DMS/Meridian

MCDN Network Ring Again

Network Services Guide

March 1991

nt northern telecom

DMS/Meridian

MCDN Network Ring Again

Network Services Guide

Publication number: 555-8001-103
Document status: Standard
Document release: 1.0
Date: March 1991

Revision history

March 1991

Document release 1.0, Standard version

Contents

Chapter 2
MSL-100 perspective   **2-1**

Figures

Tables

About this guide

This guide serves as a reference to implementing the Meridian Customer Defined Network (MCDN) Network Ring Again (NRAG) feature. Since each network may have a different switch configuration and signaling arrangement, you must datafill each switch so that the MCDN feature will work with all the switches in the network.

How to use COMPASS with this document

The COMPASS viewer lets you search this document using keywords. A keyword can be a single word or an acronym. Each page contains a header with the name of the switch discussed in that section. The titles of the figures and tables also contain references to the switch. Thus, you can search for every figure, table, or page pertaining to a specific switch.

Using COMPASS, you can search for a number of keywords that appear on the same page. Therefore, you can make comparisons between requirements or interactions of MCDN features on different switches.

For example, a manager who wants to know if there are any Calling Number (CGN) conflicts between the DMS-100 and the DMS-250 can enter the following keywords in COMPASS:

- CGN

- DMS-100

- DMS-250

COMPASS produces a list of the pages that contain *all three* of the search words on the same page. Be careful not to define your search with too many keywords, however. You may have to try several combinations of keywords to locate the desired information.

Note: When you use COMPASS to search all the documents on your CD (before opening a specific document) the application produces a list of documents containing *any* of the keywords. All the keywords do not necessarily appear in the same document.

Important keywords and acronyms for NRAG

Use COMPASS and the following list of acronyms to search this document for new or changed information related to NRAG.

ACB	Automatic Call Back
ANI	Automatic Number Identification
AR	Automatic Recall
BISI	Busy Idle Status Indication
CCBQ	Coordinated Call-back Queuing
CCBS	Call Completion to Busy Subscriber
CDN	Called Number
CDPA	Called Party Address
CFB	Call Forward Busy
CFD	Call Forward Don't Answer
CFI	Call Forward Intragroup
CFU	Call Forward Universal
CGN	Calling Number
CGPA	Calling Party Address
CPF	Called Party Free
CUSTNTWK	Customer Networking
DND	Do Not Disturb
DPC	Destination Point Code
DTRID	Terminating Transaction Identifier
EBS	Electronic Business Set
GT	Guard Timer
GT TO	Guard Timer Times Out
GTT	Global Title Translations
IAM	Initial Address Message
MSB	Make Set Busy
MSGRTE	Message Route
NETID	Network Identifier
NETNAME	Network Name
NINTNRAG	Non-Interworking Network Ring Again
NMRTNRAG	No Message Route Network Ring Again

NRAG	Network Ring Again
OPC	Originating Point Code
OTRID	Originating Transaction Identifier
PC	Point Code
QAT	Queue Advance Timer
RAG	Ring Again
TFMI	Traffic Mix Information
TO	Time Out
TCAPTRID	TCAP Transaction Identifier

General list of acronyms

Following is a list of general and SS7-related acronyms used in this document:

CLLI	Common Language Location Identifier
CO	Central Office
COS	Class of Service
DMI	Digit Manipulation Index
DMS	Digital Multiplex System
DTCI	ISDN Digital Trunk Controller
EBS	Electronic Business Set
ESN	Electronic Switched Network
GNCT	Generalized No Circuit Treatment
IBN	Integrated Business Network
IEC	Inter Exchange Carrier
ISDN	Integrated Services Digital Network
ISUP	ISDN User Part
LATA	Local Access and Transport Area
LEC	Local Exchange Carrier
MADN	Multiple Appearance Directory Number
MCDN	Meridian Customer Defined Networking
NCOS	Network Class of Service
NPA	Numbering Plan Area
PTS	Per Trunk Signaling

PRI	Primary Rate Interface
SCCP	Signaling Connection Control Part
SSN	Subsystem Number
SSP	Service Switching Point
STP	Signal Transfer Point
TCAP	Transaction Capabilities Application Part

Introduction

This guide describes how to activate the MCDN Network Ring Again (NRAG) feature in a network that consists of any of the following Northern Telecom switches: MSL-1, MSL-100, DMS-100, and DMS-250. It contains a separate chapter for each switch.

This guide documents the working of each of the MCDN features and follows the same pattern and contains the same chapter headings. Those chapter headings are as follows:

- **Description**

  Discusses the working of the feature, how a user activates it, and the circumstances under which the feature works.

- **Software requirements**

  Gives the software packages that must be loaded for the feature to work and the release numbers that support it.

- **Hardware provisioning**

  Lists the hardware necessary for the feature to function.

- **Installation rules**

  Explains rules that govern the installation of the feature.

- **Maintenance**

  Describes whatever preventive and corrective maintenance that the feature requires.

- **Datafill and translations**

  Explains the entries to be made in the overlays (for the SL-1) as well as the datafill and translations (for the DMS switches) necessary to activate the feature.

- **Feature interaction**

  Lists the features that interact with the present one and describe the interaction.

- **Operational measurements**

  Lists the feature measurements that the network's switches collect and display.

- **Logs**

  Lists the significant events about the feature that a switch maintains.

- **Service orders**

  Describes the feature's commands used to change subscriber line service tables.

- **Testing**

  Describes feature tests.

- **Billing**

  Describes the billing that accompanies a feature.

Not every subject listed above is relevant to this MCDN feature. Nor is every subject necessarily relevant to each switch in a network.

Chapter 1
MSL-1 perspective

The MCDN Network Ring Again (NRAG) feature extends the local, or nodal, ring again feature to members of the same customer group residing on different Northern Telecom switches.

Description

NRAG enables a caller who receives a busy signal at a destination set on a different switch but within the same network to have his PBX notify him when the set of the called party goes on hook and is available to receive a call.

> *Note:* NRAG on the MSL-1 requires PRI from end to end.

The following is a successful NRAG sequence:

1. User A (the originator) calls user B (the terminator) and encounters a busy signal.

2. User A requests the activation of the NRAG feature and receives a tone that confirms the activation. User A returns on hook.

   a) When user A requests NRAG, T5, the originating switch's message response timer, begins to count. When user A receives the confirmation tone, T5 stops and T6 begins. T6, the originating switch's duration timer, limits the amount of time an NRAG request may remain outstanding.

   b) When the terminating switch accepts user A's NRAG request, it starts T7, the terminating switch's duration timer. T7 stops counting either when user B's set is free and user A accepts the recall or when the NRAG request is cancelled.

3. When user B goes on hook, user A's set rings with a special cadence. User A goes off hook and the call is automatically set up to user B.

   a) When user B goes on hook, T6 stops and T2 starts. T2, the recall timer, limits the amount of time user A has to answer the special ringing cadence. When user A accepts the recall and initiates the call set-up, T2 stops.

   Note: If user A's 500 set is busy when the recall arrives, the NRAG request is cancelled.

4. User B's set rings.

   Note: It is not possible to initiate an NRAG request from an attendant station.

If one of the timers expires before an NRAG sequence has completed, the NRAG request is cancelled.

Terminals that carry NRAG

Software release 14 is the first to support NRAG for 500/2500 sets. All other sets can carry NRAG beginning with release 12 except those sets which themselves require a later software release to work (such as the Meridian 2008 which is supported only as of release 14).

Incomplete NRAG sequences

The following are descriptions of some of the possible reasons for an incomplete NRAG sequence. User A is considered the originating set, user B the terminating set.

- User A, with a 500 set, is busy when the originating switch is notified that user B is free.

- Having been notified that user B is free, user A initiates the call set-up and finds that user B has once again become busy.

- User A is busy when the terminating switch communicates that user B is idle.

- User A cancels a pending NRAG request.

- The terminating switch rejects user A's NRAG request.

- The terminating switch cancels an NRAG request after accepting its activation.

- The originating switch's duration timer (T6) expires.

- The terminating switch's duration timer (T7) expires.

- The originating switch receives no response to its NRAG request.

- User A fails to answer the notification that user B is idle.

- User B's set is subject to a call modification (such as Call Forward).

- User A's request encounters a conflicting feature at user B's set.

MSL-1 originating switch NRAG functions

The MSL-1 originating switch performs the following functions to support the Network Ring Again feature:

- Handles NRAG activations.

  Receives and recognizes the NRAG activation request from user A (switchhook flash, RGA button, etc.) and generates the `INVOKE NRAG REQUEST` to the terminating switch.

- From information available within itself and that gained from the terminating switch, verifies the following:

  - The authority of the originating user's group and/or set to make an NRAG request

  - The presence of an end-to-end ISDN PRI connection to the terminating switch

  - The existence of a route capable of transporting a facility message with TCAP information to and from the terminating switch

  - The presence of an active, compatible NRAG package on the terminating switch

  - The ability of the terminating switch to process an NRAG transaction.

- Starts and stops the NRAG originating switch duration timer (T6) and generates a cancellation message when the timer expires.

- Denies an NRAG request by not activating the RGA lamp, not providing feature confirmation messages, and by delivering denial tones (which vary with the MSL-1 set).

- Receives the calling party's NRAG cancellation and passes it to the terminating switch. Also cancels an NRAG request when notified that the terminating switch's duration timer (T7) has expired.

- Receives from the terminating switch the `CALLED PARTY FREE` notification and passes it to the originator. The form of the notice to the user varies with the set type.

- Delays an NRAG offer to a 500/2500 set when the calling party's set is busy and cancels a request when the originator duration timer (T6) expires. For a now-busy calling party with any other kind of set, enables that party to accept the NRAG offer or to ignore it and re-try the NRAG call later.

- Limits the number of pending incoming and outgoing NRAG requests, thus conserving resources when a switch's users have few trunks but no restriction on the number of NRAG requests they may make.

- Provides interfaces for different sets.

MSL-1 originating switch timers

The timers listed in table 1-1 control the NRAG functions of the MSL-1 when it is acting as an originating switch. The NRAG software controls the duration of the timers.

When one of the timers expires during an NRAG request, that request is cancelled.

Table 1-1
MSL-1 originating switch timers

Designation	Timer name and function	Duration
T2	Recall timer; limits the time between the notification of the originating user that the destination set is free and the acceptance by the originating user of that recall.	30 seconds
T5	Message response timer; limits the time between an originating switch's NRAG request and the acceptance or rejection of that request by the terminating switch.	4 seconds
T6	Originating switch duration timer; limits the time the originating switch waits for notification that the destination set is free.	30 minutes

MSL-1 terminating switch NRAG functions

The MSL-1 terminating switch performs the following functions to support the Network Ring Again feature:

- Handles NRAG requests, which entails the following:

  - Receiving the INVOKE NRAG REQUEST from the network.

  - Sending the originating switch an NRAG REQUEST REJECT if it is unable to honor an NRAG request; giving the originating switch a reason for failing to honor the request.

- Puts the INVOKE NRAG REQUEST into a queue against the destination DN. Those received first are implemented first.

  When the NRAG queue reaches its limit, the terminating switch rejects new NRAG requests.

- Monitors the idle/busy status of the destination set and notifies the originating switch when the set becomes idle.

- Generates the NRAG cancellation message when the termination switch duration timer (T7) expires or when the switch experiences difficulties and is unable to honor an NRAG request.

- Runs the queue advance timer (QAT). The QAT allows the originating switch time to recall user A and then to respond with a new call set-up.

- Handles feature interactions; allows the user of the terminating set to activate MSL-1 features while an NRAG request is pending against it. (See *Feature interactions* for information about how NRAG interacts with basic and optional MSL-1 features.)

MSL-1 terminating switch timers

The timers shown in table 1-2 control the NRAG functions of the MSL-1 when it is acting as a terminating switch. The NRAG software controls the duration of the timers.

When one of the timers expires during an NRAG request, that request is cancelled.

Table 1-2
MSL-1 terminating switch timers

Designation	Timer name and function	Duration
T7	Terminating switch duration timer; limits the time between the acceptance of the NRAG request and either the acceptance of the recall by the originating switch or the cancellation of the request.	30 minutes
QAT	Queue advance timer; limits the time between the `Called Party Free` message to the originating switch and the cancellation of the NRAG request in the absence of an acceptance by the originating switch of the recall.	4 seconds

Originating switch scanning

The MSL-1 does not support scanning of the destination set by the originating switch.

Multiple activation of NRAG

A single-line phone may maintain only one NRAG request active at a time. Activating a second NRAG request with one already pending overwrites the first request.

It is possible for a multi-line phone to keep more than one NRAG request active at the same time but the set must use a separate NRAG key for each request.

Maximum number of NRAG activations on MSL-1

The number of pending incoming and outgoing NRAG requests on an MSL-1 is limited to 25 percent of the call register.

NRAG deactivation

Having made an NRAG request, the originator of the request may cancel it at any time.

Connectivity

The MSL-1 provides NRAG connectivity to the following Northern Telecom switches:

- MSL-1 to MSL-1
- MSL-1 to MSL-100
- MSL-1 to DMS-100
- MSL-1 through DMS-250.

When a user requests the NRAG feature, the network verifies the following:

- The presence of end-to-end SS7 and/or PRI signaling
- The capability of both the originating and terminating switches and stations to process the NRAG feature.

Signaling

The successful operation of the NRAG feature depends on a PRI communication system (with Q.931 messages) that supports a TCAP equivalent over PRI.

The NRAG response time between MSL-1 switches on a network depends on the number of signalling links and their characteristics.

NRAG MSL-1 network configurations

Figures 1-1 through 1-5 illustrate the MSL-1 network configurations that support the Network Ring Again feature.

Figure 1-1
MSL-1-to-MSL-1 network
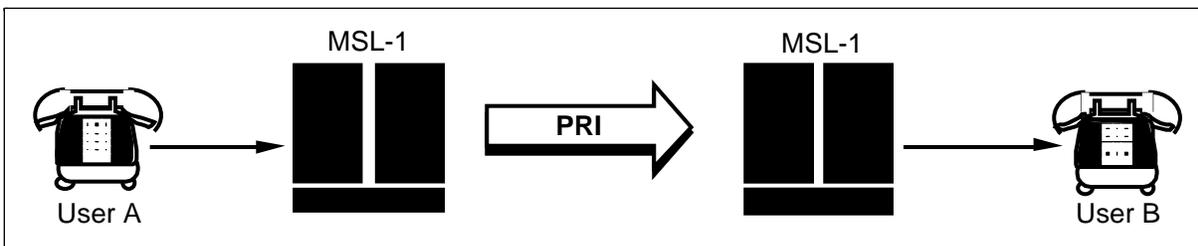
Figure 1-2
Tandem PBX network
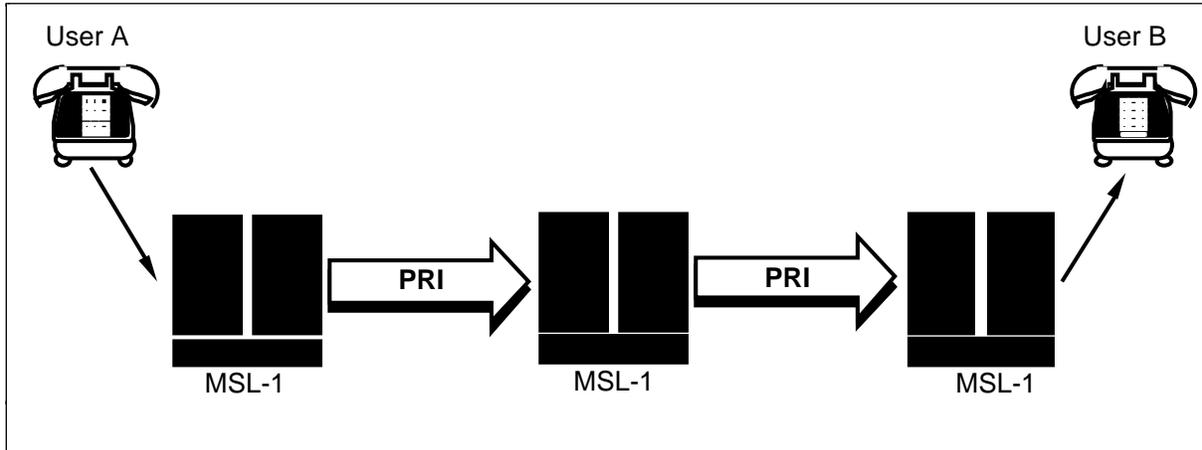
Figure 1-3
MSL-1-to-MSL-100 network
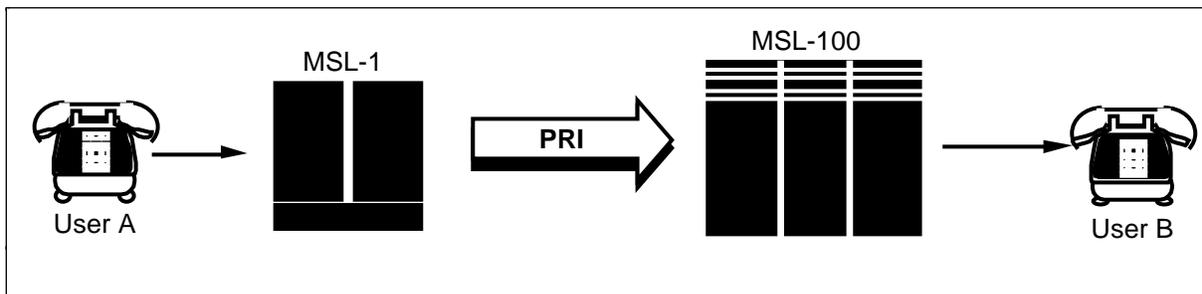
Figure 1-4
MSL-100 tandem network
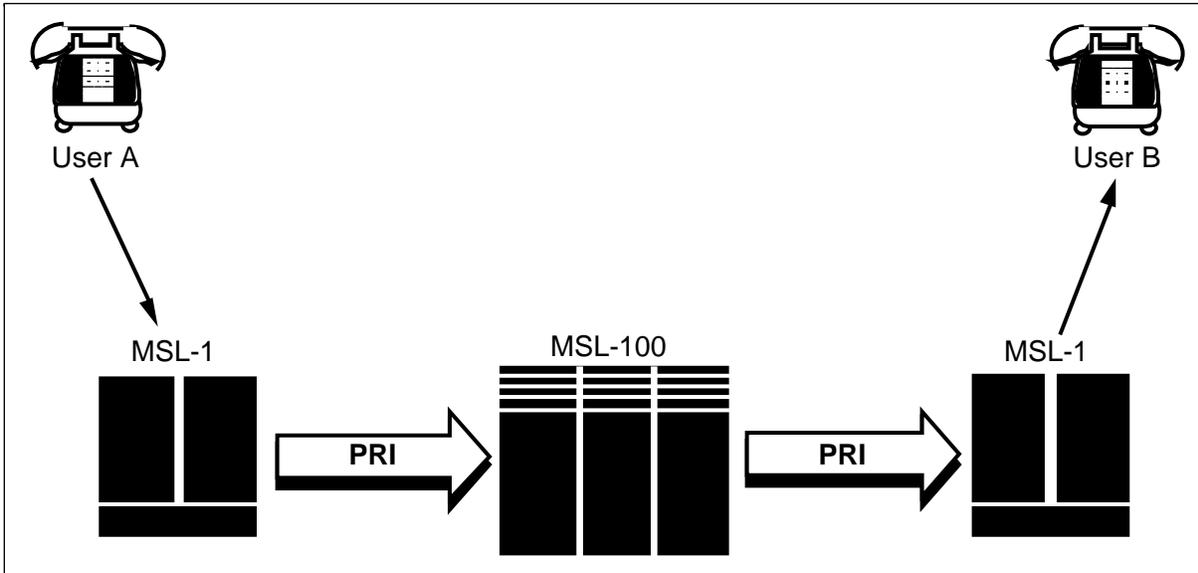
Figure 1-5
DMS-100 tandem network
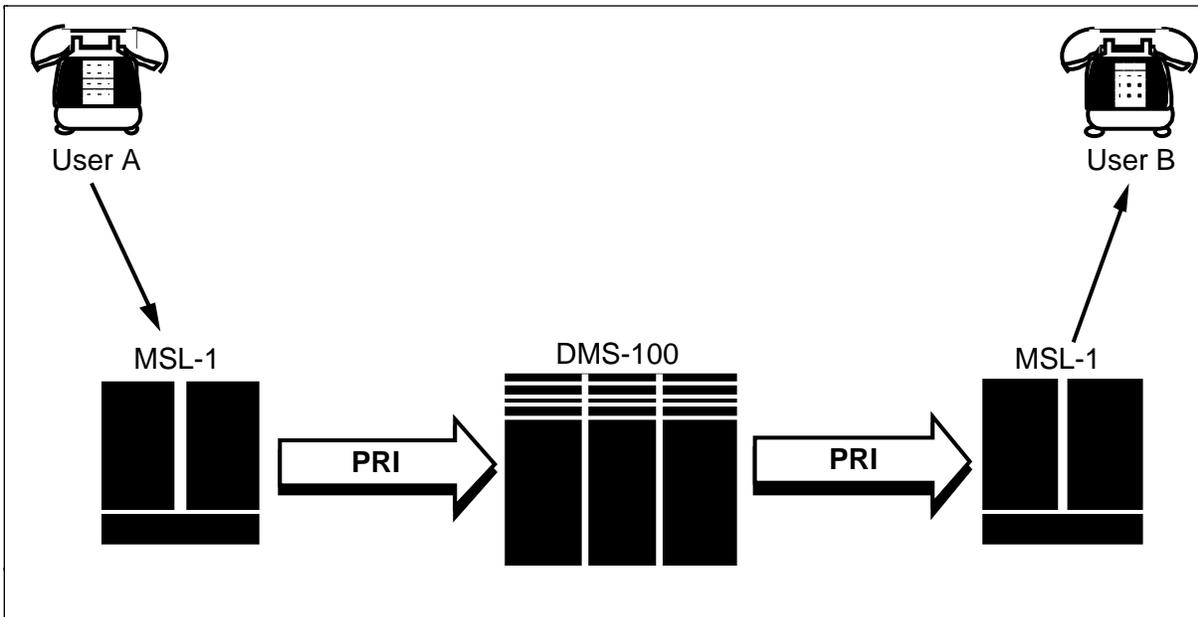
Software requirements

Network Ring Again (NRAG) software Release 12, Generic X11, is the first release to support the Network Ring Again feature. Subsequent releases also support it.

Note: Release 14 is the first one to support NRAG for 500/2500 sets.

The NRAG package number is 148.

The prerequisites of the NRAG package are the following:

- DTI - package 75
- ISDN - package 145.

Hardware provisioning

To support NRAG the MSL-1 must have the primary rate interface (PRI) and D-channel interface (DCHI) cards (for DCHI, at least firmware version 2.1).

Installation rules

No installation rules apply to the NRAG feature on the MSL-1.

Maintenance

The NRAG feature requires no maintenance on the MSL-1.

Datafill and translations

"Datafill" is a DMS term and is not usually used in the MSL-1 environment. We use it in this context to mean adding data into MSL-1 overlays.

Some minor software changes and additions in the overlay programs are necessary to modify the database to enable a network to support NRAG. These changes are set out in the overlay tables that follow.

It is necessary to change LD10 and LD11, the overlays for single- and multi-line sets respectively, to enable those sets to make NRAG requests.

Overlay 10 - Single-line set administration

Modify LD10 to enable single-line sets to initiate NRAG requests. We use here the Easy Change method.

Table 1-3
LD10 - Single-line set entries for NRAG

Field	Range of Values	Description
REQ	CHG	CHANGE
TYPE	500	Type of telephone set
TN	l s c u	Terminal number
ECHG	YES	Easy change
ITEM	CLS XRA	CLS = Class of service
		XRA = Ring again allowed

Overlay 11 - Multi-line set administration

Modify LD11 to specify a key on multi-line sets to initiate an NRAG request. We use here the Easy Change method.

Table 1-4
LD11 - Multi-line set NRAG entries

Field	Range of Values	Description
REQ	CHG	CHANGE
-continued-		

Table 1-4
LD11 - Multi-line set NRAG entries (continued)

TYPE	xxxx	Type of telephone set
TN	lll s cc uu	Terminal number
ECHG	YES	Easy change
ITEM	KEY xx RGA	xx = key number
		RGA = Ring again key

The PNI prompt in both overlay 15 (customer data block) and overlay 16 (route data block) allows the entering of a private network identifier, which allows the NRAG feature to work. While it is recommended that the PNI value be the same for each MSL-1 customer and route within a customer's network, it is not necessary that this be so.

Note: When it is impossible to make the PNI value for each customer and route on a network the same, a route must have the same PNI as the customer PNI in the switch to which it leads.

In figure 1-6 the network's MSL-1 switches and routes have the same PNI value. In figure 1-7 they have different PNI values.

Figure 1-6
Same PNI value within a network
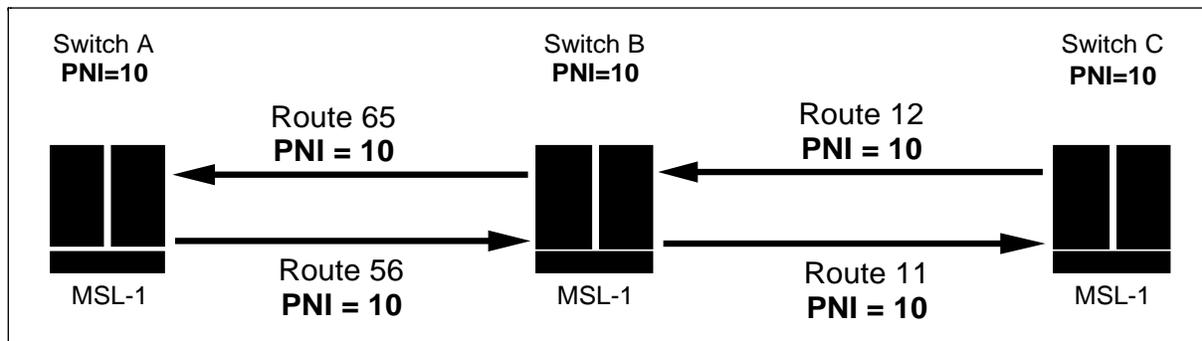
Figure 1-7
Different PNI values within a network

Switch A   Switch B   Switch C
PNI=10   **PNI=20**   **PNI=30**

Route 65   Route 12
PNI = 10   **PNI = 20**

Route 56   Route 11
PNI = 20   **PNI = 30**

MSL-1   MSL-1   MSL-1
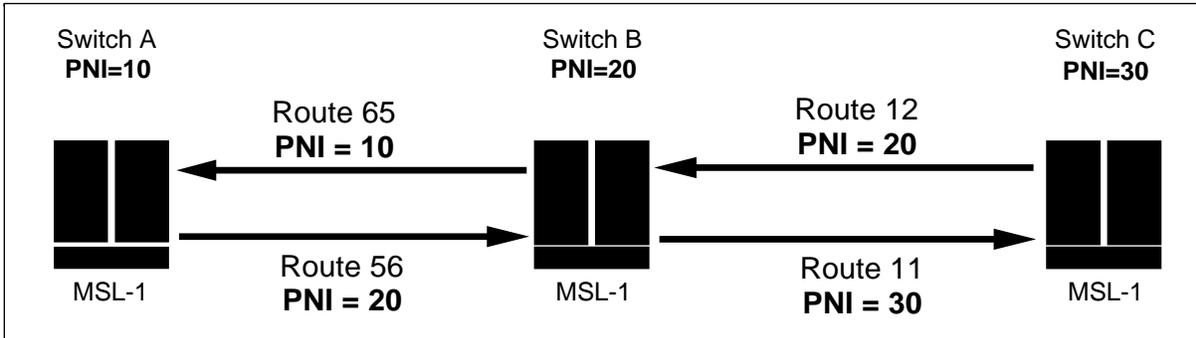
Notice that in figure 1-7 the PNI value of each route is the same as the next MSL-1 switch it encounters.

Note: Each customer group within the same MSL-1 must have a unique PNI.

Overlay 15 - Customer data block

Proceed in LB15 as follows:

Table 1-5
LD15 - Customer data block NRAG entries

Field	Range of Values	Description
REQ	CHG	CHANGE
TYPE	CDB	Customer data block
CUST	0 - 99	Customer number
ISDN	YES	Answer YES to make the PNI prompt appear.
PNI	1 - 32700	Private network identifier; enables the NRAG feature to work.

Note: For a NARS call you must specify a home location code (HLOC); for coordinated dialing plan (CDP) a local steering code (LSC). For ESN, if a switch is receiving public call types over the same PRI route at the terminating switch, specify those call types under access code 2 (AC2).

Overlay 16 - Route data block

Proceed as follows in LD16. Enter a PNI value for each route that enters a switch. For example, switch B in figure 1-7 requires a PNI value both for route 12 and for route 56.

Enter in the IFC (interface) field the name of the switch to which the route connects.

Table 1-6
LD16 - Route data block NRAG entries

Field	Range of Values	Description
REQ	CHG	CHANGE
TYPE	RDB	Route data block
CUST	0 - 99	Customer number
ROUT	0 - 511	Route number
TKTP	XXX	Trunk route type
ISDN	YES	Answer YES to make the PNI prompt appear.
IFC	D100 = DMS-100 D250 = DMS-250 SL1 = MSL-1 S100 = MSL-100 ESS = AT&T ESS4 SS12 = Norwegian SYS112	Switch to which this route connects
PNI	1 - 32700	Private network identifier; must be the same as the switch to which this route leads.

Note: Use the INAC field to permit the automatic adding of an ESN code to an incoming ESN call.

Overlay 17 - Configuration record

Specify the software release or BSC number and the interface switches by modifying LB17 as follows:

Table 1-7
LD17 - Configuration record NRAG entries

Field	Range of Values	Description
REQ	CHG	CHANGE
TYPE	CFN	Configuration data block
ISDN	YES	Answer YES to make the RLS prompt appear.
RLS	XX	Release number or BCS number
IFC	D100 = DMS-100	Switch to which this switch connects
	D250 = DMS-250	
	SL1 = MSL-1	
	S100 = MSL-100	
	ESS = AT&T ESS4	
	SS12 = Norwegian SYS112	

Overlay 21 - Print routine

Use LB21 to print the customer and route data blocks as they have been modified with LB15 and LB16.

Overlay 22 - Print package (D2PRT)

Use LB22 to print the MSL-1 print package.

NARS calls

If NRAG is to work for NARS calls, be sure that the home location code (HLOC) is specified in overlay 15.

Coordinated dialing plan (CDP)

For CDP calls, be sure that the following entries have been made:

- Overlay 15 -   local steering code (LSC)

- Overlay 86, ESN data block -

    coordinated dialing plan (CDP)

    maximum number of steering codes (MXSC)

    number of digits in CDP DN (NCDP)

- Overlay 87 -   local steering code (LSC)

    distant steering code (DSC).

Feature interactions

The tables that follow show the interaction of the NRAG feature with other basic and optional MSL-1 features, with basic and optional attendant features, with basic and optional MSL-1 set features, and with 500/2500 set features. All the features listed were part of software releases previous to Release 12, the first to support NRAG.

Note: The designations next to the feature names within the charts refer either to the class of service associated with that feature (as in CLS = fba) or to a feature's option package number and that option's mnemonic (as in 42 = ACDC).

Use the following key to interpret the feature interaction charts:

N   =   Negligible or no feature interaction

L   =   Low interaction; NRAG either uses or is used by this feature, but does not change how it works; requires testing.

M   =   Medium interaction; use of NRAG necessitates changes in this feature but will not affect how the customer uses it; requires testing.

H   =   High interaction; use of NRAG requires changes in this feature which affect how it works; requires testing.

P   =   Partly supported; some interactions between NRAG and this feature work and others do not. For example, Speed Call is supported when the user must dial some digits manually but not otherwise; requires testing.

U   =   Unsupported; feature should not be used in conjunction with NRAG but both may coexist within the system; requires testing.

I   =   Incompatible; feature should not be packaged with NRAG.

Table 1-8
Interaction of NRAG with MSL-1 basic features

MSL-1 feature	Feature interaction
Access restrictions	
• Class of service (COS) restrictions	L
• Code restrictions	L
• Trunk signaling arrangements	M
• Trunk group access restrictions (TGAR)	L
Automatic daily routines	N
Auxiliary signaling	N
Bulk data load	N
Call forward busy (CLS = fba)	L
Call forward no answer (CLS = fba)	L
Call forward no answer, second level (CLS = sfa)	L
Call forward by call type	L
Called party disconnect control	N
Class of service priority (CLS = lpr, hpr)	L
Common control software arrangement access	N
Data conversion (automatic conversion)	N
Data transmission	N
Dial pulse/dual tone multi-frequency conversion (CLS = dip)	N
Direct inward dialing (DID)	N
Direct outward dialing (DOD)	N
Directory number	
• Multiple-loop directory number (CFN = mldn)	P
Dual central processing unit	N
Dual tone multi-frequency calling (CLS = dtn)	N
Dual tone multi-frequency to dial pulse conversion	N
Dump at midnight	N
Emergency transfer control	N
E.P.S.C.S. interface	L
Flexible attendant DN (CDB = atdn)	N
-continued-	

Table 1-8
Interaction of NRAG with MSL-1 basic features (continued)

Flexible numbering plan	N
Four-wire E & M trunk	N
Hong Kong features • Network blocking for DID calls • Trunk group busy (unique tone) (CLS = hta)	 N N
Hunting • Circular • Linear • Round-robin • Secretarial • Short	 P P N P P
Intercept treatment	N
Japan DID trunk (QPC686)	N
Line lockout	N
Manual line service	N
Manual trunk service	N
Memory • Memory expansion (XN) • Memory management • Memory allocation maps • Template data structure • Soft memory failure recovery	 N N N N N
Modem trunks	N
Near immediate ringing	
Night service • Trunk answer from any station (TAFAS) (SPRE = X4)	N N
Power failure transfer	N
Private line service • 500/2500 sets • MSL-1 sets	 N N
Remote administration	N
Reserve power	N
Ring validation timing	N
-continued-	

Table 1-8
Interaction of NRAG with MSL-1 basic features (continued)

Station-to-station calling	N
System capacity improvements	
• Call register	N
• Flexible software pricing	N
• Network	N
• Omega 1/5 matching	N
- CPU	N
- Memory	N
• Peripheral equipment module (PEM)	N
• Software package increase (SPI)	N
• Tape capacity	N
• X11 template	N
• 128 trunk groups	N
• Common equipment module (CEM)	N
• Mass storage interface	N
• Gemini	N
Tandem switching	L
TIE trunks	L
Toll restrictions	N
Tones and cadences	
• Special dial tone	N
Traffic measurement	N
Two-wire E & M trunk	N
Uninterrupted line connections	N

Table 1-9
Interaction of NRAG with MSL-1 optional features

MSL-1 feature	Feature interaction
Automatic call distribution (ACD) (4N = BACD), (45 = ACDA)	
• Package A, basic	
- Call source display	U
- Feature keys	U
- First and second delay announcement	U
- Single or multiple queues	U
- Night treatment	U
- Trunk priority	U
- Ring again	U
- Auto log-in	U
• Package B, ACD advanced features (41 = ACDB)	
- Automatic overflow by number	U
- Call forcing	U
- Display queue	U
- Emergency recorder	U
- Extended agent observe	U
- Interflow	U
- Music-on-hold/delay	U
- Optional feature keys	U
- Time overflow	U
• Packages C1 and C2, ACD Load Management and ACD Management Reports (42 = ACDC), (43 = LMAN)	
- Agent log-in, log-out, walk-away, and return	U
- Ongoing status display	U
- Pos., queue, trunk reports	U
- Quarter-hour reports	U
- Supervisor commands	U
- Senior supervisor privileges	U
• Package D, ACD Auxiliary Data System (5N = ACDD), (51 = LNK)	U
- Agent log-in, log-out, walk-away, and return	U
- Load management	U
- High- and low-speed data links to auxiliary	U
- Initialization and diagnostic interfaces to auxiliary	U
Attendant administration (54 = AA)	N
Attendant overflow position (56 = AOP)	N
Automated modem pooling (78 = AMP)	N
-continued-	

Table 1-9
Interaction of NRAG with MSL-1 optional features (continued)

Automatic identification of outward dialing (3 = AIOD)	N
Automatic number identification (12 = ANI)	
• KP option	N
• Number of digits	N
• Route selection (13 = ANIR)	N
• Super trunk group support	N
• Trunk test	N
Automatic trunk maintenance (84 = ATM)	N
Autovon (military) (68 = ALVN)	
• Attendant precedence calling	N
• Autovon ICIs	N
• Autovon night service	N
• CDR enhancement (69 = ACDR)	N
• Completion to busy	N
• Feature keys	N
• Incoming preemption	N
• Outgoing preemption	N
• Precedence distinctive ringing	N
• Precedence intercept	N
• Station precedence calling	N
• Trunk interface	N
• Station loop preemption (106 = PREM)	N
Basic authorization code (SPRE = X6); (25 = BAUT)	N
Call detail recording (CDR) (4 = CDR)	N
• Calling party number	N
• CDR - link	N
• CDR - teletypewriter	N
• Charge account (SPRE = X5/key); (23 = CHG)	N
• ESN	N
• Forced charge account	N
• Network CDR	N
• Mini-CDR (31 = MCDR)	N
• OMNI - FACTS (585 processor)	N
• Parallel ports	N
• Q option (for ACD) (83 = CDRQ)	N
• 911 CDR improvement	N
• Internal CDR (108 = ICDR)	N
Call park (SPRE = X71, X72/key); (33 = CPRK)	N
-continued-	

Table 1-9
Interaction of NRAG with MSL-1 optional features (continued)

Call party name display (95 = CPND)	N
Centralized attendant service (CAS)	
• CAS main (26 = CASM)	N
• CAS remote (27 = CASM)	N
Deluxe hold (71 = DHLD)	
• Exclusive hold (CLS = xha)	N
• Individual hold indication (DN lamp)	N
Dial intercom (21 = DI)	N
Digital trunk interface (75 = PBXI)	L
Direct inward system access (22 = DISA)	U
Electronic switching network (ESN) (14 = BRTE), (28 = BQUE)	
• Basic automatic route selection (BARS) (57 = BARS)	N
• Comm. mgmt./Admin. inter (3N = CMAC)	L
• CMC	N
• Coordinated dialing plan (59 = CDP)	N
• ESN signaling (37 = NSIG)	N
• ESN (999 loc)	N
• Eleven-digit translation	N
• Flexible call back queueing (61 = FCBQ)	M
• Free calling area screening (FCAS)	N
• Incoming trunk group exclusion	N
• Multiple DID office code screening	N
• NARS traffic measurement (29 = NTRF)	N
• Network authorization code (SPRE = X6); (63 = NAUT)	N
• Network automatic route selection (NARS) (58 = NARS)	N
• Network control (32 = NCOS)	N
• Network routing controls	N
• Network speed call (39 = NSC)	N
• Network transfer (67 = NXFR)	M
• Network queueing (main CBQ, CCBQ) (38 = MCBQ)	M
• Off-hook queue (62 = OHQ)	N
• Offnet number recognition	L
• Priority queueing (6N = PQUE)	N
• Satellite link control	L
• Special common carrier account (66 = SCC)	N
• Tone detection (65 = TDET)	N
• 1+ dialing	
Enhanced end-to-end signaling (10 = EES)	N
-continued-	

Table 1-9
Interaction of NRAG with MSL-1 optional features (continued)

Flexible code restriction (49 = NFCR)	N
Hotel/motel features	
• Pre-translation (five-digit) (92 = PXLT)	N
• Supervisory console	N
• 63 consoles	N
• Automatic wake-up (102 = AWU)	N
• Background terminals (99 = BGD)	N
• Message registration (101 = MR)	N
• Room status (10N = RMS)	N
• Property management system interface (103 = PMSI)	N
History file (55 = HIST)	L
Integrated message service (35 = IMS)	
• AUX communications	N
• AUX message waiting indication	N
• Integrated voice message system (IVMS)	N
• IMS data transfer	N
• Interface maintenance	N
• Telset messaging (35 = UMG)	N
• Telset status (35 = UST)	N
ISDN primary rate interface (109 = ISA)	
• D-channel interface	N
• Enbloc dialing	N
• Bearer capability	N
• Progress tones	N
• Calling line identification	N
• Call redirection and forwarding	M
• Private network hop-off	L
• PSTN equal access	N
• Enhanced supervision	L
• Integrated services access (ISA)	M
Japan features	
• CDR with answer supervision	N
• Detection of supervision on CO trunks	N
• Last number redial	N
• Optional outpulse delay (79 = OOD)	N
• Outpulsing of asterisk and octothorpe (104 = OPAO)	N
• Special tones and ringing (94 = JTDS); (QPC646)	N
• Supervisory CO trunk (97 = JCO); (QPC628)	N
• Supervisory CO trunk (97 = JCO); (QPC686)(	N
Line load control (105 = LLC)	N
-continued-	

Table 1-9
Interaction of NRAG with MSL-1 optional features (continued)

Malicious call trace (107 = MCT)	N
Manual trunk maintenance	N
MNA restriction removal	N
Multi-customer operation (2 = CUST)	N
Multi-tenant service (86 = TENS)	N
Multiple message center (4N = BACD)	N
Music package (44 = MUS)	N
Office data administration system (2N = ODAS)	N
Recorded announcement (7 = RAN)	N
Recorded overflow announcement (36 = ROA)	N
Recorded announcement on arrival (36 = ROA)	N
Remote peripheral equipment (15 = RPE)	N
Resident debug (82 = RSDB)	N
Set relocation (53 = SR)	N

MSL-1 P/LAN interface
 	
• Alpha signaling   (85 = CSLA)
• Enhanced SDI board   (77 = CSL)
• Command and status link   (77 = CSL)
• CSL for MSL-1MS
• Digital link interface   (75 = PBXI)
• Information data services   (77 = CSL)
  - VMS
  - DS
  - CONN
• Coordinated service change
• Coordinated maintenance
	
	N
	N
	N
	N
	N
	
	N
	N
	N
	N
	N

Station-to-station call waiting	L
Test lines ((100-type, loop-around)	N
Trunk group distinctive ringing (74 = DRNG)	N
Integrated voice/data switching (IVDS)	N
Integrated serial digital line card (ISDLC)	N

Table 1-10
Interaction of NRAG with attendant basic features

Attendant feature	Feature interaction
Alarm lamps	
• Major (MJ)	N
• Minor (MN)	N
Answer, originate calls	N
Attendant console expansion (add-on modules)	N
Attendant interpositional transfer (IPT)	N
Automatic dialing	N
Automatic timed reminders (recalls)	N
Barge in	N
Busy lamp field (add-on module)	N
Busy verify	N
Call selection (ICI + loop)	N
Call waiting indication (lamp CW)	N
Camp on (with indication)	N
Conference 6	L
Console digit display	N
Cont. of trunk group access	N
Digit display	
• Display calls waiting	N
• Display of incoming calls	N
• Display source	
• Display destination	N
Emergency transfer control (switch)	N
Hold	N
Incoming call identification	N
Key sending	N
Light emitting diode (LED) indicators	N
Lockout	N
Multiple console operation	N
Multiple-listed directory numbers	N
-continued-	

Table 1-10
Interaction of NRAG with attendant basic features (continued)

Internal call type identification	N
Night service control	N
Position busy	N
Push-button dialing	N
Release	N
Release source	N
Release destination	N
Secrecy	N
Signal source and destination	N
Speed call	N
Splitting	N
Through dialing	N
Trunk group busy indication (lamps)	N
Headset/handset operation	M
Non-delayed operation	N
Non-locking keys	N
Switched loop termination	N
Volume control	N

Table 1-11
Interaction of NRAG with attendant optional features

Attendant feature	Feature interaction
Attendant administration program (54 = AA)	L
Attendant message center (46 = MWC)	
• Message cancellation	N
• Message indication	N
Automatic wake-up (102 = AWU)	N
-continued-	

Table 1-11
Interaction of NRAG with attendant optional features (continued)

Autovon (68 = AUTOVON)	
• Flash call	N
• Flash override call	N
• Immediate call	N
• Priority call	N
Calling party number (23 = CHG)	N
Call park/page (33 = CPRK); (SPRE = X71, X72)	N
Charge account (23 = CHG)	N
Departmental LDN (76 = DLDN)	N
Display/change date (8 = TAD)	N
Display/change time (8 = TAD)	N
Do not disturb	
• Individual (9 = DNDI)	M
• Group (16 = DNDG)	M
• DND intercept treatment	M
Malicious call trace (108 = MCT)	N
Mini-CDR (SL1M) (31 = MCDR)	
• Low tape alarm	N
Routing controls (ESN)	N
Station category indication (8N = SCI)	N
Stored number redial (64 = SNR)	N
System speed call (34 = SSC)	N
Console for the blind	N

Table 1-12
Interaction of NRAG with MSL-1 set basic features

MSL-1 set feature	Feature interaction
Attendant recall	N
Automatic dialing	N
Automatic pre-selection of prime DN	N
-continued-	

Table 1-12
Interaction of NRAG with MSL-1 set basic features (continued)

Busy lamp field	N
Call forward all calls	L
• Secretarial filtering	L
Call forward busy (CLS = fba)	L
Call forward no answer	L
Call forward no answer, second level (CLS = sfa)	L
Call forward by call type	L
Call pickup (CLS = pua); (SPRE = X3)	U
Call status indication	N
Call transfer	M
Call waiting	L
Common audible signaling	N
Conference	L
Data set (CLS = dta)	N
Display phone (two terminal numbers: one voice, one data)	N
Hold	N
Manual signaling (buzz)	N
Maintenance set (CLS = mta)	N
Multiple appearance directory number • Multiple call ringing • Multiple call non-ringing • Single call ringing • Single call non-ringing	 N N N N
On-hook dialing	N
Override	N
Prime directory number (PDN)	N
Privacy	N
Privacy override (CLS = poa)	N
Privacy release	N
-continued-	

Table 1-12
Interaction of NRAG with MSL-1 set basic features (continued)

Private line service	
• Private line ringing	L
• Private line non-ringing	L
Pushbutton dialing	N
Release	N
Ring again	H
Speed call	N
Station set expansion (add-on modules)	N
Tone buzzing	L
Tone ringing	L
Hands-free operation	N
Headset operation	N
Light emitting diode (LED) indicators	N
Loudspeaker/amplifier	N
Non-locking keys	N
Six-wire line cord	N
MSL-1 set range extender	N
TELADAPT connectorization	N
Volume control	N

Table 1-13
Interaction of NRAG with MSL-1 set optional features

MSL-1 feature	Feature interaction
ACD set (CLS = agn, spv) • Agent (CLS = agn)	
- ACD agent (pkg. A)	N
- Answer/call ACD Spv. (pkg. B)	N
- ACD waiting calls indicator (B)	N
- Emergency call (Pkg. B)	N
- IMS attendant (35 = IMS); (CLS = ima)	N
- Message cancellation (46 = MWC)	N
- Message indication (46 = MWC)	N
- Not ready (Pkg. A)	L
- SPID supervisor I.D.	N
• Supervisor (CLS = spv)	
- Answer calling agent (Pkg. A)	L
- ACD agent x key (Pkg. B)	N
- Answer emergency (Pkg. B)	N
- Display agents (Pkg. A)	N
- Display calls in queue (Pkg. A)	N
- Enable interflow (Pkg. A)	L
- Observe selected agent (Pkg. B)	N
- Ring selected agent (Pkg. B)	L
Attendant overflow position busy (56 = AOP)	M

Autovon   (68 = ATV N)
 	
  • Flash call
  • Flash override call
  • Immediate call
  • Priority call
	
	N
	N
	N
	N

Call park/page (33 = CPRK); (SPRE = X71, X72)	N
Calling party number (23 = CHG)	N
Charge, forced charge (23 = CHG), (24 = CAB), (52 = FCA)	N
Controlled class of service (81 = COS)	N
Dial intercom group (21 = DI)	N
Display key (19 = DDSP)	N
Digit display	N
Group call (48 = GRP)	N
Last number recall (9N = LNR); (SPRE = X89	N
-continued-	

Table 1-13
Interaction of NRAG with MSL-1 set optional features (continued)

Line load control (CLS = 11c1/11c2/11c3); (105 = LLC)	N
Line preference (72 = LSEL)	
• Incoming ringing (CLS = ira)	L
• Incoming non-ringing (CLS = nia)	L
• Outgoing ringing (CLS = ola)	L
Make set busy (17 = MSB)	M
Malicious call trace (CLS = mcta); (SPRE = X83); (107 = MCT	N
Message registration (101 = MR)	N
Message waiting (46 = MWC)	
• Key/lamp	N
• Audible message waiting (CLS = mwa)	N
Remote CAS control (27 = CASR)	N
Room status (100 = RMS); (SPRE = X86)	N
Stored number redial (64 = SNR)	N
System speed call (34 = SSC); (SPRE = X73)	N
Telset status (35 = UST); (SPRE = X84)	N
Time and date (8 = TAD)	N
Voice call	N

Table 1-14
Interaction of NRAG with 500/2500 set features

500/2500 feature	Feature interaction
Attendant recall (flash)	N
Bridging	N
Call forward busy (CLS = fba)	L
Call forward no answer (FTR = fdn)	L
Call forward no answer, second level (CLS = sfa)	L
Call forward by call type	L
Call pickup (CLS = pua); (SPRE = X3)	U
Call transfer (CLS = xfa); (flash)	M
-continued-	

Table 1-14
Interaction of NRAG with 500/2500 set features (continued)

Call waiting (CLS = cwa)	L
Conference control (flash)	L
Conference 3 (CLS = xfa); (flash)	L
Conference 6 (CLS = c6a)	L
• Conference control (SPRE = X87)	L
Dial access to features and services (flash)	L
Hold (flash)	N
Manual line service (CLS = mnl)	U
Multiple appearance directory number (SCR/SCN)	P
Ring again (CLS = xra); (flash/SPRE = X1, X2)	H
Switchhook flash	N
Off-premises extension (OPX) (CLS = opx)	U

Operational measurements

Table 1-15 shows the operational measurements for the NRAG feature.

Table 1-15
NRAG operational measurements

Operational measurement	Originating switch	Terminating switch
NRAG activation attempts	X	
Incoming NRAG requests		X
NRAG denial - system restriction	X	
NRAG denial - feature interaction	X	X
NRAG denial - user privilege	X	
NRAG denial - resource limitation	X	X
NRAG denial - other reason	X	X
NRAG T6 and T7 time-outs	X	X
NRAG deactivations by user	X	
No answer to notice of idle destination set	X	
Deactivations - other reasons	X	X

It is the job of the operational support system, the OSS, (Meridian Network Management system or the Dynamic Network Controller) to calculate the rates for the items in the table above; for example, the percentage of each event among all of the events with NRAG Activation Attempts and Incoming NRAG Requests as the base.

Also, it is advisable to set user thresholds in the OSS and operational guidelines for NRAG administration for when items in the above table fall out of range.

> *Note:* We recommend that the MSL-1 generate no TTY messages or alarms for NRAG since calls are not lost. However, we recommend that NTP operations practices do periodic examinations of the above operational management rates for resource engineering purposes.

Logs

The MSL-1 produces no logs for the NRAG feature.

Service orders

Service orders do not relate to NRAG.

Testing

Test the NRAG feature by activating it between two sets served by different switches on a network.

Billing

There is no special billing for NRAG on the MSL-1.

Chapter 2
MSL-100 perspective

MCDN Network Ring Again (NRAG) extends the capabilities of local, or nodal ring again to members of the same customer group residing on different Northern Telecom switches in the network.

An NRAG sequence originates and terminates at sets served by either an MSL-1 or an MSL-100 serving as a CENTREX. When user A encounters a busy signal at set B, he can activate NRAG by pressing a designated NRAG key or by dialing a SPRE code (for a 500 set). When user B's set becomes idle, user A is notified by recall. He acknowledges the recall and the call is set up normally.

Description

When user A initiates an NRAG request, the originating switch asks the terminating switch to scan user B's set. When user B's set goes on hook, the terminating switch notifies the originating switch, which in turn notifies user A.

NRAG is controlled by timers on both the originating and terminating PBXs. For particulars about how an NRAG sequence proceeds and what causes incomplete sequences see *MSL-1 perspective* in this document.

How NRAG sends signaling information

NRAG messages can be sent over SS7 links or the primary rate interface (PRI).

NRAG on SS7 uses the transaction capabilities application part (TCAP) for signaling. The TCAP message is then included in the signaling connection control part (SCCP) for transmission over SS7 links.

NRAG on PRI also uses TCAP messages, which are included with the PRI facility message (FAC). The facility message contains the network ID of the destination switch, along with the DN of the called number.

When received at the destination switch, the TCAP information is stripped from the FAC message. Further processing and scanning of the busy line is performed by the destination switch, as in nodal RAG.

Connectivity
The MSL-100 provides NRAG connectivity to the following Northern Telecom switches:

- MSL-100 to MSL-1
- MSL-100 to MSL-100
- MSL-100 to DMS-100
- MSL-100 through DMS-250.

Hardware requirements
NRAG requires the PRI or SS7 base packages.

Software requirements
NRAG requires BCS 30 or later and software package NTXA36AA01; for PRI: NTX791AA02.

Installation rules
There are no special installation rules for NRAG on the MSL-100.

Maintenance
There are no special maintenance rules for NRAG on the MSL-100.

Datafill and translations

NRAG can transmit signaling information to other switches using either SS7, PRI, or a combination of both (interworking). Proper datafill is imperative at each switch on the network or an NRAG request or recall will be blocked.

The following sections give the NRAG-related datafill using SS7, PRI, or interworking.

MSL-100 NRAG-related tables

The important tables for NRAG on PRI are Tables NETNAMES, CUSTNTWK, MSGRTE, DNGRPS, and TCAPTRID.

Table NETNAMES

Table NETNAMES provides a unique name and numerical ID for each switch on the private network. It also provides a field for specifying interworking of NRAG messages between PRI and SS7.

Table 2-1
Fields and values for Table NETNAMES

Field	Range of Values	Description
NETNAME	alphanumeric, 1-32 characters	The private network name. This name must be consistent on all switches or NRAG will not work.
EXTNETID	1-32767	The external network identifier. Each switch must have a unique number.
NETDIGS	0-10	A value representing the number of digits used by the logical network; used to extract the correct number of digits from the stored DN.
-continued-		

Table 2-1
Fields and values for Table NETNAMES (continued)

NETOPTS	$, NINTNRAG, NMRTNRAG, FACREJ, NMDSP, SUPPRESS	Network options. Enter $ to allow interworking of NRAG messages between PRI & SS7. Choose NINTNRAG to send signaling messages to the NRAG subsystem instead of the INTERWRK subsystem. Choose NMRTNRAG to prevent Table MSGRTE from routing NRAG on SS7 messages. A tuple will be rejected if NINTNRAG is chosen without selecting NMRTNRAG also.
		FACREJ determines whether the facility reject message is sent to the originator when the PRI facility message cannot be routed to the destination.
		NMDSP and SUPPRESS are not used by NRAG.

Datafill sequence
There is no change to the datafill sequence.

Sample datafill

```
netname          extnetid    netdigs    netopts        netopts
NETWORK1           125          7        (NINTNRAG)    (NMRTNRAG)
```

Table CUSTNTWK
Table CUSTNTWK associates a customer name with the NETNAME defined in Table NETNAMES, assigns a global customer group identifier, and provides a field for selecting the NRAG option.

Table 2-2
Fields and values for Table CUSTNTWK

Field	Range of Values	Description
CUSTNAME	alphanumeric, 1-16 characters	The customer group name.
NETNAME	alphanumeric, 1-32 characters	Must be the same as the NETNAME datafilled in Table NETNAMES.
NETCGID	1-4096	Network customer group identifier.
DNREVXLA	$	DN reverse translators. Enter $
OPTIONS	NTWKRAG	Enter NTWKRAG to enable NRAG. No other options currently available.

Datafill sequence
The NETNAME must be datafilled in Table NETNAMES before it can be assigned in Table CUSTNTWK.

Sample datafill

```
custname        netname        netcgid    dnrvxla    options
NTELCOM         NETWORK1       39         $          NTWKRAG
```

Table MSGRTE
Table MSGRTE provides the routing information for the FAC message used to transmit NRAG signaling messages. This table also provides a selector to specify PRI or SS7 routing for the signaling messages.

Table 2-3
Fields and values for Table MSGRTE

Field	Range of Values	Description
NETID	Alphanumeric, 1-32 characters	Network identifier. Enter the same value specified in the NETNAMES field of Table NETNAMES.
FROMDIGS	numeric	For NRAG, this is the outpulsed digits of the calling party. For other applications, FRODIGS specifies the first number of a range of digits.
TODIGS	numeric	For NRAG, enter the same value as in FROMDIGS. For other applications, TODIGS specifies the last number of a range of digits.
MSGRTSEL	LOCAL, PRA, SS7	Message route selector. Enter PRA or SS7 if message is to be routed over a specific D-channel or SS7 route set. Enter LOCAL if message is to be terminated at this switch.
(LOCAL subfield) DELDIGS	numeric	Number of digits to be deleted.
(LOCAL subfield) PREDIGS	numeric	The digit string to be prefixed to the destination address.
(PRA subfield) TRKCLLI	alphanumeric, 16 characters	Trunk CLLI
(PRA subfield) DELDIGS	numeric	Number of digits to be deleted from destination address.
-continued-		

Table 2-3
Fields and values for Table MSGRTE (continued)

(PRA subfield) PREDIGS	numeric	The digit string to be prefixed to the destination address.
(PRA subfield) OPTIONS	alphanumeric	Enter NEWNET
(SS7 Subfield) DPC	alphanumeric	Destination point code. Enter the CLLI name.
(SS7 subfield) DELDIGS	0-10	Number of digits to be deleted from destination address.
(SS7 subfield) PREDIGS	numeric	The digit string to be prefixed to the destination address.
(SS7 subfield) OPTIONS	alphanumeric	Enter NEWNET

Datafill sequence
The NETNAME must be datafilled in Table NETNAMES before the NETID field can be assigned in Table MSGRTE.

Sample datafill
```
netid       fromdigs    todigs    msgrtsel
NETWORK1     515          815       SS7    DALLASPC 0 N $
```

Table DNGRPS
Table DNGRPS is necessary if the terminating switch contains a tuple for an ADDRESS option for a called party's NETNAME.

Table 2-4
Fields and values for Table DNGRPS

Field	Range of Values	Description
SNPA	numeric, 3 digits	Serving numbering plan area. The first three numbers of the DN.
OFC	numeric, 3 digits	Office code. The next three numbers of the DN.
FROMDIGS	numeric, 4 digits	Beginning number of a range of the last four digits of DNs.
-continued-		

Table 2-4
Fields and values for Table DNGRPS (continued)

TODIGS	numeric, 4 digits	Ending number of a range of the last four digits of DNs.
NETOPTS	NETNAME, OPTION, NAME, ADDRESS, NONUNIQUE	Network options. Consists of subfields OPTION and NETNAME. Use OPTION to assign a calling party's NAME and ADDRESS.

Datafill sequence
The NETNAME must be datafilled in Table NETNAMES before it can be assigned in the NETOPTS field of Table DNGRPS.

Sample datafill
```
snpa      ofc   fromdigs    todigs      netopts
 214      301     2000       5000       BNR   NAME   RICH   $
```

Table TCAPTRID
Table TCAPTRID assigns the number of transaction capability application part identifiers required by NRAG. To calculate the number of IDs required, multiply the number of incoming calls receiving busy tone by the percentage of these calls attempting NRAG. Then, multiply the result by 2.

For example:

```
    240   calls receiving busy tone
X    10%  requesting NRAG
     24
X     2
     48   TCAPTRIDs required
```

Table 2-5
Fields and values for Table TCAPTRID

Field	Range of Values	Description
TCAPAPPL	ACBAR, DNVAL, NACD, NMS, NRAG, PVN, NIL, CMS, NSSTCN, MAP, MAX	Type of TCAP application. Enter NRAG.
NUMTRIDS	0-32767	Number of transaction IDs.

Datafill sequence

There is no change to the datafill sequence.

Sample datafill

```
tcapappl              numtrids

NRAG                    20
PVN                     10
ACBAR                   35
DNVAL                   12
NMS                     10
```

> ⚠ **CAUTION**
> **Cold restart required**
> Changes or additions to Table TCAPTRID do not take effect until after a cold restart.

Sample MSL-100 datafill for NRAG on PRI

Refer to the following figure and examples for the datafill necessary for implementing NRAG on PRI. The datafill examples refer to the sample network shown in the figure.

Figure 2-1
MSL-100 NRAG on example PRI network

User A is in CUSTGRPA on switch A, while User B is in CUSTGRPB on switch B. Assume user A calls user B by dialing 6-456-5678. The digit 6 is stripped off during translation and the prefix 111 is added.

Before datafilling the switches, keep the following factors in mind:

- For simplicity, datafill Table MSGRTE with the private DNs in the origination and destination elements of the FAC message.

- Datafill Table MSGRTE so that the digits leaving the originating station will be the ESN DN of the called party (user B).

- If the FAC message is routed through an intermediate switch (such as switch C above) only the ESN codes of the originating and terminating stations are needed in that switch's datafill, not the public DNs.

Switch A datafill

The following tables show the datafill necessary to enable NRAG on switch
A in the example shown in figure 2-1.

```
Table NETNAMES
```

netname	extnetid	netdigs	netopts
NETABC	63	0	$

```
Table CUSTNTWK
```

custname	netname	netcgid	dnrevxla	options
CUSTABC	NETABC	121	$	NTWKRAG

```
Table MSGRTE
```

msgrtkey	msgrtres
NETABC 111456 111456	PRA PRAATOB 3 N $
(outpulsed digits)	PRA PRAATOC 3 N $
NETABC 123 123	LOCAL 3 214555
(incoming digits)	
NETABC 456 456	PRA PRAATOB 0 N $
(reply digits DNGRPS)	PRA PRAATOC 0 N $
NETABC 555 555	PRA PRAATOB 3 456 $
(reply digits norm.)	PRA PRAATOC 3 456 $

The reply digits tuple (NETABC 456 456) is necessary if Table DNGRPS
on the terminating switch (B) contains a tuple for a range of DNs that
contains user B's DN with an ADDRESS option for network NETBAC as
follows:

```
Table DNGRPS (on switch B)
```

snpa	ofc	fromdigs	todigs	netopts
703	555	0000	9999	NETBAC (ADDRESS 000 456 NNNN) $

Switch B datafill
The following tables show the datafill necessary to enable NRAG on switch
B in the example shown in Figure 2-1.

```
Table NETNAMES


netname      extnetid      netdigs      netopts
NETBAC          63            0            $



Table CUSTNTWK


custname    netname    netcgid    dnrevxla    options
CUSTBAC     NETBAC       121         $        NTWKRAG



Table MSGRTE


msgrtkey                  msgrtres
NETBAC 111123   111123   PRA PRABTOA 3 N $
(outpulsed digits)       PRA PRABTOC 3 N $


NETBAC 123   123         PRA PRABTOA 0 N $
(reply digits DNGRPS)    PRA PRABTOC 0 N $


NETBAC 456   456         LOCAL 3 703555
(incoming digits)


NETBAC 555   555         PRA PRABTOA 3 456 $
```

The reply digits tuple (NETABC 123 123) is necessary if Table DNGRPS
on the terminating switch (A) contains a tuple for a range of DNs that
contains User A's DN with an ADDRESS option for network NETABC as
follows:

```
Table DNGRPS (on switch A)


snpa    ofc    fromdigs    todigs    netopts
214     555      0000       9999      NETABC (ADDRESS 000
                                      123 NNNN) $
```

Switch C datafill
The following tables show the datafill necessary to enable NRAG on switch
C in the example shown in Figure 2-1.

```
Table NETNAMES


netnames        extnetid      netdigs       netopts
NETCAB             63            0              $



Table MSGRTE


msgrtkey                      msgrtres
NETCAB 123   123               PRA PRACTOA 0 N $
(incoming digits)


NETCAB 456   456               PRA PRACTOB 0 N $
(incoming digits)
```

Sample MSL-100 datafill for NRAG on SS7
In addition to Table MSGRTE, described in the preceding section, Tables
C7LOCSSN and C7NETSSN must be filled to ensure correct routing of
NRAG messages over SS7 links. Each switch must have the same
subsystem name, with a unique subsystem number.

Refer to the following figure and examples for the datafill necessary for
implementing NRAG on SS7. The datafill examples refer to the sample
network shown in the figure.

Figure 2-2
MSL-100 NRAG on example SS7 network
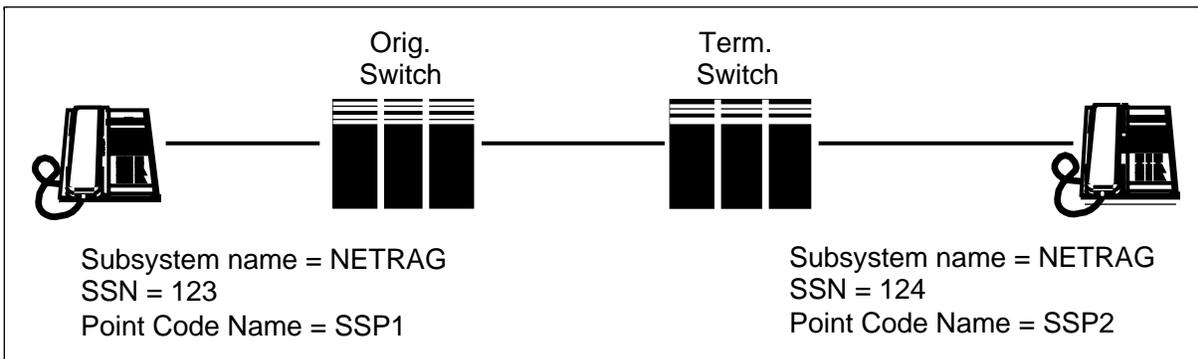
Subsystem name = NETRAG
SSN = 123
Point Code Name = SSP1

Subsystem name = NETRAG
SSN = 124
Point Code Name = SSP2

Datafill at originating switch

```
Table C7LOCSSN                          Table C7NETSSN


NETRAG   123   1 N N $                   SSP2   NETRAG   124
```

Datafill at terminating switch

```
Table C7LOCSSN                          Table C7NETSSN


NETRAG   124   1 N N $                   SSP1   NETRAG   123
```

Feature interactions

The following section describes the interactions between NRAG and the called party's features.

Table 2-6
Feature interaction summary for NRAG on MSL-100

Feature	Limitations/Interactions
Call Forwarding	No interaction if called party has CFU, CFI, or CFD. NRAG request will be forwarded if called party has CFB. NRAG on SS7 cannot be requested if forwarded to station is busy.
	NRAG recalls are not forwarded if originator has CFU, CFI, or CFD.
Call Pickup	No interaction with called party's Call Pickup function. NRAG recalls cannot be picked up by originator.
Call Waiting/Attendant Camp-On	NRAG can be requested if called party has call/calls waiting. Any calls waiting take precedence over NRAG recalls. Same limitation for Attendant Camp-On.
Three-way/ Conference Calling	• Originator can activate NRAG against a station involved in Three Way/Conference Call.
	• Originator cannot activate NRAG while on second leg of Three Way call.
	• 500/2500 set cannot deactivate NRAG while on second leg of Three Way call.
	• EBS user can deactivate NRAG at any time except during recall.
-continued-	

Table 2-6
Feature interaction summary for NRAG on MSL-100 (continued)

Make Set Busy/ Do Not Disturb	• Originator can receive NRAG recalls even if MSB/DND is activated. • Originator receives reject message if called party has MSB/DND activated.
Hunt Groups	Originator can activate NRAG request against any station in a DNH, MLH, or DLH group. The request applies to any member in the logical group. When any member becomes free, originator is recalled.
Uniform Call Distribution	NRAG cannot be activated against any UCD directory number of a UCD group. NRAG can be activated against the individual station's DN.
Automatic Call Distribution	NRAG cannot be activated against any ACD directory number in an ACD group.
Multiple Appearance Directory Number	NRAG is assigned on a per line basis. Only one NRAG request allowed per MADN member.
Call Back Queuing	CBQ and NRAG/RAG are activated by same method, depending on type of set. DMS determines which feature to use. • If destination is a line and originator receives busy treatment, DMS uses nodal RAG. • If destination is an ISUP trunk and originator receives busy treatment, DMS uses NRAG. • If destination is trunk and user receives GNCT, DMS uses CBQ. Only one NRAG/RAG or or CBQ request may be pending at one time.
Attendant Console	NRAG cannot be activated against an attendant console. NRAG can be activated against a busy station talking to an attendant console.

Interaction with call types

NRAG supports the PRIVATE call type only. A MSL-100 using the MCDN Integrated Services Access (ISA) application, however, can also specify a TIE call type.

Operational measurements

NRAG on PRI provides operational measurements of the message traffic generated on PRI D-channels. These OMs are part of the primary rate access facility (PRAFAC) group and include origination, termination, and tandem

messages. The OM register increases each time an event occurs. The following table shows the individual registers in the PRAFAC group:

Table 2-7
MSL-100 OM registers for PRAFAC

Register	Description
FACMSGOR	The number of facility messages originated at a switch.
FACMSGTM	The number of facility messages terminated at a switch.
FACMSGTR	The number of facility messages transmitted by a switch.
DISNORTX	The number of facility messages discarded because no route list was found in Table MSGRTE.
DISCNGST	The number of facility messages discarded due to congestion at the switch.
DISRTUNA	The number of facility messages discarded because no outgoing route was available (D-channel not in service).
REJCNGST	The number of facility reject messages rejected due to application or network congestion at the switch
REJMSGOR	The number of facility reject messages originated at a switch.
REJMSGTM	The number of facility reject messages terminated at a switch.
REJMSGTR	The number of facility reject messages transmitted by a switch.
REJMSGDS	The number of facility reject messages discarded by a switch.
REJNORTX	The number of facility reject messages rejected by a switch because no routing translation exists for the destination.
REJRTUNA	The number of facility reject messages discarded because no outgoing route was available.

Logs

There are no special log considerations for NRAG on the MSL-100.

Service orders

The NRAG option on the MSL-100 is datafilled on a per-line basis using the customer group RAG option assigned to the set.

Testing

There are no special testing considerations for NRAG on the MSL-100.

Billing

There are no special billing considerations for NRAG on the MSL-100.

Chapter 3
DMS-100 perspective

MCDN Network Ring Again (NRAG) extends the capabilities of local, or nodal ring again to members of the same customer group residing on different Northern Telecom switches in the network.

Signaling information from an MSL-1 or an MSL-100 (as a CENTREX) is routed through a DMS-100 using either PRI or SS7 or a combination of both. The routes are specified in the datafill. See*Datafill and translations* in this chapter.

Description

When user A initiates an NRAG request, the originating switch asks the terminating switch to scan user B's set. When user B's set goes on hook, the terminating switch notifies the originating switch, which in turn notifies user A.

NRAG is controlled by timers on both the originating and terminating PBXs. For particulars about how an NRAG sequence proceeds and what causes incomplete sequences see *MSL-1 perspective* in this document.

How NRAG sends signaling information

NRAG messages can be sent over SS7 links or the primary rate interface (PRI).

NRAG on SS7 uses the transaction capabilities application part (TCAP) for signaling. The TCAP message is then included in the signaling connection control part (SCCP) for transmission over SS7 links.

NRAG on PRI also uses TCAP messages, which are included with the PRI facility message (FAC). The facility message contains the network ID of the destination switch, along with the DN of the called number.

When received at the destination switch, the TCAP information is stripped from the FAC message. Further processing and scanning of the busy line is performed by the destination switch, as in nodal RAG.

Connectivity

The DMS-100 provides NRAG connectivity to the following Northern Telecom switches:

- DMS-100 to MSL-1

- DMS-100 to MSL-100

- DMS-100 to DMS-100

- DMS-100 through DMS-250.

Hardware requirements

NRAG requires the PRI or SS7 base packages.

Software requirements

NRAG requires BCS 30 or later and software package NTXA36AA01; for PRI: NTX791AA02.

Installation rules

There are no special installation rules for NRAG on the DMS-100.

Maintenance

There are no special maintenance rules for NRAG on the DMS-100.

Datafill and translations

NRAG can transmit signaling information to other switches using either SS7, PRI, or a combination of both (interworking). Proper datafill is imperative at each switch on the network or an NRAG request or recall will be blocked.

The following sections give the NRAG-related datafill using SS7, PRI, or interworking.

DMS-100 NRAG-related tables

The important tables for NRAG on PRI are Tables NETNAMES, CUSTNTWRK, MSGRTE, DNGRPS, and TCAPTRID.

Table NETNAMES

Table NETNAMES provides a unique name and numerical ID for each switch on the private network. It also provides a field for specifying interworking of NRAG messages between PRI and SS7.

Table 3-1
Fields and values for Table NETNAMES

Field	Range of Values	Description
NETNAME	alphanumeric, 1-32 characters	The private network name. This name must be consistent on all switches or NRAG will not work.
EXTNETID	1-32767	The external network identifier. Each switch must have a unique number.
NETDIGS	0-10	A value representing the number of digits used by the logical network; used to extract the correct number of digits from the stored DN.
-continued-		

Table 3-1
Fields and values for Table NETNAMES (continued)

NETOPTS	$, NINTNRAG, NMRTNRAG, FACREJ, NMDSP, SUPPRESS	Network options. Enter $ to allow interworking of NRAG messages between PRI & SS7. Choose NINTNRAG to send signaling messages to the NRAG subsystem instead of the INTERWRK subsystem. Choose NMRTNRAG to prevent Table MSGRTE from routing NRAG on SS7 messages. A tuple will be rejected if NINTNRAG is chosen without selecting NMRTNRAG also.
		FACREJ determines whether the facility reject message is sent to the originator when the PRI facility message cannot be routed to the destination.
		NMDSP and SUPPRESS are not used by NRAG.

Datafill sequence

There is no change to the datafill sequence.

Sample datafill

```
netname          extnetid    netdigs    netopts         netopts

NETWORK1           125          7       (NINTNRAG)     (NMRTNRAG)
```

Table CUSTNTWK

Table CUSTNTWK associates a customer name with the NETNAME defined in Table NETNAMES, assigns a global customer group identifier, and provides a field for selecting the NRAG option.

Table 3-2
Fields and values for Table CUSTNTWK

Field	Range of Values	Description
CUSTNAME	alphanumeric, 1-16 characters	The customer group name.
NETNAME	alphanumeric, 1-32 characters	Must be the same as the NETNAME datafilled in Table NETNAMES.
NETCGID	1-4096	Network customer group identifier.
DNREVXLA	$	DN reverse translators. Enter $
OPTIONS	NTWKRAG	Enter NTWKRAG to enable NRAG. No other options currently available.

Datafill sequence
The NETNAME must be datafilled in Table NETNAMES before it can be assigned in Table CUSTNTWK.

Sample datafill

```
custname      netname      netcgid    dnrvxla    options
NTELCOM       NETWORK1       39          $         NTWKRAG
```

Table MSGRTE
Table MSGRTE provides the routing information for the FAC message used to transmit NRAG signaling messages. This table also provides a selector to specify PRI or SS7 routing for the signaling messages.

Table 3-3
Fields and values for Table MSGRTE

Field	Range of Values	Description
NETID	Alphanumeric, 1-32 characters	Network identifier. Enter the same value specified in the NETNAMES field of Table NETNAMES.
FROMDIGS	numeric	For NRAG, this is the outpulsed digits of the calling party. For other applications, FRODIGS specifies the first number of a range of digits.
TODIGS	numeric	For NRAG, enter the same value as in FROMDIGS. For other applications, TODIGS specifies the last number of a range of digits.
MSGRTSEL	LOCAL, PRA, SS7	Message route selector. Enter PRA or SS7 if message is to be routed over a specific D-channel or SS7 route set. Enter LOCAL if message is to be terminated at this switch.
(LOCAL subfield) DELDIGS	numeric	Number of digits to be deleted.
(LOCAL subfield) PREDIGS	numeric	The digit string to be prefixed to the destination address.
(PRA subfield) TRKCLLI	alphanumeric, 16 characters	Trunk CLLI
(PRA subfield) DELDIGS	numeric	Number of digits to be deleted from destination address.
-continued-		

Table 3-3
Fields and values for Table MSGRTE (continued)

(PRA subfield) PREDIGS	numeric	The digit string to be prefixed to the destination address.
(PRA subfield) OPTIONS	alphanumeric	Enter NEWNET
(SS7 Subfield) DPC	alphanumeric	Destination point code. Enter the CLLI name.
(SS7 subfield) DELDIGS	0-10	Number of digits to be deleted from destination address.
(SS7 subfield) PREDIGS	numeric	The digit string to be prefixed to the destination address.
(SS7 subfield) OPTIONS	alphanumeric	Enter NEWNET

Datafill sequence

The NETNAME must be datafilled in Table NETNAMES before the NETID field can be assigned in Table MSGRTE.

Sample datafill

```
netid      fromdigs    todigs    msgrtsel

NETWORK1    515         815       SS7    DALLASPC 0 N $
```

Table DNGRPS

Table DNGRPS is necessary if the terminating switch contains a tuple for an ADDRESS option for a called party's NETNAME.

Table 3-4
Fields and values for Table DNGRPS

Field	Range of Values	Description
SNPA	numeric, 3 digits	Serving numbering plan area. The first three numbers of the DN.
OFC	numeric, 3 digits	Office code. The next three numbers of the DN.
FROMDIGS	numeric, 4 digits	Beginning number of a range of the last four digits of DNs.
-continued-		

Table 3-4
Fields and values for Table DNGRPS (continued)

TODIGS	numeric, 4 digits	Ending number of a range of the last four digits of DNs.
NETOPTS	NETNAME, OPTION, NAME, ADDRESS, NONUNIQUE	Network options. Consists of subfields OPTION and NETNAME. Use OPTION to assign a calling party's NAME and ADDRESS.

Datafill sequence

The NETNAME must be datafilled in Table NETNAMES before it can be assigned in the NETOPTS field of Table DNGRPS.

Sample datafill

```
snpa      ofc    fromdigs    todigs      netopts
 214      301     2000        5000        BNR   NAME   RICH   $
```

Table TCAPTRID

Table TCAPTRID assigns the number of transaction capability application part identifiers required by NRAG. To calculate the number of IDs required, multiply the number of incoming calls receiving busy tone by the percentage of these calls attempting NRAG. Then, multiply the result by 2.

For example:

```
    240   calls receiving busy tone
X   10%  requesting NRAG
     24
X      2
     48   TCAPTRIDs required
```

Table 3-5
Fields and values for Table TCAPTRID

Field	Range of Values	Description
TCAPAPPL	ACBAR, DNVAL, NACD, NMS, NRAG, PVN, NIL, CMS, NSSTCN, MAP, MAX	Type of TCAP application. Enter NRAG.
NUMTRIDS	0-32767	Number of transaction IDs.

Datafill sequence
There is no change to the datafill sequence.

Sample datafill

tcapappl	numtrids
NRAG	20
PVN	10
ACBAR	35
DNVAL	12
NMS	10

⚠️ **CAUTION**

Cold restart required
Changes or additions to Table TCAPTRID do not take
effect until after a cold restart.

Sample DMS-100 datafill for NRAG on PRI
Refer to the following figure and examples for the datafill necessary for
implementing NRAG on PRI. The datafill examples refer to the sample
network shown in the figure.

Figure 3-1
DMS-100 NRAG on example PRI network

User A is in CUSTGRPA on switch A, while User B is in CUSTGRPB on switch B. Assume user A calls user B by dialing 6-456-5678. The digit 6 is stripped off during translation and the prefix 111 is added.

Before datafilling the switches, keep the following factors in mind:

- For simplicity, datafill Table MSGRTE with the private DNs in the origination and destination elements of the FAC message.

- Datafill Table MSGRTE so that the digits leaving the originating station will be the ESN DN of the called party (user B).

- If the FAC message is routed through an intermediate switch (such as switch C above) only the ESN codes of the originating and terminating stations are needed in that switch's datafill, not the public DNs.

Switch A datafill

The following tables show the datafill necessary to enable NRAG on switch A in the example shown in figure 3-1.

```
Table NETNAMES
```

netname	extnetid	netdigs	netopts
NETABC	63	0	$

```
Table CUSTNTWK
```

custname	netname	netcgid	dnrevxla	options
CUSTABC	NETABC	121	$	NTWKRAG

```
Table MSGRTE
```

msgrtkey	msgrtres
NETABC 111456 111456	PRA PRAATOB 3 N $
(outpulsed digits)	PRA PRAATOC 3 N $
NETABC 123 123	LOCAL 3 214555
(incoming digits)	
NETABC 456 456	PRA PRAATOB 0 N $
(reply digits DNGRPS)	PRA PRAATOC 0 N $
NETABC 555 555	PRA PRAATOB 3 456 $
(reply digits norm.)	PRA PRAATOC 3 456 $

The reply digits tuple (NETABC 456 456) is necessary if Table DNGRPS on the terminating switch (B) contains a tuple for a range of DNs that contains user B's DN with an ADDRESS option for network NETBAC as follows:

```
Table DNGRPS (on switch B)
```

snpa	ofc	fromdigs	todigs	netopts
703	555	0000	9999	NETBAC (ADDRESS 000 456 NNNN) $

Switch B datafill
The following tables show the datafill necessary to enable NRAG on switch B in the example shown in Figure 3-1.

```
Table NETNAMES


netname     extnetid    netdigs     netopts
NETBAC        63           0            $



Table CUSTNTWK


custname    netname    netcgid    dnrevxla    options
CUSTBAC     NETBAC       121         $         NTWKRAG



Table MSGRTE


msgrtkey                    msgrtres
NETBAC 111123    111123    PRA PRABTOA 3 N $
(outpulsed digits)         PRA PRABTOC 3 N $


NETBAC 123    123          PRA PRABTOA 0 N $
(reply digits DNGRPS)      PRA PRABTOC 0 N $


NETBAC 456    456          LOCAL 3 703555
(incoming digits)


NETBAC 555    555          PRA PRABTOA 3 456 $
```

The reply digits tuple (NETABC 123 123) is necessary if Table DNGRPS on the terminating switch (A) contains a tuple for a range of DNs that contains User A's DN with an ADDRESS option for network NETABC as follows:

```
Table DNGRPS (on switch A)


snpa    ofc    fromdigs    todigs    netopts
214     555      0000       9999      NETABC (ADDRESS 000
                                      123 NNNN) $
```

Switch C datafill
The following tables show the datafill necessary to enable NRAG on switch C in the example shown in Figure 3-1.

```
Table NETNAMES

netnames       extnetid      netdigs       netopts
NETCAB            63            0             $
```

```
Table MSGRTE

msgrtkey                    msgrtres
NETCAB 123   123             PRA PRACTOA 0 N $
(incoming digits)


NETCAB 456   456             PRA PRACTOB 0 N $
(incoming digits)
```

Sample DMS-100 datafill for NRAG on SS7
In addition to Table MSGRTE, described in the preceding section, Tables C7LOCSSN and C7NETSSN must be filled to ensure correct routing of NRAG messages over SS7 links. Each switch must have the same subsystem name, with a unique subsystem number.

Refer to the following figure and examples for the datafill necessary for implementing NRAG on SS7. The datafill examples refer to the sample network shown in the figure.

Figure 3-2
DMS-100 NRAG on example SS7 network
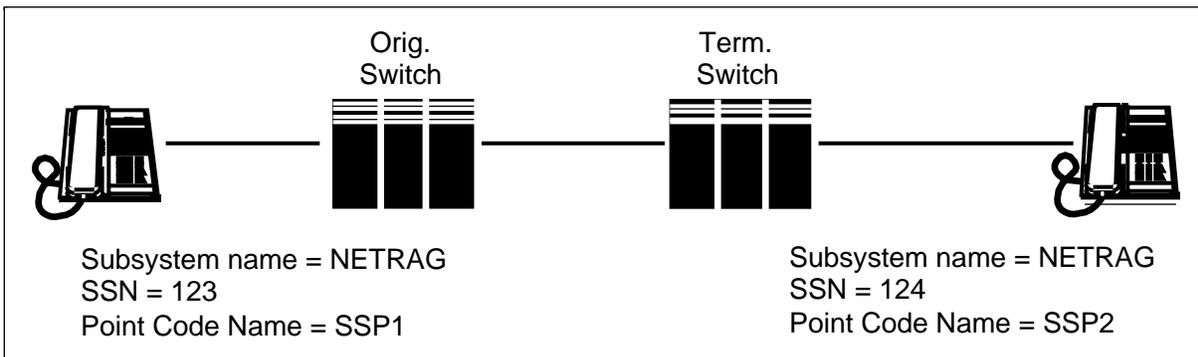
Subsystem name = NETRAG
SSN = 123
Point Code Name = SSP1

Subsystem name = NETRAG
SSN = 124
Point Code Name = SSP2

Datafill at originating switch

```
Table C7LOCSSN                         Table C7NETSSN


NETRAG   123   1 N N $                  SSP2   NETRAG   124
```

Datafill at terminating switch

```
Table C7LOCSSN                         Table C7NETSSN


NETRAG   124   1 N N $                  SSP1   NETRAG   123
```

Feature interactions

The following section describes the interactions between NRAG and the called party's features.

Table 3-6
Feature interaction summary for NRAG on DMS-100

Feature	Limitations/Interactions
Call Forwarding	No interaction if called party has CFU, CFI, or CFD. NRAG request will be forwarded if called party has CFB. NRAG on SS7 cannot be requested if forwarded to station is busy. NRAG recalls are not forwarded if originator has CFU, CFI, or CFD.
Call Pickup	No interaction with called party's Call Pickup function. NRAG recalls cannot be picked up by originator.
Call Waiting/Attendant Camp-On	NRAG can be requested if called party has call/calls waiting. Any calls waiting take precedence over NRAG recalls. Same limitation for Attendant Camp-On.
Three-way/ Conference Calling	• Originator can activate NRAG against a station involved in Three-way/Conference Call. • Originator cannot activate NRAG while on second leg of Three-way call. • 500/2500 set cannot deactivate NRAG while on second leg of Three-way call. • EBS user can deactivate NRAG at any time except during recall.
-continued-	

Table 3-6
Feature interaction summary for NRAG on DMS-100 (continued)

Make Set Busy/ Do Not Disturb	• Originator can receive NRAG recalls even if MSB/DND is activated. • Originator receives reject message if called party has MSB/DND activated.
Hunt Groups	Originator can activate NRAG request against any station in a DNH, MLH, or DLH group. The request applies to any member in the logical group. When any member becomes free, originator is recalled.
Uniform Call Distribution	NRAG cannot be activated against any UCD directory number of a UCD group. NRAG can be activated against the individual station's DN.
Automatic Call Distribution	NRAG cannot be activated against any ACD directory number in an ACD group.
Multiple Appearance Directory Number	NRAG is assigned on a per line basis. Only one NRAG request allowed per MADN member.
Call Back Queuing	CBQ and NRAG/RAG are activated by same method, depending on type of set. DMS determines which feature to use. • If destination is a line and originator receives busy treatment, DMS uses nodal RAG. • If destination is an ISUP trunk and originator receives busy treatment, DMS uses NRAG. • If destination is trunk and user receives GNCT, DMS uses CBQ. Only one NRAG/RAG or or CBQ request may be pending at one time.
Attendant Console	NRAG cannot be activated against an attendant console. NRAG can be activated against a busy station talking to an attendant console.

Interaction with call types

NRAG supports the PRIVATE call type only. A DMS-100 using the MCDN Integrated Services Access (ISA) application, however, can also specify a TIE call type.

Operational measurements

NRAG on PRI provides operational measurements of the message traffic generated on PRI D-channels. These OMs are part of the primary rate access facility (PRAFAC) group and include origination, termination, and tandem

messages. The OM register increases each time an event occurs. The following table shows the individual registers in the PRAFAC group:

Table 3-7
DMS-100 OM registers for PRAFAC

Register	Description
FACMSGOR	The number of facility messages originated at a switch.
FACMSGTM	The number of facility messages terminated at a switch.
FACMSGTR	The number of facility messages transmitted by a switch.
DISNORTX	The number of facility messages discarded because no route list was found in Table MSGRTE.
DISCNGST	The number of facility messages discarded due to congestion at the switch.
DISRTUNA	The number of facility messages discarded because no outgoing route was available (D-channel not in service).
REJCNGST	The number of facility reject messages rejected due to application or network congestion at the switch
REJMSGOR	The number of facility reject messages originated at a switch.
REJMSGTM	The number of facility reject messages terminated at a switch.
REJMSGTR	The number of facility reject messages transmitted by a switch.
REJMSGDS	The number of facility reject messages discarded by a switch.
REJNORTX	The number of facility reject messages rejected by a switch because no routing translation exists for the destination.
REJRTUNA	The number of facility reject messages discarded because no outgoing route was available.

Logs

There are no special log considerations for NRAG on the DMS-100.

Service orders

The NRAG option on the DMS-100 is datafilled on a per-line basis using the customer group RAG option assigned to the set.

Testing

There are no special testing considerations for NRAG on the DMS-100.

Billing

There are no special billing considerations for NRAG on the DMS-100.

Chapter 4
DMS-250 perspective

MCDN Network Ring Again (NRAG) extends the capabilities of local, or
nodal ring again (RAG) to members of the same customer group residing on
different Northern Telecom switches in a network.

For example, callers receiving a busy signal can request the PBX to notify
their station when the called party goes on hook. The originator can then
either accept or reject the call. If accepted, the original call is set up
automatically. Because NRAG uses connectionless signaling, network
resources are not used while an originator is waiting for the recall message.

Description

NRAG on the DMS-250 is a transport feature. There are no feature-specific
options or parameters to datafill. However, to ensure that the DMS-250
accepts and re-transmits NRAG signaling messages, some routing tables
contain new fields or values. Correct datafill on all nodes of an NRAG call
is essential or the call will be blocked. Refer to *Datafill and translations* for
specific information.

Interworking and tandeming

The NRAG signaling information can be transmitted across the network by
either Signaling System #7 (SS7) or the Primary Rate Interface (PRI). To
communicate with central offices or PBXs using either type of signaling, the
DMS-250 supports *interworking* and *tandeming*.

Interworking gives the DMS-250 the capability to exchange either SS7 or
PRI signaling between any two nodes of an NRAG call. Tandeming gives
the DMS-250 the capability to transport NRAG signaling between two or
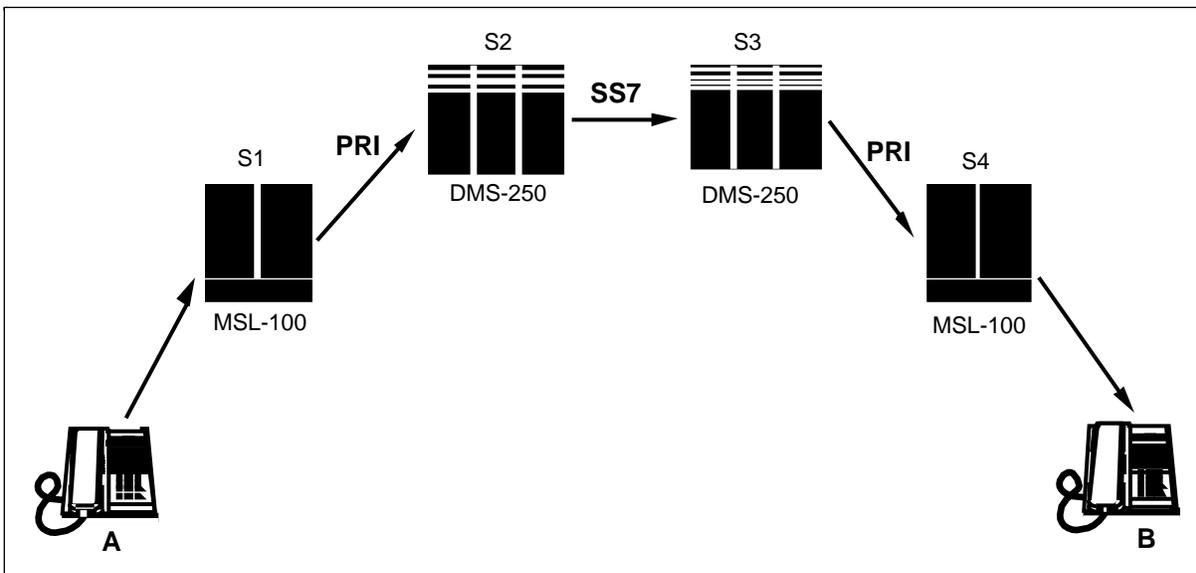more successive DMS-250s to complete the call.

The following are valid combinations between any two DMS-250s transporting NRAG signaling information:

- PRI to PRI
- PRI to SS7
- SS7 to PRI
- SS7 to SS7.

Figure 4-1 shows NRAG interworking between SS7 and PRI.

Figure 4-1
DMS-250 NRAG interworking

User A initiates the NRAG request. S1 then sends a Q.932 Facility message (FAC) to S2 over the PRI D-channel. This message contains the NETID, the Origination and Termination information elements, and TCAP information.

S2 uses Table MSGRTE to route the call, based on the NETID and the Termination information element of the FAC message. These two elements determine whether the FAC message is routed over the PRI D-channel or translated to an SCCP message for transmission over an SS7 signaling link.

For SS7 signaling, as shown in Figure 4-2, Table MSGRTE instructs the PRI facility to send a Destination Point Code (DPC) to the Signaling Connection Control Part (SCCP). The SCCP performs a Global Title Translation (GTT) and routes the FAC message to S3.
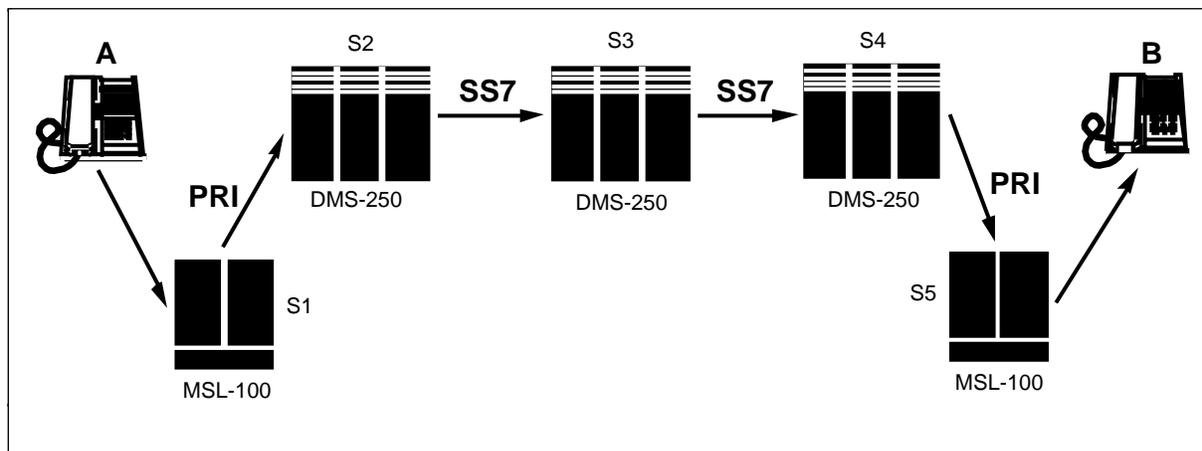
S3 receives the NRAG message over SS7. It must be re-translated for transmission over PRI to S4. The DMS-250 Message Route Subsystem uses

the NETID and Called Party Address from the SCCP to access Table MSGRTE. This table indicates which PRI D-channel to use. The Message Route Subsystem then adds the TCAP data to the FAC message and sends it to S4 for processing.

Refer to *Datafill and translations* for an example of the datafill required for interworking.

Figure 4-2 shows NRAG tandeming of SS7 messages. The principle is the same for PRI tandeming.

Figure 4-2
DMS-250 NRAG SS7 tandeming

User A initiates the NRAG request. S1 sends a Q.932 FAC message to S2 containing the NETID and Terminating information element. The PRI facility in the DMS-250 uses this information to index Table MSGRTE and send an SCCP message to S3 over an SS7 signaling link.

The Message Subsystem of S3 uses the NETID and dialed digits in the SCCP to determine routing over an SS7 link.

S4 receives the NRAG message over SS7. It must be re-translated for transmission over PRI to S5. The DMS-250 Message Route Subsystem uses the NETID and Called Party Address from the SCCP to access Table MSGRTE. This table indicates which PRI D-channel to use. The Message Route Subsystem then adds the TCAP data to the FAC message and sends it to S5 for processing.

Refer to *Datafill and translations* for an example of the datafill required for tandeming.

Connectivity

The DMS-250 provides NRAG transport capability to the following Northern Telecom switches:

- MSL-1
- MSL-100
- DMS-100

Software requirements

Transport of PRI or SS7 NRAG messages requires BCS30 or laterand software package NTXG11AA01 (NTX791AA02 for PRI).

Hardware requirements

Since NRAG is a transport feature, there are no special hardware requirements. Transport of PRI NRAG messages requires the base packages for PRI andSS7.

Installation rules

There are no special installation rules for NRAG on the DMS-250.

Maintenance

There are no special maintenance rules for NRAG on the DMS-250.

Datafill and translations

There are three important tables for NRAG on the DMS-250. Table MSGRTE determines which route the NRAG connectionless message or facility message is sent over a PRI/SS7 signaling link. Table NETNAMES defines internal logical network names and associates them with an external global network identifier. Table C7LOCSSN provides a list of all subsystems present at an SS7 node.

Consistent datafill throughout the network is imperative. For example, NRAG tandeming of SS7 messages requires consistent datafill of Table NETNAMES in each switch in the network. Be sure any updates or changes to the datafill in one switch are made to all nodes.

Table MSGRTE

Table 4-1 shows the fields and values for Table MSGRTE.

Table 4-1
Fields and values for Table MSGRTE (DMS-250)

Field Name		Values	Description
NETID		Alphanumeric	Network Identifier
FROMDIG		XXXXXX, three or six digits	From digits. Originator of NRAG request. Three digits for ESN numbers, six digits for public numbers (NPA & NNX)
TODIG		XXXXXX, three or six digits	To digits. Terminator of NRAG request. Three digits for ESN numbers, six digits for public numbers (NPA & NNX)
MSGRTESEL		LOCAL, SS7, PRA	Type of route to be selected from route list
(LOCAL subfields) DELDIGS		0-10	Number of digits to delete
	PREDIGS	1-10, N	Number of prefix digits to add
(SS7 subfields)	DPC	Alphanumeric	Destination Point Code
	DELDIGS	0-10	Number of digits to delete
	PREDIGS	1-10, N	Number of prefix digits to add
	OPTIONS	NEWNET	Optional parameters. Only the NEWNET option is supported.
-continued-			

Table 4-1
Fields and values for Table MSGRTE (DMS-250) (continued)

	NETNAME	Alphanumeric	The new network name used to replace the network ID in the destination address message. Must already be datafilled in Table NETNAMES.
(PRA subfields)	TRKCLLI	Alphanumeric	Trunk CLLI
	DELDIGS	0-10	Number of digits to delete
	PREDIGS	1-10, N	Number of prefix digits to add
	OPTIONS	NEWNET	Optional parameters. Only the NEWNET option is supported.
	NETNAME	Alphanumeric; 32 characters	The new network name used to replace the network ID in the destination address message. Must already be datafilled in Table NETNAMES.

Sample of datafill for Table MSGRTE

```
netid      fromdigs      todigs      msgrtsel

BNRPVI    427          427         LOCAL 0 N $
BNRPVI    446          446         SS7 DPCTOC1 0 N $
PUBLIC    303998       303998      PRA DCHTOB2 0 N $
```

Table NETNAMES

Table 4-2 shows the fields and values for Table NETNAMES.

Table 4-2
Fields and values for Table NETNAMES (DMS-250)

Field	Values	Description
NETNAME	Alphanumeric, 32 characters	Logical network name
EXTNETID	0-32767	External Network ID. Used to identify logical networks.
NETDIGS	0-10	Network digits. Used to extract the correct number of digits from the DN.
NETOPTS	$	Enter ?

Sample of datafill for Table NETNAMES

```
netname      extnetid      netdigs      netopts
PUBLIC       0             0               $
BNRPVI       2             0               $
```

Table C7LOCSSN

Table 4-3 shows the fields and values for Table C7LOCSSN.

Table 4-3
Fields and values for Table C7LOCSSN

Fields	Values	Description
SSNAME	...INTERWRK...	Subsystem Name. Use INTERWRK for NRAG.
SSNUMBER	2-254	Subsystem number of this point code. Must be unique within Table C7LOCSSN.
MININST	1-32	Minimum number of instances a subsystem must be in service.
REPLINFO	Y, N	Replicate information
TFMI	Y, N	Traffic mix information
PCNAMES	Alphanumeric	A vector of up to 64 point code names to be informed of status changes at the local subsystem.

Sample of datafill for Table C7LOCSSN

```
ssname       ssnumber    mininst    replinfo    tfmi    pcnames
INTERWRK        5           5          N          N        $
```

Datafill sequence

There is no change to the datafill sequence.

Call flow and datafill for DMS-250 interworking

The following example shows the call flow and datafill necessary for each node of an NRAG call using DMS-250 interworking. Only the datafill relevant to NRAG is shown. However, all PRI and SS7 tables must be datafilled correctly. For more information on PRI and SS7 datafill on the DMS-250, refer to the appropriate NTPs. The important tables for the interworking nodes (S2 and S3), are MSGRTE, NETNAMES, and C7LOCSSN.

In the example, user A and user B can be called using either the PRIVATE number (NETID=BNRPVI) or the PUBLIC number (NETID=PUBLIC). Assume that user A initiates an NRAG request on user B.

Figure 4-3
DMS-250 interworking call flow
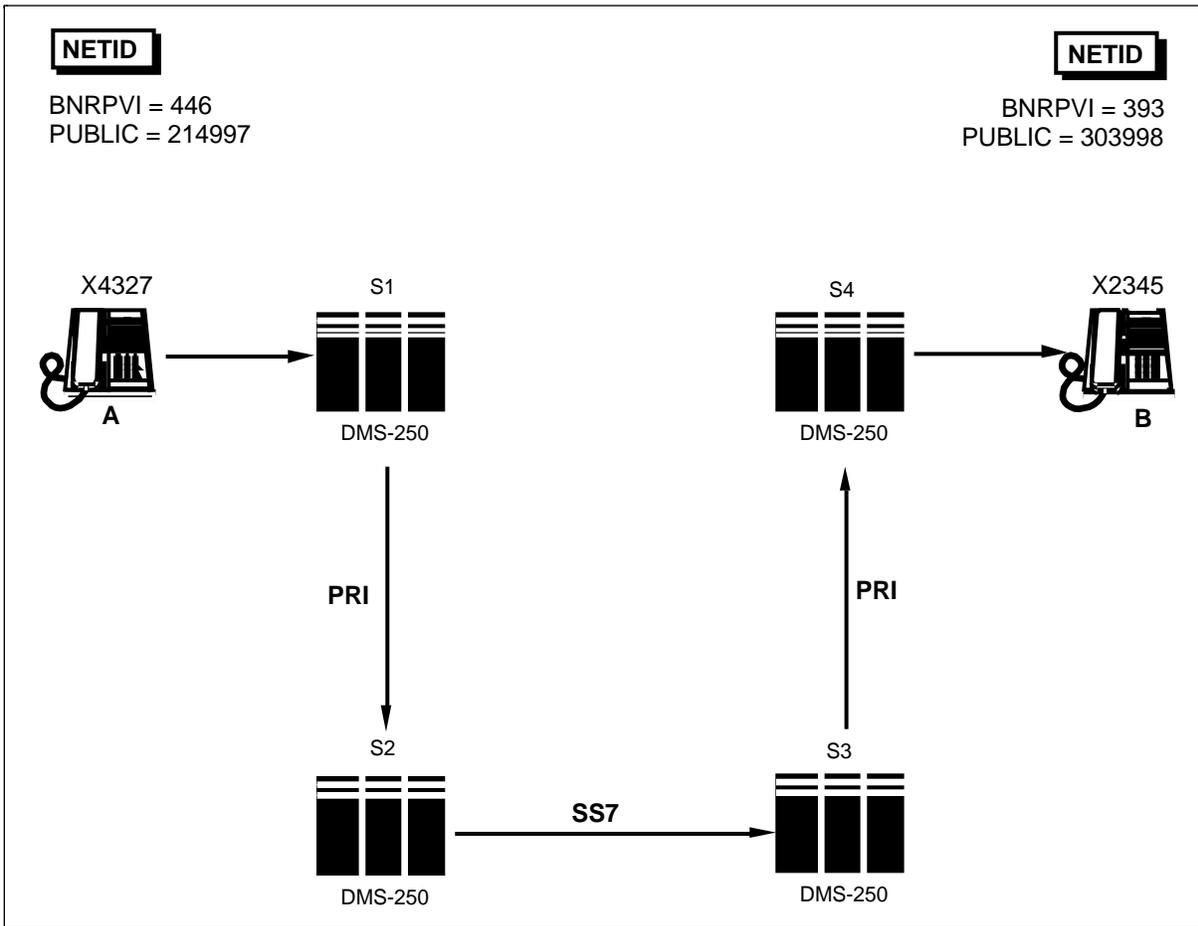
Call flow for DMS-250 interworking

Refer to figure 4-3 for the following explanation of interworking on the DMS-250. This example describes a user dialing a private number, although

the call flow is the same for a public number. Table MSGRTE translates the dialed digits to determine whether the dialed number is public or private.

Making an NRAG request

User A dials the private number for User B, 393-2345. Node S1 extracts the terminator's NETID and the dialed digits 393 from the FAC message. S1 then uses Table MSGRTE to route the call over the D-channel associated with the TRKCLLI, DCHTOB1.

The PRI facility of S2 uses the NETID and digits 393 in Table MSGRTE to determine that the message must be sent over an SS7 link. Table MSGRTE also provides the destination point code (DPC) for this tuple, DPCTOC.

The message route subsystem of S3 uses the NETID and digits 393 in Table MSGRTE to determine that the NRAG message must be sent over the D-channel, DCHTOC1.

Node S4 uses Table MSGRTE to determine that the NETID and digits 393 indicate a local call and completes the NRAG message to User B.

Receiving an NRAG response

Node S4 uses Table MSGRTE the NETID (BNRPVI), and the digits 446 to route the NRAG message over the PRI D-channel DCHTOC.

The PRI facility of S3 uses the NETID (BNRPVI) and digits 446 found in Table MSGRTE to route the NRAG message over an SS7 link with a DPC of DPCTOB.

The message route subsystem of Node 2 uses the NETID (BNRPVI) and digits 446 found in Table MSGRTE to route the NRAG message over the DCHTOA PRI D-channel.

Node 1 uses the NETID and digits 446 to determine that the call is local. The message is completed to User A.

Sample of datafill for DMS-250 interworking

Tables 4-4, 4-5, and 4-6 are an example of the datafill for Tables MSGRTE, NETNAMES, and C7LOCSSN for nodes S1, S2, S3 & S4. Note that the datafill for Tables NETNAMES and C7LOCSSN on nodes S2 & S3 must be the same.

Table 4-4
Table MSGRTE datafill for DMS-250 interworking

Node S1
BNRPVI   393   393   PRA   DCHTOB1 0 N +
PRA   DCHTOB2 3 303998 NEWNET PUBLIC
BNRPVI   446   446   LOCAL   0 N $
PUBLIC   303998   303998   PRA   DCHTOB2 0 N $
PUBLIC   214997   214997   LOCAL   0 N $

Node S2
BNRPVI   393   393   SS7   DPCTOC   0 N $
BNRPVI   446   446   PRA   DCHTOA   0 N $
PUBLIC   303998   303998   SS7   DPCTOC1   0 N $
PUBLIC   214997   214997   PRA   DCHTOA1   0 N $

Node S3
BNRPVI   446   446   SS7   DPCTOB   0 N $
BNRPVI   393   393   PRA   DCHTOD1   0 N $
PUBLIC   303998   303998   PRA   DCHTOD2   0 N $
PUBLIC   214997   214997   SS7   DPCTOB1   0 N $

Node S4
BNRPVI   393   393   LOCAL   0 N $
BNRPVI   446   446   PRA   DCHTOC 0 N +
PRA   DCHTOB1 3 214997 NEWNET PUBLIC
PUBLIC   303998   303998   LOCAL   0 N $
PUBLIC   214997   214997   PRA   DCHTOC1 0 N $

Table 4-5
Table NETNAMES datafill for DMS-250 interworking

Nodes S2 & S3
PUBLIC   0   0 $
BNRPVI   2   0 $

Table 4-6
Table C7LOCSSN datafill for DMS-250 interworking

| Nodes S2 & S3				
INTERWRK 5 5 N N $				

Call flow and datafill for DMS-250 tandeming

Figure 4-4 shows the call flow and datafill necessary for each node of an NRAG call using DMS-250 PRI tandeming. Only the datafill relevant to NRAG is shown. However, all PRI and SS7 tables must be datafilled correctly. For more information on PRI and SS7 datafill on the DMS-250, refer to the appropriate NTPs. The important table for the tandeming nodes is Table MSGRTE.

In the example, user A and user B can be called using either the PRIVATE number (NETID=BNRPVI) or the PUBLIC number (NETID=PUBLIC). Assume that user A initiates an NRAG request on user B.

Figure 4-4
DMS-250 tandeming call flow
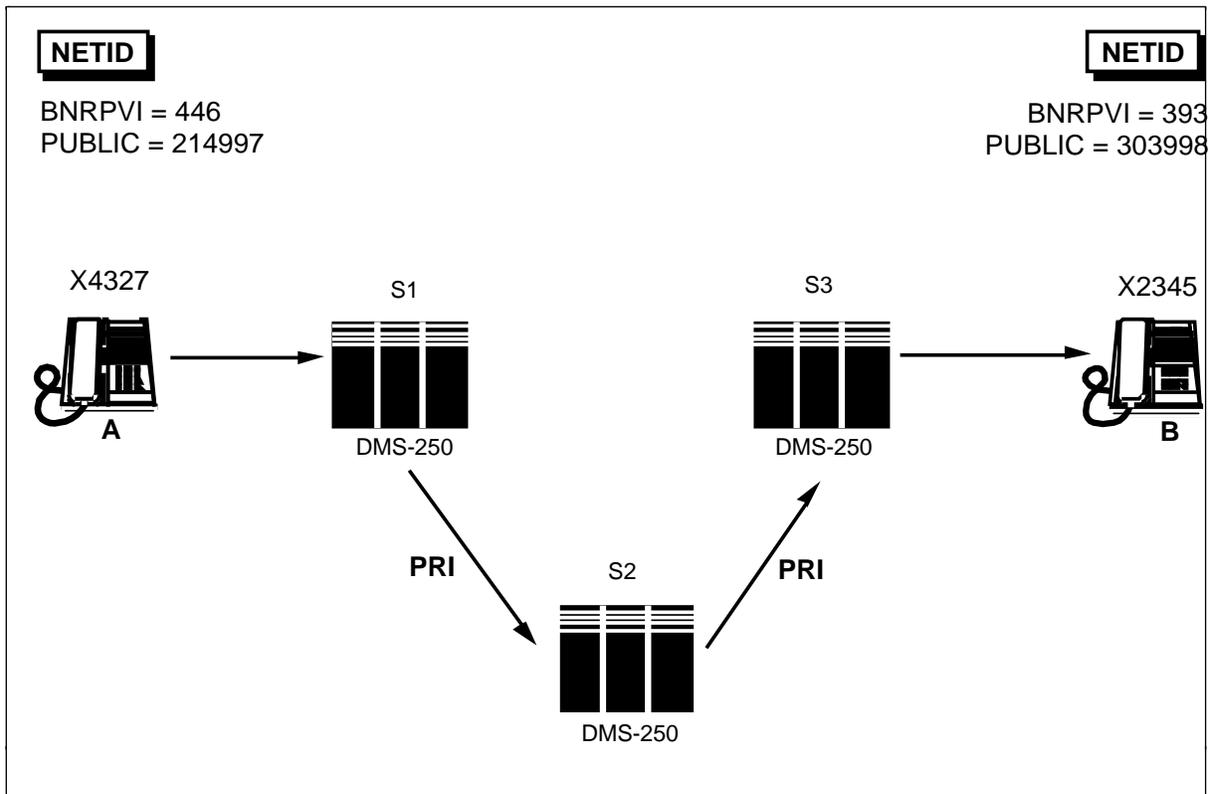
Call flow for DMS-250 tandeming

Refer to figure 4-4 for the explanation of tandeming on the DMS-250. This example describes a user dialing a private number, although the call flow is the same for a public number. Table MSGRTE translates the dialed digits to determine whether the dialed number is public or private.

Making an NRAG request

User A dials the private number for User B, 393-2345. Node S1 extracts the terminator's NETID and the dialed digits 393 from the FAC message. S1 then uses Table MSGRTE to route the call over the D-channel associated with the TRKCLLI, DCHTOB1.

The PRI facility of S2 uses the NETID and digits 393 in Table MSGRTE to determine that the message must be sent over the D-channel for this tuple, DCHTOC.

The PRI facility of S3 uses the NETID and digits 393 in Table MSGRTE to determine that the destination is local and completes the NRAG message to User B.

Receiving an NRAG response

Node S3 uses Table MSGRTE and the FAC message (containing the NETID=BNRPVI and the digits 446) to route the NRAG message over the PRI D-channel DCHTOB.

The PRI facility of S2 uses the NETID (BNRPVI) and digits 446 found in Table MSGRTE to route the NRAG message over the D-channel associated with the TRKCLLI, DCHTOA.

Node 1 uses the NETID and digits 446 to determine that the call is local. The message is completed to User A.

Sample of datafill for DMS-250 tandeming

Table 4-7 is an example of the datafill for Table MSGRTE for nodes S1, S2, and S3.

Table 4-7
Table MSGRTE datafill for DMS-250 tandeming

Node S1				
BNRPVI	393	393	PRA	DCHTOB1 0 N +
			PRA	DCHTOB2 3 303998 NEWNET PUBLIC
BNRPVI	446	446	LOCAL	0 N $
PUBLIC	303998	303998	PRA	DCHTOB2 0 N $
PUBLIC	214997	214997	LOCAL	0 N $
Node S2				
BNRPVI	393	393	PRA	DCHTOC 0 N $
BNRPVI	446	446	PRA	DCHTOA 0 N $
PUBLIC	303998	303998	PRA	DPCTOC1 0 N $
PUBLIC	214997	214997	PRA	DCHTOA1 0 N $
Node S3				
BNRPVI	393	393	LOCAL	0 N $
BNRPVI	446	446	PRA	DCHTOB 0 N +
			PRA	DCHTOB1 3 214997 NEWNET PUBLIC
PUBLIC	303998	303998	LOCAL	0 N $
PUBLIC	214997	214997	PRA	DCHTOB1 0 N $

Feature interactions

There are no feature interactions for NRAG on the DMS-250.

Operational measurements

There are no new operational measurement considerations for NRAG on SS7.

NRAG on PRI provides operational measurements of the message traffic generated on PRI D-channels. These OMs are part of the Primary Rate Access Facility (PRAFAC) group and include origination, termination, and tandem messages. The OM register increases each time an event occurs. The following table shows the individual registers in the PRAFAC group:

Table 4-8
DMS-250 OM registers for PRAFAC

Register	Description
FACMSGOR	The number of facility messages originated at a switch.
FACMSGTM	The number of facility messages terminated at a switch.
FACMSGTR	The number of facility messages transmitted by a switch.
DISNORTX	The number of facility messages discarded because no route list was found in Table MSGRTE.
DISCNGST	The number of facility messages discarded due to congestion at the switch.
DISRTUNA	The number of facility messages discarded because no outgoing route was available (D-channel not in service).
REJCNGST	The number of facility reject messages rejected due to application or network congestion at the switch
REJMSGOR	The number of facility reject messages originated at a switch.
REJMSGTM	The number of facility reject messages terminated at a switch.
REJMSGTR	The number of facility reject messages transmitted by a switch.
REJMSGDS	The number of facility reject messages discarded by a switch.
REJNORTX	The number of facility reject messages rejected by a switch because no routing translation exists for the destination.
REJRTUNA	The number of facility reject messages discarded because no outgoing route was available.

Logs

The DMS-250 maintains no logs for NRAG.

Service orders

There are no service order considerations for NRAG on the DMS-250.

Testing

There are no special testing considerations for NRAG on the DMS-250.

Billing

There is no billing for NRAG on the DMS-250.

DMS/Meridian

MCDN Network Ring Again

Network Services Guide

Address comments to:
ESN 6 - NTI - HELP

**northern
telecom**