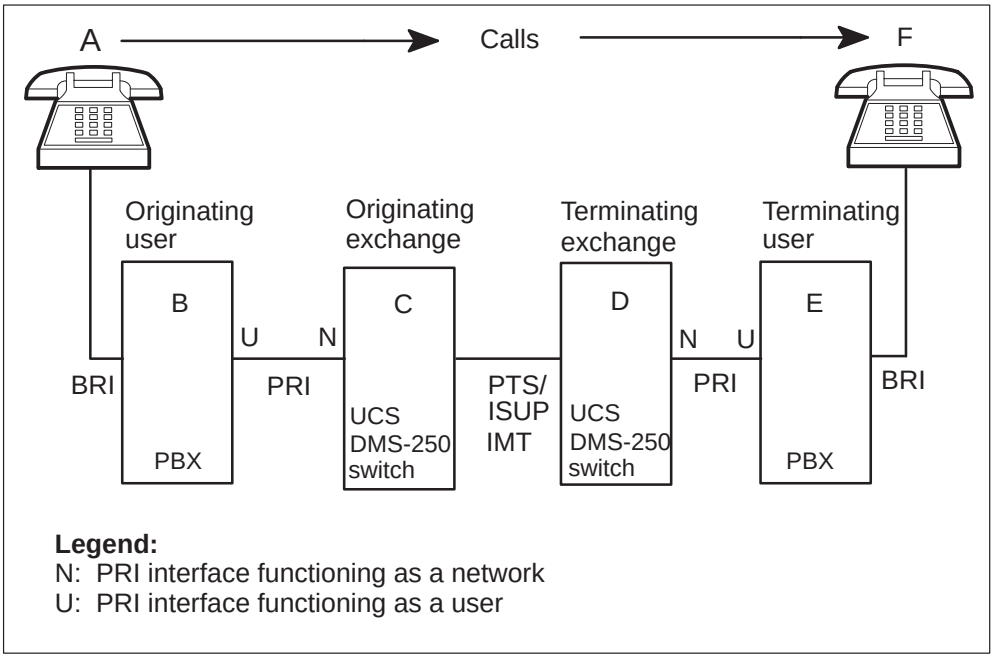
- When a Q.931 SETUP message is sent, the user interface expects a Q.931 CALL PROC message in response. The network interface receives CALL PROC, ALERT, or CONN in response.
- The user interface has one extra Q.931 call state, CONN_SENT, which is entered when a CONN message is sent to the network. Timer T313 is started on the user side and is cancelled on receipt of a Q.931 CONN ACK message. The active state is then entered. When a network interface transfers a Q.931 CONN message, the network state is set directly to active (no timer is started).
- Sending a CONN ACK message is not mandatory for the user in response to a CONN message, but it is mandatory for the network in response to a CONN message.
- If the link fails, the network interface sets timer T309 for all calls in the active state. If the timer expires, the call is taken down. For the user side, the call is left up.

For call control procedures, there are only a few differences between the network side and the user side. The text that follows focuses on the UCS DMS-250 switch as the network and the differences are stated explicitly.

Figure 6-1 shows a call between points A and F proceeding through the various nodes through PRI. The node at point C (call incoming on a PRI) is

referred to as an originating exchange. The node at point D (call outgoing on a PRI) is referred to as a terminating exchange.

Figure 6-1
Originating and terminating exchanges in a PRI connection



Call establishment at the originating exchange

Call establishment at the originating exchange is equivalent to an incoming PRI call to the UCS DMS-250 switch (node C in Figure 6-1, when the UCS DMS-250 switch is the network).

User call request

When a call is initiated, a SETUP message is sent over the PRI interface to the network. The network attempts to allocate the B-channel requested in the incoming SETUP message and, if successful, attempts to route the call based on the called party number (CDN) information element (IE).

The B-channel requested in the SETUP message maps one-to-one with a particular trunk member in the PRI trunk group. The network selects that channel, if it is available to make the connection, and marks it busy; the B-channel is no longer available for other calls.

Call proceeding

After successful translation of the CDN, the network chooses an outgoing route and proceeds to terminate the call. When the outgoing channel (PRI or non-ISDN) is successfully allocated, a CALL PROC message is sent over

the originating PRI interface. The CALL PROC message contains the originating channel identification (CID) allocated by the network. At this point, the voice path between the originating and terminating interfaces is established, so that ringing is passed in-band by the terminating office.

In the event that an outgoing route cannot be successfully allocated, a CALL PROC message may be sent to the originating PRI interface as described in "Call routed to treatment" in this chapter.

Termination on PRI interface

When terminating on a PRI interface, the network receives a CALL PROC, ALERT, or CONN message as the first response to an outgoing SETUP message. (The user, when terminating to a PRI interface, receives a CALL PROC message.)

If the network receives an ALERT message from the terminating PRI interface, the network sends an ALERT message over the originating PRI interface.

If the network receives a CONN message from the terminating PRI interface, the network sends a CONN message to the originating PRI interface and a CONN ACK to the terminating PRI. The originator may also respond with CONN ACK. (The user always receives a CONN ACK in response to a CONN sent to the network.)

Termination on non-ISDN trunk

In the case of a PRI to non-ISDN trunk call, after the CALL PROC message is sent to the originating PRI, a PROG message is sent containing a progress indicator IE with the value *Call is not end-to-end ISDN*.

An ALERT message is not sent, because there is no way of knowing whether alerting is actually taking place on the called station when calling out over a per-trunk signaling (PTS) trunk.

If the network receives an indication from the outgoing trunk that the far end has answered, a CONN message is sent out over the originating PRI interface. The originator responds with CONN ACK. (The user receives a CONN ACK in response to a CONN sent to the network.)

Note: If the UCS DMS-250 switch is forced to reselect another non-ISDN trunk after terminating to a non-ISDN trunk, a second progress message is sent. If the call reselects a PRI trunk group, the call remains *not end-to-end ISDN* and no additional messages are sent.

Call establishment at the terminating exchange

Call establishment at the terminating exchange is equivalent to an outgoing PRI call from the UCS DMS-250 switch (node C in Figure 6-1) when the UCS DMS-250 switch is the network.

Network call request

The network indicates the arrival of a call to a user by sending a SETUP message across the terminating PRI interface. The network allocates a B-channel and specifies it in the CID IE in the outgoing SETUP message.

If the originator is a non-ISDN trunk, a progress indicator IE containing the value *Call is not end-to-end ISDN* is included in the outgoing SETUP message.

B-channel allocation

When a call is terminated to an outgoing PRI trunk member, the trunk member is marked busy and the B-channel is allocated (made unavailable to other calls). If no trunk members are available, route advancement occurs until there are no more choices in the route list, after which the call is routed to an all-circuits-busy treatment. When a B-channel is allocated, a SETUP message containing this CID is sent to the terminating PRI interface and the B-channel is cut through.

The allocation of trunk members in ascending or descending sequential order is datafilled in table TRKGRP. Opposite ends of a PRI connection are datafilled in such a way as to minimize glare. This is accomplished by one end of the interface selecting trunk members in ascending sequential order, and the other in descending sequential order.

User response

If the indicated B-channel is successfully allocated, it responds to the network with a CALL PROC, ALERT, or CONN message; otherwise, it responds with REL COM to the network.

The reception of CALL PROC by the network does not cause a CALL PROC message to be sent to an originating PRI. This is because a CALL PROC was already sent when the network routed the call. (CALL PROC is of local significance within a single interface.)

If the network receives an ALERT message from the outgoing PRI, this message is sent to the originator if the originator is an ISDN agent; otherwise, it is ignored.

If the network receives a CONN message from the outgoing PRI, this message is sent to the originator if the originator is an ISDN agent and the network sends a CONN ACK to the outgoing PRI.

Figure 6-2 shows the message sequence between the network and the two users on a PRI-to-PRI call.

Figure 6-2
Q.931 message sequence for a PRI-to-PRI call setup

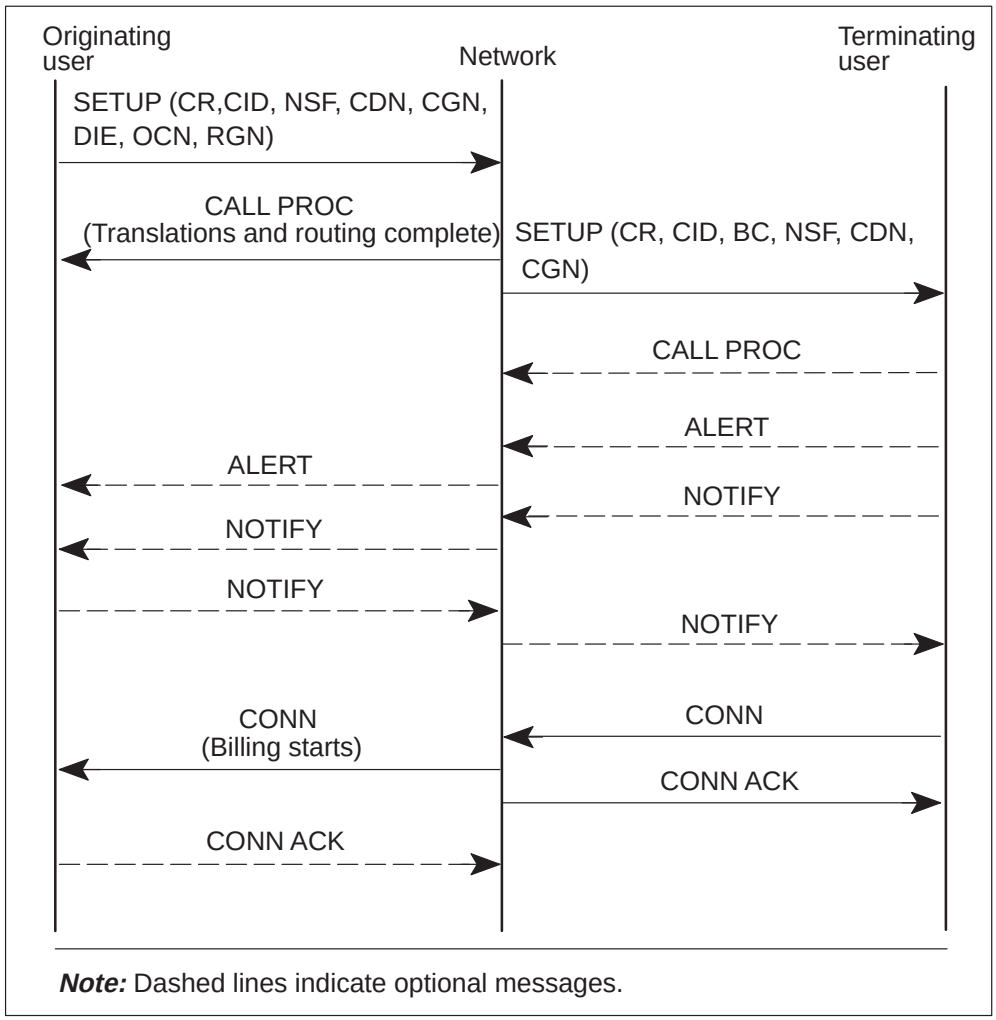


Figure 6-3 shows the message sequence between the network and the originating PRI interface when the terminator is a non-ISDN trunk. Since interworking has occurred, a progress indicator IE containing the value *Call not end-to-end ISDN* is sent in a PROG message over the originating PRI.

Figure 6-3
Q.931 message sequence for a PRI-to-non-ISDN trunk call setup

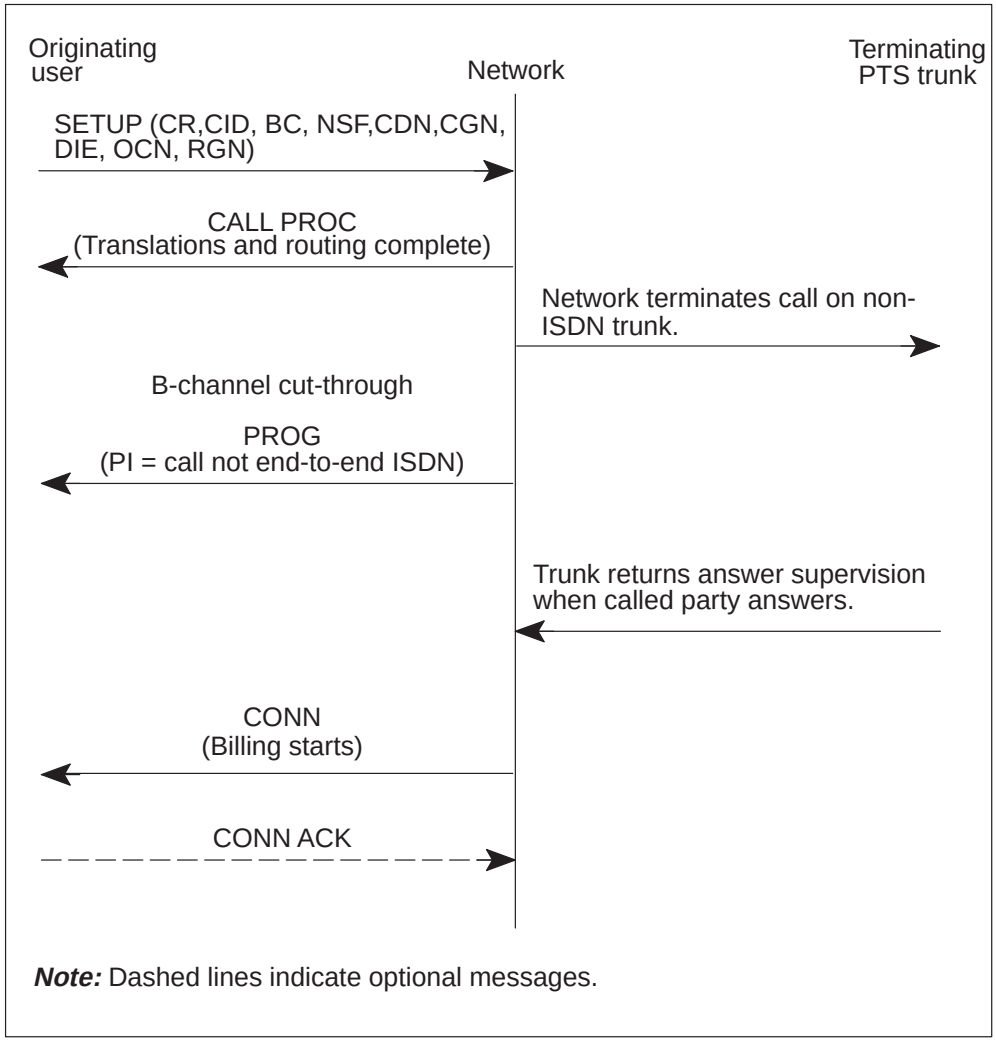
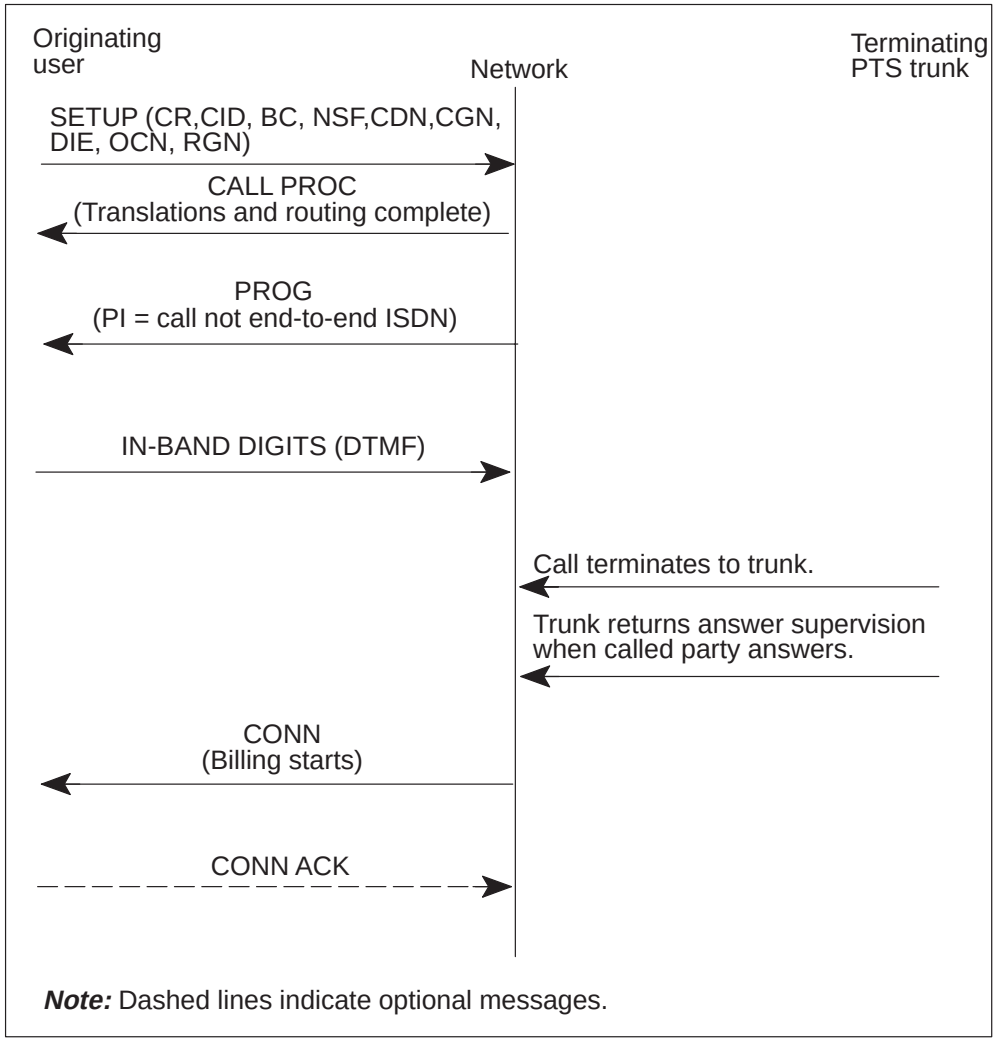


Figure 6-4 provides a diagram of a PRI call that requires in-band DTMF digit collection. The PBX ensures that the subscriber is capable of providing DTMF digits.

Figure 6-4
Digit collection PRI-to-trunk



UCS DMS-250 switch call setup

The following describes how the UCS DMS-250 switch selects a PRI B-channel to make an outgoing call. Once a route is determined, and the trunk group selected (within the route verified as a PRI type), the call is treated as a PRI termination. The next idle member in the trunk group is chosen according to the SELSEQ field in table TRKGRP.

The selected trunk member is, in effect, the B-channel. It is reserved and the Q.931 SETUP message is built. All digits must be present before sending the SETUP message.

In any PRI connection, one end of the interface functions as the user, and the other functions as the network. The UCS DMS-250 switch can function as

the user or network in a PRI connection, but is ideally configured as the network.

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

Call takedown (normal call clearing)

This following paragraphs describe the procedures for call takedown when either the user or the network initiates normal call clearing.

Abnormal error conditions

A normal disconnect sequence consists of three messages: DISC, REL, and REL COM.

Whether the user or the network initiates call clearing of an established call, the first message is always a DISC message. The other end of the connection responds with a REL message, then the side initiating call clearing responds with REL COM.

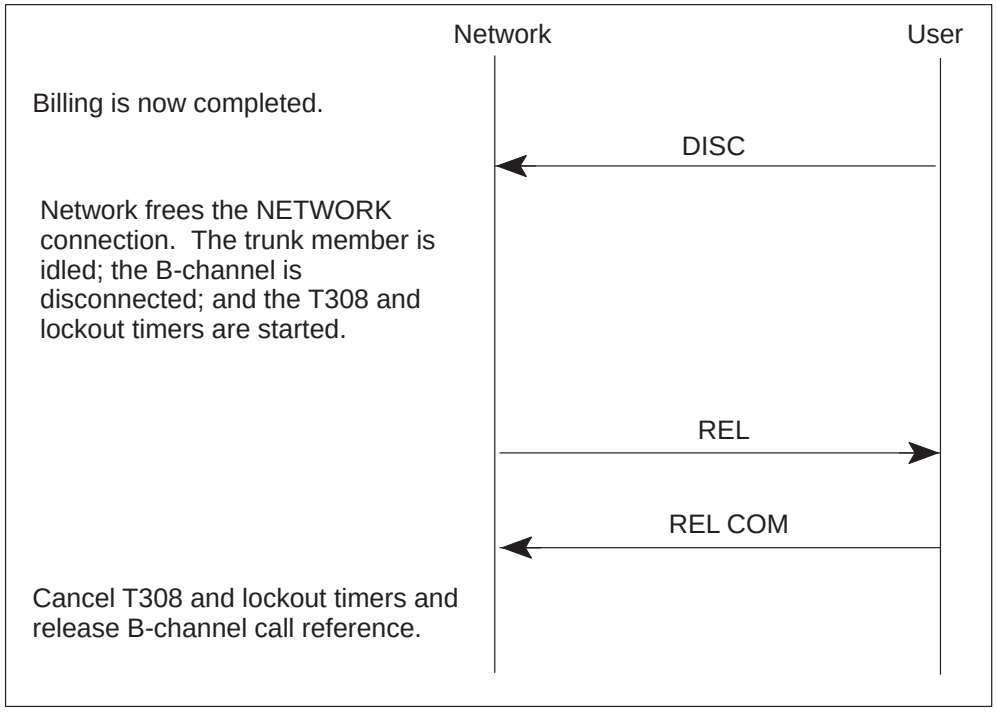
User-initiated call clearing

Receipt of the DISC message over a PRI trunk is equivalent to detecting an onhook signal on a PTS trunk. Ultimately, the network idles the PRI trunk member by disconnecting the B-channel. The channel remains unavailable for any other calls. The network responds to the DISC message by starting timer T308, starting a UCS DMS-250 switch internal lockout timer, and sending a REL message to the user. This is shown in Figure 6-5.

The lockout timer (trunk guard timer) is datafilled in the table TRKSGRP as TRKGRDTM. The value is typically less than 2.5 s. The paragraph “B-channel lockout” in this chapter discusses what happens when the lockout timer expires.

When the network receives a REL COM message from the user, the B-channel and call reference are deallocated and both are free to be allocated for other calls.

Figure 6-5
PRI-to-PRI trunk disconnect, user initiates call clearing

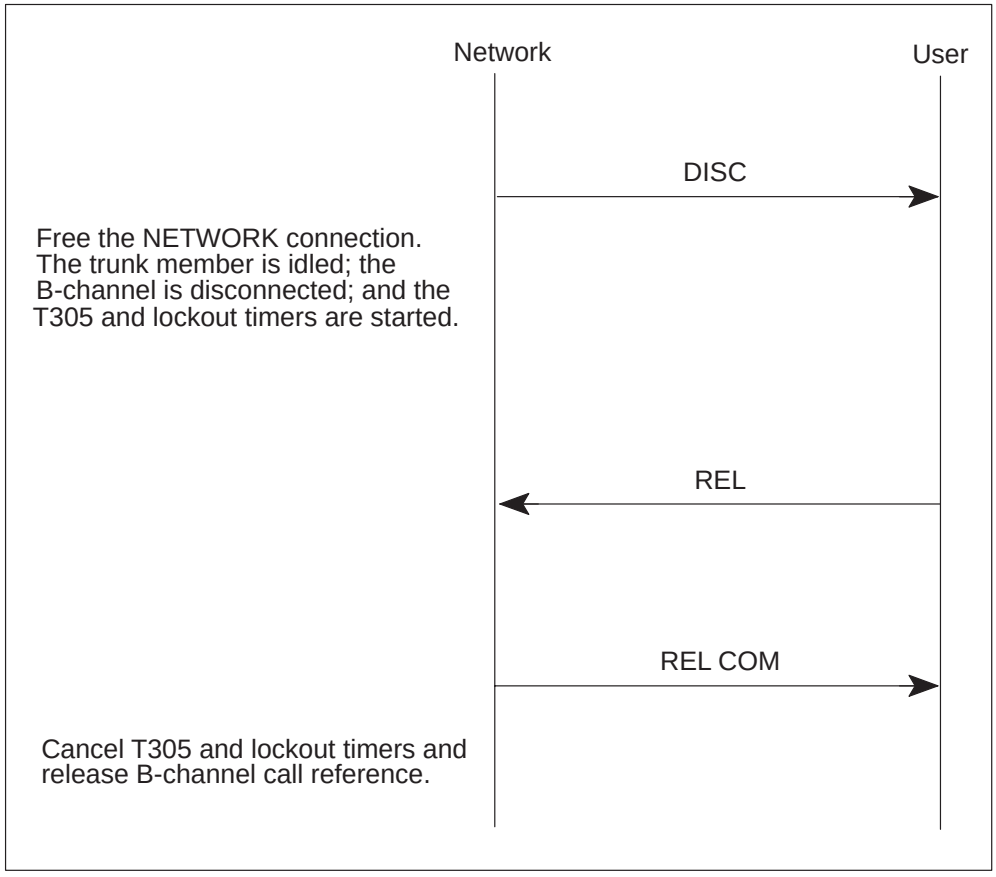


Network-initiated call clearing

When the network initiates call clearing, a DISC message is sent to the user, the network disconnects the B-channel, deallocates the trunk member, and starts timer T305 and the lockout timer. The B-channel is not available for other calls.

Upon receipt of a REL message from the user, the network cancels T305 and releases the B-channel and call reference; the B-channel is now available for other calls. The network sends a REL COM message to the user, as shown in Figure 6-6.

Figure 6-6
PRI-to-PRI trunk disconnect, network initiates call clearing

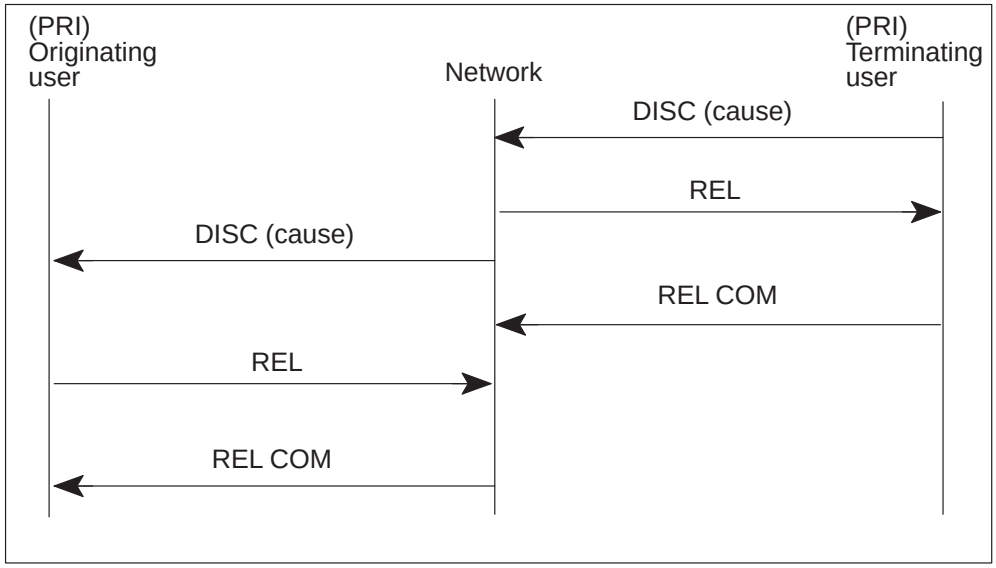


Call takedown (disconnect with cause)

The following paragraphs describe the procedures for call takedown when a call cannot be completed due to an error condition. When the node receives a DISC message from a terminating PRI interface, and the message contains a cause value that indicates anything other than normal call clearing, the node performs the actions of non-ISDN originator or PRI originator.

- non-ISDN—If the originator is a non-ISDN agent, the cause is mapped to a UCS DMS-250 switch treatment and the originator is routed to that treatment. The terminating PRI is deallocated and idled.
- PRI originator—If the originator is a PRI interface, mapping the cause to a treatment is not necessary. Instead, the cause is relayed to the originating PRI in a REL message. The originating and terminating PRI interfaces are deallocated and idled as shown in Figure 6-7.

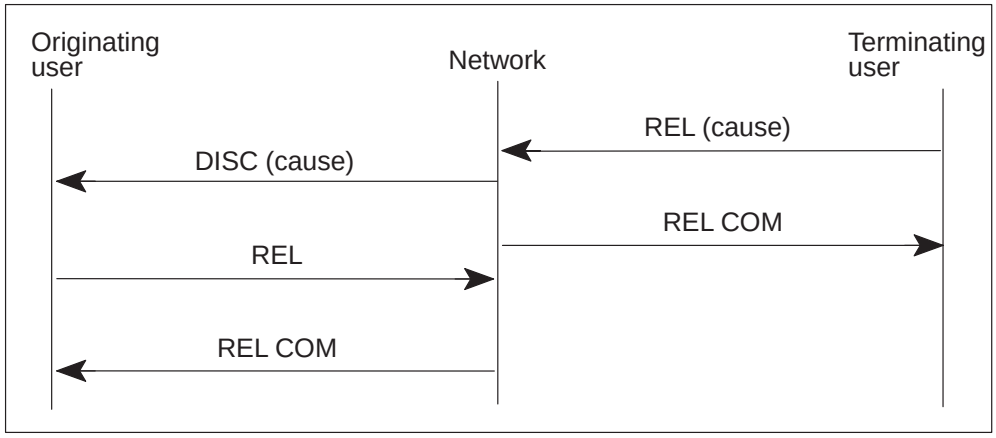
Figure 6-7
DISC with cause



The UCS DMS-250 switch supports a two-message release sequence when handling abnormal error conditions. This sequence involves a REL-REL COM sequence of messages. The net results are identical to the three-message release sequence, in which the release sequence begins with a DISC message.

In Figure 6-8, the network receives a REL message from the terminator indicating an abnormal call clearing. This REL with cause is relayed to the originating PRI as a DISC message and a REL COM message is sent to the terminator. The sequence of DISC, REL, REL COM for the originator is as in normal call clearing.

Figure 6-8
REL with cause



Mapping of cause values to treatments

Table CSEMAP maps an inbound cause value to applied treatment. It consists of a two-part key containing a protocol value and a cause value to a treatment.

CSEMAP table datafill example

Table 6-1 is datafilled by the user to contain tuples for Q.764 and Q.931 protocols. For more information, see the *UCS DMS-250 Data Schema Reference Manual.*

Table 6-1
CSEMAP datafill example

CSEMAP key Protocol	Cause	Treatment	Route Advance	Recol	OPTION
Q764	INTWUNSP	RODR	Y	Y	$
Q931	NILCAUSE	RODR	N	Y	$
Q931	OGCBARD	RODR	Y	Y	$
—end—					

Call authorization

The address is taken from the incoming SETUP message. The authcode is taken from table CALLATTR and verified. If the incoming message needs supplementary code collection or account code collection, the call is not blocked. The suppcode/account code is retrieved from table MLTATTR. The index to this table is obtained from table LTCALLS. (Refer to “Suppcode/account code collection for PRI data calls” in Chapter 9 “Feature interaction”.)

Call types supported

For incoming calls, the UCS DMS-250 switch supports the call types PUBLIC, PRIVATE, WATS, and TIE call types. For outgoing calls, the UCS DMS-250 switch supports the call types PUBLIC, PRIVATE, TIE, FX, and INWATS. Table 6-2 shows the interpretations of dialed numbers. The special feature hotline digit interpretations are not supported.

Table 6-2
Dialed number interpretation

Dialed number	Interpretation
1+10-digit direct dialed digit	1+NXX-NXX-XXXX
800 call	1 + 800-NXX-XXXX
900 call	1 + 900-NXX-XXXX
10-digit direct dialed digit number	NXX-NXX-XXXX
1+ 7-digit	1+NXX-XXXX
7-digit private network	NNX-XXXX
Public speed number	ZNXX
Private speed number	1NN
International direct dialed digit	011+CC+NX...X
Operator (0–)	0
Operator (0+)	0+NXX-NXX-XXXX
Operator (international direct dialed digit)	01+CC+NN
Operator (011+)	011+CC+NN
Datacall	#FC+7/10 digits
Test call	10X or 95X-XXXX
Note: N = 2 through 9; X = 0 through 9; Z = 2 through 8.	

UCS DMS-250 switch processing

The UCS DMS-250 switch looks at the CDN and the call type in the setup message (or the numbering plan indicator [NPI], if no call type is available) to determine how to translate the call.

Figure 6-9 illustrates the path a call takes to reach a destination. Values that map into another table are shown in boxes.

Each table shown in Figure 6-9 has a specific function. The call comes into the UCS DMS-250 switch over D2MPRI, a PRA250 trunk is mapped against the ISDN 900 logical terminal identifier (LTID). The LTID, in this case ISDN 900, is the index into table LTCALLS.

Table LTCALLS supplies the necessary information to begin translation of the CDN when indexed by LTID and CALLTYPE. In this case, the call type is PRIVATE. As shown in Figure 6-9, the LTCALLS tuple associated with ISDN 900 and call type PRIVATE is the interexchange carrier translation

information (XLAIEC). The XLAIEC refinement provides a call attributes index (CALLATTR, which, in the example, is 600) is used to reference into table CALLATTR.

Figure 6-9
Datafill example for call to the private network

Called party number = 9963131, Calltype = PRIVATE

TABLE TRKGRP
D2MPRI PRA250 0 NPDGP NCIT N 0 +
ASEQ N NIL 0 N 814 (ISDN900)

Where: D2MPRI is the name of a PRI trunk on the DMS-250 switch between the DMS-250 switch and the PBX, and ISDN 900 is the LTID that indexes into Table LTCALLS.

TABLE LTCALLS

ISDN 900 PVT XLAIEC 600

Where: 600 is the call attributes index for PVT calls on ISDN 900

TABLE CALLATTR

600 444 AUTH 0 8140000 0 N PRIX 0 NSCR NONE NIL

Where: 8140000 is the authcode, and the underlined 0 is the authcode database indicator of the filed authcode. In this example, the number of digits to dial (shown in the box) is zero.

TABLE AUTHCODU

8140000 VALID 0 0 444 04 222 4 $ 0 N N N N 0 +
N 0 0

Where: 444 04 is the OPART/TPART combination of the authcode.

TABLE PARTOSTS

04 444 904

Where: 904 is the STS to be used to translate the call.

TABLE STDPRTCT

POS PRIX
SUBTABLE STDPRT
996 996 CT ONNET 7 7 0

TABLE HNPACONT
POS 904
SUBTABLE HNPACODE
996 996 LRTE 15
SUBTABLE RTEREF
15 S D D2SPRI $

Table CALLATTR contains translations information used in translating and screening UCS DMS-250 switch calls. Either CLID screening or authcode translation can be selected. In the example, authcode translation is selected

in table CALLATTR and the pretranslator name and authcode field contain PRIX and 8140000, respectively.

The authcode and the authcode database index are used in the same way as authcodes filed against non-PRI trunk groups. They act as an index into tables AUTHDIN and AUTHCODU (or AUTHCDUn, where n = 2–5). These tables provide additional translations information, primarily originating partition (OPART) and terminating partition (TPART).

Additionally, the AUTHCODE field provides a means to bill calls originating on the PRI and is captured in the call detail record accordingly. Also, the authcode provides information related to supplementary digits, such as PIN digits and account code digits.

The authcode datafilled in CALLATTR can be datafilled to require the subscriber to partially or completely dial the authcode, together with optional PIN and account code digits (less than seven digits datafilled or a value of NOAUTHS), the subscriber is prompted with the following dialing plan:

```
AUTHCODE + (PIN DIGITS) + ADDRESS DIGITS + (ACCOUNT CODE)
```

In any case, the address digits dialed replace those received in the SETUP message of the call.

Note: Whereas account code digits are required when ACCTLEN is greater than zero, PIN digits are required only when the authcode is not completely filed against the CALLATTR tuple. When the authcode is completely filed, PIN processing is ignored.

The pretranslator name (PRIX in Figure 6-9) indexes into table STDPRTCT to locate the pretranslator subtable. The pretranslator PRIX contains an entry for the dialed digits and (in this case) marks the call as call type ONNET. On the UCS DMS-250 switch, ONNET calls are considered to be private. Marking the call as CT ONNET or CT OFFNET has the effect of changing the NPI, on the outgoing side of the call, to either PRIVATE or E.164.

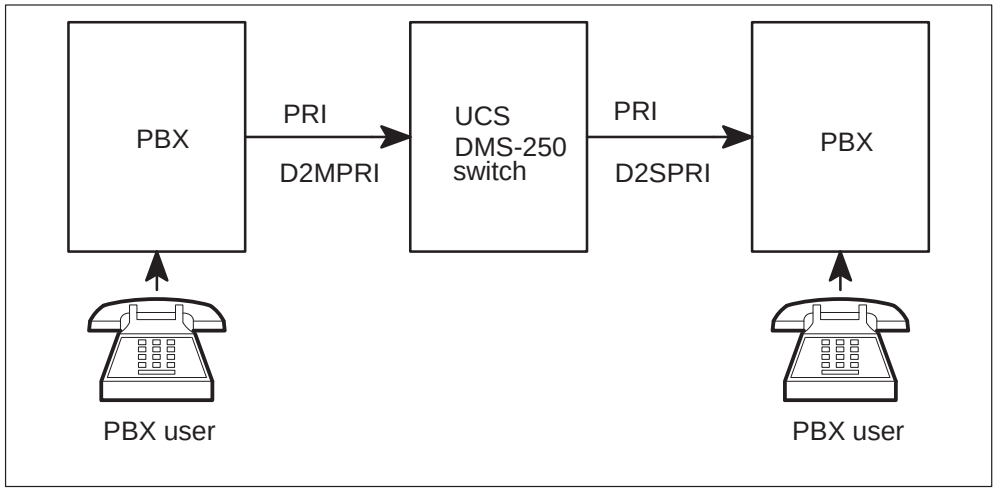
The OPART and TPART (provided by the AUTHCODU tables) are used to determine a serving translations scheme (STS). This is done by accessing table PARTOSTS, which is indexed by the combined OPART and TPART. The STS obtained from PARTOSTS is used in the following step, which is translated through table HNPACONT.

Translations proceed normally, having the desired effect of terminating the call to the trunk group D2SPRI. Since the pretranslator marked the call as ONNET, the outgoing NPI of the CDN is marked as PRIVATE.

Sample DAL TIE dialing plan

Figure 6-10 shows a sample DAL TIE call to the private network.

Figure 6-10
Sample TIE call to the private network



UCS DMS-250 switch processing for a DAL TIE call

The UCS DMS-250 switch looks at the incoming SETUP message to determine how to handle the call and, in the case of a DAL TIE call, routes the call to a terminating agency immediately after authcode verification or CLID screening. Figure 6-11 illustrates the path taken during a typical TIE call.

The call comes into the UCS DMS-250 switch over D2MPRI, a PRA250 trunk mapped against the ISDN 900 LTID. This LTID is the index into table LTCALLS.

Table LTCALLS supplies the necessary information to begin terminating the call. In this case, with a call type of TIE, the LTCALLS tuple indicates that the call should be immediately routed to the outgoing OFRT 20 route. In addition, the call attributes index of 600 is used to provide for CLID screening or authcode information used for billing. If the authcode validation option is selected, the authcode is accessed through table CALLATTR (or received in-band from the subscriber), and must pass validation before the call proceeds.

If the call passes authcode validation, the call proceeds immediately to table OFRT, which contains the route to which this DAL TIE call should be sent. This route is of type integrated services access (ISA), which indicates a special ISA call type. In this case, all outgoing calls on this route are marked as DAL TIE calls, using a facility number of 5. At this point the call

has completed and the outgoing SETUP message, with network-specific facilities or DAL TIE, is sent to the terminating PBX.

Figure 6-11
Datafill example for a typical DAL TIE call

Called party number = 3130, Calltype = TIE

TABLE TRKGRP
D2MPRI PRA250 0 NPDGP NCIT N 0 +
ASEQ N NIL 0 N 814 (ISDN 900)

Where: D2MPRI is the name of a PRI trunk on the DMS-250 switch and the MSL-PBX, and ISDN 900 is the LTID that indexes into table LTCALLS.

TABLE LTCALLS
ISDN 900 TIE XLAIEC 600 (OFRT 20)

Where: 600 is the call attributes index for PVT calls on ISDN 900, and OFRT 20 is the office route index used to terminate the call.

TABLE CALLATTR
600 444 AUTH 0 8140000 0 N PRIX 0 NSCR NONE NIL

Where: 8140000 is the authcode, and the underlined 0 is the authcode database indicator of the filed authcode. In this example the number of digits to dial (shown in the box) is zero.

TABLE AUTHCODU
8140000 VALID 0 0 444 04 222 4 $ 0 N N N N 0 + N 0 0

TABLE OFRT
20 ISA N N N TIE 5 D2SPRI

Release link trunk capability for PRA250 trunk types

Calls that normally process from the UCS DMS-250 switch into a PBX and then are redirected back out of the PBX to the same UCS DMS-250 switch tie up the PRI trunks. A release link trunk (RLT) allows the PRI facilities between the PBX and the UCS DMS-250 switch to be released after the call is redirected and bridged. The PRI facilities are then freed for additional call processing.

Call routed to treatment

If a call originated by a PRI interface cannot be completed by the UCS DMS-250 switch (for example, the terminator is busy, or no circuits are available to route the call), one of two things happens:

- If the UCS DMS-250 switch treatment maps to a Q.931 cause value, the cause value is sent to the originating PRI in a REL COM message. The originating PRI trunk member is deallocated and idled. In this case, the REL COM message is the first message sent after receiving the SETUP message.
- If the treatment cannot be mapped to a corresponding Q.931 cause value, the network routes the call to treatment. A CALL PROC message, followed by a PROG message, is sent to the originating PRI containing the progress indicator (PI) = *in-band tones and announcements* and cause (CSE) = *unknown*. In this case, the CALL PROC message is the first message sent after receiving the SETUP message, as shown in Figure 6-12.

Figure 6-12
Call routed to treatment

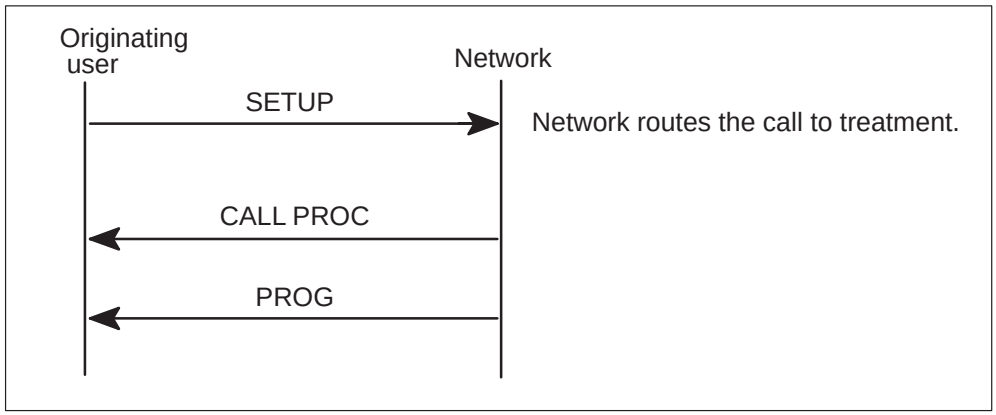


Table TMTMAP

Table TMTMAP provides mapping of switch treatments to call failure messages for both Q.764 and Q.931 protocols. The table maps a three-part key of a protocol value, a treatment, and a bearer capability to either an indication of applying the treatment, or a cause value and location code. This allows call processing to process an in-switch treatment in a flexible manner.

The TMTMAP datafill indicates either to apply the treatment in-band or to send out a release message with the datafilled cause value and location code onto the originating trunk. For the latter, a log can be optionally generated.

Table 6-3 is datafilled by the user to contain tuples for Q.764 and Q.931 protocols. For more information, see the *UCS DMS-250 Data Schema Reference Manual*.

Table 6-3
Treatment-to-cause mapping

TMTMAP KEY			TMTMPVAR				
Protocol	**Treatment**	**BC capacity**	**Format**	**Processing**	**Cause value**	**Location**	**Log**
Q764	UNDT	ALLBC	ISUP	NOLOCAL	NORMUNSP	LOCLNET	N
Q764	NOSC	ALLBC	ISUP	NOLOCAL	NOCIRCAV	LOCLNET	N
Q764	MSCA	ALLBC	ISUP	LOCAL			
Q764	MSLC	ALLBC	ISUP	NOLOCAL	MISDTRPR	LOCLNET	N
Q931	UNDT	ALLBC	PRI	INTLOCAL	UANUM	END_USER	Y
Q931	BUSY	ALLBC	PRI	NOLOCAL	NILCAUSE	LOCLNET	N
—end—							

Exception conditions

B-channel glare

Glare is a simultaneous termination and origination on a single trunk member.

Glare occurs when the UCS DMS-250 switch tries to select an idle PRI trunk member for termination just as a SETUP message is being received from the PBX requesting the same trunk member. When this happens, the following rules apply:

- If, during processing a termination, the UCS DMS-250 switch detects an origination, the origination is either denied or allowed to proceed based on the BCHGLARE datafillable parameter in table TRKSGRP. If the BCHGLARE parameter indicates that the UCS DMS-250 switch should YIELD, the switch selects another member to complete the call.

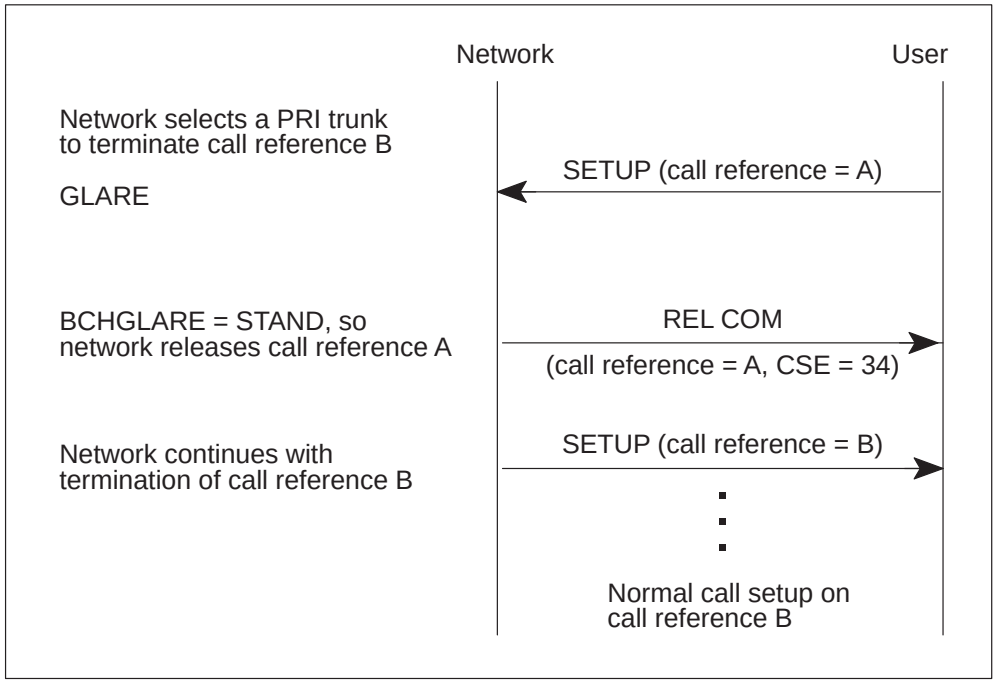
  Note: Although the UCS DMS-250 switch network provides the ability to datafill a PRI interface so that it yields to glare conditions, this is discouraged, because it conflicts with the Q.931 standard that states the user always yields to the UCS DMS-250 switch network.

- If, on the other hand, the UCS DMS-250 switch attempts to route to a B-channel that has already begun to process an origination, the UCS DMS-250 switch does not terminate to the B-channel regardless of BCHGLARE datafill. The terminating call selects another member to complete the call.

If yielding or standing is based on BCHGLARE (BCHGLARE = STAND), the following information applies. If BCHGLARE is datafilled as STAND, the UCS DMS-250 switch continues processing on the terminating call. The UCS DMS-250 switch responds to the SETUP message with a REL COM message containing CSE value 34, *no circuit/channel available*, indicating that the requested B-channel is not available. This is followed by a SETUP message containing the call reference for the terminating call, as shown in Figure 6-13.

If BCHGLARE is datafilled as YIELD (BCHGLARE = YIELD), the UCS DMS-250 switch allows the origination to proceed on the PRI trunk member and responds to the SETUP message in the same manner as for regular call setup.

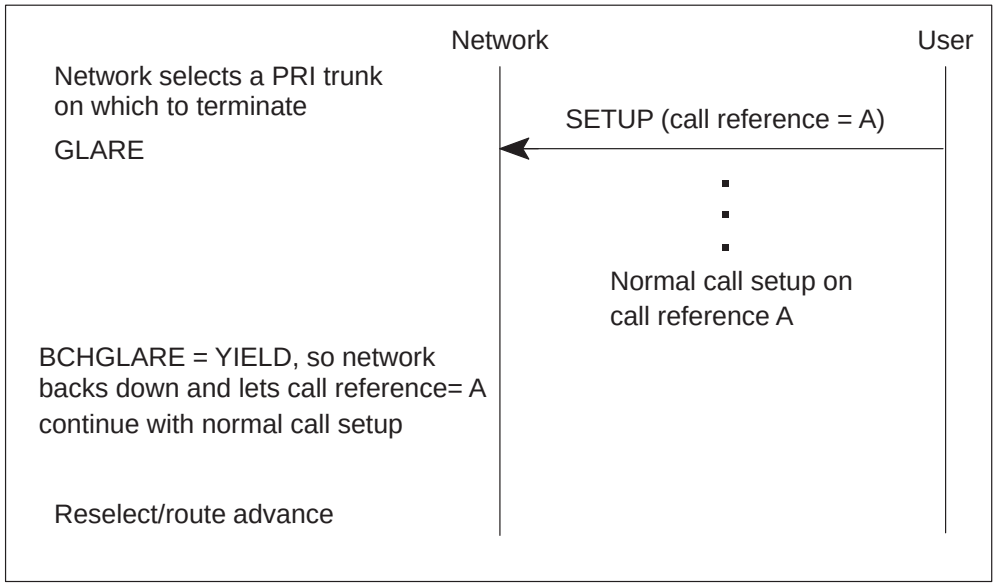
Figure 6-13
B-channel glare, BCHGLARE = STAND



The call that attempted to terminate on the PRI member attempts to select a different member of that PRI trunk group. If no members are available, the

call route advances to the next element in the route list. If this fails, the call is routed to treatment, as shown in Figure 6-14.

Figure 6-14
B-channel glare, BCHGLARE = YIELD



B-channel lockout

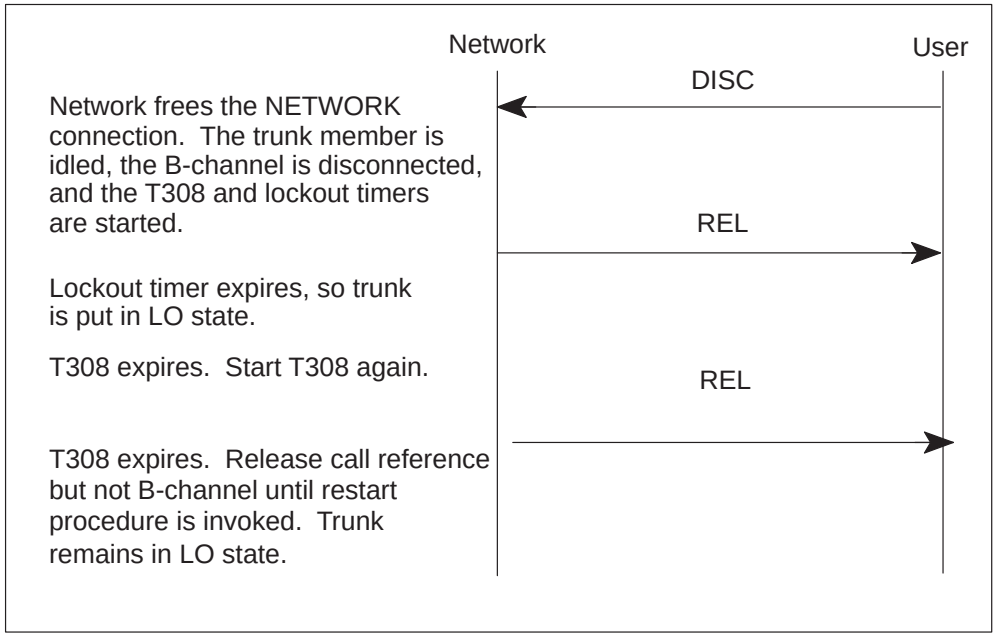
The following paragraphs describe what happens when one end of the connection does not receive the expected message before timer T308 or the UCS DMS-250 switch lockout timer expires.

User-initiated call clearing

If the UCS DMS-250 switch internal lockout timer expires before a REL COM message is received, the network puts the trunk member in the lockout state. If the REL COM message is received before timer T308 expires, the trunk member is returned to idle from the lockout state.

If timer T308 expires before a REL COM message is received and after the lockout timer has expired, a second REL message is sent and timer T308 is restarted. If it expires a second time, the trunk member remains in the lockout state until restart procedures are invoked on the PRI; otherwise, the PRI trunk member is returned to idle from lockout, as shown in Figure 6-15.

Figure 6-15
User initiates call clearing, timer expires



Network-initiated call clearing

If the lockout timer expires before a REL message is received, the network puts the trunk member in lockout state. If timer T305 expires before a REL message is received, the network sends a REL message to the user and starts timer T308 while waiting for REL COM.

If the REL COM message is received before timer T308 expires, the trunk member is returned from the lockout state to idle, as shown in Figure 6-16. If the user does not respond after a second REL message is sent from the network, the action taken is as shown in Figure 6-17.

Figure 6-16
Network initiates call clearing, timer expires

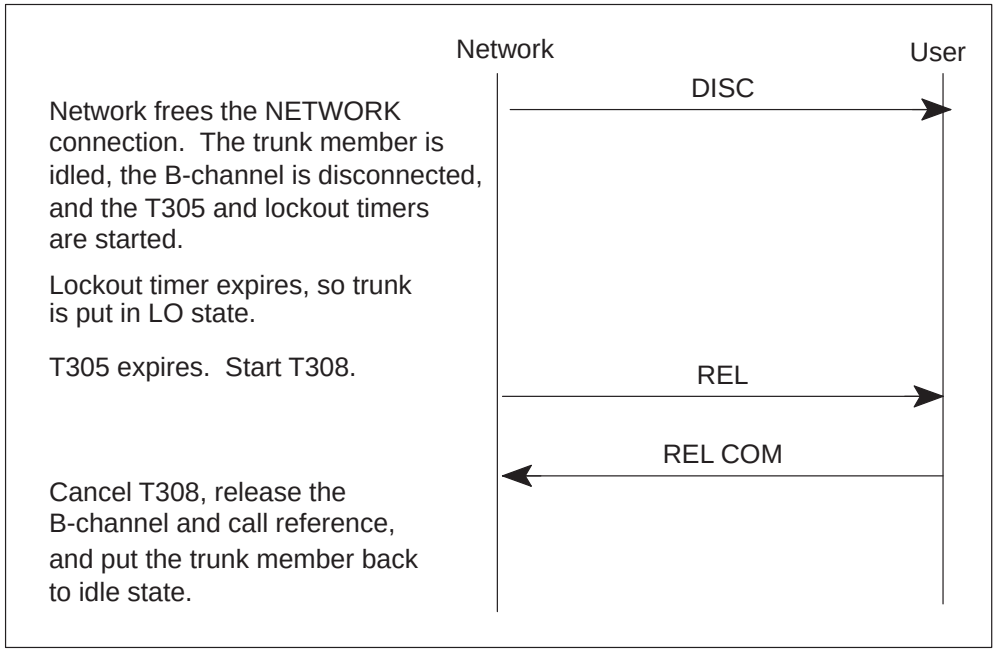
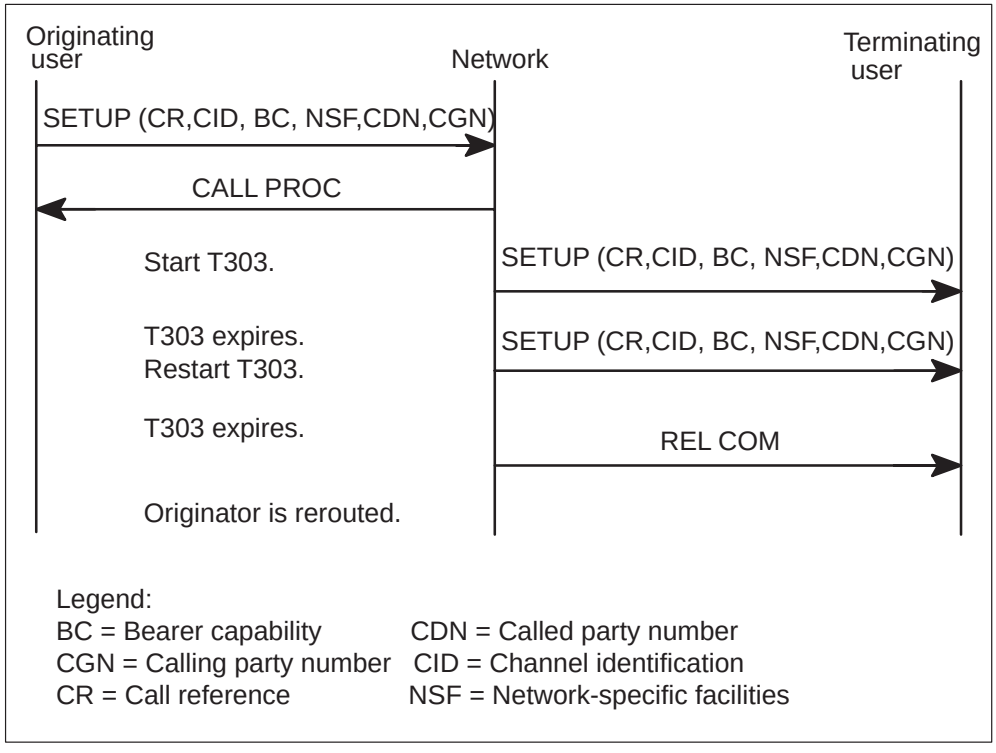


Figure 6-17
PRI-to-PRI call setup, no response from terminator



No response to SETUP

As shown earlier in Figure 6-2, the network initiates call setup by sending a SETUP message over the PRI interface to the terminating user. At that time, the network starts timer T303 and waits for a CALL PROC, ALERT, CONN, or REL COM message before this timer expires.

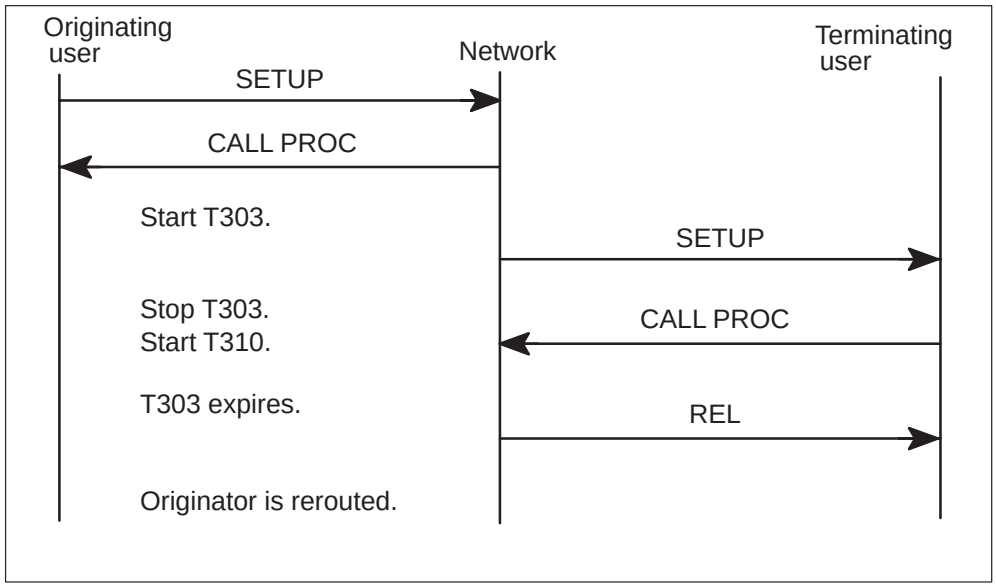
If this timer does expire, the network sends the SETUP message again and restarts timer T303. If there is a response before T303 expires, call setup continues.

If T303 expires a second time, a REL COM message is sent to the terminating user. The network idles the terminating PRI trunk member and reselects or route advances the originating user to the next element in the route list, as shown in Figure 6-16.

No response after CALL PROC

After receiving a CALL PROC message from the terminating user, if timer T310 expires before any call progress indication is received from the terminating user, the UCS DMS-250 switch releases the call and provides call-not-accepted treatment. Call progress indication is in the form of one of the following messages: ALERT, CALL PROC, CONN, or REL. The call control in this event is shown in Figure 6-18.

Figure 6-18
PRI-to-PRI call setup, no response after CALL PROC



Protocol violations

If a protocol violation is detected during the termination of a call over a PRI interface, the originator responds to the network with a REL message indicating the reason for the protocol violation. Possible protocol violation cause values include the following:

- IE nonexistent
- protocol error unspecified
- message type is nonexistent
- invalid IE contents
- mandatory IE is missing
- message is not compatible with state

If the UCS DMS-250 switch receives a REL or DISC message with any of these cause values, it reselects or route advances.

PRI subscription parameters

The subscription parameters that apply to the primary rate interface (PRI) on the UCS DMS-250 switch divided into three groups:

- Facility parameters define the hardware configuration of the PRI interface. These parameters include locations of PRI B- and D-channels, Q.931 message characteristics, and variable aspects of the call control procedures.
- Service parameters define the logical services applied to the PRI interface. These parameters primarily specify the number of calls allowed on an interface, together with the allowable bearer services.
- Integrated access parameters define the Integrated Services Access (ISA) environment of the PRI interface. These parameters are specifically related to call types and supply information for translations and routing. See Chapter 9, “Feature interaction,” for more information on ISA subscription parameters.

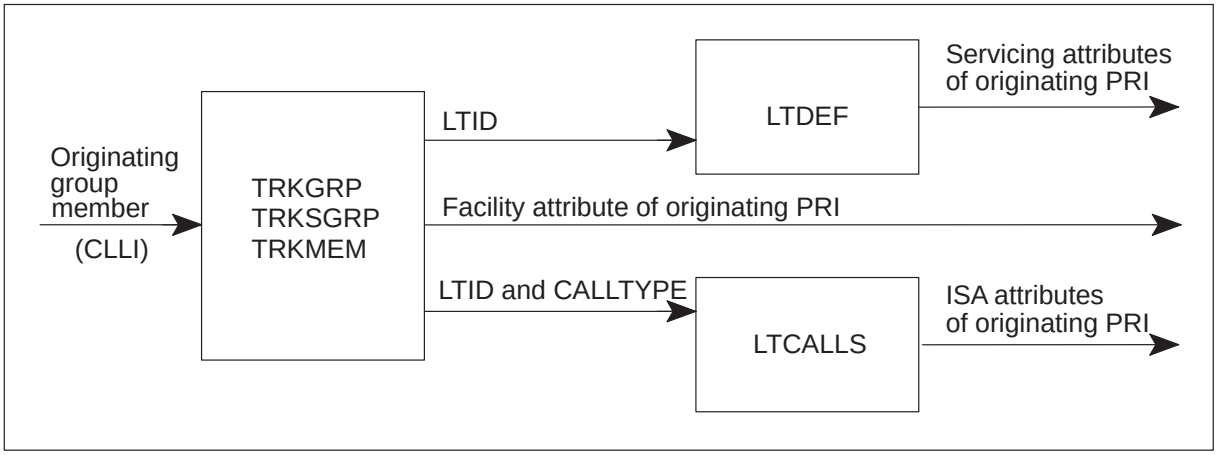
Subscription parameter relationships

The facility, service, and ISA parameter groups that define a PRI interface are closely related. The basis for the association among the three groups is the common language location identifier (CLLI) and the logical terminal identifier (LTID). The CLLI identifies the PRI interface as a unique trunk group, together with associated subgroup and member data. The LTID functions as the key to the various service-related tables. Together, they completely define a PRI interface.

The CLLI and LTID are related to each other through the use of mapping controlled by a tuple in the table LTMAP. This table, which may be updated by service personnel, identifies the CLLI related to a given LTID. This relationship, in turn, is reflected in the read-only field LTID of table TRKGRP. This method provides a consistent and flexible means of associating facility and service data for PRI interfaces.

Figure 7-1 shows the various subscription parameters for PRI interfaces.

Figure 7-1
Originating PRI subscription parameters



Facility-related interface parameters

The following software tables define the facility interface parameters for a PRI. Each table is indexed primarily by CLLI and supplies a level of detail about the characteristics of the PRI interface.

- TRKGRP defines the general interface parameters.
- TRKSGRP defines the parameters that affect the Q.931 signaling protocol, and also defines the location of the timeslot tied to the D-channel handler.
- TRKMEM defines individual B-channels for the PRI interface. Each entry in TRKMEM corresponds to a B-channel on the PRI. These B-channels must be on the same peripheral as the D-channel handler that is datafilled in table TRKSGRP.

Service-related interface parameters

The following software tables define the service interface parameters for a PRI interface. Each table is indexed primarily by LTID and supplies a description of the service provided on the PRI interface.

- LTDEF defines the logical terminal identifier (LTID) and provides parameters that control the number of calls that appear on the logical terminal.
- LTMAP provides mapping between the logical terminal identifier (service data) and the trunk group (facility data).

PRI interworking

The primary rate interface (PRI) interworks with the following agents:

- PRI
- direct access line (DAL) (FXO, FXS)
- DAL TIE
- FGA
- FGB
- FGC
- FGD
- per-trunk signaling (PTS) intermachine trunk (IMT)
- ISUP IMT
- T100, T102

Any attempt to route to or from an agent not on the PRI interworks list results in a Not Acknowledged (NACK) treatment.

Table 8-1 lists the connections from other agents-to-PRI.

Table 8-1
Connections from other agents-to-PRI

To PRI from	Calling party number (Is the calling party number delivered to the called party interface? Yes or No)	Progress indicator (Is the progress indicator *call is not end-to-end ISDN* supplied to the PRI interface for this call type? Yes or No)
PRI	Yes	Yes
DAL (FXO, FXS)	No	Yes
DAL TIE	No	Yes
FGA	No	Yes
FGB	Yes	Yes
FGC	No	Yes
FGD	Yes	Yes
PTS IMT	No	Yes
ISUP IMT	Yes	No
T100, T102	No	Yes

Table 8-2 lists the connections from PRI-to-other agents.

Table 8-2
Connections from PRI-to-other agents

To PRI from	Calling party number (Is the calling party number delivered to the called party interface? Yes or No)	Progress indicator (Is the progress indicator *call is not end-to-end ISDN* supplied to the PRI interface for this call type? Yes or No)
PRI	Yes	Yes
DAL (FXO, FXS)	No	Yes
DAL TIE	Yes	Yes
FGA	No	Yes
FGB	No	Yes

—continued—

Table 8-2
Connections from PRI-to-other agents (continued)

To PRI from	Calling party number (Is the calling party number delivered to the called party interface? Yes or No)	Progress indicator (Is the progress indicator *call is not end-to-end ISDN* supplied to the PRI interface for this call type? Yes or No)
FGC	No	Yes
FGD	No	Yes
PTS IMT	No	Yes
ISUP IMT	Yes	No
T100, T102	No	Yes
—end—		

Telephone treatments and tones interworking

If a UCS DMS-250 switch treatment (in the PRI switching office) is applied to a call, the Progress (PROG) message (with appropriate CAUSE information element [IE]) is sent across the PRI interface.

The CAUSE information element is accompanied by one of the following:

- in-band tone
- in-band announcement
- no in-band treatment

The following treatments cause in-band tones and announcements to be applied:

- Generalized No Circuit (GNCT) treatment
- Vacant Code (VACT) treatment
- Vacant Country Code (VACC) treatment
- Vacant Speed Number (VACS) treatment

A list of the CAUSE values generated by treatments is given in Chapter 6, “Call control procedures.”

The following in-band tones are typically accompanied by a message or a CAUSE IE that conveys the intent of the tone:

- busy tone
- reorder tone

- audible ringback

If a call is supplied a busy or reorder tone, a PROG message is dispatched to the originator indicating in-band tones and announcements are available together with a cause value of *cause unknown.* The audible ringback tone is not accompanied by a PROG message, but may be accompanied by an Alerting (ALERT) message if the call is end-to-end ISDN.

The following tones are not generated on the PRI interface:

- dial tone (applies only to cut-through dual tone multifrequency [DTMF] dialing)
- subscriber prompt tone (applies only to cut-through DTMF dialing)

Subscriber prompt tones include the following:

- authcode prompt tone
- calling card prompt tone
- account code prompt tone

Digital recorded announcements interworking

Digital recorded announcement feature supports the use of digital recorded announcement machines (DRAM) to provide announcements to PRI interfaces. DRAMs may be used to specify a route list or an announcement to be applied to a treatment.

PRI to in-band interworking

The interworking between ISDN PRI with the existing in-band signaling (FGA, FGB, FGC, FGD, DAL, IMT, or T250) is provided.

PRI-to-ISUP interworking

Interworking between ISDN PRI and CCS7 ISUP requires message protocol mapping between the CCITT recommendations Q.931 (ISDN PRI protocol) and Q.764 (CCS7 ISUP).

The PRI/ISUP messages listed in Table 8-3 are interworked. The PRI message in the second column is mapped to the ISUP message in the third column.

Table 8-3
Interworking of PRI and ISUP messages

Message type	PRI message	ISUP message
Call establishment	ALERT	Address Complete Message (ACM) (Note 1)
Call establishment	CONN	Answer Message (ANM)
Call establishment	PROG	ACM (Note 1)
Call establishment	SETUP	Initial address message (IAM)
Call takedown	DISC	Release (REL) (Note 2)
Call takedown	REl	REL (Note 2)

Note 1: ACM can be mapped to ALERT or PROG depending on the value of the backward call indicator. If the backward call indicator reveals interworking with per-trunk signaling trunks, ACM is mapped to a PROG message; otherwise, it is mapped to an ALERT message.
Note 2: REL can be mapped to a DISC or REL message depending on the state of the call. When an active call is cleared, REL is mapped to a DISC; otherwise, it is mapped to a REL.

The following PRI/ISUP messages are not interworked, because they have only local significance:

- PRI Call Proceeding (CALL PROC)
- PRI Connect Acknowledge (CONN ACK)
- PRI Release Complete (REL COM)
- ISUP Release Complete (RLC)

Note: Any PRI/ISUP message that is not in the preceding list is not interworked by this feature.

The diagrams that follow illustrate the interworking between PRI and ISUP protocol messages for call establishment and takedown.

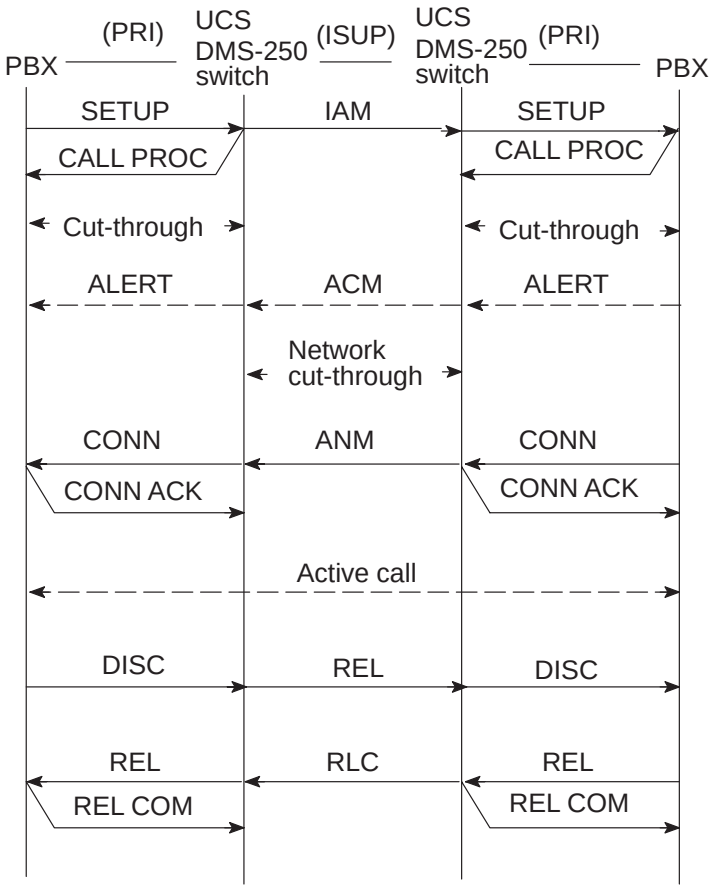
The following list applies to all of the interworking diagrams:

- The Q.931 messages CALL PROC, CONN ACK, and REL COM have only local significance and are not mapped.
- The ISUP message RLC has only local significance and is not mapped.
- The PRI interfaces through pulse code modulation (PCM) in both directions upon receipt of the CALL PROC message.

- The CCS7 network cuts through PCM in both directions upon propagation of the ACM.
- The terminating exchange (either ISDN or non-ISDN) provides the ringback tone.
- For active call clearing, an ISUP REL message is always mapped to a Q.931 Disconnect (DISC) message.

Figure 8-1 illustrates PRI to ISUP to PRI call setup and takedown with three-stage call clearing.

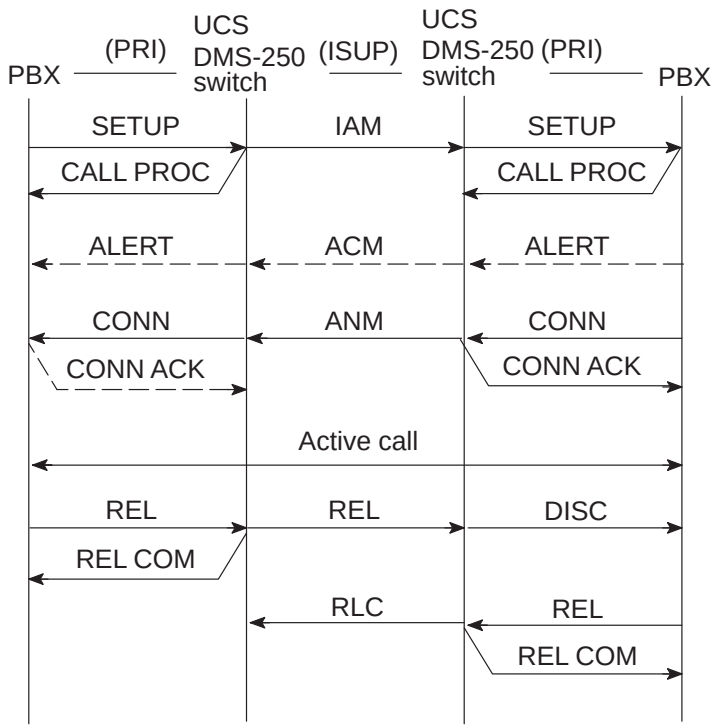
Figure 8-1
PRI-to-ISUP-to-PRI call setup and takedown with three-stage call clearing



Note: Solid lines indicate mandatory messages, and dashed lines represent optional messages.

Figure 8-2 illustrates two-stage call clearing where a Q.931 REL message maps into the ISUP REL message at the interworking switch initiating call clearing (that is, the calling-access UCS DMS-250 switch) and an ISUP REL message maps into a Q.931 DISC message on the other interworking switch (the called-access UCS DMS-250 switch).

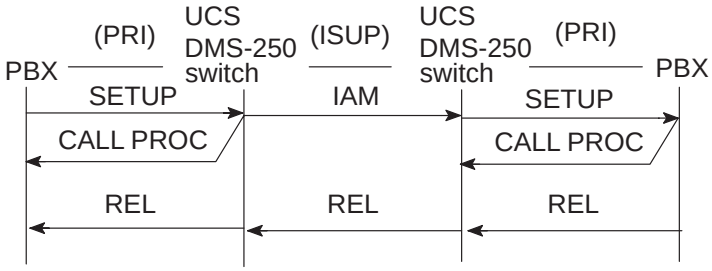
Figure 8-2
PRI-to-ISUP-to-PRI call setup and takedown with two-stage call clearing



Note: Solid lines indicate mandatory messages, and dashed lines represent optional messages.

Figure 8-3 is an example of an unsuccessful call attempt where the called PRI indicates that the user end is busy and releases the call with a Q.931 REL message. The REL message is mapped into an ISUP REL message, which in turn is mapped to Q.931 REL at the calling-access UCS DMS-250 switch.

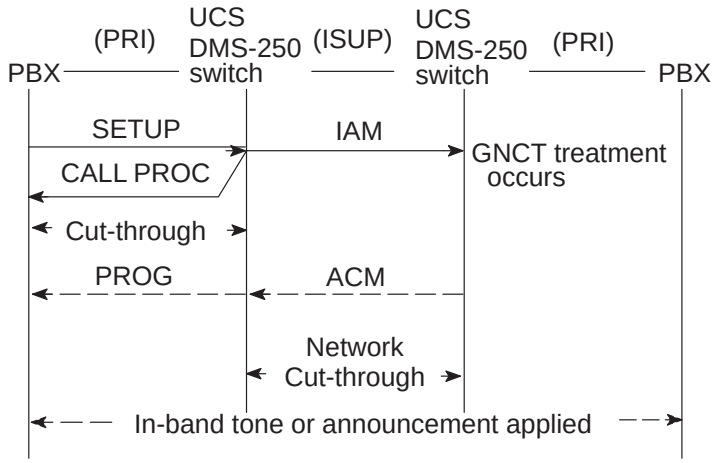
Figure 8-3
Unsuccessful call attempt (user busy)



Note: Solid lines indicate mandatory messages, and dashed lines represent optional messages.

The call shown in Figure 8-4 is an example of the interworking with the in-band tone and announcement applied within the network as a result of a treatment.

Figure 8-4
PRI-to-ISUP-to-PRI call treatment

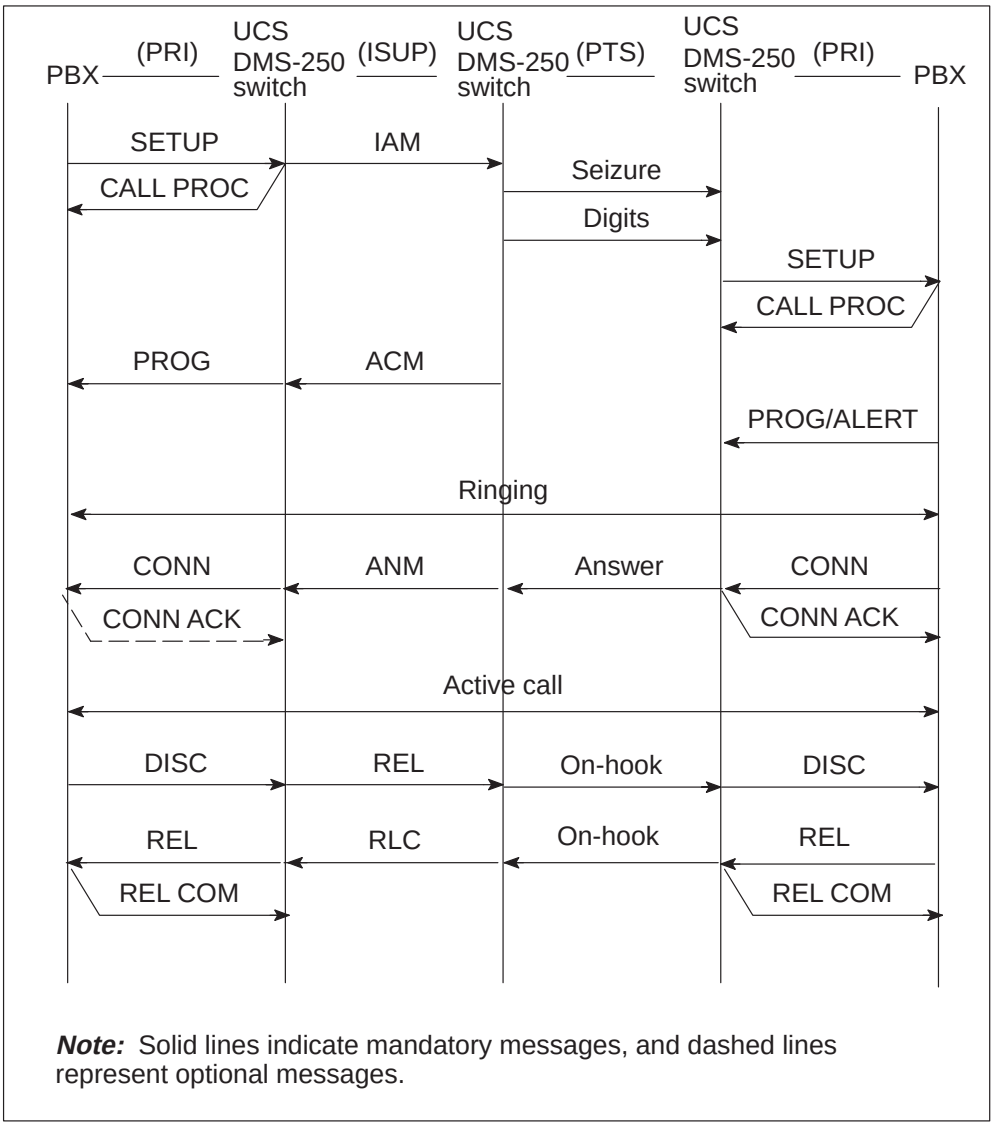


Note: Solid lines indicate mandatory messages, and dashed lines represent optional messages.

Figure 8-5 illustrates a call interworking with a non-ISUP trunk within the network. Note that the ACM is mapped to a PROG (instead of an ALERT message, indicating that interworking has been encountered. At the PTS/PRI interface, all Q.931 messages are received but ignored.

Note: Progress description in the progress indicator is set to *not end-to-end ISDN*.

Figure 8-5
Interworking with a non-ISUP trunk within the network

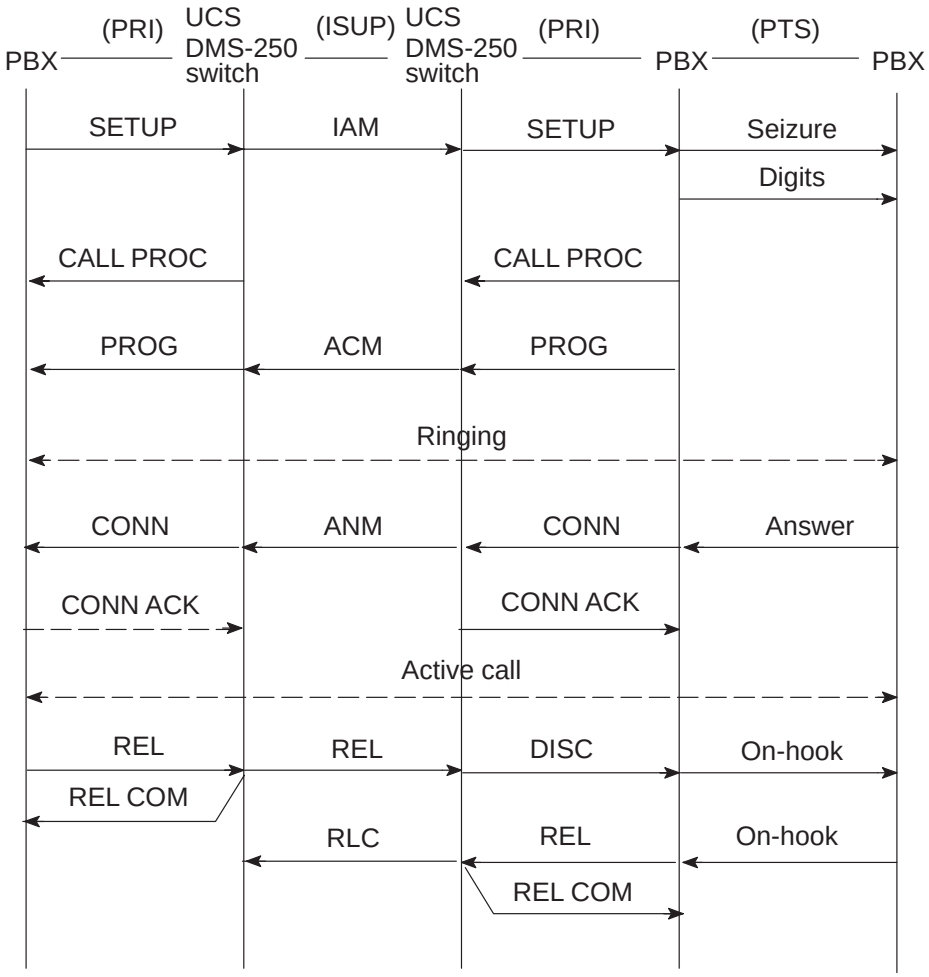


Note: Solid lines indicate mandatory messages, and dashed lines represent optional messages.

Figure 8-6 illustrates a call interworking between ISDN and PTS where the call is routed over a PTS trunk after leaving ISDN.

Note: The PROG message, with PI set to *not end-to-end ISDN*, is sent back upon encountering the PTS trunk. The PROG message is mapped into the ACM with *interworking encountered* bits set at the called-access switch. The ACM is then mapped to a PROG at the calling-access switch.

Figure 8-6
Interworking between PRI-to-PTS trunk



Note: Solid lines indicate mandatory messages, and dashed lines represent optional messages.

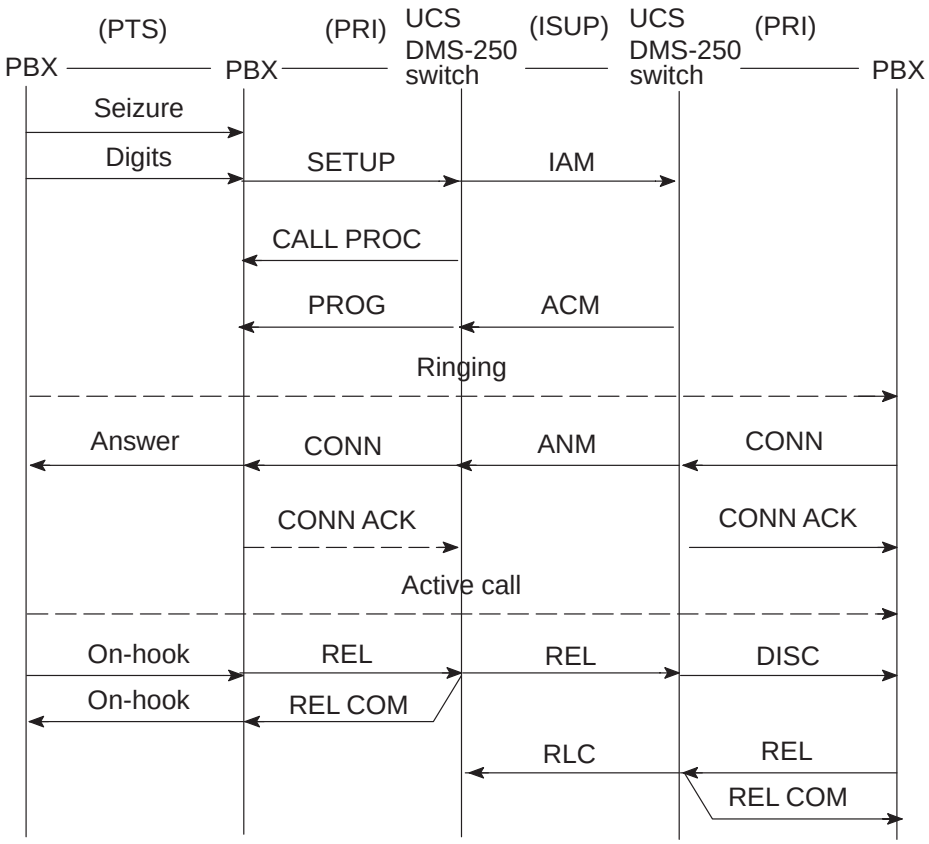
Figure 8-7 illustrates a call interworking between a PTS trunk and ISDN, where the call originates on a PTS trunk and then is routed to ISDN.

The forward call indicator indicates *interworking encountered.*

The progress message is mapped into the ACM with the interworking bit set in the backward call indicator.

The progress description in the progress indicator is set to *not end-to-end ISDN*.

Figure 8-7
Interworking between PTS to PRI trunk



Note: Solid lines indicate mandatory messages, and dashed lines represent optional messages.

PRI/ISUP message mapping

Table 8-4 details the interworking of the messages shown in Figures 8-1 through 8-7. The interworking is detailed by outlining the mapping for each PRI IE to each respective ISUP parameter.

The message and IE mapping is bidirectional.

Table 8-4
Information element mapping of PRI-to-ISUP messages

Message	User/network message IEs	Network message	Network message IEs	Status
ALERT	<—>	ACM (Note 1)		
	Message type	<—>	Message type	Mapped
			Backward call indicator	Unmapped (Note 2)
CONN	<—>	ANM		
	Message type	<—>	Message type	Mapped
			Backward call indicator	Unmapped (Note 2)
DISC	<—>	REL (Note 3)		
	Message type	<—>	Message type	Mapped
	Cause	<—>	Cause indicator	Mapped
PROG	<—>	REL (Note 4)		
	Message type	<—>	Message type	Mapped
	Progress indicator	<—>	Backward call indicator	Mapped
	Cause			Unmapped (Note 5)
DISC	<—>	REL (Note 6)		
	Message type	<—>	Message type	Mapped
	Cause	<—>	Cause indicator	Mapped
SETUP	<—>	IAM		
	Message type	<—>	Message type	Mapped
	Bearer capability		User service info	Mapped

—continued—

Table 8-4
Information element mapping of PRI-to-ISUP messages (continued)

Message	User/network message IEs	Network message	Network message IEs	Status
	Progress indicator		Forward call indicator	Mapped
	Calling party number		Calling party number	Mapped
	Called party number		Called party number	Unmapped (Note 7)
			Nature of connection	Unmapped (Note 7)
			Calling party's category	Unmapped (Note 7)

Note 1: ACM mapping is dependent upon the bit field settings in the backward call indicator parameter. If this parameter indicates that interworking has not been encountered, the ACM is mapped to the ALERT message; otherwise, it is mapped to the PROG message.

Note 2: No mapping is defined in the Q.931 protocol, but the contents of the Backward Call Indicator determine whether or not the ACM is mapped to PROG or ALERT.

Note 3: The ISUP REL message is always mapped to DISC for active call clearing. A Q.931 DISC or REL can be mapped to an ISUP REL message.

Note 4: ACM mapping is dependent upon the bit field settings in the Backward Call Indicator parameter. If this parameter indicates that interworking has not been encountered, the ACM is mapped to the ALERT message; otherwise, it is mapped to the PROG message.

Note 5: Because there is no mapping for the cause IE, it is dropped. The *in-band treatment indicator* is carried through the progress indicator IE, but without the cause qualification.

Note 6: The two-message call clearing procedure (no DISC sent prior to a REL) may be employed for certain types of call scenarios (for example, unsuccessful call setup). In these situations, a Q.931 REL is mapped to an ISUP REL message. At the other access PRI, the mapping depends on the state of the call. If the call is in the process of setup, an ISUP REL is mapped to a Q.931 REL message. For active call clearing, an ISUP REL message is mapped to a Q.931 DISC message.

Note 7: No mapping is defined. Fields are set to the default values currently used by the ISUP software on the UCS DMS-250 switch.

—end—

PRI/ISUP message bit-field mapping

The following paragraphs outline Q.931 IE values, the corresponding ISUP parameter (currently supported on the UCS DMS-250 switch), and the respective bit field mappings.

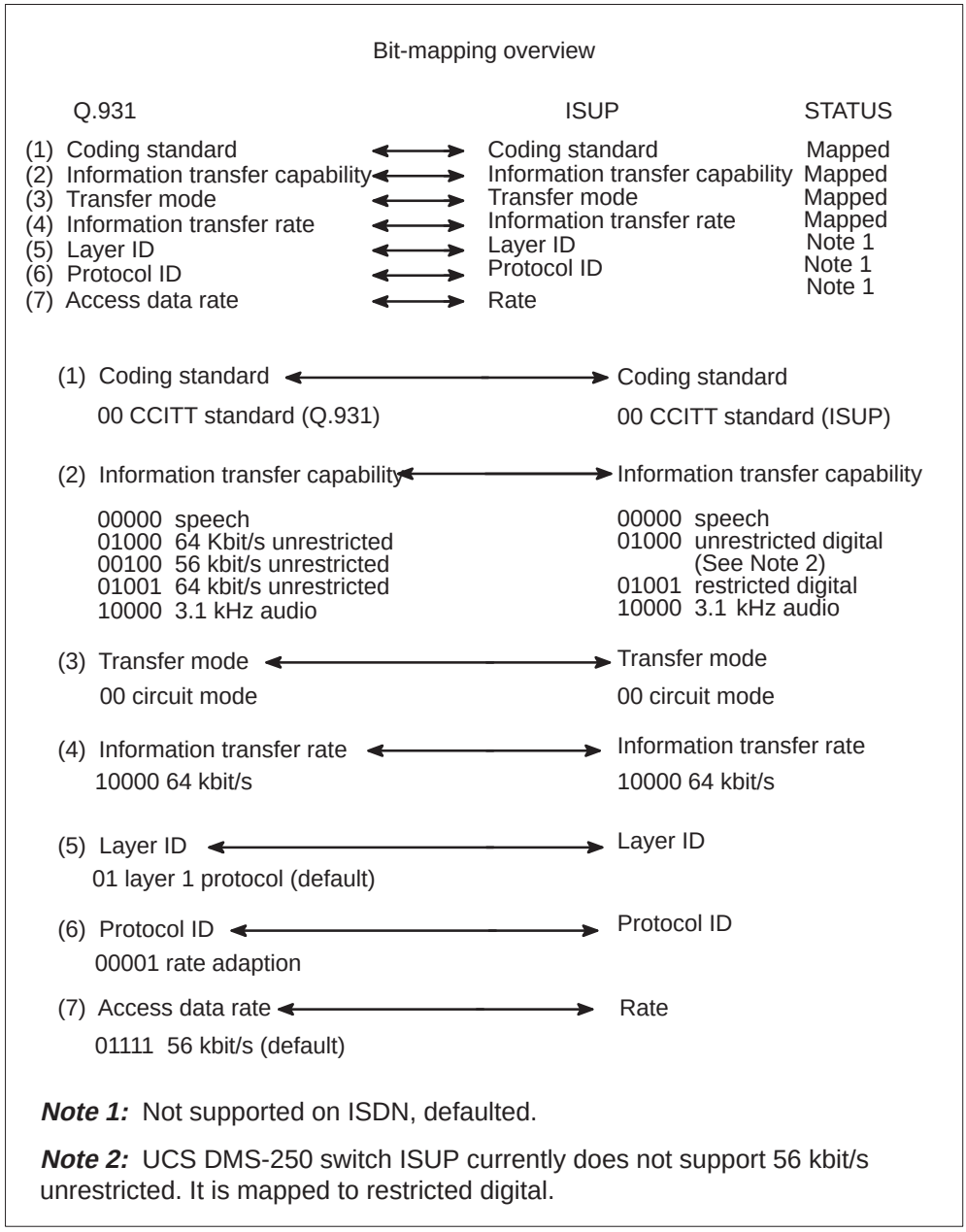
Figures 8-8 through 8-11 follow the same format. The numbers in parentheses, down the left side of each figure, correspond to each other.

Bearer capability IE to/from user service information parameter mapping

The bearer capability IE indicates the provision by the network of one of the bearer capabilities. It is defined in CCITT Recommendation I.211.

The bearer capability IE is referenced by the SETUP message as a mandatory field. No default bearer capability may be assumed by the absence of this IE. Figure 8-8 provides the bit mapping overview, as well as the bit field mapping of the bearer capability IE to the user service information parameter.

Figure 8-8
Bearer capability IE to/from user service information parameter



Note 1: Not supported on ISDN, defaulted.

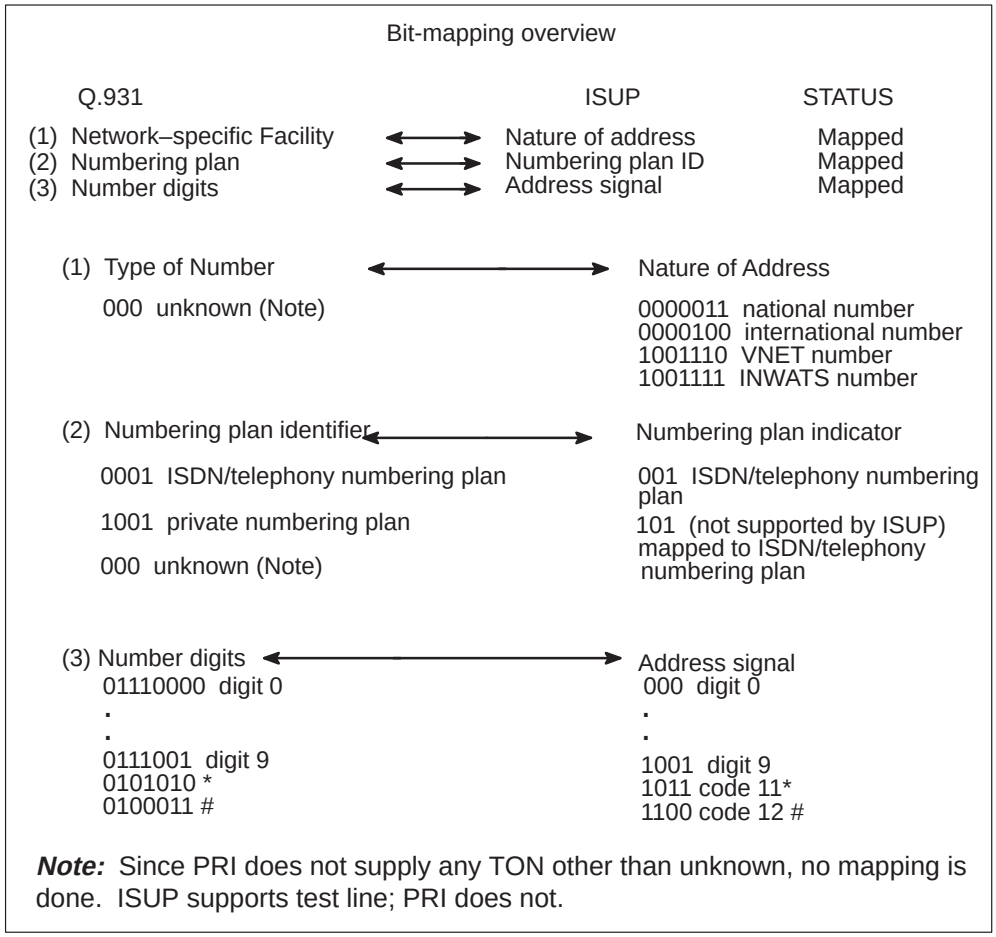
Note 2: UCS DMS-250 switch ISUP currently does not support 56 kbit/s unrestricted. It is mapped to restricted digital.

Called party number IE to/from Called Party Number parameter mapping

The purpose of the called party number IE is to identify the called party. This IE is referenced by the SETUP message as a mandatory parameter.

Figure 8-9 provides the bit mapping overview, as well as the bit field mapping, for the mapping of the called party number IE to the Called Party Number parameter.

Figure 8-9
Called party number IE to/from Called Party Number parameter



Note: Since PRI does not supply any TON other than unknown, no mapping is done. ISUP supports test line; PRI does not.

Calling party number IE to/from Calling Party Number parameter mapping

The purpose of the calling party number IE is to identify the origin of a call. This IE is referenced by the SETUP message as an optional field.

The Calling Party Number parameter is referenced in the IAM. In the current implementation of ISUP, this parameter is not supported. This feature provides calling party number in the IAM when interworking with PRI. Figure 8-10 provides the bit mapping overview, as well as the bit field mapping, the calling party number IE to the Calling Party Number parameter.

Figure 8-10
Cause IE to/from cause parameter

Bit-mapping overview

Q.931	ISUP	STATUS
(1) Type of number	Nature of address	Mapped
(2) Numbering plan ID	Numbering plan ID	Mapped
(3) Presentation indicator	Address presentation restricted	Mapped
(4) Screening indicator		Mapping undefined
(5) Number digits	Address signal	Mapped

(1) Type of number

000 unknown

Nature of address

0000011 national number
0000100 international number
1001110 VNET number
1001111 INWATS number

(2) Numbering plan identifier

0001 ISDN/telephony numbering plan
1001 private numbering plan
000 unknown (Note)

Numbering plan indicator

001 ISDN/telephony numbering plan
101 (not supported by ISUP) mapped to ISDN/telephony numbering plan

(3) Presentation indicator

00 presentation allowed
01 presentation restricted
10 presentation not available

Address presentation restricted

00 presentation allowed
01 presentation restricted

No mapping defined, mapped to presentation restricted.

(4) Screening indicator

00 user-provided, not screened
01 user-provided, verified and passed
10 user-provided, verified and failed
11 network-provided

A corresponding ISUP field for mapping does not exist. Default value is network-provided.

(5) Number digits

01110000 digit 0
.
.
0111001 digit 9
0101010 *
0100011 #

Address signal

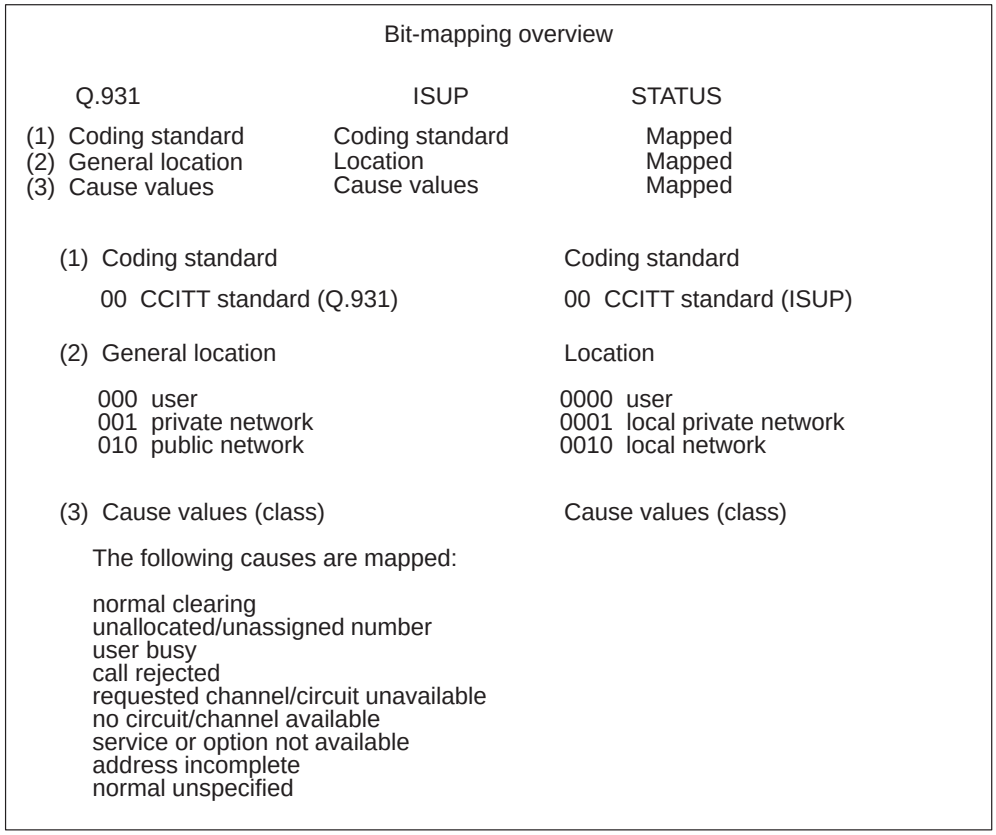
000 digit 0
.
.
1001 digit 9
1011 code 11*
1100 code 12 #

Cause IE to/from Cause parameter mapping

The purpose of the cause IE is to describe the reason for generating certain messages, to provide diagnostic information in the event of procedural errors, and to indicate the location of the cause originator. This IE is referenced by the DISC, PROG, and REL messages as an optional field.

Figure 8-11 provides the bit mapping overview, as well as the bit field mapping, of the cause IE to the cause parameter.

Figure 8-11
Cause IE to/from cause parameter



Progress indicator IE to/from backward/forward call indicator mapping

The purpose of the progress indicator IE is to identify events that occur during the life of a call.

The progress indicator IE maps to the following:

- backward call indicator (in PROG to ACM mapping)
- forward call indicator (in SETUP to IAM mapping)

The progress indicator IE is referenced as:

- mandatory by the PROG message
- optional by the SETUP message

The following progress description values are supported on the UCS DMS-250 switch:

- call is not end-to-end ISDN
- in-band information is available

Backward Call Indicator parameter

The Backward Call Indicator parameter is referenced in the ACM. The ACM can be mapped to the ALERT message or the PROG message, depending on what type of interworking is encountered.

If the ACM is mapped to the PROG message, the Backward Call Indicator parameter can be mapped to the progress indicator IE.

If the ACM is to be mapped to the ALERT message (no interworking was encountered), no mapping is defined for the Backward Call Indicator parameter.

Forward Call Indicator parameter

This Forward Call Indicator parameter is two octets long and is referenced in the IAM as a required parameter.

Progress description to/from Backward Call Indicator parameter/Forward Call Indicator parameter mapping

Progress description to/from Backward Call Indicator parameter/Forward Call Indicator parameter mapping is shown in Table 8-5.

Table 8-5
Progress description to/from Backward Call Indicator parameter/Forward Call Indicator parameter mapping

Progress description	to/from	Backward Call Indicator parameter/Forward Call Indicator parameter mapping
Call is not end-to-end ISDN		Set interworking bit (bit i for Backward Call Indicator and bit D for Forward Call Indicator)
In-band information available		No mapping defined in ISUP (not applicable for Forward Call Indicator)

Unmapped ISUP fields

The following ISUP fields have no defined mapping, but are referenced in messages. (The default values are used when interworking with PRI messages.)

- Calling party's category

  Note: This is a mandatory parameter in the IAM. The default value is *unknown* (0000 0000).

- Nature of connection indicators

  Note: This is a mandatory parameter in the IAM.

The default value used in the IAM message parameter is as follows:

8	7	6	5	4	3	2	1
H	G	F	E	D	C	B	A

The contents of the individual bits are as follows:

- bits BA: satellite indicator
  - — 00 no satellite circuit in the connection (default)
  - — 01 one satellite circuit in the connection
- bits DC: continuity check indicator
  - — 00 continuity check not required (default)
  - — 01 continuity check required on this circuit
  - — 10 continuity check performed on a previous circuit
- bit E: echo suppressor indicator
  - — 0 outgoing half echo suppressor not included (default)
  - — 1 outgoing half echo suppressor included
- bits HGF are spare and coded 000

Feature interaction

Software answer

The following paragraphs describe the services and features that are supported on the primary rate interface (PRI).

- audio tone detectors (ATD)
- answer supervision distinction (ASD)
- operator services bridging
- pooled echo cancellers
- switched digital data service (SDDS)

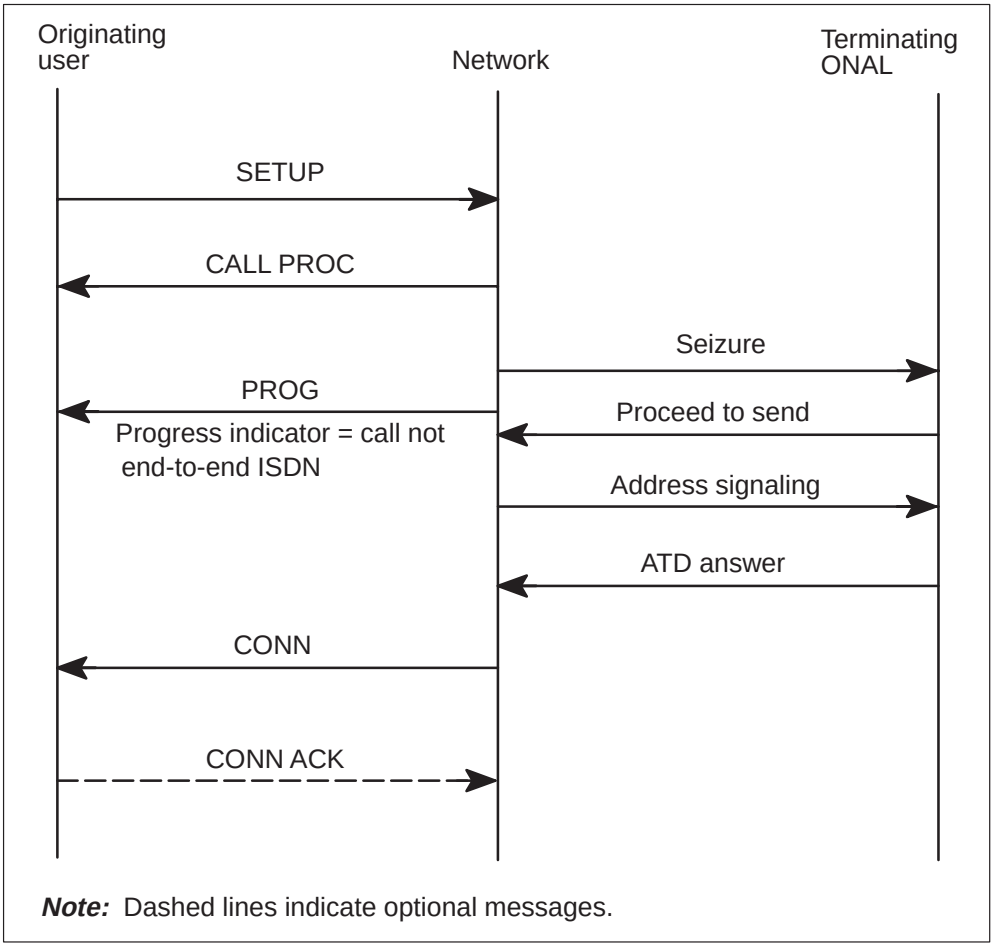
Audio tone detectors

ATDs provide a means for the UCS DMS-250 switch to detect an answer on a circuit that does not support supervisory signals for hardware answer. The determination of when the called party answers is based on the audio signals generated from the called party.

PRI agencies do not support the use of ATDs to monitor answer on PRI-terminated calls. However, a PRI agency may connect to an agency that supports ATDs. In such a case, the PRI reports an answer when the ATD indicates that an answer has been received from the called party.

Figure 9-1 illustrates the relationship between an originating PRI and a terminating per-trunk signaling (PTS) off-network access line (ONAL).

Figure 9-1
Audio tone detection



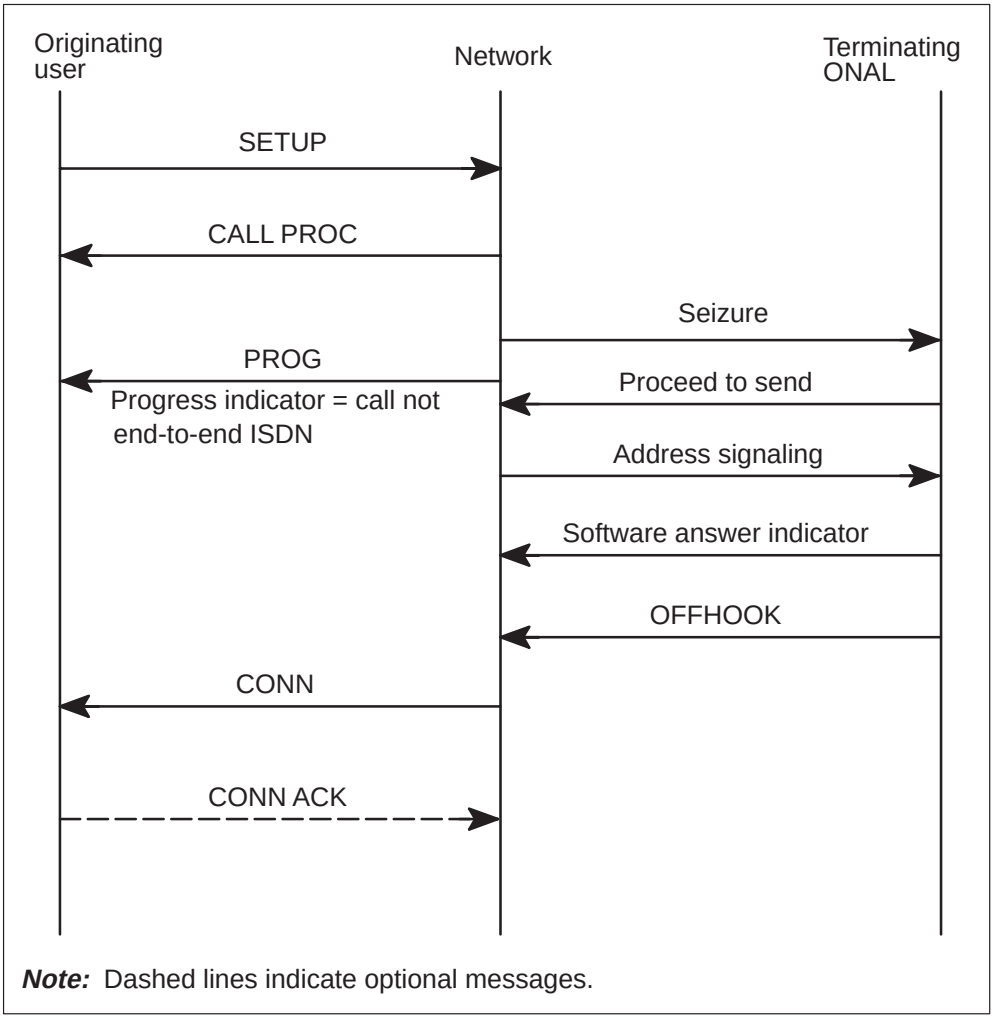
Note: Dashed lines indicate optional messages.

Answer supervision distinction

The ASD software answer capability allows the operating company to make software answer programmable for intermachine trunks (IMT) and direct access line (DAL) termination information element (TIE) trunks on a per-trunk-group basis. ASD allows an outgoing trunk to ignore hardware answer for billing. ASD allows the UCS DMS-250 switch to receive an answer supervision indicator when a software answer is detected by the far end. This capability should not be confused with ATD, although the two are interrelated.

Although ASD is not supported on PRIs, a PRI may connect to a circuit that supports ASD. The call flow diagram in Figure 9-2 illustrates the relationship between an originating PRI and a IMT trunk with ASD capability.

Figure 9-2
Answer supervision distinction (ASD)



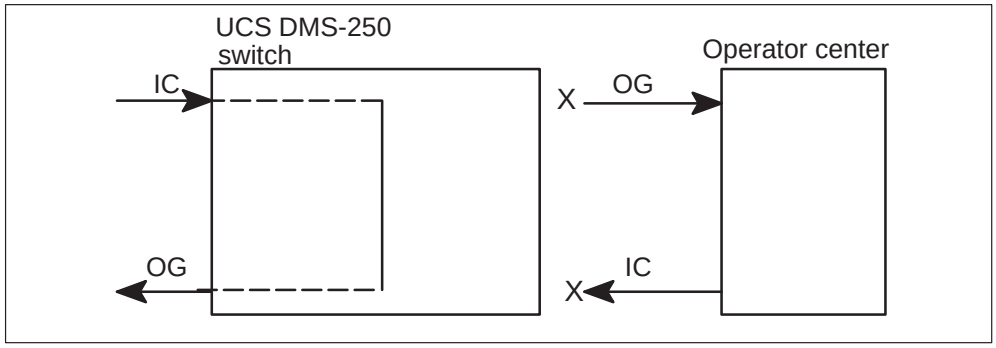
Note: Dashed lines indicate optional messages.

Operator services bridging

Operator services bridging allows calls to be bridged at the operator gateway switch. This frees up incoming and outgoing operator access trunks.

The trunk configuration of the operator service bridging, is shown in Figure 9-3.

Figure 9-3
Trunk configuration for operator services bridging



Although the UCS DMS-250 switch has control over when to bridge, the operator center can instruct the UCS DMS-250 switch not to bridge the call. Call bridging instructions are transmitted to the UCS DMS-250 switch by the service type digits. Bridging on the UCS DMS-250 switch is initiated after receipt of the start charge indicator (long wink).

Operator bridging is supported for calls originating or terminating over PRI trunk interfaces. All calls that involve operator bridging with PRI trunks acting as originators or terminators, are classified as non-ISDN calls. This is true even if the call is eventually bridged, and directly connects two PRI trunks. The indication that the call is non-ISDN is performed using the progress indicator IE contained in the outgoing call SETUP message or the outgoing Progress (PROG) message.

If the originating agent and the terminating agent are both PRI, any calling party number information received from the originating PRI is passed to the terminating PRI on operator-bridged calls.

After the UCS DMS-250 switch transmits the PROG message to the originating user, the call is classified as *not end-to-end ISDN*. It remains in this state for the duration of the call.

Pooled echo cancellers

Routing through the echo canceller pool is required for calls whose round-trip delay from point of presence to point of presence is 41 milliseconds or greater. The echo cancellers are provided through one incoming and one outgoing (looparound) trunk group per UCS DMS-250 switch.

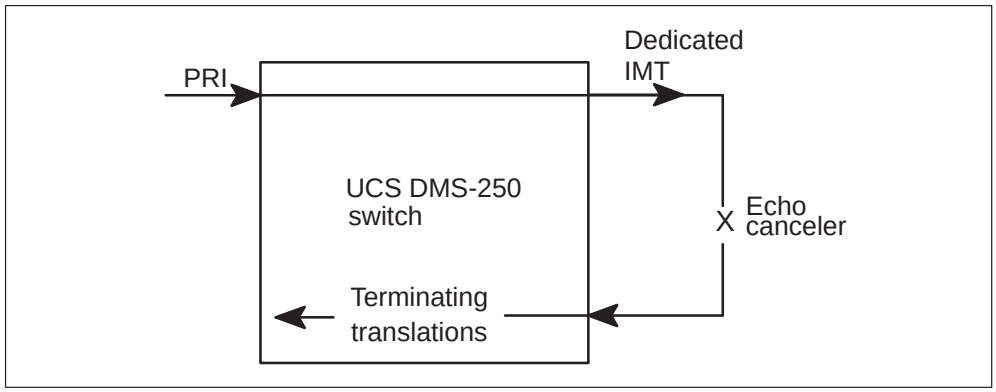
A call requires echo cancellation if the sum of the ZONE numbers for the originating and terminating trunk groups indicate that an echo canceller should be attached. For PRI trunks, as in other UCS DMS-250 switch trunk groups, the ZONE parameter resides in table TRKGRP.

Once it is determined that a call requires echo cancellers, the use of the looparound IMT trunk group classifies the call as a non-ISDN call. At this point, a PROG message is sent to the originating PRI indicating that the *call is not end-to-end ISDN*.

Note: If the bearer capability (BC) information element (IE) specifies that a call requires data facilities, pooled echo cancellers are not used. Pooled echo cancellers are not used on circuit-switched or voice-band data calls.

The use of pooled echo cancellers on the UCS DMS-250 switch is shown in Figure 9-4. The terminating route selection is based on translations parameters defined for the dedicated incoming IMT trunk. At that point, the UCS DMS-250 switch does not access any data associated with the originating PRI agent.

Figure 9-4
Pooled echo cancellers on the UCS DMS-250 switch



Switched digital data service

A digital data indicator (DDI) may be assigned to DAL and IMT trunk types. This allows trunk groups to be restricted as follows:

- carry data only
- carry voice only
- carry voice and data

The digital data service restricts the combinations of originating and terminating DDIs that can be used. For example, calls originating over trunks with a DDI of DATA_ONLY can terminate only to trunks with a DDI of DATA_ONLY or VOICE_DATA.

Conversely, calls originating over trunks with a DDI of VOICE_ONLY must terminate to trunks marked as VOICE_ONLY or VOICE_DATA.

For PRIs on the UCS DMS-250 switch, the DDI parameter is not associated with the PRI trunk group. Instead, service subscription parameters indicate whether the PRI is capable of sustaining voice, voice-band data, or circuit-mode data.

The default is that all capabilities exist on the PRI. Options in table LTDEF specify that a capability is not provided using the parameters NOVOICE, NOVBD, and NOCMD. If the capability is disallowed, calls that require the disallowed service may not originate or terminate on the PRI.

The equivalents between the SDDS DDI and the PRI capabilities are provided in Table 9-1. This table shows the relationship between the DDI datafilled on DAL and IMT trunks to the LTDEF options that apply to PRI agencies. Where no options are specified, the default PRI bearer capability is to support voice and data. When interworking between a PRI trunk and a non-ISDN trunk, the same rules apply as described for the SDDS.

Table 9-1
DDI and LTDEF relationships

DDI	LTDEF options specified
DATA_ONLY	NOVOICE
VOICE_ONLY	NOCMD and/or NOVBD
VOICE_DATA	No options specified (default)

The service required over the PRI is indicated by the BC IE. However, this does not preclude the possibility of using the SDDS dialing plan, which explicitly indicates the need for data services.

PRI facilities support the SDDS dialing plan in the following form:

```
# + FC + 7/10D
```

PRIs do not support account codes on the SDDS dialing plan. All digits must be received in the incoming SETUP message, because the UCS DMS-250 switch does not support collection of subscriber-dialed DTMF digits over PRIs.

The UCS DMS-250 switch interprets the SDDS dialing plan by searching the CALLATTR datafilled pretranslator name for the dialed digits. The pretranslator should contain a facility code digit entry specifying that the call be classified as DATA.

If the entry exists, the call is marked as data and terminations on PRIs contain a BC indicating data. If the originating PRI SETUP message indicates a data call type (56 kbit/s, 64 kbit/s, or 3.1 kHz), the BC is passed unchanged to the terminating user. Otherwise, data calls result in a BC of 3.1 kHz.

Use of the DATACALL selector in the pretranslator table is provided only for facilities that are datafilled to support data calls. PRI facilities datafilled for voice only, receive Service Currently Unavailable (SCUN) treatment when attempting to use the DATACALL selector.

To indicate that a PRI is used for voice only, the LTDEF options NOCMD and NOVBD must both be selected.

Calls that use the SDDS dialing plan to indicate that a call is for data may not route to a trunk marked as voice only. Data calls that attempt to route to a voice-only PRI route advance past the PRI agent.

Call authorization

Call authorization on the UCS DMS-250 switch is performed using four characteristics:

- authcodes
- security codes
- account codes
- calling line identification

Authcodes

Authorization codes (AUTHCODES) are 7-digit codes that are used as follows:

- identify a subscriber
- bill a call to a subscriber
- screen against unauthorized access to the network
- indicate class of service available to the subscriber
- indicate special features available to the subscriber

The contents of two fields, AUTHDIAL and VAUTHFLD, in table CALLATTR determine whether an authcode is fully dialed, partially dialed/filed, or not dialed. The interpretation of the AUTHDIAL and VAUTHFLD field values is shown in Table 9-2.

Table 9-2
AUTHDIAL and VAUTHFLD field value interpretation

Field name	Range	Description
AUTHDIAL	0 to 7	A zero indicates that there are no authcode digits to be dialed, and, therefore, it is a fully filed authcode.
VAUTHFLD	NOAUTHS or seven-digit authcode	NOAUTHS indicates a fully dialed authcode. An authcode that is datafilled as six digits or less is a partially filed authcode. A 7-digit authcode indicates that it is fully filed.

In the case where AUTHDIAL is datafilled as 0, VAUTHFLD must be datafilled with a seven-digit authcode. If AUTHDIAL is datafilled as 7, VAUTHFLD must be datafilled as NOAUTHS.

However, if AUTHDIAL is datafilled as N (a digit in the range of 1 to 6), VAUTHFLD must be datafilled with an authcode of (7 to N) digits.

If the originating call contains a call type that is not datafilled or is disallowed, the call is routed to treatment. (Refer to “ISA call types” in this chapter.)

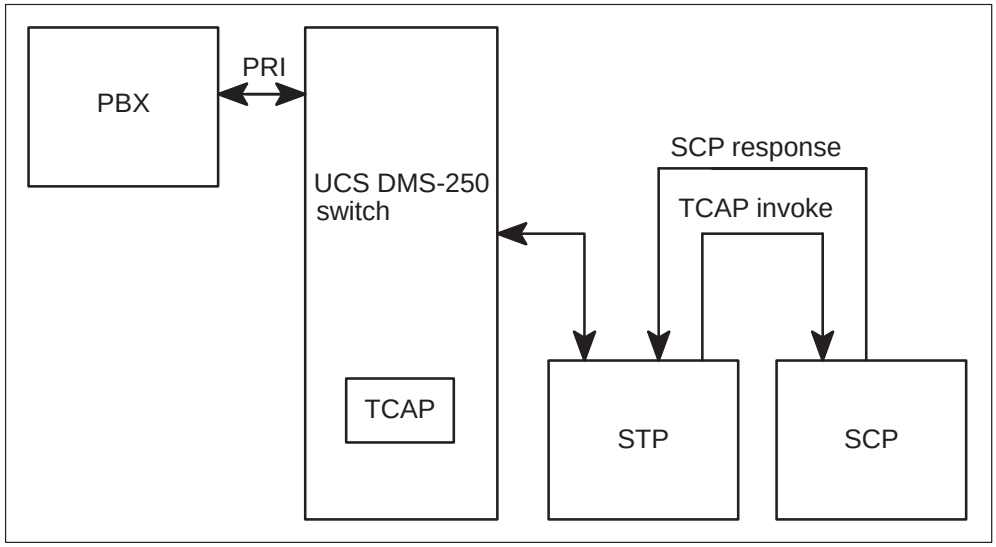
Authcode validation

Authcode validation is performed against the authcode filed in table CALLATTR.

Authcode validation is performed by first searching the authcode database index (ADIN), which is filed against the call attribute tuple in table AUTHDIN. Table AUTHDIN indicates whether the authcode is in-switch only, service control point (SCP) only, or in-switch and SCP.

If the datafill indicates that the desired authcode is not in the in-switch database and SCP validation is allowed, a query requesting validation is sent to the SCP. This query is a translation capabilities application part invoke message that is sent to the SCP through the signaling transfer point (STP), as illustrated in Figure 9-5.

Figure 9-5
Validation at SCP



The possible responses from the SCP are

- RETURN RESULT—a record containing the authcode validity and feature data
- RETURN ERROR—a message indicating operation failure of a validation
- REJECT—a message indicating protocol errors found in a received message
- no response within the timeout period specified by the office parameter AUTH_SCP_RESPONSE_TIMEOUT

If the ADIN does not have a corresponding AUTHDIN tuple, an invalid Authcode treatment is invoked. The same treatment is applied if the authcode is not found in the database.

If the SCP makes no response within the time specified by the office parameter AUTH_SCP_RESPONSE_ TIMEOUT, call processing applies the database Server Communication Failure (SCFL) treatment and sets the CDR COMPCODE to a value of 1 (indicating a treated call). The SCFL treatment is also applied for RETURN ERROR and REJECT messages.

If the authcode is found in the database, the status of the authcode is examined to determine the course of action to take in handling the call. The status of an authcode is one of the ones shown in Table 9-3.

Table 9-3
Status of the authcode

Authcode	Description
Valid	Call processing proceeds normally on the call, using the data stored against the authcode to process the address digits received in the CALL SETUP message.
Temporarily-invalid	Treatment TEMPORARILY INVALID is applied to the call. If necessary, treatment-to-cause mapping is performed.
Perminvalid	Treatment INVALID AUTHCODE is applied to the call. If necessary, treatment-to-cause mapping is performed.

Traveling authcodes have access to the network independent of the geographical location of the subscriber. The authcode is determined to be traveling, if the originating partition (OPART) of the authcode does not match the OPART of the PRI. Authcodes must be authorized to travel by the appropriate parameters in the authcode database (table AUTHCODU). If the authcode is not authorized to travel, the call is given Invalid City Code (INCC) treatment, resulting in treatment-to-cause mapping.

Filed hotline numbers

The UCS DMS-250 switch offers the ability to file hotline numbers against a subscriber authcode. If hotline digits are filed against an authcode, calls that originate with that authcode cause the address digits from the Q.931 SETUP message to be replaced with the digits filed against the authcode's hotline number. The hotline number is then used for any necessary routing and screening.

The PRI does not prevent the use of hotline numbers filed against authcodes. If a call originates on a PRI with an authcode that has a filed hotline number, that number is used as the address digits for the call. The restriction and use of authcode hotlines is the administrative responsibility of switch operators.

Security codes

Security codes are in the form of PIN digits. They are multidigit DTMF codes used as another level of screening beyond the authcodes. PIN digits are of variable length, between 0 and 4 digits, and are based on the authcode parameter PINDIGS.

Dialed authcode is supported for the UCS DMS-250 switch. If the authcode filed against the call attribute specifies that PIN digits are required, the PIN digits are ignored for incoming calls that use that authcode.

Account codes

Account codes are 2- to 12-digit DTMF codes used to allow chargeback of calls to projects, departments, or accounts. The requirement to enter an account code is specified by the authcode parameter ACCTLEN, which specifies the number of account code digits to dial.

The maximum number of account code indexes is 100,000, and the maximum number of account codes per index is 65,535.

In-switch account code validation

The only instance when validation of an account code is not done at the SCP is when VALIDATE_ACCT_AT_DMS250 is datafilled as Y, specifying in-switch translation.

SCP account code validation

When authcode verification is performed at the SCP, the contents of feature data returned from the SCP contain data associated with the validation of the account code. A description of this data is provided in Table 9-4.

Table 9-4
Account code validation and digit collection

Feature data	Range	Description
Account code validation required	0 or 1	A 0 indicates no account code validation is required. A 1 indicates that the subscriber account needs to be validated at the SCP before the call can be completed.
Account code length	2 to 12	All digits provide the exact number to be collected.

When account code length is greater than one, call processing collects the account code digits. Following the digit collection, if account code validation required has a value of 1, a TCAP invoke message is sent to the SCP requesting validation.

Calling line identification

When an ISDN PBX subscriber attempts an outside call accessing the DMS-250 system, the UCS DMS-250 switch detects this call origination over a PRI trunk interface. The PBX initiates the call request by sending a SETUP message over the PRI to the switch. Within this message is a calling line identification (CLID)/calling station identifier (CSI).

The UCS DMS-250 switch screens calls based on the CLID/CSI or authcode. Calls can be screened based on authcode or CLID. If CLID screening is selected, this feature performs CLID validation, COS screening, and invokes COS screening override (if COS fails).

CLID screening and translations are invoked based upon the call type and datafill in table CALLATTR. This table is modified to add BILLTYP, which can take the values of CLID, AUTH, or NONE, indicating either a CLID, an authcode, or no screening required.

For CLID calls, table ANISCUSP is accessed using the received CLID, and the screening is performed using the UCS DMS-250 switch automatic number identification call processing software. The contents of the ACCTLEN (account code length) and ACCTVAL (account code validation) fields in table ANISCUSP specify whether an account code associated with a CLID must be collected and whether it is to be validated at the SCP.

If the datafill indicates that an account code must be collected, the UCS DMS-250 switch optionally prompts the subscriber to enter a 2- to 12-digit account code specified by the field ACCTLEN. If the dialed number of account code digits is less than the required number, the call is given a Partial Dial treatment. If the customer dials too many digits, the extra digits are ignored.

If the value of the field ACPROMPT in table TRKGRP of the originating trunk is set to Y, a prompt is issued. Upon successful collection of account code digits, validation is performed, if necessary. If the field ACCTVAL is datafilled with a value of Y, a query requesting validation is sent to the SCP.

The types of screening functions performed are as follows:

- check for partial CLID (required)
- CLID number validation (required)
- CLID COS screening (optional)
- CLID COS override checking (optional)
- CLID-associated account code validation (optional)

As part of PRI-originating call processing, the CLID and CALLTYPE origination data is collected from the incoming SETUP message. The ten-digit CLID identifies the originator for billing purposes. The CLID is comprised of a numbering plan area (NPA), office code, and a station directory number. The call type determines how calls are translated and what type of screening is required.

The call types associated with this feature are

- PUBLIC
- PRIVATE
- WATS
- TIE

The call type received in the SETUP message used in conjunction with the logical terminal identifier (LTID) is used as a multipart key to access an entry in the LTCALLS (logical terminal calls) table. The LTID is contained in the trunk group data associated with the incoming PRA250 trunk.

The LTCALLS table provides integrated services access (ISA)-related data about PRI call types. The LTCALLS tables contains a field (CALLATTR) that is an index into the CALLATTR table. The indexed entry in the CALLATTR table contains a set of specific translation and screening parameters used by ISDN call processing to handle a PRI call. The CALLATTR table data specifies if CLID screening should be performed as part of PRI-originating call processing.

The SCP validates travel card numbers (TCN) and account codes associated with TCN calls that originate on PRA250 trunks. Call processing is identical to the existing UCS DMS-250 switch capability.

Responses from the SCP for account code validation are the following:

- return result
- return error
- reject

If the return result indicates that the account code is valid, call processing continues. If it indicates that the account code is invalid, the call is blocked with an invalid account code treatment.

If the SCP makes no response within the time specified by the office parameter ACCT_SCP_RESPONSE_TIMEOUT, the dialed account code digits are assumed to be valid. The call proceeds with the call detail record (CDR) COMPCODE set to a value of 9, indicating an SCP response timeout.

A reject or a return error is handled the same way as a timeout, except that the CDR COMPCODE is set to 4, indicating a signal system error.

Reorigination

Reorigination allows the caller to place numerous calls without having to reenter the billing number (after calls such as calling card number, ACCT code, or authcode). During conversation or anytime after completion of the dialing sequence, the caller can press the # key to gain attention of the carrier access and authorization code. In response, the switch sends the caller a dial tone so that another number can be dialed.

Dialing plans

The types of dialed numbers that may require authcode, TCN, and account code validation are shown in Table 9-5.

Table 9-5
Types of dialed numbers

Type of number	Numbers dialed
seven-digit DDD	NXX-XXXX
1+seven-digit DDD	1 + NXX-XXXX
ten-digit DDD	NXX-NXX-XXXX
1+ten-digit DDD	1 + NXX-NXX-XXXX
IDDD	011 + CC + NSN
Private speed (not translated at the SCP)	1NN
Public speed	ZNXX
Datacall	#FC + 7/10 digits
TCN	0 + (NXX) + NXX-XXXX + TCN
Zero minus	0
Zero plus	0 + (NXX) + NXX-XXXX
Note: The following legend applies:	
CC: country code	N = 2 to 9
FC: two-digit facility code , either 56 or 99	X = 0 to 9
TCN = travel card number	Z = 2 to 8

The subscriber also dials an access code for the following dialing plans:

Note: The meaning of the special characters used in the dialing plans are explained in the following paragraph.

- In the case of a fully filed authcode or a CLID with COS not exceeded, the dialing plan is:

```
{DIALED NUMBER} + ([<ACPROMPT>] + ACCT)
```

- In the case of a fully filed authcode or a CLID with COS exceeded and COS override allowed, the dialing plan is

  ```
  DIALED NUMBER + <PROMPT> + AUTH + (PIN) + (ACCT)
  ```

- In the case of a fully dialed or partially dialed/filed authcode, the dialing plan is:

  ```
  <SDT> + AUTH + (PIN) + (DIALED NUMBER) + ([<ACPROMPT>] +
  ACCT)
  ```

- In the case of a TCN and account code, the dialing plan is:

  ```
  0 + {DIALED NUMBER} + TCN + ([<ACPROMPT>] + ACCT)
  ```

- In the case of a cutthru type call, the dialing plan is:

  ```
  {DIALED NUMBER} + (PIN) + (<ADPROMPT>) + ADDRESS DIGITS +
  (<ACPROMPT> + ACCT)
  ```

For these dialing plans, the abbreviations and special characters are described as follows:

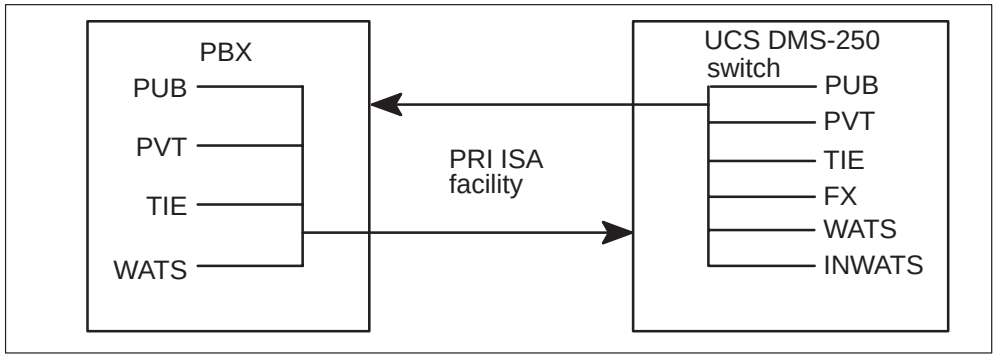
- ACPROMPT = account prompt (a 1.0-second burst of 400 Hz tone)
- ADPROMPT = dial tone used in cutthru type calls
- PROMPT = authcode prompt (a 0.1-second burst of 350 Hz tone, followed by a 0.1-second interval of silence, followed by a 0.1-second burst of 440 Hz tone, ending with a steady dial tone)
- () = optional
- <> = prompt
- {} = the digits are in the SETUP message instead of being dialed by the customer.

In the case of COS override, a second Transaction Capabilities Application Part (TCAP) message is sent to SCP using the existing call processing.

Integrated services access

ISA defines the process of giving call-by-call access to public and private network services through one common integrated access facility, as shown in Figure 9-6.

Figure 9-6
Integrated services access



Enhancements to the PRI signaling protocol permit access to the segregated facilities within the network. The services provided over a single PRI include

- originating
  - — PUB
  - — PVT
  - — WATS
  - — TIE
- terminating
  - — PUB
  - — PVT
  - — WATS
  - — TIE
  - — FX
  - — INWATS

ISA provides a way in which the T1 access facility can evolve from a statically defined access arrangement to an access pipe (where any open access circuit can originate or terminate any switched service to which the customer subscribes). Under this service-based architecture, calls originating over an ISA PRI facility are handled by call type.

ISA call types

In the UCS DMS-250 switch ISDN environment, call types are defined using the network-specific facilities (NSF) IE of the incoming CALL SETUP message. The NSF IE, in conjunction with the numbering plan indicator (NPI) field of the called party number (CDN) IE, provides a variety of call types and services.

If the NSF IE is not received by the UCS DMS-250 switch, the called number NPI sets the called type to private (for an NPI of private) or public (for an NPI of E.164).

Table 9-6 lists the call types supported for incoming calls.

Table 9-6
ISA incoming call types for called number plan indication

Call type	E.164	PVT
PUB	Standard home numbering plan area translations, using CALLATTR to access translations and screening data.	Call is not supported using this value. Not recommended!
PVT	On-net translations, using CALLATTR to access translations and screening data.	On-net translations, using CALLATTR to access translations and screening data.
TIE	TIE services are provided to private network customers only. TIE calls should not use this value, even though they will not be rejected. Not recommended!	ISA route reference, to choose an outgoing route directly. or On-net translations, using CALLATTR to access translations data.
WATS	ISA route reference, to choose an outgoing route directly. or Standard HNPA translations, using CALLATTR to access translations and screening data.	Outward WATS does not apply when trying to reach private network subscribers. Not recommended!

Table 9-6
ISA incoming call types for called number plan indication

Call type	E.164 PVT
INWATS	INWATS translations are not supported by PRI on the UCS DMS-250 switch.
FX	FX service translations are not supported by PRI on the UCS DMS-250 switch.

Not all combinations of call type/NPI are valid on the UCS DMS-250 switch. The UCS DMS-250 switch applies Feature Not Allowed (FNAL) treatment to calls originating on PRIs with disallowed call types. FNAL treatment is also applied on calls that originate with a call type not datafilled in tables LTCALLS. Treatment-to-cause mapping may be performed (depending on interface and service parameters).

Table 9-7 provides a brief description of the available call types on the UCS DMS-250 switch.

Table 9-7
UCS DMS-250 switch call types

Call type	Description
PUB	Generic service in which the address digits (called number) conform to the CCITT Recommendation E.164 format. Calls of type PUB can be translated directly using standard home numbering plan area translations.
PVT	Specialized service for calls whose address digits (called number) do not conform to the E.164 format. These calls generally pertain to a private network call in which the address digits are not significant in the public numbering plan.

Table 9-7
UCS DMS-250 switch call types (continued)

Call type	Description
WATS	Outward wide-area telephone service. Outward WATS calls are calls that are packaged to be billed at a flat rate for an unlimited number of calls over a specific period of time. Outward WATS calls conform to the public numbering plan (E.164) and can be translated using standard home numbering plan area translations.
TIE	Calls involving the use of dedicated facilities to link one or more nodes of a customer private network. TIE trunks do not require translations to choose an outgoing route. Instead, terminating information is passed in the NSF IE, making it possible to establish a temporary link throughout a private network without repetitive translations.

ISA subscription parameters

ISA subscription parameters define the ISA environment of the ISDN PRI. The control of direct routing, translations, and screening is based on a relationship between the PRI and the incoming call types. The use of such a relationship provides the ability to determine separately the services that should be applied to each of the ISA call types available on the PRI.

ISA tables

The ISA tables and their functions are described in the following paragraphs.

Table LTCALLS

This table contains the ISA data for all PRI call types. Each call type has a unique entry in this table and contains the following information:

- The call attribute index (CALLATTR) indexes into table CALLATTR. This index provides a means to assign separate translations environment to each of the ISA call types (separate pretranslators and STSs for PUBLIC and PRIVATE).
- ISA routing is an alternative to interexchange routing and provides a means to route individual call types directly to an outgoing trunk without first passing through translations and screening. Further discussion can be found in this chapter under “IEC translations versus ISA routing.”
- Table LTCALLS includes the XLARTE selector XLAISA.
  - — The XLAISA selector, along with an eight-character router name, directs ISDN to use the ISAXLA table. Table ISAXLA is accessed when the station identification is employed in the translation and routing for the call from a PRI trunk.

Table CALLATTR

This table specifies all of the translations and screening information necessary to process PRI calls. Indexed by field CALLATTR (from table LTCALLS), each tuple of this table can apply to one or more call types and/or interfaces, reducing the occurrence of repetitive information.

Figure 9-7 illustrates the relationship among the various ISA subscription parameter tables.

Figure 9-7
ISA subscription parameters

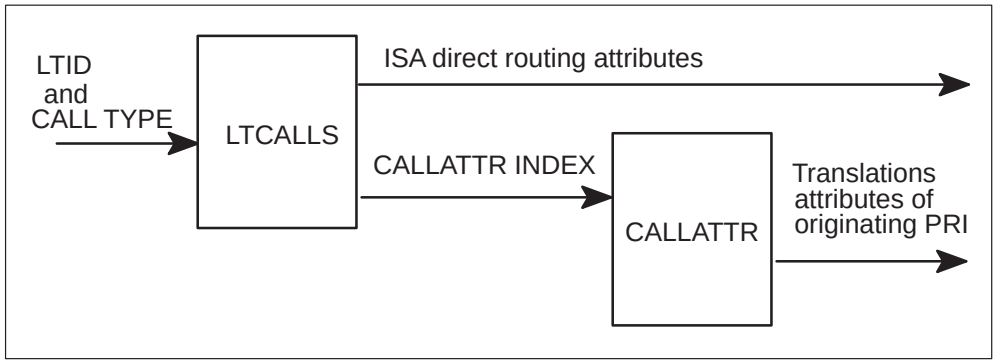


Table ISAXLA

Table ISAXLA is accessed by an eight-character router name and SID range to form the key. The key drives the translation and routing further on to table CALLATTR, then possibly to a table of route references, such as table OFRT.

Table ISAXLA defines the service-related data associated with ISA calls that use the SID to determine translations and routing for calls datafilled in table LTCALLS. Table LTCALLS does not need to be datafilled prior to datafilling this table. Once the LTID is determined from the trunk CLLI and the call type is determined from the NSF, LTCALLS is accessed. If the selector is XLAISA, the SID from the NSF is employed along with the router name to access the ISAXLA table.

ISA call type throttling

Call type throttling provides a method of controlling the number of calls that originate and terminate on an ISDN trunk. PRI ISA calls are limited based on each ISA call type that appears on the PRI trunk group.

The following PRI ISA call types are supported on an ISDN trunk:

- inbound
  - PUB

  - PVT
  - WATS
  - TIE
- outbound
  - PUB
  - PVT
  - TIE
  - WATS
  - INWATS
  - FX

The NUMCALLS field in table LTDEF and the OPTIONS field in table LTCALLS are used to perform call type throttling. The NUMCALLS field specifies the expected number of members datafilled in TRKMEM for this trunk group, thereby establishing the size of the base call pool. The OPTIONS field defines the fields that contain the guaranteed number of calls allowed on the trunk and the maximum number of calls allowed for that call type.

Call type throttling is provided only for calls that originate and/or terminate over DMS-250 PRI trunks. Only ISA calls invoke the throttling feature.

The UCS DMS-250 switch performs ISA call type throttling before invoking off-hook queuing. In essence, the system verifies the logical resources prior to verifying the physical resources. Once a call is throttled, it remains a throttled call through off-hook queuing until the system disconnects the call.

Interexchange carrier translations versus ISA routing

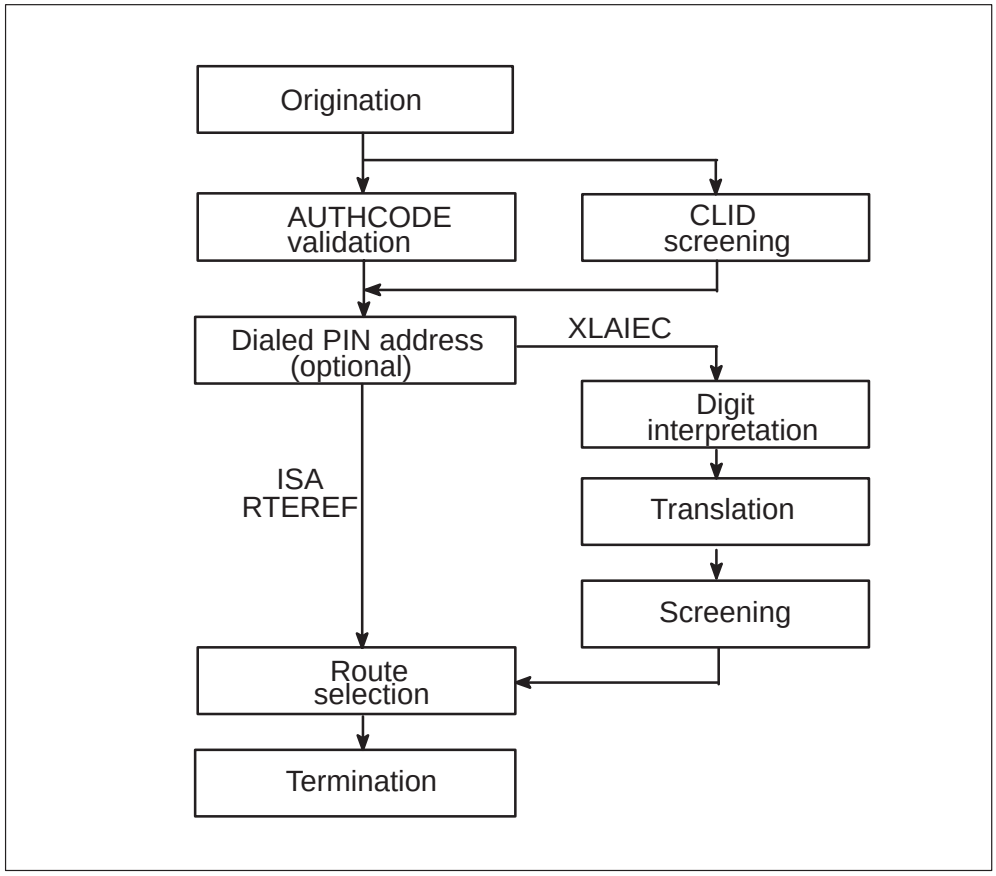
The UCS DMS-250 switch offers two options for processing incoming PRI calls: interexchange carrier translation and routing (XLAIEC) and ISA route reference routing (ISA RTEREF).

XLAIEC allows calls to be processed following the existing set of procedures for UCS DMS-250 switch digit interpretation, translations, screening, and routing.

ISA route reference (ISA RTEREF) routing allows calls to be terminated immediately after authcode screening, without the need for any form of digit interpretation or translations. This method provides a substantial decrease in call completion time.

Figure 9-8 shows a comparison of XLAIEC and ISA RTEREF and illustrates the process of directly routing after CLID screening or authcode validation is performed.

Figure 9-8
XLAIEC versus ISA RETREF



The assignment of a call to either XLAIEC or ISA RTREF is based on call type and is datafilled in table LTCALLS. The XLARTE field, which should be datafilled with the value XLAIEC, specifies that the call type receives its translations and routing information from the interexchange carrier translation tables.

The TABNAME field provides the ability to specify whether the call is directly routed without translations and screening. If the optional TABNAME field is omitted (a $ is entered instead of an outgoing route index such as OFRT 20), the call proceeds through the standard interexchange carrier translations and screening. If a route is datafilled in the TABNAME field, the call progresses immediately to the outgoing route list without any form of translations or screening. In either case, authcode validation is performed to ensure that the authcode datafilled in table

CALLATTR is valid. In-band authcode collection and ISA direct routing are not mutually exclusive, and either or both can be used on a given call.

Assignment of interexchange carrier translation or ISA direct routing based on call type provides the possibility of a mixture of the two methods over a given PRI. For example, PRIVATE and PUBLIC calls can be processed using interexchange carrier translations (by omitting the TABNAME field) and calls of type TIE can be processed using ISA direct routing. TIE calls are especially suited to ISA direct routing since the use of the TABNAME parameter provides a virtual nailed-up connection between the originator and the terminator. In essence, the originator has a dedicated connection directly to the terminator.

Translations of dialed digits

The UCS DMS-250 switch offers many services based on translations of dialed digits. The virtual private network translations supported by PRI include the following:

- off-net dialing
- private network dialing (on-net dialing)
- public speed dialing
- private speed dialing
- international direct distance dialing (IDDD)
- operator services dialing
- test calls
- off-hook queuing
- time-restricted calling

Universal access is not supported in PRI on the UCS DMS-250 switch. Requests for this service result in a FNAL treatment.

The UCS DMS-250 switch executes the following steps when performing interexchange carrier translations on an originating PRI call:

- Using the call type received in the incoming SETUP message and the LTID associated with the trunk group, the UCS DMS-250 switch accesses the LTCALLS information relevant to the call. If the call type is not datafilled or is not supported, the UCS DMS-250 switch applies FNAL treatment to the call.

- Using the call attribute index (CALLATTR) that is datafilled against the LTCALLS tuple, access the call attribute parameters related to the call in table CALLATTR. If the CALLATTR index datafilled in table LTCALLS leads to a CALLATTR tuple that is not datafilled, the UCS DMS-250 switch applies Vacant Code (VACT) treatment to the call. Also, the UCS DMS-250 switch outputs a DATABASE ACCESS TROUBLE log, indicating that the call attribute could not be found.
- The UCS DMS-250 switch validates the authcode datafilled in table CALLATTR if AUTH billing is selected. This provides access to information such as TPART and COS.
- Using the pretranslator name datafilled in table CALLATTR, the UCS DMS-250 switch pretranslates the address digits received in the SETUP message (which were supplied by the authcode hotline). As specified by pretranslations, the UCS DMS-250 switch performs any necessary digit processing, route selection, or call type assignment.
- If the address digits correspond to a public speed number, the UCS DMS-250 switch searches for the speed digits in the corresponding database. If the digits are not found or if speeds are denied, the UCS DMS-250 switch sets appropriate treatment. If the digits are found, the UCS DMS-250 switch replaces the dialed digits with the DDD or private network number stored against the speed digits. The UCS DMS-250 switch returns to the previous step to begin processing on the new address digits.
- The UCS DMS-250 switch performs translations on the address digits using the serving translations scheme (STS) that is determined by the OPART and TPART associated with the authcode or CLID used to screen the call. The STS provides a unique HNPA control table used to perform translations of up to ten digits.
- After an outgoing route has been selected, route selection proceeds to locate an available terminating agency to complete the call.

The following paragraphs define the circumstances and procedures used to translate specific call types and digit interpretations.

Off-net dialing

A location off the network can be reached by using a direct distance dialing (DDD) number of the form NXX-NXX-XXXX or an IDDD number of the form 011 + Country Code + NX...X, where N=2 to 9 and X=0 to 9. A DDD off-net number is entered directly by a subscriber or is retrieved from a speed list.

An off-net number is differentiated from other dialed number types in that the first digit ranges from 2 to 9 (such as NXX-NXX-XXXX), or 011 for IDDD calls. To differentiate between off-net numbers and other types of

address digits, the pretranslator must be datafilled to perform three- or six-digit pretranslations to distinguish the NXX-NXX (or NXX) as an off-net number. The pretranslator used is determined on a per-call-type basis and is datafilled in table CALLATTR. A pretranslator result of CT OFFNET indicates that the address digits apply to an off-net number. The pretranslator result also indicates the minimum number of digits that should be received in an incoming SETUP message. Failure to receive the minimum number of digits results in Partial Dial (PDIL) treatment.

On-net dialing

A location on the network can be reached using a seven-digit private network number of the form NXX-XXXX, where N=2 to 9 and X=0 to 9. This number can be directly input by the subscriber or retrieved from a speed list.

The on-net number is differentiated from other dialed number types through the use of a pretranslations table, which identifies three-digit codes to be NPA or on-net office codes (NXX). This implies the restriction that on-net NXXs and off-net NPAs cannot conflict within a given pretranslator. The pretranslator used is determined on a per-call-type basis and is datafilled in table CALLATTR. A pretranslator result of CT ONNET indicates that the address digits apply to an on-net number. The pretranslator result also indicates the minimum number of digits that should be received in an incoming SETUP message. Failure to receive the minimum number of digits results in PDIL treatment.

Public speed dialing

A public speed number allows for an abbreviated form of a called number. The called number used for routing the call is retrieved by table lookup, supplying a ten-digit DDD number or a seven-digit private network number.

A public speed number, in the form ZNXX, is distinguished from other forms of address digits through the use of a pretranslations table, which identifies four-digit codes to be public speed numbers through the use of the CT selector with the PUBSPD call type.

Once it is determined that the number corresponds to a public speed, the speed digits are located in the list of public speed numbers, one of which may be associated with an OPART. If the speed number is successfully located in the speed list, call processing replaces the digits dialed by the customer with the digits from the speed database. Interexchange carrier translations are reinitialized at that point, beginning with digit interpretation and pretranslations.

If the speed number is not located in the speed list, vacant speed treatment is applied to the call. If public speed numbers are not allowed on the OPART, reorder treatment is applied to the call.

In any case where treatment is applied to the call, cause-to-treatment mapping may be applied.

Private speed dialing

Private speed numbers allow a subscriber to associate a speed number to an authcode. This essentially provides the ability to associate a speed number to the authcode filed against the originating PRI call type. By datafilling a unique authcode on each individual call type of a PRI, separate private speed lists can be achieved for each ISA call type.

Address digits are determined to be private speed numbers through the use of a pretranslations table, which can specify that a three-digit code corresponds to a private speed number through the use of the CT selector with the PRVSPD call type. Once the call is determined to be a private speed call, an attempt is made to locate the number in the speed list corresponding to the authcode. Once the number is found, call processing replaces the digits dialed by the customer with the digits from the speed database. Interexchange carrier translations are reinitialized at that point, beginning with digit interpretation and pretranslations.

If the subscriber is not allowed to dial private speed numbers (specified by an authcode parameter) or if the speed number is not valid (not in the speed list), the call is routed to Vacant Speed treatment.

In any case where the call is assigned a treatment, cause-to-treatment mapping may be performed.

International direct distance dialing

IDDD allows subscribers to place calls to locations outside of North America without operator intervention.

An IDDD number consists of the international access number (011), the true country code (one to three digits in length), and the NSN (one to 14 digits in length) and is in the form

```
011 + Country Code + NSN
```

The maximum number of digits in an IDDD number is 18, including the 011.

An IDDD number is recognized over a PRI because the first three digits of the dialed number are the international access code, 011. The number of digits following the 011 varies, based on the true country code.

Once an IDDD call has been identified and the IDDD digits have been collected, the country code digits are translated by the international translation scheme. The call is then routed over an outgoing trunk to a system capable of continuing the call.

Note: A speed number cannot be an IDDD number. An IDDD number is always entered directly by the subscriber and is part of the CDN IE of the incoming CALL SETUP message.

Operator services dialing

Operator services calls are calls that require a connection from a UCS DMS-250 switch to an operator center.

The UCS DMS-250 switch supports calls that require a connection from an incoming operator services tie trunk to an ISDN PRI trunk.

Calls are determined to require operator services based on the dialed number, which can take one of the forms shown in Table 9-8.

Table 9-8
Calls requiring operator services

Dialed numbers	Description
0	Zero minus
0 + NXX-XXXX	Zero plus
0 + NXX + NXX-XXXX	Zero plus
01 + CC + NN	International operator-assisted

If a call requires operator assistance, the call progresses by accessing the appropriate LTCALLS tuple to retrieve the call translations information. The translations information required to complete operator services calls takes one of two forms: zero minus calls or all calls other than zero minus.

All calls other than zero minus route according to standard translations, beginning with the pretranslator datafilled in table CALLATTR. The pretranslator should contain the appropriate tuple to choose an outgoing route for operator services calls. It is recommended that zero plus calls be routed using the T-selector from the pretranslator. This allows selection of an outgoing route and control of the number of digits received.

Operator services calls can also be routed by the automatic number identification (ANI) or the pseudo ANI (PANI) rather than using trunk group parameters or office parameters. The ANI and PANI route a call to a particular operator service position or can route IDDD calls to an outbound network. A call can be routed by the ANI or PANI if the following conditions are met:

- the office parameter ROUTING_BY_ANI is set to YES
- table ANISCUSP has datafill in the optional fields PRTNM and ROUTEIDX
- the incoming call has a valid ANI or PANI

If any of these conditions are not met, the call is routed through table TRKGRP.

Operator services types are three-digit numbers. Also, when an undatafilled operator service type is used, a log is generated and the call is routed to treatment.

The UCS DMS-250 switch and the operator center can communicate using ISDN PRI signaling.

Test calls

UCS DMS-250 switch test calls facilitate various manual and automatic tests from distant toll and local offices without intervention at the called office. The test line facilitates testing by presenting known conditions upon connections being made to them. Test line test calls can be originated manually from the trunk test position, or automatically in automatic trunk test.

The UCS DMS-250 switch supports connections from PRI trunks to T100 and T102 test lines. The UCS DMS-250 switch also supports calls received from distant offices. If these calls conform to the 10X or 95X-XXXX format, they are classified as test calls. The information digits 10 or 95 indicate test calls.

Off-hook queuing

Off-hook queuing for calls on ISDN PRI trunks enables these kinds of calls to enter a timer queue and wait for an idle trunk from a number of eligible route choices. Off-hook queuing provides multiple queue points within a route list and a wait time associated with each queue point to handle the variation of the queue point. Controls are implemented to find out whether incoming PRI or terminating PRI are eligible for queuing.

The following conditions must be met before a trunk is eligible for off-hook queuing:

- The trunk group to be terminated to has all trunks busy.
- Off-hook queuing (OHQ) is set in the OPTIONS vector in table TRKGRP for the originating trunk.
- OHQTERM is set in the OPTIONS vector in table TRKGRP for the terminating trunk.
- Off-hook queuing route selectors are datafilled in a route table (one of the OFRT tables or subtable RTEREF of tables HNPACONT or FNPACONT). The following are valid route selectors for off-hook queuing
  - — SQ (standard queuing)
  - — NQ (non-standard queuing)
  - — QH (all the previous route choices that allow queuing can be queued upon)

Associated with each queue point (QH selector) is a time stamp that specifies the duration of off-hook queuing at that point. The duration of OHQ (off-hook queuing) for each point is between 1 and 255 seconds. If either the incoming or outgoing trunk does not allow OHQ (TRKGRP field), no queuing is done.

When a call encounters a queue point with route choices that can be queued upon, the call is suspended for as long as the time stamp specifies. If any members of the trunk group become idle during this time, the call is unsuspended and allowed to go through on the idle trunk. If the duration of the time stamp expires, the call route advances to the next route choice following the queue point.

If a call is queued, either a high tone, low tone, or silence tone is sent back to the caller based on the value of an office parameter.

If a queue point is encountered and no previous route choices permit OHQ, the call route advances.

Methods of trunk selection for off-hook queueing

The selection type for trunk groups is set in the SELSEQ field of the table TRKGRP. The following are the SELSEQ values that can be used with off-hook queuing:

- MIDL (most idle)—This method selects the trunk that has been idle for the longest period of time.

- LIDL (least idle)—This method selects the trunk that has been idle for the shortest period of time.
- ASEQ (ascending sequence)—This method gives each trunk in a trunk group a fixed position on a list, then searches the list from the first (lowest numbered) list member to the last (highest numbered) list member for an idle trunk.
- DSEQ (descending sequence)—This method gives each trunk in a trunk group a fixed position on a list, then searches the list from the last (highest numbered) list member to the first (lowest numbered) list member for an idle trunk.
- CWCTH (clockwise circular trunk hunt)—This method gives each trunk in a trunk group a fixed position on a list, then searches the list for an idle trunk. The search starts with the trunk following the most recently released trunk, down through the last member of the list and back to the top and down into the list again.
- CCWCTH (counterclockwise circular trunk hunt)—This method gives each trunk in a trunk group a fixed position on a list, then searches the list for an idle trunk. The search starts with the trunk following the most recently released trunk, up through the first member of the list and back to the bottom and up into the list again.

Enhanced services platform interface

The UCS DMS-250 switch interfaces with the enhanced services platform (ESP) in order to offer many billable services—such as time, weather, information, voice mail, and audiotext—as well as services that are not billable, such as a help session.

ESP Reorigination

Subscribers connected to the ESP can extend calls from the ESP back to the UCS DMS-250 switch. If the caller, after finishing one of these calls, wants to use further ESP services, the # key reconnects to the ESP. Once reconnected, the caller can use any of the services provided by the ESP.

The UCS DMS-250 switch does not support reorigination for calls originating on PRI, gateway intermachine trunk, electronic tandem network direct access line (EDAL) or electronic tandem network intermachine trunk (ETN DAL) trunk groups.

ESP to ISDN operator services interworking

ESP to ISDN operator services interworking provides interworking between the ESP and ISDN operators.

The UCS DMS-250 switch table TRKGRP allows routing of ESP extended calls to an ISDN operator. The subfield ESP_ZEROMPOS is in the OPTIONS field of table TRKGRP.

An ESP extended call can terminate to the following trunks:

- DAL
- ONAL
- EANT
- ONAT
- PRA250
- EDAL
- IMT
- ISDN

Treatment routing

The UCS DMS-250 switch can specify that treated calls be routed to either tone, announcement, or an outgoing route. This routing is performed using a treatment subtable from table TMTCNTL and by specifying that the appropriate treatment route to the required choice.

Since individual treatment subtables might not list all possible treatment codes, the UCS DMS-250 switch may have to access several treatment control subtables until it encounters the treatment code result prescribed by the operating telephone company. To determine the result of the treatment code, look for the treatment code in the subtable at a position relevant to the originator of the call (for example, position PRA250 for calls originated by a PRI). Next, look for the treatment code in subtable at position PRA250. Last, look for treatment code RODR in subtable at position OFFTREAT.

Regardless of the table where the treatment is found, the routing result of the treatment table (that is, the specification of the tone, announcement, or office route) is ignored for originating PRI trunks. Instead, all treatment incurred on originating PRI trunks results in a DISC or REL message with a cause value obtained through treatment-to-cause mapping.

Alternate treatments

The UCS DMS-250 switch can also specify that all calls routed to treatment from a PRI should route according to the information datafilled in the ALTERNATE subtable of TMTCNTL. The reference to the ALTERNATE subtable takes the place of the reference to the PRA250 subtable and therefore precludes the possibility of referencing both subtables.

Use of alternate treatments is specified using the ALTTRTMT parameter in the trunk group table for the incoming PRI trunk group.

Interexchange carrier screening and routing

PRI supports the following interexchange carrier screening and routing services:

- restricted usage by date and time
- incoming exclusions
- class-of-service (COS) screening
- CALLATTR COS screening
- retranslations for origination PRIs (see Note)
- multiple class-of-screening (COS) capability

Note: This screening and routing capability is provided for interexchange carrier translations and calls that use ISA direct routing. It can be used for all call types, regardless of LTCALL datafills.

Restricted usage by date and time

This capability allows calls to be restricted during specified time periods based on a parameter associated with the subscriber's COS screening index, which is stored against the AUTHCODE, and on the true originating date and time of the subscriber.

An authcode parameter specifies the COS screening index. The associated COS screening entry in table COSUS supplies the time-restricted service for the COS. It is possible to assign a COS screening index to the authcode filed against the PRI call type. This restriction applies to all calls of the particular type that originate over the PRI.

If the authcode associated with a call type is found to be time-restricted, the date and time of the subscriber origination are compared against the restricted times for the subscriber. The true origination date and time of the subscriber are calculated by using the local time bias field in the originating trunk group (field TIMEBIAS). This field specifies whether to add or subtract up to 12 hours in 1-hour increments from the UCS DMS-250 switch time to calculate the subscriber's true origination date and time.

Calls failing restricted usage by date and time screening are blocked and given restricted usage treatment. Depending on service subscription parameters, cause-to-treatment mapping may be performed.

For a particular day, time, and date, there can be up to a maximum of 255 defined restriction indexes.

Incoming exclusion

Incoming exclusion prevents subscribers from calling back into their own local calling area. Hence, intrastate traffic that is not permitted for specialized common carrier by individual state public utilities commissions can be blocked.

Incoming exclusion is controlled by the trunk group parameter IEXCLINX by specifying which of the 160 area codes are excluded. Up to eight of these excluded area codes can be further excluded down to the exchange code (NXX) level. Up to 256 incoming exclusion schemes may be specified.

Incoming exclusion is performed only on OFFNET numbers of at least six digits. If the OFFNET number consists of exactly seven digits, the trunk group parameter SNPA is temporarily prefixed onto the dialed digits before screening is performed. This ensures that screening is performed against the intended NPA-NXX combination.

If a DDD number is collected from the dialed digit stream or retrieved from a speed list, the first three or six digits of the ten-digit number are compared against the excluded NPA and NPA-NXX combinations for that originating PRI. Calls that are found to be excluded are given LOCAL CALL AREA BARRED treatment, which may result in treatment-to-cause mapping.

Class-of-service screening

COS screening provides the ability to select on-net, off-net, IDDD, and time-of-day restrictions based on the dialed number received by the UCS DMS-250 switch. This selection is performed based on an index assigned to the AUTHCODE that is filed against the incoming call type.

COS is performed on all call types where interexchange translation is performed (all call types that do not perform ISA direct routing). This includes 0- and 0+ calls. The calling card database is also screened for COS.

Each COS index corresponds to a tuple that can restrict the usage of off-net DDD and IDDD calls. Against each, the ability exists to:

- allow or disallow the call type
- allow the call type and perform time-of-day screening and destination digit screening against the dialed number
- allow the call type, performing no time-of-day or destination digit screening against the dialed number in the COSUS table
- allow the call type, performing time-of-day but no destination digit screening against the dialed number in the COSUS table

Each index to the COSUS table contains additional information required to restrict the types of calls that may originate with the specific COS screening index. The customer may then datafill the action for each COS screening failure. The failure action may be either a treatment, an announcement, or tone.

COS screening may be performed on the following areas:

- IDDD (International Direct Distance Dialing) call allow/disallow
- IDDD restriction screening
- IDDD destination screening over table COSSCRN
- IDDD destination digits screening
- DDD (Direct Distance Dialing) call allow/disallow
- DDD restriction screening
- DDD destination screening over table COSSCRN
- DDD destination digits screening
- ON_NET call allow/disallow
- ON_NET restriction screening
- ON_NET destination screening over table COSSCRN
- ON_NET destination digits screening
- ZERO_MINUS call allow/disallow
- ZERO_MINUS restriction screening
- ZERO_PLUS call allow/disallow
- ZERO_PLUS restriction screening

Table 9-9 compares the COS treatment codes with the COS screening fail reason. The COSUS Treatment Granularity feature generates all of the treatment codes, with the exception of COSX, RSDT, and IDPB.

Table 9-9
COS screening failure treatment codes

Treatment codes	COS Screening Fail Reason
COSX	default value for all of the failure except restriction and IDDD disallow
RSDT	default value for restriction screening
IDPB	IDDD call disallowed
IRET	IDDD day and time restricted/blocked
ISCN	IDDD table COSSCRN screening failed
IDST	IDDD destination digits screening failed
DDPB	DDD call disallowed
DRET	DDD day and time restricted/blocked
DDSN	DDD table COSSCRN screening failed
DDST	DDD destination digits screening failed
ONPB	ON_NET call disallowed
ORET	ON_NET day and time restricted/blocked
OSCN	ON_NET table COSSCRN screening failed
ODST	ON_NET destination digits screening failed
ZMPB	ZERO_MINUS call disallowed
ZMRT	ZERO_MINUS day and time restricted/blocked
ZPPB	ZERO_PLUS call disallowed
ZPRT	ZERO_PLUS day and time restricted/blocked

Multiple COS capability

Multiple COS capability is provided through the use of table MULTICOS (MULTIple COS) screening and the appropriate call processing enhancements. Table MULTICOS creates a one-to-many relationship between a subscriber number (AUTHCODE, ANI, or TCN) and the COSUS table indexes for COS screening. This provides the ability to provision the COSUS table indexes on a more reusable level, such as by geographical regions.

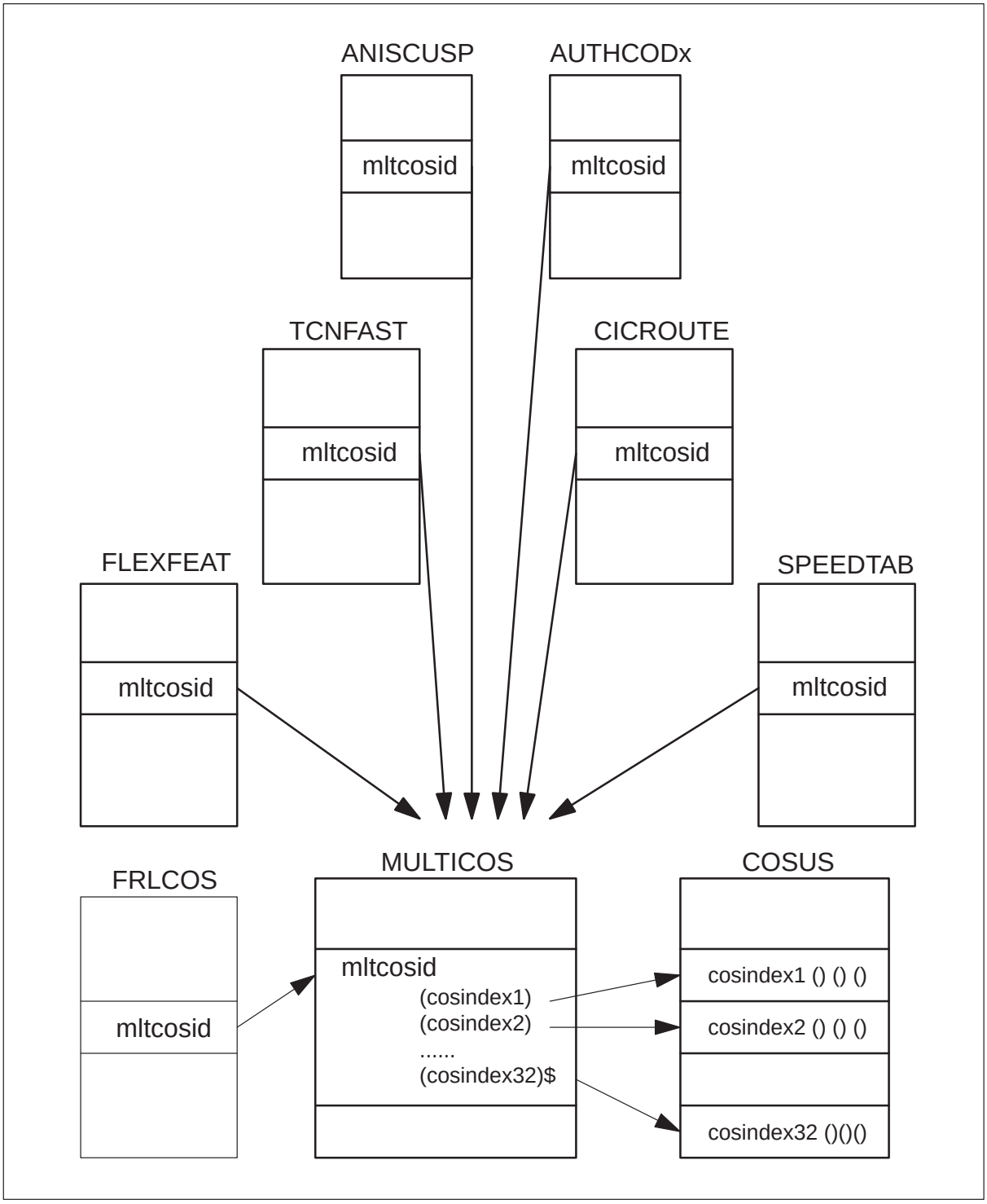
A call that originates on a UCS DMS-250 switch and requires COS screening can access table COSUS multiple times through the MLTCOSID field in table MULTICOS.

The MLTCOSID field in tables ANISCUSP, AUTHCODx, CICROUTE, TCNFAST, FLEXFEAT, FRLCOS and SPEEDTAB is used to access table COSUS multiple times during a single call.

A MLTCOSID index value of zero in tables ANISCUSP, AUTHCODx, CICROUTE, TCNFAST, FLEXFEAT, FRLCOS and SPEEDTAB indicates that no COS screening is required. An entry of zero is not allowed in the MULTICOS table.

Figure 9-9 illustrates table control for MULTICOS.

Figure 9-9
Table control for MULTICOS

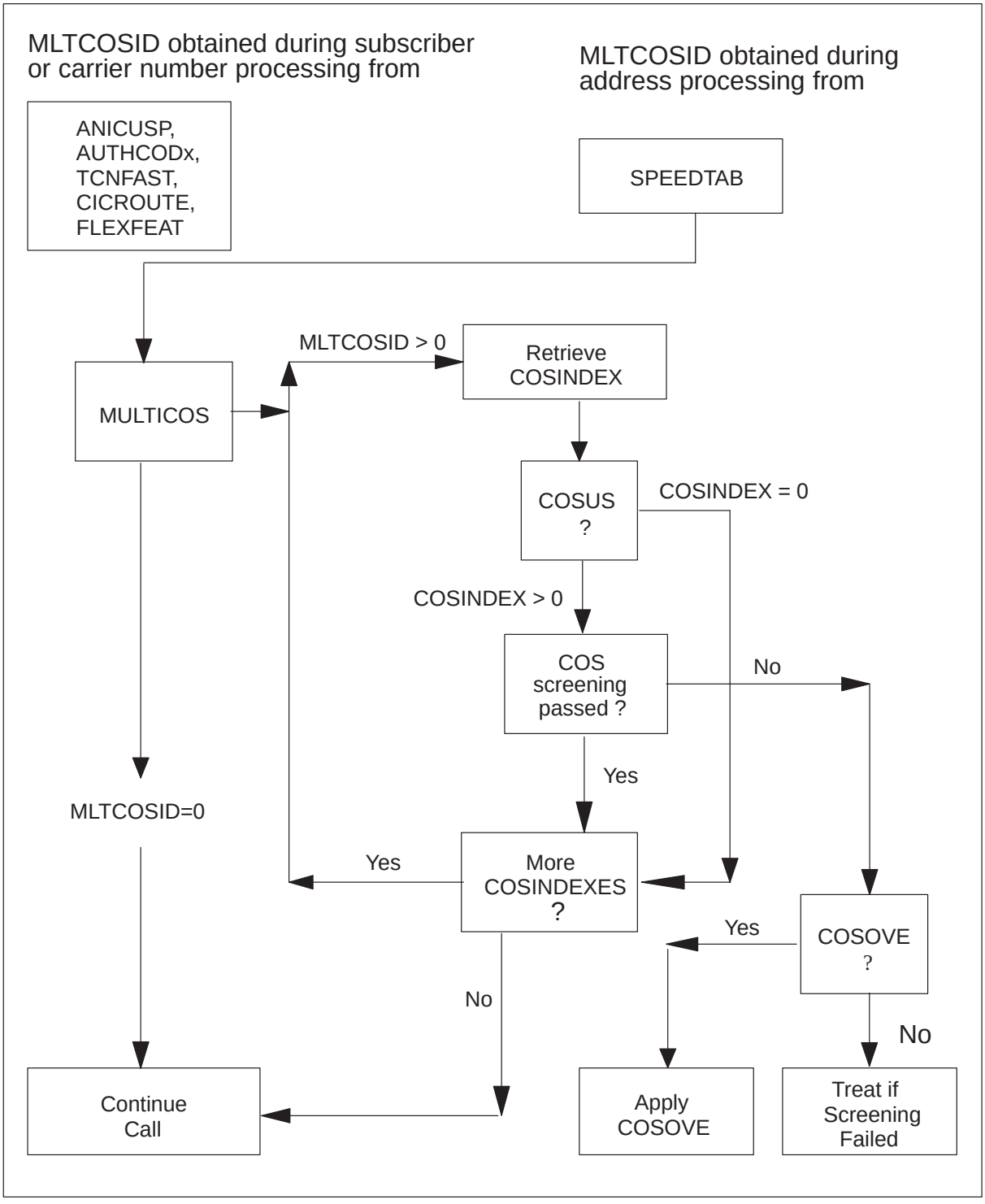


Call processing

COS screening typically occurs during address processing. The value provided by the MLTCOSID option is used to index into table MULTICOS which provides one or more indexes into table COSUS. Each COSINDEX processed, provides the parameters for COS screening to be performed on the received address digits.

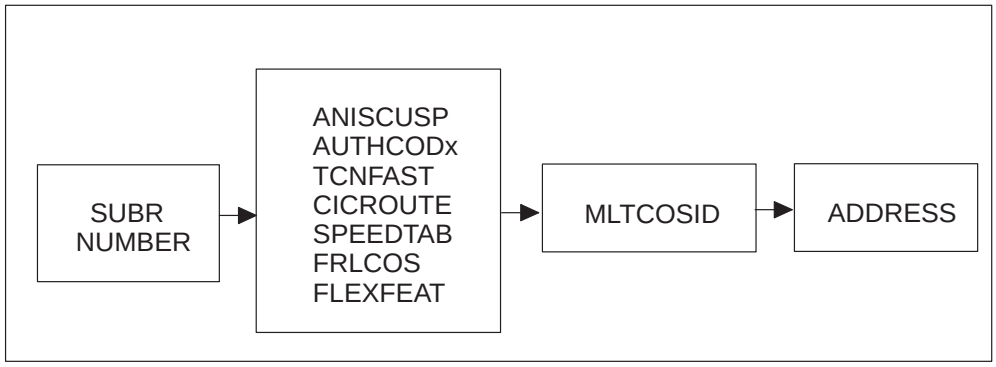
The COS screening option may be processed multiple times during call processing. How each subsequent MLTCOSID option is handled depends on what stage in the call the option is processed. MLTCOSID option processing differs if the option is processed before or after address processing. See Figure 9-10.

Figure 9-10
Call processing for MULTICOS



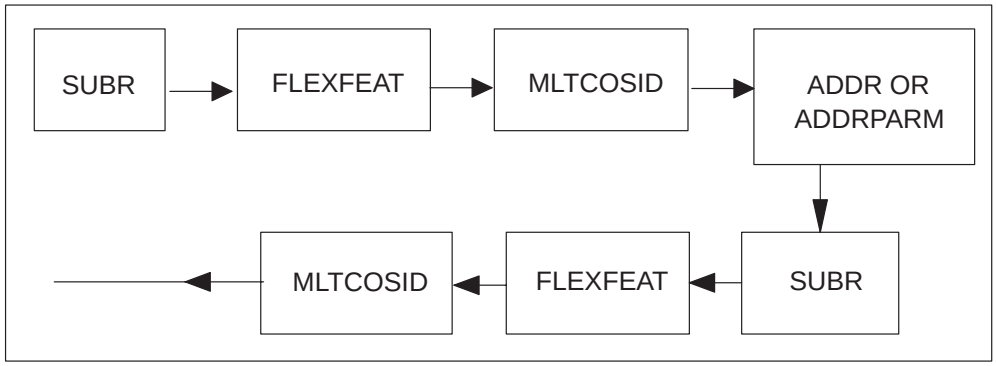
When the MLTCOSID option is processed before the address is collected, the MULTICOS table index is stored. Each time the MLTCOSID option is handled, the current COSINDEX overwrites the previously stored value. See Figure 9-11.

Figure 9-11
MLTCOSID option processed before address collected



With FlexDial framework, the MLTCOSID option can be processed after an ADDR or ADDRPARM collectable is executed. The MULTICOS index is stored, overwriting the previously recorded value. COS screening is then executed (or re-executed) using the new index identified. See Figure 9-12.

Figure 9-12
MLTCOSID option processed after ADDR or ADDRPARM collectable



If COS screening is successful, then processing of the address is completed under normal conditions and processing of the call continues.

If COS screening fails and the COSOVE option is not provisioned, then treatment is set and immediately applied to the call.

If the COSOVE option is provisioned against the originating agent:

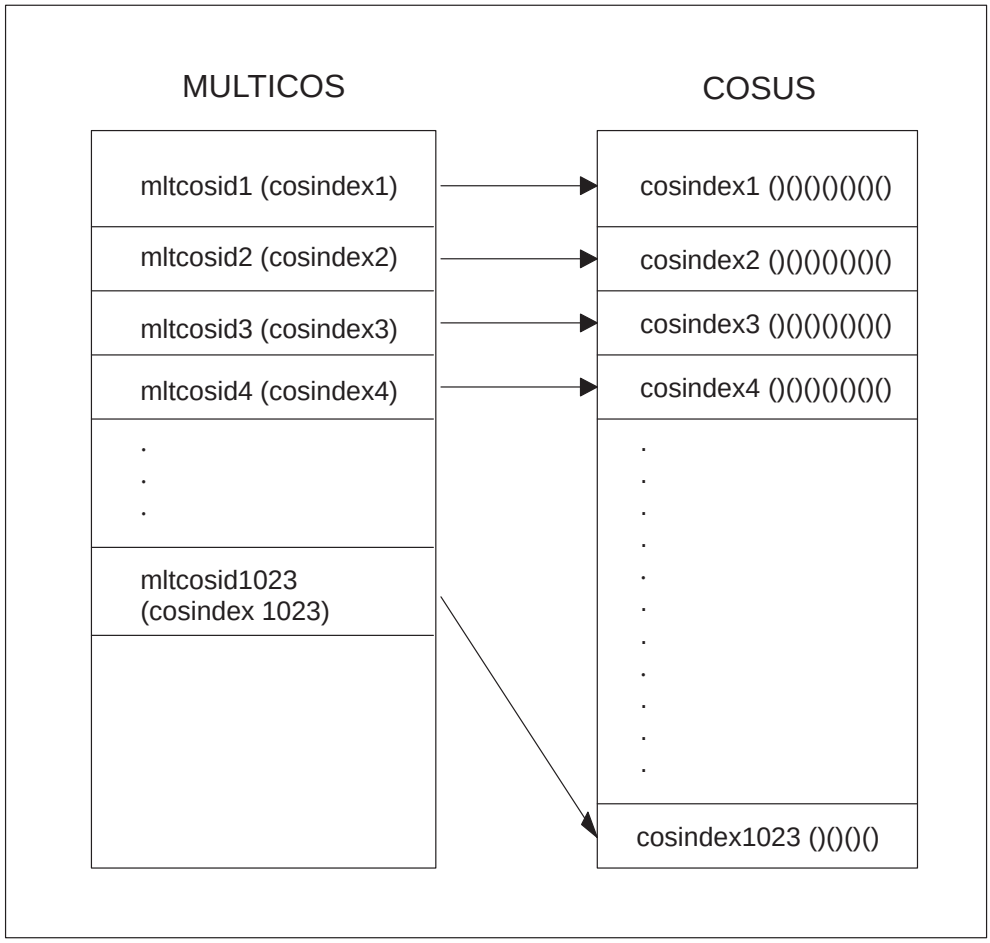
- in table TRKFEAT for AXXESS agents, then the FLEXDIAL table index specified by the COSOVE option is processed and the collectable list identified replaces the remainder of the current collectable list.
- in table TRKGRP for non-AXXESS agents, then call processing prompts the subscriber to dial another number.

For more information on FlexDial, see the *UCS DMS-250 FlexDial Framework Application Guide.*

Initial deployment of MULTICOS

The initial deployment of the MULTICOS table, requires the tuples of table MULTICOS to resemble table COSUS datafill. Only the datafilled tuples in table COSUS should be referenced in table MULTICOS. This redirects the COSINDEX in table COSUS. See Figure 9-13.MULTICOS.

Figure 9-13
Initial deployment of MULTICOS



CALLATTR class-of-service screening

CALLATTR class-of-service screening determines whether the originating and terminating types of trunks are allowed to be connected to each other based on their service class. CALLATTR class-of-service screening is performed on all PRI calls, regardless of whether ISA direct routing is performed.

The CALLATTR class-of-service parameter exists in table CALLATTR for a given PRI and represents a value of 0 to 119. If this combination of originating and terminating trunk group is not allowed, the route choice is abandoned. The next route choice in the route list is considered for termination.

Retranslation for origination PRIs

The UCS DMS-250 switch currently has the ability to assign an outgoing route selector, which indicates that calls terminating to that route are capable of retranslating to another outgoing route. In retranslation, the following can be specified: the STS to use when retranslating the call and a digit manipulation (DIGMAN) index, which is used to add or delete digits from the called number field prior to retranslations. The new digits are then pretranslated and translated according to interexchange carrier translations.

The pretranslator name used cannot be specified. The source of the pretranslator name depends on the nature of the retranslated call. For non-PRI-originated calls, the pretranslator name is taken from table TRKGRP. For PRI-originated calls, the pretranslator name is taken from table CALLATTR and from the CALLATTR tuple used on the originating PRI call.

Satellite screening

PRI is not supported over satellite facilities. All PRI agencies originating on or terminating from the UCS DMS-250 switch must travel over land-based transmission media. Satellite screening, the process of preventing the consecutive use of satellite transmission media, is not applicable to PRI facilities. However, if satellite screening is performed on PRI agencies, the call does not produce an error and satellite screening passes. (Screening indicates that the PRI is a nonsatellite trunk.) Satellite screening always fails for calls that are marked as DATA.

ISA route reference (RTEREF) routing

The UCS DMS-250 switch offers two options for processing incoming PRI calls: interexchange carrier translation and routing (XLAIEC) and ISA route reference routing (ISA RTEREF).

ISA route reference (ISA RTEREF) routing allows calls to be terminated immediately after AUTHCODE validation, without the need for any form of digit interpretation or translations. A comparison between ISA RTEREF routing and interexchange carrier translations can be found in "Interexchange carrier translations versus ISA routing" in this chapter.

The parameters required to invoke ISA RTEREF routing are in table LTCALLS, which contains the data for all call types on a PRI. Each LTID/call type combination may have unique parameters associated with it, providing for a multiple of unique ISA RTEREF combinations.

The LTCALLS fields required to invoke ISA RTEREF routing are provided in the following list:

- LTID—Logical terminal identifier. This field provides the first part of the two-part key into LTCALLS. Each LTID is associated with a PRI (trunk group) and is used to index into service-related parameters for the interface. For a more detailed discussion, refer to "Subscription parameter relationships" in Chapter 7, "PRI subscription parameters."
- CALLTYP—call type. This field is synonymous with call type, which is obtained by the NSF IE of the incoming PRI call. For a more detailed discussion, refer to "ISA call types" in this Chapter.
- XLARTE—translations route. This field indicates the type of translations and routing to be performed on incoming calls of this LTID/call type. For ISA RTEREF routing, this field contains the value XLAIEC.
- CALLATTR—call attributes index. This field provides an index into table CALLATTR, which contains information relating to the AUTHCODE filed against this call type.
- TABNAME—route reference to which all incoming calls of this LTID/call type are routed. The route reference consists of a route table name (such as OFRT) and a route reference number. The table name and route number provide a specific instance in the routing table to which all calls are routed. The presence of data in this field indicates the use of ISA direct routing, as opposed to interexchange carrier translations.
- OPTIONS

Sample tuples in table LTCALLS are shown in Figures 9-14 and 9-15.

The tuple shown in Figure 9-14 indicates that ISA direct routing is to be performed.

Figure 9-14
Tuple indicating ISA direct routing

LTID	CALLTYP	XLARTE	CALLATTR	TABNAME	OPTIONS
ISDN 20	TIE	XLAIEC	25	OFRT 90	$

The tuple shown in Figure 9-15 indicates that interexchange carrier translations are to be performed:

Figure 9-15
Tuple indicating interexchange carrier translations

LTID	CALLTYP	XLARTE	CALLATTR	TABNAME	OPTIONS
ISDN 20	PUB	XLAIEC	25	$	$

When datafilled as shown in Figure 9-15 for CALLTYP TIE, all TIE calls originating on LTID ISDN 20 are routed directly to table OFRT, route instance 90. This routing takes place immediately after AUTHCODE validation is performed, using the authcode datafilled against call attribute index 25.

Conversely, as shown in Figure 9-15 the sample tuple for CALLTYP PUB, all PUB calls originating on LTID ISDN 20 are translated, screened, and routed according to the interexchange carrier translations parameters. This is indicated by the absence of a value for the field TABNAME.

ISA route selector

The primary purpose of the ISA route selector is to provide the outgoing call types for calls terminating to PRIs. Each ISA route selector provides a call type that is transmitted in the NSF IE of the outgoing call SETUP message. The ISA route selector allows identification of the particular outgoing routes as relating uniquely to one of the call types supported on the UCS DMS-250 switch.

Outgoing call types INWATS and FX are supported. In addition, all call types that are supported on incoming calls to the UCS DMS-250 switch are also supported as outgoing call types from the UCS DMS-250 switch.

Bearer capability for PRI

The UCS DMS-250 switch supports the following BC for PRI trunks:

- speech
- 56 kbit/s unrestricted

- 64 kbit/s unrestricted
- 64 kbit/s restricted
- 3.1 kHz audio

Calls that originate on PRIs may be denied access based on the BC specified in the incoming call SETUP message and the service parameters found in table LTDEF.

These service parameters from table LTDEF are the options: NOVOICE, NOVBD, and NOCMD. NOVOICE indicates that the speech BC is not allowed to originate or terminate on the PRI. NOVBD indicates that the 3.1 kHz BC is not allowed on the PRI. NOCMD indicates that PRI is not capable of supporting 56 kbit/s unrestricted, 64 kbit/s unrestricted, or 64 kbit/s restricted BC.

When originating or terminating on a PRI, the service parameters are checked to ensure that the BC specified in the call SETUP message is supported over the PRI.

When interworking between a PRI agency and a non-ISDN agency, tests are performed to ensure that the agency is capable of supporting the specified BC.

When terminating to a PRI, the BC IE is passed unchanged unless the call is marked as data through translations. In the event that the call is marked as data, the following rules apply:

- If the originator is a non-ISDN agency, the BC of 3.1 kHz is sent with the outgoing SETUP message.
- If the originator is a PRI agent but no BC is received, the BC of 3.1 kHz is sent with the outgoing SETUP message.
- If the originator is a PRI agent and the BC is VOICE, the BC of 3.1kHz is sent. If the originating BC is 56 kbit/s, 64 kbit/s, or 3.1 kHz, the BC is passed unchanged.

The PRI SETUP message received from the PBX or the ISDN User Part (ISUP) Initial Address Message (IAM), provides information about a call, including the BC. The low layer compatibility (LLC) is another information type related to the BC.

The network screens calls based on a BC and its LLC. The LLC optional IE is transported across the UCS DMS-250 switch ISUP network by the access transport parameter of the IAM.

BC functions provide the following:

- supplies predefined BCs
- allows the customer to assign/modify BC data
- screens calls based on BCs
- provides interworking support for screening of BCs
- maintains interworking with integrated echo canceller interexchange carrier
- maintains digital data indicator (DDI) functions
- provides billing information based on the call BC

The default BCs provided are the following:

- transfer capability
- transfer mode
- coding standard

All calls over PRI have a BC associated with them. For a call to be completed over PRI, it must be made between trunks having an identical or compatible BC/LLC. Calls made to a terminating trunk with an incompatible BC/LLC after failing to allocate a compatible terminating trunk with route advance, result in the originator receiving a treatment (generated by the route exhaust procedure). The call is not completed.

It is possible for PRIs, DALs, and IMTs (PTS) to originate calls to CCS7 networks over ISUP trunks. It is also possible for ISUP to make calls to these trunk types.

To allow interworking with ISUP trunks, the UCS DMS-250 switch assumes that all calls from other networks (by trunks with traditional signaling or PRI) are speech calls, unless otherwise noted.

To allow interworking with non-ISDN networks, the UCS DMS-250 switch assumes that all calls from other networks (by trunks with traditional signaling) have BC/LLC of speech calls, unless otherwise noted by using the functionality of switch designation 56/99.

BC enhancements involve the following tables: DTUPRO, BCDEF, BCCOMPAT, and TRKGRP. In the TRKGRP table, the BCNAME field is added, and the Digital Data Indicator field is modified.

Calling number delivery

The purpose of the calling party number (CGN) IE is to identify the origin of the call. The calling number delivery service provides this number to the called party except when interworking from a PTS trunk.

Note: There is no call detail record (CDR) indication that the calling number has been delivered to the terminating agent. If the calling number has been delivered, it appears in the ANISP field of the CDR.

Actions at the originating exchange

When a SETUP message is received from the calling user, the network checks to see whether the CGN IE is included. If so, the following rules for the calling number delivery apply:

- If the screening indicator is not present in the CGN, it is set to *user-provided, not screened* and the calling party number provided by the user is sent unchanged in the outgoing SETUP message that goes to the terminating PRI. If the screening indicator is present in the CGN, it is relayed to the terminating PRI.
- If a presentation indicator is provided in the calling party number, it is passed unchanged to the terminating PRI. Otherwise, it is set to the subscription default value *presentation allowed.*

If the SETUP message does not contain the CGN IE, the following rules apply:

- The network uses the default destination number (DN) for this originating PRI to pass into the terminating PRI. The numbering plan indicator (NPI) of the IE is set to *telephony numbering plan (E.164).* If the optional field DFLTCGN is not entered, the CGN is not delivered to the terminating agent (the CGN IE is not delivered).
- The screening indicator is set to *network-provided,* and the presentation indicator is set to the default value *presentation allowed.*

Actions at the terminating exchange

When the network initiates a call to the called user, a SETUP message is sent over the terminating PRI. If the originator of the call is a PRI trunk, the actions described in the preceding section, “Actions at the originating exchange,” are taken.

If the originator is a FGD or FGC trunk, the CGN is relayed as received in the ANI of the originating trunk. In this case, however, the information digits received from the incoming PTS trunk are not relayed to the terminating PRI.

If the CGN is not available due to interworking with a PTS trunk, the CGN IE is not sent over the outgoing PRI. This implies that the PI and SI fields are also not delivered.

Primary rate interface call protocol

PRI call protocol entails CLID screening and determining if a call uses standard PRI call protocol or PRI with dialtone return protocol.

PRI protocol calling line identification screening

Incoming PRI SETUP messages provide two items used in CLID screening. A ten-digit CLID (comprised of an NPA, office code, and station directory number) is used to identify the originator for billing purposes and a CALLTYPE (either PUBLIC, PRIVATE, WATS, or TIE) is used to determine translation and screening requirements. The CALLTYPE and the LTID from table TRKGRP are used to access table LTCALLS. A CALLATTR field in table LTCALLS indexes table CALLATTR, which contains ISDN call type-specific translation and screening parameters.

PRI with dialtone return

PRI with dialtone return initiates a dialing plan that provides subscribers, who are not connected to a FGD office, with a simpler means of interexchange network access. The UCS DMS-250 switch must have DTCIs equipped with UTRs; no changes are made to standard PRI messaging protocol.

For dialtone return, the subscriber first dials an access number. The PBX routes the call to the UCS DMS-250 switch and sends a PRI SETUP message. The UCS DMS-250 switch sends a CALL PROC message to the PBX and screens the CLID field of the SETUP message against a value in table ANICUSP. If the CLID is an allowed ANI, the UCS DMS-250 switch cuts through a voice channel and returns dial tone. This is done on the B-channel requested in the PRI SETUP message by connecting a universal tone receiver to the B-channel trunk. (Calls with disallowed CLIDs are routed to ANI database failure treatment.) The subscriber can now dial the PIN and the address digits of the called party.

Standard PRI call protocol versus PRI with dialtone return call protocol

The value in the OPTION field CUTTHRU of table CALLATTR indicates whether a call should follow standard PRI protocol or the PRI with dialtone return protocol. BILLTYP must be set to CLID in order to enter CUTTHRU in the OPTION field of table CALLATTR. Standard PRI calls and dialtone return PRI calls must be kept on separate CALLATTR indexes and different trunk groups. The only difference between the two protocols is the return of dialtone by the PRI with dialtone return protocol and that PRI with dialtone return collects and routes a subscriber-entered PIN, called party address, and

calling party account code. Only in-switch screening of PIN digits and account codes is available through PRI with dialtone return.

PRI calls

Not all PBXs provide a full ten-digit CLID in the message presented to the UCS DMS-250. Some provide a ten-digit CLID that consists of the NPA, office code, and the PBX station number. Some of the PBXs only provide the station number. This is the reason why a partial CLID received in the incoming SETUP message is valid. The PBX does not the same number of digits to identify a particular station subtending the PBX. A partial CLID received in the SETUP message is not always the same length.

Internally, the UCS DMS-250 always deals with a ten-digit CLID. The UCS DMS-250 must also handle different CLID lengths in the incoming SETTUP message. If the received CLID is ten-digits, the received CLID is used to screen the call. If the received CLID is les than ten-digits, a default CLID is used to construct a full ten-digit field. This field, DEFCLID in table CALLATTR, contains the default CLID. The default CLID contains a (NPA + OFFICE CODE + STATION NUMBER) structure. If a partial CLID is received, the beginning digits starting with NPA of the CLID are missing. The partial CLID and the default CLID construct a full ten-digit CLID. The missing digits are extracted from the beginning of the default CLID and prefixed to the received CLID. For example, if the received CLID (XXXX) is four-digits, then the first six-digits (NPA + OFFICE CODE) of the default CLID are prefixed to the received CLID. This maintains the ten-digit CLID requirement for CLID screening.

Once a complete CLID is available to process, an original received CLID or a restructured CLID, it must be validated. A comparison is made between the working CLID and table ANISCUSP. If a match is not found, the call is given the ANI_DATABASE_FAILURE treatment. If there is a match, the received or reconstructed CLID is checked to be an automatic number identification. If the CLID is a casual ANI, then the default CLID is used to screen the call.

CLID screening is not performed on every PRI-type originating call. CLID call screening is optionally performed based on the table datafill. Field BILLSEL in table CALLATRR is used for this purpose. The billing selector field, BILLSEL, indicates the method of screening to be performed. The alternative to screening the call based on CLID (BILLSEL = CLID) is to screen the call by authcode (BILLSEL = AUTH) or directly route the call without any special screening (BILLSEL = NONE). The NONE case applies to CCS7 IMT trunks and requires a direct route. No translation is required. If NONE is datafilled as the billing selector on a PRI type trunk, the FEATURE_NOT_ALLOWED treatment is generated. If CLID screening is selected, table ANISCUSP controls are used for call processing.

PRI originations

Calls that are CLID billed use the ANIDELV field of table ANISCUSP to control Automatic Number Identification (ANI) delivery for PRI originations. The ANIDELV field is set to either ALWAYS, NEVER, CPNONLY, or CGNONLY. Table 9-10 shows the corresponding parameter delivered for each value.

Table 9-10
ANI delivery on a CLID PRI origination (field ANIDELV of table ANICUSP)

Terminators	ALWAYS	NEVER	CPNONLY	GCNONLY
SS7 FGD	CLID or default CLID*	None	CLID or default CLID	None
PTS FGD	CLID or default CLID*	None	None	CLID or default CLID*
Note: * If CLID is marked as CASUAL, then the default CLID is used.				
—end—				

Calls that are not CLID-billed use the ANIDELV option of table CALLATTR to control ANI delivery. The ANIDELV option appears anywhere in the options vector. Table 9-11 shows the corresponding parameter delivered for each value.

Table 9-11
ANI delivery on a non-CLID PRI origination (option ANIDELV of table CALLATR)

Present	Not Present
CLID**	None
Note: ** If the received CLID is less than ten-digits, then the default DEFCLID is used to construct a full ten-digit CLID.	
—end—	

PRI terminations

The ANIDELV option of table CALLATTR controls delivery of ANI on PRI terminations. The ANIDELV option is found in the options vector for each

tuple in table CALLATTR. If the ANIDELV option is not present in the options vector, no parameters are sent to the terminating trunk. Table 9-12 shows what parameters are mapped to the CLID when the ANIDELV option is present in the options vector.

Table 9-12
ANI delivery on a PRI termination (ANIDELV option of table CALLATTR)

Parameter received	Present	Not Present
CPN, CGN, and OLI	CGN maps to CLID	None
CPN	CLID	None
CGN and OLI	CLID	None
CLID	CLID	None
ANI	CLID	None
PANI	CLID	None
None	None	None

—end—

Customer group transport

Customer group transport lets the identity of customer groups be transported across national and international networks. This allows access and sharing of network resources between customers belonging to different customer groups.

Customer group transport implements customer group transport between a UCS DMS-250 switch and network services software switch using the PRI. This involves creating a unique dialing plan for the PRI such that the customer group information is transported as part of the CGN in the Q.931 SETUP message.

Customer group transport is part of the global virtual private network implementation, which is intended to provide uniform ISDN services between participating networks.

Route Based Outgoing Parameter Modifications

The following paragraphs describe the limitations and restrictions for Route Based Outgoing Parameter Modifications.

- Calling Party Address (CPA) and Charge Number (CGN) Control
- Generic Digits (GENDIGS)

Calling Party Address (CPA) and Charge Number (CGN) Control

The limitation for Calling Party Address (CPN) and Charge Number (CGN) control is as follows:

- Entries related to control of the CGN parameter in table RTEATTR are ignored for calls terminating to PRI agencies.

Generic Digits (GENDIGS)

The limitations and restrictions for Generic Digits (GENDIGS) are as follows:

- Entries related to control of GENADDR parameters in table RTEATTR are ignored for calls terminating to PRI agencies.
- The number of Generic Digits parameters that can be built on PRI terminations is limited by the size of the memory block used to store the parameter information. Each parameter requires 2 bytes of overhead and the digits for the parameter are stored in Binary-Coded Decimal. There are 46 total bytes available for building Generic Digits parameters. Therefore, any combination of GENDIGS parameters that require less than 46 bytes will be delivered completely. Any parameters to be delivered after this limit is reached will not be included in the SCP_C_TERMINATE message.
- Current functionality does not support mapping of Generic Digits parameters on Tandem PRI calls (PRI-PRI, PRI SS7, SS7 PRI). This restriction will be maintained. Therefore, the only Tandem case in which Generic Digits parameters will be passed from the origination message to be outpulsed is SS7-SS7.

Database information

The primary rate interface (PRI) subscription parameters allow customers to support PRI and configure it to their particular needs. The UCS DMS-250 switch assigns the parameters by datafilling a set of software tables.

Database correlation

A number of database items must be correlated in the UCS DMS-250 switch to ensure a properly functioning PRI.

Configuration data correlation

There is no correlation in the hardware-related database.

Layer 1 data correlation

The correlation of layer 1 data is shown in Table 10-1.

Table 10-1
Layer 1 database correlation

Description	UCS DMS-250 switch (table CARRMTC)
Card type	Field: CARD, Value: NT6X50AA, NT6X50AB, or NTX5X50EL
Frame format, Superframe format, Extended superframe format	Field: FF, Value: SF or ESF
Line encoding, Zero code suppression, Binary 8 zero substitution	Field: ZLG, Value: ZCS or B8ZS
Bit error ratio base, Bipolar violation, CRC errors	Field: BERB, Value: BPV or CRC
Data link, No data link, FDL - source ext, FDL - source is 2	Field: DLK, Value: NILDL, FDL, or FDL2
Inhibit alarm transmit	Field: IAT, Value: Y or N

—continued—

Table 10-1
Layer 1 database correlation (continued)

Description	UCS DMS-250 switch (table CARRMTC)
Bit error ratio maintenance limit	Field: BERML, Value: 6 (exponent)
Bit error ratio out-of-service limit	Field: BEROL, Value: 3 (exponent)
Errored second threshold	Field: ES, Value: 864
Frame bit error maintenance limit	Field: FRAMEML, Value: 17
Frame bit error out-of-service limit	Field: FRAMEOL, Value: 511
Slip count maintenance limit	Field: SLIPML, Value: 4
Slip count out-of-service limit	Field: SLIPOL, Value: 255
—end—	

Layer 2 data correlation

The correlation of layer 2 data is shown in Table 10-2.

Table 10-2
Layer 2 database correlation

Description	UCS DMS-250 switch (table TRKSGRP)
Associate D-channel with PRI	Field: DCHNL, Value: Timeslot on DS-1 of the PRI D-channel
Data rate of D-channel	Field: DCHRATE, Value: 56 kbit/s or 64 kbit/s

Layer 3 facility data correlation

The correlation of layer 3 facility data is shown in Table 10-3.

Table 10-3
Layer 3 database correlation

Description	UCS DMS-250 switch
Q.931 interface identifier	Table: LTCPSINV, Field: IID, Value: 0 ***Note:*** When datafilling multiple DS-1s for each trunk group, use a unique IID for each DS-1.
Q.931 call reference value length	Table:TRKSGRP, Field: CRLENGTH, Value: 2
B-channel selection	Table: TRKGRP, Field: SELSEQ, Value: ASEQ, DSEQ, or WIDEBAND
Loss and level	Table: TRKGRP, Field: PADGRP, Value: NPDGP
User-network interface	Table: TRKSGRP, Field: IFCLASS, Value: NETWORK
Q.931 progress indicator location	Table: TRKSGRP, Field: LOCATION, Value: NETWORK
B-channels defined	Table: TRKMEM, Field: PMTYPE, Value: DTCI, Fields: DTCICKTTS, DTCICKTNO

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.

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

Table descriptions

Figure 10-1 shows the interdependencies of tables within the UCS DMS-250 switch and the resulting datafill order. Tables are datafilled from top to bottom. Tables at the same vertical position (in the figure) can be datafilled in parallel.

The following paragraphs describe the hardware configuration used to provide PRI facilities on an integrated services digital network (ISDN) digital trunk controller (DTCI).

Figure 10-1
UCS DMS-250 switch datafill order for ISDN PRI tables

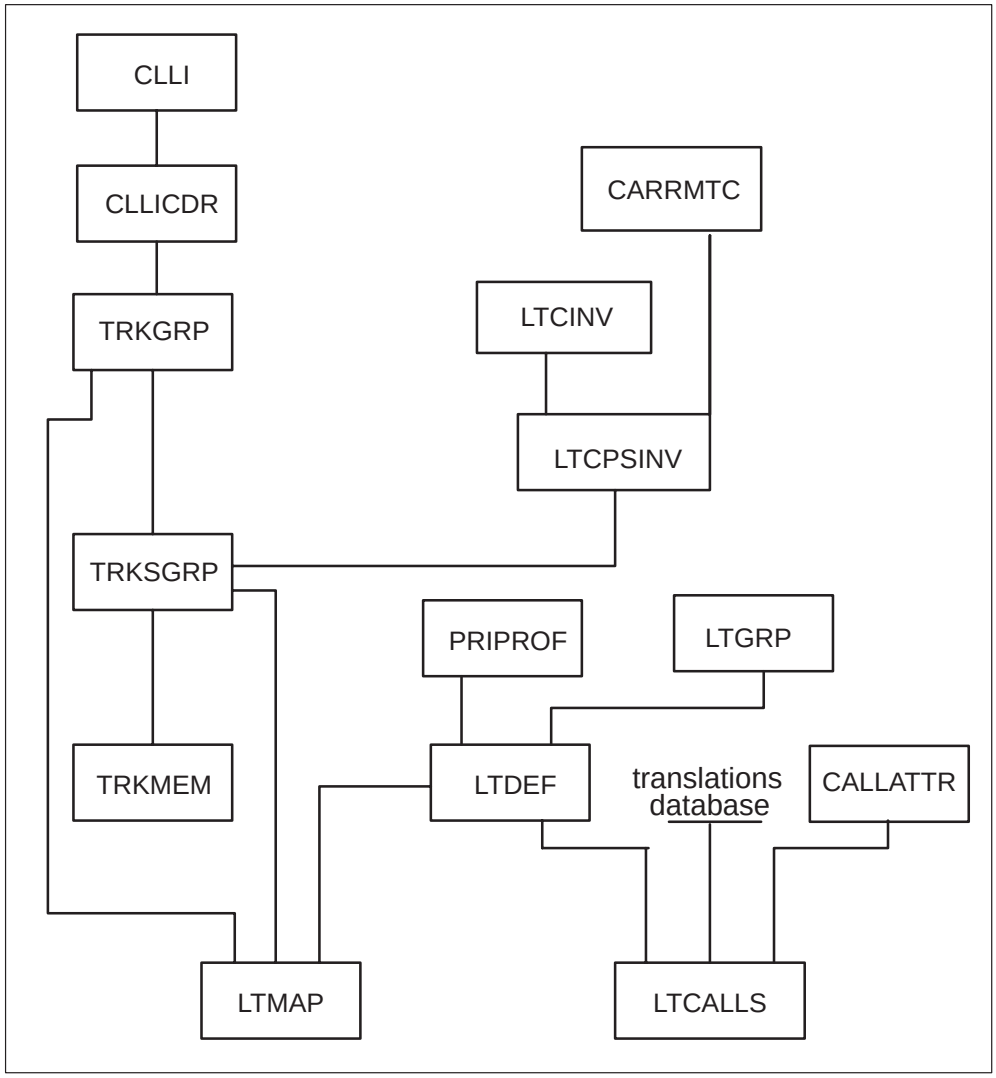


Table CLLI

The common language location identifier (CLLI) codes (maximum of 1024) are used to uniquely identify the far end of each announcement, service circuit, test trunk, tone, and trunk group.

Table CLLI contains three fields from left to right, in the following order:

- CLLI
- TRKGRSIZ
- ADMININF

CLLI field

The 16-character alphanumeric CLLI field must start with an alpha character (and contain no special characters). It is recommended that a CLLI code contain no more than 12 characters.

The recommended subfields for a CLLI code are

- PLACE (four characters)
  - — PLACE identifies the city or town at the far end of each trunk group, or the name for each tone, announcement, test trunk, or service circuit.
- PROV (two characters)
  - — PROVINCE or STATE identifies the province or state at the far end of the trunk group.
- BLDG (two characters)
  - — BUILDING identifies the building number at the far end of the trunk group.
- TRAFUNIT (three characters)
  - — TRAFFIC UNIT identifies the designation of the traffic unit at the far end of the trunk group (not currently used for UCS DMS-250 switch).
- SUFX (one character)
  - — SUFFIX uniquely identifies trunk groups that terminate at the same CLLI location (not currently used for UCS DMS-250 switch).

TRKGRSIZ field

The TRKGRSIZ (trunk group size) field contains a numeric value in the range of (0 to 2047). Set this field to equal the maximum number of trunks that are assigned to a trunk group. The value in this field allocates store, so it may be greater than the number of initial working trunks.

ADMININF field

The 32-character alphanumeric ADMININF (administration information) field is treated as a character string. Subfields are separated by periods, and the string ends with a blank. The operating company uses this field to record administrative information (not used by the switch).

The recommended subfields for ADMININF are

- TRAFCLS (alphanumeric)
  - — TRUNK GROUP TRAFFIC CLASS. Optional, for administrative purposes only. If not required, enter a dash. Otherwise, set it equal to a traffic class defined in operating company practices.

- OFFCLS (alphanumeric)
  - — OFFICE CLASS. Optional, for administrative purposes only. If not required, enter a dash. If the TRKGRTYP subfield is blank, leave this subfield blank. Otherwise, set it equal to an office class defined in operating company practices.
- TRKGRTYP (alphanumeric)
  - — TRUNK GROUP TYPE. Optional, for administrative purposes only. If not required, leave blank. If CLLI is set to SPAREnnnnnn, set this subfield to SPARE. Otherwise, set it to equal a trunk group type defined in operating company practices.

Sample entries for table CLLI fields (for a toll switch) are shown in Table 10-4.

Table 10-4
Sample entries for table CLLI fields

CLLI	TRKGRSIZ	ADMINF
HLFSNS0101T0	24	PH.43.IT
OTWAON23CG00	225	FG.45.DTS
OTWAON23CG01	30	CO.54.CA
OTWAON2323H1	150	LA.54.LA
FPOT	0	MI
LKOUT	0	MI
IDLE	0	MI
CF3P (Note 1)	12	MI
TERM102T (Note 2)	10	MI
TERM102L (Note 2)	0	MI
TERM100Q (Note 2)	0	MI

Note 1: This pseudo-fixed CLLI code is associated with the three-port conference circuits in a toll switch.

Note 2: The recommended CLLI codes TERM102T, TERM102L, and TERM100Q are associated with the terminating 102 test lines in a switch.

Table CLLICDR

The CCLICDR table associates the originating CLLI with the terminating trunk group number identified in the call detail record (CDR).

This table must be datafilled before restoring a load (after a load dump) and after datafilling table CLLI.

Table CLLICDR contains two fields:

- CLLINAME (alphanumeric)
  - — Enter any CLLI name that exists in table CLLI.
- EXTNUM (0 to 9999)
  - — EXTERNAL NUMBER. Enter the value for the external number to be associated with a CLLI name in the CDR.

Example:

CLLINAME	EXTNUM
DMODEMC	2145
TERM105T	2258

Table LTCINV

This table maintains a list of line-trunk controller-based peripherals that are datafilled in the UCS DMS-250 switch. It identifies where the ISDN DTC (DTCI) is located, the load and exec lineups required, and the network link connections.

Fields of importance in the TERMTYPEs vector include the following:

- TERMTYPE—PRAB must be datafilled.
- EXEC—datafill as UTR250.

Another important field of importance is OPTCARD; its vector must include ISP16.

ITA configuration (LTCINV)

The TERMTYPES vector in table LTCINV must be datafilled as follows to configure integrated trunk access (ITA) on DTCI:

- TERMTYPE—PRAB must be datafilled.
- EXEC—Datafill as UTR250.
- TERMTYPE—AB250 must be datafilled.

- EXEC—Datafill as UTR250.
- TERMTYPE—ABTRK must be datafilled.
- EXEC—Datafill as DTCEX.

Table LTCPSINV (LTC P-side inventory)

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

Important fields of importance in the P-side links vector for PRI trunks include the following:

- AREASELECT—must be DS1PRA.
- CARRIDX—as defined in table CARRMTC.
- Information identification (IID)—must be unique for each DS-1 within a PRI trunk group.

```
Example:
    0  DS1PRA  DEFAULT  N  0  NIL
```

An important field of importance in the P-side links vector for per-trunk signaling (PTS) trunks is AREASELECT, which must be DS1.

```
Example:
    0  DS1PRA  DEFAULT  N
```

Table CARRMTC

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

The following is an example tuple:

```
DTCI  DEFAULT  255 255 DS1 NT6X50AB MU_LAW  SF  B8ZS  BPV
NILDL  N  250  1000  50  50  150  3  6  864  100  17  511  4  255
```

The DS-1 link can be configured in four basic operational modes:

- SF/ZCS
- SF/B8ZS
- ESF/ZCS

- ESF/B8ZS

Levels for performance parameters of DS-1 links can be changed from their default values. Although the DS-1 card type can be either NT6X50AA or NT6X50AB, the card type must be specified as NT6X50AB or NT6X50EL, because the NT6X50AA card cannot support 64kbit/s clear data rate.

SF/ZCS

Superframe (SF) format and zero code suppression (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 bipolar 8 zero substitution (B8ZS) line encoding allow the passing of 64 kbit/s unrestricted information. (All bytes/octets are passed transparently.)

ESF/ZCS

Extended superframe (ESF) format and ZCS line encoding are like SF/ZCS except that the yellow alarm is sent through the facility data link, and cyclic redundancy check 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 may be specified. The defaults are given in parentheses.

- bit error ratio base—bipolar violations or cyclic redundancy check (available with ESF framing)
- 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 (10^{-6})
- bit error rate out-of-service limit threshold expressed as a negative exponent of 10 (10^{-3})
- errored second limit (864)
- severe errored second limit (100)

Changing attributes

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

- Make sure the associated carriers are either man-busy (MANB) or offline (OFFL).
- Create a new tuple, if necessary, in table CARRMTC with the required attributes. Usually, the best way to do this is to copy an existing tuple and change only the fields that you want modified.
- In the P-side inventory table LTCPSINV assign the new tuple to the desired DS-1 carriers.
- Busy and return the carrier to service.

UCS DMS-250 switch PRI facility-related tables

UCS DMS-250 switch PRI facility-related tables describe the characteristics of the hardware interface and B-channel allocation.

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

Table TRKGRP

For all applications (PRI and non-PRI), table TRKGRP defines data associated with each trunk group interface.

The following is an example tuple in table TRKGRP:

GRPKEY GRPTYP	TRAFSNO PADGRP	NCCLS	GRPINFO
ATRTRK ATR	0 NPDGP	NCIT 7	16

Important fields include the following:

- GRPTYP—used for call processing. For PRI, this should always be PRA250, as shown in the preceding example.
- WBGRPING—specifies the trunk selection method used by wideband call on a particular trunk group. The range of values is FIXED, FLOATING, or FLEXIBLE.
- SELSEQ—For PRI narrowband services, ASEQ (ascending sequential) or DSEQ (descending sequential) is used. The other end of the trunk uses the opposite value to reduce B-channel glare.
- NSFDFLT—default network-specific facilities. Applied to calls when no network-specific facilities (NSF) is applied.
- LTID—read-only field is composed of LTGRP (ISDN) and LTNUM (555). Upon making an entry in table LTMAP, the two parts of the LTID field are automatically updated.
- DDI—allows the call processing task to screen calls to allow route selections of data only, voice only, or mixed (default). The DDI field is applicable to the following trunk group types:
  - — dedicated access line (DAL)
  - — off-network access trunk (ONAT) for FGB and FGC
  - — equal access network trunk (EANT) for DAL FGD, PTS FGD, and ISUP FGD
  - — PRI
  - — intermachine trunk (IMT) for PTS IMT, ISUP IMT, ISUP IMT reseller, and ISUP RLT
- OPTIONS
  - — This field eases the introduction of new features and fast features.
  - — A field is activated by typing its symbolic name in the OPTIONS vector.
  - — A field is deactivated by deleting its symbolic name from the OPTIONS vector. If no fields are to be added to the OPTIONS vector, a $ is typed in the first OPTIONS field.

Table TRKSGRP

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

The following is an example tuple:

```
K2KPRI64CL 0 DS1SIG ISDN 15 15 87Q931 2 N STAND +

    NETWORK PT_PT PVTNET Y UNEQ 16 PRANODE N
    DEFAULT DTCI 10 0 24 64K HDLC $
```

Important fields include the following:

- CARDCODE
  - — DS1SIG is the card code used for ISDN PRI.
- SIGDATA
  - — This is 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 considered the network (user) end of the protocol. It is recommended that the UCS DMS-250 switch be datafilled as the network end of the PRI trunk.
- DCHNL
  - — The main D-channel used for this PRI interface. It consists of:
    - – DTCINO
    - – DTCICKTNO
    - – DTCICKTTS
    - – DCHRATE (data rate of D-channel values are 64 and 56 kbit/s)

To configure ITA on DTCI, the non-PRI trunk groups must be datafilled in Table TRKSGRP along with PRI trunk groups.

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

Example of tuples:

```
K2KPRI64CL 1 0 DTCI 10 0 1
K2KPRI64CL 2 0 DTCI 10 0 2
K2KPRI64CL 3 0 DTCI 10 0 3
```

Important fields include the following:

- EXTRKNM—first digit of the key of this tuple should be (but is not required to be) the same as the DTCI circuit time slot number to ensure that trunk selection is done in the correct order.
- PMTYPE—peripheral module type used for PRI is DTCI.

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

Example of 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
K2KABTRK2  1 0 DTCI 10 0 5
```

The AREASELECT field in P-side links vector of the DTCI tuple in table LTCPSINV must be DS1PRA for ITA.

PRI service-related tables

The parameters in the following tables describe the type and level of services provided on the PRI interface.

The tables used to describe these logical characteristics of the interface are

- PRIPROF
- LTDEF
- LTCALLS

The mapping of these logical attributes to the physical interface is done through table LTMAP.

Table PRIPROF

This table holds data about the status of function switches that define a particular issue of a variant. When this table is initialized, the default values for the fields are invoked.

Important fields include the following:

- PROFNAME

  — An eight-character string (user-defined). Default is NIL.
- VARIANT

— The contents of this field specifies one of three protocols the profile name is to be associated with. Possible values are NTNAPRI or N449PRI. Default is NTNAPRI.

- ISSUE

  — The contents of this field specifies the release issue of the variant. Possible value is V1. Default is V1.

- Profile

  — A vector of up to 64 function switch names. Default is NIL.

Function switches (for PROFILE vector)

To provide complete interworking between the UCS DMS-250 switch and an SL-1, the following function switches have been implemented for protocol variant NTNAPRI.

- NOPIALRT

  — Do not put PI in the ALERT message if sending to an SL-1.

- XPLCTIID

  — Do not use implicit IID if SL-1.

- CIXBIT0

  — Always set extension bit to 0 in channel number byte of the channel identification.

- CSE27T47

  — The SL-1 cannot handle a cause of 27 (dest_out_of_service). This function switch changes the cause value to 47 (resource unavailable).

- RMBCSE82

  — The SL-1 sends a cause of 82 (identified channel does not exist), then the UCS DMS-250 switch sets the channel RMB.

  Note: To meet interworking requirements for interfacing with an SL-1 switch, one or more of the function switches must be datafilled as enabled for protocol variant NTNAPRI.

Table LTDEF

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

Important fields include the following:

- LTAP

  — The access privilege of the LT; must be B for PRI.

- VARIANT
  - — The contents of this field specifies the protocol variant for a particular interface.
- ISSUE
  - — The contents of this field contains a specific release of a PRI variant.
- OPTIONS
  - — The options NOVOICE, NOVBD, NOCMD, and NOPMD 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

The LTCALLS table defines service-related data associated with the call type.

Call types supported by this table include public, private,WATS, INWATS, FX, and TIE.

Inside the OPTIONS field of this table is the selector THROTL, which contains two pieces of information:

- RSVCALLS—The number of reserved trunk members for a calltype.
- MAXCALLS—The maximum number of members allowed for a specified calltype over the designated trunk group.

The following is an example tuple (call type = TIE):

```
ISDN 1 TIE TABNAME 28 (OFRT 230) (THROTL  10 15)$
```

The TABNAME field points to subtable INDEX, which contains route lists to route or translate calls.

SD OUTGO1
(S represents a selector, D represents a trunk type, and OUTGO1 is the CLLI name of the outgoing trunk.)

For wideband services, the following trunk types are supported:

- S — Standard
- T — Table routing
- N — Non-standard
- ST — Allows chaining of route lists
- CND — Time of day screening
- RX — Retranslation
- EXDS — Extended digit screening
- ISA — PRI routing (except for OHQ and CBQ)

The following selectors are not supported for wideband services:

- SQ — Standard queuing
- NQ — Non-standard queuing
- QH — Queue header
- TPBX — Tandem PBX
- MEM — Member selection
- FEAT — For international IMTs
- ISA — OHQ and CBQ options

Table LTMAP

This table maps logical terminal identifiers) to CLLIs. Once an entry has been made in LTMAP, table TRKGRP is automatically updated. The TRKGRP field LTID is changed from $ to the LTGRP, and LTNUM is entered in LTMAP.

Example of a tuple:
ISDN 555 CLLI K2KPRI64CL (TEI 0) $

Important fields include the following:

- MAPTYPE—always CLLI for PRI.
- CLLI—name of the PRI trunk datafilled in table TRKGRP.
- OPTIONS—only valid entry in this field is TEI 0.

CI command DISPDCH

The command DISPDCH is not supported for DTCI D-channel handler (DCH). The following message displays when the CLLI corresponds to a DCH on a DTCI:

There is no DCH associated with this trunk group.

System performance: operational measurements and logs

This chapter describes operational measurements (OM) and logs for the following areas:

- Layer 1—DS-1 OMs and logs
- Layer 2—Link Access Procedure on the D-channel (LAPD) OMs
- Layer 3—Call processing OMs

Operational measurements

The operational measurement (OM) system on the UCS DMS-250 switch acquires, maintains, and displays operating data that provides indications of performance of various parts of the UCS DMS-250 switch. The OM system acquires OM data from hardware and software sources in the UCS DMS-250 switch.

OM information is gathered through scans of equipment components and activities. Data is collected, stored, and output according to a series of parameters defined by 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 increment 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 be directed (or scheduled in advance) to appear at a specified output device.

Logs

Log reports are subsystem messages that are the result of tests, software errors, and equipment diagnostics. OMs and logs can be used together to pinpoint the exact location of a problem.

Layer 1 OMs and logs

DS-1 operational measurements

The DS1CARR OM group monitors the performance of DS-1 lines. This OM group replaced the CARR OM group. Provisioning for the registers in the DS1CARR group is done for each DS-1 line.

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

- DS1OMINF—This field consists of the overall carrier sequence number followed by the site, the peripheral module (PM) type, the external PM sequence number, and the DS-1 line number within the PM.
- DS1LCGA—This field counts the number of times a DS-1 local carrier group alarm is received from the peripheral module.
- DS1RCGA—This field counts the number of times a DS-1 remote carrier group alarm is received from the peripheral module.
- DS1BER—This field counts the number of times the out-of-service or maintenance limits for bit errors (counted as defined in CARRMTC) have been exceeded. (This field replaced DS1BPV.)
- DS1LOF—This field counts the number of occurrences of DS-1 loss of framing 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 the carrier was in a system_busy state.
- DS1MBU—This field is a usage count of the amount of time the carrier was in a man_busy state.
- DS1PBU—This field is a usage count of the amount of time the carrier was in a PBSY state because the P-side (remote) peripheral was not in service.
- DS1CBU—This field is a usage count of the amount of time the carrier was in a CBSY state because its C-side peripheral (in this case, the ISDN digital trunk controller, or DTCI) 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.

- DS1AIS—This field contains the count of the messages that are received from the PM, indicating that the PM has received an alarm indication signal (AIS).
- DS1ECF—This field contains the count of the number of echo canceler failures in the DS-1 carrier during a 10-minute audit period. The TRK109 log is generated by the trunk maintenance subsystem when a test of a DS-1 fails.

DS-1 carrier logs

The following DMS-250 logs are output in relation to events on DS-1 carrier.

- PM109 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.
- PM110 is generated by the PM subsystem when BPV, SLIP, MTCE, or OOS limits are set or cleared; or when the carrier card fails maintenance or is replaced.
- PM111 is generated by the PM subsystem when a system-busy carrier is returned to service.
- PM112 is generated by the PM subsystem when a carrier slip counter is initialized.
- PM186 is generated by the PM subsystem as a general information log for carriers.

Layer 2 OMs

DCH (ISDNLL) operational measurements

The ISDNLL OMs are used to monitor the performance of the logical links and the associated D-channel handler (DCH) cards.

The following registers are used:

- ILLS16TX—This field counts the number of service access point identifier (SAPI) 16 frames transmitted. For PRI, it is always zero (0).
- ILLS16RX—This field counts the number of SAPI 16 frames received. For PRI, it is always zero (0).
- ILLS0TX—This field counts the number of SAPI 0 I-frames transmitted. It should be nonzero on an in-service DCH.
- ILLS0RX—This field counts the number of SAPI 0 I-frames received. It should be nonzero on an in-service DCH.
- ILLREJTX—This field counts the number of times a DCH's transmitted I-frame has been rejected.

- ILLREJRX—This field counts the number of times a DCH receives an I-frame with an invalid send sequence number and sends a REJ S-frame.
- ILLDISC—This field counts the number of times an I-frame is discarded because of Integrated Services Digital Network (ISDN) access controller congestion.
- ILLLORNR—This field counts the number of transitions to the Receiver Not Ready state. This field counts the number of times the DCH is in this state as opposed to the number of messages lost as a result of being in RNR state, and indicates that the Meridian SL-1/100 is overloading the UCS DMS-250 switch.
- ILLRMBSY—This field counts the number of times a DCH receives an RNR S-frame. It indicates that the Meridian SL-1/100 is being overloaded at times by the UCS DMS-250 switch.
- ILLPRSBM—This field counts the number of times a DCH receives a set asynchronous balanced mode extended (SAME) U-frame to initiate link establishment or reestablishment.
- ILLINVTE—This field counts the number of received frames containing an invalid TEI.
- ILLCRC—This field counts the number of received frames with cyclic redundancy check errors. Numbers greater than 100 per day indicate errors at layer 1.

Level two OMs

The OM group PRADCHL2 monitors layer 2 traffic traveling over the PRI D-channels.

Layer 3 OMs

Call processing OMs

Layer 3 PRI call processing performance can be monitored from two main OM groups: trunk group (TRK) and treatment. For any primary rate interface (PRI), 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 done for each trunk group.

The following list describes TRK OM registers and their use:

- 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 is 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 timeout, 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 is dropped because the peripheral module detected an origination before it could seize the trunk.
- OUTFAIL—This field counts the number of times 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 tracks the amount of time directional reservation is activated for this two-way trunk group.
- PREU—This field tracks the amount of time protective reservation is activated for this two-way trunk group.
- 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 counts 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 counts the number of trunks found to be in the following states:
  - tk_man_busy

— tk_seized

— tk_nwm_busy

- OUTMTCHF—This field counts the number of attempts to get a network path from an incoming agent to a selected trunk of this group that fail because of network blockage.
- CONNECT—This field counts the number of outgoing seizure attempts on this trunk group that appear to result in successful connections.
- TANDEM—This field counts the number of calls incoming on this trunk group initially routed to an outgoing trunk group.
- AOF—This field counts the number of incoming calls where automatic number identification failure has been detected. This is not applicable to PRI trunks.
- ANF—This field counts the number of incoming centralized automatic message accounting or traffic oriented position system calls where automatic number identification failure is detected. This is not applicable to PRI trunks.
- TOTU—This field is the sum of the fields TRU, SBU, and MBU.

Treatment OMs

The OM groups for treatments are described as follows.

Table 11-1
Treatment OMs

OM groups	Treatment			
Customer unauthorized	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 an improper procedure for the action to be performed.			
	These treatments are			
	INAC	CNDT	MSCA	MSLC
	UNCA	HNPI	UNOW	TDND
	UNIN	TESS	DNTR	UNPR
	NOCN	INAU	TINV	CNOT
	DCFC	DODT	RSDT	FNAL
	UMOB	ANIA	NACK	CACE

—continued—

Table 11-1
Treatment OMs (continued)

OM groups	Treatment			
	D950	N950	ILRS	ORSS
	DACD	ADBF	FDNZ	CCNV
	CCNA	LCAB	INCC	ANBB
	IVCC			
Customer miscellaneous	These treatments explain call situations attributable to customer action but not related to authorization. This does not include treatments used to mark the progress or completion of call features.			
	These treatments are			
	UNDT	PDIL	PSIG	VACT
	UNDN	BLDN	OPRT	TRBL
	ANCT	DISC	BLPR	ATBS
	TDBR	VACS	ANTO	CFWV
	VCCT	ATDT		
Equipment related	These treatments handle failures resulting from switching equipment malfunction. This does not include treatments used to handle software or hardware resource shortages.			
	These treatments are			
	SYFL	SSTO	PNOH	PTOF
	NMZN	ERDS	STOB	STOC
	INOC	AIFL	FDEER	CONP
	NCFL	NONT	NCUN	
Feature related	These treatments explain call situations that are attributable to a certain call feature, whether plain old telephone service, integrated business network, or other. This does not include treatments that deny access to features for reasons of authorization.			
	These treatments are			
	BUSY	MANL	ORMC	CONF
	RRPA	ORAF	TRRF	ORAC
	ORMF	SRRR	PMPT	PRSC

—continued—

Table 11-1
Treatment OMs (continued)

OM groups	Treatment			
	MHLD	PGTO	CCTO	NINT
	NCIX	NCII	NCTF	
Resource shortage	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.			
	These treatments are			
	NOSC	NBLN	EMR1	EMR2
	CQOV	NCRT	NECG	FECG
	TOVD	EMR3	EMR4	SORD
	GNCT	EMR5	EMR6	NOSR
	CGRO			
—end—				

OM thresholding and alarming (NTX385AA)

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 a specified alarm level and threshold. 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 associated with log OM2200 are displayed at the EXT level of the MAP terminal and are as follows:

- OMNOALARM (NA)
- OMMINOR (MN)
- OMMAJOR (MJ)
- OMCRITICAL (CR)

Service verification

This chapter outlines the verification of the various services and describes the following:

- steps performed to guarantee that services function properly
- steps taken to isolate problems when they occur

Call setup service over PRI

To ensure that calls over a primary rate interface (PRI) can be placed successfully, put the PRI-related facilities into service and perform T100 and T102 tests.

Putting PRI-related facilities into service

To put PRI-related facilities into service, perform the following steps.

Step	Action
1	Ensure the carrier is in service (INSV). “Verification of PRI facility on UCS DMS-250 switch” in this chapter describes how to bring a carrier into service.
2	Ensure the PRI trunk is in service and idle (IDL). “Verification of PRI facility on UCS DMS-250 switch” in this chapter describes bringing a PRI into service.
3	Datafill the PRI-related tables. “PRI datafill verification” in this chapter describes PRI-related tables and their functions.

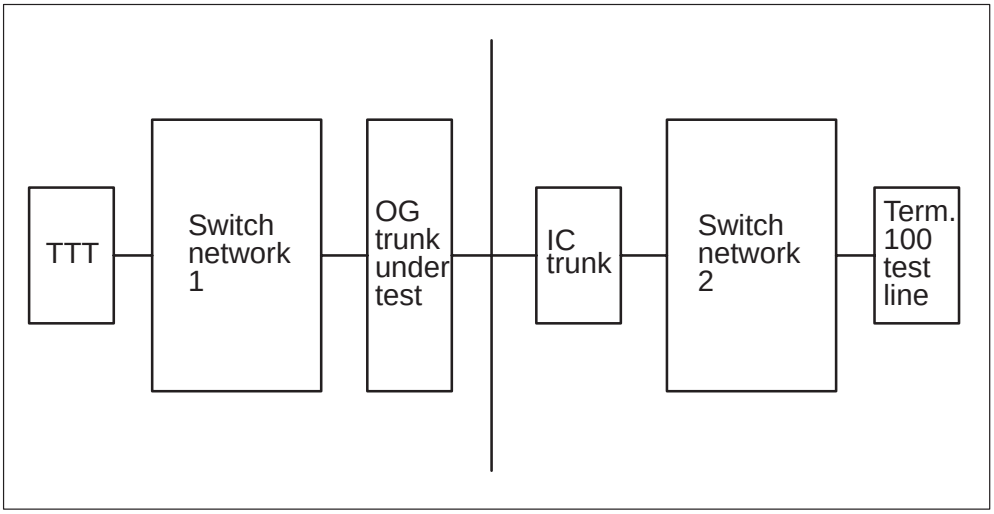
TL100 tests over PRI trunks

The TL100 Test, also known as a quiet or balanced termination, provides noise and loss measurements. There are three versions of the test:

- T100
- N100
- S100

A block diagram of the TL100 configuration is shown in Figure 12-1.

Figure 12-1
TL100 configuration



T100 test

You can use test (TST) commands from the trunk test position (TTP), manual, and monitor levels of the MAP terminal to execute a T100 or T102 test.

If you know the version of the distant office test line, you can perform that version directly, and a 2 s delay per trunk is not required. Otherwise, perform the T100 test.

When the T100 test line test is performed, a 2 s time-out is used to check for a milliwatt tone. If a milliwatt tone is detected, the N100 version of the test is executed. If no tone is detected, the S100 version of the test is initiated.

N100 test

The N100 test includes a milliwatt test and can be used for far-to-near loss measurements.

The operating sequence of the N100 version of the 100 testline is as follows:

- Connect level meter of trunk test terminator (TTT) to outgoing trunk.
- Outpulse test code to terminating office that responds with off-hook when milliwatt generator is connected.
- Milliwatt tone is received from the far-end office and measured by level meter.
- The far-end office provides continuous quiet termination until released. The near-end office measures noise on the trunk.

- The test is terminated and the trunk is disconnected.

S100 test

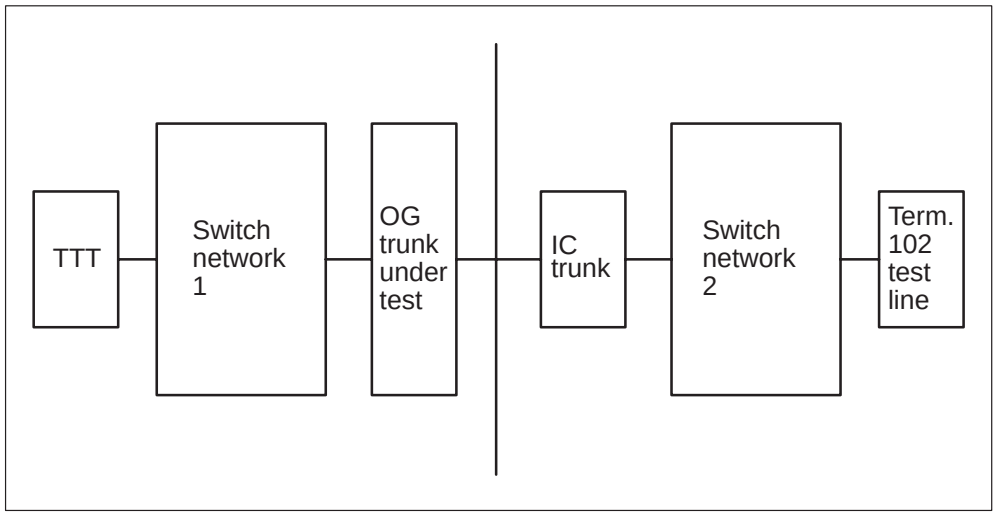
In the S100 version, the parts of the sequence involving the milliwatt test are eliminated.

TL102 tests over PRI

The 102 test line, also known as a milliwatt testline, provides far-to-near transmission loss measurements.

Figure 12-2 shows a block diagram of the TL102 configuration.

Figure 12-2
TL102 configuration



A 9 s off-hook signal is sent from the far end, during which the milliwatt test tone is applied. The milliwatt test tone is followed by an on-hook signal, then quiet termination.

If the far end is a local office, the test tone is repeated in 10 s cycles (9 s on and 1 s off).

If the far end is a toll office, quiet termination continues until the near end releases the connection, or requests another test cycle (by means of a ring-forward signal). The milliwatt source-levels are office-dependent and trunk-group-dependent.

Note: ISDN PRI trunks do not support ring-forward.

The operating sequence of the 102 testline is as follows:

Step	Action
1	Connect trunk under test to TTT.
2	Outpulse test code to far-end office that returns off-hook.
3	The level meter of TTT measures milliwatt tone level and compares it with the expected measured loss (EML).
4	The test is terminated.

Note: In the T100 and T102 test line test descriptions, the terms *on-hook* and *off-hook* are used. These terms are not applicable for ISDN PRI trunks.

Call over a PRI

Step	Action
1	From an ISDN private branch exchange (PBX), make a call over a PRI trunk facility to another ISDN PBX.
2	Verify that the call is terminated correctly.
3	Verify that the calling party number is displayed on the terminating set.
4	Verify that the called party number is displayed on the ISDN-compatible PBX terminal.
5	Verify that the 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 (described in the *DMS-100 Bit Error Rate Performance Testing Manual)*. Northern Telecom (Nortel) recommends a minimum of ten minutes per test.

Customer questionnaires

Two customer questionnaire forms are provided.

- PBX Telecom Manager Trouble Report Form (two pages)
- PBX End-User Trouble Report Form (one page)

PBX telecom manager trouble report form

This form is completed by the PBX telecommunications manager when reporting problems to the operating company. It emphasizes the problems possibly visible to the operating company's manager.

Note: Circle or check all possible problems in the appropriate areas on the forms.

Figure 12-3
PBX Telecom Manager Trouble Report Form

PBX Telecom Manager Trouble Report Form

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

CUSTOMER NAME ; CONTACT NAME ;

DMS RELEASE BCS ; DTCI ;

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_____ _____ CLLI_____

D–Channel DTCI_____ _____ _____ _____ Number of B–Channels_____

Call Attributes

CDN_____ NPI_____ CGN_____

DMS-250) Solution/Action Taken

no_fault found_ok miss_operate no_response mb/rts

unable_to_reproduce database_table fris clear_when_tested

CSR_____ clear_after_diagn

Figure 12-4
PBX Telecom Manager Trouble Report Form, page 2

Outside Plant Solution/ActionTaken

FORWARDED TIME hrs. m DATE / /19

CLEARED TIME hrs. m DATE / /19

WORK DONE

SWITCH PROBLEM = DMS PM CPU CMC LCM DTCI DS1

TERMINAL PROBLEM = CPE

OTHER

HARDWARE

PEC: ; SERIAL #: ; LOCATION: ;

DIAGNOSTIC FAILURE ON SUSPECT HARDWARE YES/NO

OTHER DETAILS:

RELEASE

DS-1 6X50AB _____

PRINTOUTS

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

PBX end-user trouble report form

This form is completed when trouble reports are filed by end users of the switch. It emphasizes the problems that are possibly visible to the end user, and has space for comments. Circle or check all possible problems in the problem description area of the form.

Figure 12-5
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 UCS DMS-250 switch

This section defines the possible states for the following PRI components:

- PRI trunk
- carrier
- ISDN digital trunk controller (DTCI)
- D-channel

PRI datafill verification

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

The PRI facility-related tables consist of the following:

- table TRKGRP
- table TRKSGRP
- table TRKMEM

The PRI service-related tables consist of the following:

- table LTDEF
- table LTCALLS
- table LTMAP

If the trunk group has not been associated with a logical terminal identifier (LTID) in table LTMAP, PRI is not accessible. This may be verified by scanning the tuple in table TRKGRP for an LTID (for example, ISDN 999).

Interpreting PRI trunk states on the UCS DMS-250 switch

Table 12-1 lists PRI trunk states.

Table 12-1
PRI trunk states

PRI trunk state	Explanation
Carrier fail (CFL)	The circuit is removed from service because of a failure associated with the DS-1.
Call processing busy (CPB)	The facility or member is currently carrying traffic; thus, the facility is busy.
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.
D-channel fail (DFL)	The D-channel associated with this B-channel is not in service and no messaging can take place.
D-channel manual busy (DMB)	This is the state an ISDN PRI trunk member has when the D-channel handler (DCH) associated with the D-channel is out of service. Every member in the trunk group that is not INB and is associated with the out-of-service DCH sustains the state D-channel manual busy (DMB) until the DCH is returned to service.
Idle (IDL)	The trunk member is in service and idle.
Installation Busy (INB)	The circuit is installed but has not yet been placed in service.
Lockout (LO)	The D-channel associated with the facility is in service. However, CCS7 Layer 3 cannot communicate with the far end because there is no synchronization over CCS7 Layer 2; there is synchronization but no logical link is established, and CCS7 Layer 3 is not responding to a restart or release.
Manual Busy (MB)	The circuit is removed from service by a maintenance person.
Peripheral Manual Busy (PMB)	The circuit is not available because the associated peripheral (the PRI DTCI) is out of service.
Remote Make Busy (RMB)	A circuit has the state RMB when the far end of the B-channel is removed from service. As a result, call setup fails.
System Busy (SB)	The circuit is removed from service by system maintenance, which performs periodic tests.

Restoring service to the PRI trunk on the UCS DMS-250 switch

Table 12-2 lists the various actions to be taken based on trunk states shown at the UCS DMS-250 switch MAP terminal.

If the problem is due to the DCH—that is, B-channel states in D-channel manual busy (DMB), D-channel fail (DFL), and lockout (LO)—refer to Table 12-8 for troubleshooting information.

Table 12-2
UCS DMS-250 switch PRI trunk (B-channel) states and actions

UCS DMS-250 switch states	Resource out of service	Actions to be taken
PMB	The PRI DTCI is out of service.	- Enter PM level of the MAP terminal - Post the DTCI - Isolate the fault
DMB	The DCH is out of service.	- Enter PRADCH level of the MAP terminal - Post the DCH - Isolate the fault
RMB	The remote end of the PRI trunk is out of service.	- Enter TTP level of the MAP terminal - Post the PRI trunk group - Isolate the fault
LO	DCH cannot communicate with Layer 3.	- Enter PRADCH level of the MAP terminal - Post the associated DCH - Isolate the fault
CFL	The carrier is out of service.	- Enter carrier level of the MAP terminal - Post the carrier - Isolate the fault
MB	The PRI is Manual Busy.	- Enter TTP level of the MAP terminal - Post the PRI trunk group - Return the circuits to service
SB	The PRI circuit is system busy.	The system will return the member to service after test is completed.

Interpreting carrier states on the UCS DMS-250 switch

Table 12-3 lists DS-1 carrier states.

Table 12-3
DS-1 carrier states

DS-1 carrier state	Explanation
In Service (INSV)	The DS-1 is in service and can be used to service a trunk. No alarms are present.
Manual 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 off-line.
Off-line (OFFL)	The DS-1 is off-line.

Restoring service to the carrier

Table 12-4 lists DS-1 carrier states and actions.

Table 12-4
DS-1 carrier states and actions

UCS DMS-250 switch states	Resource out of service	Actions to be taken
OFFL	Carrier is off-line	From carrier level of the MAP terminal: busy and return the carrier to service (RTS).
MANB	Carrier is manual busy	From carrier level of the MAP terminal: return the carrier to service. Note the new carrier state.
SYSB	Carrier is system busy	From carrier level of the MAP terminal: diagnose the fault. Note the new carrier state.

Interpreting PRI DTCI states

Table 12-5 lists PRI DTCI states.

Table 12-5
PRI DTCI states and actions

DTCI state	Explanation and action
In Service (INSV)	The DTCI is in service. No action is required.
In Service Trouble (IStb)	A fault does exist in the DTCI; however, services are not impacted.
Off-line (OFFL)	The DTCI is off-line and possibly pending office data modifications.
Manual Busy (MANB)	The DTCI has been manually busied by maintenance personnel. Manual maintenance may be in progress.
C-side Busy (CBSY)	This implies there is no in-service message connection between the DTCI and the network, or the network is out of service.
System Busy (SYSB)	The DTCI is out of service. The system has detected a fault and taken the DTCI out of service.

Restoring service to the DTCI

Table 12-6 lists DTCI states and actions.

Table 12-6
UCS DMS-250 switch DTCI states and actions

UCS DMS-250 switch states	Resource out of service	Actions to be taken
MANB	DTCI is manual busy	From PM level of the MAP terminal: - Post the DTCI - Return the DTCI to service
ISTB	DTCI is in service trouble	From PM level of the MAP terminal: - Post the DTCI - Enter QUERYPM FLT - Diagnose fault
CBSY	The DTCI is C-side busy	From PM level of the MAP terminal: - Post the DTCI - Enter TRNSL C - Diagnose C-side links not in service
SYSB	The DTCI is system busy because of a problem the system detected	- System log is generated as to fault that occurred. - Diagnose the problem. - System returns the DTCI to service if no fault is found.

Interpreting DCH states

Table 12-7 lists DCH states.

Table 12-7
Interpreting DCH states

DCH state	Explanation
In service (INSV)	The D-channel is in service.
Manual busy (MANB)	Maintenance personnel have manually busied the D-channel 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 operating company personnel.
Initializing (INI)	The D-channel is being initialized by the system. The system brings up the D-channel when the other facilities are brought into service.
Carrier fail (CFL)	The carrier on which the D-channel is provisioned failed.
Lock-out (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 CCS7 Layer 3 at the far end is not responding although CCS7 Layer 2 is established and ready.

Restoring service to the DCH

When the DCH state is LO or RNR, refer to “Troubleshooting” in Chapter 3, “D-channel handler,” for additional information on troubleshooting.

Table 12-8 lists the DCH states and actions.

Table 12-8
UCS DMS-250 switch DCH states and actions

UCS DMS-250 switch states	Resource out of service	Actions to be taken
INB	D-channel is installation busy	- Enter the PRADCH level of the MAP terminal. - Post, BSY, and RTS the DCH.
INI	DCH is being initialized	No action is required. The system will bring up the DCH.

—continued—

Table 12-8
UCS DMS-250 switch DCH states and actions (continued)

UCS DMS-250 switch states	Resource out of service	Actions to be taken
PMB	DTCI is busy	- Enter the PM level from the MAP terminal. - Post the DTCI. - Isolate the fault.
CFL	carrier failed	No action is required if DTCI is going through a restart. Otherwise, enter the carrier level of the MAP terminal, then BSY and RTS the carrier.
MANB	DCH is manual busy	From CI level of the MAP terminal: - Enter MAPCI; MTC; TRKS; TTP; PRADCH. - Post the DCH. - Return the DCH to service.
LO	logical link failed	Refer to “Troubleshooting” in chapter 3, *D-channel Handler*.
RNR	far-end Layer 3 is not responding	Make sure that the far-end DCH is in service.
		—end—

Engineering recommendations

This chapter provides recommendations to simplify the configuration and engineering of the Integrated Services Digital Network (ISDN) digital trunk controller (DTCI) primary rate interface (PRI).

PRI configurations

Maximum number of B-channels controlled by a single D-channel

Multiple DS-1s can contain B-channels controlled by a single PRI D-channel. It is recommended that a PRI interface be configured such that the number of B-channels does not exceed 47. (However, note that this is not a restriction and the maximum number of B-channels that a PRI interface can support on a DTCI is 479.)

Usage of non-PRI signaling on the idle B-channels in a DS-1

Any channels within the DS-1 that are not 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 DTCI allows these non-PRI channels to be provisioned as a per-trunk signaling trunk. In other words, any AB-trunk supported by the UCS DMS-250 switch can be datafilled on the non-PRI channels.

DCH to DS-1 mapping

There exists a one-to-one mapping between the D-channel handler (DCH) and the DS-1, as datafilled in table TRKSGRP.

Recommended DCH to DS-1 mapping on DMS DTCI does not apply, as the mapping is determined by the datafill.

Optimal DS-1/DCH card assignments on DMS DTCI

This does not apply, as this discussion pertains to signaling terminal card provisioning.

Signaling terminals

This does not apply to the DTCI.

DTCI port allocation for DS-1/DS-30 port groups

For trunk call processing, C-side channels are preallocated 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 time switch; 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.)

Figure 13-1 summarizes the mapping of groups of P-side ports to C-side ports. The number of ports usable as DS-1 ports and ST ports for each grouping is also indicated.

Figure 13-1
PRI DTCI P-side-to-C-side port mapping

Port group (configuration)	P-side port	C-side port	DS-1 ports Min	Max
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

C-side port requirements

This does not apply because signaling terminal cards are not used on the DTCI.

DS-1 card locations

This does not apply because signaling terminal cards are not used on the DTCI.

Reliability considerations

Backup trunk group

To reduce the impact of PRI failures or degradations, backup trunk groups can be set up in the UCS DMS-250 switch routing tables. The backup groups can be either PRI or AB-trunk groups.

Non-PRI trunks as backup

For example, the backup trunk group may reside on the DTCI since it can support non-PRI trunks. Route selection should be set up to select the PRI trunk first, with rerouting to the non-PRI trunks if the PRI is completely

busy or out of service. The route/trunk databases in the UCS DMS-250 switch have to be set up to accomplish this. The overflow from PRI could result in calls being offered in both directions by a single two-way trunk group, or by two one-way trunk groups.

When a user dials the code to reach the PRI trunk, the call is routed using route OFRT 99. Calls are first offered through the PRI group DMS2MSLPRI. If this is 100% busy, out of service, or experiences protocol failure during call setup, the call is reoffered on the dedicated access line trunk DMS2MSLDAL. Calls incoming on DMS2MSLDAL are handled the same way as calls incoming on DMS2MSLPRI.

Multiple PRI links

This does not apply.

UCS DMS-250 switch loss and level datafill

PRI requires the additional tuples in table PADDATA. The following example shows the recommended datafill for the UCS DMS-250 switch central office to support the ISDN PRI loss and level plan.

Table 13-1
Datafill for the UCS DMS-250 switch

Key port 1	Key port 2	Data pad 1T02	Data pad 2T01
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

Note: PRIP is the PAD group associated with the PRI interface on the UCS DMS-250 switch.

DS-1 to DS-30 channel mapping

Tables 14-1 and 14-2 provide the mapping of DS-1 ports and channels to DS-30 port and channel and back again. Given a particular DS-1 port and channel (port 0, channel 1, for example), Table 14-1 shows that DS-1 port 0, channel 1 maps into DS-30 port 3, channel 30. Similarly, Table 14-2 shows that DS-30 port 3, channel 30 maps into DS-1 port 0, channel 1.

Table 14-1
DS-30 port/channel for each DS-1 channel and port

DS-1 channel	DS-1 port 0	DS-1 port 1	DS-1 port 2	DS-1 port 3	DS-1 port 4
1	3/30	0/1	1/1	2/1	3/1
2	0/2	1/2	2/2	3/2	0/3
3	1/3	2/3	3/3	0/4	1/4
4	2/4	3/4	0/5	1/5	2/5
5	3/5	0/6	1/6	2/6	3/6
6	0/7	1/7	2/7	3/7	0/8
7	1/8	2/8	3/8	0/9	1/9
8	2/9	3/9	0/10	1/10	2/10
9	3/10	0/11	1/11	2/11	3/11
10	0/12	1/12	2/12	3/12	0/13
11	1/13	2/13	3/13	0/14	1/14
12	2/14	3/14	0/15	1/15	2/15
13	3/15	0/16	1/16	2/16	3/16
14	0/17	1/17	2/17	3/17	0/18
15	1/18	2/18	3/18	0/19	1/19

—continued—

Table 14-1
DS-30 port/channel for each DS-1 channel and port (continued)

DS-1 channel	DS-1 port 0	DS-1 port 1	DS-1 port 2	DS-1 port 3	DS-1 port 4
16	2/19	3/19	0/20	1/20	2/20
17	3/20	0/21	1/21	2/21	3/21
18	0/22	1/22	2/22	3/22	0/23
19	1/23	2/23	3/23	0/24	1/24
20	2/24	3/24	0/25	1/25	2/25
21	3/35	0/26	1/26	2/26	3/26
22	0/27	1/27	2/27	3/27	0/28
23	1/28	2/28	3/28	0/29	1/29
24	2/29	3/29	0/30	1/30	2/30

—end—

Table 14-2 is indexed by DS-30 port number (across the top) and DS-30 channel number (down the left); the resulting entry is the DS-1 port number and channel number (within the port group).

Table 14-2
DS-1 port/channel for each DS-30 channel and port

DS-30 channel	DS-30 port 0	DS-30 port 1	DS-30 port 2	DS-30 port 3
1	1/1	2/1	3/1	4/1
2	0/2	1/2	2/2	3/2
3	4/2	0/3	1/3	2/3
4	3/3	4/3	0/4	1/4
5	2/4	3/4	4/4	0/5
6	1/5	2/5	3/5	4/5
7	0/6	1/6	2/6	3/6
8	4/6	0/7	1/7	2/7
9	3/7	4/7	0/8	1/8

—continued—

Table 14-2
DS-1 port/channel for each DS-30 channel and port (continued)

DS-30 channel	DS-30 port 0	DS-30 port 1	DS-30 port 2	DS-30 port 3
10	2/8	3/8	4/8	0/9
11	1/9	2/9	3/9	4/9
12	0/10	1/10	2/10	3/10
13	4/10	0/11	1/11	2/11
14	3/11	4/11	0/12	1/12
15	2/12	3/12	4/12	0/13
16	1/13	2/13	3/13	4/13
17	0/14	1/14	2/14	3/14
18	4/14	0/15	1/15	2/15
19	3/15	4/15	0/16	1/16
20	2/16	3/16	4/16	0/17
21	1/17	2/17	3/17	4/17
22	0/18	1/18	2/18	3/18
23	4/18	0/19	1/19	2/19
24	3/19	4/19	0/20	1/20
25	2/20	3/20	4/20	0/21
26	1/21	2/21	3/21	4/21
27	0/22	1/22	2/22	3/22
28	4/22	0/23	1/23	2/23
29	3/23	4/23	0/24	1/24
30	2/24	4/24	4/24	0/1

—end—

Description of UUI Information Elements and Parameters

This chapter provides a description of the User-to-User Information (UUI) Information Elements (IE) and Parameters feature. This feature allows the UCS DMS-250 switch to convey information among ISDN users across the network.

The Q.931 UUI Information Element is supported for the ISDN protocol. The UUI parameter and UUI indicator parameter are supported for the ISUP protocol.

Call Processing

User-to-User Service (UUS) starts with the receipt of the UUI IE in an originating Q.931 SETUP message from the customer premise equipment (CPE). Upon successful initiation of UUS, other call messages can carry both the UUI IE (ISDN PRI) and UUI Parameter (ISUP) in both the calling to called party and called party to calling party directions. Table 15-1 shows this process.

Table 15-1
ISDN PRI to ISUP message mapping summary

PRI Message	ISUP Message
Setup (SETUP)	Initial Address Message (IAM)
Progress (PROGRESS)	Address Complete Message (ACM)
Progress (PROGRESS)	Call Progress Message (CPG)
Alerting (ALERT)	Address Complete Message (ACM)
Connect (CONNECT)	Answer Message (ANM)
Disconnect (DISC)	Release (REL)

—continued—

Table 15-1
ISDN PRI to ISUP message mapping summary

PRI Message	ISUP Message
Release (REL)	Release (REL)
Release Complete (REL COM)	Release (REL)
—end—	

Description of Information Elements and Parameters

This section describes the following information elements and parameters:

- Q.931 UUI IE
- ISUP UUI Parameter
- ISUP UUI Indication Parameter

Q.931 User to User Information (UUI) Information Element

The format and content of this IE is detailed according to the applicable protocol as described in Figure 15-1.

Figure15–1
Q.931 User to User Information (UUI) information element

Byte	8	7	6	5	4	3	2	1
1	0	0	1	0	0	0	0	0
	User–User Information Element Identifier							
2	Length of User - User contents							
3	Protocol Discriminator							
4	User Information							
:	:							
n	:							

The identifier value for this IE is #7E.

The structure is defined as follows:

- The IE must be at least three bytes long for the UUS functionality to be invoked.
- A maximum of 128 bytes of user information can be included (n = 131).
- The Protocol Discriminator is coded as 0 0 0 0 0 0 0 0 to indicate *User Specific* protocol.
- This information is not interpreted by the UCS DMS-250 switch, but is carried transparently across the network.

ISUP UUI Parameter

The format and content of this parameter is detailed according to the applicable protocol as described in Figure 15-2.

Figure15–2
ISUP UUI parameter

Byte	8	7	6	5	4	3	2	1
1	0	0	1	0	0	0	0	0
	User–User Information Parameter Identifier							
2	Length of User - User contents							
3	Protocol Discriminator							
4	User Information							
:	:							
n	:							

The identifier value for this parameter is #20.

The structure is defined as follows:

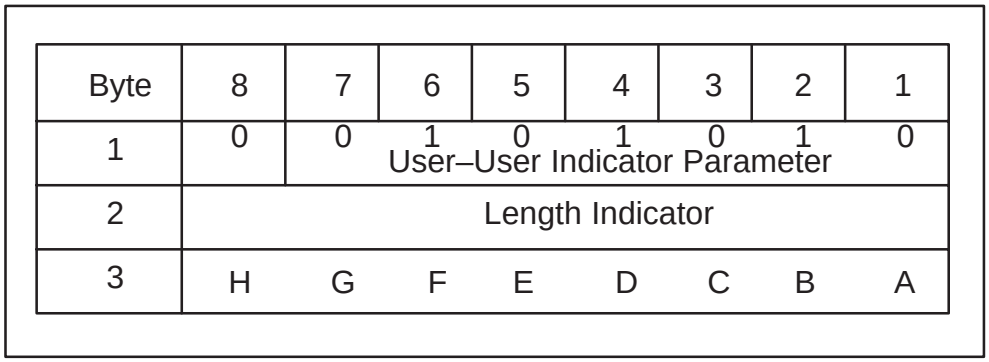
- A maximum of 128 bytes of user information can be included (n = 131).
- The Protocol Discriminator is coded as 0 0 0 0 0 0 0 0 to indicate *User Specific* protocol.
- This information is not interpreted by the UCS DMS-250 switch, but carried transparently across the network.
- A maximum of 128 bytes of user information can be included (n = 131).

- The Protocol Discriminator is coded as 0 0 0 0 0 0 0 0 to indicate *User Specific* protocol.
- This information is not interpreted by the UCS DMS-250 switch, but carried transparently across the network.

ISUP User to User Indication Parameter

The format and content of this parameter is detailed according to the applicable protocol as described in Figure 15-3.

Figure15–3
ISUP user to user indication parameter



The identifier value for this parameter is #2A.

This parameter only contains a single byte field, with bit A and bit H providing any significant information. All other bits for this implicit type 1 service are ignored. This parameter is only used in messages in the backward call direction. Both bit A and bit H are set to 1 when a UUI Parameter is discarded by the network.

Information Element and Parameter Summary

The X in Table 15-2 indicates that the information element, or parameter, can be included in the message identified in the column on the left. A blank entry indicates inclusion of the information element, or parameter, is invalid or not applicable.

Table 15-2
Information element and parameter summary

Message	UUI IE	UUI Parm	UUI Indicator	Notes
Setup (SETUP)	X			
Progress (PROGRESS)	X			Network to User direction only
Alerting (ALERT)	X			
Connect (CONNECT)	X			
Disconnect (DISC)	X			Call clearing message
Release (REL)	X			Only if first call clearing message
Release Complete (REL COM)	X			Only if first call clearing message. User to Network direction only.
Initial Address Message (IAM)		X		
Address Complete Message (ACM)		X	X	
Answer Message (ANM)		X	X	
Call Progress (CPG)		X	X	
—end—				

Limitations and restrictions

The following limitations and restrictions apply for the UUI Information Elements and parameters.

- The maximum length supported for the new ISDN UUI IE is 131 bytes.
- The maximum length supported for the new ISUP UUI Parameter is 131 bytes.
- The Q.931 UUI IE is included in a Q.931 PROGRESS message in the Network to User direction only.
- The Q.931 UUI IE is included in a Q.931 REL COM message in the User to Network direction only.

- The protocol specifics outlined in this document reflect UUS for the Nortel North American PRI variant (NTNAPRI) and AT&T System 85 variant (N449PRI) only. This service is not supported on the ETSI PRI protocol variant.
- The UCS DMS-250 switch validates UUS subscription for ISDN PRI call originations only.
- The UCS DMS-250 UCS05 product CM load (PCL) does not support UUS backward compatibility with pre-UCS05 PCLs. The UCS DMS-250 switch has no special signaling procedures for this failure scenario.
- When the UCS DMS-250 switch receives a UUI IE in a message that does not support UUI, the switch uses cause value 99 “Info. Element Nonexist. or not Implemented”. The UCS DMS-250 switch uses this in the Q.931 STATUS message response. This is not compliant with the ANSI T1.621 standard. This scenario falls under the domain of the Bellcore TR-1268 standard.
- If identical ISDN PRI requirements exist in the ANSI T1.621 standard and Bellcore TR-1268 standard, this feature aligns with the Bellcore TR-1268 standard.
- There is no UUS failure scenario when the UUS call in progress encounters an ISUP agent that does not understand the UUI Parameter.
- When the UCS DMS-250 switch discards the UUI IE from a Q.931 message, indication of this is only communicated to the far end (FE) of the PRI. Indication that the UUI IE was discarded (a Q.931 STATUS message) is not propagated along adjacent PRI trunk connections.
- UUS is not supported on the U449PRI and U459PRI ISDN PRI protocol variants. A UUS call in progress that encounters a U449PRI or U459PRI ISDN PRI protocol variant discards the UUI and returns no indication to the calling user of this action.

List of terms

ACM
Address Complete Message

ADIN
authcode database index

ALERT
Alerting Message

AMI
alternate mark inversion

ANI
automatic number identification

ANM
Answer Message

ASD
answer supervision distributor

ASEQ
ascending sequence

ATD
audio tone detector

B8ZS
bipolar 8 zero substitution

BC
bearer capability

BER
bit error rate

BPV
bipolar violation

BSY
Busy

CALL PROC
Call Proceeding Message

CBSY
C-side busy state

CCS7
Common Channel Signaling #7

CCS7-IMT
Common Channel Signaling #7 Intermachine Trunk

CCITT
International Consultative Committee on Telegraphy and Telephony

CDN
called party number

CDR
call detail record

CFL
Carrier Fail parameter or state

CGN
calling party number

CID
channel identifier

CLID
calling line identifier

CLLI
common language location identifier

CONN ACK
Connect Acknowledge Message

CPD
Call Processing Deload parameter

CPE
customer premises equipment

CRC
cyclic redundancy check

CSI
calling station identifier

D1
primary D-channel

D2
secondary D-channel

D2/D3/D4
channel banks that handle A[B] bit signaling

DAL
dedicated access line

DCH
D-channel handler

DDD
direct distance dialing

DDI
digital data indicator

DFL
D-Channel Fail parameter

DISC
Disconnect Message

DMB
D-Channel Manual Busy parameter

DRAM
digital recorded announcement machine

DS-0
A single channel of a T-span, DS-0 handles a data rate of 56 or 64 kbits/s

DS-1

A collection of 24 DS-0 channels, DS-1 occupies an entire T-1 span and handles a data rate of 1.544 Mbit/s.

DS-30

A link used internally in the DMS-250 switch, DS-30 handles a data rate of 2.54 Mbit/s

DSEQ

descending sequence

DSX-1

A patch panel for a digital cross-connect.

DTC

digital trunk controller

DTCI

Integrated Services Digital Network digital trunk controller

DTMF

dual-tone multifrequency

E.163

Telephony Numbering Plan

E.164

ISDN Numbering Plan (enhances E.163 and retains X.121)

EANT

equal access network trunk, allows access to the trunk side of the equal access end office (EAEO). Also, they may connect to access tandem switches. These trunks are also known as feature group D trunks.

EOPS

Enhanced Operator Position System

ES

errored seconds

ESF

extended superframe format

FDL

Facility Data Link

FGA
Feature group A

FGB
Feature group B

FGC
Feature group C

FGD
Feature group D

FNAL
Feature Not Allowed treatment

FPS
frame pattern sequence

GNCT
Generalized No Circuit treatment

HDLC
high-level data link control

IAM
initial address message

IDDD
international direct-distance dialing

IDL
Idle parameter

IE
information element

IEC
interexchange carrier

IID
interface identifier

IMT
intermachine trunk

INB
Installation Busy parameter

INCC

Invalid City Code

INI

Initializing state

INWATS

inward wide-area telephone service

INSV

In Service state

ISA

integrated services access

ISDN

Integrated Services Digital Network

ISP

ISDN signaling processor

ISTB

In Service Trouble state

ITA

Integrated Trunk Access, for a DS-1 this means that the trunk has been provisioned to allow access by more than one type of trunk (usually PRI and non-PRI).

ISUP

ISDN User Part

LAPB

Link Access Procedure on the B-channel

LAPD

Link Access Procedure on the D-channel

LCGA

Local Carrier Group Alarm

LDN

Local Carrier Group Alarm

LIDL

least idle

LLC
low layer compatibility

LO
Lockout parameter or state

LTID
logical terminal identifier

MANB
Manual Busy state

MAP
Testing and maintenance center for telco switching equipment

MB
Manual Busy parameter

MP
master processor

NACK
Not Acknowledged

NCTE
network customer terminating equipment

NPA
numbering plan area

NQ
non-standard queuing

NSF
Network-specific facilities

NXX
office code

OFFL
Offline state

OHQ
off-hook queuing

OM
operational measurement

ONAL

off-network access line, connects the DMS-250 switch to the line side of a class 5 central office. Also called a feature group A trunk.

ONAT

off-network access trunk, connects a DMS-250 switch to the trunk side of a class 5 central office. Also labeled as feature group B or feature group C.

OSI

open systems interconnect

OSID

originating switch identifier

OSR

operator services record

OST

operator service trunk

OTG

originating trunk group

PANI

pseudo automatic number identification

PBX

private branch exchange

PCM

pulse code modulation

PDIL

partial dial

PDN

private directory number

PEC

product engineering code

PIN

personal identification number

PMB

Peripheral Manual Busy parameter

PRI
primary rate interface

PROG
Progress Message

PTS
per-trunk signaling

PUB
Public (call-type)

PVT
Private (call type)

Q.921
CCITT recommendation for Layer 2 of ISDN

Q.931
CCITT recommendation for Layer 3 of ISDN

RCGA
remote carrier group alarm

REL COM
Release Complete Message

RLC
ISU Release Complete Message

RLT
release link trunk

RMB
Remote Make Busy parameter

RNR
Remote Not Responding state

RTS
return to service

SAPI
service access point identifier

SES
severe errored seconds

SETUP
Q.931 message type

SID
station identification number

SF
superframe format

STS
serving translations scheme

SWACT
switch of activity

SYSB
System Busy state

TCAP
Translation Capabilities Application Part

TIE
termination information element (trunk directly connecting two PBXs)

TSC
temporary signaling connection

UAS
unavailable seconds

UNEQ
Unequipped state

VACC
Vacant Country Code treatment

VACS
Vacant Speed Number treatment

VACT
Vacant Code treatment

WATS
wide-area telephone service

XLAIEC
interexchange carrier translation and routing

XPM

XMS peripheral module

ZCS

zero code suppression

64R

64 kbit/s Restricted

64C

64 kbit/s Clear (unrestricted)

Ordering information

Use the following table for ordering Nortel NTPs (Nortel Networks Technical Publications) and Product Computing-Module Loads (PCLs):

Type of product	Source	Phone	Cost
Technical documents (paper or CD-ROM)	Nortel Product Documentation	1-877-662-5669	Yes
Individual NTPs (paper)	Merchandising Order Service	1-877-662-5669	Yes
Marketing documents	Sales and Marketing Information Center (SMIC)	1-800-4NORTEL (1-800-466-7835) * ESN 444-5930	No

When ordering publications on CD

Please have the CD number and software version available, for example, **HLM–2621–ENCDRPDF 06.02**.

When ordering individual paper documents

Please have the document number and name available, for example, **297-2621-001, UCS DMS-250 Master Index of Publications**.

When ordering software

Please have the eight-digit ordering code, for example, **UCS00012**, as well as the ordering codes for the features you wish to purchase. Contact your Nortel Networks representative for assistance.

Digital Switching Systems

UCS DMS-250

Integrated Services Digital Network (ISDN) Reference Manual

Product Documentation–Dept 3423
Nortel Networks
P.O. Box 13010
RTP, NC 27709–3010
1–877–622–5669

Publication number: 297-2621-106
Product release: UCS13
Document release: Standard 07.03
Date: August 2000
Printed in the United States of America

NORTEL NETWORKS™

How the world shares ideas.