SL-1

Electronic Switched Network

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Introduction

The Electronic Switched Network (ESN) is a private communications network intended for use by large business customers with distributed operating locations.

This document introduces the reader to the concepts of the ESN with emphasis on the switching components.

References

For more information on the Electronic Switched Network (ESN) or on networking features and load configuration, refer to the following Northern Telecom publications:

- *Electronic Switched Network signaling guidelines* (309-3001-180)
- *Electronic Switched Network transmission guidelines* (309-3001-181)
- *X11 features and services* (553-3001-305)
- *Basic and Network Alternate Route Selection description* (553-2751-100)
- *Coordinated Dialing Plan description* (553-2751-102)
- *ISDN Primary Rate Interface description and administration* (553-2901-100)
- *ISDN Primary Rate Interface installation* (553-2901-200)
- *ISDN Primary Rate Interface maintenance* (553-2901-500)
- *X11 input/output guide* (553-3001-400)

The prime element of the Electronic Switched Network (ESN) is an ESN node. The ESN nodes are strategically located (see Figure 1) to concentrate on on-network traffic and access to off-network facilities efficiently and economically. An ESN can be a single ESN node serving a few locations in a metropolitan area or multiple ESN nodes serving up to 999 locations that can be located across the country.

The ESN nodes direct calls from a switch in one geographical location to a switch in any other geographical location in a cost-efficient and easy-to-use manner by:

- eliminating long, complex dialing plans and replacing them with an abbreviated Uniform Dialing Plan (UDP) common to all switches that are part of the ESN
- providing a means of controlling the number and types of trunks that are available to each network user and the Time of Day that access to a trunk (or group of trunks) is allowed
- selecting the least-cost trunk route available to complete a call between switches automatically
- providing uniform network access to stations served directly by the ESN node and stations served at other switches (ESN mains, Conventional mains) connected by means of tie trunks to an ESN node as shown in Figure 1.
- providing the call originator with the option to either accept or refuse a call that is to be completed over an expensive trunk route if there are not any least-cost trunk routes currently available
- providing optional queuing features that allow the call originator (when all trunks are currently busy) either to remain off hook until a trunk becomes idle or to hang up and receive a call back from the SL-1 when a trunk becomes idle-thus eliminating repeated, time-consuming dialing attempts
- collecting and printing traffic data related to the ESN operation (thus allowing the efficiency of the network to be monitored)

To accomplish the efficient call-handling operations in an ESN, each ESN node utilizes some, or all, of the following unique ESN software features listed below and described in this document:

- Transparent Data Networking (TDN, described in *Transparent Data Networking* (553-2731-110), which provides a transparent data channel for data modules to perform end-to-end protocol exchange. With TDN, two data modules wait for a circuit path to be established before exchanging protocol parameters.
- Network Class of Service (NCOS)
- Network Alternate Route Selection (NARS)
- Network Signaling (NSIG)
- Network Traffic Measurements (NTRF)
- Off-Hook Queuing (OHQ)
- Call-Back Queuing (CBQ)
- Coordinated Call-Back Queuing (CCBQ)
- Call-Back Queuing to Conventional Mains (CBQCM)
- Free Calling Area Screening (FCAS)
- Coordinated Dialing Plan (CDP)
- Network Authorization Codes (NAUT)

Switch definitions

In the context of this publication, the following definitions of the various switch types that are considered to be part of an ESN network can be applied. These definitions are used for convenience and do not constitute the only possible ESN configuration.

ESN node A switch equipped with features identified in Table 1 and configured within the network as shown in Figure 1.

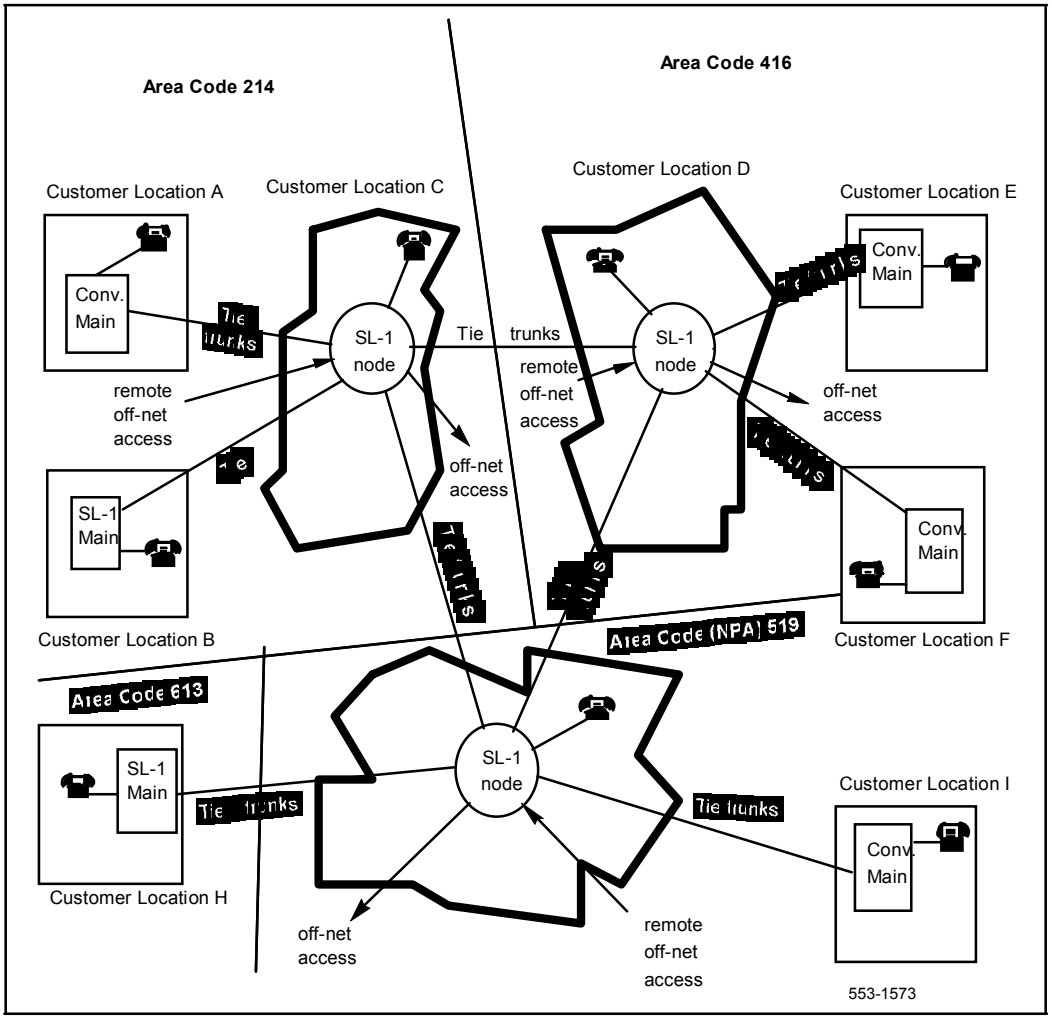
ESN main A switch equipped with features identified in Table 1 and that is connected by means of tie trunks to a single ESN node. An ESN main can also be equipped with the Basic Alternate Route Selection (BARS) feature to provide alternate route selection capabilities for calls placed to satellite switches that are located on the ESN main. See *Basic and Network Alternate Route Selection description* (553-2751-100).

Conventional main A switch that is connected to an ESN node and equipped with none of the features listed in Table 1. Other switch types can include Step-by-Step (SXS), Electronic Tie Network (ETN), and DIMENSION.

Table 1
Feature package requirements for ESN nodes and ESN mains

Description	ESN node	ESN main
Network Alternate Route Selection	X	
Off-Hook Queuing	X	
Call-Back Queuing	X	
Coordinated Call-Back Queuing	X	X (optional)
Call-Back Queuing to Conventional Mains	X	
Network Signaling	X	X
Free Calling Area Screening	X	
Network Class of Service	X	X
Coordinated Dialing Plan	X	X (optional)
Basic Alternate Route Selection		X (optional)
Network Authorization Code	X	
Basic Authorization Code		X (optional)
Network Traffic Measurements	X	X (optional)
Note: A switch is termed a Conventional main if none of the above feature packages are equipped at the switch.		

Figure 1
Example of an Electronic Switched Network



Network Class of Service

The Network Class of Service feature (NCOS) is an integral part of Network Control (NCTL) and Routing Control in an ESN. NCOS provides the means to control:

- which trunk routes are eligible for access to attempt call completion
- whether or not queuing is offered to a call originator
- whether or not the originator of a network call receives a warning tone when an expensive trunk is selected to complete the call
- whether or not the user is allowed to access the Network Speed Call (NSC) feature

An ESN node (and ESN main) can accommodate 100 (0 to 99) to Network Class of Service (NCOS) groups, with each group made up of different network-access characteristics. Once each NCOS group is defined through service change, the line, trunk, and attendant groups connected directly to the switch are assigned to the NCOS group that best serves the particular requirements of each. The NCOS to which each group is assigned is independent of the regular class of service assigned to them. Incoming tie trunks that connect another switch (ESN main, Conventional main, ETN switch) to the ESN node are also assigned to an NCOS group that determines their level of access to the network facilities at the ESN node.

Note: Pre X11 release 13, an ESN node can accommodate 16 (0 to 15) NCOS groups.

Facility Restriction Level

Included as part of each NCOS group is a Facility Restriction Level (FRL) number that ranges from 0 (low-privilege) to 7 (high-privilege). The FRL is used by the software to determine the alternate route selection choices available for specific network call attempts by a line or trunk within an NCOS group.

For example, a user assigned in an NCOS group having an FRL of 3 would be allowed access only to alternate route selection choices assigned an FRL of 3 or less; access to trunks with an FRL greater than 3 would be denied. Thus, by assigning low-privilege network users to an NCOS group having a low FRL and high-privilege network users to an NCOS group having a higher FRL, the customer can control access to all network facilities.

Expensive Route Warning Tone

In some instances, expensive trunk routes can be assigned to an NCOS group with an FRL that would allow them to be accessed by some network users. When this occurs, the originator of the network call may be sent an optional Expensive Route Warning Tone (ERWT).

The ERWT tone alerts the caller that an expensive route has been selected to complete the call and provides the caller with the option of either accepting or rejecting the call before it is completed over the expensive route. Eligibility for ERWT is allowed or denied to individual lines and incoming trunk groups on an NCOS group basis.

Queuing

Each NCOS group also defines whether or not the various queuing features are available to lines or trunks assigned to the group.

Network Alternate Route Selection

Network Alternate Route Selection (NARS) provides a comprehensive and flexible networking package that can be tailored to a customer's network. Prime elements of the NARS feature are:

- simple network access codes
- a Uniform Dialing Plan (UDP)
- dialing transparency
- automatic least-cost routing
- Time of Day (TOD) routing
- automatic on-network (on-net) to off-network (off-net) overflow
- network controls through Network Class of Service (NCOS) and Facility Restriction Levels (FRL)
- One to ten digit translation, restriction, recognition (X11 release 5 and later)
- Free Calling Area Screening (FCAS)
- Expensive Route Warning Tone (ERWT)

Table 2 lists the features equipped for Network Alternate Route Selection/Basic Alternate Route Selection (NARS/BARS). Parenthetical values are for releases prior to X11 release 13. If NARS/BARS features are equipped on the same switch for different customers, the NARS values apply to the switch.

Table 2
NARS/BARS feature parameters

Parameter	Features equipped at switch	
	BARS	**NARS**
NCOS groups	0-99 (0-7)	0-99 (0-15)
Facility Restriction Levels	0-7	0-7
Digit manipulation tables	1-255	1-255
Route lists	0-127	0-255
Route list entries	0-31 (0-7)	0-31 (0-7)
FCAS tables	1-127	1-255
SDR tables	0-255	0-511

Legend:
NCOS = Network Class of Service
FCAS = Free Calling Area Screening
SDR = Supplemental Digit Restriction

If the New Flexible Code Restriction (NFCR) feature (see *X11 features and services* (553-3001-305)) operates in conjunction with Basic Alternate Route Selection (BARS) and/or Coordinated Dialing Plan (CDP), the number of available NCOS groups is eight for releases prior to X11 release 13 and 100 beginning with X11 release 13.

NARS access codes

To access Network Alternate Route Selection (NARS), the user at an ESN node, ESN main, or Conventional main dials either one of two customer-assigned network access codes, AC1 or AC2. These access codes are typically 8 for on-net and long distance calls (AC1), and 9 for off-net and local calls (AC2). However, any one- or two-digit code can be used, provided the access code assigned for AC1 is different from that assigned for AC2 and there is no conflict with any other part of the dialing plan.

> ***Note:*** Only TIE trunks allow digit insertion on the AC1 code. Direct Inward System Access (DISA) Central Office (CO) trunks require the user to dial the AC1 code.

Dialing a NARS access code triggers NARS to perform the necessary call processing and routing using a specified set of network translation tables. This mechanism is used to implement the Uniform Dialing Plane (UDP) for private networks. (NARS dial tone may or may not be provided to the caller after an access code is dialed, at the option of the customer.)

Uniform Dialing Plan

The Uniform Dialing Plan (UDP) enables users at an ESN node, ESN main, or Conventional main to dial all calls in a uniform manner, regardless of the location of the calling party or the route that the call takes.

UDP for on-net calling

An on-net call is one that terminates at a customer-owned location. To reach any on-net location, the user dials the on-net access code (AC1), followed by seven digits. The format for this call would be:

AC1 * LOC + XXXX

Legend:

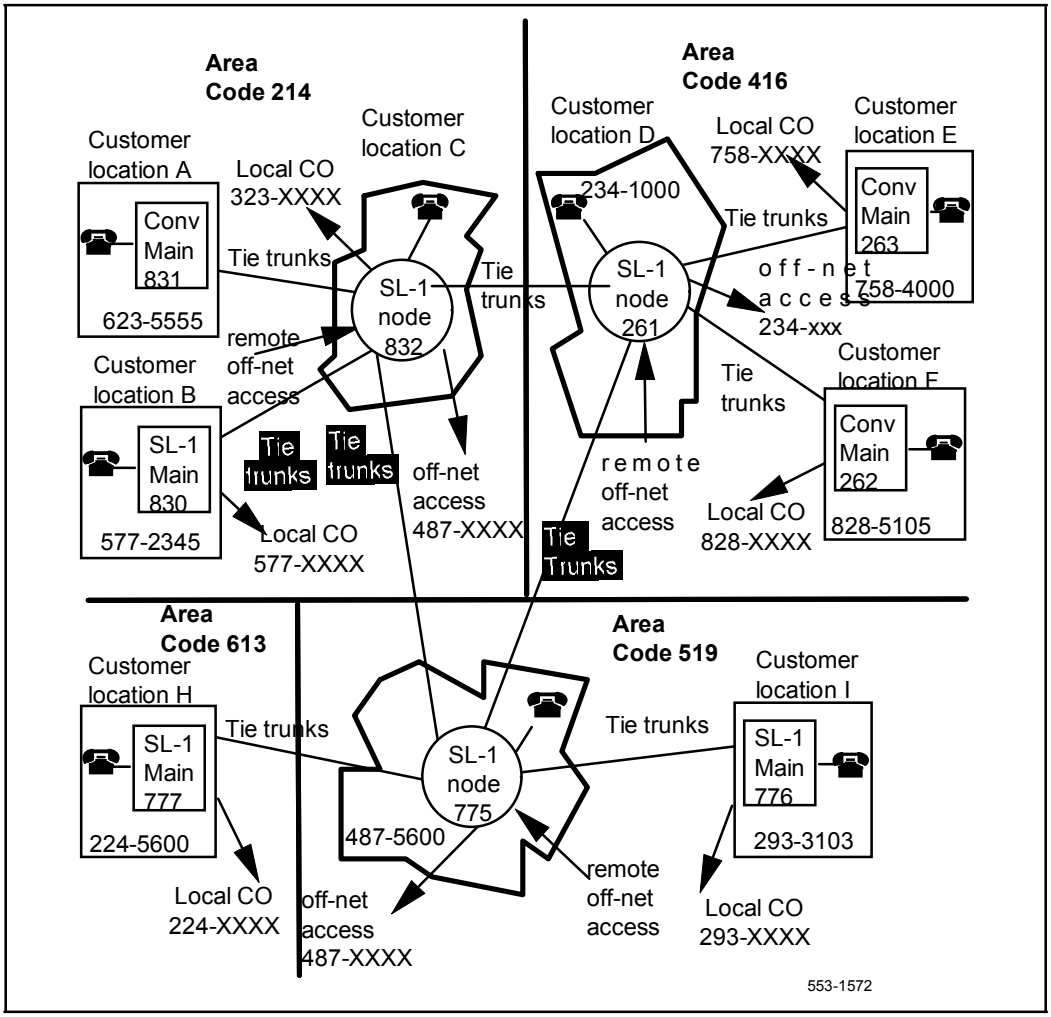
AC1 = the one-digit or two-digit on-net access code
* = pause for NARS dial tone (optional)
LOC = a three-digit Location Code assigned for the destination location (area code)
XXXX = the extension number of the party to be reached at the destination location

Each switch that is part of the network (including the ESN nodes) is identified by a unique three-digit Location Code (LOC) assigned at the ESN node. If 1+ dialing is used, there must be no conflict between the Location Code number assigned for a switch and all Numbering Plan Area (NPA) codes. (Optimally, 1+ dialing applies to NPA calls but not to local or network calls).

A customer-owned location can be either physically connected to the network (by means of private trunk facilities) or virtually connected to the network (by means of public facilities). If a location is virtually connected to the network, the dialed Location Code (LOC) is translated and converted by NARS translation (at the ESN node) into the public number for the virtual location; for example, the Direct Distance Dialing (DDD) number or the Direct Inward Dialing (DID) number.

Figure 2 illustrates an ESN network with a typical UDP. A user at any customer location, such as LOC 776 (Conventional main, location I) who wishes to call extension number 3283 at LOC 777 (ESN main, location H) must first dial 8 (AC1), pause for the optional NARS dial tone from ESN node at location G, then dial 777-3283.

Figure 2
Example of an ESN with a typical Uniform Dialing Plan



UDP for off-net calling

An off-net call is one that does not terminate at a customer-owned location, although network facilities may handle some of the call routing. As Figure 2 indicates, a call is off-net if a user at LOC 776 calls a number associated with Central Office (CO) 758-XXXX in the foreign area code 416.

Table 3 lists the dialing formats for the various types of UDP calls.

UDP for switch equipped with Directory Number Expansion

The Directory Number Expansion (DNXP) package allows an internal Directory Number (DN) to have up to seven digits. If the DNXP package is equipped, a seven-digit LOC call to an ESN switch can be terminated to a seven-digit internal DN. This is accomplished by using the Digit Manipulation Index (DMI) for a Home Location Code (HLOC). The HLOC can have an optional DMI that defines digits to be inserted and leading digits to be deleted. The DMI option can be selected and defined in LD90 (refer to *X11 input/output guide* (553-3001-400)).

A seven-digit LOC call to an ESN switch with five-digit, six-digit, or seven-digit internal Directory Numbers (DNs) can be achieved by manipulating its Home Location Codes (HLOCs)-deleting the first three digits and inserting one, two, or three digits respectively.

For example, an existing ESN switch with LOC 646 and four-digit dialing plan is upgraded to a five-digit dialing plan by prefixing the digit 2. An incoming on-net (LOC) call can be handled as follows:

1. Define a Digit Manipulation Index (DMI) for the Home Location Code (HLOC) 646 by:
   - Deleting the first three digits (for example, 646)
   - Inserting the digit 2
2. The Location Code (LOC) call 646-2359 to a telephone of this switch has become a HLOC call in the switch (with the same digit string). Therefore, it is converted to 22359 and terminated to the desired telephone.

Table 3
Dialing formats for NARS UDP calls (Part 1 of 2)

Call type	Dialing format	Code capacity
On-Net (Notes 1, 2 and 3)	AC1 * LOC + XXXX	640
DDD FNPA (Note 1)	AC1 * 1 + NPA + NXX + XXXX	160
Network Speed Call	AC1 * LA + LN	1
Operator-assisted DDD	AC1 * 0 + NPA + NXX + XXXX	160
International DDD	AC1 * 011 + CC + NN	99
Operator-assisted International DDD	AC1 * 01 + CC + NN	99
DDD HNPA (Note 1)	AC2 * 1 + NXX + XXXX	1
DDD operator	AC2 * 0	1
Local calls (Note 1)	AC2 * NXX + XXXX	640
Special local services	AC2 * SPN	8
Toll-free calls	AC2 * 800 + NXX + XXXX	1
Toll-free calls (Note 1)	AC2 * 1 + 800 + NXX + XXXX	1
Toll special numbers	AC2 * 900 + NXX + XXXX	1
Toll special numbers (Note 1)	AC2 * 1 + 900 + NXX + XXXX	1

AC1 Access code for on-net, long distance and Network Speed Calls. Can be any 1 or 2 digits number

AC2 Access code for local calls. Typically the digit 9, can be either 1 or 2 digits in length.

Note 1: If 1+ Dialing is used, the On-Net and Local Calls code capacities are increased to 800 and 792 respectively.

Note 2: If the code 1XX is reserved for future 1+ Dialing use, and not for Network Speed Call codes, then the location code capacity will be reduced to 639 if a 3-digit NSC code is used, 632 if a 2-digit NSC code is used, or 560 if a one-digit NSC code is used.

Note 3: When 1+ Dialing is used, Network Speed Call access will be in the form of 2XX-9XX as a subset of the location codes utilized in the UDP . The location code capacity will be reduced to 799 if a 3-digit NSC code is used, 792 if a 2-digit NSC code is used, or 720 if a one-digit NSC code is used.

Table 3
Dialing formats for NARS UDP calls (Part 2 of 2)

Call type	Dialing format	Code capacity
*	Symbol meaning wait for NARS dial tone (optional).	
NPA	Numbering Plan Area (NPA) code. Any number of the form NXX.	
HNPA	Home Numbering Plan Area (HNPA) code. Any number of the form NXX.	
FNPA	Foreign Numbering Plan Area (FNPA) code. Any number of the form NXX.	
CC	Country code. Any 1, 2, or 3 digits from 2 to 9.	
NN	National Number. Depends on national dialing plan; max 12 digits including Country Code.	
N	Any of the digits 2 to 9.	
X	Any of the digits 0 to 9.	
LA	List access code. Any 1, 2, or 3 digits from 0 to 9.	
LN	List element number. Any 1, 2, or 3 digits, maximum of 1000 element numbers.	
LOC	Three-digit location code for each UDP network location.	
NXX	Local Exchange Code.	
XXXX	4-digit directory number.	
SPN	Special numbers: for example, 411, 611, or may be XXXX.	

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Dialing transparency

Extending the UDP to a remote-access switch (ESN main or Conventional main) is accomplished by forming a single tie trunk access group between the remote switch and the ESN node. Users at this remote switch access the trunk group to the node by dialing the on-net access code (AC1). The ESN node is arranged to insert the digit for AC1 on each incoming call from the switch automatically, this allows access for on-net and long distance calling in a transparent fashion. Local calling is arranged through conventional dial 9 Central Office (CO) trunks at the remote access switch.

Note: If an ESN node replaces a tandem switch in a Tandem Tie Trunk Network (TTTN), other tandem switches in the network can tandem through the ESN node using the same access codes as before. This requires that there be no dialing conflicts between the access codes for the TTTN trunks and the dialing plan implemented at the ESN node.

Automatic least-cost routing

For each call translated at an ESN node, NARS selects a route entry from a route list of up to 32 outgoing alternate routes (eight alternates prior to X11 release 13) to complete the call. Any combination of trunks, for example, Central Office (CO), Foreign Exchange (FX), or TIE, can be specified in a route list.

Note: The Meridian Bandwidth Controller (DCA System 9000), in conjunction with ESN routing lists, improves the capacity of T1 based tandem networks by choosing the optimum path for a voice or data call.

Typically, the first entries in a route list are the least-cost routes to a destination and are defined through a service change as the initial set (I set). The remaining routes in the list (if any) are the more expensive routes to a destination and they are the extended set of routes in the list. Refer to Call-Back Queuing on page 45 and Off-Hook Queuing on page 51 for more information on I set and extended set routes.

Associated with each entry in a route list is information relevant to:

- the route number (0 to 511)
- the minimum Facility Restriction Level (FRL) required for access
- the time of day the route can be accessed
- whether or not queuing Call-Back Queuing (CBQ) or Off-Hook Queuing (OHQ) is allowed on the route
- whether or not the route is to receive Expensive Route Warning Tone (ERWT) treatment
- a digit manipulation table index number (0 to 255)
- a Free Calling Area Screening (FCAS) table index number (0 to 255)
- information for conversion from an on-net call to an off-net call

Route eligibility

NARS translates a dialed LOC, Numbering Plan Area Code (NPA), Local Exchange Code (NXX), or Special Number (SPN) into a route list and searches the list sequentially for an available route. Route eligibility for a given call is based on the caller's NCOS, the NCOS-defined Facility Restriction Level (FRL), the current Time of Day (TOD), and Class of Service (CLS).

Because each entry in a route list has a minimum FRL required for access and all network users are assigned an FRL through their NCOS, the network communications manager can restrict the type of calls allowed to users.

For example, a user assigned to an NCOS group with an FRL of 0 would only be able to make calls to the special local services numbers that have an FRL of 0. In addition, the communications manager can restrict high-cost facilities by assigning a high FRL to the expensive routes in a route list and a lower FRL to a user's NCOS.

Digit manipulation

Any trunk type can be specified in a route list. However, certain trunk types require that Network Alternate Route Selection (NARS) modify dialed digits to conform to trunk dialing requirements. To do this, NARS uses digit manipulation tables to modify the dialed digits.

Each digit manipulation table, up to 256, is associated with a Digit Manipulation Index (DMI) number and defined at each ESN node as shown in Figure 3. Digit manipulation can delete up to 15 leading digits and insert up to 20 leading digits.

See Figure 2 for an example of an ESN with a typical Uniform Dialing Plan. A user at Conventional main location I dials the number 8-613-596-9084 to reach an off-net station in the 613 Numbering Plan Area (NPA) associated with ESN main, location H.

At the ESN node, NARS selects the appropriate route list for call completion to NPA 613 and finds that the only available route to that NPA is a local CO trunk that requires the insertion of the leading digit 1 for long distance calls. The route list entry for this route specifies a Digit Manipulation Index (DMI) number (0 to 255; 0 means no digit manipulation is required). NARS references the digit manipulation table indicated by the index number, deletes digits as specified in the table (none in this case), inserts the required digits (1 in this case) and completes the call on this route.

Time of Day routing

NARS provides up to eight (0 to 7) Time of Day (TOD) schedules. Each entry in a route list is assigned to the TOD schedule that specifies the hour(s) that the particular entry can be accessed to ensure the most cost-effective route selection. A typical TOD schedule is shown in Table 4. A TOD schedule can be associated with any number of arbitrarily selected 15-minute periods. However, any one 15-minute period can appear only in one TOD schedule.

Based on the Time of Day (TOD) schedule in Table 4, a route list entry assigned to TOD schedule 2 is accessed only between the hours of 00:00 to 07:44 and 17:30 to 23:59. Access to the route at any other time is denied. TOD schedules can be turned on or off through service change as the traffic conditions change. A TOD schedule is turned on for an entry by turning off all other TOD schedules.

Table 4
A typical TOD schedule

TOD schedule	Time period
2	00:00 to 07:44 17:30 to 23:59
1	07:45 to 08:59 12:00 to 13:14 16:00 to 17:29
0	09:00 to 11:59 13:15 to 15:59

Flexible ESN 0 Routing

Flexible ESN 0 Routing, available beginning with X11 release 16, uses four prefixes to call the local operator (prefix of 0) or international operator (prefix 00), or to make station-to-station international calls (011), calling card, collect, or other operator-assisted international calls (01).

Normally, the ESN translation table only contains leftwise unique numbers (for example, if one entry begins with the digits 123, no other entry can begin with the digits 123. The four special 0 prefixes, which are not leftwise unique, are an exception to this rule.

Flexible ESN 0 Routing is part of the existing Basic Alternate Route (BARS) (57) and NARS (58) packages and interacts only with these features. Since NARS has two translation tables, two Flexible ESN 0 Routing data blocks are included in NARS. A call could be routed two different ways.

Flexible ESN 0 Routing applies to all route types and network types that are supported by ESN. For information on the appropriate prompts and responses in service change (LD90), refer to Northern Telecom Publication *X11 input/output guide* (553-3001-400).

Automatic on-net to off-net overflow

If all on-net facilities to a location are busy or blocked, NARS can convert a dialed UDP number to the Listed Directory Number (LDN) or Direct Inward Dialing (DID) number of the destination location and use off-net facilities to complete the call.

For example, a user at Conventional main location I (Figure 2) dials 8-777-3283 to reach a party with extension number 3283 at ESN main location H. At the ESN node, NARS translates the dialed LOC number (777) into a route list, and searches all eligible routes in the list. Failing to find an available tie trunk route, NARS then seizes local off-net facilities and, to complete the call, outpulses either:

- 224-3283, if location H is arranged for Direct Inward Dialing (DID), or
- 224-5600, if location H is not arranged for Direct Inward Dialing (DID)

The overflow feature is subject to these restrictions:

- Only one Listed Directory Number (LDN) may be defined per Location Code (LOC).
- DID numbers must have the same Local Exchange (NXX) as the LDN.
- Only one contiguous DID Directory Number (DN) range can be defined per location. DNs that lie outside the range are converted to the LDN.

Multiple DID Office Code Screening

Multiple DID Office Code Screening is available with X11 release 5 and later as a NARS overflow enhancement. The screening process helps route network calls through the public network using on-net to off-net conversion. The call can terminate at any DN defined in the Location Code memory data block.

For each LOC defined, Multiple DID Office Code Screening allows:

- the definition of multiple Local Exchange (NXX) codes
- the definition of multiple ranges of DN within each NXX

The following arrangements of multiple office codes (NXX) and multiple DN ranges are possible:

- single office code with a single DN range (the only alternative prior to X11 release 5)
- single office code with multiple DN ranges
- multiple office codes, each with a single DN range
- multiple office codes with multiple DN ranges

Multiple DID Office Code Screening is subject to the following requirements:

- Only one NPA per LOC is allowed.
- Ranges defined within an LOC must be unique. Overlapping or duplication of ranges is not permitted.
- Each DID range is limited to four digits.
- A maximum of 20 DID ranges may be defined per LOC, regardless of the number of office codes.

Incoming Trunk Group Exclusion

With X11 release 5 and later, Incoming Trunk Group Exclusion (ITGE) enhances the NARS feature that blocks calls from main users trying to reach destinations in the Home Numbering Plan Area (HNPA) or other restricted NPAs, NXXs, LOCs and Special Numbers (SPNs). When the feature is configured, users cannot use the network to circumvent the restrictions. They are forced to dial off-net instead and become subject to whatever restrictions are imposed at the main.

Standard call blocking affects outgoing calls to a specific NPA, NXX, Special Number (SPN) or LOC at the ESN node if the call is from a specific incoming trunk group. As a result:

- The caller cannot loopback through a home switch, for example, the Home Numbering Plan Area (HNPA) or home NXX. Calls that should have been made off-net from the caller's home switch are blocked at the node.
- Main users cannot use ESN to make calls to NPA, NXX, Special Number (SPN), or LOC numbers that they are not permitted to call from the home switch.

Customers define their own sets of restricted trunk routes to specific NPA, NXX, SPN or LOC. There is one Incoming Trunk Group Exclusion Index (ITEI) (maximum 255) for each defined NPA, NXX, SPN or LOC. Each index points to an Incoming Trunk Group Exclusion (ITGE) table that defines a maximum of 128 restricted routes. Incoming Trunk Group Exclusion provides full ten-digit restriction for NPA and SPN codes, seven-digit restriction for NXX codes and LOC. The code itself may be restricted.

NARS tests every ESN call it receives to see if the dialed code is a restricted SDRR type (Supplemental Digit Restriction/Recognition). If it is, NARS checks whether or not it has an ITGE restriction and if there is an Incoming Trunk Exclusion Index (ITEI) number (1 to 255) associated with it. If an ITEI is defined, NARS searches the ITGE table corresponding to the dialed code. If the incoming trunk route is a member of the ITGE, the NARS process terminates and the call is blocked. Otherwise, call processing continues.

Off-Net Number Recognition

Off-Net Number Recognition eliminates the need to use two extra CO trunks when a private network subscriber dials a DID or Direct Distance Dialing (DDD) number that terminates at an ESN location. Calls are routed directly to the dialed DN (DID calls) or to the LDN (DDD calls), rather than being switched from the terminating ESN switch to the CO and back again.

The customer defines Off-Net Number Recognition parameters for local and remote DDD and DID locations in the Network Translation Tables and Supplemental Digit Restriction/Recognition blocks (SDRR). Recognition of up to ten digits can be defined.

Table 5
Network Translation Tables

Call type	Network translation table (number of digits)	SDRR block (number of digits)
NPA	3	1-7
NXX	3	1-4
SPN	4	1-7

Up to 512 Supplemental Digit Restriction/Recognition (SDRR) blocks can be defined. Each table can contain up to 64 entries. Off-net numbers are recognized at the last intelligent NARS/BARS switch. Translation of the NPA, NXX or SPN identifies the method of treatment for the call. If the data type is SDRR and the index is an SDRR table index, Supplemental Digit Restriction/Recognition is applied by comparing the dialed digits with the numbers declared in the SDRR block.

- If no match is found in the SDRR, route selection is called, call processing resumes and the call is routed to the CO of the terminating off-net number.
- If a match is found and the number is in the denied block, standard call blocking occurs.
- If a match is found and the number is recognized as a terminating number at the local switch (for example, the last intelligent NARS/BARS switch), the call is terminated at DN (DID calls) or at the attendant DN (DDD calls).

- If a match is found and the dialed number is a recognized number terminating at a remote Conventional main, route selection is called, the appropriate digit manipulation takes place, and the call is routed directly to the conventional main. DID calls terminate at the dialed number and Direct Distance Dialing (DDD) calls terminate at the attendant DN.

Digit translation/restriction/recognition

The ESN provides a 1-digit through 11-digit translation/restriction/ recognition capability through the use of Network Translation Tables. There are two Network Translation Tables, one associated with each of the network access codes (AC1 and AC2).

Normal translation mechanisms translate the dialed network access code, determine that the call is to be processed by NARS, and select the appropriate Network Translation Table as shown in Table 5. The NARS translation determines the method to be used to process the call and applies digit restriction or recognition where required. The result of translation is to invoke route selection via a specified route list or to block the call. More information on digit recognition can be found under Off-Net Number Recognition on page 24.

Network Translation Table

Each NPA (area code) translation entry, excluding the Home Numbering Plan Area (HNPA) contains:

- a route list index number (0 to 255) that indicates which route list to use for a call to this NPA
- whether or not there are telephone numbers within this NPA to which network calls are to be blocked
- whether or not there are telephone numbers within this NPA that cannot receive network calls because of ITGE restrictions (X11 release 5 and later)
- whether or not there are numbers under this NPA that are to be recognized as DID or Direct Distance Dialing (DDD) codes to an on-net location (X11 release 5 and later)
- a list (up to 64) of one- to seven-digit numbers that follow the NPA and are to be blocked or recognized in this NPA

Each NXX office code translation entry contains:

- a route list index number (0 to 255) that indicates which route list to access in processing a call to this NXX
- whether or not there are telephone numbers within this NXX to which network calls are to be blocked
- whether or not there are telephone numbers within this NXX to which network calls are to be blocked because of ITGE restrictions
- whether or not there are numbers under this NXX that are to be recognized as DID or DDD codes to an on-net location
- a list of up to 64, one- to four-digit numbers that follow the NXX and are to be blocked or recognized in this NXX

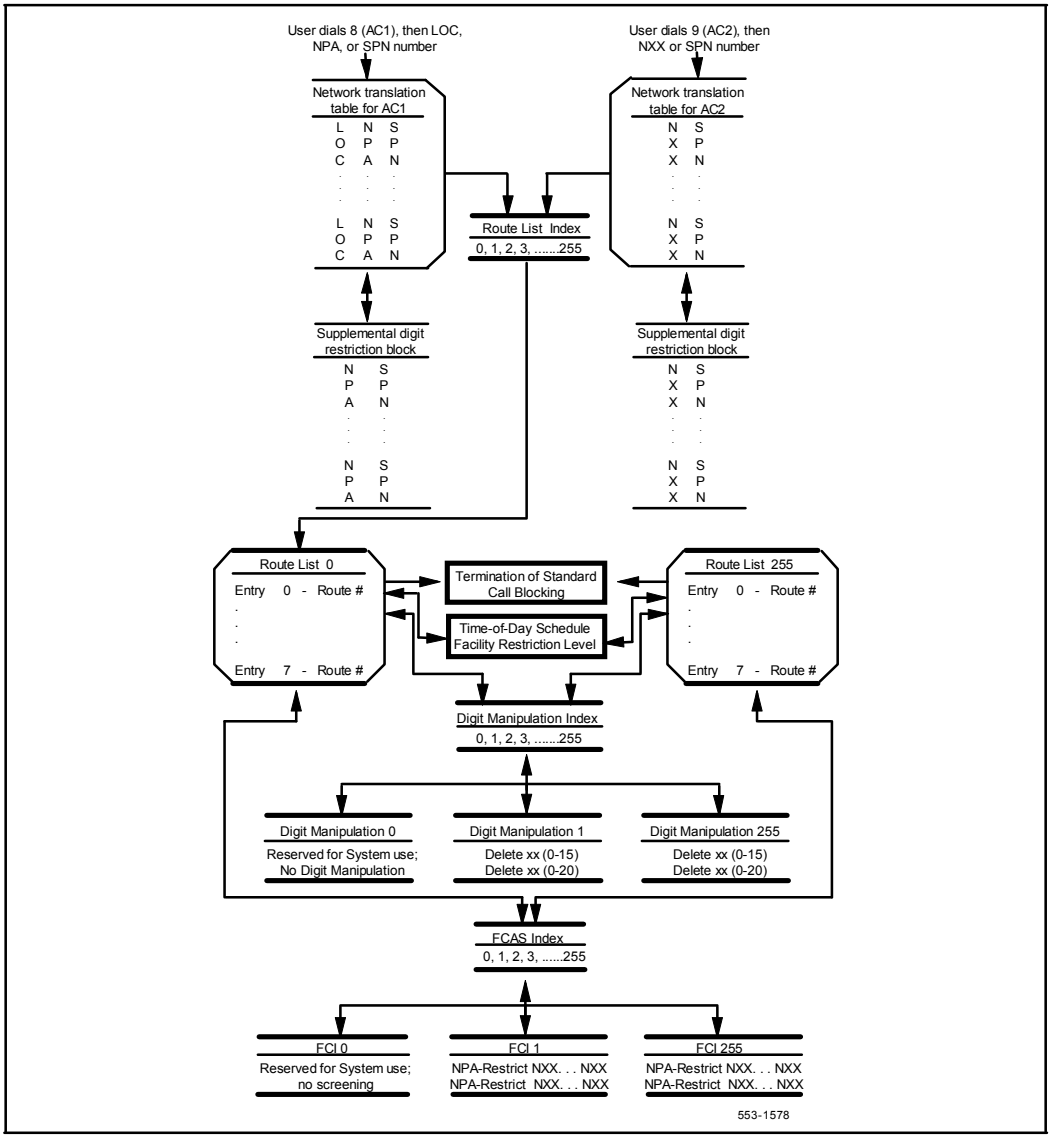
Each LOC translation entry, excluding the HLOC contains:

- a route list index number (0 to 255) that indicates which route list to access in processing a call to this LOC
- the Listed Directory Number (LDN) to which the LOC number is to be converted when using off-net DDD facilities
- the ranges of DID numbers to which the LOC number can be converted when using DID facilities
- whether or not there are LOC numbers to which network calls are to be blocked because of ITGE restrictions

Each Special Number (SPN) translation entry contains:

- a route list index number (0 to 255) that indicates which route list to access in processing a call to this SPN
- whether or not there are digits following SPN numbers to which network calls are to be blocked
- whether or not there are SPN numbers to which network calls are to be blocked because of ITGE restrictions
- whether or not there are SPN numbers that are to be recognized as codes to an on-net location
- a list of up to 64 entries, of one- to seven-digit numbers that are to be blocked or recognized when following the SPN

Figure 3
NARS elements accessed at an ESN node to process a network call



Supplemental digit restriction

Supplemental digit restriction blocks, which vary by release, function as follows:

- block access to certain telephone numbers
- recognize off-net calls dialed to on-net locations
- prevent routing of calls to the home switch of the originating trunk group by either on-net or off-net facilities

See Table 6 for more information. The customer can also specify through service change the treatment that blocked calls receive. For example, overflow tone, intercept to attendant, or recorded announcement. One block can be assigned per NPA, NXX, or SPN.

Table 6
Supplemental digit restriction blocks per NARS or BARS

Network package	X11 release 4	X11 release 5 and later
ESN node	256	512
BARS	32	256

Note: For X11 release 4 and earlier, one block can recognize or restrict up to 16 numbers. For X11 release 5 and later software, one block can recognize or restrict up to 64 numbers.

Free Calling Area Screening

The Free Calling Area Screening (FCAS) is a NARS feature that provides the customer with the capability of full six-digit (NPA-NXX) screening to determine the route choice for completion of off-net calls. With FCAS, a customer can allow calls to NXX codes within the free calling area surrounding a particular on-net location, and restrict (deny) calls to those NXX codes that would incur long distance charges.

The FCAS is implemented in a similar fashion to digit manipulation, for example, through FCAS tables. There can be up to 256 FCAS tables defined at an ESN node. Each table can contain up to 15 NPA codes. Up to 800 NXX codes can be restricted within each NPA code. Each FCAS table is referenced by a Free Calling Index (FCI) number (0 to 255), where FCI = 0 is a system default meaning no Free Calling Area Screening is required. The appropriate FCI number is then assigned to the applicable route list entries.

Whenever a route list entry is being considered for an off-net call (for example, 8-NPA-NXX-XXXX), NARS checks to see if there is an FCI number (other than 0) referred to by the entry. If an FCI number other than 0 is defined, the appropriate FCAS table for the dialed NPA is found and used for NXX screening.

If the dialed NXX is denied in the table, NARS does not use the route list entry for call completion, but continues to search for another eligible route list entry. If the dialed NXX is not denied in the table, the route list entry is eligible for the call. Calls converted to the LDN of a location are screened only if the NPA is included as part of the LDN. NXXs allowed in an Free Calling Index (FCI) table are the only ones allowed for that route list entry.

Expensive Route Warning Tone

This feature enables the network manager to select certain users to receive an Expensive Route Warning Tone (ERWT). Eligibility for this tone is based on the user's NCOS. The tone, which is three 256-ms bursts of 440 Hz, notifies the user that NARS has selected facilities designated as expensive to complete the call. Upon receipt of ERWT, the user has the choice of either allowing the call to complete over the expensive facilities or going on hook to avoid the increased expense. The user must make this choice within a programmable time of 0 to 10 seconds. The tones must be activated for the customer group and the expensive route cannot be part of the initial set (I set) in the route list.

If the call originator is located at an ESN node or ESN main, the Ring Again (RGA) feature is defined for the user, and the user is eligible for extended CBQ option ([a]), then Ring Again may be activated to queue the call; see the various queuing features for more information.

If the ESN node is equipped for Call Detail Recording (CDR), acceptance of an expensive route after ERWT is received is noted in the CDR record.

NARS bypass control

A customer can allow selected users to bypass the NARS feature for call completion between any two locations, for example, two locations that share a high community of interest. To do this, routes and trunks are set up between the two locations and assigned an access code distinct from the AC1 and AC2 codes used to access NARS.

The normal trunk controls; for example, Trunk Group Access Restriction (TGAR), Class of Service (CLS), and code restriction are then used to enable access only to the selected users. All other users are denied access to the trunk group and are forced to use NARS for all calls.

Network speed call

The Network Speed Call (NSC) feature enables a user at an ESN node, ESN main, or Conventional main who is normally restricted from making certain types of NARS calls to make such a call if the destination is a company-approved number defined in a System Speed Call (SSC) list. This feature requires that the System Speed Call feature be equipped in addition to Network Speed Call. See *X11 features and services* (553-3001-305).

The user dials the NARS access code, then dials a customer-defined Network Speed Call (NSC) access code (one, two, or three digits) to make a speed call. The NSC access code must be different from Special Numbers and from all LOC, NPA, and NXX codes.

A service change in the network translation overlay associates an NSC access code with a System Speed Call (SSC) list (maximum number of lists is 4096 beginning with X11 release 13; earlier, the limit was 254). If the SSC list changes in length, the list access code and list number must be deleted and reentered into the NARS translator. An NCOS number is associated with each SSC list, but applies to the call only if the FRL (0 to 7) is greater than that associated with the call originator's assigned NCOS.

> ***Note:*** If 1+ dialing is specified for an NPA, NXX, or SPN number in a translator, the digit 1 must not be used as the leading digit for Network Speed Call list codes in that translator.

The user then dials the number of the desired entry in the SSC list. Entry numbers can range from 0 to 9, 00 to 99, or 000 to 999, depending upon the number of elements allocated when the list was defined through service change. After the dialing is finished, the digits defined for the list entry are passed to NARS/BARS translation for processing. Route and feature (Off-Hook Queuing [OHQ], Call-Back Queuing [CBQ]) eligibility for call completion are based on the FRL of the NCOS associated with the SSC list only if the FRL of the user's assigned NCOS is lower than that of the list.

Network Call Transfer

Network Call Transfer (NXFER) improves the operation of the existing Call Transfer (XFER) feature between two switches when a call is transferred back to the originating switch. The regular XFER feature requires two tie trunks to complete the call. With NXFER, the originating switch completes the transfer itself, and the tie trunks are dropped. Refer to *ISDN Primary Rate Interface description and administration* (553-2901-100) for a detailed description.

The benefits of the Network Call Transfer (NXFER) feature include:

- reduced use of access tie lines
- improved transmission performance, since tie lines are not used for the completed connection
- similar operation to the existing XFER feature

Figures 4 and 5 illustrate a Network Call Transfer (NXFER) operation in which telephone A receives a call from B and transfers it to C. As shown in Figure 4, NXFER and Network Signaling (NSIG) software at both ends of the tie trunk allow telephone A at one ESN switch (I) to transfer the tie trunk call from telephone B (switch II) to a third party, telephone C (switch II). As shown in Figure 5, if the transfer is allowed, stations B and C connect on switch II. The ESN tie trunks are dropped after the transfer occurs. In comparison, regular Call Transfer (XFER) requires two tie trunks and both switches to connect stations B and C, as shown in Figure 6.

Figure 4
Connection during NXFER

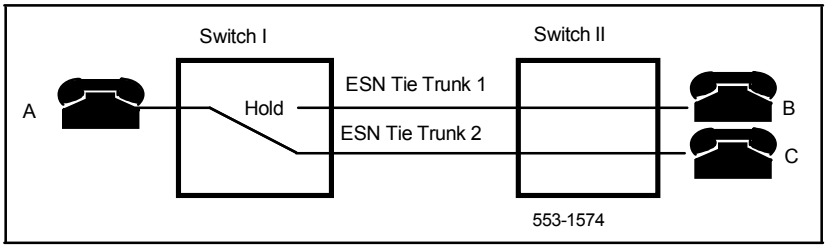


Figure 5
Connection after NXFER

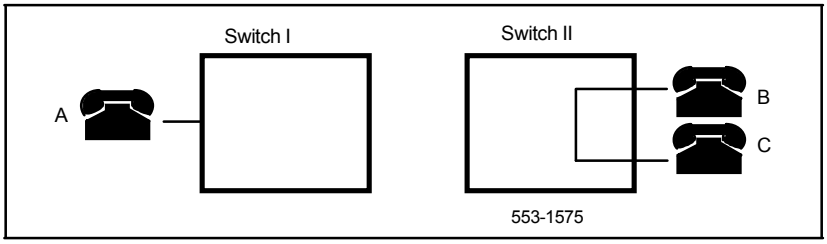
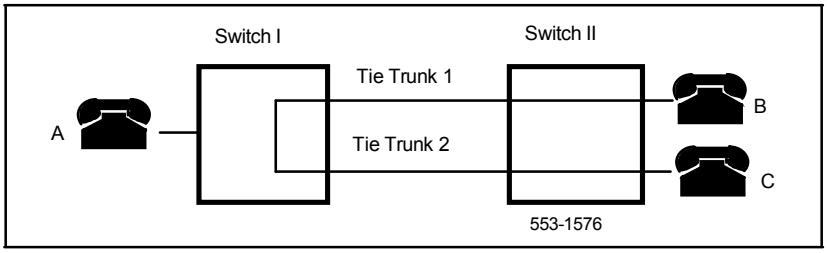


Figure 6
Connection after XFER



1+ dialing

With 1+ dialing, both NARS translation tables are equipped for four-digit translation (based on the first one to four digits), thus allowing NARS customers the option of dialing 1+ after the NARS access code for long distance calls. See Table 3 for dialing formats for NARS Uniform Dialing Plan (UDP) calls.

The 1+ dialing capability also eliminates ambiguity between identical three-digit NPA, NXX, and LOC codes so that the NARS customer can route calls to an NPA, NXX, or LOC code that conflicts with one of the customer's three-digit codes.

If 1+ dialing is specified for an NPA, NXX, or SPN number in a translator, the digit 1 must not be used as the leading digit for Network Speed Call list codes in that translator.

Network Control

Network Control (NCTL) is an enhancement to the NCOS feature that extends NCOS controls to users located at ESN main switches. Network Control requires that the ESN main and serving ESN node be equipped with the Network Signaling (NSIG) feature.

ESN main NCOS

Users (lines, trunks, attendants) at an ESN main are assigned an NCOS, which is used to determine their level of access to network facilities at the serving ESN node. When a user at an ESN main initiates a call to, or through, an ESN node, the user's assigned NCOS can be transmitted on Traveling Class of Service (TCOS), depending on tie trunk settings (ESN, ESN2, etc.). If the user's NCOS is transmitted to the serving node and the node is equipped with Basic Alternate Route Selection (BARS), only NCOS 0 to 7 can be assigned at the node. Therefore, only NCOS 0 to 7 should be assigned at the ESN main even though an ESN main with NSIG can have NCOS 0 to 15.

If the node is equipped with NARS, then NCOS 0 to 15 can be assigned both at the node and at the ESN main. The transmitted NCOS (or TCOS) overrides the NCOS (or FRL) assigned to the incoming tie trunk group at the node, and it is used to determine the user's eligibility for network resources/features at the ESN node. Thus, a user at an ESN main has the same network access capabilities as a user at the ESN node who is assigned the same NCOS.

> ***Note:*** If the user at the ESN main enters a valid authorization code prior to placing a NARS call, the NCOS associated with the authorization code is transmitted to the ESN node in place of the user's assigned NCOS.

Calls from a Conventional main to the ESN node are controlled by the NCOS assigned to the incoming trunk group at the ESN node, since the Conventional main does not have NSIG.

ESN node TCOS

Network Control (NCTL) at an ESN node can provide a Traveling Class of Service (TCOS) mechanism that controls route access and Off-Hook Queuing (OHQ) eligibility for calls placed to or through another ESN node or an associated ESN main, it enables the ESN node to interface with switches that are part of an Electronic Tandem Network (ETN), provided that the SIGO setting on the tie trunk is set for ETN at both ends.

The Traveling Class of Service (TCOS) is, in effect, the FRL of a user's assigned NCOS. When a user at an ESN node initiates a call to another ESN node or an ESN main, the TCOS (for example, the FRL of the user's assigned NCOS) is transmitted to the other ESN node. At the receiving ESN node, the TCOS (0 to 7) replaces the FRL of the NCOS assigned to the incoming trunk group.

Route access and OHQ eligibility for the call are, therefore, based on the NCOS of the incoming trunk group with the modified FRL (for example, TCOS).

> ***Note:*** The Network Control (NCTL) data block (LD87) is used to define OHQ eligibility on a per FRL (TCOS) basis. For example, if FRL 4 is defined as OHQ eligible, then all users who have an NCOS with a FRL of 4 are eligible for OHQ on calls placed to another ESN node or to an associated ESN main.

If a user at an ESN main or Conventional main initiates a call that tandems through the serving ESN node to another ESN node or ESN main, TCOS applies to the call as if the call originated at the serving ESN node.

ETN switch compatibility

The TCOS is equivalent to the Traveling Class Mark (TCM) used at Electronic Tandem Network (ETN) switches. See Technical Publication 42709, Tie Trunk Signaling Compatibility for Connecting to a DIMENSION PBX, July 1979.

When a ten-digit UDP call or Distance Steering Code (DSC) Coordinated Dialing Plan (CDP) call is made from an ESN node to an Electronic Tandem Network (ETN) switch, the dialed digits, together with the TCOS number (0 to 7), are sent to the connected ETN switch. At the ETN switch, the TCOS number received from the ESN node is used as a Traveling Class Mark (TCM) to determine route access and OHQ eligibility at the ETN switch.

Similarly, when a call is made from an ETN switch to an ESN node, the dialed digits, together with the Traveling Class Mark (TCM) number (0 to 7), are sent to the connected ESN node. The ESN node interprets the received TCM number as a TCOS number. The received TCM (for example, TCOS) replaces the FRL of the NCOS assigned to the incoming trunk group from the ETN switch. This new FRL (for example, TCM) is then used to determine route access and OHQ eligibility for the call.

However, if a Distance Steering Code (DSC) CDP call is terminated on a switch as a Local Steering Code (LSC) call, the TCOS value transmitted by the connected switch will not be collected and saved by this switch.

Network Signaling

The Network Signaling (NSIG) feature provides the required signaling protocol to interface nodes with ESN mains, nodes with other nodes, and nodes with Electronic Tie Network (ETN) switches.

Installing NSIG at a Conventional main enhances it and it becomes an ESN main. When callers at an ESN main place calls through a node with NSIG, their NCOS or TCOS travel with the call and are interpreted at other NSIG equipped switches. The tie trunk settings determine and control the operation of this feature.

When the NSIG feature is equipped at a switch, there are options available (Route Data Block [RDB], LD16) to define the signaling arrangements between that switch and any other switch connected to it by means of tie trunks. These options define what call information is to be transmitted to a connected switch and what call information is to be received from a connected switch. The option selected depends on the type of connected switch (ESN node, ESN main, Conventional main, ETN) and the options (for example, Coordinated Call-Back Queuing [CCBQ], Call-Back Queuing to Conventional Mains [CBQCM]) that are available to the connected switch.

The signaling options are STD (standard), ESN, ESN2, ESN3, ESN5 (Electronic Switched Network), and ETN (Electronic Tie Network).

STD Arranges the tie trunk group for transmission/reception of the called number between switches. Sends outpulsed digits.

ESN (X11 release 2 only) Arranges the tie trunk group for transmission/reception of the call type, NCOS/TCOS, and called number between switches, and is required on systems equipped with the CCBQ/CBQCM feature. Sends call type, NCOS or TCOS, and dialed digits.

ESN2 (X11 release 3 and later) Arranges the tie group as described for ESN in X11 release 2. Used unless switch has NXFER or Satellite Link Control (SAT).

ESN3 (X11 release 3) Arranges the tie group as described for ESN in X11 release 2 and is required on systems equipped with the NXFER or Satellite Link Control features.

ESN5 (X11 release 5 and later) Arranges the tie group as described for ESN in X11 release 2; needed with Digital Trunk Interface (DTI).

ETN Arranges the tie trunk group for transmission/reception of the called number and TCOS/TCM between switches and is used when connected to an ETN switch. Sends outpulsed digits and TCOS.

Application

Following is a description of how these options are applied to accommodate the different switch types that can be connected to an ESN main or ESN node that is equipped with the NSIG feature.

ESN node An ESN node can be connected by means of tie trunks to another ESN node, an ESN main, a Conventional main, and/or an ETN Switch.

- If the ESN node connects to another ESN node, both ends of the connecting tie trunk group are defined with the ETN option.
- If the ESN node is equipped with X11 release 2 and connects to an ESN main equipped with X11 release 2, both ends of the connecting tie trunk group are defined with the ESN option.
- If the ESN node is equipped with X11 release 3 and the ESN main is equipped with X11 release 3, both ends of the connecting tie trunk group are defined with the ESN3 option.
- If the ESN node is equipped with X11 release 2 and the ESN main is equipped with X11 release 3, the node end of the connecting tie trunk group is defined with the ESN option, and the main end is defined with the ESN2 option.
- If the ESN node is equipped with X11 release 3 and the ESN main is equipped with X11 release 2, the node end of the connecting tie trunk group is defined with the ESN2 option, and the main end is defined with the ESN option.

- If the ESN node connects to a Conventional main, the node-end of the tie trunk group is defined with the STD option.
- If the ESN node connects to an ETN switch, the node-end of the tie trunk group is defined with the ETN option.

ESN main An ESN main can be connected by means of tie trunks to an ESN node and satellite switches.

- If the ESN main is equipped with X11 release 2 and connects to an node equipped with X11 release 2, both ends of the connecting tie trunk group are defined with the ESN option.
- If the ESN main is equipped with X11 release 3 and the ESN node is equipped with X11 release 3, both ends of the connecting tie trunk group are defined with the ESN3 option.
- If the ESN main is equipped with X11 release 2 and the ESN node is equipped with X11 release 3, the Main end of the connecting tie trunk group is defined with the ESN option, and the node end is defined with the ESN2 option.
- If the ESN main is equipped with X11 release 3 and the ESN node is equipped with X11 release 2, the Main end of the connecting tie trunk group is defined with the ESN2 option, and the node end is defined with the ESN option.
- If there are satellite switches (non-ESN) connected to the ESN main, the main-end of the tie trunk groups from the satellite switches are defined with the Standard (STD) option.

Requirements

The following requirements apply:

- An ESN main can connect to only one ESN node. Both switches must have NSIG for NSIG related features.
- Tie trunks between ESN nodes and ESN mains must be arranged for Dual Tone Multi-Frequency (DTMF) sending/receiving, wink-start operation and must have answer supervision.
- ESN node compatibility with ETN switches is limited to seven-digit on-network, ten-digit off-network, and Distance Steering Code (DSC) CDP calls.

Satellite Link Control

Tandem trunk calls, when connected through more than one communications satellite trunk, are subject to transmission distortion due to propagation to and from communications satellites. The Satellite Link Control (SAT) feature ensures that the configuration of a call does not include more than one communications satellite trunk.

Requirements

- This feature applies to ESN network calls (NARS/BARS/CDP) only.
- ESN Proprietary Signaling (NSIG) is required among ESN switches.
- Routes that receive digits from satellites or send digits to satellites have to be marked as SATELLITE routes.

Routing Control

The Routing Control (RTC) feature provides a mechanism for changing a user's network-access capabilities when a special TOD schedule is in effect, when an extended TOD is in effect, or when the user presses a Routing Control key on the console.

NCOS map

With the NARS feature, TOD schedule 7 is the special TOD schedule. Associated with the special TOD schedule is a NCOS map. The NCOS map lists all NCOS numbers.

Associated with each listed NCOS is an alternate NCOS number (greater than, equal to, or smaller than) that replaces the original NCOS number when the special TOD schedule is in effect. Table 7 illustrates a typical NCOS map.

Table 7
Typical NCOS map for special TOD schedule 7

Original NCOS	Alternate NCOS	Original NCOS	Alternate NCOS
0	0	8	2
1	0	9	3
2	0	10	3
3	1	11	4
4	1	12	4
5	2	13	5
6	2	14	5
7	2	15	5

Note: When TOD Schedule 7 is in effect, the alternate NCOS replaces the user's original NCOS.

Invoking Routing Control

The alternate NCOS numbers associated with special TOD schedule 7 are normally invoked when the time specified for TOD schedule 7 corresponds to the time in the system clock. Additionally, the alternate NCOS numbers can be scheduled for implementation (through service change) for the full 24-hour period of specified days of the week. This capability enables network-access capabilities to be reduced automatically on weekends or company holidays.

The attendant can also manually invoke the special TOD schedule by using a Routing Control (RTC) key on the console. Pressing the RTC key lights the associated lamp and invokes the special TOD schedule. To deactivate Routing Control, the RTC key is pressed again. The associated lamp goes dark, and normal TOD schedules are once again in effect.

> ***Note:*** Authorization Code can be used to override the restrictions imposed through routing control. If a user enters a valid authcode, the NCOS number associated with the authcode is applied for the duration of the call.

Call-Back Queuing

Call-Back Queuing (CBQ) is an ESN node feature that provides queuing for network calls encountering busy or blocked facilities at the ESN node. CBQ enables the calling party to go on hook after activation of the Ring Again (RGA) feature and receive a call back from the ESN node when a network facility becomes available. See *X11 features and services* (553-3001-305).

The CBQ feature is available only to stations located at an ESN node. Unlike OHQ, CBQ is offered only at the originating ESN node. Access to CBQ is accomplished through the existing Ring Again (RGA) feature.

Options

Two options for CBQ eligibility are defined by the call originator's NCOS. The first option, CBQ(i), means that CBQ may be offered after only the initial route set of a route list has been examined for an available route. The second option, CBQ(a), means that CBQ may be offered after both the initial and extended (for example, all) route sets of a route list have been examined. In either case, a call offered CBQ is first queued against the initial route set.

Eligibility

Before offering CBQ to a call originator, the following eligibility tests are performed.

- At least one of the routes in the initial route set is defined as CBQ eligible.
- The user's NCOS is defined as permitting CBQ; either CBQ(i) or CBQ(a).
- The call is not eligible for OHQ. Calls that are eligible for both OHQ and CBQ will be offered OHQ.
- The user's telephone is allowed access to the Ring Again feature and does not have another CBQ or Ring Again call already in the queue.
- The CBQ feature is enabled for this customer.

CBQ(i) eligible For call originations by a caller defined as CBQ(i) eligible, the system searches the initial route set for an available route. If no available route is found, CBQ is offered to the caller subject to the CBQ eligibility tests.

CBQ(a) eligible For call originations by a caller defined as CBQ(a) eligible, the system examines the initial route set for an available route. If no available route is found, the extended route set is then searched for an available route. If an available route is not found in the extended set, then CBQ is offered, subject to the CBQ eligibility tests. However, if an available route in the extended route set is found that is designated as expensive, the user's NCOS allows ERWT, and ERWT is enabled for the customer, the tone is given and the system delays terminating the call. During this delay the user has the following options:

- Refuse the expensive route by abandoning the call.
- Wait and allow the call to complete over the expensive route.
- Activate the Ring Again feature (feature key or access code) to place the call in the CBQ. The user must be CBQ(a) eligible; otherwise, operation of the Ring Again feature is ignored.

Offer

The CBQ offer consists of an optional recorded announcement, followed by overflow tone. If the user wishes to accept the CBQ offer, Ring Again must be activated within 30 seconds. Ring Again activation follows present feature operation for SL-1 and 500/2500 telephones. See *X11 features and services* (553-3001-305). The CBQ offer can be refused by going on hook. If the user neither accepts nor refuses the CBQ offer within 30 seconds, the call is force disconnected. If the user wishes to accept the CBQ offer, Ring Again must be activated within the programmed time (default is 20 seconds).

CBQ calls are placed in a priority-ordered trunk queue (together with OHQ calls, if any) with a starting priority and maximum priority (see LD87) defined by the call originator's NCOS. (Refer to Off-Hook Queuing on page 51 for additional information on priority queuing.) At the same time, two timers are started.

- a queue promotion timer and a route advance timer
- each with values defined through the originator's NCOS

At intervals defined by the queue promotion timer, the priority of the call is incremented until it reaches its maximum priority.

Each time the call priority is incremented, its position in the CBQ is advanced. If the route advance timer reaches its maximum value before the call can be terminated on a route in the initial set (I set), the extended set of routes is added to the routes that the call is currently queued against.

> ***Note:*** A route advance timer (RADT) set to 0 never expires. The user always queues for I set routes only.

Expensive route warning tone is not given to calls that have been queued, even if terminated on expensive facilities. Unless cancelled by the call originator, CBQ calls remain in the queue until they have been offered a trunk; there is no time limit on CBQ calls. Calls can only be routed on routes in the I set or extended set if the FRL in the NCOS is equal to or greater than the FRL assigned to the route in the route list.

Call back

When a trunk becomes available for a CBQ call, it is seized to prevent incoming originations during the CBQ call back period. Outpulsing of digits (either those originally dialed by the user or those required as a result of digit manipulation) is started at a slow, fixed rate. The number of digits to be outpulsed determines how long the trunk can be held while the CBQ call back is being offered to the originating station. The system computes this time by allowing 10 seconds before the first digit is outpulsed and 256 seconds between subsequent digits.

The originator of the call is alerted to the CBQ call back by either tone buzzing and a winking Ring Again feature lamp (SL-1 telephone), or short bursts of ringing (500/2500 telephone). The SL-1 telephone user must accept the call back within the computed value of outpulse time or the service-changeable CBQ time limit of 10 to 30 seconds, whichever is less. A user with a 500/2500 telephone must accept the call back within 6 seconds. Acceptance of the CBQ call back is performed with present Ring Again operating procedures.

When a CBQ call back is answered at a digit display SL-1 telephone, the originally dialed digits are displayed. If the user does not answer the call back within the time limit, the call is removed from the queue and discarded. If the user accepts the call back within the time limit, the call is terminated. A CBQ call can be canceled by the originating station by means of the existing procedures for Ring Again cancellation.

Feature interactions

The CBQ feature interacts with the following features.

- **Barge-In, Force Disconnect** Between the time a trunk is seized for a CBQ call and the user accepts the CBQ call back, the trunk can be stolen by the attendant or force disconnected through service change. If this occurs, there is no guarantee that the call can be terminated when the user accepts the CBQ callback. Under these circumstances, the call is treated like a new origination and NARS/BARS is used to reattempt termination. This can result in the call being blocked and being offered CBQ a second time.
- **Hunting, Call Forward, Multiple Appearance DN** CBQ call backs to stations at an ESN node are offered only to the originating station, regardless of the hunting or call forwarding that may be in effect. Other appearances of a station's Directory Number (DN) are not offered the call back.
- **Attendant functions** Because the Ring Again feature is not supported at attendant consoles, CBQ is not offered to an attendant regardless of the CBQ eligibility of the NCOS assigned to the attendant.

Off-Hook Queuing

Off-Hook Queuing (OHQ) is a software feature that can be equipped at an ESN node and/or ESN main. The feature enables a call originator to remain off hook for a short time (customer programmable) until a network facility for call completion becomes available at the ESN node or ESN main.

Eligibility

Network calls may be placed in an OHQ if all trunk routes (entries) in the initial route set of a route list (see note) are busy, and the following criteria are met:

- OHQ has been allowed for that customer group.
- At least one of the trunk routes in the initial route set of a route list is defined as being eligible for OHQ.
- The NCOS of the call originator (at an ESN node or an ESN main) is defined to permit OHQ.
- The incoming trunk group at the ESN node or ESN main is defined in software to permit OHQ for incoming calls.
- The TCM received at the ESN node from an ETN switch is compatible with a FRL that is defined to permit OHQ.
- The TCOS received at the ESN node from another ESN node is compatible with an FRL that is defined to permit OHQ.
- The probability that the call times out in the OHQ before a trunk becomes available is below a specific threshold.
- The OHQ feature is enabled.

Note: A marker determines which route list entries are in the initial route set (see automatic least-cost routing). Typically, the initial route set contains the cheaper routes to a particular destination. The remaining routes in the route list, if any, comprise the extended route set and are usually the more expensive routes to the destination. Only routes in the initial route set should be defined to allow OHQ. OHQ are not offered by routes in the extended route set even if they are defined to allow OHQ.

Calls that do not meet the preceding requirements for OHQ eligibility can be offered CBQ at this point.

Availability

The OHQ software performs an availability test to prevent calls from entering the OHQ when there is a high probability that the call will time out before a trunk becomes available. The following process is used to make this test:

- For each trunk route, a counter is maintained that reflects the current number of calls with the maximum queue priority of 3 queued against it. This includes all calls in OHQ, Ring Again, and those CBQ calls that are currently at priority 3 as well as any direct-access calls in progress.
- Each trunk route has a threshold value that indicates the maximum number of priority 3 calls that can be queued against it before OHQ timeout becomes a high probability. Before a call is placed in the OHQ, the current queue count is compared with the threshold value for each eligible trunk route in the initial set of routes. If at least one of the trunk routes has a count that is less than or equal to the threshold value, the call is allowed to OHQ against all OHQ eligible routes.

  Note: A maximum priority (0, 1, 2, or 3) and a starting priority (0, 1, 2, or 3) are assigned to each user through LD87. Zero is the lowest priority while three is the highest. Calls are queued according to their starting priority and move to a higher queue (up to their maximum priority) as their promotion timer allows. Once calls reach their maximum priority, they wait for an available trunk in the I set. If the route advance timer (RADT) expires, they can also queue for the extended set routes.

Offer

If all eligibility and availability checks are successful, the call originator is given a distinctive OHQ offer tone (a 1 second burst of 440-Hz tone) when the call enters the OHQ. The call originator either accepts the OHQ offer by remaining off hook or declines the offer by going on hook.

OHQ calls are placed in a priority-ordered queue with all other calls waiting for trunks. OHQ calls are assigned the maximum priority (3), since other network facilities may be held while the call is queued. A timer with an initial value equal to the software-defined OHQ time limit is started to limit the duration of the OHQ. The OHQ time limit is service changeable within the range of 2 to 60 seconds.

The queue is examined whenever a trunk becomes idle in a trunk route on which one or more calls are queued. If a call is found that can be terminated on an idle trunk, the available trunk is seized and the call terminated.

If the OHQ timer expires before the call can be terminated, the call is removed from the OHQ. At this time, the remaining eligible routes in the route list (the extended set) are examined, and the call is either terminated or given standard blocking treatment if no facilities are available. CBQ will not be offered at this point as OHQ was already offered. The ERWT is not given to calls that have been queued, even if terminated on expensive facilities.

OHQ can be offered to call originators located at an ESN node, ESN main, Conventional main or ETN switch. Also, as a call progresses through the network, OHQ can be offered to the call originator from any of the ESN nodes or ESN mains that are used to process the call. For example, OHQ can be offered more than once for a given call.

Feature interactions

The OHQ feature has the following interactions with existing features:

Call modification

Station users are not allowed to activate call modification features (hold, call transfer, conference) while waiting in the OHQ. Switchhook flash used to activate features from 500/2500 telephones is ignored. Similarly, operation of set feature keys is ignored.

Camp-On, Call Waiting

If the attendant extends a call to a telephone that is in the OHQ, the Call-Waiting tone is not offered to the telephone. If the attendant releases, the call is camped on the OHQ telephone, but no warning tone is given. When the Camp-On call is recalled to the attendant console, the attendant can repeat the Camp-On procedure. Once the OHQ call is in an established state, the Camp-On tone is provided.

Attendant functions

- The attendant cannot Barge-In during trunk seizure for OHQ calls.
- If the attendant extends a network call for a telephone user and the call is offered OHQ, the attendant must inform the caller of the OHQ offer before releasing from the call.
- The attendant is not allowed to operate the Release key or another Loop Key (LPK) if the source call is in conference and the destination call is in the OHQ. Operation of the Release Destination key is permitted, however, and causes the OHQ call to be abandoned.

Coordinated Call-Back Queuing

The Coordinated Call-Back Queuing (CCBQ) feature enables stations at an ESN main to be offered CBQ when network calls are blocked at the serving ESN node. When facilities become available at the ESN node, the call originator at the ESN main is alerted by a call back from the node. This feature requires that the ESN main and associated ESN node be equipped with the Network Signaling (NSIG) feature.

Eligibility

When a telephone at an ESN main originates a network call through an ESN node, the NCOS of the call originator, the call type, and whether or not the telephone is allowed access to the Ring Again feature is transmitted to the ESN node. If an authcode is entered at the ESN main prior to dialing a network call, the NCOS associated with the authcode is transmitted to the ESN node. When received by the node, this NCOS is used to determine CCBQ eligibility and is used for the duration of the call, unless further modified by the Authcode Conditionally Last feature.

The CBQ eligibility tests are performed. In addition, a check is made that the incoming trunk group from the ESN main is defined (at the ESN node) to permit CBQ and that the call type allows CBQ. CCBQ is offered to the user at the ESN main if the eligibility tests are successful. If the tests are unsuccessful, standard call blocking is applied to the call.

As for stations at an ESN node, the call originator at an ESN main can invoke Ring Again upon receipt of ERWT if the originator's NCOS is defined at the ESN main as CBQ(a) eligible.

Offer

The CCBQ offer and acceptance sequences are identical to those for stations at the ESN node (see Call-Back Queuing on page 45). The optional recorded announcement and overflow tone are provided by the ESN node. In addition, after the recorded announcement is provided, the ESN node transmits a signal to the ESN main. This signal indicates that the call is in a state that allows Ring Again.

When the call originator at the ESN main activates Ring Again, the ESN main assigns a unique queue identification number to the call. This number is transmitted to the ESN node to indicate CCBQ acceptance. At the ESN main, the call is placed in a holding queue. At the ESN node, the call, together with the queue identification number, is placed into the trunk queue. The ESN main to ESN node tie trunk is released.

Call back

When an outgoing trunk is seized by the ESN node for a CCBQ call, slow outpulsing is started to hold the trunk while a call back is made to the call originator at the ESN main. The ESN node seizes an available tie trunk to the ESN main and transmits the queue identification number of the call to the ESN main. The ESN main then initiates a call back to the call originator. Callback presentation to the call originator is as for standard Ring Again (see Call-Back Queuing on page 45).

> ***Note:*** If no tie trunks to the ESN main are idle, the outgoing trunk is released and can be offered to another call. The CCBQ call retains its position in the queue but is not offered another trunk until a tie trunk to the ESN main becomes available.

When the call originator at the ESN main accepts the CCBQ call back, answer supervision is sent from the ESN main to the ESN node. The ESN node completes the call, and the digits are outpulsed at a normal rate.

If the call originator is equipped with a 500/2500 telephone and is engaged in a call when the ESN node initiates a CCBQ call back, a signal is transmitted from the ESN main to the ESN node. The ESN node releases the outgoing trunk and places the CCBQ call into a holding queue for 5 minutes. No attempt is made to seize another outgoing trunk for the call until the holding time expires. This process occurs only once.

If the originating telephone is still busy, the CCBQ is canceled automatically at the ESN node. No indication is given to the call originator of the CCBQ cancellation. To prevent the CCBQ call from remaining indefinitely in the holding queue at the ESN main, the ESN main sets a time limit of 1 hour for CCBQ calls. When this time limit expires, the CCBQ call is canceled automatically. CCBQ call back to a busy telephone is as for normal Ring Again.

The call originator at the ESN main can cancel the CCBQ call at any time; however, the ESN node is not aware of the cancellation until the CCBQ call back is attempted.

Feature interactions

The CCBQ feature interacts with the following features:

- **Initialize** If the main initializes while calls are queued at the node, CCBQ call backs from the node are not answered because the initialization has cleared the holding queue at the main. The node treats these calls as call-back-no-answer calls and cancels the CCBQ automatically. If the node initializes, CCBQ calls that are in the trunk queue are lost. The main cannot detect this situation. To prevent calls from remaining indefinitely in the holding queue at the main, the main sets a time limit of 1 hour for CCBQ calls. If a call back from the node is not received within 1 hour, the main cancels the CCBQ call automatically.
- **Attendant functions** Attendants at an main are not offered CCBQ. Attendant Barge-In on trunks involved in CCBQ operations results in cancellation of the CCBQ call.
- **AIOD and ANI** Automatic Identification of Outward Dial (AIOD) and Automatic Number Identification (ANI) facilities can be used to complete CCBQ calls from an ESN node. The outgoing toll call is billed to the access tie trunk rather than the telephone at the ESN main.

Coordinated Call-Back Queuing Against Main

The Coordinated Call-Back Queuing Against Main (CCBQAM) feature enables stations at nodes to be offered CBQ for network calls that are blocked at a main. When facilities become available at the main, the call originator at the node is alerted by a call back from the main. CCBQAM otherwise functions identically to CCBQ at the node.

Call-Back Queuing to Conventional Mains

The Call-Back Queuing to Conventional Mains (CBQCM) feature allows call originators at a Conventional main to access the CBQ feature at an ESN node.

Eligibility

When a telephone at a Conventional main originates a network call through an ESN node, the NCOS assigned to the incoming trunk group is used to determine the Call-Back Queuing to Conventional Mains (CBQCM) eligibility. This NCOS, as well as the incoming trunk group, must be defined as CBQ eligible.

Offer

The Call-Back Queuing to Conventional Mains (CBQCM) offer to the call originator at a Conventional main consists of an optional recorded announcement followed by special (interrupted) dial tone. (The announcement and tones are provided from the ESN node.) To accept the CBQCM offer, the call originator dials the extension number associated with the telephone being used for the call. When the last digit of the extension number is dialed, a confirmation tone (three 256-ms bursts of dial tone) is sent from the ESN node to the call originator. The call is placed in the CBQ at the ESN node when the call originator goes on hook.

The CBQCM offer can be refused by going on hook any time before the last digit of the extension number is dialed, or by remaining off hook for longer than 30 seconds after receipt of the confirmation tone. If the CBQCM is neither accepted nor rejected within 30 seconds, the caller is given overflow tone (from the ESN node) and the call is disconnected.

Call back

When an outgoing trunk becomes available at the ESN node, it is seized and slow outpulsing is started. The ESN node then seizes a tie trunk (see note) to the Conventional main and outpulses the extension number of the call originator. The call originator must answer the call back before slow outpulsing is completed; otherwise, the call back is canceled and the outgoing trunk is released.

> ***Note:*** If no tie trunks are currently available to the Conventional main, the node releases the outgoing trunk. The CBQCM call retains its position in the queue but is not offered another outgoing trunk until a tie trunk to the Conventional main becomes available.

When the call originator answers the CBQCM call back, answer supervision must be transmitted from the Conventional main to the ESN node. Upon receipt of answer supervision from the Conventional main, the ESN node transmits a tone (three 256-ms bursts of dial tone) to notify the call originator that the call is a CBQCM call back, and completes the call.

If the call originator's telephone is busy, or the originator does not answer when the call back is placed, the ESN node places the call in a suspended state for 5 minutes. After 5 minutes, another call back is attempted if the outgoing trunk is free. If the telephone that originated the call is still busy or does not answer, the ESN node cancels the call back.

No provision is made for CBQCM cancellation by a call originator at a Conventional main. Once the CBQCM offer is accepted, the call remains in the queue until the ESN node initiates a call back.

Requirements

Station users at Conventional Mains cannot activate Ring Again to refuse expensive routes after the ERWT is given.

The ESN node seizes the same tie trunk group that was used to initiate CBQCM for the CBQCM call back. Thus, these trunk groups must be two-way (incoming and outgoing).

Conventional mains must provide answer supervision on tie trunks connected to the ESN node. These switches must also permit transmission or repetition of telephone dial pulses for CBQCM operation. This feature cannot be used with systems that operate in senderized mode. Operation may require adjustment of the interdigit timeout on systems that employ simulated cut-through operation.

Multiple call back queues are allowed per trunk group for the Conventional main by dialing any digits (up to 7) based on the availability of SL-1 call registers.

Conventional mains must not allow CBQCM call back calls to be modified by call transfer or call forward to an outside line. Call modifications like this can result in the tie trunk not being released at the end of the call.

Network Authorization Codes

The Authorization Code feature enables selected users to temporarily override the access restrictions assigned to a station or trunk. A user can enter an authorization code (authcode) to access more of the system facilities than would normally be allowed to the particular station or trunk because of the assigned Network Class of Service (NCOS), Class of Service (CLS), and Trunk Group Access Restriction (TGAR) codes.

This feature is useful when a user initiates a call from someone else's telephone and requires access to more system facilities, for example, access to long distance calling, than are allowed to that telephone. Entering a valid authcode enables the user to access these additional features. Once a valid authcode is entered, the NCOS, CLS, and TGAR associated with the authcode replace the NCOS, CLS, and TGAR associated with the telephone for the duration of the call.

The Network Authorization Code (NAUT) feature provides the customer with two package options:

- Basic Authorization Codes (BAUT) for general applications
- Network Authorization Codes (NAUT) for network applications

Basic Authorization Codes

The Basic Authorization Code (BAUT) package provides for up to 4096 authcodes of 1 to 14 digits. Users can enter an authcode after dialing the Special Service Prefix (SSP) and the digit 6, before dialing any call, including a NARS call. With the BAUT package, an authcode can be entered when:

- originating a call from a local station or tie trunk
- initiating a call transfer or conference from a local station
- originating a call by means of the Direct Inward System Access (DISA) feature

Network Authorization Codes

The Network Authorization Codes (NAUT) package provides for up to 20,000 authcodes of 1 to 7 digits. With X11 release 13 and later, the authcodes can have from 1 to 14 digits. The NAUT package incorporates all the features of the Basic Authorization Code (BAUT) package, adds a conditionally last option for entering an authcode after dialing a NARS call, and allows the attendant to enter an authcode.

Authcode Conditionally Last

With the NAUT package, users can be prompted conditionally for an authcode after dialing a NARS call. The prompt is by an authcode request, which consists of 10 bursts of dial tone, followed by steady dial tone. The authcode request can optionally be preceded with an appropriate recorded announcement. The user is prompted for an authcode entry only if:

- an authcode was not previously entered
- the FRL associated with the user's NCOS is less than the service change-assigned minimum FRL of the route list that NARS would use for the call.

Users at an ESN main or Conventional main connected by means of tie trunks to an ESN node can optionally be prompted for an authcode entry after dialing a NARS call. The user is prompted for an authcode entry only if:

- no authcode was previously entered
- the FRL associated with the NCOS of the incoming (or two-way) tie trunk, or the caller's NCOS if it is being sent, is less than the minimum FRL of the route list that NARS would use for the call
- the route is defined in the Route Data Block (RDB), LD16, to prompt for an authcode entry on incoming NARS calls.

Users accessing an ESN node by means of the Direct Inward System Access (DISA) feature to make a BARS/NARS call are prompted for an authcode entry if:

- no authcode was previously entered
- the FRL of the NCOS assigned to the DISA Directory Number (DN) is less than the minimum FRL of the route list that NARS would use for the call

Attendant input of authcode

Normally, because an attendant is not restricted from accessing any system resource, the attendant does not need to have an authcode. The Network Authorization Code package enables the attendant to enter an authcode for other callers; for example, the attendant can enter an authcode, after dialing the Special Service Prefix (SSP) and the digit 6, and complete a long distance call for a local user whose CLS is Toll Denied (TLD). If the Call Detail Recording (CDR) of authcodes is defined for the customer, the local user's authcode digits appear in the CDR for billing purposes.

Attendants are normally assigned an NCOS having a high FRL so that they can make any type of call, including NARS calls. An attendant can be prompted for an authcode entry if the FRL required to access a route list for a NARS call is greater than the FRL of the attendant's NCOS.

Authcode validation

The software validates an inputted authcode on the basis of the number of digits dialed and the dialed digits themselves. If the authcode contains more or fewer digits than the defined authcode length (Authcode Data Block [AUB], LD88), the authcode is invalid. Similarly, if the dialed authcode digits are not defined in the Authcode Table (AUT), LD88, the authcode is invalid. When an invalid authcode is encountered, no response is given to the user until the End-of-Dialing (EOD) timer expires. This increases the security of authcodes by making it difficult for an unauthorized user to determine the length of a valid authcode. When the EOD timer expires, overflow tone is given for 15 seconds and the call is force disconnected.

Authcode administration

With the NAUT and BAUT packages, a classcode structure is used as part of authcode administration. A classcode is a definition of a combination of CLS, Trunk Group Access Restrictions (TGAR), and NCOS codes. There can be up to 116 (0 to 115) classcodes defined through the Authcode Data Block (AUB), LD88, each having a different combination of CLS, TGAR, and NCOS codes. Each authcode is associated with a classcode. Authcodes that have the same combination of CLS, TGAR, and NCOS codes are assigned the same classcode.

With the NAUT package, authcodes can be defined individually by the customer or generated automatically by the system. When defining or generating new authcodes, a classcode with which the new authcodes are to be associated is specified. The new authcode is then automatically assigned the CLS, TGAR, and NCOS codes associated with the specified classcode.

When an authcode is to be removed from use, a facility exists to prevent that authcode from being reused. For example, the authcode is not accepted as valid input when individually defining authcodes. This is accomplished through an exemptcode.

When an authcode is removed from use, an exemptcode is assigned to the authcode in place of the classcode. The exemptcode is the month, for example, JAN, FEB, taken from the system clock. If an exemptcode is not requested, the removed authcode is returned to the pool of unused authcodes and can be reused at any time.

The Route List Block (RLB) program (LD86) is used to define a minimum FRL for each route list. This minimum FRL (range 0 to 7) is used to determine whether or not to prompt for an authcode entry after a call. If a minimum FRL is not specified, the actual minimum FRL in the initial route set is used. Similarly, the Route Data Block (RDB) program (LD16) is used to define whether or not to prompt for an authcode entry on calls on incoming or two-way tie trunk groups.

Feature operation

Use the authcode after SSP (500/2500/SL-1 telephones). To enter an authcode after the Special Service Prefix (SSP), the caller proceeds as follows:

1 If a call is not in progress, go off hook or press a DN key. If there is a call in progress, switchhook flash (500/2500 telephone) or press the Call Transfer or Conference key (SL-1 telephone) to obtain special dial tone.

2 Dial the authcode access number (SSP and the digit 6). Dial tone is removed after the SSP digit is dialed.

3 Dial the authcode digits. A second dial tone sounds if the authcode is valid. If the authcode is invalid, no response is given until the End-of-Dialing (EOD) timer expires, then overflow tone is given for 15 seconds and the call is force disconnected.

4 When the second dial tone sounds, dial the call in the normal manner. If Call Transfer/Conference is in effect, complete the transfer/conference as normal.

Authcode after SSP (attendant)

To enter an authcode after SSP, the attendant proceeds as follows:

1 If there is a call on the source loop, go to step 2. If there is no call on the source loop, press an idle Loop key (LPK).

2 Dial the authcode access number (SSP and the digit 6), followed by the authcode.

3 Dial as usual after receiving dial tone denoting a valid authorization code. If the code is invalid, overflow tone is returned immediately.

Authcode Conditionally Last

The following procedure is used to enter an Authcode Conditionally Last from a 500/2500/SL-1 telephone or attendant console (NAUT package only):

1 Place a call.

2 Receive an authcode request (optional recorded announcement followed by 10 bursts of dial tone, followed by steady dial tone), indicating that an authcode entry is required.

3 Dial the authcode. Dial tone is removed after the first digit is dialed. If the authcode is valid, the call is processed as a normal call. If the authcode is invalid, overflow tone is returned when the End-of-Dialing (EOD) timer expires.

Feature interactions

Feature key operations While a user is entering an authcode, the following feature keys operate as intended and do not affect operation of the Authorization Code feature:

- Make Set Busy
- Buzz
- Volume Control

The following key operations are ignored during authcode operation:

- Conference
- Override
- Call Forward
- Call Transfer
- Call Pickup
- Charge Account
- Calling Party Number
- Privacy Release
- Ring Again
- Barge-In and Busy Verify

- Speed Call
- Recall
- Do Not Disturb
- Digit Display

The following key operations abort the authcode operation, and any digits entered for an authcode are ignored:

- Directory Number
- Paging
- Voice Call
- Not Ready
- In-Calls
- Call Waiting
- Hold
- Release

If the caller initiates a switchhook flash while entering an authcode, the results are unpredictable: the switchhook flash may be ignored or interpreted as the digit 1.

Authcodes after SSP can be stored as Speed Call or Autodial entries. When this is done, the stored number (entry) must contain only the access code and authcode digits.

All digits in the entry after the access code are interpreted as authcode digits. In the case of Authcode Conditionally Last, authcodes can be stored as Autodial entries, but not Speed Call entries. If necessary, the caller can continue to enter more authcode digits after operation of the Autodial or Speed Call key. However, for security reasons, authcodes should not be stored as Autodial or Speed Call entries.

Call Detail Recording If the Call Detail Recording (CDR) of authcodes is specified, then each time an authcode is entered, a record is generated on the CDR device. The record is passed to CDR only if one of the following occurs:

- the call becomes established, for example, trunk is seized or local telephone answers
- the call cannot be completed, for example, no trunks available

Authcode input by means of Tie trunks Authcodes can be entered by means of access tie trunks. Incoming or two-way tie trunk groups at a switch equipped with the NAUT feature can be defined to prompt for an authcode entry.

Direct Inward System Access If a caller makes a NARS call in association with a valid Direct Inward System Access (DISA) call, the NCOS associated with the DISA Terminal Number (TN) is used for NARS route selection. If the FRL of this NCOS is too low to access the route list that NARS has selected for the call, the caller will be prompted for an authcode entry, unless an authcode (for example, Authcode after SSP) was entered previously.

Barge-In/Busy Verify If Barge-In or Busy Verify is used by the attendant to break into a connection where an authcode is being entered, the authcode entry will be affected. If the authcode entered is invalid as a result, the user will be given overflow tone when the EOD timer expires.

Centralized Attendant Service The Central Attendant Service (CAS) feature enables several remote switches to share the attendant services at one central location. A CAS attendant can enter an authcode by means of a Release Link Trunk (RLT) before connecting or transferring calls to the connecting remote PBX.

If the CAS attendant enters a NARS number by means of a Release Link Trunk (RLT), the NCOS associated with the NCOS of the attendant at the remote PBX is used in the NARS route selection process. If the FRL of this NCOS is inadequate, the CAS attendant may be prompted for an authcode entry. See *Centralized Attendant Service description and engineering* (553-2681-100).

Call Forward The Call Forward feature provides two customer options:

- Call Forward-Originating party's CLS (CFO)
- Call Forward-Forwarding party's CLS (CFF)

With the NAUT package and the CFO option, a caller may be prompted for an authcode entry after a call to a telephone that forwards the call to a NARS number. With the CFF option, the user will not be prompted by the local switch for an authcode entry after such a call.

Network Class of Service An NCOS is assigned to each telephone and each incoming tie trunk at an ESN node. An authcode entry modifies the user's NCOS for the duration of the call. The FRL associated with the user's assigned NCOS is used to determine if it is necessary to prompt for an authcode entry. After an authcode is collected and validated, the NCOS associated with the authcode is used for the duration of the call.

Network Alternate Route Selection During NARS route selection, the FRL associated with the call originator's NCOS is compared with the FRL of the selected route list. If the originator's FRL is lower and no authcode was entered previously, the system may prompt for an authcode entry. A valid authcode modifies the originator's NCOS, and hence, FRL. This new FRL is then used for route selection.

Network Queuing When an authcode is entered, the NCOS associated with the authcode is used to determine Network Queuing capabilities.

Coordinated Dialing Plan Authcode after SSP can be used before dialing a CDP call. If the NAUT package is equipped, the conditionally last request for an authcode entry applies.

Requirements

Users on PBX or Centrex systems connected by tie trunks to an ESN node can use the Authcode Conditionally Last feature, provided that these systems transmit or repeat all digits dialed by the users in response to the authcode request. This feature cannot be used by certain systems that operate in senderized mode. Correct operation may require adjustment of EOD timeout on systems that employ simulated cut-through operation.

In an ESN network consisting of multiple switches equipped with the NAUT package, authcodes should be requested only once on a given call. This requires careful engineering of:

- the tie trunk group option for authcode prompting
- the FRL values assigned to route lists

Users at an ESN main or Conventional main arranged for the UDP by a dedicated trunk group to an ESN node can use the Authcode Conditionally Last feature at the ESN node in the same manner as those stations located directly at the ESN node. However, these users cannot access the Authcode after SSP feature by the same trunk group.

Coordinated Dialing Plan

The Coordinated Dialing Plan (CDP) allows a customer with a number of local switches to coordinate the dialing plan of the stations at these switches. A telephone user can call any other telephone within the CDP group of switches by dialing a unique three- to seven-digit number assigned to the telephone.

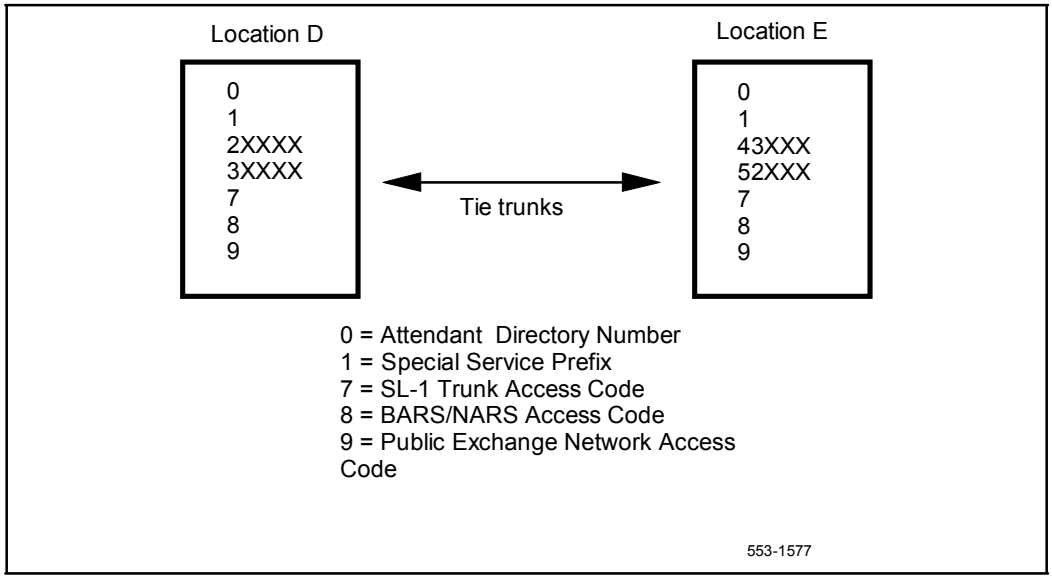
If the switch is equipped with the Directory Number Expansion (DNXP) package, the number assigned to each telephone can have up to ten digits.

A CDP can be arranged to provide a centralized public exchange network capability that channels access to and from the public network through a single switch within the CDP group.

The CDP software provides the translation and digit manipulation capability that is necessary to implement the coordinated dialing plan. Calls dialed within the CDP format can be terminated locally after digit translation and digit deletion. Or, calls can be routed to a remote switch in the CDP group following digit translation, route selection, and digit deletion and/or insertion. Figure 7 illustrates how a coordinated dialing plan might be implemented at two customer locations.

> ***Note:*** The maximum number of leading digits to be deleted from a Local Steering Code is four. However, if the Directory Number Expansion (DNXP) package is equipped, this number is increased to seven digits.

Figure 7
Example of a Coordinated Dialing Plan



Steering codes

Referring to Figure 7, users at Location D can call stations at Location E by dialing 43XXX or 52XXX. Similarly, users at Location E can call stations at Location D by dialing 2XXXX or 3XXXX. If a user at Location D dials 43XXX or 52XXX to reach a telephone at Location E, Location D uses the digits 43 or 52 as a Distant Steering Code (DSC) to select the trunk group to Location E. Similarly, if a user at Location E dials 2XXXX or 3XXXX to reach a telephone at Location D, Location E uses the digit 2 or 3 as a DSC.

The same format is used for calling local stations; for example, users at Location E dial 43XXX or 52XXX to reach local stations at Location E. In this case, the software interprets the digits 43 or 52 as a Local Steering Code (LSC) and deletes them from the dialed number in order to terminate the call locally.

Note: Where possible, four-digit extension numbers should be maintained as CDP DNs. As long as the first digit or digits of these extension numbers are unique at each location, all or part of the extension number may be used as a steering code. There cannot be duplicate extension numbers at two locations on a CDP network.

If the switch at Location E is arranged to provide centralized access to the public exchange network, digit 9 at Location E is considered a Trunk Steering Code (TSC) for public exchange access. At Location D, digit 9 is a TSC that invokes digit manipulation to insert the required digits to route the call through Location E to the public exchange network. Similarly, users at Location D can call the attendant at Location E by simply dialing 0 , if Location D does not assign Digit 0 as the local attendant access code.

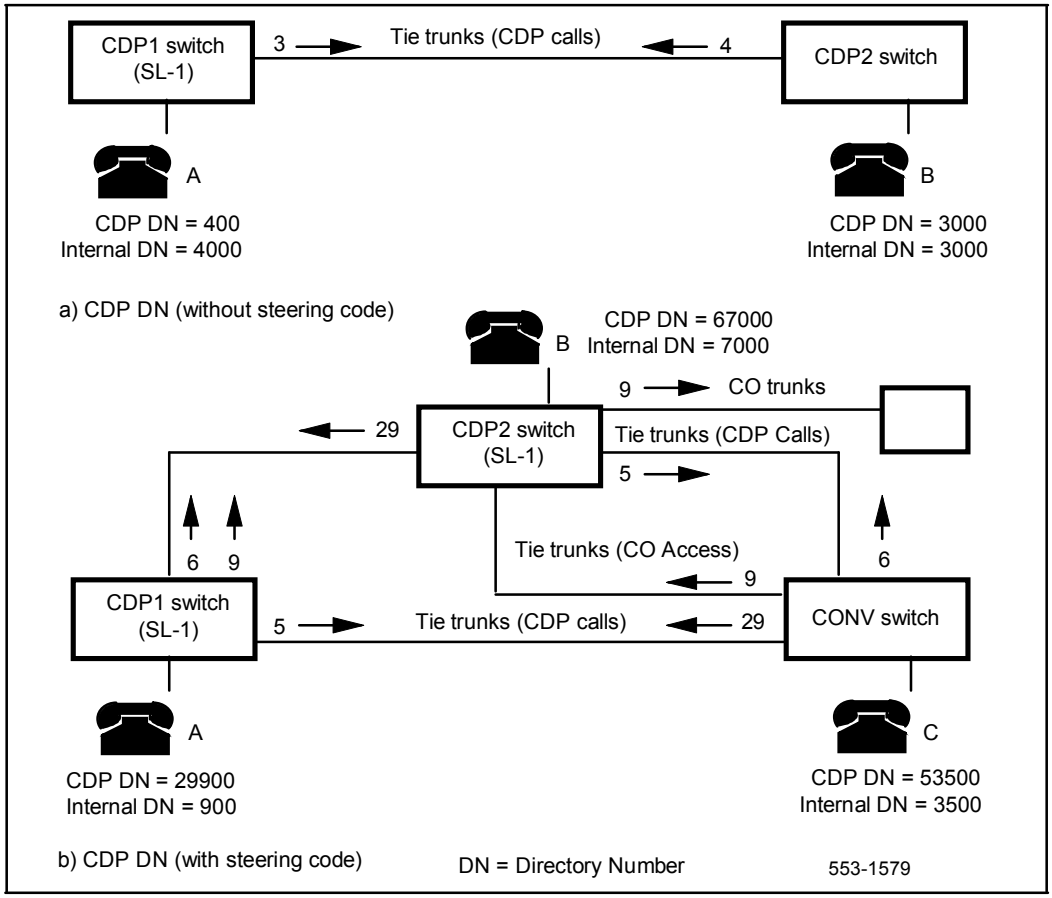
Steering codes can be composed of one to four digits. If the DNXP package is equipped, the steering codes can have up to seven digits.

At each switch in the CDP group, the steering codes must be distinct (for example, the initial digits must be unique) from any assigned access codes. As Figure 7 shows, 0 is reserved as the attendant access code; 1 is reserved as the Special Service Prefix (SPRE); 7 is reserved as a trunk access code; 8 is reserved as a NARS access code; and 9 is reserved as the public exchange network access code. This means there are five digits remaining that can be used as the leading digits of steering codes (for example, 2, 3, 4, 5, and 6). The CDP feature supports up to 10,000 steering codes.

Note: Pre X11 release 13, the CDP feature supports up to 5000 steering codes.

A CDP DN consists of an internal DN prefixed with the appropriate steering code. A typical CDP configuration is shown in Figure 8.

Figure 8
A typical CDP configuration



Conventional switch access

If a Conventional (CONV) switch, any type without the CDP software, is integrated as part of a CDP group (see Figure 8), the steering codes defined at a CDP switch to access the Conventional switch may be repeated or absorbed (for example, deleted) by the CDP switch. The steering codes are repeated if the Conventional switch is identified by more than one steering code; they are absorbed if all the numbers at the Conventional switch begin with the same steering code.

Calls to a CDP switch from the Conventional (CONV) switch are made by dialing the desired CDP DN (for example, telephone C at the CONV switch dials 67000 to reach telephone B at switch CDP2). The CONV switch uses digit 6 as a trunk access code for the tie trunk route to switch CDP2. After tie trunk seizure, the CONV switch outpulses the remaining digits (7000) to CDP2. At CDP2, digit 6 is inserted on the incoming tie trunk from the CONV switch, and the call is completed to telephone B.

Local calls at the Conventional (CONV) switch are made by dialing only the internal DN (for example, 3500), rather than the CDP DN (for example, 53500), unless the CONV switch can be arranged to absorb digit 5, or employs a five-digit numbering plan.

As shown in Figure 8, switch CDP2 is arranged to provide centralized access to the public exchange network. For users at the CONV switch to access this capability, a separate tie trunk route must be provided to switch CDP2. This is because switch CDP2 is arranged to insert digit 6 on the incoming tie trunk route from the CONV switch used for CDP calls. For public exchange network calls, digit 9 must be inserted on the incoming tie trunk route from the CONV switch. Similarly, if users at the CONV switch are to be allowed access to the ESN capabilities (for example, NARS) at switch CDP2, another tie trunk route must be provided for this purpose.

A second alternative exists where one tie trunk route connects the CONV switch to the CDP equipped switch. Users dial an access code to this tie trunk group, then dial the necessary CDP digits to reach other switches, or the necessary BARS/NARS digits for network calls through the node. The tie trunk route at the CDP switch is not programmed to insert digits in this example.

CDP routing

Up to 128 route lists can be defined at a switch equipped with the CDP feature software. If CDP is equipped at an ESN node, 256 route lists can be defined. A route list is used to define the alternate route choices for CDP calls to a particular destination.

Route choices in a route list are called route list entries. There can be up to seven (0 to 6) route list entries associated with each route list. If a switch is equipped with the NARS software in addition to the CDP feature software, NARS route lists, a maximum of 256, can be shared by both NARS and CDP calls.

> ***Note:*** Pre X11 release 13, up to 32 route lists can be defined at a switch equipped with the CDP feature software. Also, there can be up to three (0 to 2) route list entries associated with each route list.

Route lists are associated with each Distance Steering Code and Trunk Steering Code that can be dialed at a CDP switch. Each code is defined to the CDP software, together with the route list number that must be accessed for call completion to the destination indicated by the steering code. The entries in the specified route list are then searched sequentially for an available and eligible trunk route. Local Steering Codes are not associated with route lists.

CDP digit manipulation

Route list entries can be associated with digit manipulation tables. There can be 32 (0 to 31) digit manipulation tables defined at a CDP switch. If CDP is equipped at an ESN node, 256 (0 to 255) tables can be defined. Digit manipulation table 0 is used as an indication that no digit manipulation is required.

Each digit manipulation table (except 0) can be defined to delete a number (0 to 15) of leading digits of a dialed CDP number and to insert up to 24 different leading digits, including the asterisk (*) to indicate a dialing pause, where required.

CDP Time of Day schedules

Two (0 to 1) TOD schedules can be defined at a CDP switch. If CDP is equipped at an ESN node, eight (0 to 7) TOD schedules can be defined. Each route list entry is associated with a TOD schedule. When a route list entry is selected for a CDP call, the CDP software compares the current time of day with the TOD schedule assigned to the route list entry.

If the current time of day is within the interval defined by the TOD schedule, the route list entry is used for the call. If the current time of day is not within the interval defined by the TOD schedule, or if the TOD schedule is turned off (in software), the route list entry is not eligible for the call. TOD schedules can be selectively turned on or turned off by the customer through service change.

Queuing

Queuing against local stations is provided by the standard Ring Again (RGA) feature. For calls directed to a remote CDP switch, RGA can be applied if all local outgoing trunk routes to the remote CDP switch are busy or blocked. RGA cannot be applied against busy or blocked stations/trunks at the remote CDP switch. Blocking tone is not provided until the full CDP number (or Trunk Steering Code [TSC]) is dialed.

Feature interactions

NARS The CDP feature can be implemented at a switch equipped with the NARS software feature. If such is the case, the following considerations apply:

- Steering codes for CDP calls must be distinct from the assigned NARS access codes.
- CDP numbers can be integrated with the ESN UDP; for example, a five-digit CDP number can be the same as the last five digits of a seven-digit UPD number.
- NARS/BARS route lists, digit manipulation tables, and TOD schedules can be shared by CDP calls. (CDP route lists must be numbered 0 to 31.)
- Users eligible for the OHQ and CBQ features can use them when placing CDP calls.
- FCAS does not apply to CDP calls.

Automatic Identification of Outward Dial (AIOD) and Automatic Number Identification (ANI) Calls made to the public exchange network when the AIOD or ANI feature is equipped will have either the internal DN recorded, if the call originates at the CDP switch interfacing to the public network, or the trunk access code, if the call originates at another CDP switch.

Attendant features If a user at a local CDP switch calls the local attendant, the local user's internal DN (not the full CDP DN) is displayed.

If a user at a CDP switch calls an attendant at another CDP switch, the trunk access code and member number of the incoming trunk are displayed. The following attendant features are supported at the local CDP switch, but are not supported between CDP switches:

- Automatic Timed Recall
- Barge-In, Busy Verify
- Camp-On
- Interposition Calling

CLS/TGAR treatment For CDP calls, all Class of Service (CLS) treatment remains the same as standard treatment with the exception of Conditionally Toll-Denied (CTD) and Conditionally Unrestricted (CUN) CLS, which are treated as Unrestricted (UNR). Users with an FR2 class of service can make local CDP calls but cannot make CDP calls to distant switches. Trunk Group Access Restrictions (TGAR) are ignored for routing CDP calls.

Code Restriction Code Restriction is applied to calls made only from stations with a Toll-Denied (TLD) class of service. Standard or flexible Code Restriction can be applied, on a trunk route basis, to public exchange network trunk calls.

Call Detail Recording The local internal DN (not the complete CDP DN) is recorded in the normal CDR manner. The maximum internal DN length remains at four digits; but if the DNXP package is equipped, the internal DN can have up to seven digits. The full CDP DN is shown in the dialed number field.

Common Control Switching Arrangement A CDP number can be part of a Common Control Switching Arrangement (CCSA) dialing plan. Digit absorption and manipulation for CCSA calls is handled as usual by the switch. A CCSA call can terminate at a switch in a CDP group other than the switch that hosts the CCSA network. This operation is transparent to the originator of the CCSA call.

Direct Inward Dialing Because a CDP DN can be up to seven digits long, the capability of inserting up to six leading digits on DID trunks is provided.

End-to-End Signaling End-to-End signaling is allowed for CDP calls.

Call Modification Call Modification, for example, Call Transfer (XFER), Call Forward, and Conference, is allowed for CDP calls. When using these features, the user dials within the CDP format.

Hunting Hunting across different switches in a CDP group is not supported. Standard Hunting can be applied to local CDP calls.

Message Center The Message Center capability is not supported across CDP switches. However, locally it operates as normal.

Digit Display

- **Outgoing CDP call** The complete dialed CDP DN is displayed at the originating telephone.
- **Incoming CDP call** The trunk access code and member number of the incoming trunk route is displayed.
- **Internal CDP call** At the originating telephone, the complete dialed CDP DN is displayed. If the call hunts or is picked up by another telephone, the internal DN of the answering telephone is displayed. At the terminating telephone, the internal DN of the originating telephone is displayed.

Network traffic measurements

The Network Traffic (NTRF) feature provides traffic measurement data related to network performance and network traffic. The NTRF feature can be equipped at ESN nodes and ESN mains. Using this data allows the network manager to assess the effectiveness of the network and to identify specific areas of network operation where improvements are needed.

The network traffic measurements accumulated at a switch equipped with the NARS (ESN node), BARS (ESN main), or CDP feature encompass the following areas of operation (in addition to regular traffic measurements):

- Network Class of Service (NCOS)
- Routing
- Off-Hook Queuing (OHQ)
- Call-Back Queuing (CBQ)
- Coordinated Call-Back Queuing (CCBQ)
- Call-Back Queuing to Conventional Mains (CBQCM)
- Incoming Trunk Groups

Routing traffic measurements

A route list is a list of outgoing alternate trunk routes to a specific location from a switch.

Trunk routes in a route list are termed route list entries. The number of route lists/entries that can be defined at a switch depends on the features equipped at that switch. Table 8 lists the parameters for the different features and feature combinations. The values shown in parentheses are for X11 release 13 and greater.

Legend for Table 8:

NCOS = Network Class of Service

FCAS = Free Calling Area Screening

SDR = Supplemental Digit Restriction

Table 8
Summary of networking feature parameters

Parameter	BARS	NARS	CDP	CDP with BARS	CDP with NARS
NCOS Groups	0-99 (0-7)	0-99 (0-15)	0-99 (0-3)	0-99 (0-7)	0-99 (0-15)
Facility Restriction Levels	0-7	0-7	0-7	0-7	0-7
Digit Manipulation Tables	1-255	1-255	1-31	1-255	1-255
Route Lists	0-127	0-255	0-31 (0-127)	0-127	0-255
Route List Entries	0-31 (0-7)	0-31 (0-7)	0-6 (0-2)	0-31 (0-7)	0-31 (0-7)
FCAS Tables	1-127	1-255	-	1-127	1-255
SDR Tables	0-255	0-511	-	0-255	0-511
Steering Codes	- -	- -	1-10,000 (1-5,000)	1-10,000 (1-5,000)	1-5000

Note 1: If the NARS and BARS features are equipped in the same switch but for different customers, the highest parameter values apply to that switch; for example, if one customer has NARS and another customer has BARS, the NARS parameters apply to the BARS customer.

Note 2: If the New Flexible Code Restriction (NFCR) feature is equipped, the number of available NCOS groups is 8, see *X11 features and services* (553-3001-305). With X11 release 13 and later, this number is expanded to 100.

Note 3: NSIG provides 16 NCOS groups.

Note 4: Parameters in parentheses are for releases prior to X11 release 13.

The TFN001 routing measurements provide data related to route list utilization. The measurements show how often a route list was accessed, which entries in the list were used, and whether the call was successful in completing a selection or connection. Routing traffic measurements are available at ESN node and ESN main switches.

The routing traffic measurements contain the following statistics for each defined route list:

- **Route list requests** This measurement identifies the total number of call attempts for which the called destination translations identified this route list to attempt call completion.
- **Route list requests served without delay** This measurement reflects the total number of network calls that were routed without encountering blocking or queuing.
- **Expensive route acceptances** This measurement identifies the number of calls that were allowed to complete over an expensive trunk route after the Expensive Route Warning Tone (ERWT) was given.
- **Route list requests standard blocking** This measurement identifies the number of call attempts that could not be served because a route or queuing process was not available to a user. The blocked call may have been routed to overflow tone, a recorded announcement, or the attendant.
- **Route list entry usage count** This measurement identifies the number of calls that were routed successfully over a particular route (entry) in a route list. A count is maintained for each route list entry.

OHQ measurements

Traffic measurements for Off-Hook Queuing (OHQ) are associated with each route list and identify the utilization of the OHQ feature. The OHQ measurements are included with the routing traffic measurements (TFN001), and contain the following statistics for each route list:

- **Quantity of calls placed in OHQ** This measurement identifies the number of calls that attempted to use a route in the route list. But because facilities were not immediately available, the call was permitted to remain off hook to wait for facilities.
- **Average time in OHQ** This measurement identifies the average duration that calls remained in the OHQ until a route became available. The value (expressed in units of 0.1 second) represents the average time in the queue. Calls that timed out in the queue before a route was selected are also included in the average.
- **Quantity of calls abandoned from OHQ** This measurement identifies the number of calls that were placed in the OHQ but were abandoned. For example, the caller went on hook before a route became available or the time limit was reached.

CBQ measurements

Traffic measurements for CBQ are associated with each route list and identify the utilization of the feature. The CBQ measurements are included with the routing traffic measurements (TFN001) and contain the following statistics (for each route list):

- **Quantity of CBQ calls** This measurement identifies the number of calls that were offered CBQ and accepted the offer.
- **Average time in CBQ** This measurement identifies the average duration (in units of 0.1 second) calls remained in the CBQ. Calls that were canceled and calls that were served are included in this measurement.
- **Quantity of CBQ offerings** This measurement is a count of the number of calls that were offered CBQ, regardless whether or not the offer was accepted.
- **Quantity of CBQ user cancellations** This measurement identifies the number of calls that were removed from the CBQ on the call originator's request. For example, cancellation of the Ring Again feature.
- **Routing traffic report output format** The routing traffic measurements are output for each route list as shown in Table 9.

Table 9
TFN001 routing format

System ID		TFN001							
Customer number									
RLST	xxx	route list requests	route list requests served without delay	expensive route acceptance	route list requests standard blocking	not defined	not defined		
	RT		route list entry use	route list entry use	route list entry use	route list entry use	route list entry use	route list entry use	route list entry use
			SL1TD calls	SL1TD calls	SL1TD calls	SL1TD calls	SL1TD calls	SL1TD calls	
	OHQ	OHQ calls	time in OHQ	abandoned calls					
	CBQ	CBQ calls	average time in CBQ	CBQ offerings		CBQ user cancel			
Example									
0434		TFN001							
000									
RLST	000	00345	00344	00012	00000	00000	00000		
	RT		00000	00000	00000	00000	00000	00000	00000
			00000	00000	00000	00000	00000	00000	00000
			00000	00000	00000	00000	00000	00000	00000
			00000	00000	00000	00000	00000	00000	00000
			00000	00000	00000	00000	00000	00000	00000
			00000	00000	00000	00000	00000	00000	00000
			00000	00000	00000	00000	00000	00000	00000
			00000	00000	00000	00000	00000	00000	00000
	OHQ	00000	00000	00000					
	CBQ	00000	00000	00000	00000				

Note 1: OHQ and/or CBQ information is printed only if the feature is equipped and activated.

Note 2: The two fields not defined always show zeroes (0).

NCOS measurements

The TFN002 NCOS measurements are shown in Table 10.

Traffic measurements are collected for each defined NCOS group to indicate the grade of service, in terms of blocking and queuing delay, being provided by the system. If a grade of service is determined by the communications manager to be inappropriate for users in a particular NCOS group, then the communications manager can either reassign the users to another NCOS group, redefine the characteristics of the existing NCOS group, or change the routing parameters. NCOS measurements are available at ESN node and ESN main switches.

The TFN002 NCOS measurements contain the following statistics for each defined NCOS group:

- **Quantity of calls attempted** This measurement identifies the total number of call attempts generated by users in an NCOS group.
- **Routing requests served without delay** This measurement identifies the number of call attempts that were routed without encountering blocking or queuing.
- **Expensive route acceptance** This is a count of the number of callers who accepted an expensive route to complete a call.
- **Network Call Standard Blocking** This measurement identifies the number of call attempts that could not be completed because a route or queuing process was not available to a user. The blocked call may have been routed to overflow tone, a recorded announcement, or the attendant.
- **Quantity of calls refusing expensive routes** This measurement identifies the number of calls that were given ERWT and elected not to use the expensive route.
- **Quantity of calls placed in OHQ** This measurement identifies the number of calls that were placed in the OHQ.
- **Average time in OHQ** This measurement identifies the average duration that calls remained in the OHQ until a route became available. The value (in units of 0.1 second) represents the average time that calls were in the queue. Calls that timed out in the queue before a route was selected are also included in the average.

- **Quantity of CBQ calls** This measurement identifies the number of calls that were offered CBQ and accepted the offer.
- **Average time in CBQ** This measurement identifies the average time that calls waited in the CBQ for a route to become available. It includes calls that requested a cancellation, calls that were served, and direct Ring Again against trunks. The average time is expressed in units of 0.1 second.

Table 10
TFN002 NCOS report

Format							
System ID	TFN002						
Customer number							
NCOS	network class of service group	calls attempted	routing requests served without delay	expensive route acceptances	network call standard blocking	not defined	calls refusing expensive routes
	OHQ	OHQ calls	average time in OHQ				
	CBQ	CBQ calls	average time in CBQ				
Example							
0423	TFN002						
000							
NCOS	000	00207	00197	00000	00001	00000	00000
	OHQ	00007	00237				
	CBQ	00000	00000				

Note 1: OHQ and/or CBQ information is printed only if feature is equipped and activated.

Note 2: The field that is not defined always shows all zeroes (0).

Incoming trunk group measurements

The incoming trunk group measurements (TFN003) are output as shown in Table 11.

The TFN003 Incoming Trunk Group Measurements provide an indication of the incremental traffic that was imposed on incoming trunk groups by the network queuing features. Data are provided for each incoming or two-way trunk group that is offered OHQ, CCBQ, or CBQCM. These measurements are available at ESN nodes.

The following measurements are accumulated for each incoming (or two-way) trunk group:

- **Quantity of calls placed in OHQ** This measurement identifies the number of incoming trunk calls that were placed in the OHQ for possible connection to another trunk group.
- **Average time in OHQ** This measurement reflects the average time (in units of 0.1 second) that calls waited in the OHQ for a trunk to become available. The average time includes those calls that were removed from the OHQ by caller abandonment or were removed from the queue after expiration of the OHQ time limit.
- **Quantity of incoming calls offered CCBQ or CBQCM** This measurement identifies the number of incoming trunk calls that were blocked at the ESN node and for which the user was given the option of accepting an ESN node-initiated call back when facilities would become available. The measurement relates to use of the CBQ feature by users at an ESN main (Coordinated Call-Back Queuing) or Conventional main (Call-Back Queuing to Conventional Mains).
- **Quantity of calls accepting CCBQ or CBQCM** This measurement identifies the number of incoming trunk calls that were blocked at the ESN node, were offered CBQ, and accepted the offer. The count relates to CBQ acceptances by users at an ESN main or Conventional main.
- **Average time in CBQ** This measurement (expressed in units of 0.1 second) reflects the average time that users at an ESN main or Conventional main remained in the CBQ (at the ESN node) for a facility to become available.

Note 1: When a CCBQ call back is offered to a busy station at an ESN main, the call is removed from the queue for 5 minutes, then reinserted in the queue. This process occurs only once. The additional queuing time is added to the average time. The 5-minute suspension time is not included in the average time, nor is its reinsertion into the queue pegged as another CBQ call.

Note 2: When a CBQCM call back is offered to a station at a Conventional main that is busy or fails to answer the call back, the call is removed from the queue and reinserted into the queue as specified in Note 1.

- **Quantity of calls blocked in call back** This measurement identifies the number of CBQ call backs (CCBQ or CBQCM) initiated by the ESN node that could not be completed because an outgoing trunk group (to the ESN main or Conventional main) was not available.
- **Callback Attempts No Answer and cancellation** This measurement identifies the number of call back attempts that were not successful because the caller failed to answer the call back. CBQ call backs to a station at an ESN main that has previously canceled CBQ are treated as Call-back Attempts No Answer.

Table 11
TFN003 Incoming Trunk Group

Format						
System ID		TFN003				
Customer number						
TRKG	incoming trunk group					
	OHQ	calls placed in OHQ	average time in OHQ			
	CBQ	incoming calls offered CBQ, CCBQ, CBQCM	calls accepting CBQ, CCBQ, CBQCM	average time in CBQ, CCBQ, CBQCM	blocked CBQ, CCBQ, CBQCM call backs	call back attempts not answered or canceled
Example						
0423	TFN003					
000						
TRKG	003					
	OHG	00006	00263			
	CBQ	00000	00000	00000	00000	00000

OHQ threshold violation measurement

The output format for this threshold measurement is shown in Table 12.

The OHQ overflow threshold measurement (TFN101) provides an indication that more than the expected number of users are timing out in the OHQ. This means that OHQ is offered and accepted, but a trunk does not become available before the service-changeable OHQ time limit expires. This could result from trunks being out of service, an incorrectly defined OHQ time limit, or temporary traffic overload.

Table 12
OHQ threshold violation measurement

Format	
System ID	TFN101
Customer number	
OHQT timed out OHQ calls	threshold
Example	
0423TFN101	
000	
OHQT 00333	00000

Traffic measurement options

New traffic measurement options are introduced with the NTRF feature.

These options are set and/or queried through use of the Traffic Control (TFC) program (LD02) in the normal manner. For more information, see *Traffic measurement formats and output* (553-2001-450). The options are:

- to generate routing measurements (TFN001)
- to generate NCOS measurements (TFN002)
- to generate incoming trunk group measurements (TFN003)

List of terms

AC
access codes

AIOD
Automatic Identification of Outward Dial

ANI
Automatic Number Identification

AUB
Authcode Data Block

AUT
Authcode Table

BARS
Basic Alternate Route Selection

BAUT
Basic Authorization Code

CAS
Central Attendant Service

CBQ
Call-Back Queuing

CBQ(i)
initial CBQ option

CBQ(a)
extended CBQ option

CCBQ
Coordinated Call-Back Queuing

CCBQAM
Coordinated Call-Back Queuing Against Main

CCSA
Common Control Switching Arrangement

CDP
Coordinated Dialing Plan

CDR
Call Detail Recording

CFF
Call Forwarding-forwarding party's COS

CFO
Call Forwarding-originating party's COS

CO
Central Office

CONV
Conventional (switch)

DDD
Direct Distance Dialing

DISA
Direct Inward System Access

DMI
Digit Manipulation Index

DN
Directory Number

DNXP
Directory Number Expansion

DSC
Distance Steering Code

DTMF
Dual Tone Multi-Frequency

EOD
End-of-Dialing

ERWT
Expensive Route Warning Tone

ESN
Electronic Switched Network

FCAS
Free Calling Area Screening

FCI
Free Calling Index

FRL
Facility Restriction Level

HLOC
Home Location Code

HNPA
Home Numbering Plan Area (code)

ITEI
Incoming Trunk Exclusion Index

ITGE
Incoming Trunk Group Exclusion

LDN
Listed Directory Number

LOC
Location Code

LPK
Loop key

LSC
Local Steering Code

NARS
Network Alternate Route Selection

NAUT
Network Authorization Code

NCOS
Network Class of Service

NCTL
Network Control

NPA
Numbering Plan Area (code)

NSC
Network Speed Call

NSIG
Network Signaling

NTRF
Network Traffic (measurement)

NXFER
Network Call Transfer

NXX
Local Exchange

OHQ
Off-Hook Queuing

RDB
Route Data Block

RGA
Ring Again

RLB
Route List Block

RLT
Release Link Trunk

RTC
Routing Control

SAT
Satellite Link Control

SDRR
Supplemental Digit Restriction/Recognition

SPN
Special Number

SPRE
Special Service Prefix

SSC
System Speed Call

SSP
Special Service Prefix

STD
Standard (signaling)

TCM
Traveling Class Mark

TCOS
Traveling Class of Service

TFC
Traffic Control

TFN
Network Traffic

TGAR
Trunk Group Access Restrictions

TLD
Toll Denied

TOD
Time of Day

TSC
Trunk Steering Code

TTTN
Tandem TIE Trunk Network

UDP
Uniform Dialing Plan

XFER
Call Transfer

SL-1

Electronic Switched Network

Description

Information subject to change without notice.
Release 6.0
Standard
October 31, 1993
Printed in the U.S.A.