

297-1001-064

DMS-100 Family

Subscriber Carrier Module 100 Rural

General Description

BCS35 and up Standard 05.01 March 1993



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About this document

This document describes all aspects of the Subscriber Carrier Module - 100 Rural (SMR). Included is information on the Remote Concentrator Terminal (RCT), as well as information on how to maintain the SMR, RCT, lines, and carrier links. Descriptions of the SMR and RCT are supported by details on physical configuration, maintenance tasks from the MAP, operational measurements, logs, and data schema. Additional information describes SMR call processing and performing maintenance tasks, as well as the cards that make up the SMR.

When to use this document

Northern Telecom (NT) software releases are referred to as batch change supplements (BCS) and are identified by a number, for example, BCS29. This document is written for DMS-100 Family offices that have BCS35 and up.

More than one version of this document may exist. The version and issue are indicated throughout the document, for example, 01.01. The first two digits increase by one each time the document content is changed to support new BCS-related developments. For example, the first release of a document is 01.01, and the next release of the document in a subsequent BCS is 02.01. The second two digits increase by one each time a document is revised and rereleased for the same BCS.

To determine which version of this document applies to the BCS in your office, check the release information in *DMS-100 Family Guide to Northern Telecom Publications*, 297-1001-001.

How to identify the software in your office

The *Office Feature Record (D190)* identifies the current BCS level and the NT feature packages in your switch. You can list a specific feature package or patch on the MAP (maintenance and administration position) terminal by typing

>PATCHER;INFORM LIST identifier
and pressing the Enter key.

where

identifier is the number of the feature package or patch ID

You can identify your current BCS level and print a list of all the feature packages and patches in your switch by performing the following steps. First, direct the terminal response to the desired printer by typing

>SEND printer_id

and pressing the Enter key.

where

printer_id is the number of the printer where you want to print the data

Then, print the desired information by typing

>PATCHER;INFORM LIST;LEAVE

and pressing the Enter key.

Finally, redirect the display back to the terminal by typing

>SEND PREVIOUS

and pressing the Enter key.

Where to find information

The chart below lists the documents that you require to understand the content of this document, or to perform the tasks it describes. These documents are also referred to in the appropriate places in the text.

More than one version of these documents may exist. To determine which version of a document applies to the BCS in your office, check the release information in *DMS-100 Family Guide to Northern Telecom Publications*, 297-1001-001.

Number	Title
297-1001-103	<i>Peripheral Modules</i>
297-1001-814	<i>Operational Measurements Reference Manual</i>
297-1001-510	<i>Log Report Manual</i>
297-1001-515	<i>Peripheral Modules Maintenance Reference Manual</i>
363-2011-001	<i>Product Index - 363-2011</i>
363-2011-100	<i>DMS-1 Digital Multiplex System - System Description</i>
363-2011-102	<i>Remote Concentrator Terminal - Description</i>

What precautionary messages mean

Danger, warning, and caution messages in this document indicate potential risks. These messages and their meanings are listed in the following chart.

Message	Significance
DANGER	Possibility of personal injury
WARNING	Possibility of equipment damage
CAUTION	Possibility of service interruption or degradation

Examples of the precautionary messages follow.



DANGER
Risk of electrocution

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



WARNING
Damage to backplane connector pins

Use light thumb pressure to align the card with the connectors. Next, use the levers to seat the card into the connectors. Failure to align the card first may result in bending of the backplane connector pins.



CAUTION
Loss of service

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

How commands, parameters, and responses are represented

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

Input prompt (>)

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

>BSY

Commands and fixed parameters

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

>BSY LINK

Variables

Variables are shown in lowercase letters:

>BSY LINK ps_link

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

Responses

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

Any active calls may be lost
Please confirm ("YES" or "NO"):

The following example illustrates the command syntax used in this document.

	Step	Action
Step number	1	Busy the P-side link of the SMU by typing
Instruction		>BSY LINK ps_link
Command input		and pressing the Enter key.
Parameters list		where ps_link is the number of the P-side link (0 through 19)
Example input		Example input: >BSY LINK 7
Example output		Example of a MAP response: Any active calls may be lost Please confirm ("YES" or "NO"):

Hardware architecture

Overview of the SMR-RCT configuration

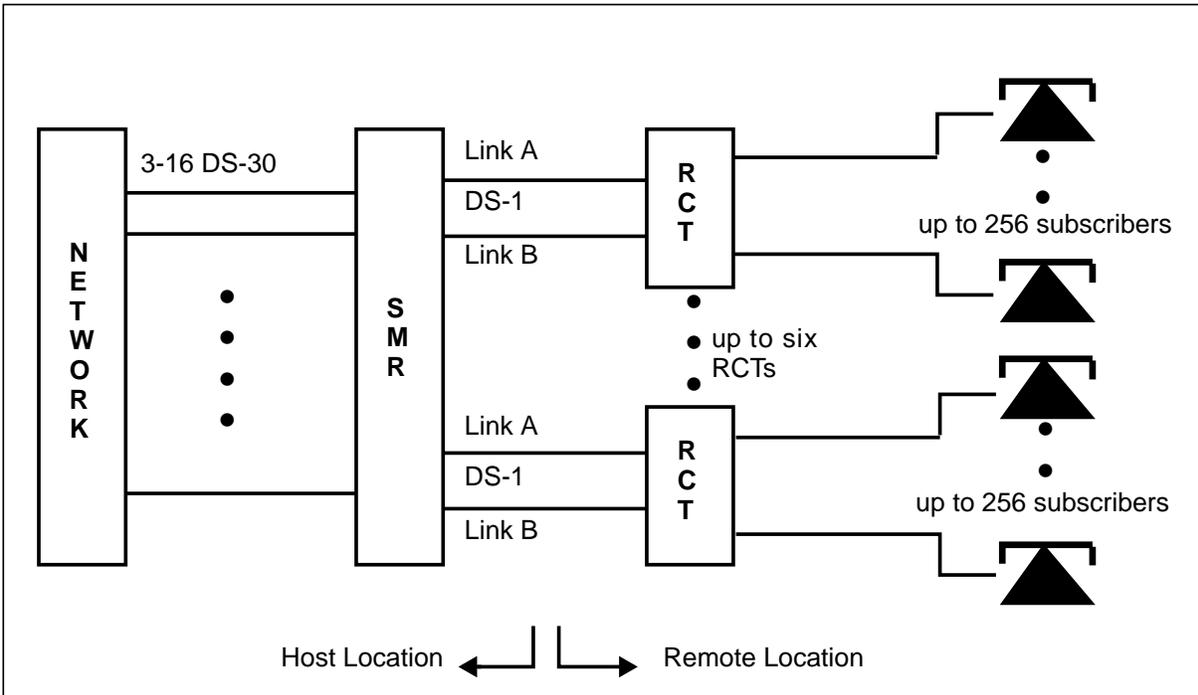
The Subscriber Carrier Module-100 (SCM-100) is a family of peripheral modules based on architecture of the Line Group Controller (LGC) and Digital Trunk Controller (DTC), subsets of the Line and Trunk Controller (LTC) peripheral.

The Subscriber Carrier Module-100 Rural (SMR), a member of the SCM-100 family, replaces the Control Concentrator Terminal (CCT) of the DMS-1R subscriber carrier system and provides a direct digital interface between the DMS-1R Remote Terminal (RCT) and the DMS-100.

Note: The SMR is also referred to as Subscriber Carrier Module-100 Rural: Interface to DMS-1 Rural (SCM-100R) or Subscriber Carrier Module Rural (SCMR).

Figure 1-1 shows the basic configuration of the SMR and how it connects to the RCTs and the DMS-100.

Figure 1-1
Basic SMR-RCT configuration



Note that the SMR connects to the DMS-100 over three to 16 DS-30 links. Also note that the SMR can support up to six RCTs. Each RCT connects to the SMR over two DS-1 lines. A protection DS-1 line can also be configured. This protection DS-1 line is configured as a separate hardware subsystem. In this configuration, a Lynch Automatic Protection system (APS) component is placed at both the host and remote site.

Feature applications

Subscriber services

Ringling

The SMR supports all currently available ringing schemes: coded, frequency selective, and superimposed.

Coin

The SMR can provide service for the following types of coin lines:

- **Postpay**
Dial tone is provided with the microphone disconnected. After the subscriber dials the desired number, an operator intercepts the call and requests the coin deposit.
- **Semi-postpay**
The subscriber receives dial tone and dials the number, but as soon as the called party answers, the microphone is disabled. A coin deposit enables the microphone and allows a two-way conversation.
- **Prepay**
Although the subscriber may or may not need to deposit coins to dial a number, he or she must deposit coins before dialing is completed (unless the number is a free access service). Note that a prepay phone gives full control over the coin to the operator.

Moreover, the SMR provides the following ways for the subscriber to receive dial tone:

- **Coin First**
The subscriber must first deposit a coin before receiving dial tone.
- **Dial Tone First**
The subscriber does not have to deposit a coin to get dial tone.

Custom calling features

The SMR-RCT subsystem provides custom calling services such as Speed Calling, Call Waiting, Three-way Calling, and Call Forwarding.

Call processing features

Tones

The SMR provides all the basic tones to an RCT, including dial tone, busy tone, reorder (fast busy) tone, audible ringing (ringback) tone, high tone, receiver offhook (ROH) tone, and call waiting tone.

Channel assignment

The RCT can connect channels (on the DS-1 link) to subscriber lines in one of the following modes:

1 Non-dedicated

Subscriber lines have full access to all channel time slots on the DS-1 links on a first-come-first-serve basis. A service request from the RCT initiates channel assignment. The assigned channel is maintained in the busy state for the duration of the call and is released at the end of the call.

2 Dedicated

DS-1 channels are assigned permanently for special subscriber needs with a nailed up connection between the subscriber line and a DS-1 time slot.

Note: In both modes, the RCT performs channel assignment according to commands from the SMR.

Ringling

The SMR supports the following:

- Frequency selective ringing with two-party ANI
- Multiparty divided, coded ringing
- Single-party bridged ringing
- Superimposed ringing
- Two-party divided ringing with ANI

Coin

The SMR provides postpay, semi-postpay, and prepay coin line service on a Dial Tone First (DTF) basis through the configuration of the QPP409A/B/C coin card in the RCT. With the ground start switch option enabled, the SMR can also provide coin first service for a prepay phone.

Warm SwAct

The warm SwAct feature is the process by which control of maintenance and call processing passes from the active unit of an SMR to the inactive unit. During the switch, the active unit becomes inactive, and the formerly inactive unit, gaining control, becomes active.

A warm SwAct occurs automatically when the DMS system detects a failure in the active SMR unit. A warm SwAct under these conditions is called an *uncontrolled* warm SwAct. A *controlled* warm SwAct occurs when operating company personnel issue the SWACT command from the PM level of the MAP or when a scheduled diagnostic such as the routine exercise (REX) test occurs. When a warm SwAct occurs, calls in the talking state are maintained, but calls in transient states such as digit collection or ringing are dropped. Subscribers receive dial tone immediately after the call is dropped.

A warm SwAct requires that both SMR units be in service. After a reload or a restart, the warm SwAct feature is automatically enabled. It can be disabled by issuing the command WARMSWACT OFF at the MAP (with the SMR posted) and reenabled by issuing the command WARMSWACT ON.

The warm SwAct feature also operates transparently before an actual switch of activity by ensuring that the inactive unit of the SMR has the data necessary to maintain established calls (calls in the talking state) and process new calls should it become the active unit.

The following restrictions apply to the warm SwAct feature:

- Established calls may be dropped during warm SwAct.
SMR units communicate by sending messages through an intermodule communication (IMC) link. The transmission rate is limited by peripheral processor real time. Dynamic updates occur at low priority, and if traffic is heavy through the SMR, real time is taken up with call processing work. Consequently, the inactive unit may not receive dynamic data. If a warm SwAct occurs during this time, some established calls may be dropped. The number dropped is traffic dependent, but specific data is unavailable.
- An established call maintained, during a very high usage period, over an *uncontrolled* warm SwAct may lose its hook-flash capability to initiate flash-activated subscriber features (call transfer, three-way calling, conference calls, call parking, and executive busy override) for the remainder of the call. Under these conditions, The hook flash may be ignored.

For example, subscriber A calls subscriber B and a speech path is established. A system-detected fault then occurs and an uncontrolled

warm SwAct is initiated on the XPM connected to subscriber A. The speech path is still maintained. However, when subscriber A attempts to set up a three-way call, the hook flash is ignored.

- Feature AF3747, Enhanced Warm SwAct, a feature of feature package NTX270AA, improves the XPM code that handles the warm SwAct operation. This feature, available in BCS34 and up, allows flash-activated subscriber features to retain flash-hook capability over a *controlled* warm SwAct *under specific conditions*. These conditions have to do with the line service options assigned to the line that survived the SwAct. Some line service options, when active, could disable the Enhanced Warm SwAct feature. Table 2-1 lists those line service options that do *not* disable the Enhanced Warm SwAct feature. Any line service option not listed in Table 2-1 might, when active, disable feature AF3747.

Note: Feature AF3747, Enhanced Warm SwAct, is enabled only for *controlled* warm SwActs (that is, when the SW ACT command is issued by a craftsperson or when SwAct occurs as part of the REX test sequence).

The following examples clarify the capabilities and limitations of feature AF3747, Enhanced Warm SwAct:

In the first example, subscriber A calls subscriber B and a speech path is established. A warm SwAct then occurs on the XPM connected to subscriber A because of a scheduled REX test. The speech path is maintained over the SwAct. Subscriber A then flashes the hook switch to set up a three-way call. Dial tone is received and subscriber A dials the third party number. The third party answers and subscriber A then flashes the hook switch to connect subscriber B, completing the three-way call. In this example, the Enhanced Warm SwAct feature remained enabled because no disabling line service option was active during the SwAct.

In the second example, subscriber A calls subscriber B and a speech path is established. Subscriber A has the call waiting (CWT) line service option. A third party dials subscriber A who receives indication of the waiting call. A controlled warm SwAct then occurs on the XPM connected to subscriber A. When subscriber A attempts to place subscriber B on hold to access the waiting call, the hook flash is ignored and the speech path between subscribers A and B is maintained. In this example, the Enhanced Warm SwAct feature is disabled and flash-hook capability is lost because an incompatible line service option was active during the SwAct.

- A coin phone call like other calls may be taken down during heavy traffic accompanied by a warm SwAct or when the terminating party does not answer and a warm SwAct occurs. The coin is returned. The subscriber must reoriginate and hang up to get the deposit back.
- Subscriber line tests (end-to-end, single-end, and jack access) are aborted when a warm SwAct occurs.
- If a DS-1 link fails, calls on that link that are not reassigned prior to the warm SwAct and updates in the inactive unit are dropped.

Table 2-1xxx Line service options compatible with the Enhanced Warm SwAct feature
Residential features
Automatic Call Back
Automatic Recall
Call Screening
Calling Number Delivery
Calling Number Delivery Blocking
Customer Originated Trace
Call Pickup
Make Set Busy
Meridian Digital Centrex terminal features
Automatic Call Distribution (ACD)
ACD Name And Number
ACD Make Set Busy
ACD Emergency Key
Automatic Dial
Automatic Line
Bell Core Line Study
Business Set Display (see note)
Call Forwarding
Calling Line Identification
Calling Name Inspect (see note)
Call Pickup
-continued-

Table 2-1xxx Line service options compatible with the Enhanced Warm SwAct feature
Meridian Digital Centrex terminal features
Carrier Toll Denied
Closed User Group
Code Calling
Code Restriction
Comfort Tone
Customer Data Change
Cut Through Dialing
Data Loop Around
Datapath DU Profile
Datapath Modem Pooling
Denied Call Forwarding
Denied Incoming
Denied Originating Service
Denied Terminating Service
Directed Call Pickup No Barge In
Direct Inward System Access
Directory Number Network Attributes
Direct Outward Dialing
Electronic Switching Network
Equal Access PIC
Equal Access Toll Denied
Essential Line Service
Expensive Route
Hunt Groups
Last Number Redial
Line Screening
MADN Hold (POTS)
Make Set Busy
-continued-

Table 2-1xxx
Line service options compatible with the Enhanced Warm SwAct feature

Meridian Digital Centrex terminal features

Network Dial Plan Display (see note)
Network EBS Display (see note)
Network Speed Calling
No Receiver Off Hook Tone
Off Hook Queuing
Originating Line Select Option
Permanent Hold
Private Business Line
Private Network
Private Virtual Network
Query Time Display (see note)
Random Make Busy
Requested Suspension
Security Code
Sleeve Leads for Public File Reporting System
Special Billing Number
Speed Calling Long
Speed Calling Short
Speed Calling User
Star Equivalent
Station Message Waiting
Stop Hunt
Subscriber Line Usage
Terminating Line Select Option
Toll Essential Service
Uniform Call Distribution

-continued-

Table 2-1xxx Line service options compatible with the Enhanced Warm SwAct feature
Meridian Digital Centrex terminal features
Voice Message Exchange
Note: Display is not correct after the SwAct.
End

Warm SwAct and the SwAct back feature

Feature AF5007, XPM Pre-SwAct/Post-SwAct Audit, available in BCS35 and up, improves the warm SwAct operation by denying the SwAct if the inactive unit is deemed incapable of maintaining activity or communication with the CC. Under these conditions, this feature also provides the capability to SwAct back to the originally active unit. The software that drives this feature is the SwAct controller.

SwAct controller

All manual requests and selected system requests for warm SwActs are routed to the SwAct controller in the CC. The SwAct controller then polls PM diagnostic history data located in the CC and XPM status data (not to be confused with XPM static data) in the XPM. Based on the data polled, the SwAct controller either denies the request for a warm SwAct or allows a warm SwAct to proceed.

If the SwAct controller denies a manual request for a warm SwAct, the user is informed that the request is denied. A reason for the denial is provided and, in most cases, the user is also informed that he or she can override the SwAct controller by entering the SWACT FORCE command. If the user decides to override the SwAct controller, a warm SwAct is attempted without consulting diagnostic history or status data. The active unit of the XPM drops activity and becomes the inactive unit. This unit is kept in service until the newly active unit can verify two-way communication with the CC and the capability to maintain activity.

If two-way communication is available and the newly active unit can maintain activity, the inactive unit is system-busied and returned to service. If communication fails or if the newly-active unit is incapable of maintaining activity, a SwAct back to the originally active unit occurs. Refer to figure 2-1 for an example of a SwAct back.

During a SwAct back, the originally active unit attempts to regain activity. If successful, the inactive unit is system-busied and returned to service, and the active unit remains in service. Stable calls from the originally active unit are preserved over the SwAct back. All new calls that are made after the SwAct and before the SwAct back are dropped. If a SwAct back is

unsuccessful, both units of the XPM are system-busied and returned to service.

Note 1: Operational measurements and peg counts are not reinitialized following a SwAct back.

Note 2: This feature is not supported during XPM or CC overload.

The SwAct back capability is provided for the following SwAct commands issued by a user:

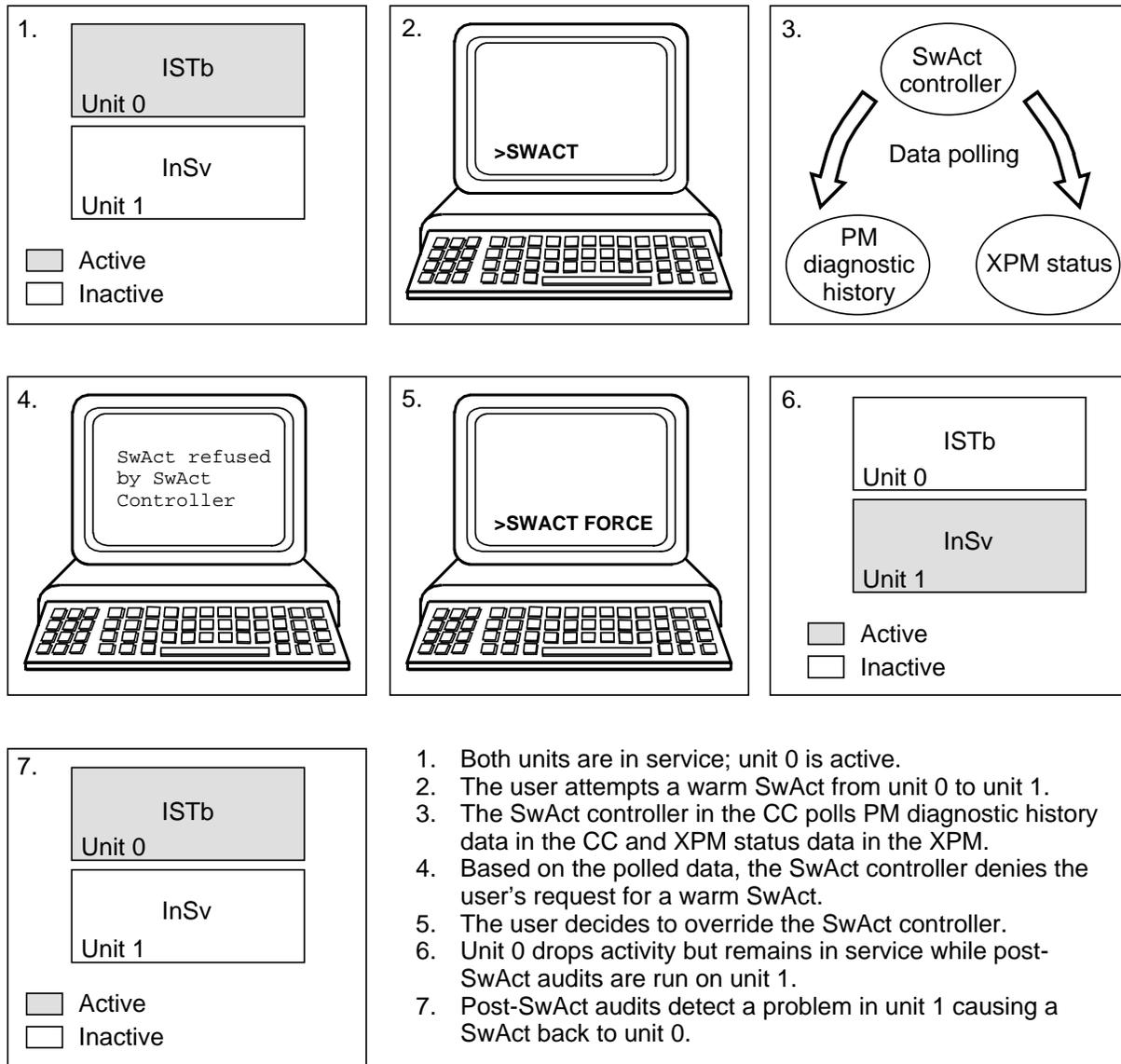
- SWACT
- SWACT TEST
- SWACT NOW
- SWACT ALL
- SWACT FORCE
- TST REX NOW
- BSY UNIT *unit_no*
where unit_no is the number of the active unit
- BSY ACTIVE

Note: The SwAct back capability is also provided for a routine exercise (REX) test initiated by the REX scheduler. For more information on how this feature interacts with REX testing, refer to “Routine exercise test” on page 3-6.

PM diagnostic history data Feature AF5006, PM Diagnostic History, available in BCS35 and up, provides a data base of information on each XPM unit subtending the DMS-100 switch. This information is used by the SwAct controller to determine if an inactive unit is capable of maintaining activity should a warm SwAct occur. The information collected is reset whenever the unit successfully gains activity. For more information about this feature, refer to “XPM diagnostic history” on page 2-14.

XPM status data The SwAct controller also polls data in the XPM to determine if the inactive unit is capable of maintaining activity. The XPM responds to the SwAct controller query by communicating that the active unit can or cannot comply with a request to drop activity based on the status data. For more information about XPM status data, refer to “Pre-gain audit” on page 3-19.

Figure 2-1xxx
SwAct back example



Channel reassignment

Channel reassignment is the process of automatically transferring calls in the talking or ringing state from a failed or manually busied DS-1 link to free DS-1 channels on a properly functioning DS-1 link within an RCT. Reassignment protects active calls from being lost when a DS-1 link or associated hardware is placed out-of-service.

Note that calls in the talking or ringing state are automatically reassigned to idle DS-1 channels on the other normal link up to its full capacity of 24 channels. Calls in the talking state are reassigned before calls in the ringing

state. Calls in states other than talking or ringing, such as digit collection, are dropped but receive dial tone immediately.

Calls that cannot find idle DS-1 channels or encounter shelf blocking are disconnected and a PM180 SWER log is printed. Shelf blocking prevents subscriber lines from the same shelf from being assigned to the same numbered channel on different DS-1 links. For example, if a subscriber from shelf 1 on an RCT occupies channel 0 on DS-1 link A, another subscriber from shelf 1 on the same RCT cannot be assigned to channel 0 on DS-1 link B.

When a failed or busied link is returned to service, reassigned calls are not returned to that link.

Note that when a protection link is present in hardware, protection switching has priority over channel reassignment.

When reassignment occurs, service may be interrupted for approximately one second in the talking or audible ringback state. Calls in the ringing state may receive partial ring or no ringing for one cycle.

Interactions

If a line test is in progress and channel reassignment occurs, the line test will probably fail or the results could be inaccurate. The test must be repeated.

Channel reassignment affects Three-way Calling. For a three-way call, party A, while talking to party B, flashes to obtain party C. If the digroup that party A is using fails, A will get a dial tone and B will get a reorder tone.

When a Warm SwAct occurs in conjunction with channel reassignment, calls in the talking state are maintained. Calls in the ringing state are dropped but receive dial tone immediately.

Administration features

Data assignment

Several inventory tables within DMS are used to define the SMR-RCT subsystem. The LTC Inventory (LTCINV), Line Inventory (LNINV), and RCT Inventory (RCTINV) tables are the primary tables affected.

Inventory for the SMR is based on that used for the LTC; two tables, LTCINV and LTC P-Side Inventory (LTCPSINV) tables, cover all LTC and LTC-based peripherals.

The line-related table LNINV is altered to support RCT lines. Unlike DMS-100 line cards, RCT line cards support one through four lines instead of one. Changes are implemented to reflect the maximum number of RCT

supported lines as 256 and the physical location slot of a line within the RCT.

The RCT inventory table holds configuration information for the RCT, data used by call processing, ringing data for subscriber lines, and available RCT maintenance facilities.

Operational measurements

For BCS33 a new OM group, XPMLINK, is added to the following OM groups that are affected by the SMR-RCT subsystem:

- PM and PMTYP. Dual unit peripheral module maintenance summary
- DTSR. Traffic and dial tone speed recording for host site
- SITE. Traffic and dial tone speed recording for remote sites
- Subscriber line usage (SLU) groups
- Other traffic measurement groups (OFZ, TFCANA, LMD, and related groups).
- XPMLINK. C-side and P-side channel usage, availability, and blockage.

To see how the SMR-RCT subsystem has been integrated into these groups, refer to the following paragraph and operational measurements in Chapter 5, entitled "Administration".

Dial tone speed recording

Software for Dial Tone Speed Recording (DTSR) supports DMS-1R RCT lines. To accommodate these lines, OM tables SITE (remote site) and DTSR (host site) are modified. In OM table SITE, fields exist for RCT Dial Pulse (DP) and Digitone (DT) line measurements.

Both DP and DT calls are counted, with totals of each registered. Calls requiring more than three seconds for dial tone are registered as delayed calls. These delayed calls are also registered for both line types.

Overload control

This feature increases the ability of the SMR to handle large numbers of ongoing calls. It also provides gradual, non-service-affecting degradation of call processing when traffic exceeds normal levels.

The SMR uses a 6X81BA card (A-bit/B-word) to interface up to six RCT modules, each supporting up to 256 subscriber lines. The 6X81 card is a key component in SMR-RCT messaging. The SMR sends messages to and receives messages from the RCT through the 6X81 card. These messages include channel assignment and maintenance data.

As the number of originations and terminations on these RCT modules increases, operation of maintenance functions slows, such as remote diagnostics. Call processing functions may become degraded. For example,

delays may occur in supplying dial tone to subscribers. The SMR prevents this degradation. The SMR also prevents software faults from occurring when an abnormally high incidence of simultaneous call processing events occur due to hardware malfunction or destruction.

The SMR distributes simultaneous originations over a short period, rather than immediately processing them. This prevents peripheral bursts of activity, which could load the CPU and degrade ongoing calls. Hardware faults that might cause false originations on several lines are prevented from seriously affecting ongoing calls.

The overload control feature prioritizes call processing functions and establishes thresholds. For example, a threshold exists for the number of calls allowed in the digit collection state (a heavy user of processor time).

Maintenance features

The SMR provides routine maintenance and operation checks for identifying card failures and other malfunctions for the following:

- the SMR itself
- the RCT
- subscriber lines.

Diagnostics for the SMR

Maintenance of the SMR can be divided into the following areas.

Monitoring the SMR from the MAP

The SMR is integrated into the PM level of the MAP display and can be queried and manipulated in the same way as other PMs. Note, however, the following changes:

- P-side test failure with an SMR indicates a faulty DS-1 line
- If the craftsperson attempts to busy a p-side DS-1 link and a second DS-1 link is out of service, the system prompts for confirmation

System maintenance

The following changes occur during test sequences:

- Two additional diagnostics, one for the A-bit/B-word card and one for the Pad-Ring card, are run.
- An SMR uses B-word commands to communicate to an RCT. The SMR sends B words over each DS-1 link to the RCT and expects replies. If replies are not received, the B-word hardware times out. An unsolicited message indicates a B-word timeout on the corresponding link, indicating that the RCT is not communicating.

SMR audits (call processing and maintenance software)

Call processing software is audited for hung lines and hung channels. Hung lines are physically idle in the RCT but call processing busy in the SMR software. Hung channels are physically idle in the RCT and call processing busy in the SMR software or call processing busy in the RCT and idle in the SMR. The SMR software exists in memory on the MP card.

Maintenance software is audited to compare RCT maintenance data to SMR maintenance data. Severe maintenance faults detected by audits may result in RCT links or entire RCT modules being taken out of service.

Audits initiate corrective action for discrepancies occurring over two consecutive audit cycles.

XPM diagnostic history

Extended Peripheral Modules Diagnostics History, feature number AF5006 provides a resident database to record selected diagnostic results of XPMs. This feature captures diagnostic results that indicate the XPM's sanity. The data in this database may be used to influence DMS maintenance activities. This database provides operating company personnel with MAP command access to data on the accumulated results of diagnostics. Data in the history database is retained over warm, cold, and reload restarts. This feature is part of software package New Peripheral Maintenance (NTX270AA), and is not an optional feature.

This feature is one of a group of three inter-related features. The two remaining features are: XPM PreSwact/Post Swact Audit, feature number AF5007, and XPM REX Control and Trouble Notification Improvements, feature number AF5008. Feature AF5007 uses a subset of diagnostic results, along with past REX tests and SWACT results to determine if a SWACT should be performed. The functionality introduced by feature AF5007 is referred to in this text as the *SWACT controller*. Feature AF5008 modifies the XPM REX test to use the *SWACT controller* and provide log enhancements.

An XPM may execute diagnostics to test the functionality of its hardware. Diagnostics may run as a result of CC or XPM requests. Diagnostics the XPM performs are usually part of XPM audits. The diagnostic results provided by feature AF5006 are used for system analysis by the *SWACT controller* and operating company personnel.

SWACT controller This feature provides short term diagnostic performance data to the *SWACT controller*. A set of query procedures are provided for applications which desire such information. The *SWACT controller* determines if a SWACT is advisable. Short term data for a given unit means diagnostic and audit failure counts measured since the last time a unit successfully gained activity.

Operating company personnel analysis Feature AF5006 provides data on the failure history of diagnostics. This data is in the form of the number of failures that occur and which cards are at fault. MAP commands are provided to display data for a given XPM or for all XPMs supported by this feature. Two sets of data are available through the use of MAP commands: short term failure counts and long term failure counts.

- Short term failure counts are accumulated from the last time a unit successfully gained activity. This data may be useful to operating company personnel in guiding their maintenance activities and supporting organizations for outage analysis. If an outage occurs, it is recommended the XPM Diagnostic History data for that peripheral be included with other pertinent data.
- Long term failure counts are accumulated from the last time long term failure counts are reset, by manual action or BCS application. Long term failure counts are intended to last for the life of the BCS. This data is channeled back to the design community to provide data for further diagnostic system improvements.

Functionality described in this feature is implemented on SuperNode and BNR Reduced Instruction Set Computing (BRISC) platforms. Only the diagnostics and associated cards essential to the *SWACT controller* are supported on NT-40 platforms. This restriction is due to NT-40 data store requirements. For the NT-40 platform the diagnostic results and suspect cards captured is smaller than the SuperNode or BRISC platforms.

Description of diagnostics

Because different PM contain different hardware, different diagnostics are run on every type of PM. There are approximately 75 diagnostics for XPMs. Only a subset of the 75 diagnostics is run on any given PM. This feature captures failures for the following types of diagnostics:

- in service
- out of service
- single diagnostic
- facility audit
- other audits

Each diagnostic implicates zero or more cards as determined by the XPM. In some instances, card lists are generated by CC for display at the MAP terminal or in logs. Any card implicated by a XPM diagnostic or audit, and reported to CC is included in a list of card failures.

Note: Feature AF5006 records only those cards implicated by an XPM and not cards generated by CC.

Diagnostics may be grouped together and run as a set of diagnostics or run as a single test. Commonly defined sets are

- in-service tests
- out of service tests
- facility audit tests
- mate diagnostics
- ROM diagnostics

In-service and out of service tests

In-service and out of service tests are solicited tests; they are run only as a result of CC requests. When CC requests to test an XPM unit by using the manual TST command, manual or system RTS, SWACT, BSY or REX commands, the XPM runs a set of diagnostics. The diagnostics included in the set vary according to the PM type of the XPM, the state of the XPM unit, and the activity of the XPM unit. If the unit is in service, the XPM runs a set of in-service diagnostics. If the unit is out of service, the XPM runs a set of out of service diagnostics.

The results of individual diagnostics are returned to CC along with a final result for the entire set. If any cards are faulty, a card list is generated and transferred to CC at the termination of the set of tests.

Facility audit

The facility audit is a set of diagnostics the XPM runs periodically to test itself. If problems are encountered, a message is sent to CC indicating the problem along with a list of faulty cards.

Mate diagnostics

If communications are lost with one unit, that unit may be diagnosed by its mate unit, and the results sent to CC by the mate unit.

ROM diagnostics

If the XPM is at ROM level, a set of ROM diagnostics may be implemented.

This feature does not capture failures, nor does it capture the cards implicated by mate and ROM diagnostics. For each diagnostic, a card list or log is generated at the MAP terminal, but no card list or diagnostic failure is recorded in the diagnostic history.

Table 2-2 lists and describes diagnostics supported by this feature. The diagnostics are classified as *solicited*, *audit*, or *both*. In addition, diagnostics the *SWACT controller* requires are identified.

Table 2-2 Diagnostics supported			
Diagnostic name	Description	Type	Required by SWACT controller
AB DIAG	A/B Bits	solicited	no
AMUDIAG	6X50 External Loop	solicited	no
CONT DG	Continuity Diag	solicited	no
CSMDIAG	CSM Diag	solicited	no
CS SPCH	Network Links	solicited	no
DS1DIAG	P-Side DS-1	solicited	no
FAC AUD	Facility Audit	audit	no
FORMATR	Local Formatter	solicited	no
MSG IMC	IMC Link	both	yes
PADRING	6X80 Pad/Ring	solicited	no
PARITY	Parity Audit	audit	yes
PS LOOP	P-Side Loops	solicited	no
PS SPCH	P-Side Speech Links	solicited	no
SCM AB	6X81 A/B Bits	solicited	no
SCM MSG	SCM A/B DDL Msg	solicited	no
SPCH DG	Speech Path	solicited	no
SYNC DG	Sync Diag	both	yes
TONES DG	Tone Diag	both	no
TS DIAG	Time Switch Diag	solicited	no
End			

Table 2-3 lists the cards supported by this feature.

Table 2-3 Supported cards	
Card name	Description
NT6X40	Net Interface Link
NT6X41	Speech Bus Formatter and Clock
-continued-	

Table 2-3 Supported cards (continued)	
Card name	Description
NT6X42	CSM
NT6X44	Timeswitch and A/B Bit Logic
NT6X45	Master/Signalling/File Processor
NT6X47	MP Memory
NT6X48	DS30A Interface
NT6X50	DS-1 Interface
NT6X70	Continuity Card
NT6X80	SCM Pad/Padring
NT6X81	SCM A/B Bit
End	

How diagnostics are stored

This feature stores diagnostic results in the form of counters. Each unit of each peripheral supported by this feature has its own set of counters. Counters are kept for diagnostic failures and for cards found to be faulty. Three types of counters are kept:

- diag
 - the number of times a diagnostic fails
- card
 - the number of times a card is reported as faulty
- diag and card combination
 - the number of times a diagnostic and card combination occurs

Two subcounters are kept for each of the three counters: a short term failure counter, and a long term failure counter. The short term failure counters are used by feature AF5007 to determine if a SWACT is advisable. Short term failure counters are reset frequently throughout the BCS cycle. Long term failure counters record the diagnostic history of a peripheral or office over an extended period of time. Long term failure counters are reset using the QUERYPM DIAGHIST RESET command or by a BCS application.

A single test failure can report one or more diagnostic failures and zero or more cards which are faulty. It is possible for a diagnostic running in one unit to report cards in that unit and also its mate unit. When a diagnostic fails, the individual diagnostic routine sends the failure information to the

history database. Table 2-4 summarizes how each type of counter is incremented and the differences necessary on NT-40 platforms.

Table 2-4 Counter Increments		
Counter	SuperNode, BRISC	NT-40
Diag	Increments short and long term failure counts for all diagnostics on the unit the diagnostic is run.	Increments short and long term failure counts for diagnostics required by the <i>SWACT controller</i> .
Card	Increments short and long term failure counts for all cards in the unit or units in which the card is physically located.	Increments short and long term failure counts for cards associated with diagnostics required by the <i>SWACT controller</i> .
Diag and card	Increments short and long term failure counts for all combinations of diagnostics and cards. This counter is for cards in the same unit the diagnostic is run.	Diagnostic and card combinations are not stored by the NT-40 because of data store limitations.

Resets and timestamps

The history database stores five timestamps for every peripheral:

- for the node
 - the time when long term failure counters are last reset
- for unit 0
 - the time when short term failure counters for unit 0 are last reset
 - the time when the last diagnostic failure occurred on unit 0
- for unit 1
 - the time when short term failure counters for unit 1 are last reset
 - the time when the last diagnostic failure occurred on unit 1

Short term counters are reset (set to zero) internally on a unit basis when a unit successfully gains activity. This gain of activity may happen as a result of an RTS or SWACT command. Long term counters are reset on a node basis from an XPM posted at the MAP terminal. When long term counters are reset, a log is generated with a summary of the data collected for that node prior to the reset.

A BCS application resets all diagnostic history data, including short and long term failure counts. In this case, a log with long term failure counts is not generated.

PM601 PM diagnostics history log

PM601 is generated when operating company personnel reset long term failure counters to zero for a XPM posted at the MAP display. PM601 is also generated when a XPM is deleted from datafill. The information provided by PM601 is the summary of the history of diagnostic failures collected since the prior reset time.

This log is an information log and should be kept in a form that can be passed on for analysis to the Technical Assistance Service (TAS) and field support organizations in the event of a later outage. The following is an example of a PM601 log.

```
PM601 AUG20 09:44:15 2741 INFO XPM Diagnostic History
SMDR 1
Reset Long Term Failure (LTF) counts
LTF last reset: 92/07/01 06:22:10
Summary of LTF counts prior to reset:
                                UNIT 0      UNIT 1
DIAGLIST
    AB DIAG                      1          1
    SPCH DG                      0          1
-----
CARDLIST
    NT6X44                      1          1
    NT6X41                      0          1
    NT6X69                      0          2
```

Diagnostics for the RCT

RCT maintenance can be divided into the following areas.

RCT alarms

The RCT is equipped with 18 alarms, each used for a different component. The SMR scans these alarms routinely and displays alarm conditions at the MAP. The SMR monitors RCT alarm registers. Every six seconds CC RCT maintenance receives unsolicited messages informing it of alarm changes. Refer to the Maintenance section of this document for alarm descriptions and the related logs.

RCT Common Equipment Audits

Introduced in BCS30, feature AF2344, SMR Audit Robustness, allows audits to be run on RCT lines so that faults may be isolated to cards in the RCT. Chapter 9, entitled "RCT lines maintenance", explains these audits and the alarms that are produced.

Protection switching

Protection switching for the DS-1 lines is performed by the Lynch Automatic Protection System (APS). Protection switching that is enabled through software is no longer provided. The changes that occur at the maintenance and administrative interfaces are described in this document.

Line testing (SLTA versus SLTD)

The RCT employs either Subscriber Loop Test Digital (SLTD) or Subscriber Loop Test Access (SLTA). SLTD uses a QPP423 card (also called a Digital Test Head) mounted on the RCT to which any subscriber loop can be connected. The SMR allows operation of this test head from a DMS-100 Line Test Position (LTP).

SLTA uses a QPP568A card and Shelf Bypass Assembly (ED7208-32G6). The Bypass Assembly is required for each RCT shelf on which testing is to take place. This equipment allows metallic test access to a subscriber loop and line card. With SLTA it is possible to bridge into a subscriber circuit.

Note that operator verification is possible through a metallic test access, and three-port conference circuits are unnecessary.

XPM parity audit

Parity audits are handled whenever possible by the central control (CC), so that a return to service is performed as efficiently as possible.

There are three types of parity faults:

- hard (requires the intervention of a craftsperson)
- soft (can be cleared by the CC)
- intermittent (can be cleared by the CC).

A PM181 informs the craftsperson about the type of parity fault. Other logs, such as PM128 and PM106, tell the craftsperson what action (if any) the CC is performing and whether the CC has cleared the fault. The >QUERYPM FLT command is also used. For more information, refer to Chapter 7, entitled "SMR maintenance".

Operator verification

When SLTD is present, three port conference circuits are used for operator verification. With SLTA, test trunks are used, and bridging into the subscriber circuit is possible.

Note that this feature is not compatible with the feature processing environment. After the failure, if features are in progress, no Mon-Talk connection is made. Also note that operator verification on RCT lines to AUTOVON trunks and other operator trunks is also restricted.

Unsupported LCM features

Most features supported by the LCM are supported by the SMR-RCT system (refer to the Line Assignment tables and Line Feature tables in *Local Customer Data Schema*, 297-2101-451, for descriptions of LCM features). The main exceptions are contained in the following list:

- Four-party ANI
- Integrated Business Network (IBN)
- Private Branch Exchange (PBX) Line Features
- Random Make Busy (RMB)
- Remote Register, SD Point (RMS)
- Remote Meter (Register) Pulsing (RMP)
- Remote Message Register for Local Calls (RMR)
- Remote Message Register for other than Local Calls (RMT)
- Sleeve Lead Control (FRO)
- Sleeve Lead Control for Public Fire Reporting System (FRS)
- Stop Hunt (SHU).

Software operation

In the SMR-RCT subsystem, the DS-1 bits are used to transmit both PCM speech and messages that are necessary in initiating and controlling a call as well as messages related to maintenance. The following sections describe how the bits are organized and how A-bits and B-words are assembled so that a call can be set up, maintained, and taken down.

DS-1 frame organization

While reading this section, refer to Figure 3-1, which illustrates the DS-1 frame and shows how frames containing A-bits or B-bits are identified.

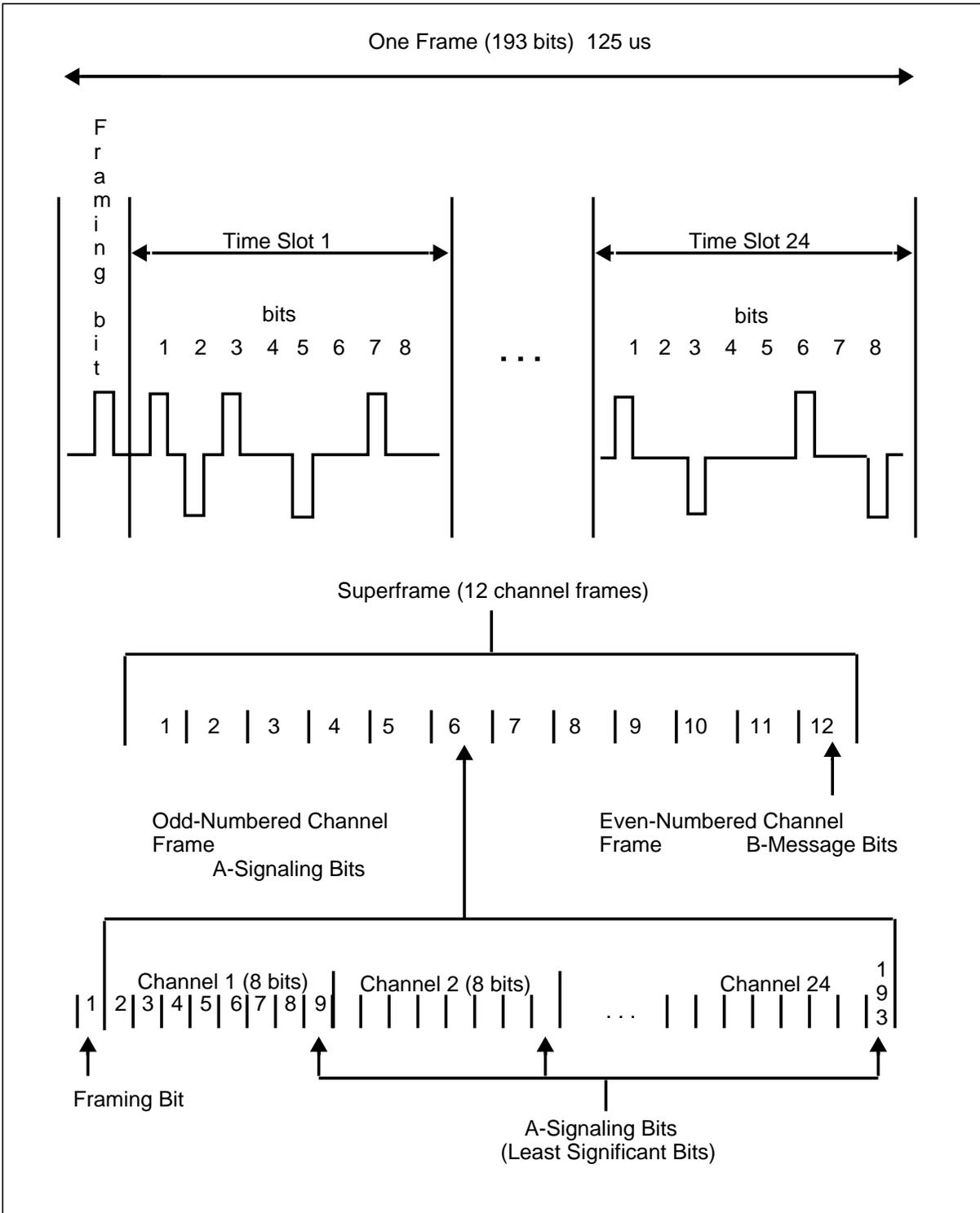
The SMR and RCT communicate with each other through system control messages and signaling bits sent over a DS-1 line.

The DS-1 frame format

The SMR and RCT exchange information over a DS-1 line operating at a rate of 1.544 Mb/s. The DS-1 line signaling format consists of twenty-four 8-bit bytes and a framing bit for a total of 193 bits per frame. The 8-bit bytes fit into time slots or channels and hold speech information, although selected channels can contain signaling and control information. The framing bit precedes the 24 channels, as shown in Figure 3-1 .

3-2 Software operation

Figure 3-1
DS-1 frame format



The framing bit is used for frame alignment and superframe alignment, a superframe consisting of twelve 24-channel frames. The framing bit identifies the location of the first time slot in the frame. When the SMR or RCT receives a framing bit, it is notified that the following eight bits contain information from time slot one.

Superframe alignment identifies frames in which time-slot-associated signaling bits are present. In superframe alignment, the framing bits, one for each 24-channel frame, form a 12-bit pattern. This pattern is shown in Figure 3-2 .

Figure 3-2
Superframe alignment pattern

Frame Number	1 2 3 4 5 6 7 8 9 10 11 12
Framing Bit Value	1 0 0 0 1 1 0 1 1 1 0 0
Framing Bit Type	Ft Fs Ft Fs Ft Fs Ft Fs Ft Fs Ft Fs

Framing bits from frames 1, 3, 5, 7, 9, and 11 are called Frame timing (Ft) bits; framing bits from frames 2, 4, 6, 8, 10, and 12 are called Frame signaling (Fs) bits.

When an Fs bit changes from 0 to 1 (this occurs in the transition from frame 4 to frame 6), it signals the SMR or RCT that the sixth frame follows the 1 framing bit. Similarly, when a Fs bit changes from 1 to 0 (this occurs in the transition from frame 10 to frame 12), the SMR or RCT is notified that the twelfth frame follows the 0 framing bit.

Identifying the sixth and twelfth frames in a superframe is important because these frames contain time-slot-associated signaling bits. These bits are found on all 24 time slots of the sixth and twelfth frames in the least significant bit position. Originally, a speech-signal bit occupied this position, but it was robbed and replaced with a signaling bit that depends on the direction the data is traveling.

Signaling bits located in the sixth frame are called A-bits, and signaling bits located in the twelfth frame are called B-bits.

Use of A-bits and B-words

A-bits are signaling bits and contain information such as switch status, ringing, dial pulses, ANI information, and coin control. The A-bits can be encoded as continuous zeros (A=0), continuous ones (a=1), alternating ones and zeros (A=1/0), or 8-bit code words that are used to send hex codes.

B-bits are assembled into 24-bit words, called B-words, that contain the following three 8-bit bytes, as shown in Figure 3-3:

- 1 An opcode byte instructs the RCT on the type of operation to perform and the type of memory to access.
- 2 An address byte contains the address code or location of the card and channel to which the data byte is addressed.
- 3 A data byte, if used for a write operation, sends a channel number and control bits to the RCT. During scan and read operations, the data byte returns the eight bits of data from the addressed RCT memory or register.

Figure 3-3
B-word organization

DS-1 'B' Signaling Channel Bit Position																							
1 8								9 16								17 24							
B-Word Bit Definition (0 = LSB)																							
OPCODE								ADDRESS								DATA							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
								Shelf	Card		Line												
								2	1	0	2	1	0	1	0	Channel				SD			
																4	3	2	1	0	2	1	0

B-word messages are, in essence, commands and responses to or from the RCT, depending on the direction of the message.

B-word commands are issued to send five types of commands to the RCT:

- 1 Scan eight lines for hook switch status
- 2 Read/Write connection memory (to connect subscriber x to channel y)
- 3 Read/Write auxiliary memory (to control line cards)
- 4 Read/Write maintenance registers

5 Read alarm registers.

The RCT does not generate unsolicited B-word messages; it responds to the last command it received.

Line scan bits (SC)

To determine hook switch status and coin presence, the line cards are scanned (Sc) using the B-word facility. Line cards are scanned eight lines at a time, starting on an even card number.

Figure 3-4 shows the relationship between line cards, lines, and the returned B-word data byte. The B-word data bits seven through four refer to line scan bits zero through three, respectively, on line card j , where j is an even line card number. The B-word data bits three through zero refer to line scan bits zero through three, respectively, on line card $j + 1$.

The only exception to this pattern is the universal coin line card, where the line scan bits are paired. As shown, SC0 and SC1 give scan information in a two-bit segment for coin line 0, while SC2 and SC3 refer to coin line 1 on coin card j . There are only two lines on a coin card and the paired scan bits include coin presence information in addition to hook switch status.

Figure 3-4
Line scan layout

7	6	5	4	3	2	1	0	B-word Data Bits
SC0	SC1	SC2	SC3	SC0	SC1	SC2	SC3	Scan Bits
0	1	2	3	0	1	2	3	Line Number
0	0	1	1	0	0	1	1	Coin Line Number
Line Card j				Line Card $j + 1$				Line Card Number

Line card control (signal distribution)

We have seen that A-bits are used for signaling. However, the way these bits are interpreted depends on the type line card that receives or sends them. This is done through the Signal Distribution (SD) state, which is part of the auxiliary memory that is B-word accessible. (Figure 3-3 shows where the

SD state is located.) One of up to eight SD states can be assigned to the channel and hence active line card.

Overview of call processing

Line scanning

Line cards are scanned eight lines at a time using the method described previously in the paragraph labeled Line scan bits (SC). Line scanning is controlled through B-words. Note that a record is kept of B-word line scan operation failures. This record can be used in conjunction with the line audits.

Channel assignment

Every line on the RCT must have a channel assigned to pass supervision, ringing, and speech information. Only the line scanning function is independent of RCT channel assignment.

Channel setup is performed with a B-word operation over the selected digroup to assign a DS-1 channel to a line address (shelf number, card number, and line number), to set the busy/idle bit to busy, and to set the appropriate SD state. This information is stored in the QPP417 Address Remote (one per Digroup).

The SMR keeps records of which channels are in use. Note that because of hardware restrictions, no two lines on the same line shelf can be assigned the same channel number on Digroup A and Digroup B. Note that this constraint can contribute to an All Channels Busy condition, explained later.

When a call terminates to an RCT in which all DS-1 channels are busy, the SMR sends a reorder tone to the originating party. If the call originates from an RCT coin phone, the QPP409 card has an automatic hardware mechanism to return deposited coins (for example, coin first lines).

Note: For a description of ringing, refer to RCT Ringing Hardware in Chapter 4, entitled "Engineering".

Routine exercise test

A REX test includes a series of tests performed on an XPM unit, ideally initiated daily by the system scheduler or manually by operating company personnel. The REX test combines the diagnostic and functional routines available on XPMs. Results of the REX test can be divided into four classes:

- not performed
- passed
- failed

- aborted by manual action (that is, maintenance action with the FORCE parameter or with the ABTK command from another MAP terminal with the XPM posted)

All four classes output a log or display a message at the MAP terminal. Only passed and failed REX tests are stored in the maintenance record. Failure reasons are available only for failed REX tests.

The sequence of events performed by the REX state machine (or controller) is enumerated as follows:

- 1 Test the inactive unit (includes in-service tests only).
- 2 SysB the inactive unit.
- 3 RTS the inactive unit (includes out-of-service tests only).
- 4 Wait for superframe and data sync to be achieved.
- 5 Perform a pre-SwAct audit.
- 6 Perform a warm SwAct.
- 7 SysB the newly inactive unit.
- 8 RTS the inactive unit.
- 9 Wait for superframe and data sync to be achieved.
- 10 Run in-service diagnostics (TST) on the newly active unit.
- 11 Run in-service diagnostics (TST) on the inactive unit.

The REX state machine (controller) actions are shown in figure 3-5.

If a REX test fails, a PM600 log is generated. The PM600 log initiates a major alarm for the XPM that failed the REX test. The major alarm appears at the MAP terminal under the PM banner at the top of the display.

If an InSv or OOS diagnostic test fails, the REX failure reason includes the mnemonic (an easy-to-remember abbreviation) of the diagnostic that failed and the unit that failed (0 or 1).

The PM600 log details the start time of each step the REX test executed, the unit affected by the REX step, and the failure reason. REX steps included in the log after the failed step are recovery actions that REX initiates as a result of the failure. The unit number is only included if the REX action is unit specific (BSY unit, RTS unit, TST unit, sync) and not an action affecting the node (SwAct, BSY both units). The log's supplemental data consists of a cardlist and mnemonic of the failed diagnostic. Table 3-1 lists the mnemonics for the diagnostics and a description of the diagnostic.

Table 3-1xxx Diagnostic name and description	
Diagnostic name (mnemonic)	Description of diagnostic
ABDIAG	A/B Bits
AMUDIAG	6X50 External Loop
CONT DG	Continuity Diag
CSMDIAG	CSM Diag
CS SPCH	Network Links
DS1DIAG	P-Side DS-1
FORMATR	Local Formatter
MSGDIAG	6X69 Messaging Card
MSG IMC	IMC Link
PADRING	6X80 Pad/Ring
PS LOOP	P-Side Loops
PS SPCH	P-Side Speech Links
SMS AB	6X81 A/B Bits
SMS MSG	SMS A/B DDL Msg
SPCH DG	Speech Path
SYNC DG	Sync Diag
-continued-	

Table 3-1xxx	
Diagnostic name and description (continued)	
Diagnostic name (mnemonic)	Description of diagnostic
TONE DG	Tone Diag
TS DIAG	Time Switch Diag
End	

The QUERYPM command and command strings QUERYPM FLT and TST REX QUERY contain information about the last REX. Both system and manually initiated REXs store and display a new date/time and status (passed/failed) in the REX maintenance record. *Passed* means that the REX completed with no errors. *Failed* means that the REX did not complete because of an error. This information is available through the QUERY PM and TST REX QUERY commands. If the REX fails, the user either performs a manual RTS, a manual REX, or an automated REX to return the XPM to service from ISTb.

A REX maintenance record is stored for each XPM containing the following information:

- the REX scheduler, if the XPM is in the system
- the date/time and result (passed/failed) of the last REX
- the failure reason, diagnostics failures, and a list of faulty cards (if applicable), if the last REX failed
- the date/time of prior failed REX
- the date/time of first passed REX following prior failure

The following restrictions apply to REX tests:

- The system REX (SREX) controller only runs REX on one XPM at a time if the office uses the NT-40 processor. However, SuperNode supports concurrent REX testing for up to ten XPMs with the same REX test class.
- For REX to be run, the node must be in service, in-service trouble because of a REX failure, or in-service trouble because P-side DS-1 links are out-of-service.
- If a warm SwAct is not possible, REX will terminate rather than perform a cold SwAct.
- After successful completion of REX, the XPM has a new active unit (because of the SwAct).
- If a restart occurs while REX is in progress, the PM600 log is not output because the restart deallocates the temporary data store used to build the PM600 log.

- No SwAct controller override is provided for manual REX. See “SwAct controller” on page 2-8.

REX state machine interface to the pre-SwAct and post-SwAct audits

The REX state machine (or controller) permits the SwAct controller to refuse to attempt a SwAct. For information on the pre-SwAct and post-SwAct audits, see “Pre-SwAct and post-SwAct audits” on page 3-18. Specifically, the REX controller

- calls the SwAct controller during the pre-SwAct step just before the SwAct request is initiated. The SwAct controller determines if it is advisable for a SwAct to be attempted based on the diagnostic history of the unit maintained in the diagnostic history database (refer to the discussion of the PM diagnostic history database, feature AF5006, on page 2-14), the result of the last SwAct attempt to the inactive unit, and the data returned by the XPM in the pre-SwAct query message. This means an XPM can fail the pre-SwAct step of REX but show no failures in the DiagHist level of the MAP display, if the reasons for the pre-SwAct failure do not include diagnostic failures.
- accounts for SwAct denial and failure reasons
- terminates a REX test if a SwAct is denied
- terminates a REX test if a SwAct occurs, but the active unit of the XPM is unchanged from the time the REX test began. REX terminates without recovery actions because the SwAct code will submit a BSY/RTS of the inactive unit.
- displays the failure reason for a SwAct denial or failure performed during a manual REX at the MAP terminal as *REX failed*. The detailed reason for the failure can be obtained using the command string TST REX QUERY for the posted XPM. In addition, a PM600 log report is generated detailing the REX failure reason.

PM600 REX failed log report

PM600 logs record the maintenance actions performed on the XPM during the failed REX from the start of the REX to the step that failed. This information can be used to pinpoint the source of the REX failure. The causes and for a PM600 log follow:

- Warm SwAct
- Warm SwAct turned off
- PreSwAct audit failure
- Autonomous SwAct
- OOS tests of inactive unit 0
- OOS tests of inactive unit 1
- RTS of inactive unit 0

- RTS of inactive unit 1
- Achieving superframe/data sync of unit 0
- Achieving superframe/data sync of unit 1
- InSv tests of inactive unit 0 before SwAct
- InSv tests of inactive unit 1 before SwAct
- InSv tests of active unit 0 after SwAct
- InSv tests of active unit 1 after SwAct
- InSv tests of inactive unit 0 after SwAct
- InSv tests of inactive unit 1 after SwAct
- RTS of inactive unit 0 after SwAct
- RTS of inactive unit 1 after SwAct
- Achieving superframe/data sync of unit 0 after SwAct
- Achieving superframe/data sync of unit 1 after SwAct
- SwAct to unit 0 refused by SwAct controller
- SwAct to unit 1 refused by SwAct controller
- SwAct back to unit 0 occurred
- SwAct back to unit 1 occurred
- Recovery failed-SwAct

The PM600 log is output when an XPM REX test fails. PM600 provides a record of the steps that occurred during the REX from start to the test that failed, including any recovery actions that REX may have initiated. This log helps to determine the cause of the XPM REX failure. The following example shows a PM600 log report.

** PM600 JUN08 01:28 8600 TBL REX FAILED XPM 0
Node:ISTb, Unit 0 Act:InSv, Unit 1 Inact:SysB (Diag Failed)

<u>REX Step</u>	<u>Unit</u>	<u>Start Time</u>	<u>Failure Reason</u>
Tst Inact	0	09:17:33	
Bsy Inact	0	09:17:47	
RTS Inact	0	09:18:15	
Sync Inact	0	09:21:43	
PreSwAct	0	09:21:51	
Warm SwAct	-	09:22:37	
Bsy Inact	1	09:22:40	
RTS Inact	1	09:23:08	
Sync Inact	1	09:25:27	
Tst Act	0	09:22:50	REX test failed-InSv tests of active Unit 0 after Swact
Warm SwAct	-	09:25:28	
Bsy Inact	0	09:25:29	
Finished	-	01:28:25	

Supplemental Data

Diagnostic Failures: UTRDIAG

Site	Flr	RPos	Bay_id	Shf	Description	Slot	EqPEC
HOST	01	L15	SME	00	65 SMR : 000	15	6X92

Effects of a Warm SwAct

With Warm SwAct, the inactive unit of the SMR can maintain established calls (calls in the talking state) and process new calls when it takes control of the SMR in a switch of activity with its mate. When established calls are maintained in this manner, the process is known as Warm SwAct. Calls that are in a transient state, such as dialing or ringing, are not maintained when a Warm SwAct occurs. Subscribers are dropped, but when they reoriginate they receive dial tone immediately, except in the case of mode II dual circuits, when the subscriber must go onhook first to reoriginate a call.

Warm SwAct requires that both units of the SMR be in-service and Warm SwAct enabled. Warm SwAct is enabled by default after a system reload-restart; however, the switch operator can disable Warm SwAct by issuing the following command at the PM-level of the MAP against a posted SMR:

WARMSWACT OFF

If a SwAct is attempted for an SMR while Warm SwAct capability is disabled, a Cold SwAct occurs. While activity may be transferred, in-process calls are lost.

The switch operator can reenable Warm SwAct by issuing the following command at the PM-level of the MAP:

WARMSWACT ON

Refer to *Peripheral Modules Maintenance Reference Manual*, 297-1001-515 for more information on the SwAct command. Note that the inactive unit is briefly removed from service, and a PM181 log is produced.

Note: Throughout the SwAct descriptions, the following terms are used. As an example, assume that an SMR is In service (InSv) and that unit 0 is active and unit 1 is inactive.

- Original active unit - the active unit before the SwAct (unit 0)
- Original inactive unit - the inactive unit before the SwAct (unit 1)
- Newly active unit - the active unit after the SwAct (unit 1)
- Newly inactive unit - the inactive unit after the SwAct (unit 0)
- Drop message - the message the original active unit (unit 0) sends to the CC telling the CC that it has dropped activity
- Gain message - the message the newly active unit (unit 1) sends to the CC telling the CC that it has gained activity.

Two types of updates, both containing information about the SMR-RCT subsystem, can occur when information is transferred from the original active to the original inactive unit of the SMR: bulk data updates and ongoing data updates.

Bulk data update When Warm SwAct is enabled, if both units of the SMR are in-service, the inactive unit requests from the active unit a bulk transfer of critical dynamic data needed to maintain established calls and continue call processing, should a SwAct occur. This transfer is known as a bulk data update.

If, however, the inactive unit is out of service when Warm SwAct is enabled, it requests a bulk data update when it is returned to service (RTS).

Bulk data includes RCT status, P-side and C-side port statuses (open/closed), and call processing data (for example, connection of a specific line circuit to a specific DS-1 channel).

Ongoing data update When the bulk transfer of critical data is complete, communication continues between the mates so that information may continue to flow from the active unit to the inactive unit in what is known as an ongoing data update. As these data change, the inactive unit is updated so that it maintains the capability to take over call processing (CP) from its mate should a SwAct occur.

Table 3-1 lists critical dynamic data transferred to the inactive unit when Warm SwAct is enabled along with the conditions for changes in this data.

The active unit sends this information to its mate, first in bulk, then on an ongoing basis as data in the active unit change.

Table 3-1
Critical dynamic data

Dynamic Data	Condition for Change
Call Data	Call is established or disconnected.
Terminal Status	Terminal (line or trunk) is put into or taken out of service.
Port Status	P- or C-side port change in state (open or close) is requested.
DS-1 Maintenance	Maintenance or data synchronization reporting over DS-1 links is enabled or disabled.
P-side Node Status	P-side node (that is, RCT) is busied or returned to service.
Protection Switching	Protection switching is enabled, disabled, switched, or unswitched.
Nailed-up Connections	P-side to P-side "nailed-up" connection for special services is established or taken down.
-continued-	

With this data, the inactive unit may take over call processing from its mate while retaining a majority of established calls.

There are two kinds of SwAct, controlled and uncontrolled. Controlled SwActs are performed as a result of manual requests such as Warm SwAct, and as a result of system requests such as busying the active unit while the inactive unit is inservice or RTSing the inactive while the active unit is out of service. A controlled SwAct will also occur as part of the Routine Exercise (REX) sequence performed on both units of the SMR.

Uncontrolled SwActs, as seen by the CC, are performed as a result of a hardware failure or a trap in the active unit. When a SwAct occurs, the CC and the SMR exchange a series of messages so that each is aware of what is happening. The SwAct is considered complete when the CC receives the gain message from the newly active unit.

Messaging improvements

If the CC does not receive the drop message, then the SwAct Operation Robustness BCS31 feature allows the original active unit to reset through its

mate unit. This feature is helpful if the C-link to the original active unit is out of service.

The CC does not always receive the drop and gain messages from the SMR because of suspect noise on the C-side messaging links during a SwAct. To account for this noise, the XPM REX/SWACT Robustness BCS32 feature allows the CC more opportunities to receive the messages. If the SMR does not receive an acknowledgement from the CC within one second of sending the gain message, another gain message is sent. This process is repeated for 15 seconds (a maximum of 15 gain messages could be sent to the CC) before the SMR times out. If the CC does not receive the gain message within 20 seconds it can assume the SwAct failed.

Limitations

The limitations of a Warm SwAct are:

- Warm SwAct is used for maintaining calls. If a subscriber line test is active and a Warm SwAct occurs, the test will fail.
- Because of bandwidth limitations on the IMC link between the two SMR units and limited SP real time, call data is synchronized between the mates when there is no call processing. Therefore, under heavy traffic, call data in the inactive unit may not be up to date. Some established calls may be dropped when SwAct occurs.
- A call that has been switched, during a very high usage period, from active to inactive units by an uncontrolled Warm SwAct may lose its hook flash capability to initiate custom calling features for the remainder of the call: under these conditions, a hook-flash may be ignored.
- If an origination is made from a coin phone and the call is not maintained during a Warm SwAct due to heavy traffic or no answer at the terminating end, the coin is neither returned nor collected. It remains in the hopper. The calling party immediately receives dial tone and, since the coin is still in the hopper, can redial. If the calling party presses the hookswitch, the coin is returned.
- Timing is lost for a billing call when a Warm SwAct occurs. For example, if a subscriber makes a toll call that lasts five minutes before a Warm SwAct occurs, then continues the call for ten minutes after the SwAct, neither time appears in the call records.

Interactions

Activity switch may occur while a subscriber line test is in progress. When SwAct occurs, the ongoing test fails. The switch operator can release the connection to the Metallic Test Pair, reaccess the test network, and retry the test.

Removal of OOS diagnostics

Prior to BCS31, issuing the >SWACT command would automatically invoke the out of service diagnostic test set on the newly inactive unit. This helped

ensure that the newly inactive unit had no faults and could therefore take over call processing again if necessary.

However, if there is a failure during the Warm SwAct, the newly inactive unit must be put back into service as quickly as possible. With diagnostics being run on this newly inactive unit, the sequence of returning to the original active-inactive configuration is slowed. In BCS32, to speed up this return to the original configuration, the out of service diagnostic test set is no longer automatic during a Warm SwAct.

Note that these tests are still run under the following conditions:

- 1 The >SWACT command now has the parameter TEST, which allows the SwAct sequence to include the OOS diagnostics.
- 2 The Routine Exercise (REX) tests continue to include the OOS diagnostics, since these tests are important to the REX sequence; moreover, REX tests are scheduled during low-traffic periods to minimize any impact on call processing.

Activity drop reasons

Following are reasons that a SwAct is necessary:

- Activity timeout - The SMR has experienced an activity or sanity timeout.
- Trap - The SMR has trapped.
- Request - A drop of activity has been requested (for example, a SwAct or restart).
- Duplicate fault - A critical operational fault of duplicated hardware has occurred.
- Jammed - The SMR unit has been jammed.
- Static data corruption - The static data audit had found data corruption in the SMR unit.
- Pre-SwAct audit failure - A pre-SwAct audit has failed. The unit may not be able to gain activity.

The most up-to-date reason for an activity drop during SwAct is included in the PM181 log.

Pre-SwAct and post-SwAct audits

The purpose of the SwAct audits is to provide a mechanism in the XPM that increases SwAct reliability by preventing a SwAct to a mate unit that is deemed incapable of maintaining activity. If a SwAct does occur and the newly active unit does not establish two-way communication with the CC, a SwAct back to the originally active unit is attempted. The new mechanism within the XPM that provides this additional SwAct reliability is based on the following audits:

- pre-SwAct audits
 - pre-drop
 - pre-gain
- post-SwAct audits
 - post-gain
 - post-drop

Each of these audits exists in each unit. Since a SwAct involves the dropping of activity by one unit and the gaining of activity by the mate unit of a peripheral, each audit has a unique role in the various states of a SwAct. The audits controlling a SwAct within the XPM are described in more detail in the following sections.

Pre-drop audit

The function of the pre-drop audit is to accept a request to drop activity and to determine if the mate unit is in a condition suitable to accept activity. This audit runs only in the active XPM unit.

A SwAct of the peripheral can be initiated from one of two possible sources:

- the CC, in the form of a request to the active unit to drop activity
- the active XPM unit, causing an autonomous SwAct

In determining whether to drop activity, the pre-drop audit evaluates the following criteria:

- source of the request (CC or XPM)
- type of drop request
- known status and history of the currently active unit
- known status and history of the inactive mate unit

For a CC-initiated SwAct, the SwAct Controller queries the XPM. The pre-drop audit in the XPM responds to this query, informing the CC whether the active unit can comply with a request to drop.

Pre-gain audit

The pre-gain audit monitors the XPM status data in the inactive unit and sends this information to the pre-drop audit in the active unit. The pre-drop audit uses this information to determine if the active unit should drop activity. The XPM status data examined by the audit includes the following:

- Facility audits - the result of the last run for each diagnostic in the facility audit for a given peripheral is recorded in the XPM.
- Status information contained within the unit - this information includes if the inactive unit
 - is in service and ready
 - has CC links OK
 - does not have corrupt static data
 - is in sync
 - is not jammed as the inactive unit

Note: Since not all diagnostic paths can be reached by an inactive unit, it may be necessary to perform a manual SwAct with the FORCE option to clear a failure from the pre-gain audit record.

The pre-gain audit continues to monitor and report unit status and condition information while the unit is inactive. Once the pre-drop audit determines the active unit can drop activity using the information provided by the pre-gain audit, a warm SwAct occurs and the post-gain audit in the newly active unit begins to run.

Post-gain audit

The post-gain audit runs in the newly active unit. Its only purpose is to verify the unit establishes two-way communication with the CC. If communication is established, the newly active unit maintains activity. If the communication check fails, the unit forces a drop of activity to initiate a SwAct back to the originally active unit. In this case, the pre-drop audit does not refuse the SwAct but allows it to proceed. If the SwAct back fails, the entire XPM node is busied and returned to service.

Post-drop audit

The post-drop audit runs in the newly inactive unit. The newly inactive unit remains in service temporarily without initializing. The main function of the post-drop audit is to clean up the call processing data structures of unstable calls and non-synced stable calls. Once it is determined a SwAct back is not needed or a SwAct back is complete, the XPM informs the CC, and the inactive unit is busied and returned to service.

Engineering

This section describes the tasks required to plan and engineer the Subscriber Carrier Module-100 Rural (SMR).

The following functional groups in an operating company perform tasks that are covered in this section:

- Long-range planning
- Network design
- Switching engineering
- Network planning

Service requirements

The Subscriber Carrier Module-100 Rural (SCM-100R) also referred to as Subscriber Module Rural (SMR), is the first peripheral in the SCM-100 Family. It replaces the Control Concentrator Terminal (CCT) of the DMS-1R subscriber carrier system and provides direct digital interface between the DMS-1R Remote Concentrator Terminal (RCT) and the DMS-100F.

Supported features (SMR-RCT)

The following list summarizes features supported for the SMR-RCT subsystem.

- 256 RCT-serviced subscriber lines
- coin functions (pre-pay, semi-post-pay and post-pay)
- Custom Calling Services (Speed Calling, Call Waiting, Three-way Calling, and Call Forwarding)
- dial pulse, Digitone
- Dial Tone Speed Recording (DTSR)
- DMS-1R RCT integrated alarms
- Operational Measurements
- Operator Verification
- POTS
- Protection Switching (software feature deleted-replaced by an operating company provided hardware device)

- Station Ringer Test

Real time impact

Refer to REAL :: TIME for processor occupancy for Subscriber Module Rural (SMR). Adjustments must be made for every additional RT after the first.

Memory capacity

Refer to MEMCALC for memory provisioning.

Interpretation of traffic based data

Three to 16 DS-30 speech links connect the SMR to the network ports of the network modules. The SMR is compatible with all existing and new network modules. The quantity of DS-30 ports to the network should be engineered on a non-concentration basis due to the concentration already existing at the RCT; therefore, configure DS-30 ports per a channel-in/channel-out ratio of one-to-one.

SMR architecture

The Subscriber Module Remote (SMR) is similar in configuration to the Line and Trunk Controller (LTC).

Shelf and unit layout

The SMR is redundant, having two units. Each SMR unit is able to support processing and control functions. The units operate in "hot" standby configuration: one unit is active while the mate unit is on standby. When a fault is detected on the active unit, standby control on the mate unit takes over. This unit then maintains full control of the links until the failure is corrected.

Unit 0 always occupies the lower shelf in a standard DMS-100 frame, and unit 1 always occupies the upper shelf. The units consist of LTC cards and two cards unique to the SMR.

See Table 4-1 for a list of these cards, their product engineering codes (PEC) and their general specification (GS) document numbers. Refer to the GS for further information on the cards. These cards are also described in the glossary.

Table 4-1
SMR cards

Card Name	PEC	GS Number
Speech Bus Formatter	NT6X41AA	GS6X41
Channel Supervision Message	NT6X42AA	GS6X42

Message Interface	NT6X69AC	GS6X69
Time Switch	NT6X44AA	GS6X44
Master Processor	NT6X45AC	GS6X45
Signaling Processor	NT6X45AC	GS6X45
Signaling Processor Memory	NT6X46BA or NT6X46AC	GS6X46
Master Processor Memory	NT6X47AB or NT6X47AC	GS6X47
DS-1 Interface Card	NT6X50AA	GS6X50
A-Bit/B-Word	NT6X81BA	GS6X81
Ring/Pad	NT6X80AA	GS6X80
DS-30 Interface Card	NT6X40AA	GS6X40
Power Converter	NT2X70AE	GS2X70

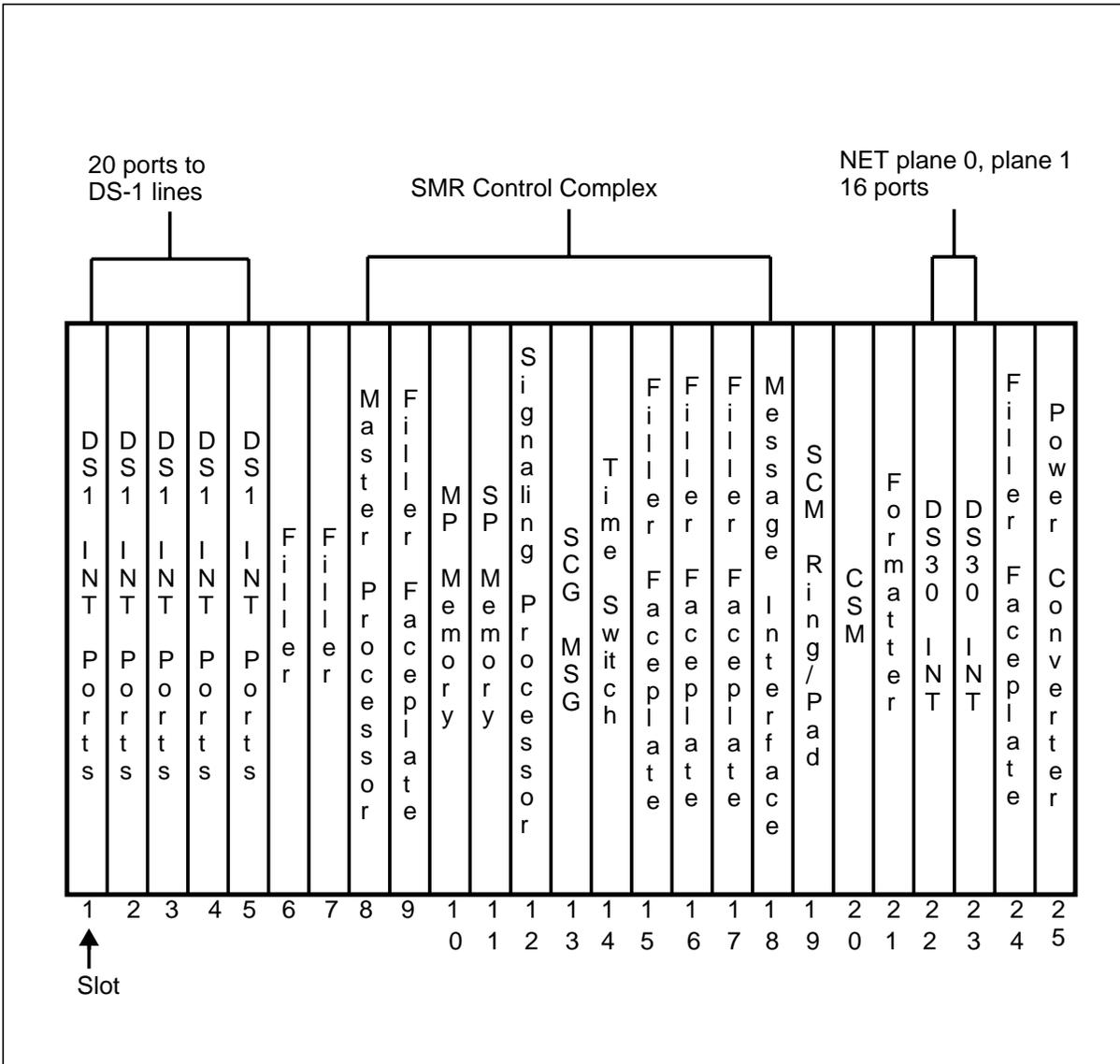
The SMR has one of the two signaling processor memory cards listed in Table 4-1. They each provide one megabyte of memory. The master processor memory is a total of four megabytes. This is established with two 6X47AB cards with 2M each, or with one 4M 6X47AC card.

The new Messaging circuit pack provides the SMR with an additional two megabytes of memory, increasing the total memory capacity to four megabytes. The new Message circuit pack, NT6X69AC, is required for applications after BCS32.

The two unique SMR cards adapt the SMR to interface the DMS-1R RCT. The A-bit/B-word card automatically scans subscriber lines, inserts A- and B-bits into the PCM data stream, and extracts A- and B-bits from the PCM data stream. The Ring/Pad card selectively attenuates speech samples from 0 to 7 dB and provides the DMS-1R RCT with PCM ringing instructions for frequency selective and superimposed ringing.

Besides the A-bit/B-word, Ring/Pad, and basic LGC cards, the SMR also has DS-1 and DS-30 Interface packs, spare card slots for adding more cards, and two power converter cards. Power for the DS-1 interface cards is provided by the standby power converter if the active converter fails. The locations of all possible cards are shown in Figure 4-1 .

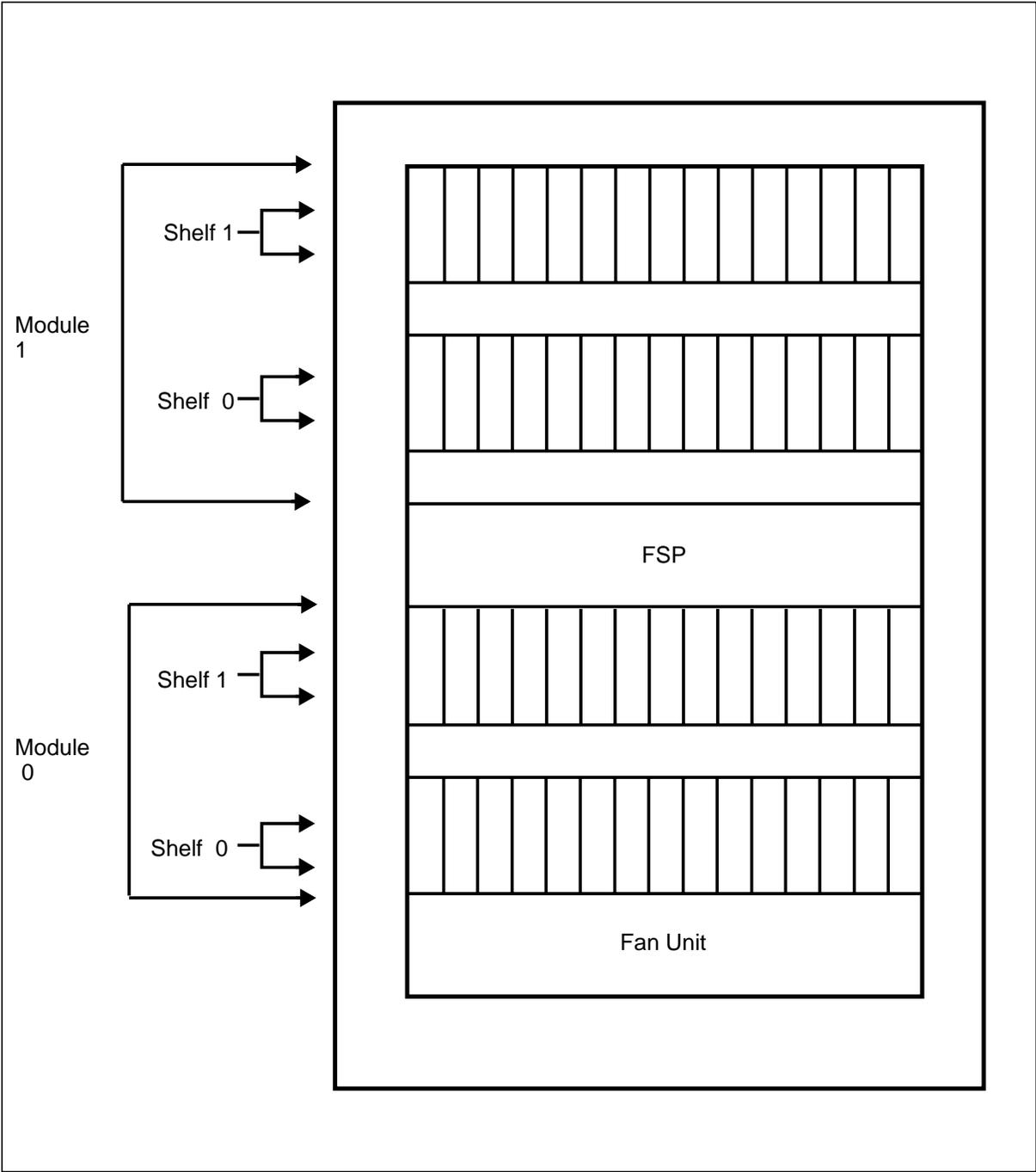
Figure 4-1
SMR unit (front view)



Frame

The SCM backplane is designed to accommodate combinations of peripheral modules, so that any combination of SMR, LGC, DTC, and LTC can be provisioned in one frame. See Figure 4-2 for SMR equipment frame layout.

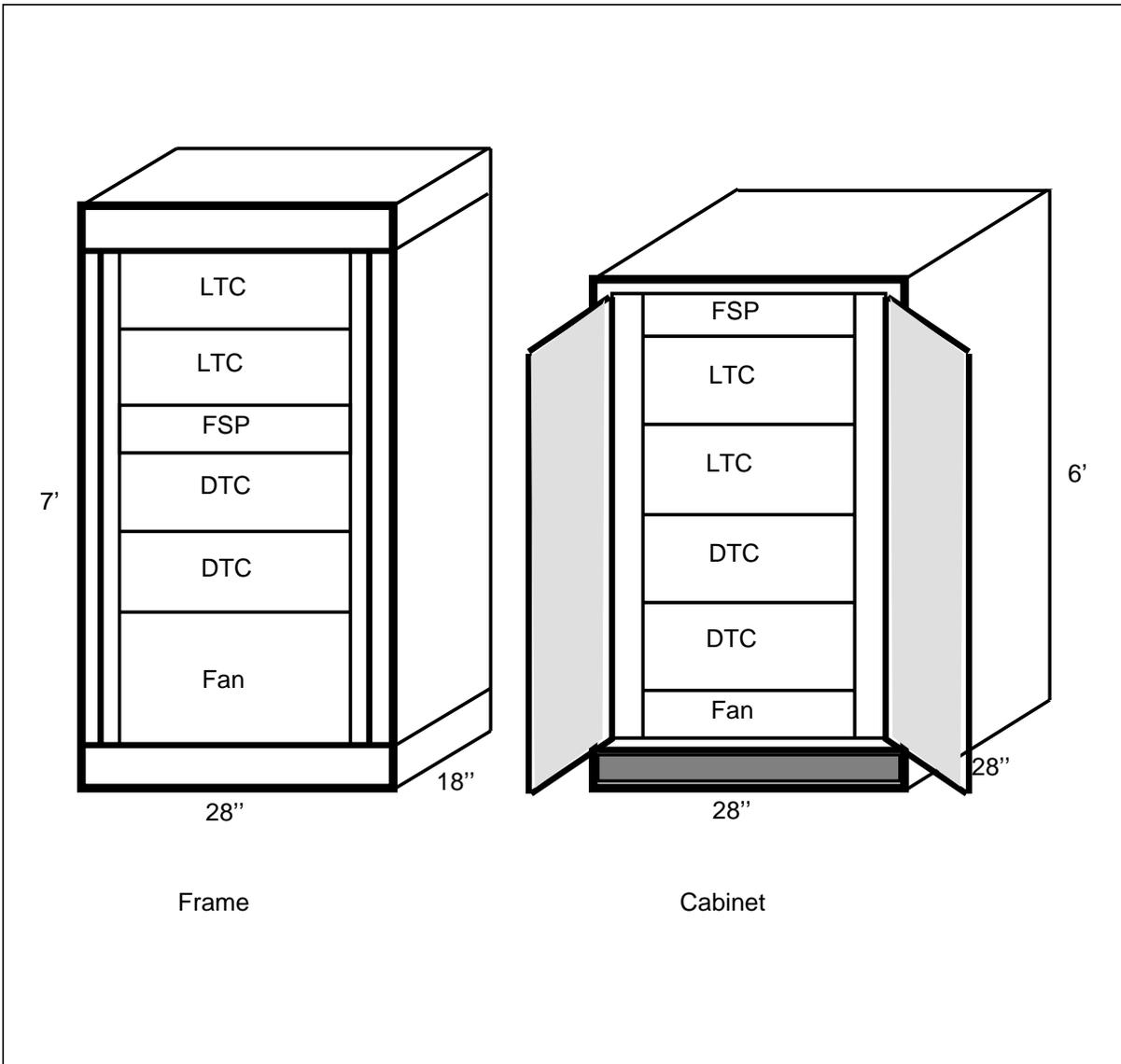
Figure 4-2
SMR frame (front view)



The SMR shelf pairs are housed in a standard DMS-100 single-bay frame referred to as an SMR equipment frame (SME) or in a cabinetized version of the frame. The SME and its cabinetized version contains two pairs of shelves, each pair referred to as a module. Module 0 is made up of the lower

two shelves, while the two upper shelves form module 1. Both the frame and the cabinet contain a Frame Supervisory Panel (FSP), which provides power control and alarm circuits, and a fan unit that supplies a cooling air flow. Figure 4-3 illustrates the differences between the frame and the cabinet.

Figure 4-3
Comparison of the SMS frame to the SMS cabinet



SMR provisioning

Hardware provisioning

DS-1 and DS-30 links

The SMR has up to 16 pairs of DS-30 links to the network that are connected to four DS-30 Network Interface cards (two in shelf 0 and two in shelf 1). Each card supplies 8 DS-30 ports, providing a maximum of 32 (0-31) ports on a fully equipped SMR. Sixteen ports are dedicated to network plane 0 and 16 to plane 1. Port assignments are distributed among the four DS-30 cards: even-numbered ports are assigned to plane 0 and odd-numbered to plane 1. At least three ports per SMR are required for interface with the Network Module.

When operating as an SMR, each shelf is equipped with DS-1 interface cards according to the number of Remote Concentrator Terminals (RCT) configured on the SMR. Each DS-1 circuit pack is connected to the control coupler of both shelves. Up to five DS-1 interface cards exist on each shelf with each providing two DS-1 ports. Port assignments for each shelf follow:

- Shelf 0: Ports 0, 1, 4, 5, 8, 9, 12, 13, 16, 17
- Shelf 1: Ports 2, 3, 6, 7, 10, 11, 14, 15, 18, 19

Protection lines (DMS-1R RCT)

The SMR supports up to six DMS-1R RCT with each RCT servicing up to 256 subscriber lines. The RCT is connected to the SMR by one or a maximum of two DS-1 lines with an optional DS-1 line called a protection line.

A protection line is a DS-1 line which can connect to up to six RCTs in a daisy chain. A protection line serves as a spare DS-1 which can be rapidly switched in to replace a failed DS-1. The protection line is connected to the RCT by relays which physically substitute the protection line's wires for the wires of a normally working line. When provisioning protection lines, a minimum of one DS-1 line per SMR is required. The maximum is six per SMR, or one per RCT.

The Alcatel (Lynch) Automatic Protection Switch (B302MA09) is recommended. These Lynch units must be installed and used in accordance with the Lynch instruction manual in order to comply with subpart J, part 15, of FCC Rules for Class A computing devices. Refer to Alcatel for further information on the Lynch Automatic Protection Switch.

Tone receivers (DMS-1R RCT)

The SMR provides all basic tones to an RCT, including dial tone, busy tone, reorder tone, audible ringing (ringback) tone, high tone, receiver offhook tone, and call waiting tone. Additionally, the SMR supports all the currently available ringing schemes: coded, frequency selective, and superimposed.

The Universal Tone Receiver (NT6X92BB) is not currently supported in the SMR. Digitone Receivers (NT2X48AB) must be provisioned for lines at the RCT.

Sparing levels provisioning

Standard sparing algorithms apply.

Software provisioning

The SMR basic software feature package is NTX213AC. Interdependent software feature packages are:

- NTX000AA - Bilge
- NTX001AA - Common Basic
- NTX270AA - New Peripheral Maintenance Package
- NTX901AA - Local Features I

NTX213AC contains the following features:

- SMR Ringing Robustness AF0012
- SMR Dynamic Channel Reassignment AF0089
- RCT Link Fault Isolation Enhancement AF1345
- NT6X81 Firmware Robustness AF2341
- SMR B-Word Facility Robustness AF2342
- SMR Maintenance Robustness AF2343
- SMR Audit Robustness AF2344
- RCT Subscriber Loop Test Digital Robustness AF2345
- SMR Call Processing Robustness AF2347
- SMR A-Bit Facility Robustness AF2348
- PP B Word Facility BC0753
- PP A-BIT/B-WORD Functional Diagnostic BC0755
- PP Pad/Ring Diagnostic BC0756
- CC Type/Data Extension BC0758
- CC SCM Inventory Table BC0759
- CC RCT Inventory Table BC0760
- PP Digital Test Head BC0761
- CC SCM Maintenance BC0762
- PP A-Bit Facility BC0763
- CC RCT Maintenance BC0764
- CC Alarms BC0771
- CC & PP Traffic Measurements BC0772
- CC Logs BC0773

• CC Protection Switching for SMR	BC0776
• PP P-Side Channel Allocation	BC0777
• PP Ringing	BC0778
• PP POTS Call Processing	BC0779
• T1 Maintenance for Remote Links	BC0956
• PP Protection Switching	BC1114
• CCX RCT Lines Maintenance Phase II	BC1133
• LTA on RCTS (CC)	BC1679
• SMR PP OMS and DTSR	BF0485
• SMR PM Maintenance - Phase II	BF0552
• PP SMR Audits	BF0569
• PP SMR Warm SWACT	BF0572
• SMR Overload Control	BF0580
• LTA on RCTS (PP)	BF0695
• Operator Verification for SMR	BV1171
• Remote Service Bureau Line Maintenance	BV1172
• CC Line Inventory	BV1173
• MAP Line Maintenance	BV1175
• PP 2 PYT ANI	BV1176
• PP Coin Functions	BV1177
• PP RCT Control Circuit Maintenance	BV1178

Note that these features are part of the NTX213AC (not the AB) package. Also note that starting from BCS27 protection switching is not part of the AB package.

Tools for provisioning

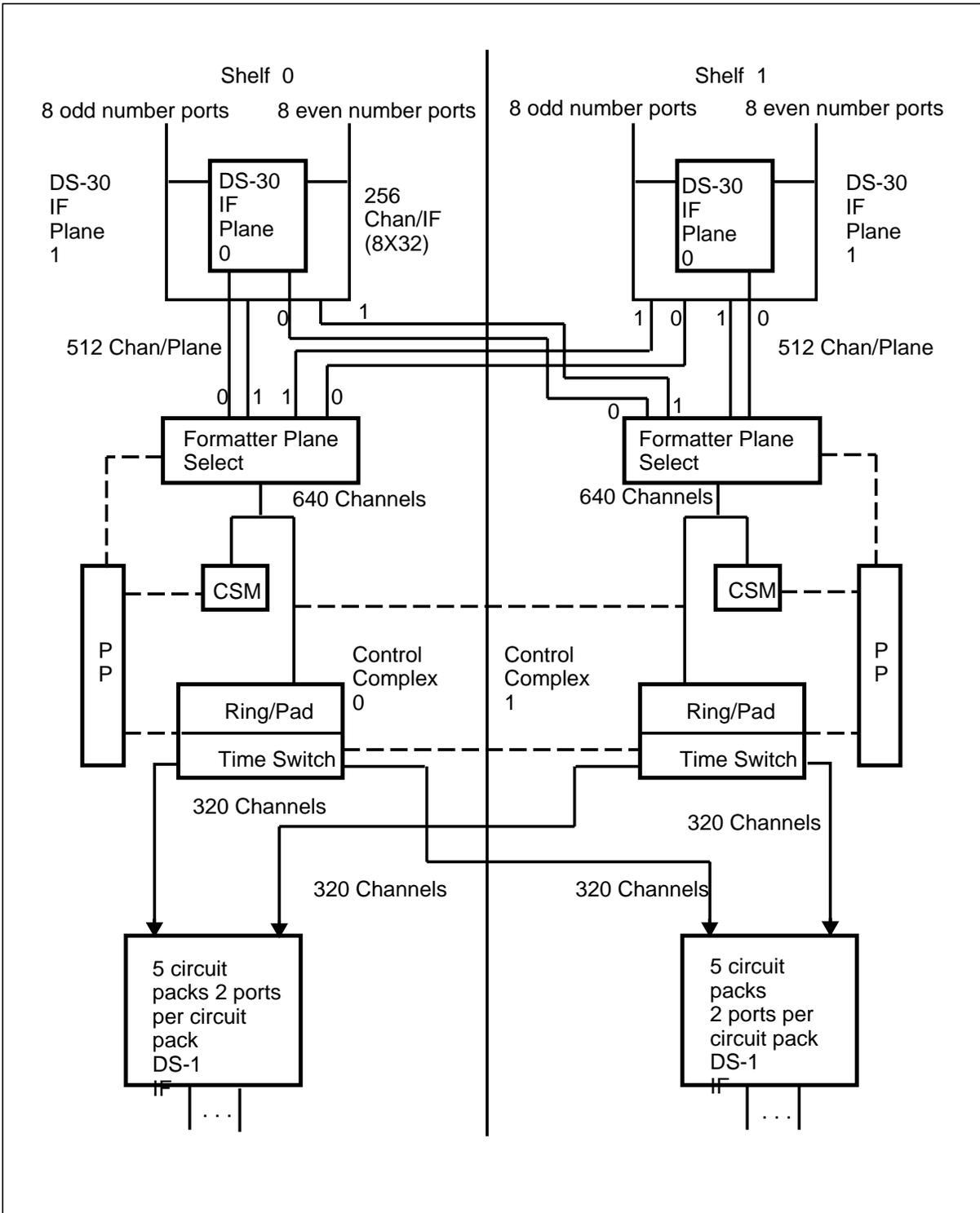
Refer to NT Access and 8620 questionnaire for provisioning the DMS-1R RCT subsystem. Contact the Northern Telecom regional representative for further assistance.

Functional description of the SMR

Voice and data flows

Since the Subscriber Module Rural (SMR) is based on line and trunk controller (LTC), its internal voice and data flow diagram is similar, as shown in Figure 4-4.

Figure 4-4
SMR functional block diagram



Each pair of DS-30 cards per shelf outputs 256 (8 X 32) channels per plane to the formatter cards in units 0 and 1, thus providing a duplicated path through the currently active control complex. Each formatter handles 512 speech channels (256 channels from each unit) per network plane. The 512 speech channels are added to 128 internal service channels and converted to a 640-channel (512 plus 128) bus to the SMR control complex.

Note that all the DS-1 ports (0-19) are controlled by the active unit, regardless of where they reside.

A-bit/B-word card

The SMR A-bit/B-word card is microprocessor based and unburdens the Signaling Processor (SP) of intensive Input/Output (I/O) operations required by the DMS-1R RCT. Its two main functions are:

- Inserting A- and B-bits into and extracting A- and B-bits from the PCM data stream
- Scanning subscriber lines for offhook (inactive supervision).

By carrying out these functions, the A-bit/B-word card enables the SP to concentrate on other control tasks. The A-bit/B-word card communicates with the SP through common memory residing in its RAM and to the Time Switch through two serial I/O circuits. The A-bit/B-word card can support ten DMS-1R RCT.

Ring/Pad card

The Ring/Pad card performs the following functions:

- attenuate voice samples
- provide ringing PCM samples to the DMS-1R RCT for frequency selective and superimposed ringing.

The Ring/Pad card contains digital pad values that decrease selectively the magnitude of voice samples on a per channel basis. Voice attenuation is important on subscriber lines to avoid unwanted echoes. Typically, a 2-dB of loss is introduced to avoid these undesirable characteristics.

The Ring/Pad card can decrease the magnitude of a voice sample from 0 to 7 dB in 1-dB increments. The amount of loss introduced depends on several factors including

- Ability of the RCT line card to introduce attenuation. These cards can introduce up to 2 dB of loss.
- Destination of the call.

Voice samples are padded only in the outgoing (RPCM) direction: Network to DMS-1R RCT. No loss is introduced to incoming (XPCM) samples.

The Ring/Pad Ringing Processor (RP) provides ringing PCM samples that simulate a low-frequency sine wave of a set of four of the existing 13 ringing frequencies and four dc control voltages (the superimposed remote line card uses these voltages). The frequencies and voltages are

- Frequencies (Hz)

- 16.00	16.67	20.00	25.00	30.00
- 33.33	40.00	42.00	50.00	54.00
- 60.00	66.00	66.67		
- Voltages (V)

- +48 Ring	+48 Tip	-48 Ring	-48 Tip.
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The low-level PCM samples are amplified at the RCT and decoded by the QPP440, QPP445, or QPP541 cards in the following ways:

- The QPP440 card uses the PCM samples to "chop" a 300-V dc supply coming from the RCT Converter card. It chops the dc supply at a rate synchronous with the ringing signal to generate a ringing waveform.
- The superimposed remote card QPP445 uses the PCM only to select a ringing generator and to choose which side of the line to apply the ringing. Actual ringing voltage is supplied by a ringing generator, either -20 Hz voltage or +20 Hz voltage.
- The QPP541 card chops a 48-V power supply.

RCT architecture

Shelf and unit layout

There are four types of shelves, plus a fuse panel, in an RCT. (Three of these shelves are shown in Figure 4-5).

- Common shelf (one per RCT).

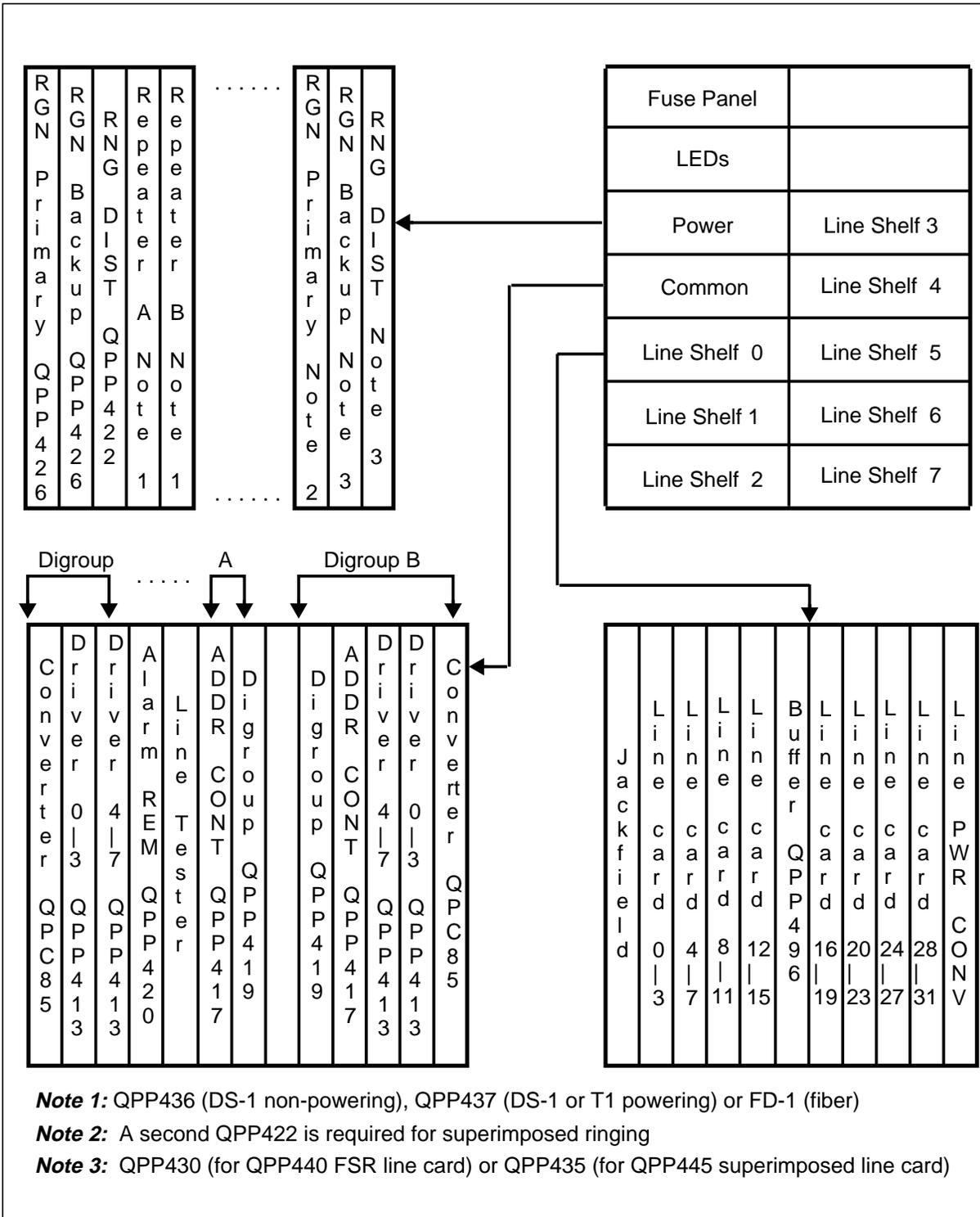
This shelf contains all of the cards associated with a digroup, as well as the alarm remote, local switch, and line test circuit cards.
- Power shelf (one per RCT).

This shelf is equipped with a backplane for use with lines that operate with single-frequency, frequency-selective (FSR), or superimposed ringing. The shelf contains ringing generator and ring distribution circuit cards as well as repeaters. The rightmost slots can contain either the QPP430 converters or the QPP435 ringing generators that are required for the QPP440 FSR and QPP445 superimposed line cards, respectively. The QPP541 FSR line card does not require the QPP430 converter.
- Line Shelf (up to eight per RCT).

Each line shelf contains the following components:

- line cards (up to eight)
- buffer card
- line power converter
- jackfield (optional)
- Order-Wire and Fault-Locate Shelf.
This shelf contains cards that are used for termination and access to the order-wire and fault-locate pairs of the DS-1 lines. Refer to *Order-Wire and Fault-Locate Shelf*, 363-2011-103 for more information.
- Fuse panel.
This is used to distribute power to each of the circuit card shelves of the RCT.

Figure 4-5
RCT shelf layout



Guidelines for configuring line cards

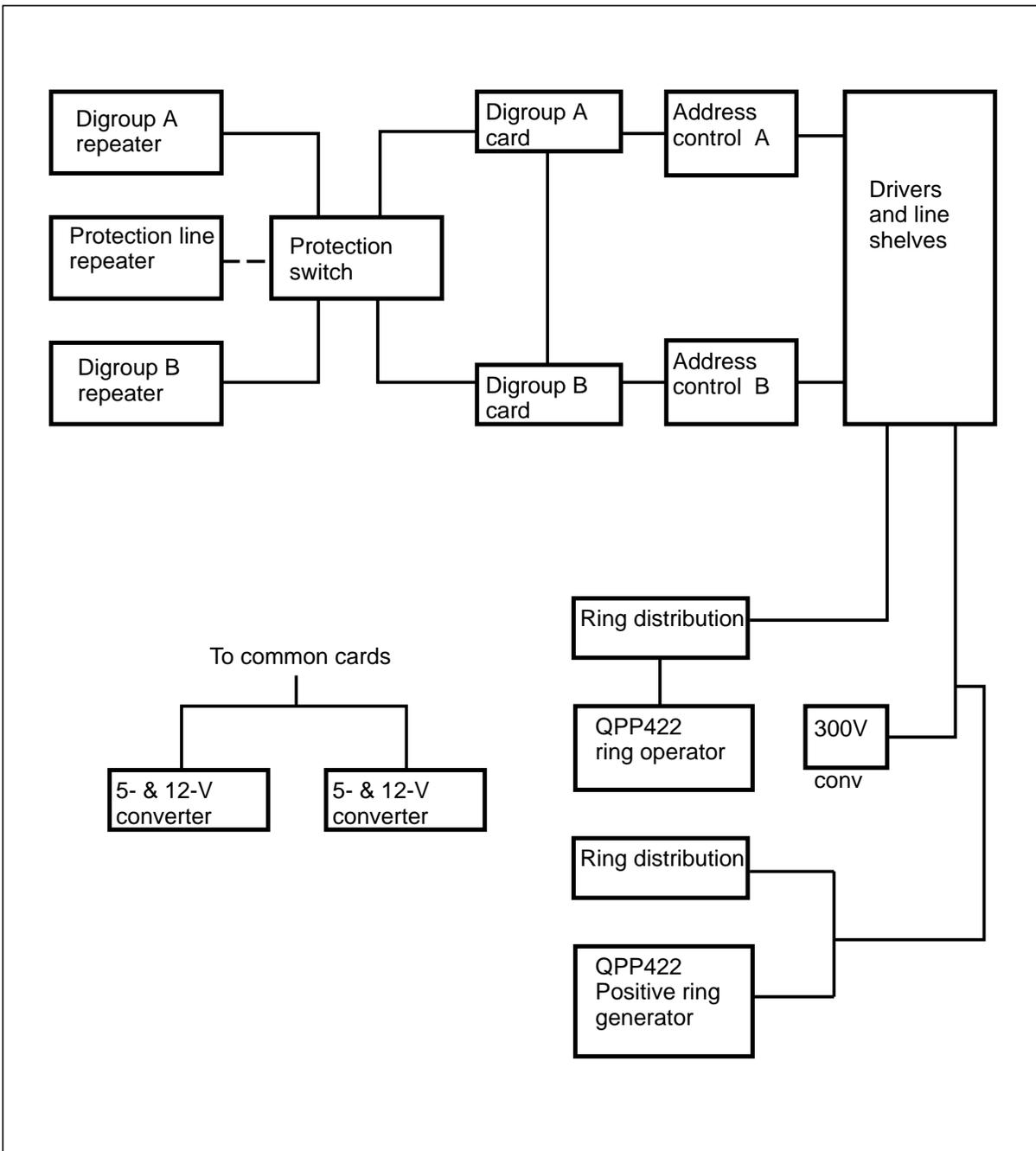
The RCT supports up to eight line shelves with each line shelf having a mix of eight line and coin cards. A line card supports four subscriber lines while a coin card supports two lines. Note that since there can be no more than two coin cards per line shelf (which must occupy the leftmost two slots), the total line capacity can vary between 192 subscriber lines (with the maximum 32 coin lines) and 256 subscriber lines (with no coin lines).

Do not mix QPP407 and QPP541 on the same RCT shelf. This can cause severe card damage.

Functional description of the RCT

Figure 4-6 illustrates RCT architecture.

Figure 4-6
RCT block diagram



Repeater

The Repeaters link to the DS-1 lines and monitor signals from the digital line for loss of signal and for bipolar violations.

Digroup card

The Digroup card performs bipolar/unipolar conversion and extracts the clock signal, frame pulse, and B word from the incoming signal. The received signal is synchronized to the framing pattern.

Address control card

This card performs B word decoding and encoding. The first time the SMR sends a B-word, the Address Control circuit pack stores it. The second time the SMR sends the same B word, the Address Control card receives it, checks it for error, and decodes it. The RCT then executes the B-word command. RCT registers and memory address data are encoded into the outgoing B word when requested by a SMR.

The switch settings on the Address Control Card must all be set to ON.

Other components

Each address control interfaces to the line shelves through two drivers. Each line shelf has its own line power converter. A pair of 5- and 12-V converters (one power converter per digroup) provides power to the logic circuits. Two ringing buses connect the Ringing Generators to the line shelves.

Digroups A and B are referred to as links 0 and 1, respectively.

Overview of RCT line cards

Following is a brief description of the RCT line cards.

- **Single Party Remote (QPP405)**
This card supports four single-party subscriber lines. Bridged ringing is provided by a -20 Hz ringing generator.
- **Universal Remote (QPP407)**
This card supports four subscriber lines. These subscriber lines may be equipped for either single party service or multiparty service with divided ringing (-20 Hz on either the tip or ring side). For two-party service, ANI detection is supported. For multiparty lines greater than two, outgoing call service is routed to an operator for call handling.
- **Frequency Selective Remote (QPP440/541)**
These cards support four subscriber lines with two-party ANI and frequency selective ringing with divided ringing. They allow the standard harmonic, decimonic, and synchronomic ringing schemes.
- **Superimposed (QPP445)**
This card supports four subscriber lines with two party ANI and divided ringing. During ringing control, the QPP445 decodes several PCM signal

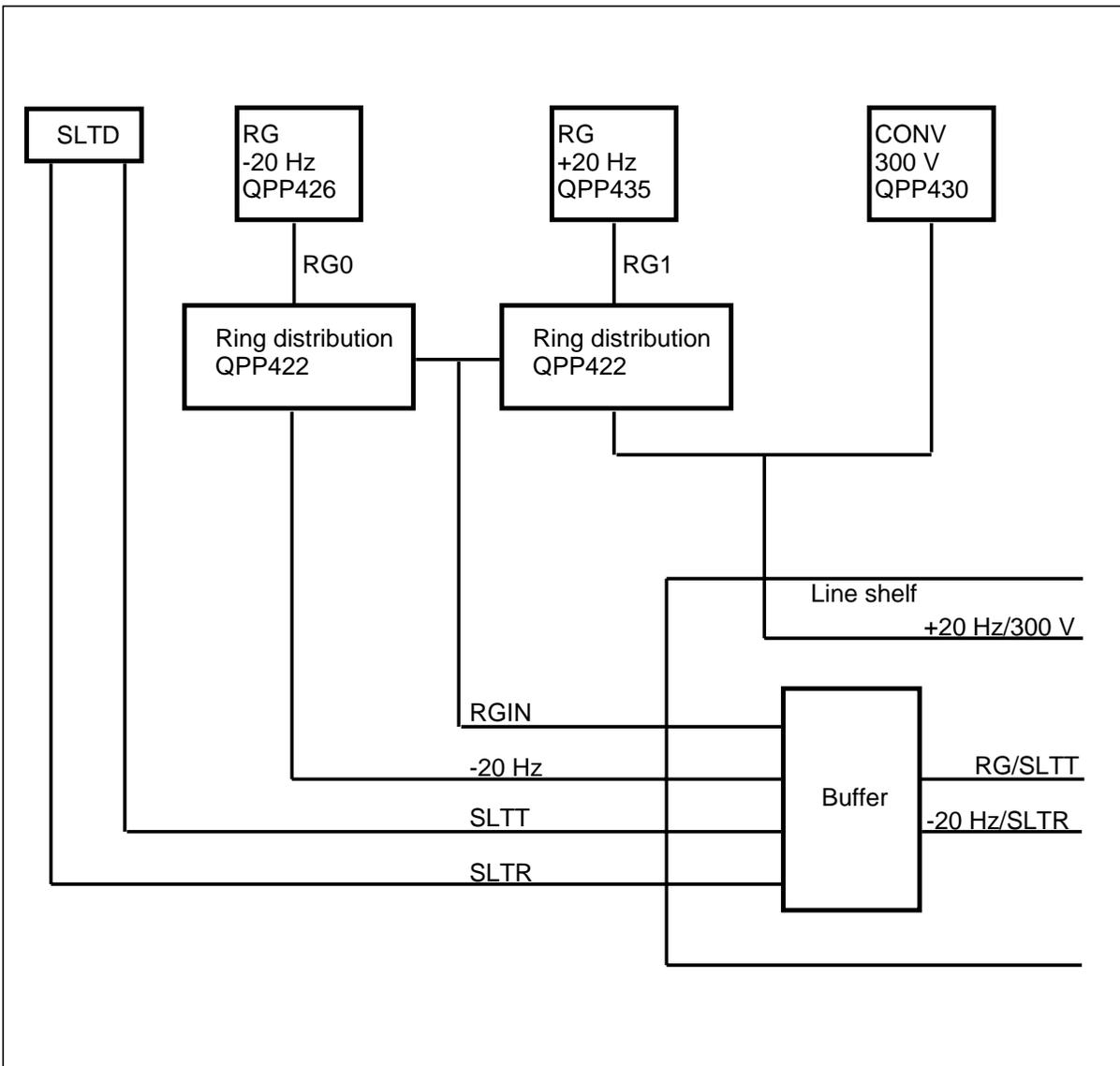
ranges (from the SMR) to apply either -20 Hz or +20 Hz ringing to either the tip or ring side of the party line. A rectifier device in the telephone set is associated with the ringer that allows current to pass in one direction only. Thus a four-party line may be supported with this ringing scheme.

- Universal Coin Remote (QPP409)
This card supports two coin lines that have either postpay, semi-postpay, or prepay phone service.

RCT ringing hardware

Figure 4-7 shows the hardware required for ringing subscriber stations connected to an RCT. Included in the figure is the Subscriber Line Test Digital (SLTD) unit, which, while not required for ringing, uses the same bus as the QPP426 Ringing Generator (RG).

Figure 4-7
RCT ringing hardware



The RCT uses two types of Ringing Generator cards and one type of Power Converter card as shown in the following list:

- QPP426 Coded or Superimposed Ringing card
- QPP435 Positive Superimposed Ringing card
- QPP430 300 V dc card (required by FSR lines)

The QPP426 and QPP430 support 20 ringers, and five lines can be rung simultaneously. The QPP435 supports 21 ringers, and five lines can be rung

simultaneously. The QPP426 and QPP435 cards both require a QPP422 Ring Distribution card to function properly.

The load limits of these three Ring Generators are as follows:

- QPP426 20 ringers per five lines at a time
- QPP435 21 ringers per five lines at a time
- QPP430 20 ringers per five lines at a time

The RCT provides two Ring Generator (RG) buses to each of its eight line shelves. These two buses are referred to as -20 Hz and +20 Hz/300 V, respectively.

The QPP426 Ring Generator card uses the -20 Hz bus, and the QPP422 Ring Distribution card distributes it to each line shelf. Note that different versions of the QPP426 can also provide -25 Hz or -30 Hz. Thus, the -20 Hz bus can carry -25 Hz or -30 Hz under the -20 Hz name.

At the shelf level, the -20 Hz bus is shared by the Ringing Generator and the SLTD card (if equipped).

The +20 Hz/ 300 V bus, as indicated by the name, is used by either the QPP435 positive Ring Generator or the QPP430 300 V Power Converter. If the positive RG uses the Bus, the RG power is distributed to the line shelves via the QPP422 Ring Distribution card. The Power Converter does not require a distribution card.

Both Ring Generators and the Power Converter can have an associated backup unit. This backup unit is automatically switched into service on failure of the primary.

The remainder of this document refers to the -20 Hz bus as -20 Hz and the +20 Hz/300 V bus as either +20 Hz or 300 V.

RCT line cards and their ringing requirements

This section provides an overview of the types of ringing provided by the SMR-RCT subsystem, the ringing capabilities associated with each type of line card. For a more detailed description of how ringing works for specific line cards, refer to Chapter 3, entitled "Software operation".

The RCT uses several types of cards, as illustrated in Table 4-2.

Table 4-2
RCT cards

Card Number	Function	Number of Lines	Ringling Requirements
QPP405	Single Party	4	-20 Hz
QPP407	Universal	4	-20 Hz, T/R Select, ANI
QPP409C	Universal Coin	2	-20 Hz, coin functions
QPP440	FSR (old style)	4	300 V, ring PCM, T/R select, ANI
			-20 Hz, SLT, reverse battery, coin functions
QPP445	Superimposed	4	-20 Hz, +20 Hz, ANI, ring PCM (for polarity and T/R select)
QPP541	FSR (new style)	4	Ring PCM, T/R select, ANI

The line card-Ring Generator associations follow. An X in each box indicates that the card and Ringing Generator are associated.

Figure 4-8
Line card-ring generator associations

	QPP405	QPP407	QPP409	QPP440	QPP445	QPP541
QPP426	X	X	X		X	
QPP430				X		
QPP435					X	

The QPP440, QPP445, and QPP541 cards require the Ring/Pad card (NT6X80). The QPP445 line card uses the PCM from the Ring/Pad card to determine which Ringing Generator to use and which side of the line to apply the ringing. One of the Ringing Generators supplies actual voltage.

To ring a line, the SMR sends the RCT B words to connect the line to a ring bus. Ringing cadence is then controlled by A bits. For FSR or superimposed lines, ringing PCM from the SMR Ring/Pad card is connected to produce a frequency. The following FSR groups are the most common:

- Synchronomic-16 16 Hz 30 Hz 42 Hz 54 Hz 66 Hz
- Synchronomic-20 20 Hz 30 Hz 42 Hz 54 Hz 66 Hz
- Decimonic 20 Hz 30 Hz 40 Hz 50 Hz 60 Hz
- Harmonic 16.67 Hz 25 Hz 33.33 Hz 50 Hz 66.67 Hz

The SMR uses four frequencies within a group. The architecture of the NT6X80 card imposes this restriction. The selected frequencies are datafilled in the RCTINV table. The RCT gets FSR information when it is returned to service.

The following four direct current voltages are provided by the Ring/Pad card for the QPP445 line card:

- +48 V Ring side
- +48 V Tip
- -48 V Ring
- -48 V Tip

Ringing schemes (FSR, superimposed, and coded)

Three ringing schemes follow. A ringing cycle consists of three phases. Each phase is two seconds long. While only five subscriber sets can be rung simultaneously, 15 can be scheduled, five in each phase. As one set of five lines becomes silent, the second set begins to ring, and the third set is ready to ring when the second set finishes.

Figure 4-9 shows the ringing scheme for FSR lines. The cycle is two seconds of ringing followed by four seconds of silence.

Figure 4-9
One, two, or multiparty FSR

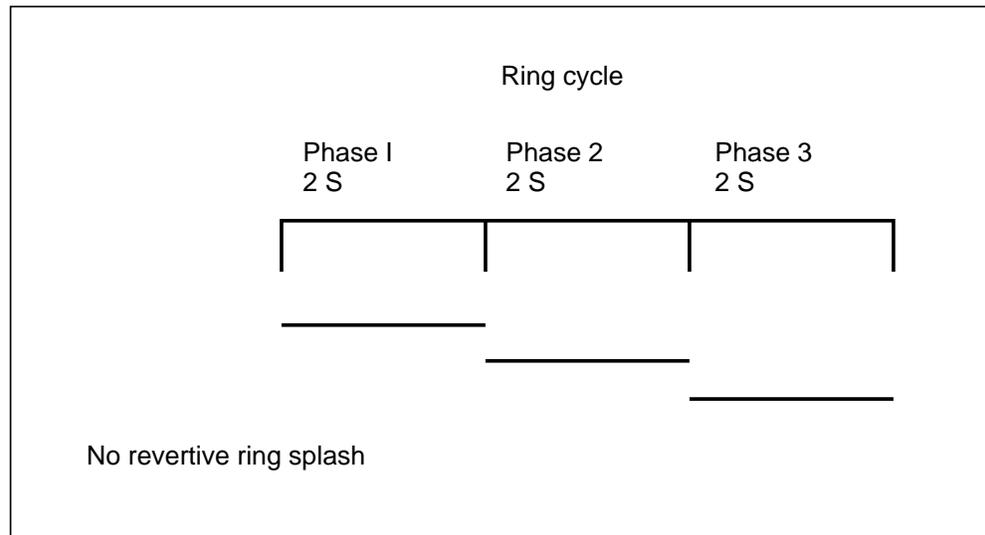


Figure 4-10 shows the ringing schemes for superimposed ringing. Code 1 is two seconds of ringing followed by four seconds of silence. Code 2 is one second of ringing followed by one-half second of silence followed by one-half second of ringing. The revertive ring splash indicates that an originator receives a one-half second ring splash for each phase. This burst of ringing notifies the originator that the called party's line is ringing.

Figure 4-10
Superimposed ringing

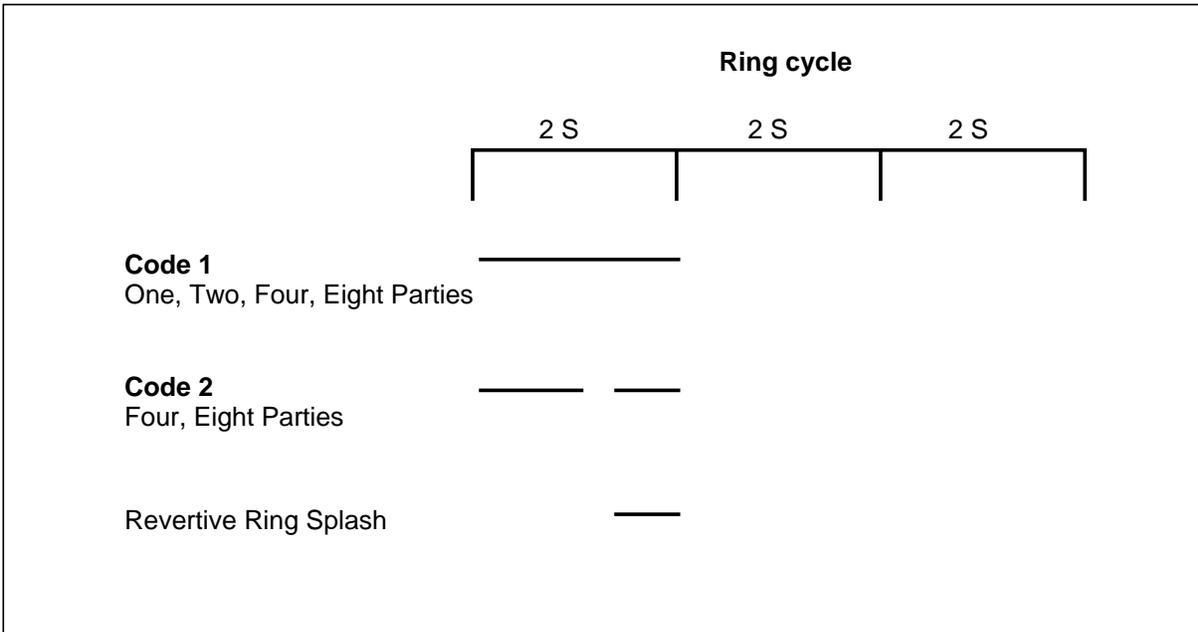
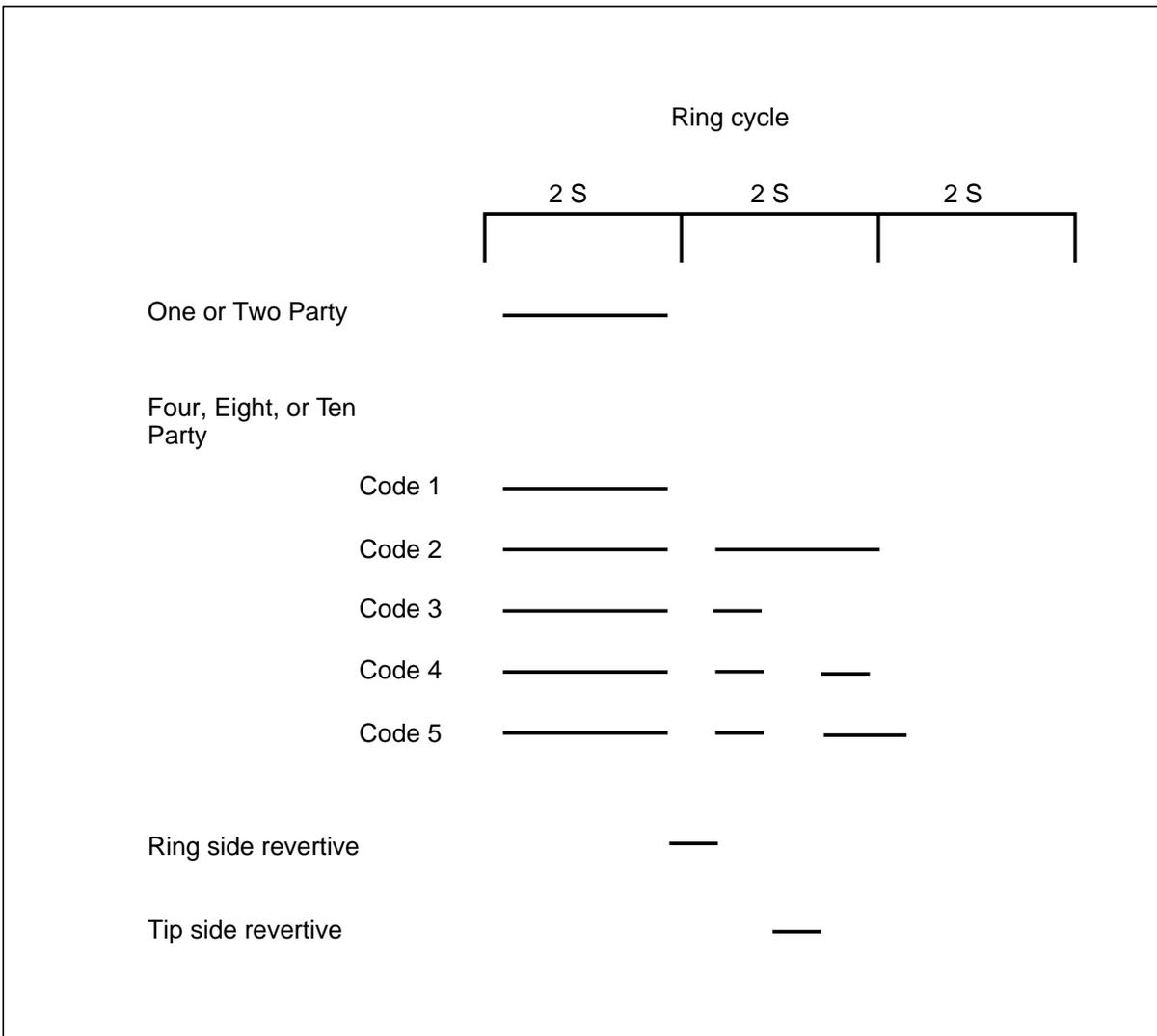


Figure 4-11 shows the ringing scheme for coded ringing. One- and two-party lines ring for two seconds and are then silent for four seconds. Five codes for four-, eight-, or ten- party lines are also shown in Figure 4-11. Two subscribers can have the same code if one party is on the tip side of the line, and the other party is on the ring side. Up to ten parties can thus be accommodated in coded ringing: five on the tip side and five on the ring side.

Figure 4-11
Coded ringing



Lynch APS engineering

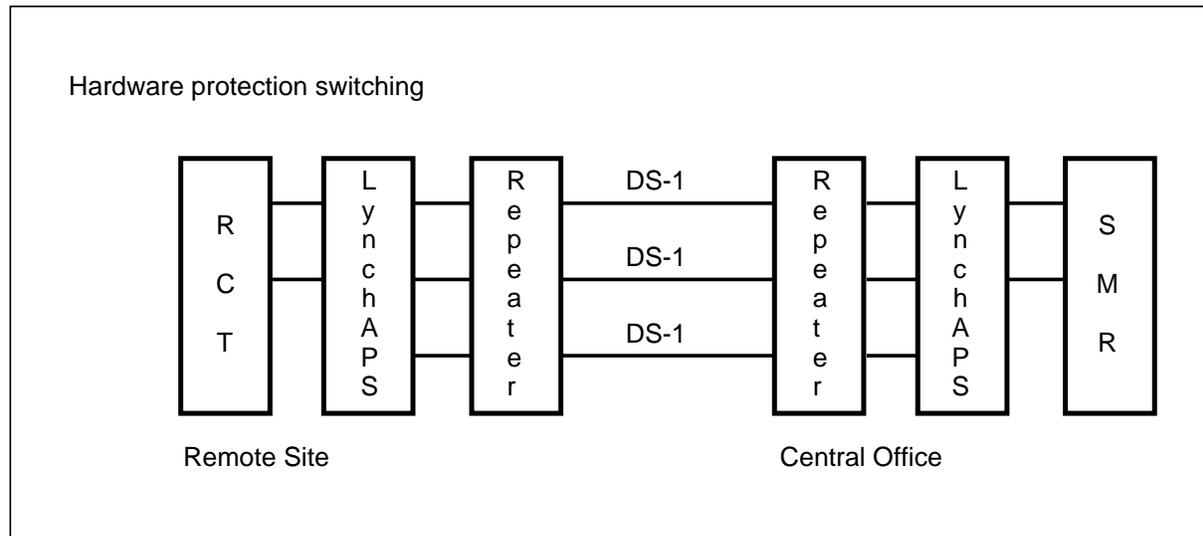
With the GFX213AC package, software protection switching for the DS-1 lines is no longer provided. Rather, a separate hardware product is required. This document contains an overview of the Lynch Automatic Protection Switching System (APS), which is provided through Northern Telecom.

Lynch APS configuration

Figure 4-12 shows at a high level how the Lynch APS is added to the SMR-RCT system.

For more information on terminations for the RCT digroups, refer to *Installation Wiring Guides*, 363-2011-202.

Figure 4-12
Protection switching configurations



Set up of MAP alarms

The Lynch APS allows the operating company to set two alarms:

- minor - The Lynch APS has activated protection switching.
- major - Two DS-1 links have failed, the office has lost service, or the APS itself has failed.

From the Lynch APS at the host site, cables are connected to the MDF and then to the NT0X10AA scan points. Tables ALMSC and ALMSCGRP are datafilled so that these alarms appear at the EXT level of the MAP.

At the remote site, cables are connected to the RCT alarm unit. Table RCTALM is datafilled so that remote alarms appear at the PM level.

Since alarms for protection switching can appear at both the EXT and PM levels, the operating company can decide whether one (or both) should be used. For complete information on how the SMR and RCT are installed and connected to the Lynch APS, refer to the IM925 (Section 5636), *Installation Wiring Guides*, 363-2011-202, and method of procedure for "Installation of Lynch B302 Automatic Protection Switch into Integrated DMS-1 Rural RCT."

Physical/electrical interface specifications

The SMR and RCT communicate over DS-1 links. The electrical signal over these links must be bi-polar return-to-zero and operate at the standard DS-1 rate (1.544 Mb/s). To ensure compatibility with network facilities, the RCT may use one of the following options:

- 1 be equipped with an office repeater that is either
 - non-powering (QPP436) or
 - powering (QPP437)
- 2 use a separate span shelf with external office repeaters to terminate the digital lines up to 750 feet from the RCT.

The following subsections detail the physical and electrical characteristics of the network digital interface for the RCT.

Physical

The interface cable coming from the external office repeater or from the carrier facility is terminated directly on the bay of the RCT at a designated pin field on the back of the RCT shelf. There are also connections that are used for the cabinet alarms and the metallic test pair. Refer to *System Installation - General*, 363-2011-200 for more information.

Electrical (equalization, loss, and delay)

The characteristics of the DS-1 electrical signal at the Network interface are specified in *Performance Specification*, 363-2011-180. The characteristics of the order wire, fault locate, and the test pair are specified in *DS-1 Digital Line Engineering*, 363-2011-151.

- Cable Equalization

By using the switch options on the QP419 Digroup card, the operating company can adjust the signal level transmitted from the RCT and therefore accommodate various cable lengths from the RCT to the office repeaters. The maximum length is 750 feet (230 meters), using the equivalent of shielded 22 gauge cable.
- Loss

The amount of loss for line cards from the subscriber line to the digital interface is 0 db; from the digital interface to the subscriber line, 2 db. The transmission loss is specified at 1004 Hz.
- Transmission Delay

To ensure adequate transmission performance, the voice frequency round-trip delay on the two-wire digital path must be limited. The maximum round-trip delay through the RCT is less than one ms. The

remaining delay can be allocated to other elements of the two-wire path such as the DS-1 line to the SMR.

A 200 ms scan rate will limit the maximum round-trip distance (SMR-RCT-SMR) to 97 miles (156 km). At longer scan rates, the maximum distance increases by the following:

- 260 ms - 284 miles (457 km)
- 320 ms - 472 miles (760 km)
- These distances are for 22-gauge cable. For 19-gauge cable, multiply the distances by a factor of 1.03. For 24-gauge cable, multiply the distances by a factor of 0.94. For 26-gauge cable, multiply the distances by a factor of 0.92.

Also note that the maximum difference in length between Digroup A and Digroup B lines between two terminals must be less than five miles (eight km).

Administration

Role of the administrator

Administrators are responsible for monitoring the effects of Subscriber Carrier Module-100 Rural (SMR) call processing on the overall performance of the DMS-100 central office.

Monitoring SMR performance factors

Patterns of heavy SMR call processing activity may tax the engineered configuration of the DMS-100 central office and the links that carry the calling traffic. The following paragraphs describe the areas most prone to overloading.

Performance factors that require monitoring are:

- Traffic and hardware use, including
 - dial tone speed recording (DTSR)
 - link usage and blockage
 - call attempts
 - peripheral module real time occupancy
 - subscriber line usage (SLU)

The administrators can use operational measurements (OMs) and log reports to track how well SMR call processing is being handled by the office and to recognize any problems.

Operational measurements

For an overview of operational measurements (OM), consult *Operational Measurements*, 297-1001-814, and *Operational Measurements Reference Manual*, 297-1001-320. These NTPs discuss OM system organization, OM groups, and the fields contained in each group. Document 297-1001-320 provides further information on OM output format and OM-related log reports.

General information on the editing of DMS data tables, including descriptions of table editor commands, may be found in *Table Editor Reference Manual*, 297-1001-310. Additionally, explanations of each OM management table and its fields are contained in *Operational Measurements Reference Manual*, 297-1001-320. This document also contains general OM command descriptions and interactive examples.

The SMR feature package implements OM groups XPMLNK, PM, PMTYP, DTSR, SITE, Subscriber Line Usage (SLU) groups, and other traffic-related groups.

OM Group XPMLNK

Link usage and blockage

Link usage and blockage statistics are collected by the OM group XPMLNK in order for operating personnel to determine optimum link use. This feature does not include any measurements of nailed-up connections or non-switched special services. OM group XPMLNK information is used in provisioning the switch and in troubleshooting. The information may also be used in reliability studies and reports.

The OM group XPMLNK monitors the peg and usage counts. These measurements are reported every 15 minutes. The XPM OM system does a transfer of active to holding registers 1 minute before it sends the information to the CC. The usage measurements are reported in hundred call seconds (CCS). This accuracy is achieved by sampling every 10 seconds. The peg measurements are the actual number of allocation attempts or blocked allocation attempts.

All measurements are made directly whenever possible. Reports are made on a per-SMR basis. The information is measured on a per-link basis. Thus the registers contain information representing an aggregate of all links from the SMR. The operating company can use this information to engineer the SMR more efficiently and without effort on behalf of the craftsman.

Previously, in order to obtain this information, the operating company personnel were required to sum and adjust various OMs. The adjustments made to the OMs were based on experience and estimation. The OM group XPMLNK provides more accurate link utilization information than was previously available, and it is provided automatically at regularly scheduled intervals. Refer to the description of OM group XPMLNK registers in Table 5- 1.

How to evaluate link usage and blockage performance

OM group XPMLNK gives the user information on the following:

C-side and P-side link call busy usage counts. This provides the amount of time, expressed in CCS, that the P-side or C-side links are busy/in-use for call processing or P-side maintenance tasks (such as line diagnostics), or any task that uses a channel.

C-side and P-side link allocation attempt pegs. This provides the number of times an attempt was made to use either a P-side or C-side channel for some task. That is, any time a channel is allocated, the register will be pegged.

C-side and P-side link blockage pegs. This provides the number of failed attempts for a speech path due to the unavailability of either a speech link or an idle channel on the C-side or P-side of the SMR.

C-side and P-side link maintenance usage. This provides the total amount of time, measured in CCS, that the P-side or C-side links are unavailable due to being in a maintenance busy status.

Table 5-1
XPMLNK REGISTERS

OM Group XPMLINK	Register	Description
XPMLNK group This group measures link blockage and usage for all XPMs with switched lines (not nailed-up) to provide for more accurate provisioning of the office.	CSLCBU	This register tallies the amount of time, expressed in CCS that the C-side links are busy/in-use due to call processing.
	PSLCBU	This register tallies the amount of time, expressed in CCS that the P-side links are busy/in-use due to call processing.
	CSLAA	This register pegs the number of times an attempt was made to use a C-side channel for a task
	PSLAA	This register pegs the number of times an attempt was made to use a P-side channel for a task
	CSLBLK	This register pegs the number of failures in providing a speech path due to the unavailability of either a speech link or an idle channel on the C-side of an XPM.
	PSLBLK	This register pegs the number of failures in providing a speech path due to the unavailability of either a speech link or an idle channel on the P-side of an XPM.
	CSLMU	This register tallies the total amount of time, expressed in CCS that the C-side link is unavailable for call processing.
	PSLMU	This register tallies the total amount of time, expressed in CCS that the P-side link is unavailable for call processing.

OM group PM and PMTYP

PM and PMTYP are two OM groups that replace OM groups LM, TM, DCM, PM1, and PM2. Group PM supports OM for individual peripheral modules, while group PMTYP supports OM for types of peripherals; for example, all SMR at a central office or all LM at an office.

A specific PM can be excluded from the PMTYP counts by datafilling specific PM in a new table called PMEXCEPT. In this way, PM being tested can be excluded from the peg and usage counts for a type of PM. More information on the PMEXCEPT table is included in the Data assignment section of this document.

The registers listed in Table 5-2 apply to PM and PMTYP OM groups for SMR and other LTC peripheral modules. The registers listed first under the field name apply to group PM; the registers listed second and containing a T as part of the name apply to group PMTYP.

Table 5-2
PM and PMTYP. Dual unit peripheral module maintenance summary.

Field Name	Register Description
PMMWXFR/ PMTMWXFR	PM Manual Warm Transfer. Peg count of the number of transfers of activity caused by manual intervention, resulting in a WARM SWACT (Switch of Activity between units in which in-process calls remain connected). Brought about by: <ul style="list-style-type: none"> • Execution of command 'SWACT NOW' at the MAP • Manual BSY of active unit while the standby mate unit is InSv.
PMSWXFR/PMTSWXFR	PM System Warm Transfer. Peg count of the number of transfers of activity caused by system intervention, resulting in a WARM SWACT. Brought about by: <ul style="list-style-type: none"> • System-initiated WARM SWACT • Active unit going SysB • C-side link closure to active unit while inactive unit InSv.
PMMCXFR/PMTMCXFR	PM Manual Cold Transfer. Peg count of the number of transfers of activity caused by manual intervention, resulting in a COLD SWACT (Switch of Activity between units in which in-process calls are lost). Brought about by: <ul style="list-style-type: none"> • Execution of command 'SWACT NOW' at the MAP • Manual BSY of active unit while the mate unit is InSv.
-continued-	

Field Name	Register Description
PMSCXFR/PMTSCXFR	<p>PM System Cold Transfer. Peg count of the number of transfers of activity caused by system intervention, resulting in a COLD SWACT. Brought about by:</p> <ul style="list-style-type: none"> • System-initiated COLD SWACT • Active unit going SysB • C-side link closure to active unit while inactive unit InSv.
PMMBTCO/PMTMBTCO	<p>PM Manually Busy Terminal Cutoff. Peg count for every terminal in CP_busy or CP_busy_deload state when the PM is made ManB.</p> <p>For two terminals involved in a two-port call, this peg is incremented only once if the PM goes ManB.</p>
PMSBTCO/PMTSBTCO	<p>PM System Busy Terminal Cutoff. Peg count for every terminal in CP_busy or CP_busy_deload state when the PM is made SysB or CBsy.</p> <p>For two terminals involved in a two-port call, this peg is incremented only once if the PM goes SysB or CBsy.</p>
PMPSEERR/PMTPEERR	<p>PM P-side Error. Peg count of the number of errors detected on the p-side links of the PM.</p> <p>Currently, the SMR does not connect to DS-30A links, only DS-1 links.</p>
PMPSFLT/PMTPSFLT	<p>PM P-side Fault. Peg count of the number of faults detected on the p-side links of the PM. These faults are also pegged for register PM2PEERR. and are associated with an attempt by the system to remove the p-side link from service.</p> <p>Currently the SMR does not connect to DS-30A links, only DS-1 links.</p>
-continued-	

Field Name	Register Description
PMMBP/PMTMBP	PM Module Manually Busy. Peg count of the times a PM is made manually busy from in-service or in-service-trouble.
PMSBP/PMTSBP	PM Module System Busy. Peg count of the times a PM is made system busy from in-service or in-service-trouble.
-continued-	

Note the following:

- Two PM and PMTYP registers that are not used for the SMR are PMRGERR/PMTRGERR and PMRGFLT/PMTRGFLT. PMRGERR/PMTRGERR is used with an InSv LCM and is incremented when a problem is detected in the Ringing Generator, regardless of the state of the Ringing Generator.
 - PMRGFLT/PMTRGFLT is used when both the LCM and Ringing Generator are InSv and a problem is detected with the Ringing Generator.
- Three PM and PMTYP registers that are not supported for SMR and related LTC peripherals are PMCCTDG/PMTCTDG, PMCCTFL/PMTCTFL, and PMCCTOP/PMTCTOP.

The following fields for OM group PM and PMTYP remain the same for peripheral modules, including SMR:

- PMERR/PMTERR
- PMFLT/PMTFLT
- PMUMBU/PMTUMBU
- PMUSBUS/PMTUSBUS
- PMMMBU/PMTMMBU
- PMMSBU/PMTMSBU

For more information on these fields, consult *Operational Measurements*, 297-1001-814.

As a result of the enhancements introduced in BCS32, the following OM registers are no longer pegged as a result of tests performed by Routine Exercises (REX) on the SMR:

- Register: PM2ERR Group: PM2
- Register: PMERR Group: PM
- Register: PMTERR Group: PMTYP

PM and PMTYP counts for RCT

Registers that deal with loading, initialization, units, activity transfers, and P-side links have no meaning to a RCT. Consequently, many registers incremented for the SMR are not incremented for the RCT. The following four registers are used with the RCT:

- PMERR/PMTERR
- PMFLT/PMTFLT
- PMMSBU/PMTMSBU
- PMMMBU/PMTMMBU

Dial tone speed recording

Dial Tone Speed Recording (DTSR) measures the ability of a DMS-100 switch to return dial tone within three seconds. Three factors cause dial tone delay:

- time taken by call processing to recognize the origination
- time taken by the switch to allocate resources, such as channels and receivers, for the call
- time taken by the switch to set up dial tone.

These three factors vary for each switch, depending on the type of line from which the call was originated, the location of the associated line card, and the type of peripheral interface to the CC.

DTSR information is gathered and stored in two OM groups, DTSR and SITE. Group DTSR is dedicated to DTSR counts for the host site only. Group SITE, however, contains DTSR counts for each remote site, as well as additional traffic information.

All DTSR counts are held in pairs. The first part of each pair is a count of all calls; the other is the count of calls with a dial tone delay exceeding three seconds.

Each site has two such pairs: one pair is for Dial Pulse (DP) originated calls; one is for Digitone (DT) originated calls.

OM Group SITE

Eight pegs are added to OM group SITE, as shown in Table 5-3 .

Table 5-3
SITE - Traffic and DTSR for remote sites.

Field Name	Register Description
RCTDP_T	A count of total sampled calls on RCT DP lines.
RCTDP_T2	The extension register of RCTDP_T. Multiply by 65536 and add to RCTDP_T to get the true number of sampled DP calls.
RCTDP_D	A count of sampled calls on RCT DP lines where dial tone delay exceeded three seconds.
RCTDP_D2	The extension register of RCTDP_D. Multiply by 65536 and add to RCTDP_D to get the true number of delayed DP calls.
RCTDT_T	A count of total sampled calls on RCT DT lines.
RCTDT_T2	The extension register of RCTDT_T. Multiply by 65536 and add to RCTDT_T to get the true number of sampled DT calls.
RCTDT_D	A count of sampled calls where dial tone delay exceeds three seconds or there was a Digitone receiver queue overflow.
RCTDT_D2	The extension register of RCTDT_D. Multiply by 65536 and add to RCTDT_D to get the true number of delayed DT calls.

Figure 5-1 is part of a sample OMSHOW display of group SITE data and includes the eight new registers.

Figure 5-1
SITE group display

```

>omshow site active

SITE

CLASS:      ACTIVE
START:
SLOWSAMPLES

KEY (SITE_INDEX)
INFO (SITE_MODULE_COUNT)
INTRASIT    INTERSIT    RORIGOUT    INRTERM
LMDP_T      LMDP_D      LMDT_T      LMDT_D
LCMDP_T     LCMDP_T2    LCMDP_D     LCMDP_D2
LCMDT_T     LCMDT_T2    LCMDT_D     LCMDT_D2
LCMKS_T     LCMKS_T2    LCMKS_D     LCMKS_D2
RCTDP_T     RCTDP_T2    RCTDP_D     RCTDP_D2
RCTDT_T     RCTDT_T2    RCTDT_D     RCTDT_D2

1 REM1
  02
      0          0          0          0
      0          0          0          0
      357        0          0          0
      132        0          0          0
      99         0          0          0
      324        0          0          0
      245        0          0          0

```

Traffic measurement OM

Several other DMS-100 OM groups are measured for the SMR-RCT subsystem, such as OFZ, TFCANA, LMD, CARR, and other traffic-related groups but no changes are required in their fields.

Subscriber line usage (SLU) OM groups

The SLU OM groups monitor the peg and usage counts on any line or group of lines connected to a DMS-100 Family office by the OM system. Each monitored line is scanned at an office-defined scan interval, and the peg count registers in one of four OM groups record traffic data on selected lines or line groups. For more information on SLU OM and their implementation, consult *Operational Measurements, 297-1001-814*, and *Operational Measurements Reference Manual, 297-1001-320*.

Subscriber line usage uses SLU input tables and the SLU OM groups. The input tables are used by the craftsperson to specify the lines to be monitored. The corresponding OM groups are used to record and manipulate the collected measurements.

SLU OM for RCT

In the input tables, line equipment may be identified in field NUM_7D by an operational equipment number identifier (OE number). The OE number has the same format as the line equipment number (LEN), as follows:

PM_TYPE <site> <frame> <unit> <drawer/line subgroup> <circuit>

To give SLU support to lines connected by RCT, the ranges of these subfields for RCT are as follows:

- Site. Four-character location identifier of the OE.
- Frame. Frame number. Range: 0-99.
- Unit. Unit number. Up to ten RCT may be configured. Range: 0-9.
- Drawer/line subgroup. Also known as shelf for RCT. Range: 0-7.
- Circuit. Circuit number. Range: 0-31.

DMS-1R and DMS-100 OM comparison

The DMS-1R is equipped with physical counters that are pegged under certain conditions. This section details current stand-alone OM capabilities of the DMS-1R and explains how they compare with those of the DMS-100.

- Originating peg count. This counter is incremented every time a channel connection from a RCT to a SMR is established after an origination is processed.

In the DMS-100, the register LMD_NORIGATT is incremented every time an origination message is received at the CC. The register LMD_ORIGFAIL is incremented when an origination fails.

The difference of ORIGFAIL from NORIGATT can be less than a DMS-1 originating peg count, because, unlike in the DMS-1R, ORIGFAIL counts failures such as permanent signal, partial dial, and mutilated digits, that occur after a channel in an RCT DS-1 link is assigned.

- Terminating peg count. This DMS-1R physical register is pegged when a channel connection is established between an SMR and an RCT during termination attempt.

DMS-100 provides a register (LMD_NTERMAT) that counts terminating attempts. LMD_TERMBLK pegs the number of terminating calls blocked.

Since TERMBLK pegs either DS-30 channel busy blocking or any other peripheral blocking condition, the difference of TERMBLK from NTERMATT is, in general, not equivalent to the terminating peg count in the DMS-1.

- High hourly CCS. This physical counter pegs the hourly usage of each channel to the RCT.

The register LMD_LMTRU provides traffic usage counts for all lines on a peripheral. Since this counter pegs the usage count for lines in call-processing-busy and call-processing-busy-deload states, it is different than high hourly CCS.

- Total CCS. This counter physically pegs the usage of each channel to the DMS-1R, or RCT. DMS-100 has accumulating registers that provide the same function.
- All channels busy. This counter is pegged whenever all channels on the DS-1 lines are in use. Currently, no DMS-100 OM register supports this count.
- Terminating calls blocked. This counter records the number of termination attempts blocked. Terminating attempts in DMS-1R are blocked for two reasons: an all-channels-busy condition or a line shelf contention. Line shelf contention occurs when a channel on one DS-1 link is assigned to a line; the corresponding channel on the other DS-1 link cannot be assigned to another line on the same shelf.
- Originating call delayed. This physical counter in the DMS-1R pegs the number of calls that must wait three seconds or more before being assigned a channel on a DS-1 link. OM groups DTSR and SITE provide the same capabilities on the DMS-100.

The PMEXCEPT table is used for PM to be excluded from OM group PMTYP operational measurements on a PM-type basis. This ensures that specific PM, such as those under test, do not influence peg and usage counts for specific types of PM.

For more information on this table, refer to *Common Customer Data Schema*, 297-1001-451.

Translations, parameters, and service orders

Data assignment

Table 6-1 lists the tables that are datafilled when configuring the SMR and RCT.

Table 6-1
NTX213AB01 - datafill

Table or Office Parameter	Section	Form
LTCINV	064	2018A,B
LTCPSINV	064	2018A
RCTINV	116	2023A,B
RCTALM	181	2172
PADDDATA	055	2155A,B
LNINV	123	2038
PMEXCEPT	088	2386
CARRMTC	066	216A,B

For complete information on these tables, refer to *Local Customer Data Schema*, 297-2101-451 and *Common Customer Data Schema*, 297-1001-451. This section highlights the aspects of these tables that are relevant to the SMR-RCT subsystem. Where necessary, tables that are affected by the hardware protection switching system are explained in detail.

Data mismatch

Three types of updates keep the inactive unit of the SMR provided with the data necessary to control maintenance and call processing:

- static data

- bulk data
- dynamic data

Static data update

Static data holds SMR configuration information, such as the association between SMR P-side ports and DMS-100 link numbers. The CC sends this information to both units of the SMR when the SMR is returned to service. The CC also sends this information to an in-service SMR when either Table RCTINV or Table LNINV is modified.

When configuration information is altered by the craftsperson, the system sets the SMR to in-service trouble (ISTb), informs the craftsperson that a static data mismatch exists, and provides information for appropriate action to take. In some cases, the craftsperson is prompted to busy the inactive unit, return it to service, and switch unit activity. In other cases, the system may prompt the craftsperson to busy the inactive unit, return it to service using the NODATASYNC option, and switch unit activity. (The NODATASYNC option allows the craftsperson to update the inactive unit with CC data without the transfer of data from the active unit.) With all static data mismatches, the system prompts the craftsperson with the appropriate action to take.

Note: Returning the inactive unit to service using the NODATASYNC option disables the warm SwAct feature; a cold SwAct is then required to switch unit activity.

Bulk data update

A bulk data update transfers the following information from the active SMR unit to the inactive unit when the inactive unit is returned to service:

- RCT status (in service/busy)
- FSR codes
- subscriber states (idle/busy)

A bulk data update brings the inactive unit of the SMR up to date with the active unit.

Dynamic data update

A dynamic data update occurs on an ongoing basis as changing data in the active unit is updated in the inactive unit. The following information is included in dynamic data updates:

- RCT status (in service/busy)
- FSR codes
- subscriber states
- channel reassignment

- port statuses
- DS-1 link information

Tables LTCINV and LTCPSINV (affected by protection switching)

Two tables, LTCINV and LTCPSINV, are used for all LGC-based peripherals, including the SMR.

In the following example, table LTCPSINV has been datafilled for two RCTs. Note that only two DS-1 links are assigned for each RCT; a third DS-1 for protection switching is no longer entered.

When datafilling table LTCPSINV, do not use link 0; refer to the following example:

```

LTCNAME
      PSLINKTAB
-----
SMR 0
(0 NILTYE) (1 NILTYE) (2 DS1 DEFAULT N)
(3 DS1 DEFAULT N) (4 NILTYE) (5 DS1 DEFAULT N)
(6 DS1 DEFAULT N) (7 NILTYE) (8 NILTYE) (9 NILTYE)
(10 NILTYE) (11 NILTYE) (12 NILTYE) (13 DS DEFAULT N)
(14 DS1 DEFAULT N) (15 NILTYE) (16 NILTYE) (17 NILTYE)
(18 NILTYE) (19 NILTYE) $

```

Data updating in tables LTCINV and LTCPSINV

After a tuple is changed in the LTCINV or LTCPSINV table, the SMR must receive a static data update; otherwise, call processing could be affected. For example, if a NILTYE entry is changed to DS1, but the SMR fails to receive static data for the link, call processing is not supported for the link. To update static data after altering the LTCPSINV table, perform the procedure that automatically appears on the MAP display when static data is altered by the craftsperson.

Note: If the user tries to input a link as a protection link (PROTLINE), the entry is rejected.

Table RCTINV (activating line audits)

The RCT is configured in a separate table, RCTINV.

Note that the field PROTINFO has been removed and that there is a new field, LINEAUDT. In the following example, table RCTINV is datafilled such that the line audits are activated.

```

RCTNO FRTYPE FRNO SHPOS FLOOR ROW FRPOS  LOAD  CSPMNO
LKINFO          RNGDATA SLTINFO  LINEAUDT
-----
REMT 13 0 RTR  0 32  1 F  7 NO_LOAD SMR 10
( 1) ( 2) $   F 20 30 40 50  SLTD   Y

```

To invoke the line audits, use the table editor to change the value from N to Y. Once the table has been updated, the line audits are active. Note that busying and returning to service any component of the SMR-RCT subsystem is *not* required.

In BCS26, a patch is applied so that the PROTINFO field is used to activate the line audits. Once this patch is applied, the PROTINFO field is datafilled as Y to activate these audits. The PORT and PRIORITY subfields are 0 and 0. These values are used regardless of what the craftsperson enters. In BCS30, the field is replaced with LINEAUDT.

Table RCTALM

The RCTALM table contains information on RCT alarms, covering DS-1 carrier faults, RCT card failures, and related problems.

Note: The RCTALM field can be datafilled with the alarms LFA and LFB. These alarms, when activated, will appear at the PM level of the MAP . With hardware protection switching, the craftsperson can look for alarms at both the EXT and PM level.

Table PADDATA

The PADDATA table contains a field called RCTPAD that holds the value for the RCT line circuit pad (if one is used). This table must be datafilled before the LNINV table is datafilled.

Table LNINV

The RCT has cards that interface to either two or four lines. Consequently, up to four line circuit numbers can reside in the same card slot.

Six RCT cards exist:

- QPP405 Single Party Remote (four lines per card)
- QPP407 Universal Remote (four lines per card)
- QPP409 Universal Coin Remote (two lines per card)
- QPP440 Frequency Selective Remotes (four lines per card)
- QPP541 Single-party, Two-party with ANI, or Multiparty Lines
- QPP445 Superimposed Remote (four lines per card; for single-party, two-party with ANI, or multiparty lines).

For more information on these cards, refer to RCT architecture in Chapter 4, entitled "Engineering", and *DMS-1R Remote Concentrator Terminal*, 363-2011-102.

The LEN format for the RCT follows:

- | | |
|-----------------|-------------------|
| • site | Unique identifier |
| • frame | 0 - 99 |
| • unit | 0 - 9 |
| • line subgroup | 0 - 7 |
| • circuit | 0 - 31 |

Since an RCT has a maximum of eight line shelves, the line subgroup field uses only values 0 through 7. Each RCT line can support up to four lines. With eight cards per line subgroup, the circuit numbers range from 0 through 31.

Since the LEN format remains unchanged, the line-related tables and MAP displays using the LEN format need not be changed in reference to line numbering. However, other parameters need to be changed, and these are shown in the LNINV table in *Local Customer Data Schema*, 297-2101-451.

The LNINV table also contains a field for the RCT pad, besides fields for the line equipment number and other line parameters. Note that for coin cards, there are only two lines per card, and even numbers are used, such as

RCT0 4 0 0 0
RCT0 4 0 0 2

Table PMEXCEPT

The PMEXCEPT table contains a list of PM to be excluded from group PMTYP OM counts. This table is explained in *Operational Measurements*, 297-1001-814, Chapter 5.

Table CARRMTC (affected by protection switching)

Figure 6-1 shows the values for carrier maintenance that apply to the DS1 links between the SMR and RCT.

Figure 6-1
The CARRMTC table

CSPMTYPE	TMPLTNMSELECTOR	ATTR							
		CARD	VOICELAW	FF	ZLG	BERB	DLK		
(RTSML and RTSOL omitted)		IAT	LCGAST	LCGACL	RCGAST	RCGACL	AISST		
		AISCL	BEROL	BERML	ES	SES			
			FRAME	FRAME	SLIP	SLIP			
			ML	OL	ML	OL			
SMR	DEFAULT	DS1	NT6X50AA	MU_LAW	SF	ZCS	BPV	NILDL	
			Y 40	1000	50	50	150		
			1000	3 6	864 100				
				17 511	4	255			

Note the following:

- Refer to *Common Customer Data Schema, 297-1001-451*, section 066 for details on the CARRMTC table.
- The DMS system adds the first tuple for SMR to the CARRMTC table automatically during initial program load (IPL) or first restart after IPL. The entry is designated as index 0 and has the value DEFAULT in the TMPLTNM field and default values for the other fields. This tuple cannot be deleted, and only fields ES, SES, and thresholds for frame and slip losses can be changed.
- Tuples other than the default tuple must be added manually before they can be referenced in the LTCPSINV table.
These tuples can be deleted only if no DS-1 carriers are associated with them.
- Tuples can be changed in the CARRMTC table only if the associated DS-1 carriers are ManB or OFFL.

- Links that are not configured are datafilled as NILTYPE. Refer to *Common Customer Data Schema*, 297-1001-451, section 064, for information on the LTCPSINV table.
- Entering 255 in the RTSML or RTSOL fields disables the thresholds.
- The card types for the CARD field include NT6X50AA, NT6X50AB, NT6X85AA, and NT6X85AB.
- Enter SF (Standard Frame or Super Frame) in the FF field. The SMR-RCT subsystem uses the 12 (125 microseconds per frame) frame format.
- Enter ZCS (zero code suppression) in the ZLG field. If all zeroes are transmitted, a 1 is inserted in the second least significant bit position. This results in an incorrect transmission for data in the SMR-RCT subsystem but causes only minor noise for speech.
- Enter BPV under the BERB field. The CRC (cyclic redundancy check) value applies to extended super frame (ESF) format.
- Only option NILDL is valid under field DLK. No plans currently exist for the FDL and SLC96 options.
- Enter Y for the IAT field. This causes yellow alarms to be inhibited.
- Fields LCGACL, LCGAST, RCGACL, RCGAST, AISCL, and AISST are given as integers in the range 0 through 9999 in units of 10 ms. Entries of 250 and 1000 are recommended for fields LCGAST and LCGACL, respectively.
- The SMR and RCT are connected by DS-1 lines. Alarm indication signals (AIS) have no application in such a simple network. Use the default values for fields AISST and AISCL since the fields have no application for SMR-RCT.
- Fields BERML and BEROL are given as integers in the range 4 through 7 and 3 through 6, respectively. They represent the negative exponent of 10. Three, for example, represents 1 in 1000.
- With hardware protection switching, the default values are used; however, the Lynch APS determines when BPVs have reached a threshold, and causes the active in-error span to switch to the protection span.

Static data log tracking

BCS32 introduces new logs created for tracking changes made to tables RCTINV, LTCINV, and LTCPSINV. These new logs are called TUPC100, TUPC101, TUPC102, and TUPC103. Since these logs indicate datafill changes, they provide a starting point to recreating, debugging, and solving field problems. This feature is helpful since sometimes the symptoms

available at the time of service degradation are not sufficient to diagnose the problem occurring in the field. Samples of TUPC log tables are located in Chapter 7, entitled "SMR maintenance".

MTA configuration and sharing

Starting with BCS24, RCTs no longer use the MTAOWNER field of the RCTINV table to indicate sharing of a test pair off a vertical of the Metallic test access network. The key table for configuring shared access is the MTAVERT table. The MTAMDRVE and MTAHORIZ tables are also used to configure metallic testing. For details on these tables, refer to *Common Customer Data Schema*, 297-1001-451, Section 105.

All remote peripherals sharing a test pair must be of the same type. If an RCT is using a test pair, only additional RCT modules can share the test pair. RCS and RCU modules cannot share the pair with RCT modules.

RCT modules datafilled against a vertical in the MTAVERT table must have an SLTMODE of SLTA. The field SLTMODE is a field in the RCTINV table. The entries are either SLTA, SLTD, or NONE. SLTD is a testing configuration that does not use test pairs.

Up to 32 RCT modules can share a metallic test pair. It is recommended that no more than 2000 subscriber lines be supported off one test pair. This should ensure that minimal subscriber line test requests are rejected because the test pair is being used by another line.

Error messages

The following error messages can occur when a metallic test access is configured:

- CANNOT BE DELETED UNTIL UNASSIGNED FROM VERTICAL ON MTA
An RCT can not be deleted from the RCTINV table if it is still assigned to a vertical in the MTAVERT table.
- WARNING: CHANGING THIS RCT'S SLTMODE REQUIRES IT BE REMOVED FROM TABLE MTAVERT
If an RCT is assigned to a vertical in the MTAVERT table and an attempt is made to change the SLTMODE of the RCT from SLTA to SLTD or something else, the change is executed, but the previous warning message is displayed.
- RCT MUST HAVE SLTMODE OF SLTA TO USE VERTICAL
An RCT must have an SLTMODE of SLTA to be assigned a vertical in the MTAVERT table.
- DEVICES SHARING VERTICAL MUST BE OF THE SAME TYPE

RTC modules can share a test pair with RCT modules but not with other types of remote modules.

SMR maintenance

User interface for the SMR

Since the SMR is LTC-based, most aspects of the user interface for SMR are the same as those for LTC.

The section is organized as follows:

- SMR states
- PM-level MAP commands
- Manual maintenance
- System maintenance
- Advanced troubleshooting.

SMR states

The SMR is integrated into the current PM level MAP display. The PM states applicable to an SMR appear as follows in Table 7-1 .

Table 7-1
SMR states

SMR State	Code	Description
Central Side Busy	CBsy	SMR is C-side busy when DS-30 speech/ message links, used to carry messages between SMR and the DMS-100 network, are unavailable. SMR is unable to communicate with CC.
In-service	InSv	SMR is in service and available to support any intended process, such as call processing.
In-service-trouble	ISTb	SMR is still in service but flagged by system maintenance because of a minor error indication or failure in a minor audit test.
-continued-		

7-2 SMR maintenance

SMR State	Code	Description
Manual Busy	ManB	SMR is busied by a craftsman from the MAP position to allow testing and other manual maintenance action.
-continued-		
Off-line	Offl	SMR is removed from service by the craftsman to allow commissioning testing or to hold temporarily the SMR out of service.
System Busy	SysB	SMR is removed from service by system maintenance.
-continued-		

PM level maintenance commands

The commands are supported for a SMR at the PM level appear in Table 7-2.

Table 7-2
PM-level maintenance commands for SMR

Command	Function	Description
BSY	Busy	Busies a unit of a posted SMR, a P-side link, or an entire SMR.
DISP	Display	Displays a group of SMR in a particular state.
LISTSET	List set	Lists the PM types in the posted set.
LOADPM	Load PM	Loads software and data into a unit (if the SMR unit is posted) or the SMR (if the SMR is posted).
NEXT	Next	Posts the next SMR in a displayed set.
Offl	Off-line	Sets a posted SMR off-line.
PERFORM	Perform	SMR performance status displayed at the MAP and updated every minute.
POST	Post	Posts a specific SMR, all SMR in a particular state, or SMR as a group.
-continued-		

Command	Function	Description
QUIT	Quit	Quits the current PM level of the MAP or cancels an SMR selection.
QUERYPM	Query PM	Displays information about a posted SMR.
RTS	Return to service	Returns to service a p-side link, a unit of a posted SMR, or an entire SMR.
SWACT	Switch activity	Switches active and inactive units for a posted SMR.
TRNSL	Translate	Displays P- or C-side link information of a posted SMR.
TST	Test	Tests a P-side link, a unit of a posted SMR, or an entire SMR.
-continued-		

Detailed descriptions of each command follow.

BSY command

BSY	PM UNIT LINK	unit_no ps_link	[FORCE]
-----	--------------------	--------------------	-----------

The BSY command manually busies one or both units of a posted SMR (which at the time must be Offl, SysB, InSv, or ISTb) or manually busies a P-side link of a posted SMR.

Parameters and variables

A description of the parameters and variables for this command follows:

- **PM** indicates that both units of the SMR posted at the PM MAP level are to be manually busied.
- **UNIT** indicates that one unit of the SMR posted at the PM MAP level is to be manually busied.
- **unit_no** specifies which unit of the posted SMR is to be manually busied.
Values: 0 or 1
- **LINK** applies BSY to a specified P-side link between the posted SMR and one of its associated RCT.
- **ps_link** specifies which P-side link is to be busied.

Range: 0 through 19

- **FORCE** overrides all other commands that may be in effect on a unit, SMR, or link. Forces both units of the SMR to the ManB state, even if TST is in effect on one of the units. Requires confirmation, Y or N, before execution.

Responses

**nnn CALLS WILL BE TAKEN DOWN
DO YOU WISH TO CONTINUE (Y OR N)?**

Explanation The BSY command has been applied to an SMR that is performing call processing. This message is a warning that further action will affect a specified number of calls in progress or in the process of connection.

System action The system takes no further action until a response is received from the craftsperson.

User action If the craftsperson responds to the prompt with "NO", the system reports "NO ACTION TAKEN", and the command is aborted. If the craftsperson answers "YES" to the prompt, the system executes the craftsperson's request.

NO ACTION TAKEN

Explanation The craftsperson has been warned that his request to busy manually all or part of an SMR may affect calls and has chosen to discontinue the request.

System action The BSY command is aborted.

SMR pm_number BSY PASSED

Explanation The posted SMR has passed the BSY command and is now manually busy.

System action The PM level of the MAP is updated accordingly.

SMR pm_number IS MANUAL BUSY.

NO ACTION TAKEN.

Explanation The craftsperson has attempted to manually busy an SMR that is already ManB.

System action The command is aborted.

SMR pm_number LINK link_no BSY PASSED

Explanation The specified P-side link on the posted SMR has passed the BSY command and is now ManB.

System action The MAP display is updated accordingly.

SMR pm_number UNIT unit_no BSY PASSED

Explanation The specified unit of the posted SMR has passed the BSY command and is now ManB.

System action The PM MAP display is updated accordingly.

Example

The craftsperson wishes to busy manually unit 0 of SMR 2 from the MAP. SMR 2 must first be posted, then the craftsperson must input

BSY UNIT 0

The system checks and finds unit 0 of SMR 2 to be processing 57 calls actively at the time the command is issued, so the system responds

**057 CALLS WILL BE TAKEN DOWN
DO YOU WISH TO CONTINUE (Y OR N)?**

Since it is not desirable to drop the calls being processed by the RCT configured on SMR 2, the craftsperson enters

N

At this point, the system aborts the craftsperson's request for busying the unit, and responds

NO ACTION TAKEN.

DISP command

DISP	pm_state	pm_type
------	----------	---------

The DISP command displays a set of SMR in a particular PM state.

Variables

- pm_state specifies a SMR state.
Values: Offl, ManB, SysB, CBsy, ISTb, or InSv
- pm_type specifies a type of peripheral module.
Value: SMR, in this context.

Responses

pm_state SMR: NONE.

Explanation A request has been issued to display all SMR in a given state while no SMR are in this state.

pm_state SMR: pm number(s).

Explanation A request has been issued to display all SMRs in a given state. These SMRs appear in the form of a list of module numbers.

Example of the DISP command

The craftsperson wishes to view the set of all SMR that are currently offline. To do this, the operator enters

DISP OFFL SMR

The system scans all SMR and determines SMR 2 and 7 to be offline. It then responds

OFFL SMR: 2, 7.

An option called DIAGHIST is added to the DISP command. The default for this option is to display all supported XPMs. Or, it can be used with a specific PM to display all XPMs of the requested type.

If the requested PM is not supported, the following message is displayed.

`Diagnostic history is not supported for this PM type.`

If no peripherals on the requested PM exist, the following message is displayed.

`None.`

The following is an example of the DISP command using the DIAGHIST option. The system responds by displaying the diagnostic history for all XPMs supported by this feature. Each unit displays the short and long term failure counts, and the last diagnostic failure date and time. The last reset field identifies the last time when the counters were reset to zero. The last reset date and time for short term failures are displayed for each unit. The last reset date and time for long term failures is displayed for the entire node. The MAP responses in this text are for example purposes only.

>MAPCI;MTC;PM;DISP DIAGHIST

```

SMR 0 Long-Term Failure (LTF) last reset: 92/07/01 03:12:14
      UNIT 0 Short-Term Failure (STF) last reset: 92/07/03
            03:10:20
            Last diagnostic failure: 92/07/04 13:35:50
            DIAGLIST      STF      LTF
            AB DIAG      3        3
            CARDLIST      STF      LTF
            NT6X44      2        2
      UNIT 1 Short-Term Failure (STF) last reset: 92/07/01
            03:12:14
            Last diagnostic failure: 92/06/02 14:00:31
            No failures recorded
SMR 1 Long-Term Failure (LTF) last reset: 92/07/01
            03:12:14
      UNIT 0 Short-Term Failure (STF) last reset: 92/07/03
            05:24:46
            Last diagnostic failure: 92/07/04 04:55:33
            DIAGLIST      STF      LTF
            AB DIAG      1        1
            CARDLIST      STF      LTF
            NT6X44      1        1
      UNIT 1 Short-Term Failure (STF) last reset: 92/07/03
            04:20:10
            Last diagnostic failure: 92/07/04 21:30:56
            DIAGLIST      STF      LTF
            AB DIAG      1        1
            SPCH DG      1        1
            CARDLIST      STF      LTF
            NT6X44      1        2
            NT6X41      2        2
            NT6X69      2        2
SMR 2 Long-Term Failure (LTF) last reset: 92/07/01
            07:19:41
      UNIT 0 Short-Term Failure (STF) last reset: 92/07/02
            02:31:20
            No failures recorded
      UNIT 0 Short-Term Failure (STF) last reset: 92/07/03
            02:01:55
            No failures recorded
SMR 3 Long-Term Failure (LTF) last reset: 92/07/04
            13:45:30
      UNIT 0 Short-Term Failure (STF) last reset: 92/07/03
            03:17:17
            Last diagnostic failure: 92/07/01 02:44:28
            No failures recorded

```

```

UNIT 1 Short-Term Failure (STF) last reset: 92/07/03
        03:28:01
Last diagnostic failure: 92/07/03 18:29:41
        DIAGLIST      STF      LTF
        SPCH DG       1        3
        CARDLIST      STF      LTF
No cards reported by the XPM

```

Note 1: No failures are recorded on unit 1 for SMR 0 since the last long term failure. The last diagnostic failure is before the long term failure reset time.

Note 2: SMR 2 does not display the last diagnostic failure line because there are no failures in its lifetime.

The following is an example of the DISP command using the DIAGHIST option with a selected PM. The system responds by displaying the diagnostic history for all XPMs of the PM requested.

>MAPCI;MTC;PM;DISP DIAGHIST LTC

```

> MAPCI;MTC;PM;DISP DIAGHIST LTC
LTC 0 Long-Term Failure (LTF) last reset: 92/07/01
      03:12:14
UNIT 0 Short-Term Failure (STF) last reset: 92/07/03
      03:10:20
Last diagnostic failure: 92/07/04 13:35:50
      DIAGLIST      STF      LTF
      AB DIAG       3        3
      CARDLIST      STF      LTF
      NT6X44        2        2
UNIT 1 Short-Term Failure (STF) last reset: 92/07/01
      03:12:14
Last diagnostic failure: 92/06/02 14:00:31
No failures recorded
LTC 1 Long-Term Failure (LTF) last reset: 92/07/01
      03:12:14
UNIT 0 Short-Term Failure (STF) last reset: 92/07/03
      05:24:46
Last diagnostic failure: 92/07/04 04:55:33
      DIAGLIST      STF      LTF
      AB DIAG       1        1
      CARDLIST      STF      LTF
      NT6X44        1        1
UNIT 1 Short-Term Failure (STF) last reset: 92/07/03
      04:20:10
Last diagnostic failure: 92/07/04 21:30:56
      DIAGLIST      STF      LTF

```

AB DIAG	1	1
SPCH DG	1	1
CARDLIST	STF	LTF
NT6X44	1	2
NT6X41	2	2
NT6X69	2	2

LISTSET command

LISTSET	pm_type
	ALL

The ListSet command lists the discrimination numbers of the PM types that are included in the posted set. Use the ListSet command for maintenance actions planned for sets of XPMs of the same type.

Parameters and variables

- pm_type specifies the type of PM in the posted set that is to be listed with all of its discrimination numbers.
- ALL lists all of the PM types that are in the posted set and includes their discrimination numbers.

Responses

pm_type pm_number, pm_number

:
:

pm_type pm_number, pm_number

Explanation The discrimination numbers of all PM types in the posted set are listed.

no pms found

Explanation The posted set of XPMs is empty.

no pms of specified pm type found

Explanation The posted set does not contain XPMs specified.

LOADPM command

LOADPM	UNIT unit_no	[CC FULL DATA EXEC]	[1_name]	[NOWAIT]
	PM	[MATE]		

The LOADPM command loads peripheral program files into the processor of a SMR previously specified by the POST command. The SMR must be in the Offl or ManB state before entering LOADPM.

Parameters and variables

- UNIT applies LOADPM to one of the units of the posted SMR.
- unit_no specifies which unit of the posted SMR is to be loaded.
Values: 0 or 1.
- PM applies LOADPM to both units of the posted SMR.
- CC specifies that the source of the load data is to be the DMS-100 Central control (CC) data store. CC is the default if no load source is entered.
- FULL selects the FULL load mode. FULL load consists of the basic SMR software, plus the execs and the static data in the CC. FULL is default if no load mode is entered.
- DATA selects the DATA load mode. The data load mode consists of the static data and execs, but not the basic SMR software.
- EXEC selects the EXEC load mode, which consists of execs only.
- l_name is the name of the CC data file for the posted SMR. It defaults to the peripheral load name listed in the LTCINV table under the field LOAD.
- MATE specifies that the source of the data to be loaded is to be the mate unit of the posted SMR, instead of the CC load file.
- NOWAIT allows another SMR to be posted and loaded without waiting for a confirming response from the previous load request. This process allows several SMR units to be loaded from the same load source. NOWAIT also enables the MAP to be used for other input while loading is in progress.

Note: LOADPM error messages are not updated on the MAP, but are printed out in PM logs.

Responses

SMR pm_number IS CENTRAL SIDE BUSY.

NO ACTION TAKEN.

Explanation An attempt has been made to load the posted SMR while it is in the CBSy state.

System action The command is not executed.

User action The craftsperson must busy the SMR manually and reissue the command.

**SMR pm_number IS IN-SERVICE.
NO ACTION TAKEN.**

Explanation An attempt has been made to apply the LOADPDM command while the SMR is InSv.

System action The command is not executed.

User action The craftsperson must busy the SMR manually and reissue the command.

**SMR pm_number IS SYSTEM BUSY.
NO ACTION TAKEN.**

Explanation An attempt has been made to apply LOADPDM to a SMR that is SysB instead of ManB.

System action The command is not executed.

User action The craftsperson must busy the SMR manually and reissue the command.

SMR pm_number OK. CHECKSUM = # hhh

Explanation The SMR has been successfully loaded. The checksum is the value associated with the data loaded into the SMR.

***** < Reason> *****

NO ACTION TAKEN.

Explanation The command cannot be executed for a reason other than those given in the standard responses. The variable <reason> is a text string.

System action The command is aborted.

User action The craftsperson response will vary with the reason for command failure.

Example

The craftsperson has posted SMR 2 and now wishes to load the static data and execs from CC data file SM1509F to unit 0 of this SMR. Wishing to engage in other MAP activities while the unit is loading, the operator enters

LOADPDM UNIT 0 CC DATA SM1509F NOWAIT

The system checks unit 0 of this SMR and finds it ManB, so after a short period of time, the system responds

SMR 2 OK. CHECKSUM = #417

With this message, the system indicates that the SMR has been loaded successfully.

NEXT command

NEXT	
------	--

The NEXT command displays the next higher numbered SMR in a posted set.

Response

END OF POSTED SET

Explanation The craftsperson has issued the NEXT command while the last member of a displayed set is currently posted.

System action The command is aborted. NEXT does not scroll back to the top of the displayed set of SMR.

User action To use the NEXT command, the craftsperson must again post several SMR as a set and reissue the request.

The posted SMR number in all displays increases by one. Also, parameters used in the POST command (such as pm_state) change, if they are different from those for the previously posted SMR.

OFFL command

OFFL	
------	--

The OFFL command sets both units of a posted SMR to the offline state. Both units must be in the ManB state before being set Offl. The Offl state is retained over all restarts.

Responses

SMR pm_number IS CENTRAL SIDE BUSY.

NO ACTION TAKEN.

Explanation An attempt has been made to set the posted SMR to Offl while it is Cbsy, rather than ManB.

System action The command is not executed.

User action The craftsperson must first set the SMR to ManB, then reissue the command.

SMR pm_number IS IN-SERVICE.**NO ACTION TAKEN**

Explanation An attempt has been made to set the posted SMR to Offl while it is InSv, rather than ManB.

System action The command is not executed.

User action The craftsperson must first BSY the posted SMR, then reissue the command.

SMR pm_number IS OFF-LINE.**NO ACTION TAKEN.**

Explanation An attempt has been made to set the posted SMR to Offl while it is already Offl.

System action No action is necessary.

SMR pm_number IS SYSTEM BUSY.**NO ACTION TAKEN.**

Explanation An attempt has been made to set the posted SMR to Offl while it is SysB, rather than ManB. Pm_number refers to the discrimination number of the SMR.

System action The command is not executed.

User action The craftsperson must first set the SMR to ManB, then reissue the command.

SMR pm_number OFFL PASSED

Explanation The posted SMR has been placed off-line successfully.

PERFORM command

PERFORM	
---------	--

The PERFORM command, MAP menu item 17, adds SMR performance information by displaying the XPM load name and status.

Response**Display****NO ACTION TAKEN.**

Explanation The MAP display, as shown in Figure 7-1, takes on an additional level of information, displaying Load Name, Status, Reason, Logs, and Time.

**XPM Does Not Support PERFORM Tool
NO ACTION TAKEN**

Explanation This is displayed if the SMR does not respond within 10 seconds of the PERFORM command. The PERFORM directory is not entered. The terminal is locked during the 10 second waiting period.

System action None

User action Check XPM load and type for compatibility.

POST command

POST	ALLPMS site frame pm_state pm_type [ALL pm_number]
------	---

The POST command allows the craftsperson to access a specific SMR and then execute other MAP commands.

Parameters and variables

- ALLPMS posts all PM types.
- site posts all PM types in a four-character alphanumeric string at a particular site.
- frame posts all PM types within a specified frame.
Range: 0 through 99
- pm_state posts all PM types that are currently in a specified condition.
Values: SysB, ManB, Offl, CBsy, ISTb, InSv
- pm_type specifies a type of peripheral module to be posted.
Value: SMR, in this context.

Note: SMRs appear as a group on the MAP display. From this group, specific SMR may be posted by number.

- ALL specifies that all SMR be posted.
- pm_number specifies a particular SMR, identified by number, should be posted.
Range: 0 through 127

Response

Refer to Figure 7-1 for an appropriate level-4 display of the SMR or other PM.

Figure 7-1
MAP display

```

CC      CMC      IOD      Net      PM      CCS      Lns      Trks      Ext      EIO
  ●          ●      ●      ●      ●      ●      ●      ●          ●          ●

      SMR
0  Quit_      PM          SysB ManB  Offl  CBsy  ISTb  INsv
2  Post_      pm_type      x      x      x      x      x      x
3  ListSet
4          pm_type      INSV LINKS_OOS  CSIDE y PSIDE z
5  Trnsl_      Unit0      Act  state
6  Tst_      Unit1      Inact state
7  Bsy_
8  RTS_
9  Offl
10 LoadPM_
11 Disp_
12 Next
13 SWACT_
14 QueryPM_
15
16
17 Perform
18

      Userid
TIME hh mm>

```

Explanation The MAP display has changed to the appropriate maintenance level for a posted SMR or other PM. The variable <state> indicates the particular pm_state of each SMR unit. Variable x refers to the number of posted PM in a specific pm_state. Variables y and z denote the number of out of service P-side and C-side links, respectively.

System action At this level, the system permits use of maintenance commands from its menu.

User action Using these menu commands, the craftsperson can obtain information about the posted SMR or execute maintenance on the SMR.

Note the following:

- POST displays vary depending on SMR posted.
- A list of current PM types and their number ranges is displayed by entering HELP POST.

Example

The craftsperson wants to learn the state of SMR 3 and perform maintenance, if necessary, on the SMR. The craftsperson enters:

>POST SMR ALL

In response to the request, a display appears at the MAP listing all SMR in the office network, their status, their number designation, and the number of C- and P-side links out of service in each SMR.

From this level, the craftsperson enters:

>POST SMR 3

The response is displayed in Figure 7-2.

Figure 7-2
MAP display

```

CC      CMC      IOD      Net      PM      CCS      Lns      Trks      Ext      EIO
.      .      .      .      .      .      .      .      .      .

      SMR
0  Quit_      PM          SysB  ManB  Offl  CBsy  ISTb  INsv
2  Post_      SMR          0      0      0      0      0      21
3  ListSet
4          SMR 3  INSV  LINKS_OOS:  CSIDE 0  PSIDE 0
5  Trnsl_      Unit0      Act   state
6  Tst_        Unit1      Inact state
7  Bsy_
8  RTS_
9  Offl
10 LoadPM_
11 Disp_
12 Next
13 SWACT_
14 QueryPM_
15
16
17 Perform
18

      Userid
TIME  hh mm>

```

This MAP display shows that SMR 3 is in service with all C- and P-side links operating normally. Unit 0 is the active unit and unit 1 the standby unit.

QUERYPM command

QUERYPM	[FLT CNTRS]
---------	------------------

The QUERYPM command displays miscellaneous information about a posted SMR.

Parameters

- **FLT** displays the reasons for fault conditions, if any, on each of the two units of the SMR. Also gives general information on the physical location of the SMR.
- **CNTRS** displays the contents of the SMR maintenance counters. These counters record the number of times that each FLT condition has occurred. Also displays general information about the SMR, including the software load being used.

Note: QUERYPM with no parameters displays information on physical location of the SMR, the software load as datafilled in the LTCINV table, and related information.

Responses

Refer to Figure 7-3 for a MAP display of the QUERYPM FLT entry.

Figure 7-3
MAP display

```

CC      CMC      IOD      Net      PM      CCS      Lns      Trks      Ext      EIO
.      .      .      .      .      .      .      .      .      .

      SMR
0  Quit_      PM          SysB  ManB  Offl  CBsy  ISTb  INsv
2  Post_      SMR          0      0      0      0      1      32
3  ListSet
4          SMR 0      INSV  LINKS_OOS  CSIDE 0 PSIDE 0
5  Trnsl_      Unit0      Act  state
6  Tst_      Unit1      Inact state
7  Bsy_      QUERYPM FLT
8  RTS_
9  Offl      Node is ISTB
10 LoadPM_  Warm SWACT turned off by manual command
11 Disp_
12 Next_      Unit 0
13 SWACT_      no fault exists
14 QueryPM_
15          Unit 1
16          no fault exists
17 Perform
18

      Userid
TIME hh mm>

```

Explanation The craftsperson has entered QUERYPM FLT and has received information on sources of fault in and physical location of the units of the posted SMR. Values for fault condition are as follows:

- Data not up to date: There has been a failure to reload following RTS (return to service).
- Reset: An error has occurred on a DS-30 network link to the unit, and the unit is awaiting a reset by the maintenance system.
- Init: CC restart has occurred. RTS is attempting a restart.

- Diagnostics failed: unit has failed TST or RTS.
- Trap: unit has sent an initiation complete message to CC following an auto-restart.
- Activity dropped: A system-generated SWACT has occurred.
- Audit: Incorrect internal state of active or inactive unit. Active unit internal state should be READY. Fault indications are BUSY, RESTART, or SYNCING.
- Unsolicited message limit exceeded: unit has sent more than 100 unsolicited messages to CC within one minute.
- CS links: the C-side message links have failed the periodic in-service C-side links test (one per minute).
- If there are no faults in a unit of the SMR when QUERYPM FLT is invoked, the phrase "NOT SYSB OR ISTB" appears after the unit_no of the faultless SMR unit.

A display appears giving only the general information on the SMR and its location.

Explanation The craftsperson has entered QUERYPM with no parameters.

Example of the QUERYPM command

The craftsperson has posted SMR 3 and finds that unit 0 is ISTb and unit 1 has been made SysB. To diagnose the faults in these units, the craftsperson enters

QUERYPM FLT

The system responds with a MAP display, listing faults. Refer to Figure 7-4.

An option called DIAGHIST is added to the QUERYPM command. This option displays the history of diagnostics failures for the posted peripheral. Each unit displays the short and long term failure counts. The last reset date and time for short term failure counters is displayed for each unit. The last reset date and time for long term failure counters is displayed for the entire node. Reset of long term failure counters is allowed from this level. The last diagnostic failure time is the time of the last diagnostic failure which occurred on that unit. Due to memory restrictions, the NT-40 summary does not associate diagnostics and cards. The QUERYPM DIAGHIST command provides a summary of diagnostic failures and cards reported as hardware faults identical to the format displayed by the DISP DIAGHIST command. The MAP responses in this text are for example purposes only.

If the requested PM is not supported, the following message is displayed.

Diagnostic history is not supported for this PM type.

If a unit of the peripheral has no diagnostic failures or card faults, the system displays the following.

No failures recorded.

Three optional parameters are added to this option:

- reset
 - allows long term failure counters to be reset to zero. A PM601 log is generated recording a summary of the long term failure counters before they are reset.
- diag
 - displays the short and long term failure counts of the diagnostics failed by each unit of an XPM (contains no card information).
- card
 - displays the short and long term failure counts of the cards on each unit of the XPM that are reported as hardware failures (contains no diagnostic information).

Note 1: The reset parameter is not intended to be used frequently, reset changes long term failure counters to zero.

Note 2: The card parameter provides a asterisk (*) next to any card that is reported by a diagnostic on the mate unit in the XPM.

Following are examples of the QUERYPM DIAGHIST command used with and without optional parameters.

```
>MAPCI;MTC;PM;POST SMR 1; QUERYPM DIAGHIST
```

```
SMR 1 Long-Term Failure (LTF) last reset: 92/07/01
      03:12:14
UNIT 0 Short-Term Failure (STF) last reset: 92/07/03
      05:24:46
      Last diagnostic failure: 92/07/04 04:55:33
      DIAGLIST  CARDLIST          STF      LTF
      AB DIAG: Total failures      2        3
      :NT6X44                      0        3
UNIT 1 Short-Term Failure (STF) last reset: 92/07/03
      04:20:10
      Last diagnostic failure: 92/07/04 21:30:56
      DIAGLIST  CARDLIST          STF      LTF
      AB DIAG: Total failures      1        1
      :NT6X44                      0        1
      SPCH DG: Total failures      1        4
      :NT6X44                      0        1
```

:NT6X41	0	3
:NT6X69	0	1

This response is the default information for the DIAGHIST option. The default response shows the failed diagnostics and associated cards. This display shows that on unit 1, the SPCHDIAG failed one time (indicated by the 1 in the STF column) since the last time unit 1 gained activity (which was at 4:20 A.M. on 7/03). The absence of numbers underneath the 1 indicates no cards are involved. The SPCHDIAG failed a total of four times since the LTF reset time (3:12 A.M. on 7/01). Of those four failures, the 6X44 card was involved one time, the 6X41 card three times, and the 6X69 card one time. When interpreting this display, it is important to remember that a single test can result in one or more diagnostic failures and zero or more associated cards. In particular, the sum of card counts from this display may not be the actual number of times a diagnosis fails. Also, the cards may be on either unit; only certain diagnostics report failures on the mate unit. This display shows cards that are on the same unit the diagnostic is run on.

>QUERYPM DIAGHIST DIAG

```
SMR 1 Long-Term Failure (LTF) last reset: 92/07/01
      03:12:14
UNIT 0 Short-Term Failure (STF) last reset: 92/07/03
      05:24:46
      Last diagnostic failure: 92/07/04 04:55:33
            DIAGLIST      STF      LTF
            ABDIAG        2        3
UNIT 1 Short-Term Failure (STF) last reset: 92/07/03
      04:20:10
      Last diagnostic failure: 92/07/04 21:30:56
            DIAGLIST      STF      LTF
            ABDIAG        1        1
            SPCH DG       1        4
```

>QUERYPM DIAGHIST CARD

```
SMR 1 Long-Term Failure (LTF) last reset: 92/07/01
      03:12:14
UNIT 0 Short-Term Failure (STF) last reset: 92/07/03
      05:24:46
      Last diagnostic failure: 92/07/04 04:55:33
            CARDLIST      STF      LTF
            NT6X44        0        3
UNIT 1 Short-Term Failure (STF) last reset: 92/07/03
      04:20:10
```

Last diagnostic failure: 92/07/04 21:30:56

CARDLIST	STF	LTF
NT6X44	0	1
NT6X41	0	3
NT6X69	0	1

>QUERYPM DIAGHIST RESET

WARNING: The Long Term Failure (LTF) counters will be ZEROed.

Please confirm ("YES" or "NO"):

>YES

LTF counters reset to zero.

Figure 7-4
MAP display

```

      CC   CMC   IOD   Net   PM   CCS   Lns   Trks   Ext   EIO
      .   .   .   .   .   .   .   .   .   .

      SMR
0  Quit_   PM           SysB  ManB  Offl  CBsy  ISTb  INsv
2  Post_   SMR          0     0     1     0     2     12
3  ListSet
4
5  Trnsl_   SMR 3 ISTb  LINKS_OOS:  CSIDE 0 PSIDE 0
6  Tst_     Unit0    Act   ISTb
7  Bsy_     Unit1    Inact SysB
8  RTS_     QUERYPM FLT
9  Offl     Unit0    Data not up to date
           Unit1    Reset

10 LoadPM_
11 Disp_

12 Next
13 SWACT_
14 QueryPM_
15
16
17 Perform
18

      Userid
TIME hh mm>

```

This display informs the craftsperson that unit 0 has not been reloaded after an RTS and that unit 1 has a DS-30 link error and needs a reset.

QUIT command

QUIT	1 n PM ALL
------	---------------------

The QUIT command causes the current MAP display to change to a preceding level, as specified by choice of parameter. The command can be input at any level.

Parameters and variables

- 1 causes the current level display to change to the preceding level. (If a SMR was not selected, displays MTC level; if SMR or other PM was selected, cancels selection and stays at PM level.) 1 is the default parameter.
- n causes the current display to change back a number of levels, specified by n. If a PM is posted currently, this counts as one level below the PM level.
Values: 1 to 4
- PM returns the display to the MTC level from any level.
- ALL returns the display to the CI level from any level.

RTS command

RTS	UNIT unit_no PM LINK ps_link	[FORCE]
-----	------------------------------------	-----------

The RTS command returns to service one unit, a P-side link, or an entire posted SMR. Test routines are performed. RTS is executed if these tests pass. SMR must be in ManB or SysB state.

Note: For an SMR, if a fault is detected but at least one link is operational, the SMR is returned to service with an ISTb state indicated. Fatal faults result in the SMR being left out of service.

Parameters and variables

- UNIT applies RTS to one of the units of the posted SMR.
- unit_no specifies which unit of the SMR is to be returned to service.
Values: 0 or 1
- PM applies RTS to both units of the selected SMR.
- LINK applies RTS to a specified P-side link between the posted SMR and one of its associated RCT.
- ps_link specifies which P-side link is to be returned to service.
Range: 0 to 19
- FORCE bypasses diagnostic operation and forces the equipment back into service. Overrides all other commands that may be in effect on a unit or link.

Responses

OSVCE TESTS INITIATED

Explanation The craftsperson has issued a request for RTS on a posted SMR or on a unit or link with no FORCE parameter. Out of service testing is being performed on the ManB or SysB posted SMR.

System action If the SMR, unit, or link passes the tests, the system will pass RTS. If not, an error message is returned.

SMR pm_number IS (CENTRAL SIDE BUSY, IN-SERVICE, OFF-LINE)

Explanation The craftsperson has attempted to RTS an SMR, unit, or link that was in a state other than ManB or SysB.

System action The RTS command is aborted.

SMR pm_number UNIT unit_no TST FAILED, test_name TEST:

retcode FAIL MESSAGE RECEIVED FROM PM

Explanation The craftsperson has attempted to RTS a posted SMR, unit, or link, and diagnostic tests have been initiated. A unit of the SMR has failed one of the tests, designated by a test name and return code.

System action If the fault is minor, the SMR, unit, or link is returned to service in ISTb state. If the fault is serious, the SMR, unit, or link remains out of service.

User action The craftsperson should check the faulty cards or other components indicated by the failure message test name and return code, rectify the fault, and, if necessary, reissue the RTS command.

SMR pm_number UNIT unit_no TST PASSED;

SMR pm_number UNIT unit_no RTS PASSED

Explanation The craftsperson has attempted to RTS a posted SMR, unit, or link, and diagnostic tests were initiated. The SMR, unit, or link has passed the diagnostic and the RTS command was executed.

System action The state of the SMR, unit, or link changes from ManB or SysB to InSv.

Example

The craftsperson has posted SMR 3, whose units 0 and 1 are in the InSv and SysB states, respectively. To diagnose the trouble in mate unit 1 and put it back into service, the craftsperson types

RTS UNIT 1

The system initiates diagnostic tests on unit 1 and reports the results to the craftsperson with the following messages:

OSVCE TESTS INITIATED; SMR 3 UNIT 1 TST FAILED, ABITBWD TEST D1 FAIL MESSAGE RECEIVED FROM PM

Unit 1 of SMR 3 has failed the out-of-service diagnostic. Specifically, the A-bit/B-word card was determined to be faulty. Since the A-bit/B-word facility is crucial to the processing of calls, unit 1 of SMR 3 is left out of service until the fault is corrected. The craftsperson should check the A-bit/B-word card and replace it, if necessary.

SWACT command

SWACT	NOW TEST ALL
-------	--------------------

The SWACT command switches activity in a posted SMR from the active unit to the inactive unit. Both units must be InSv or ManB to do a SwAct.

Parameters

- NOW causes an immediate transfer of unit activity.
- TEST causes a newly inactive unit to go through an RTS with full OOS diagnostics.
- ALL causes a SwAct on all PMs in the post set of the same PM type as the PM displayed on the MAP.

Responses

INVALID REQUEST;

INACT UNIT MUST BE INSV OR BOTH UNITS MUST BE MANB.

Explanation The craftsperson has attempted to SwAct the units of a posted SMR while the units were in disallowed pm_states for the SwAct.

System action The command is aborted.

User action The craftsperson must busy the active unit and busy or RTS the inactive unit. The command must then be reissued.

SMR pm_number SWACT FAILED

CHECK FOR POSSIBLE LOGS

Explanation The craftsperson has attempted a SwAct for a posted SMR, but the attempt has failed due to a possible fault in the system.

System action The SWACT command is not executed.

User action The craftsperson should check for possible log outputs, attempt to determine and rectify the cause for SwAct failure, and reissue the command.

SMR pm_number SWACT PASSED

Explanation Activity has been successfully switched between units of the posted SMR.

System action The newly inactive unit becomes SysB and requires RTS to return it to ready state. RTS is applied automatically after two minutes, if the craftsperson does not manually input it before that time. The other unit begins processing calls.

The SMR provides the capability for warm SwAct in the SMR so that established calls are preserved in an activity switch between mate units. To initiate the transmission of critical data from the active to the inactive unit, warm SwAct is automatically enabled at the MAP. This means that the command WARMSWACT ON is a default command, with the command WARMSWACT OFF allowing the craftsperson to turn off warm SwAct.

If the craftsperson has turned off warm SwAct and then issues the command WARMSWACT ON, the inactive unit goes system busy while data transfer is initialized (for one to two minutes). Upon completion of the bulk data transfer, the inactive unit is returned to service (RTS). The SMR has, at this point, capability for warm SwAct.

Calls are maintained when the craftsperson asks for an immediate SwAct, with the SWACT NOW command.

Example of SWACT command

The user enters the command SWACT without parameters for a posted SMR, and the following response appears at the MAP terminal.

```
A Warm SwAct will be performed after data
sync of active terminals.
Please confirm ("YES" or "NO"):
```

The user confirms the request for a SwAct and the following message appears at the MAP terminal.

```
SwAct refused by SwAct Controller
Inactive unit has a history of:
  Message link failures
  Superframe sync failures
Inactive unit is reporting:
  Unit is jammed inactive
```

The user decides to override the SwAct controller by entering the SWACT command with the FORCE option. The following response appears at the MAP terminal.

```
A Warm SwAct will be performed after data
sync of active terminals.
Overriding the SwAct Controller
Please confirm ("YES" or "NO"):
```

The user confirms the request to override the SwAct controller and the following message appears at the MAP terminal.

```
SwAct Failed
Reason: XPM SwActback
```

The MAP response indicates that the SwAct failed and that the originally active unit regained activity.

TRNSL command

TRNSL	side (link_no)
-------	----------------

The TRNSL command identifies C-side or P-side message links of a posted SMR. This command also shows the status of the DS-30 C-side links to the DMS-100 network or the DS-1 P-side links to RCT.

Variables

- **side** selects the C-side or P-side links for display.
Values: C or P
- **link_no** identifies one specific link for display. If **link_no** is not entered, then all the C-side or P-side links are displayed.
Range: 0 to 31 (C-side) or 0 to 19 (P-side)

Responses

NO PM POSTED

Explanation The craftsperson has attempted the TRNSL command without having posted an SMR.

System action The command cannot be executed.

User action The craftsperson must post a SMR before invoking TRNSL.

A MAP display shows either a list of the C-side or P-side links indicating link connections, their capabilities, statuses, and message conditions.

Explanation The craftsperson has invoked the TRNSL command with either parameter. The significance of each code on a translate display follows:

- CAP Capability (of the links)
 - Values: MS (message) or S (speech)
- STATUS State (of the link)
 - Values: OK (InSv); ManB, SysB, ISTb, CBsy, or Offl (see table 7-1)
- MSG COND Message Condition
 - Values: CLSD (closed) or OPN (open)

Example

SMR 3 has been posted. To receive information on the C-side links of this SMR, the craftsperson enters

>TRNSL C

The system produces the display shown in Figure 7-5.

Figure 7-5
MAP response to >TRNSL C

```

CC      CMC      IOD      Net      PM      CCS      Lns      Trks      Ext      EIO
.      .      .      .      .      .      .      .      .      .

      SMR
0  Quit_      PM      SysB  ManB  Offl  Cbsy  ISTb  INsv
2  Post_      SMR      0      0      0      0      1      21
3  ListSet
4              SMR 3      ISTb  LINKS_OOS  CSIDE 0 PSIDE 1
5  Trnsl_      Unit0      Act  ISTb
6  Tst_      Unit1      Inact ISTb
7  Bsy_      TRNSL C
8  RTS_

9  Offl
10 LoadPM_
11 Disp_
12 Next
13 SWACT_
14 QueryPM_
15
16
17 Perform
18

LINK 0  NET 0 0  3;CAP MS; STATUS:  OK MSGCOND OPN, Unrestrict
LINK 1  NET 1 0  3;CAP MS; STATUS:  OK MSGCOND OPN, Unrestrict
LINK 2  NET 0 0  37;CAP S; STATUS:  OK
LINK 3  NET 1 0  37;CAP S; STATUS:  OK
LINK 4  NET 0 0  20;CAP MS; STATUS:  OK MSGCOND OPN, Restrict
LINK 5  NET 1 0  20;CAP MS; STATUS:  OK MSGCOND OPN, Restrict

      Userid
TIME hh mm>

```

SEE INSERT

All C-side links for SMR 3 are InSv, but one P-side link is out of service. All C-side links are displayed.

The capability field (CAP) indicates message (MS) and speech (S) capabilities of the links. Here, the links are operating normally, so the status is OK and the message condition (MSGCOND, link's ability to carry messages) is OPEN (OPN).

The C-side links that are connected to the presently active unit are unrestricted. Those connected to the presently inactive unit are restricted.

If a C-side link were busy, the display would be different. For example, if LINK 0 were SysB, the display might show:

LINK 0: NET 0 1 24; CAP MS; STATUS: SYSB, MSGCOND: CLSD.

To view information about the P-side links for SMR 2, the craftsperson posts this SMR and inputs:

TRNSL P

The system responds with the display in Figure 7-6.

Figure 7-6
MAP response to >TRNSL P

```

      CC      CMC      IOD      Net      PM      CCS      Lns      Trks      Ext      EIO
      .      .      .      .      .      .      .      .      .      .

      SMR
0  Quit_      PM          SysB  ManB  Offl  CBsy  ISTb  INsv
2  Post_      SMR          0      0      15    0      3      20
3  ListSet
4
5  Trnsl_     SMR 2         INSV  LINKS_OOS  CSIDE y PSIDE z
6  Tst_      Unit0        Act  state
7  Bsy_      Unit1        Inact state
8  RTS_

9  Offl
10 LoadPM_
11 Disp_
12 Next
13 SWACT_
14 QueryPM_
15
16
17 Perform
18

LINK 13 RCT0 01 3 2;CAP MS;STATUS: OK MSGCOND:OPN
LINK 14 RCT0 01 3 5;CAP MS;STATUS: OK MSGCOND:OPN

      Userid
TIME hh mm>

```

Again, the CAP field indicates MS and S capabilities of the links. The links are operating normally, with status OK and MSGCOND, ability of the link to carry messages, is OPN.

If LINK 0 were ManB, the display might show:

LINK 0: RCT0 01 3 2; CAP MS; Status:ManB, MSGCOND: CLSD.

TST command

TST	- PM UNIT unit_no LINK ps_link
-----	--------------------------------------

The TST command invokes test routines on a posted SMR, one of its units, or one of its links. SMR must be SysB, ManB, or InSv.

Note: If the SMR is ManB or SysB, then out-of-service diagnostics are performed. If one unit is InSv and the other is ManB, then in-service diagnostics are performed on the InSv unit and out-of-service diagnostics on the ManB unit.

Parameters and variables

- PM applies TST to both units of the posted SMR.
- UNIT applies TST to one of the units of the posted SMR.
Values: 0 or 1
- LINK applies TST to a specified P-side link between the posted SMR and one of its associated RCS.
- ps_link specifies which P-side link is to be tested.
Range: 0 through 19

Responses**CS LINK UNAVAILABLE****NO ACTION TAKEN**

Explanation The C-side links used for messaging are out of service, so the SMR cannot communicate with the CC.

System action The TST command cannot be executed.

User action The craftsman must put the C-side links back in service, then reissue the command.

INSVCE TESTS INITIATED

Explanation In-service testing is being performed on the posted SMR, unit, or link.

System action At completion of the diagnostic, the system notifies the craftsman of the success or failure of the test.

OSVCE TESTS INITIATED

Explanation Out-of-service testing is being performed on the posted SMR, unit, or link.

System action At completion of the diagnostic, the system notifies the craftsperson of the success or failure of the test.

SMR pm_number IS (OFFLINE, CENTRAL SIDE BUSY)

Explanation An attempt has been made to issue the TST command on a part of the SMR while the SMR or unit was not ManB, SysB, or InSv.

System action The command is not executed.

User action The craftsperson must change the state of the posted SMR or unit to ManB or InSv and reissue the command.

SMR pm_number LINK ps_link TST FAILED

Explanation A P-side link of the SMR has failed the TST command. Additional information on potentially faulty cards will appear with this message.

System action The craftsperson should check the indicated cards and replace them if necessary.

SMR pm_number LINK ps_link TST PASSED

Explanation The P-side link indicated in the TST command has passed the diagnostic.

**SMR pm_number UNIT unit_no TST FAILED
NO REPLY FROM PM**

Explanation An SMR unit has failed the applied test(s). An additional display will appear with this message, giving the physical location and the product engineering code of cards likely to have caused the failure.

System action The craftsperson should check the cards referred to and replace any that are faulty.

SMR pm_number UNIT unit_no TST PASSED

Explanation A unit of the posted SMR has passed the TST command. If a whole SMR was tested, one of these messages for each of the two units is returned.

TEST RESOURCES IN USE

NO ACTION TAKEN

Explanation Test facilities are already in use for other maintenance.

System action The TST command is not executed.

User action The craftsperson must reissue the command at another time.

Example

The craftsperson first posts SMR 2 and finds unit 0 to be SysB. To determine the problem in this unit, the craftsperson enters

TST UNIT 0

The system performs a diagnostic and indicates test initiation and results as follows:

OSVCE TESTS INITIATED SMR 2 UNIT 0 TST FAILED

Because the unit failed the diagnostic tests, information is displayed, identifying cards that may be faulty.

Site	Flr	Rpos	Bay ID	Shf	Description	Slot	EqPEC
Host	03	B03	LTE003	03	SMR:002	:08	6X45
Host	03	B03	LTE003	03	SMR:002	:23	6X40
Host	03	B03	LTE003	17	SMR:002	:23	6X40
Host	03	B03	LTE003	03	SMR:002	:12	6X45

The craftsperson should employ this information to isolate and rectify equipment problems.

PMRESET command

PMRESET	pm_type UNIT unit_no
---------	-------------------------

The PMRESET command resets a posted SMR or SMR unit. PMRESET is a non-menu (unlisted) command.

Parameters and variables

- **pm_type** applies PMRESET to a whole posted PM. Value may be SMR.
- **UNIT** applies PMRESET to one unit of a posted SMR.
- **unit_no** specifies which unit of the posted SMR is to be reset.
Values: 0 or 1

Responses

SMR UNIT unit_no PMRESET FAILED

Explanation The system was unable to successfully complete the reset on the posted unit.

SMR UNIT unit_no PMRESET PASSED

Explanation The unit has been reset. If the whole SMR has been reset, two of these messages, one for each unit, are returned.

Manual maintenance unique to the SMR

Two unique SMR messages can occur during manual maintenance:

- When a P-side link test fails, SMR cards associated with the interface to the DS-1 lines are displayed.
- When attempting to busy a P-side link, the status of the other link (second link) connecting to the same RCT is checked. If this second link is unavailable, craftspersons are prompted for confirmation to busy the first P-side link with the following message:

CALLS ON SMR MAY BE AFFECTED. PLEASE CONFIRM (YES OR NO).

System maintenance unique to the SMR (B-word time-out)

Two key items for SMR system maintenance follow:

- The SMR A-bit/B-word and Ring/Pad tests are two diagnostics run when TST or RTS is chosen from the posted SMR menu. These diagnostics are provided for two SMR cards, the A-bit/B-word and Ring/Pad cards.
- A SMR communicates with a RCT by sending B-word commands over a DS-1 link. Replies to these commands are expected from the RCT. If a reply is not received, the B-word hardware times out. An SMR keeps a count of B-word timeouts per DS-1 link and sends an unsolicited message to the CC, indicating that the RCT is not communicating on that link. When more than ten B-word unsolicited timeout messages arrive at the CC in a five minute period, the link is removed from service. A typical log message follows:

```
PM 181 OCT 26 09:10:02 0230 INFO HOST SMR 0 UNIT 0
```

```
BWORD TIMEOUT ON SMR LINK 1 TO RCT
```

Advanced troubleshooting**Using the SMR footprint tool****How the footprint tool operates**

The footprint tool collects data when key events occur in the SMR so the cause of failures can be determined. The data is stored in buffers which survive all SMR restarts and resets, including SMR program reloads, so the data can be retrieved after an SMR outage. The memory buffers are a circular queue of events that contain information about various SMR operations and their results. These buffers can be output in either a raw hex format or in a more readable format.

The SMR footprint tool has been designed with two event storage buffers: one is the active buffer and the other is the holding buffer. By having active and holding buffers, we can avoid overwriting data saved from the previous outage. When an outage occurs the active and holding buffers are swapped. The active buffer before the outage is locked to prevent the buffer from being overwritten, in the event that the SMR goes through multiple initializations.

Note: The buffers will not be locked for planned SMR outages such as manual warm SwActs, REX tests and BSY operations, or if one buffer (holding) is already locked.

Critical events in the SMR are recorded with relevant data during the normal operation of the SMR. When the active buffer is full, it wraps around to the beginning of the data area and begins overwriting previously captured data and events. This ensures that the latest events are present in the footprint area. This procedure could also result in relevant data being lost. To help avoid such loss the events have been grouped into classes. The type of events stored by the footprint tool occur in the following SMR classes are maintenance, sync, activity, diagnostics, audits, messaging, patcher, call processing, PMDEBUG, and static data. These classes of events can be selected or omitted in order to fine tune the data being collected and to prevent the data from overflowing the buffers. For example, if the suspected cause of an outage is a particular diagnostic, this class could be enabled and all others could be omitted in order to focus the data collection on the diagnostics.

When the SMR unit is about to drop (reinitialize), an extra set of events is recorded about the type of failure and its cause. As well, certain system variables are saved. Before dropping activity, a decision is made as to whether or not the active buffer should be locked based on the following:

- If the drop request came from the CC the buffers are not locked unless it is a system request
- If the drop request was autonomous (caused by some internal SMR decision) the buffers are locked.

A footprint information area is available to indicate whether a wraparound has taken place, the size of the footprint area and the address of the last used buffer. This data is useful when the SMR cannot be brought back to task level and the data must be dumped by the ROM firmware.

An audit has been added that will unlock a buffer after 24 hours to prevent the loss of data from further SMR outages. A PM189 log is produced each time the active buffer is locked or freed.

The following are examples of the type of information that is collected:

- 1 Every command that is entered from PMDEBUG is stored so that it can be determined whether an SMR outage was caused by someone invoking a dangerous command.
- 2 The start and completion of a patch applied or removed is recorded so that it can be determined whether an SMR outage was caused by the improper application or removal of a patch.

Accessing the data collected

Selection of the classes of data to collect, and access to the data collected by the tool, is through PMDEBUG. (See *PMDEBUG User Guide Technical Assistance Manual*, TAM-1001-004.) At the top level the BIGFOOT command allows access to commands for selecting and displaying data.

The Bigfoot utility stores information on passed and failed diagnostics. However, with the implementation of feature AF5008, XPM REX Control and Trouble Notification Improvements, the Bigfoot utility only maintains information on failed diagnostics (error log information) which enhances debugging efforts. In addition to error log information, the diagnostics code maintains a results graph for each set of diagnostics being run. The results graph contains data on each diagnostic test in a diagnostics run. The results graph identifies a diagnostic as passed, failed, not run, or test undefined. An example of the diagnostics graph is presented later in this section.

The three main sublevels for these functions follow:

- selection menu
selects, deletes, and queries classes of events to be captured.
- HEX DUMP command
displays collected data in raw hex format. None of the data is interpreted. This command is useful for quickly displaying data or for loads that do not have decoding routines.
- dump routine
displays formatted data. If a formatting routine is not present, raw hex format is displayed.

Data may also be displayed if the SMR is at ROM level by using the display memory command.

Table 7-3 shows the commands that are provided as part of the PMDEBUG user interface to the SMR footprint tool.

Table 7-3
SMR footprint commands

Command	Use
Display_data	Used to display formatted data. Data saved is formatted only if a display routine has been bound in.
Dump_data	Used to display unformatted data. Data is displayed in hexadecimal format (16 bytes).
Query_status	Used to get the state of the active and holding data areas. The type of information provided is contained in the SMR footprint ID area.
Class	Used to enable/disable/query event classes. The state (enabled/disabled) is displayed for the queried (or ALL) classes.
Survive	Used to enable/disable/query the ability of class settings to survive a restart.
Clear	Used to clear the data areas to their initial state. This resets the SMR footprint ID area to its initial state.
Lock	Used to lock the active or holding data area. This is provided for field personnel and designers wishing to hold on to data collected when the tool has not locked the buffers automatically.
Unlock	Used to unlock the active or holding data area. This is useful if the data collected has been displayed or is no longer needed.
Help	Gives the syntax for the above commands.

The standardized header for the output routines is:

```
<nnn>          CLASS          EVENT          CC TIME OF EVENT
                MAINTENANCE (#xx) #yy          01:13:19:12.52
```

Where nnn is the buffer number
 xx is the Hex value for the given class
 yy is the event number of the given class

Maintenance class output

Examples of stored maintenance data follow:

- Activity drop

```
<000>          CLASS          EVENT          CC TIME OF EVENT
                MAINTENANCE (#00) #00          01:13:19:12.52
```

Dropped activity.
 Parml = swact_when_ready.
 Drop source = cc_manual.

- jam

```
<000>          CLASS          EVENT          CC TIME OF EVENT
          MAINTENANCE(#00) #03          01:13:19:12.52
```

Unit Has Received a Jam Inactive Message.
 Jam source = #CC.
 Jam result = mrs_ok.
 Unit is jammed inactive.

- failed pre-SwAct audit

```
<000>          CLASS          EVENT          CC TIME OF EVENT
          MAINTENANCE(#00) #04          01:13:19:12.52
```

Pre-SWACT audit failed.
 Failure reasons are:
 The unit needs to be reloaded.
 The unit is jammed inactive.

- reception of pre-SwAct audit fail message

```
<000>          CLASS          EVENT          CC TIME OF EVENT
          MAINTENANCE(#00) #04          01:13:19:12.52
```

Pre-SWACT Audit Fail Message Received.

Operational faults

Examples of stored operational fault data follow:

```
<003>          CLASS          EVENT          CC TIME OF EVENT
          MAINTENANCE(#00) #08          01:13:19:12.52
```

Operational Fault Data Continued.
 Rec_data 0 through 6": #00 #00 #00 #00 #00 #00

```
<002>          CLASS          EVENT          CC TIME OF EVENT
          MAINTENANCE (#00) #07          01:13:19:12.52
```

Operational Fault Data Continued.
 R_list 4 through 7": #0000 #0000 #0000 #0000

```
<001>          CLASS          EVENT          CC TIME OF EVENT
          MAINTENANCE (#00)  #06          01:13:19:12.52
```

Operational Fault Data Continued.

```
R_list  0 through 3":  #0000  #0000 #0000 #0000
```

```
<000>          CLASS          EVENT          CC TIME OF EVENT
          MAINTENANCE (#00)  #05          01:13:19:12.52
```

An Operational Fault Message Has Been Received.

Source = #D6.

R_action = rr_localize - will only try to localize the fault.

R_component = #D6.

R_count = #00.

Activity class output

An example of stored activity data follow:

```
<000>          CLASS          EVENT          CC TIME OF EVENT
          MAINTENANCE (#01)  #00          01:13:19:12.52
```

Dropped Activity.

Drop reason = dr request.

Drop cid = #CC

Drop source = cc manual.

Diagnostic class output

An example of stored diagnostic data follows:

```
<000>          CLASS          EVENT          CC TIME OF EVENT
          MAINTENANCE (#02)  #00          00:00:03:20.84
```

Diag_id = did_tone_diag{#B5} - Tone Diagnostic.

Loc_msw = #0011.

Loc_lsw = #001F.

Expected = #48.

Received = #41.

Qualifier = #12.

Diagnostics results graph output

An example of the diagnostics results graph display output follows:

```
<001>          CLASS          EVENT  CC TIME OF EVENT
          DIAG GRAPH (#0F)  #00   00:00:06:34:58
```

```
Diag_id =did_cmr_diag(#7) - CMR Card Diagnostics.  
res_num=FF(P=Pass,F=Fail,N=Not Run|Test Undefined,O=Other)  
Diag Results Graph: PFNNNNNNNNNNNNNNNNNNNN
```

Patcher class output

An example of stored patcher data follows:

```
<000>          CLASS          EVENT          CC TIME OF EVENT
          MAINTENANCE (#08)    #00          01:12:03:20.84
```

```
Patch Action Started.
Patchid = XAN13X31
Patch action = remove.
Patch result = mrs_ok.
```

PMDEBUG class output

An example of stored PMDEBUG data follows:

```
<000>          CLASS          EVENT          CC TIME OF EVENT
          MAINTENANCE (#0B)    #00          01:12:03:20.84
```

```
Directory:  bigfoot
Command:   class
```

Static data class output

An example of stored static data follows:

```
<000>          CLASS          EVENT          CC TIME OF EVENT
          MAINTENANCE (#0C)    #00          01:12:03:20.84
```

```
Number of data bytes = 4.
Fiat byte = #02.
Oper byte = updtuple.
Sol byte = #08.
Tblid byte = #1F.
Data bytes 0 to 4 are:  F0 03 07 00 01
```

Limitations

The data collected by the SMR footprint facility may be lost under the following circumstances:

- SMR outages are caused by power loss
- The data is not accessed within 24 hours of the buffer being locked
- The SMR reinitialization was a result of a system action such as a REX test, manual SwAct or a BSY operation

- The size of the footprint tool data area changes in size. This could happen if the SMR unit was reloaded with a different load from the one that captured the data. For example a BCSn load may drop activity only after a few seconds in service. In order to retrieve the data, the BCSn-1 load can be loaded into the SMR. The only requirement is that the footprint tool data area in the BCSn-1 load must be as large or larger than the data area in the BCSn load. If it is smaller, some of it will have been overwritten by the operating system when the SMR was reloaded and the data will be unreadable.
- Any card is pulled from the shelf of the SMR unit that dropped.

Handling a parity error fault

In BCS28, the parity audit was introduced. If a parity fault was detected, the unit that had the fault was taken out of service, and the craftsperson had to manually test the unit and return it to service. In BCS31, the SMR reports to the CC that a parity fault has been found, and, depending on the type of parity error and the state of the SMR units, the CC will decide which action to take. In most cases, the fault can be corrected without a loss of service. The following sections give a background on the types of parity audits and an overview of the types of actions the CC undertakes. The last sections highlight the trouble indicators for each type of fault. Listed under each trouble indicator are the actions that the CC and the craftsperson should take.

Types of parity audits

The three types of parity audits are

1 Intermittent fault

This occurs when a parity error is detected, but no error is found during the reread of the location.

2 Soft fault

This occurs when a parity error is detected, and an error is found when the SMR tries to reread the location. However, no error is found when the SMR tries to write to the location. The error can occur in either the program store or memory store.

3 Hard fault

This occurs when the SMR detects a fault and can neither reread nor write to the memory location. In this case the hardware is faulty, and the associated memory card must be replaced to correct the fault.

Types of actions taken by the CC

Once the SMR has detected the parity fault, the actions taken by the CC depend on the type of parity fault found and the state of the SMR. In summary, the CC can either set the faulty unit as SysB and trigger an

appropriate recovery action, or it can set the faulty unit as ISTb. The main factors affecting the CC's course of action are whether the faulty unit is the active unit, whether warm SwAct is in effect, or whether the inactive unit is in service. The actions taken by the CC control what steps, if any, the craftsperson should take.

The primary way that the CC informs the craftsperson of a parity fault is the PM181 log. In BCS33, a new log, PM777, is introduced to assist in performing corrective hardware action by using information provided in the text. The PM180, originally introduced to report cases of software exceptions, has expanded to report audits and hardware failures that can appear as software faults. The new log is to provide more meaningful, thereby useful, fault information than previously available from some PM180 logs. The PM777 will identify, in an English text, the suspected card or cards creating the fault. By adding software routines that interface directly with hardware, hardware occurrences, that might have generated a PM180 software fault report in the past, would now generate a PM777. Converting the instances of PM180 caused by hardware faults will reduce the number of these logs and provide a more appropriate application of PM180s and PM777s. This feature interfaces with feature "Log Retrieval Facility for E1 Incidents" by providing an indication of hardware problems as a result of PM software examination. The PM777 will be handled by the Central Control log system.

These logs are therefore the primary trouble indicator. The craftsperson can also check for associated logs (such as the PM128) to understand what actions (if any) the CC is taking.

The following sections have as their header the PM181 log and the message that informs the craftsperson of the type of parity fault. Under each heading are the associated logs and indicators (the response to >QUERYPM FLT) that tell the craftsperson what the CC is doing to rectify the fault. After each subset of indicators are the actions the craftsperson should take.

The main point to remember is there are two conditions that control what actions the CC takes:

- 1 Both units are in service and warm SwAct is available.
- 2 Only the active unit is in service or warm SwAct is not available.

The reasons that these conditions control the CC action should become clear as the scenarios are explained.

Hard parity fault where both units are InSv

This is an example of a PM181 log:

```

PM181 JUL23 23:29:16 5561 INFO SMR 0 UNIT 0
Node: ISTb, Unit 0 Act: InSv, Unit 1, Inact: InSv
Parity audit detected hard parity fault
Site  Flr  RPos Bay_id  Shf Description      Slot  EqPEC
SMRR00   C05  SME 00   18  SMR: 000        10   6X47

```

Other trouble indicators follow:

- **PM128 - The SMR has been set ISTb, with the inactive unit as OOS.**

```

PM128 JUL23 23:29:16 5561 TBL  ISTb SMR 0
Node:  ISTb, (Inact OOS) From InSv
Unit 0 Inact:  SysB (Parity errors detected) from InSv
Unit 1  Act:  InSv

```
- **PM189 - The inactive unit of the SMR has a hard_flt.**

```

PM189 JUL23 23:29:17 5561 INFO PM SW INFORMATION REPORT
SMR 0 Unit 0:  Inact
TASKID:  00370037 PARAUDT, TIME:  22: 29:16.68
COMID:   FF NILCID
TEXT:   hard_flt 00 00 57 F6 00 00

```
- **>QUERYPM FLT**

```

System busy reason:  hard parity fault was detected.

```

The 'system busy' means that the inactive unit has been removed from service and cannot process calls. Since both units were in service, either the inactive unit was taken out of service, or the active unit was warm SwActed and then taken out of service.

The CC action is:

- The CC sets the inactive unit as SysB. If the faulty unit was the active unit, the CC will perform a warm SwAct and then busy the newly inactive unit.

The user action is:

- Since this is a hard fault, the craftsperson must physically replace the card that was listed in the PM181 log. The craftsperson should manually busy the inactive unit (>BSY UNIT n) and test the ROM to ensure that the correct card has been chosen (TST UNIT n ROM). After replacing the card, reload the PM (>LOADPM UNIT n CC DATA), and then RTS the PM (RTS UNIT n). The unit should successfully come back to service.

Hard parity fault where the inactive unit is OOS

This is an example of a PM181 log:

```
PM181 JUL23 23:29:16 5561 INFO SMR 0 Unit 0
Node: ISTb, Unit 0 Act: InSv, Unit 1, Inact: OOS
Parity audit detected hard parity fault
Site Flr RPos Bay_id Shf Description Slot EqPEC
SMRR00 C05 SME 00 18 SMR: 000 10 6X47
```

Other trouble indicators follow:

- PM128 - The SMR has been set as ISTb, with the active unit as ISTb from InSv.

```
PM128 JUL23 23:29:16 5561 TBL ISTb SMR 0
Node: ISTb, (Inact OOS) From InSv
Unit 0 Act: IsTb (Parity errors detected) from InSv
Unit 1 Inact: OOS
```

- PM 189 - The active unit of the SMR has a hardflt.

```
PM189 JUL 23 23:29:17 5561 INFO PM SW INFORMATION REPORT
SMR 0 Unit 0: Act
TASKID: 00370037 PARAUDT, TIME: 22:29:16.68
COMID: FF NILCID
TEXT: hardflt 00 00 57 F6 00 00
```

- >QUERYPM FLT - (XX = the MP or SP memory card)

```
The following inservice troubles exist: Hard parity fault
was detected in XX memory
```

The action by the CC is as follows:

- In this scenario, either the inactive unit is not inservice or warm SwAct is not available. The CC cannot take the faulty unit out of service, or the entire SMR would be busy and could not process calls. The CC therefore sets the active unit as ISTb.

The user action is:

- The craftsperson follows the same procedure as scenario 1, but must understand that when the unit is busied, all call processing is dropped. To avoid this, the craftsperson can also try to get the inactive unit up and processing calls, either by returning it to service or having warm SwAct available if the inactive is InSv.

Soft parity fault (program store) where both units are InSv

This is an example of a PM181 log:

```
PM181 JUL23 23:29:16 5561 INFO SMR 0 Unit 0
Node: ISTb, Unit 0 Act: InSv, Unit 1, Inact: InSv
Parity audit detected soft parity fault in program store
```

Other trouble indicators follow:

- **PM128** - The SMR has been set ISTb, with the inactive unit out of service.

```
PM128 JUL23 23:29:16 5561 TBL ISTb SMR 0
Node: ISTb, (Inact OOS) From InSv
Unit 0 Act: ISTb (Parity errors detected) from InSv
Unit 0 Inact : SysB (Parity errors detected) from InSv
Unit 1 Act: InSv
```
- **PM189** - The inactive unit of the SMR has a fault in program store.

```
PM189 JUL23 23:29:17 5561 INFO PM SW INFORMATION REPORT
SMR 0 Unit 0: Inact
TASKID: 00370037 PARAUDT, TIME: 22:29:16.68
COMID: FF NILCID
TEXT: softpgm 00 00 57 F6 00 00
```
- **>QUERYPM FLT** - (XX = SP or MP card)

```
System busy reason: soft parity fault was detected in ps
of XX memory
```

The system busy means that the CC has taken the inactive unit out of service, or the CC warm SwActed the SMR and then took the newly inactive unit out of service.

The action by the CC is as follows:

- The CC sets the inactive unit as a SysB. If the faulty unit was the active unit, the CC will perform a warm SwAct and then busy the newly inactive unit. At this point, the CC will try to recover the busy unit without craftsperson intervention. The CC invokes autoloading (assuming the correct loads are in tables PMLOADS and LTCINV), loads the unit entirely, and then returns the unit to service.

The user action is:

- Since the CC will bring the unit back to service, intervention is only required if the SMR does not return to service. Check the load tables. Also check for other trouble indicators that may mean the faulty unit cannot be returned to service.

Soft parity fault (program store) where inactive unit is OOS

This is an example of a PM181 log:

```
PM181 JUL 23 23:29:16 5561 INFO SMR 0 Unit 0
Node: ISTb, Unit 0 Act: InSv, Unit 1, Inact: OOS
Parity audit detected soft parity fault in program store
```

Other trouble indicators follow:

- PM128 - The SMR has been set ISTb, with the inactive unit already OOS.

```
PM128 JUL23 23:29:16 5561 TBL ISTb SMR 0
Node: ISTb, (Inact OOS) From InSv
Unit 0 Act: ISTb (Parity errors detected) from InSv
Unit 1 Inact: Manb
```

- PM189 - The active unit of the SMR has a fault in program store.

```
PM189 JUL23 23:29:17 5561 INFO PM SW INFORMATION REPORT
SMR 0 Unit 0: Act
TASKID: 00370037 PARAUDT, TIME: 22:29:16.68
COMID: FF NILCID
TEXT: softpgm 00 00 57 F6 00 00
```

- >QUERYPM FLT - (XX = SP or MP card)

The following inservice trouble exist: Soft parity fault was detected in ps of XX memory

The action by the CC is as follows:

- In this scenario, either the inactive unit is not in service or warm SwAct is not available. The CC cannot take the faulty unit out of service, or the entire SMR would be busy and could not process calls. The CC therefore sets the active unit as ISTb.

The user action is:

- The craftsperson must understand that since the inactive unit is OOS (or cannot take over call processing), all call processing is dropped when the craftsperson busies the unit. To avoid this, the craftsperson can also try to get the inactive unit up and processing calls, either by returning it to service or having warm SwAct available if the inactive is InSv. Otherwise, he/she should busy the active unit, load the unit with the complete load, and then RTS the unit.

Soft parity fault (data store) where both units are InSv

This is an example of a PM181 log:

```
PM181 JUL23 23:29:16 5561 INFO SMR 0 Unit 0
Node: ISTb, Unit 0 Act: InSv, Unit 1, Inact: InSv
Parity audit detected soft parity fault in data store
```

Other trouble indicators follow:

- PM128 - The SMR has been set ISTb, with the inactive unit set as SysB.

```
PM128 JUL23 23:29:16 5561 TBL ISTb SMR 0
Node: ISTb, (Inact OOS) From InSv
```

Unit 0 Inact: SysB (Parity errors detected) from InSv
 Unit 1 Act: InSv

- PM189 - The inactive unit of the SMR has a fault in program store.

```
PM189 JUL23 23:29:17 5561 INFO PM SW INFORMATION REPORT
SMR 0 Unit 0: Inact
TASKID: 00370037 PARAUDT, TIME: 22:29:16.68
COMID: FF NILCID
TEXT: softdat 00 00 57 F6 00 00
```

- >QUERYPM FLT - (XX = SP or MP card)

System busy reason: soft parity fault was detected in ds
 of XX memory

The system busy means that the CC has taken the inactive unit out of service, or the CC warm SwActed the SMR and then took the newly inactive unit out of service.

The action by the CC is as follows:

- The CC sets the inactive unit as SysB. If the Faulty unit was the active unit, the CC will perform a warm SwAct and then busy the newly inactive unit. At this point, the CC will try to recover the busy unit without craftsperson intervention. The CC returns the unit to service and ensures that new static data is downloaded and full diagnostics are run.

The user action is:

- Since the CC will bring the unit back to service, intervention is only required if the SMR does not return to service. Check for other trouble indicators that may mean the faulty unit cannot be returned to service.

Soft parity fault (data store) where inactive unit is OOS

This is an example of a PM181 log:

```
PM181 JUL23 23:29:16 5561 INFO SMR 0 Unit 0
Node: ISTb, Unit 0 Act: InSv, Unit 1, Inact: OOS
Parity audit detected soft parity fault in data store
```

Other trouble indicators follow:

- PM128 - The SMR has been set ISTb, with the active unit set at ISTb.

```
PM128 JUL23 23:29:16 5561 TBL ISTb SMR 0
Node: ISTb, (Inact OOS) From InSv
Unit 1 Inact: ManB
```

- PM189 - The active unit of the SMR has a fault in program store.

```
PM189 JUL23 23:29:17 5561 INFO PM SW INFORMATION REPORT
SMR 0 Unit 0: Act
TASKID: 00370037 PARAUDT, TIME: 22:29:16.68
COMID: FF NILCID
TEXT: softdat 00 00 57 F6 00 00
```

- >QUERYPM FLT - (XX = SP or MP card)

The following inservice troubles exist: Soft parity fault was detected in ds of XX memory

The action by the CC is as follows:

- In this scenario, either the inactive unit is not inservice or warm SwAct is not available. The CC cannot take the faulty unit out of service, or the entire SMR would be busy and could not process calls. The CC therefore sets the active unit as ISTb.

The user action is:

- The craftsperson must understand that since the inactive unit id OOS (or cannot takeover call processing), all call processing is dropped when the craftsperson busies the unit. To avoid this, the craftsperson can also try to get the inactive unit up and processing calls, either by returning it to service or having warm SwAct available if the inactive is InSv. Otherwise, the craftsperson should busy the active unit, and then RTS the faulty unit. The static data is sent as part of the RTS.

Intermittent parity fault where both units are InSv

This is an example of a PM181 log:

```
PM181 JUL23 23:29:16 5561 INFO SMR 0 Unit 0
Node: ISTb, Unit 0 Act: InSv, Unit 1, Inact: InSv
Parity audit detected intermittent parity fault
```

Other trouble indicators are:

- PM128 - The SMR has been set ISTb, with the inactive unit as OOS.

```
PM128 JUL23 23:29:16 5561 TBL ISTb SMR 0
Node: ISTb, (Inact OOS) From InSv
Unit 0 Inact: SysB (Parity errors detected) from InSv
Unit 1 Act: InSv
```

- PM189 - The inactive unit of the SMR has an intermittent parity fault.

```
PM189 JUL23 23:29:17 5561 INFO PM SW INFORMATION REPORT
SMR 0 Unit 0: Inact
TASKID: 00370037 PARAUDT, TIME: 22:29:16.68
COMID: FF NILCID
TEXT: intflt 00 00 57 F6 00 00
```

- >QUERYPM FLT - (XX = SP or MP card)
System busy reason: intermittent parity fault was detected in ps (or ds) of XX memory

The 'system busy' means that the CC has taken the inactive unit out of service, or the CC warm SwActed the SMR and then took the newly inactive unit out of service.

The action by the CC is as follows:

- The CC sets the inactive unit as SysB. If the faulty unit was the active unit, the CC will perform a warm SwAct and then busy the newly inactive unit. At this point, the CC will try to recover the busy unit without craftsperson intervention. The CC returns the unit to service and ensures that full diagnostics are run.

The user action is:

- Since the CC will bring the unit back to service, intervention is only required if the SMR does not return to service. Check for other trouble indicators that may mean the faulty unit cannot be returned to service.

Intermittent parity fault where inactive unit is OOS

This is an example of a PM181 log:

```
PM181 JUL23 23:29:16 5561 INFO SMR 0 Unit 0
Node: ISTb, Unit 0 Act: InSv, Unit 1, Inact: OOS
Parity audit detected intermittent parity fault
```

Other trouble indicators follow:

- PM128 - The SMR has been set ISTb, with the active unit as ISTb.
PM128 JUL23 23:29:16 5561 TBL ISTb SMR 0
Node: ISTb, (Inact OOS) From InSv
Unit 0 Act: ISTb (Parity errors detected) from InSv
Unit 1 Inact: SysB
- PM189 - The active unit of the SMR has an intermittent parity fault.
PM189 JUL23 23:29:17 5561 INFO PM SW INFORMATION REPORT
SMR 0 Unit 0: Act
TASKID: 00370037 PARAUDT, TIME: 22:29:16.68
COMID: FF NILCID
TEXT: intflt 00 00 57 F6 00 00
- >QUERYPM FLT - 'The following inservice troubles exist: Intermittent parity fault was detected in XX memory (XX = SP or MP card).'

The inservice means that the CC has set the active unit as ISTb, since the inactive unit is already OOS or warm SwAct is not available.

The action by the CC follows:

- The CC sets the active unit as ISTb. The CC cannot perform any recovery action at this point. However, if the audit runs twice (approximately two minutes), and no parity audit is found, the CC will return the active unit to InSv. Note, however, that if warm SwAct is still not available, the unit remains as ISTb, (in other words, no PM106 log that says the PM has returned to service).

The user action is:

- The craftsperson must understand that since the inactive unit is OOS (or cannot take over call processing), all call processing is dropped when the craftsperson busies the unit. To avoid this, the craftsperson can also try to get the inactive unit up and processing calls, either by returning it to service or having warm SwAct available if the inactive is InSv. Otherwise, the craftsperson should busy the active unit, and then RTS the faulty unit. The static data is sent as part of the RTS.

Handling data mismatch (using >RTS NODATASYNC)

When the SMR has data mismatch troubles, such as a static data mismatch with the CC, one possible scenario is to busy and RTS the entire SMR. Using the NODATASYNC parameter with RTS, the craftsperson can minimize the time needed to have the correct data in both SMR units.

When the >RTS NODATASYNC command is issued for the inactive unit, the following occurs:

- 1 The node translation table transfer from the active to the inactive unit is blocked. Also, the node tables are checked to see if they match.
- 2 Static data is loaded from the CC to the inactive unit.
- 3 Once the inactive unit is returned to service, data sync between the active and inactive unit is disabled.

Note: The NODATASYNC option is valid only for the inactive unit.

A maintenance scenario that illustrates the use of the NODATASYNC option follows. Assume that there is a static data mismatch for the SMR. The craftsperson should take the following steps:

- 1 Busy the inactive unit (>BSY UNIT n)
- 2 RTS the inactive unit using the NODATASYNC option (RTS UNIT n NODATASYNC). The inactive unit will return to service. Note that if, during the RTS, static data is changed, a PM128 log is produced with the message 'Mismatch found in node table between the two units.' Also, the >QUERYPM FLT command for the SMR will say there is a node table mismatch.

- 3 Perform a cold SwAct. If you try to perform a warm SwAct, the DMS responds that a cold SwAct will be performed in any case. With the cold SwAct, the newly inactive unit should be getting data from the newly active unit. All trouble indicators associated with the data mismatch should be cleared as the SMR returns to service.

Using tuple change log reports

As mentioned in Chapter 6, entitled "Translations, parameters, and service orders", logs track changes in tables. These log records can then be used to solve field problems if necessary. The TUPC100 log records tuple additions, the TUPC101 log records tuple deletions, the TUPC102 log displays the old tuple before the change, and the TUPC103 log displays the new tuple after the change. The format of each log report and an example of each log report follow.

TUPC100 - tuple added log

This is an example of a TUPC100 log report format:

```
TUPC100 <Date> <Time> <Log No.> INFO TUPLE ADDED
TABLE NAME: <table name>
<new tuple>
```

This is an example TUPC100 log report:

```
TUPC100 01:12:00 1000 INFO TUPLE ADDED
TABLE NAME: LTCINV
LGC 0 LTE 1 18 1 B 8 6X02AA NLT32BA (POTS POTSEX)
$ (1 4) (2 4) (3 4) (0 19) (1 20) (2 20) (3 20) (0 36)
(1 35) (2 36) (3 35) (0 52) (1 52) (2 52) (3 52) (0 4)
$ (UTR16) ) (TONE6X79) (MSG6X69) $ NORTHAM
6X45AC 6X45AC $ 6X40AA
```

TUPC101 - tuple deleted log

This is an example of a TUPC101 log report format:

```
TUPC101 <Date> <Time> <Log No.> INFO TUPLE DELETED
TABLE NAME: <table name>
<old tuple>
```

This is an example TUPC101 log report:

```
TUPC101 01:12:00 1000 INFO TUPLE DELETED
TABLE NAME: LTCINV
LGC 0 LTE 1 18 1 B 8 6X02AA NLT32BA (POTS POTSEX)
$ (1 4) (2 4) (3 4) (0 19) (1 20) (2 20) (3 20) (0 36)
(1 35) (2 36) (3 35) (0 52) (1 52) (2 52) (3 52) (0 4)
$ (UTR16) ) (TONE6X79) (MSG6X69) $ NORTHAM
6X45AC 6X45AC $ 6X40AA
```

TUPC102 - changed from log

This is an example of a TUPC102 log report format:

```
TUPC102 <Date> <Time> <Log No.> INFO TUPLE CHANGED FROM
TABLE NAME: <table name>
<old tuple>
```

This is an example TUPC102 log report:

```
TUPC102 01:12:00 1000 INFO TUPLE CHANGED FROM
TABLE NAME: LTCPSINV
LGC 0 DTE 0 51 0 L 15 6X02AA NLT31BC (POTS POTSEX)
(KEYSET KSETEX) (RMM_TERM RSMEX) $ (0 0) (0 1) (1 0)
(0 9) (1 1) (0 17) (1 9) (0 24) (1 17) (0 33) (1 24)
(0 41) (1 33) (0 49) (1 41) (1 49) $ (UTR16) (MSG6X69)
(CMR13 NILLOAD) $ NORTHAM 6X45AC $ 6X40AA
```

TUPC103 - tuple changed to log

This is an example of a TUPC103 log report format:

```
TUPC103 <Date> <Time> <Log No.> INFO TUPLE CHANGED TO
TABLE NAME: <table name>
<new tuple>
```

This is an example TUPC103 log report:

```
TUPC103 01:12:00 1000 INFO TUPLE CHANGED TO
TABLE NAME: LTCPSINV
LGC 0 DTE 0 51 0 L 15 6X02AA NLT31BC (POTS POTSEX)
(KEYSET KSETEX) (RMM_TERM RSMEX) $ (0 1) (0 0) (1 2)
(0 8) (1 1) (0 17) (1 8) (0 24) (1 17) (0 33) (1 24)
(0 41) (1 33) (0 49) (1 41) (1 49) $ (UTR16) (MSG6X69)
(CMR13 NILLOAD) $ NORTHAM 6X45AC $ 6X40AA
```

Handling Digital Phase Lock Loop (DPLL) clock failure

The Enhanced Field Failure Information Phase I BCS32 feature allows the system to identify when a loss of sync causes a system busy following a DPLL clock failure. This feature addresses this problem by having the CC

acknowledge the reception of the sync lost message. If the SMR does not receive the acknowledgment then most likely the SMR will go system busy. In this case, the next time the SMR is brought back inservice it will generate a sync_was_lost log. This feature also provides information on when the DPLL clock is having problems by logging all large out-of-phase readings.

Sync_was_lost log

The PM189 sync_was_lost log is generated when an SMR is returned to service and it had lost sync last time it was InSv and the CC had not acknowledged the sync diagnostic failure message.

This is an example of a sync_was_lost log report format:

```
PM189 <Date> <Time> <Log No.> TBL PM SW EXCEPTION REPORT
<pm> <pmno> UNIT <unit no> : <activity>
TASKID: <taskid> <taskname>, TIME: <xpmtime>, COMID: <comid>
TEXT: <text>
```

This is an example of a sync_was_lost log report:

```
PM189 JAN01 16:56:23 9554 TBL PM SW EXCEPTION REPORT
LTC 0 UNIT 0 : Inact
TASKID: 00170017 SYNC, TIME: 00:01:32.88, COMID: FF NILC
TEXT: Sync_was_lost 00 00 00
```

Big_sync_hit log

The PM189 big_sync_hit log is generated when a SMR detects a large out-of-phase reading.

This is an example of a big_sync_hit log report format:

```
PM189 <Date> <Time> <Log No.> TBL PM SW EXCEPTION REPORT
<pm> <pmno> UNIT <unit no> : <activity>
TASKID: <taskid> <taskname>, TIME: <xpmtime>, COMID: <comid>
TEXT: <text> <hit>
```

This is an example big_sync_hit log report:

```
PM189 JAN01 16:56:23 9554 TBL PM SW EXCEPTION REPORT
LTC 0 UNIT 0 : Inact
TASKID: 00170017 SYNC, TIME: 00:01:32.88, COMID: FF NILC
TEXT: Big_sync_hit 00 50
```


RCT maintenance

User interface for the RCT

In most cases, operation of the RCT with an SMR is similar to its operation with a Control Concentrator Terminal (CCT).

The section is organized as follows:

- RCT states
- PM-level MAP commands
- RCT alarms.

RCT states

The RCT is integrated into the current PM level MAP display. The current PM states, listed in Table 8-1, apply to the RCT.

Table 8-1
RCT states

RCT State	Code	Description
Central side busy	CBsy	RCT is C-side busy when its SMR is CBsy, ManB, SysB, or Offl.
In-service	InSv	RCT is providing normal service.
In-service trouble	ISTb	RCT is In-service trouble when a fault occurs on the RCT. Examples are diagnostics failing in a Digroup card or one of the following alarms being set: DFA, DFB LFA, LFB, LFP, RMJ, RMN, CPF. Also, the RCT Common Equipment audit may have detected a fault. Refer to the RCT alarms section and the RCT common equipment audit section for more information.
Manual Busy	ManB	RCT has been busied from the MAP position.
-continued-		

RCT State	Code	Description
Off-line	Offl	RCT has been removed from service by craftsperson to allow testing and other manual maintenance action.
System busy	SysB	RCT is removed from service by system maintenance. Examples or instances causing an RCT to be set SysB are when an SMR fails to receive any RCT response to B-word commands or when diagnostics fail on both Di-group cards (these cards perform bipolar/unipolar conversions).
End		

PM level maintenance commands

With a few exceptions, PM-level commands for the RCT are the same as those for SMR. RCT commands are summarized in Table 8-2.

Table 8-2
PM-level maintenance commands for RCT

Command	Function	Description
BSY	Busy	Sets a posted RCT ManB.
DISP	Display	Displays a set of RCT in a particular state.
NEXT	Next	Posts the next RCT in a displayed set.
OFFL	Off-line	Sets a posted RCT off-line.
POST	Post	Posts an RCT.
QUIT	Quit	Quits the PM level of the MAP or cancels an RCT selection.
QUERYPM	Query PM	Displays information about a posted RCT.
RTS	Return to service	Returns to service a posted RCT.
TST	Test	Invokes self diagnostics on a posted RCT.
TRNSL	Translate	Identifies c-side message links between an SMR and RCT.
End		

Note that the following commands are not available:

- LOADPM, since an RCT does not require peripheral processor software to be loaded.
- SWACT, since the RCT is not configured for redundant operation.

Further description of the available RCT commands follows. Note that parameters and system responses are similar if not identical to those of the SMR.

BSY command

BSY	
-----	--

The BSY command sets a posted RCT to the ManB state. The RCT must be SysB or InSv. The SMR is informed that both DS-1 links are P-side busy.

Response

n CALLS MAY BE AFFECTED. PLEASE CONFIRM (YES OR NO).

Explanation Calls may be affected when BSY is chosen. The craftsperson is prompted for confirmation with this message.

User action A "NO" response aborts the BSY request; a "YES" response busies the RCT.

DISP command

DISP	pm_state pm_type
------	------------------

The DISP command displays a set of RCT in a particular maintenance state.

Parameters and variables

- pm_state specifies an RCT state.
Values: Offl, ManB, SysB, CBsy, ISTb, or InSv.
- pm_type specifies a particular type of peripheral module.
Value: RCT, in this case.

Response

pm_state RCT: REM site_no frame_no unit_no

Explanation Reports which RCT is in the indicated state, by pm_number.

NEXT command

NEXT	
------	--

The NEXT command displays the next RCT in a posted set.

OFFL command

OFFL	
------	--

The OFFL command sets the RCT off-line. OFFL is executed only if the RCT is ManB. The Offl state is retained over all restarts.

Response

RCT Rem site_no frame_no OFFL PASSED

Explanation This system response indicates that the RCT, indicated by pm_number, has successfully been placed Offl.

POST command

POST	pm_type pm_state	[ALL site_no frame_no unit_no (LEN)]
------	---------------------	---

The POST command sets the RCT in a position where the craftsperson can perform MAP commands on it.

Parameters and variables

- pm_type specifies a particular type of peripheral module.
Value: RCT, in this context. RCT modules are posted as a group, from which specific RCT or RCT in a particular state can be posted.
- ALL specifies that all RCT be posted.
- LEN line equipment number specifies a particular RCT identified by site, frame, and unit.
Range: site (a specific alphanumeric value), frame (0 through 99), unit (0 through 9).
- pm_state specifies a RCT state.
Values: InSv, ManB, CBsy, Offl, SysB, ISTb

Response

The MAP displays a set of RCTs. Table 8-1 illustrates what appears after >POST RCT REM0 00 0 is entered.

Figure 8-1
MAP response to >POST RCT REM0 00 0

```

      CC   CMC   IOD   Net   PM   CCS   Lns   Trks   Ext EIO
      .   .   .   .   .   .   .   .   .   .

      SMR
0  Quit   PM           SysB  ManB  Offl  CBsy  ISTb  INsv
2  Post_  RCT           0    0    0    0    0    0
3
4           RCT rem1 05 0    INsv  LINKS_OOS  CSIDE 0
5  Trnsl  RGen OK
6  Tst    QueryPM link
7  Bsy
8  RTS
9  Offl   SEE INSERT

10
11 Disp_
12 Next
13 _
14 QueryPM
15
16
17
18

LINK OTHEREND STAT COND C S SMRSLP SMRLOF SMRBER
0  SMR 5 13 OK OPN . . 0 0 <-7.
0  SMR 5 14 OK OPN . . 0 0 <-7.

      Userid
TIME  hh  mm>

```

Explanation The craftsperson has issued the command POST RCT followed by a particular LEN code (the Remote name, the frame number, and the unit number). This display provides a status summary for all PM and all RCT. It gives the pm_state of the specified RCT and the operation status of its C-side links. Thus, posting a particular RCT displays the RCT number, its state, the state of its ringing generator (RG), and the number of C-side links out of service.

Ringling generator status information

Note that ringling generator status information cannot be obtained from the RCT. Only minor and major ringling generator alarm information is available. This alarm information is a function of the number of ringling generators installed and the number of ringling generators that have failed (see Table 8-3). The ringling generator field (RG) on the MAP takes the following values:

- Ringling generator major alarm (RMJ)
- Ringling generator minor alarm (RMN)
- No ringling generator alarm (OK)

Table 8-3
Ringling generator failure alarms

No. Ringing Generators	No. Failed	Lamp	Alarm
1	1	RMJ	Major
2	1	RMN	Minor
2	2	RMJ	Major

QUERYPM command

QUERYPM	[FLT LINK]
---------	--------------

The QUERYPM command displays information about an RCT from data tables, including physical description and location.

Parameters

- **FLT** queries RCT status and causes for current state.
 Values: InSv, ISTb, and SysB (current states)
- **LINK** queries the status of the links to the posted RCT.

Response

Figure 8-2 displays the response.

Note: The response for the QUERYPM FLT command that are relevant for the Common Equipment Line Audits are explained in Querying the RCT (>QUERYPM FAULT) in Chapter 9, entitled "RCT lines maintenance".

Figure 8-2
MAP response to >QUERY PM

```

CC      CMC      IOD      Net      PM      CCS      Lns      Trks      Ext      EIO
.      .      .      .      .      .      .      .      .      .

      SMR
0  Quit      PM      SysB  ManB  Offl  CBSy  ISTb  INsv
2  Post_     RCT      0      0      0      0      0      0
3
4          RCT rem1 05 0      INsv  LINKS_OOS  CSIDE 0
5  Trnsl     RGen OK
6  Tst      QueryPM link
7  Bsy
8  RTS
9  Offl      SEE INSERT

10
11 Disp_
12 Next
13 _
14 QueryPM
15
16
17
18

LINK OTHEREND STAT COND C S SMRSLP SMRLOF SMRBER
0 SMR 5 13 OK OPN . . 0 0 <-7.
0 SMR 5 14 OK OPN . . 0 0 <-7.

      Userid
TIME hh mm>

```

Explanation The craftsperson has entered the command QUERYPM LINK. The physical location and state of a posted RCT are displayed, as well as information on the C-side links of the RCT and the operating status of the ringing generator, specified by rg_status.

The "C" above the fifth column refers to whether the DS-1 interface card is in or out: "a" in this column would mean "in" and a "-" would mean "out".

The "S" above the sixth column refers to whether the data transmitted down the links is in or out of frame or synchrony: a "." in this column would mean "in synchrony", while a "-" in this column would mean "out of synchrony".

SMRSLP refers to the number of slips on the line, SMRLOF refers to the number of frame losses on the line, and SMRBER refers to the Bit Error Rate.

QUIT command

QUIT	1 n PM ALL
------	---------------------

The QUIT command causes the current MAP display to change to a preceding level, as specified by choice of parameter. This command can be entered at any level.

RTS command

RTS	[FORCE]
-----	-----------

The RTS command returns to service a posted RCT with or without preliminary diagnostic tests. The RCT must be ManB or SysB to be returned to service.

For an RCT, the RTS command causes execution of a basic B-word "handshake" between the SMR and RCT. If the handshake is successful, an out of service diagnostic is performed. If the RCT passes, an in service diagnostic follows. Should the handshake fail, a failure message is displayed.

If the RCT passes the in-service diagnostic, it is returned to service with an InSv state indicated. If a fault is detected, but at least one link is operational, the RCT is returned to service with an ISTb state indicated. Fatal faults result in the unit being left out of service.

The SMR is informed of status changes on both links, and the link and RCT states are updated.

Parameters

- FORCE bypasses diagnostic operation and unconditionally returns the RCT to service, provided the basic B-word handshake succeeds.

Responses**INSVCE TESTS INITIATED RCT REM site_no frame_no unit_no TEST PASSED**

Explanation The RCT, indicated by the LEN code, has passed in-service diagnostics. After passing these diagnostics, the RCT is returned to service.

OSVCE TESTS INITIATED RCT REM site_no frame_no unit_no TST PASSED

Explanation The RCT, indicated by its LEN code, has passed the out-of service diagnostics.

TRNSL command

TRNSL	
-------	--

The TRNSL command identifies C-side message links between the posted RCT and the SMR. Up to two DS-1 links connect an RCT and an SMR.

Response

After posting the RCT, the craftsperson has entered the TRNSL command. A display appears with information about the links connecting a posted RCT to its SMR. Refer to Figure 8-3.

Explanation The craftsperson has posted an RCT with a LEN code of site Rem1, frame 5, and unit 0. Both C-side links for this RCT are InSv. In general, a link with number 0 is always present and identifies the first DS-1 line; link 1 is optional but may be provisioned, depending on traffic conditions.

Figure 8-3
MAP response to >TRNSL

```

CC      CMC      IOD      Net      PM      CCS      Lns      Trks      Ext
  .      .      .      .      .      .      .      .      .

      SMR
0  Quit_      PM          0      1      0      0      0      21
2  Post_      RCT          0      0      1      0      0      1
3
4          RCT  Rem1  05 0  InSv  LINKS_OOS  Cside 0
5  Trnsl_      RGen OK
6  Tst
7  Bsy
8  RTS          LINK0 SMR 0 2 ;CAP MS; STATUS OK MSGCOND OPN

9  Offl          LINK1 SMR 0 3 ;CAP MS; STATUS OK MSGCOND OPN
10 LoadPM_
11 Disp_
12 Next
13 SWACT_
14 QueryPM_
15
16
17
18

      Userid
TIME hh mm>

```

TST command

TST	
-----	--

The TST command invokes self diagnostics on a posted RCT. The craftsperson invokes the TST command when the RCT is SysB, ManB, or InSv. Self-diagnostics are preceded by a basic B-word message "handshake" between the SMR and RCT. If the RCT replies to the message, the tests are run; failure to reply results in a failure message.

Responses

INSVCE TESTS INITIATED

RCT Rem site_no frame_no unit_no TST FAILED

NULL B-WORD TIMEOUT ON BOTH LINKS

Explanation The RCT has failed diagnostics; no B-word response to the SMR commands was sent.

OSVCE TESTS INITIATED

RCT Rem site_no frame_no unit_no TST PASSED

Explanation The RCT, indicated by the LEN code, passed TST diagnostics.

Two tests are used to check DS-1 links and RCT cards: in service test and out of service test.

The in service test consists of sending a maintenance message on each DS-1 link. If a timeout occurs, a reply message indicates a B-word timeout has occurred, and the failing link is indicated. Either failing link is system busied. If both links fail simultaneously, the RCT is system busied.

The out of service test consists of the In-Service and connection memory diagnostics on each address control card.

If this test fails, a reply message indicates the failed address control card and digroup card. A list of suspected cards is also displayed. The following example shows a particular RCT that has failed the test:

TST FAILED ON RCT 1 05 0

One of the following messages would accompany the failure response:

NULL B-WORD TIMEOUT ON LINK A
 NULL B-WORD TIMEOUT ON LINK B
 NULL B-WORD TIMEOUT ON BOTH LINKS
 TEST ON CONNECTION MEMORY A FAILED
 TEST ON CONNECTION MEMORY B FAILED
 CONNECTION MEMORY TESTS FAILED ON BOTH DIGROUPS

PMRESET command

PMRESET	
---------	--

The PMRESET command resets an RCT. It is a nonmenu (unlisted) command executed on a posted RCT that is ManB or SysB. Using PMRESET causes a RCT reset message to be sent to the SMR. The SMR, in turn, sends B words to the posted RCT. B words reset all the RCT cards. The PMRESET command is used only when bringing an RCT into the system.

Responses

RCT REM site_no frame_no unit_no PMRESET PASSED

Explanation The RCT has been reset.

RCT alarm processing

The RCT has a set of alarm registers that provide system fault recognition. When an alarm is set, the following sequence of events occurs:

- 1 The SMR scans RCT alarms every six seconds using B words. When it detects an alarm, it dispatches an unsolicited message containing the alarm type to the RCT input handler on terminal 0, the maintenance terminal.
- 2 The input handler notes the alarm message, "looks into" the RCTALM table, and obtains the proper label to apply to this alarm. After the label is obtained, a PM log report is generated containing the PM name, number, and alarm.
- 3 The alarm sets a bit in the RCT node status (reflecting the type of alarm received), sets the RCT node status to ISTb, and generates an audible alarm. If no more serious alarm exists, the top-level banner display of the MAP shows that the peripheral is ISTb.
- 4 When the craftsperson enters the PM level of the MAP, selects this RCT, and uses the QUERYPM FLT command, this alarm is displayed with the label obtained from the RCTALM table.

If several alarms have been set simultaneously, they are all displayed in the MAP workspace; however, only the most important one is displayed at the top banner.

- 5 Should the SMR B-word task detect failure of the RCT alarm card, this alarm overrides the other alarms (since the alarm data could be erroneous). This condition is indicated by the RCT being ISTb; when the QUERYPM command is issued, the alarm designation is ALARM SCANNING PROBLEM.
- 6 When the alarm is cleared, a PM log is generated, indicating that the alarm is cleared and the RCT set InSv.
- 7 As part of the RCT node audit, a message is sent to the SMR querying the state of the RCT alarms. If a discrepancy exists between the SMR and CC alarm states for the RCT contained in the node status, this condition is rectified and appropriate alarms and logs are generated to match the RCT alarm state. This audit ensures that the RCT alarm status is accurate should a message be lost.
- 8 When an RCT is busied, the alarm data in the node status are cleared and the ISTb condition removed to prevent an alarm from being indicated.

- 9 When an RCT is returned to service, a message is sent querying the RCT alarm status; the MAP, PM logs, and PM state counters are updated to match the RCT. For example, if the RCT indicates an alarm, the RCT is set ISTb instead of InSv.

RCT alarms at the MAP

The following is a list of RCT alarms, their functions, and the action the CC RCT takes when they are set. Additional alarms are included.

Note: The alarms in table RCTALM that are related to Protection switching (LFP, BPOA, BPOB, LO, PSOB, PSOA) are not used.

- DFA. Digroup fault A. This alarm register is set when a digroup A card detects a frame loss. Since the RCT digroup loops back the incoming command, any problem in the digroup card is reflected at the SMR, which takes the necessary actions.

The RCT changes the node state to ISTb, with DIGROUP A FAILED listed as the reason for the change of state.

A minor alarm is generated. When DFA is cleared, the RCT is returned to InSv.

- DFB. Digroup fault B. This alarm register is set when a digroup B card detects a frame loss. The same maintenance action taken on DFA is taken here.
- LFA. Line fault A. This alarm register is set when repeater A detects a signal loss, high bipolar violation rate on line A, or an on-board blown fuse (-48 Vdc). CC RCT maintenance changes the state of the affected RCT to ISTb, and a minor alarm is generated. LINE A FAILED is listed as the reason for the ISTb state.
- LFB. Line fault B. The same maintenance action taken on LFA is taken here.
- LPF. Line power converter failure. This alarm register is set when a line power converter fails. Since the alarm does not indicate which line power converter failed, the only maintenance taken is to change the state of the RCT to ISTb and set a major alarm. LINE POWER FAILED is listed as the reason for the ISTb state.
- RMJ. Ringing generator major alarm. This alarm register is set when a single, nonduplicated ringing generator fails, or both generators fail. CC RCT maintenance changes the state of the RCT to ISTb, and sets a major alarm. RINGING GENERATOR MAJOR ALARM is listed as the reason for the ISTb state. When this alarm occurs, the RCT has lost the ability to provide ringing service.

- RMN. Ringing generator minor alarm. When this alarm is set, only one of a duplicated pair of ringing generators has failed. The affected RCT is changed to ISTb, and a minor alarm is generated. RINGING GENERATOR MINOR ALARM is listed as the reason for the ISTb state.
- CPF. RCT power converter failure. This alarm register is set when a power converter fails. The affected RCT is changed to ISTb, and a minor alarm generated. RCT POWER CONVERTER FAILED is listed as the reason for the ISTb state.

The following alarm registers are reported to the external alarms subsystem:

- AC. AC supply or DC failure overvoltage. This alarm register indicates an over-voltage condition (the overvoltage breaker of the rectifier has tripped) or a loss of AC input power to the rectifier. This alarm requires the one or more power rectifiers supplying DC power to the RCT.
- BAT. Battery. This alarm register indicates that the battery voltage is below 47 V, probably because the battery needs recharging in an AC power loss situation.
- TEM. Temperature. This alarm register indicates that the temperature has risen above 60°C or dropped below 0°C.
- DOOR. This alarm register indicates that the RCT cabinet door is open.
- FUSE. This alarm register indicates that the RCT has blown a fuse.
- SPARE. Four spare alarms are provided for customers.

Note the following:

- These alarms are generated only if the repeaters are capable of providing the correct output to the RCT alarm pack.
- The ring generator excessive load or grounded alarm is available only with the QPP430B generator pack.

Hardware protection switching

Hardware switching activation

The Lynch APS switches the voice and messaging of a DS-1 line when either of the following occurs:

- A loss of receive (RCV) PCM, detected first as 48 consecutive zeros, then confirmed if the last 48 bits of the following 5 ms period are all zeros.
- Bipolar violations. These can be set at one in 10^3 , 10^4 , 10^5 , or 10^6 bits.

Hardware switching release

The Lynch APS returns control of the DS-1 to the service span if the DS-1 is showing no signal loss or excessive bipolar violations for 21 seconds.

CARRIER level changes

Carrier maintenance for the DS-1 links is similar to that done for other XPMs; the carriers are posted at the CARRIER level (under the TRKS subsystem level), and these DS-1 links can be busied and tested.

Note that the carrier level would not show that a carrier had been protection switched.

RCT lines maintenance

Introduction

Line circuits, subscriber loops, and stations are tested under the lines maintenance (LNS) subsystem. Line circuits and subscriber loops are tested manually and automatically in this subsystem.

Line testing helps determine if a line circuit, loop, or line circuit and loop combination is functioning properly. If the line proves faulty, line tests determine if the fault lies in the line circuit or the attached loop. When a fault is in the loop, it is usually referred to another department (for example, outside plant maintenance). When the fault is in the line circuit, the line card is replaced and the line retested to verify that the fault is cleared.

Line maintenance occurs under the following conditions:

- A command is entered from the LTP-level of the MAP
- Tests are scheduled from the ALT-level of the MAP
- Digit reception is faulty, causing a line to be tested automatically by the DMS system for foreign potential
- A call fails twice, causing it to be placed in the "shower queue" for full diagnostic testing
- Tests are invoked from the subscriber telephone set
- Tests are invoked from a test desk.

Manual line testing

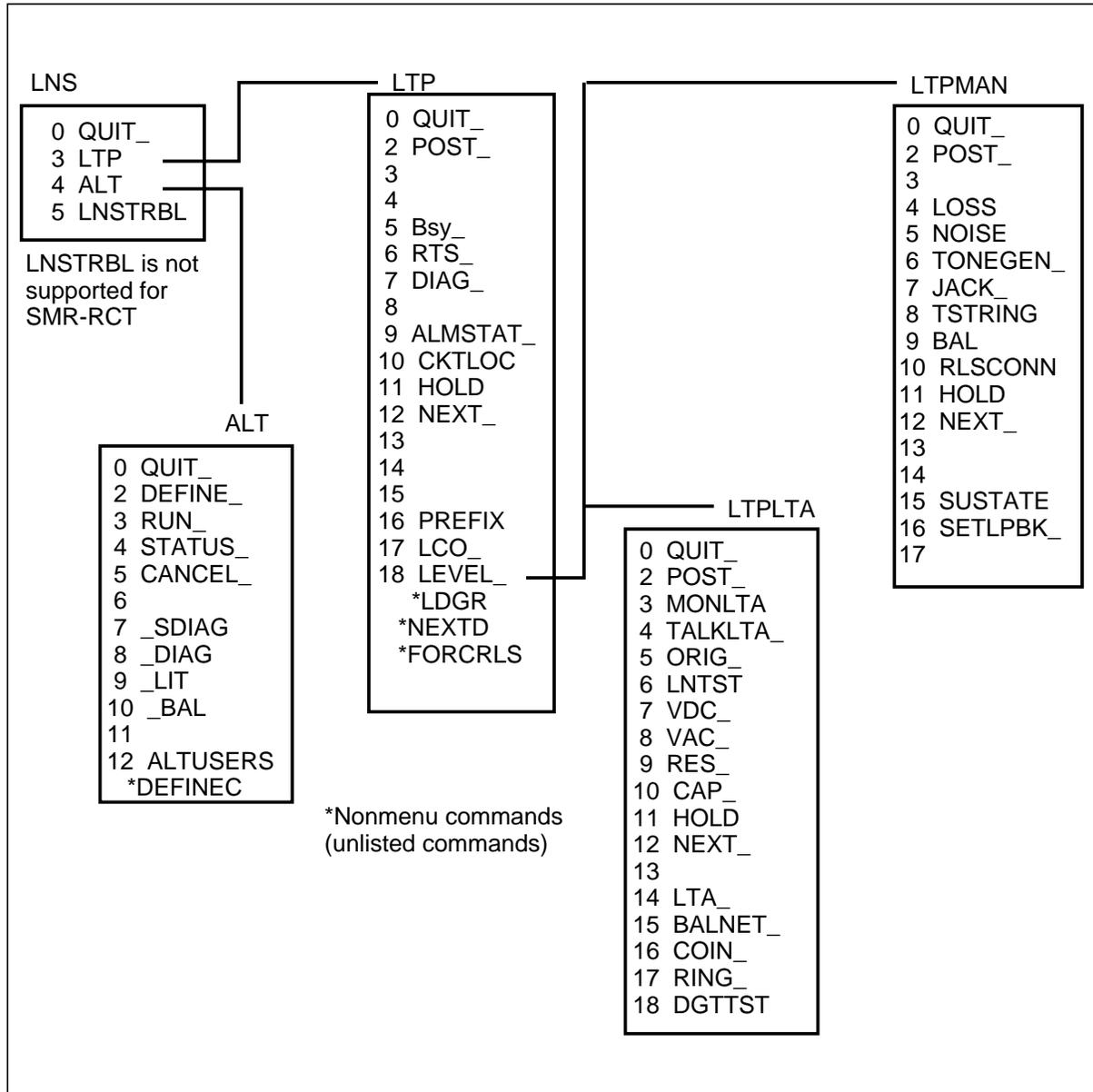
Manual line tests are performed by the craftsperson on line circuits, loops, and stations. Line circuits and loops are tested individually with results displayed to the craftsperson immediately after testing at a MAP.

Lines are tested manually as part of routine maintenance, or when either a customer report is generated or Automatic line test (ALT) failure occurs.

Manual line testing is performed at the LTP level using any of the four levels of the line maintenance (LNS) subsystem: ALT, LTP, LTPMAN (LTP Manual), and LTPLTA (LTP Line Test Access). For a description of these levels and the commands available at each level, refer to *DMS-100 Family*

Lines Maintenance Reference Manual, 297-2101-516. Figure 9-1 shows the association between the maintenance levels.

Figure 9-1
Line maintenance commands



Manual line testing at the ALT level defines one set of lines to be tested immediately. At the other three levels, manual testing is performed by placing the line to be acted upon in the control position. The craftsperson controls this line, which may be manipulated. A line must be posted first before being placed in the control position. Refer to *Line Maintenance*

Reference Manual, 297-2101-516 for a discussion of the control position and posting lines.

Automatic line testing

Automatic line tests are performed on line circuits and loops, usually on a scheduled basis, without craftsperson involvement other than for initial scheduling and inspection of logs.

Automatic line testing in a DMS-100 office is performed under the LNS subsystem and includes testing both line circuits and the attached loops.

Lines that fail to meet certain standards of quality are identified to the craftsperson by posting the failures at the Line test position (LTP) or by output reports generated by the ALT log subsystem. Refer to *Input/Output System Reference Manual*, 297-1001-129. The failures thus identified are then tested manually and corrected. For a description of Automatic line tests refer to *Line Maintenance Reference Manual*, 297-2101-516.

Station testing

Station testing is performed either under the LNS subsystem at a MAP or, in the cases of the Silent switchman (SSMAN), Station ringer, and Dialable short circuit tests, from a station. Stations are tested manually.

Results from these station tests are returned to the station.

Station testing helps determine if a station is functioning properly while connected to a loop and line circuit combination. Refer to *Line Maintenance Reference Manual*, 297-2101-516, for more information on station testing.

Hardware

Refer to *Line Maintenance Reference Manual*, 297-2101-516, for a description of hardware used in testing lines.

Configuration of the LEN for the RCT

An RCT has a software location identifier called a LEN. The LEN consists of:

- site
- frame
- unit
- line subgroup (drawer, shelf)
- line circuit

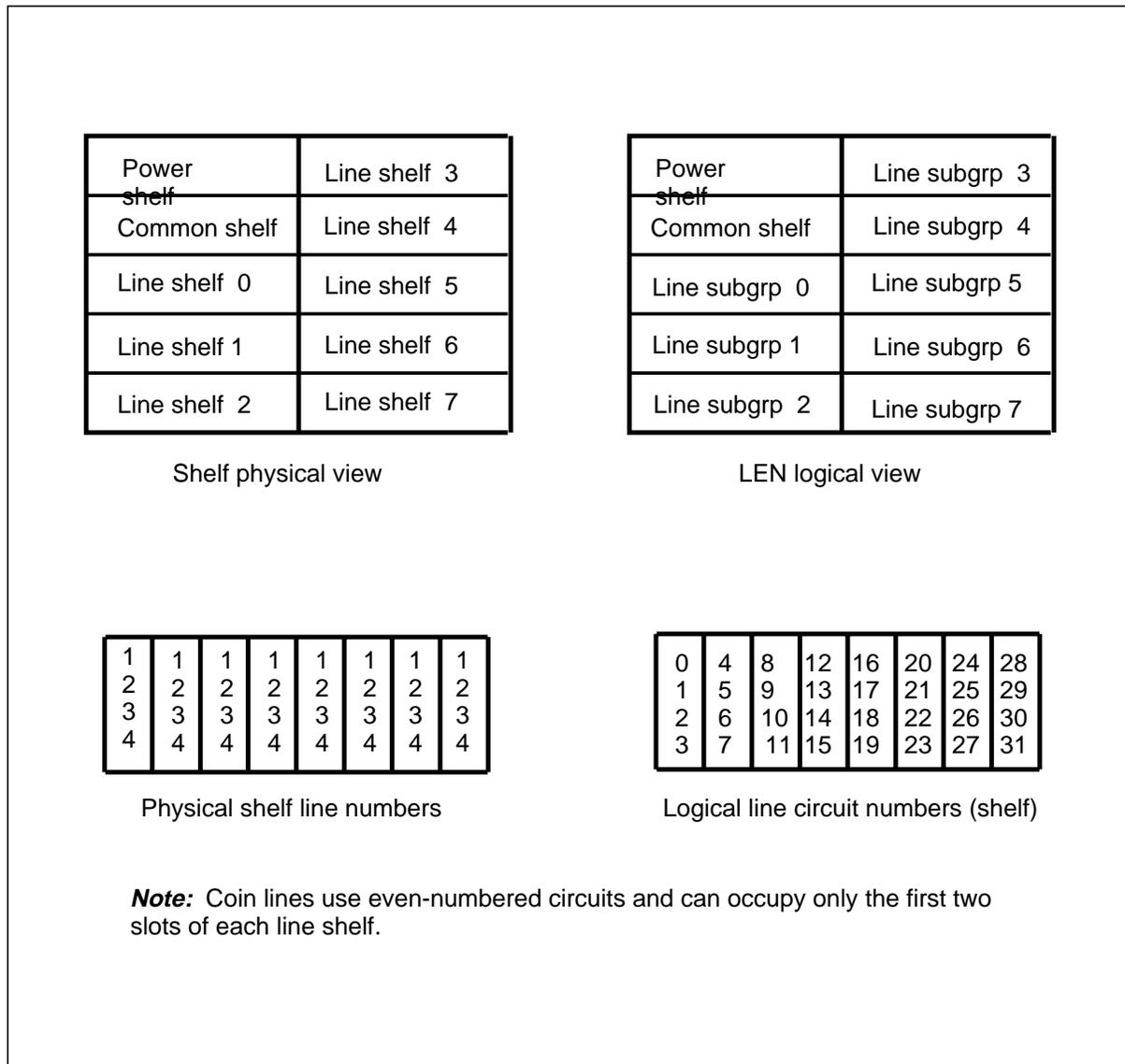
The LEN corresponds to a physical location of a line at the RCT, characterized by a shelf, slot, and line within the slot. Refer to Figure 9-2

for the correlation between LEN and physical location. The following RCT line cards are tested:

- Single-party QPP405
- Universal QPP407
- FSR QPP440 and QPP541
- Superimposed QPP445
- Universal Coin QPP409

The RCT has either the capability for Subscriber Line Test- Digital (SLTD: card QPP423) or Subscriber Line Test - Access (SLTA card QPP568A and Shelf Bypass Assembly ED7208-32G6). Note that this capability is on a per-RCT basis. The SMR can support a mix of RCTs, some with SLTD and some with SLTA. The following sections explain the configuration and capabilities of the different types of line tests.

Figure 9-2
RCT shelf physical and LEN association



Testing capabilities of the SLTD configuration

SLTD provides digital test equipment in the RCT. This hardware is controlled by B words, and its output is processed by an SMR to yield standard measurements.

SLTD provides a subscriber loop testing facility to the RCT, which is a QPP423 card mounted in the RCT. This card enables RCT subscriber lines to be tested remotely for the following line parameters:

- AC voltage on tip and ring lines

- dc voltage on tip and ring lines
- self calibration of QPP423 card
- resistance
 - tip to ring
 - tip to ground
 - ring to ground
- capacitance
 - tip to ring
 - tip to ground
 - ring to ground
- repeated ac voltage
- repeated dc voltage
- repeated resistance
- repeated capacitance.

CC maintenance requests operation of test relays to set up a subscriber line for testing. It also specifies tests to perform on that line. Only one subscriber line is tested at a time. The relay setup for SLTD consists of three connections, each made using A bits and B words:

- test bus to SLTD card
- shelf ring/test bus to test bus
- shelf ring/test bus to line card

Besides setting up subscriber line connections, B words also establish measuring circuits and testing connections.

The following times apply to execution of the tests. These are times from when an appropriate command is entered at the MAP to when a result appears at the MAP.

- ac voltage 15-25 seconds
- dc voltage 15-25 seconds
- resistance 30-45 seconds
- capacitance 75-90 seconds

The following prerequisite parameters apply to the SLTD:

- foreign ac Voltage: < 75 VRMS
- foreign dc Voltage: must be less than 75 V dc
- resistance: tip/ring voltages must be less than 9 V dc and 75 V ac
- capacitance: tip/ring voltages must be less than 9 V dc and 75 V ac

The SLTD measures the following ranges:

- ac voltage: 0 to 150 volts rms in .5 volt steps
- dc voltage: -60 to 60 Volts in .5 volt steps
- resistance: 0 Ohm to 999000 Ohms; basic tolerance = ± 10 percent (Ohm)
- capacitance 0 microfarads to 10 microfarads in .1 Uf steps; basic tolerance = ± 20 percent (microfarads).

The SMR sends B words to the DMS-1R RCT commanding it to execute tests or to read test results in its maintenance registers. The RCT returns test results to the SMR through B words.

Usage notes

In SLTD, the Shelf ringing bus is also the Subscriber loop test access bus. Initiating ringing on a line on the same shelf as a line being tested causes the test to be cancelled and reported as a test failure. The message "TEST ACCESS CANCELLED" is displayed at the MAP.

Bridging onto a subscriber line is impossible with SLTD.

Testing capabilities of the SLTA configuration

The SLTA configuration supports RCT line card testing and subscriber loop testing by providing a metallic test path between test equipment, such as a Line test unit (LTU) off of an MTM, and the line card or subscriber loop. An LTA card (QPP568A) is required as is a Shelf Bypass Assembly (ED7208-32G6) for each shelf. An RCT can have only one LTA card, and only one subscriber can be tested at a time.

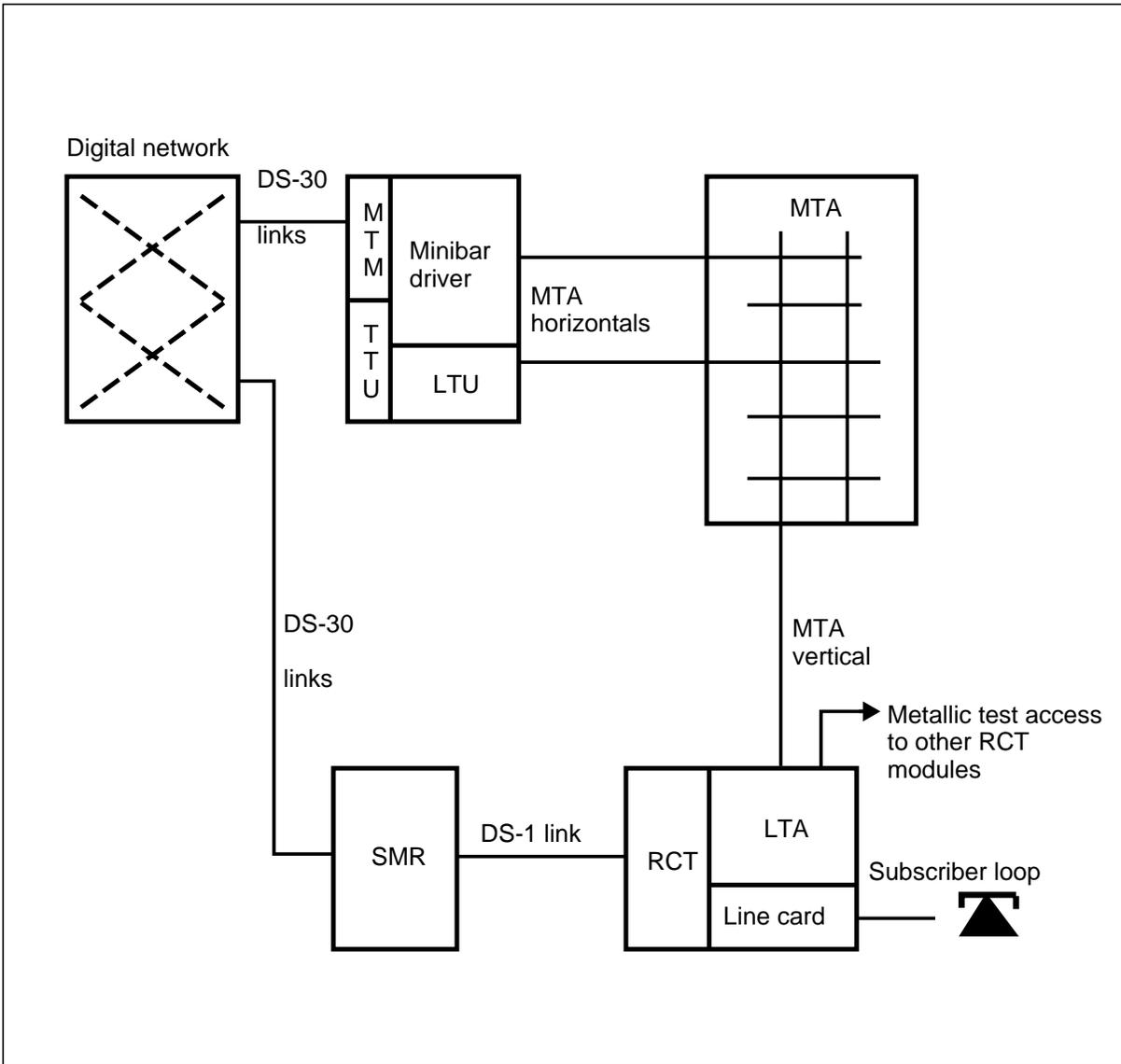
Key differences between SLTD and SLTA

Note the following differences between the SLTA and SLTD configurations:

- Because the test access and ringing busses are separate, ringing and testing can occur simultaneously on a shelf.
- The RCT has a single line circuit relay that connects ringing and test access and cuts off the line circuit from the subscriber loop.
- No programmable balance network or loss pads exist in the RCT line card; tests involving loss pads or a balance network are not run on RCT lines.

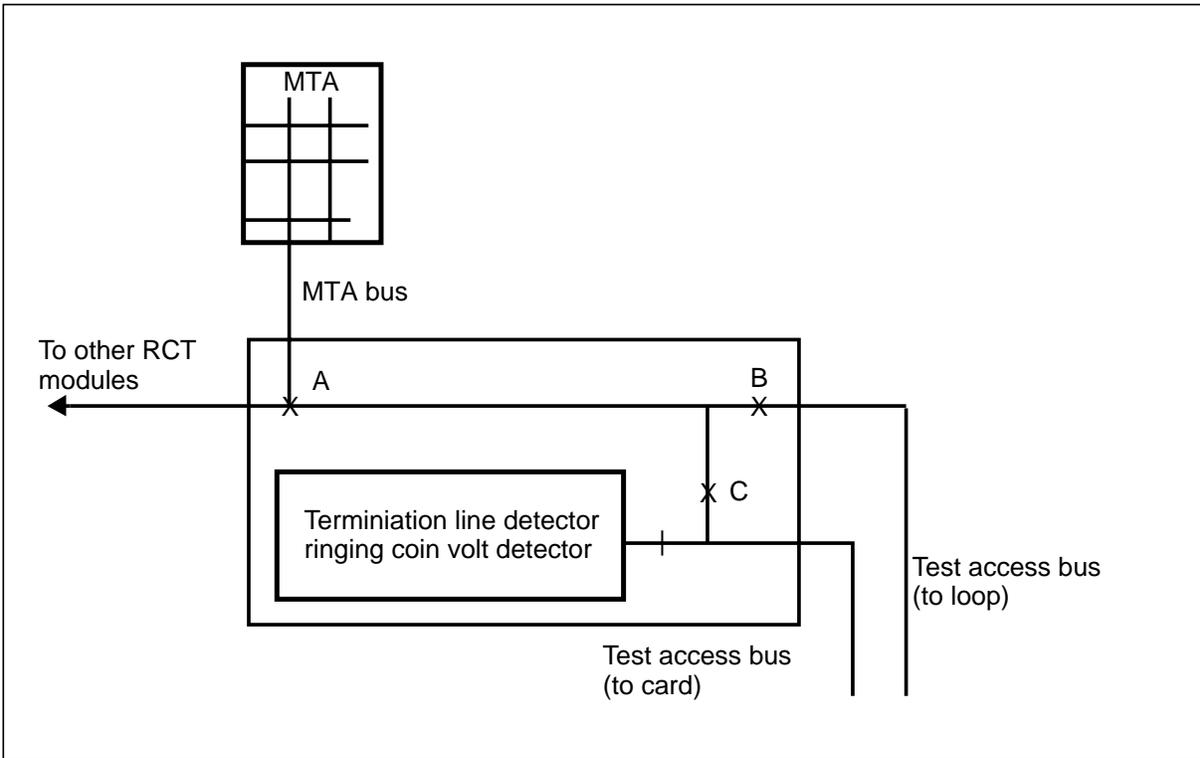
Figure 9-3 shows a general metallic test access configuration. RTC modules can share a metallic test pair. Refer to MTA configuration and sharing for more information on how the MTA configuration is datafilled.

Figure 9-3
Metallic test access configuration



The LTA card is located on the Common Shelf at the RCT and occupies the same slot that the SLTD card would occupy if it were provisioned. Figure 9-4 is a conceptual diagram of the LTA card and its configuration in the test system.

Figure 9-4
LTA card and test configuration



Operating relay A, selects an MTA bus and disconnects the bus from other RCT modules that may be sharing it. Operating relay B connects the MTA bus to the loop side of the Test access bus, which accesses the subscriber loop. Operating relay C disconnects the line card from the line detector, ringing and coin supervision circuits, and termination circuits and connects it to the MTA bus through the line side of the Test access bus.

Loop and line card testing proceeds when relay B is operated to connect the subscriber loop to the MTA bus, and the line card is connected to the detector, supervision, and termination circuits. With the Line test access bus connected out to the subscriber, the loop can be tested for ac/dc voltage, resistance, and capacitance. The line card can be tested for several transmission (for example, noise) and signaling (for example, single-party ringing) operations.

Operating relay C, while relay B is not operated, provides access to only the line card through the MTA and Test access busses. In this configuration, the line card can be tested for onhook/offhook, ringing, ring trip, and dial pulse detection.

Operating relay B while not operating relay C provides access through the MTA vertical and Test access bus to the loop only. Loop parameters, such as ac/dc voltage and resistance can be checked.

Operating relays B and C simultaneously allows access in bridged mode to both the subscriber loop and line card. This allows monitoring of a line circuit or conversing with a party on the circuit.

With relays B and C idle and selected bypass relays operated in the Shelf Bypass relay, described subsequently, the subscriber loop is completely cut off leaving it attached to nothing. A station test, such as Silent switchman, uses this configuration.

A Shelf Bypass Assembly (ED7208-32G6), attached behind each RCT shelf, is required for metallic testing. This assembly consists of relays and wire pairs that provide connections among a line card, subscriber loop, and Test access bus. Within the Bypass Assembly is a Shelf Address Unit, factory set to the number of the shelf on which the assembly is mounted. A line selector, also in the Bypass Assembly, works with the Shelf Address Unit to select a specific group of relays to be operated. These relays connect the Test access bus to a specific line card and loop. The RCT controls Bypass Assembly operation based on control commands (B words) it receives from the SMR. The LTA card signals the execution of the relays.

Overview of commands from the LTP level

Figure 9-5 displays the commands that are issued from the LTP level of the MAP as they apply to RCT line cards.

Figure 9-5
LTP commands for the RCT

```

0  Quit_      No change.
2  Post_      For RCT lines the line subgroup field of the
Line          Equipment Number (LEN) is equivalent to
shelf num     ber and is restricted to numbers 0
through 7,    since a RCT has a maximum of 8
shelves per   frame. Users may POST SLTD
(refer to the sec          tion on SLTD following
this command list).
3              Not used.
4              Not used.
5  Busy_      No change.
6  RTS_       No change.
7  Diag_      The diagnostics run depend on the type of test
              (extended) card, SLTD (QPP423) or SLTA (QPP568A). Refer
to            the section covering the Diag command fol-
lowing        this list.
8              Not used.
9  AlmStat_   No change.
10 CKTLOC     CKTLOC displays a physical shelf and slot for a
              line posted by LEN or DN. Both LEN and physi-
cal          location are displayed.
11 Hold       No change.
12 NextH_     No change.
13 NextP_     No change.
14
15           Not used.
16 Prefix_    No change.
17 LCO_       Not supported for the RCT. With SLTA, cutting
              off a line would require operating a bypass
              relay that would tie up the Test access bus
and          prevent testing all RCT lines.
18 Level_     Entering LTPMAN or LTPLTA accesses other lev
              els of the LTP.

```

The following sections highlight specific commands and how they apply to the SLTD versus the SLTA configuration.

The POST command (SLTD)

Operators can POST SLTD (meaning the QPP423 card) from the LTP level of the MAP. SLTD is present only when the PM is an RCT and is configured for SLTD. The command RTS can be executed for the posted

SLTD to return the manually busy circuit to service. The DIAG command checks the calibration of the card. The syntax for the command is

POST SLTD site_no frame_no unit_no

An example of craftsperson input might be:

POST SLTD REM1 04 0

The resulting display would show the status of the SLTD circuit and its LEN, as shown in Figure 9-6 .

Figure 9-6
Example POST SLTD output

```

      CC   CMC   IOD   Net   PM   CCS   Lns   Trks   Ext   EIO
      •   •   •   •   •   •   •   •   •   •

      LTP
0      Quit_      POST/      DELQ      BUSYQ      PREFIX
2      Post_
3
4
5      Busy_
6      RTS_
7      Diag
8
9      AlmStat_
10     Cktloc
11     Hold
12     NextH_
13     NextP_
14
15
16     Prefix_
17     LCO_
18     Level_

      Userid
TIME hh mm>

LCC PTY RNG ....LEN..... DN STA F S LTA TE RST
1FR TYPE FL REM1 02 5 08 00 NO DIRN LMB
    
```

The DIAG command (SLTD versus SLTA)

The DIAG command, executed from the LTP level, or the DIAG command, executed from the ALT level, checks an RCT line card for correct operation. Specifically, the PCM path to and from the line card and the ability of the card to respond correctly to supervisory signals (for example, onhook and offhook) are checked.

- SLTD diagnostics

The following tests are executed as part of the DIAG command when a QPP423 (SLTD) card is present:

- Transhybrid loss (Carrier channel loss)
- Noise (Idle channel noise)
- Loop detector (onhook/offhook)
- ANI
- SLTA diagnostics
 - When the QPP568A card (SLTA) is present, the following tests are executed as part of the DIAG command:
 - Transhybrid loss
 - Noise
 - ANI
 - Flux cancellation (Echo return loss)
 - Ringing & supervision
 - Coin return
 - Coin collect
 - Coin presence
 - Reverse battery
 - Single party ringing
 - Negative tip ringing
 - Positive tip ringing
 - Positive ring ringing

With SLTD, executing a diagnostic and ringing the same or another line on the same shelf is impossible, since test and ringing procedures use the same bus. If ringing is initiated for a line on a shelf holding a line being tested, the diagnostic is aborted and the following message displayed at the MAP:

TEST ACCESS CANCELLED

The following faults are detected during diagnostic execution:

- Maintenance bus fail
- LTA operation fail
- Bypass operation fail
- LTA not ready
- Offhook fail
- Onhook fail
- Tip party ground fail
- Coin collect fail
- Coin return fail

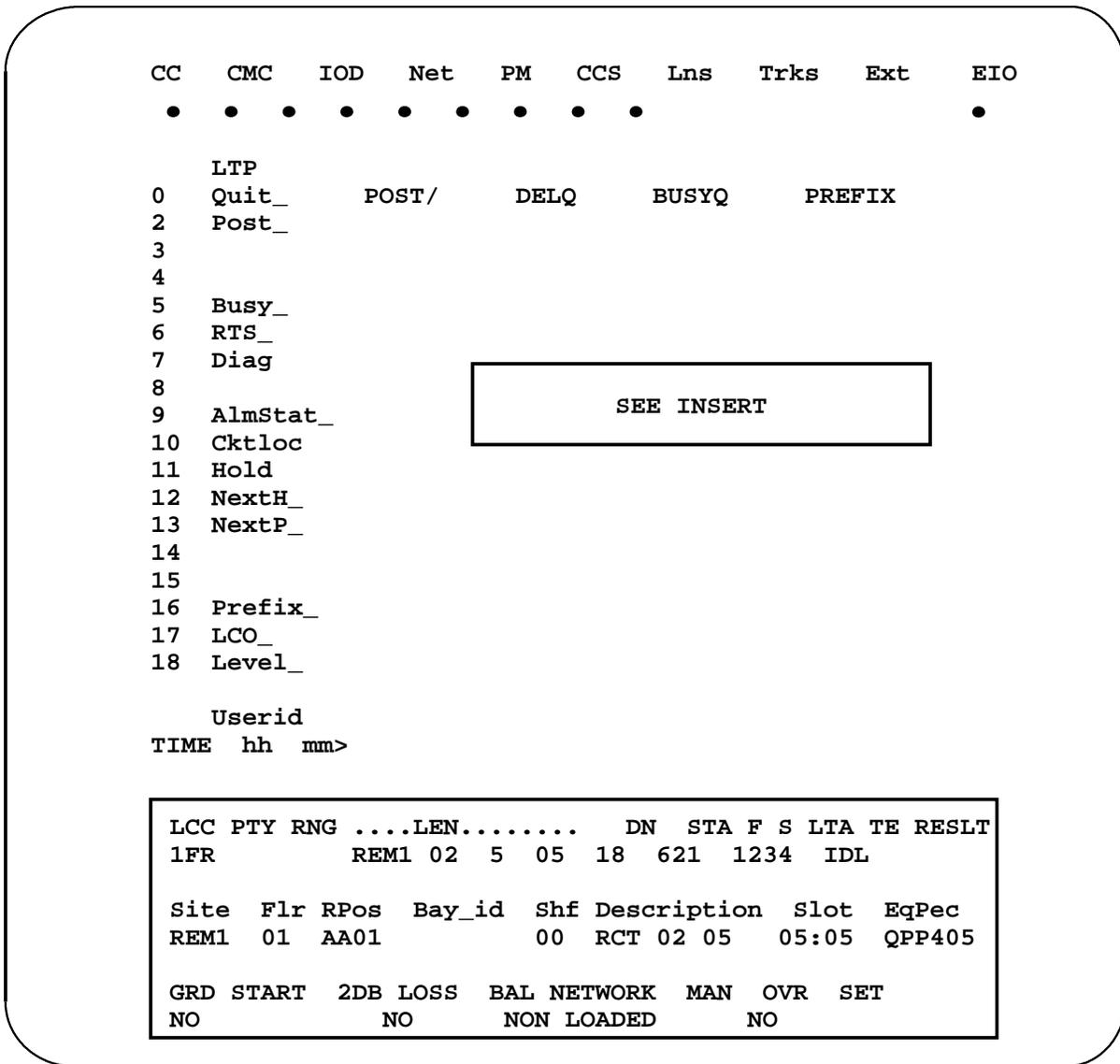
- Coin presence fail
- Carrier channel loss fail
- Echo return loss fail
- Idle channel noise
- No SCM messaging

The CKTLOC command

The CKTLOC command helps correlate the LEN of a subscriber line with its physical location. Circuit characteristics are also provided (ground start, loss, and others).

Figure 9-7 displays the output of the >CKTLOC LEN command.

Figure 9-7
MAP response of > CKTLOC LEN



The line card type is QPP405; it has neither ground start nor loss pads. The balance network is nonloaded, and no manual override setting is available. The subscriber line has a LEN of REM1 02 5 05 18. It is physically located on the card that occupies slot 5 of shelf 5.

Testing from a subscriber station

The three tests initiated from a subscriber station are the Silent switchman, Station ringer, and Dialable short circuit tests.

- Silent switchman. With SLTD, this test is not supported because operating the cutoff relay to place the subscriber loop in cutoff interfered with ringing. Attempting to run this test causes a reorder tone to be returned to the RCT line.

The test is possible with SLTA. LTA card and Bypass relays operate to cut off the subscriber loop.

- Station ringer test. The Station ringer test is supported for both SLTD and SLTA.
- Dialable locator circuit. SLTA must be present to run this test. The Dialable locator circuit test is run the same way as for other types of lines.

LTP nonmenu (unlisted) commands

The unlisted commands follow.

- NextD Posts the next RCT shelf
- Forcrs Disconnects a line circuit from test equipment or any other circuit and changes its state to ManB. Forcrs causes the DMS system to abort all testing initiated from the LTP level (including LTPMAN and LTPLTA).

Overview of LTPMAN level commands

Figure 9-8 lists the LTPMAN commands and how they apply to RCT lines.

Figure 9-8
LTPMAN commands

0	Quit_	No change.
2	Post_	For RCT modules, the drawer number field of the LEN is the shelf number and takes values 0 through 7.
3		Not used.
4	Loss	No change.
5	Noise	No change.
6	TonGen_	No change.
7	Jack_	No change.
8	TstRing	For SLTD, TstRng is not permitted. It requires ringing the subscriber and having test equipment connected simultaneously. With SLTD, ringing hardware and the SLTD card use the same bus. With SLTA, this test is allowed.
9	Bal	Not supported.
10	RlsConn	No change.
11	Hold	No change.
12	NextH_	No change.
13	NextP_	No change.
14		Not used.
15	Sustate	Not supported for RCT.
16-18		Not used.

All LTPMAN nonmenu (unlisted) commands are either LTP commands or level-change commands. The changes noted for the LTP level apply to these commands.

Overview of LTPLTA level commands

Figure 9-9 lists the LTPLTA commands and how they apply to RCT lines.

Figure 9-9
LTPLTA Commands

0 Quit_ No change.

2 Post_ For RCT lines, the drawer number field of the LEN is the shelf number and takes the values 0 through 7.

3 MonLTA_ With SLTD MonLTA is done by PCM connection rather than metallic access. If the connection is made, the following message is displayed at the MAP:

MON/TALK CONNECTED VIA PCM.
 NO LTA CONNECTION MADE.

MonLTA on a RCT line busies or deloads the line. If the line is Call Processing Busy (CPB), this command fails.
 With SLTA, MonLTA is executed using metallic test access. True monitoring takes place.

4 TalkLTA_ With SLTD TalkLTA is done by PCM connection rather than metallic access. If the connection is made, the following message is displayed at the MAP:

MON/TALK CONNECTED VIA PCM.
 NO LTA CONNECTION MADE.

If the line is CPB and no conference circuit is available, this command fails.

Note: Both MonLTA and TalkLTA are limited to lines in the idle state. The posted RCT is placed in the ManB state when MonLTA and TalkLTA are executed.
 SLTA permits true talking through metallic test access.

5 Orig_ With SLTD, ORIG is not permitted. With SLTA ORIG can be executed.

6 LnTst No change, but refer to Note 2.

7 VDC_ No change, but refer to Note 2.

8 VAC_ No change, but refer to Note 2.

9 RES_ No change, but refer to Note 2.

10 CAP_ No change, but refer to Note 2.

11 Hold No change.

12 NextH_ No change.

13 NextP_ No change.

- continued -

14 LTA_ With SLTD, only the RLS option of this command is permitted to release the Mon/Talk or LTA connections.

 With SLTA, the RLS, IN, or OUT options are permitted. IN allows access to the line card. OUT allows access to the subscriber loop.

15 BalNet_ Not permitted. No balance network exists in the RCT line card.

16 Coin_ No change.

17 Ring_ No change.

18 DgtTst No change.

Notes - With SLTD, ringing another line on the same shelf where a line is being tested results in the following message:

 TEST ACCESS CANCELLED. TRY AGAIN.

- The QPP423 card is used for these tests in SLTD. In SLTA, the LTU card is used.

All LTPLTA nonmenu (unlisted) commands are either LTP commands or level-change commands. The changes noted previously apply.

Automatic line testing (ALT) level commands

If the message TEST ACCESS CANCELLED is received from an SMR during ALT testing of a line, a special ALT log message is generated. The test is still passed, however.

The following changes apply to ALT tests for RCT lines. Figure 9-10 lists the ALT commands and how they apply to RCT lines.

Figure 9-10
ALT commands for RCT lines

0	Quit_	No change.
2	Define_	No change.
3	Run_	No change.
4	Status_	No change.
5	Cancel_	No change.
6		
7	_SDIAG	The diagnostics run for SLTD and SLT were previously noted. No differences exist between short and extended diagnostics in the RCT.
8	_DIAG	The Diag command as previously described.
9	_LIT	No change.
10	_BAL	The Balance Network test is not run on RCT lines.
11		Not used.
12	Alt Users	No change.
13-18		Not used.

Operator verification on RCT lines

Three port conference cards are used for operator verification, if metallic access is not possible; otherwise, bridged access is applied. The following restrictions apply to operator verification on a busy RCT line:

- Operator verification cannot be achieved if the line to be verified is part of a call that has a custom calling feature activated. Examples of Custom Calling Features are Call Forwarding, Speed Calling, and Call Waiting.
- Operator verification fails on calls that are routed through trunks of trunk group OP.

When verification cannot proceed, the craftsperson receives one of the following responses:

- BUSY TONE (60 ipm) indicating normal access available, but the line cannot be accessed currently for such reasons as it has an activated Custom Calling Feature or is connected to another operator.
- REORDER TONE (120 ipm) indicating normal access not available.

When verification can proceed, the operator hears a quiet line, conversation, announcement, or something else on the line.

A list of line conditions and system actions follows, with responses to the craftsperson included. The format is

- LINE CONDITION
 - Special line considerations and/or characteristics
 - DMS system response
- Line condition: IDLE LINE
 - Characteristics: Normal access available (voice and voice/data)
 - DMS Response: Normal connection made, no ringing, no tone
 - Characteristics: Normal access not available (voice and voice/data)
 - DMS response: Reorder tone (120 ipm)
 - Characteristics: data-only line
 - DMS response: verification denied, busy tone (60 ipm)
- Line condition: BUSY LINE
 - Characteristics: line is traffic busy (voice and voice/data, simple line)
 - DMS response: access connection made, craftsperson may hear conversation, quiet line, reorder, busy tone, announcement, or some other indication that the line is traffic busy.
 - The data signals are not reliable after verification because of conference port use. The line option, NO DOUBLE CONNECTION (NDC), does not allow testing and verification if the line is busy.
 - Characteristics: line up to permanent announcement or receiver offhook (ROH) tone
 - DMS response: permanent signal tone
 - Characteristics: line up to tone or announcement that is not permanent
 - DMS response: same as traffic busy simple line
 - Characteristics: line being rung
 - DMS response: operator receives busy tone (60 ipm)
 - Characteristics: line in hunting (with an idle line in the group)
 - DMS response: normal access connection made, no ringing, no tone
 - Characteristics: line in hunting (all lines in the group are busy)
 - DMS response: same as traffic busy simple line
 - Characteristics: data only line
 - DMS response: verification denied, busy tone (60 ipm)
 - Characteristics: line with activated Custom calling feature
 - DMS response: operator receives busy tone (60 ipm)

- Line condition: LINE VERIFICATION IN PROGRESS
 - Characteristics: line becomes idle during verification
 - DMS response: no-test-access connection dropped, normal access connection retained
 - Characteristics: line goes off hook during verification
 - DMS response: normal access connection retained, customer does not receive dial tone
 - Characteristics: attempt to activate custom calling feature
 - DMS response: system ignores transient state while line is verified
- Line condition: LINE WITH CUTOFF ON DISCONNECT OPTION
 - Characteristics: line has the cutoff on disconnect (COD) option
 - Operator can obtain a verification connection. However, if the nonverify party goes on hook, the call is taken down and the craftsperson is sent a busy tone (60 ipm).

RCT common equipment audits

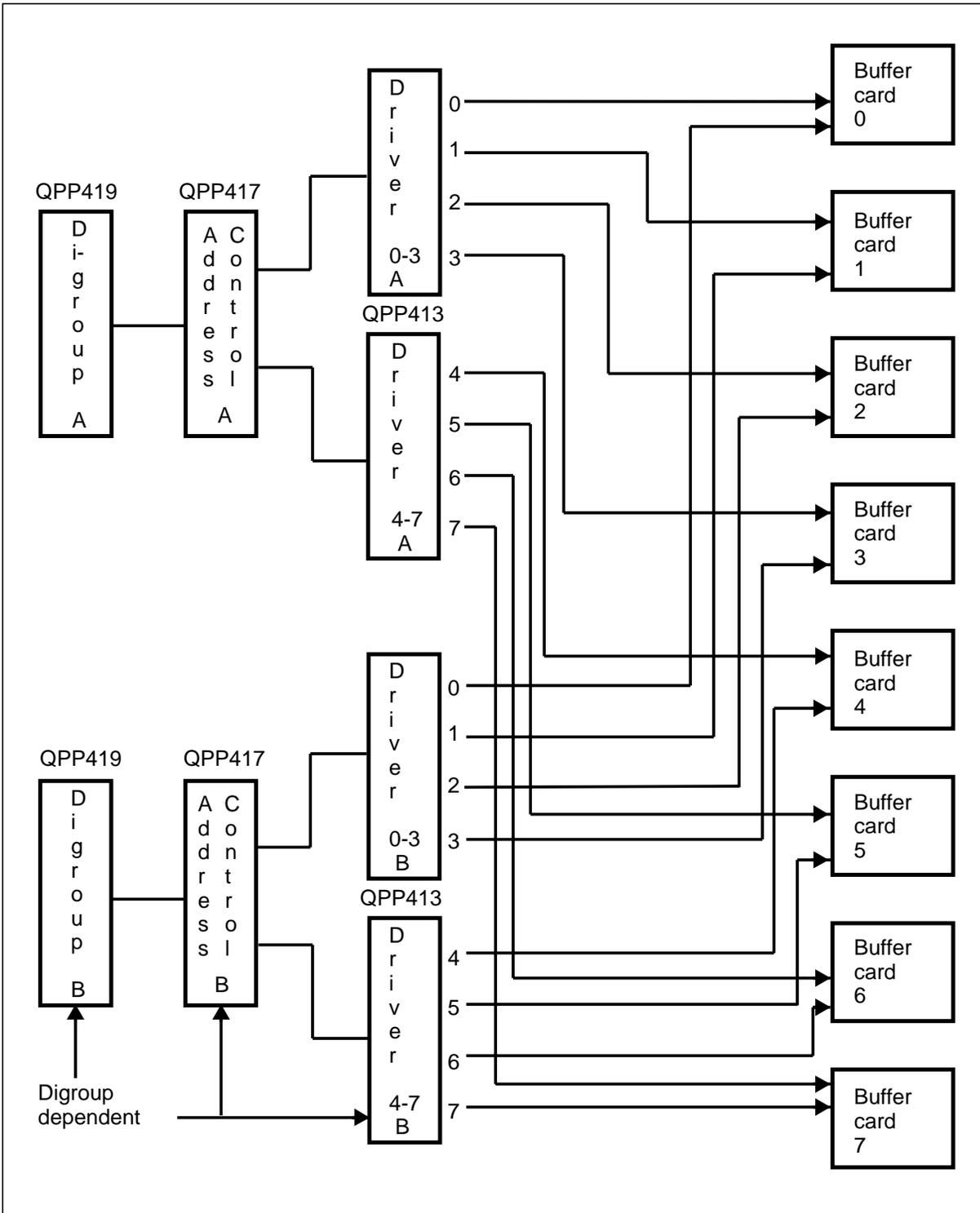
RCT common equipment identification

Figure 10-1 shows the logical configuration of the RCT cards. Note how, in a fully configured RCT, there are two digroup cards, two address cards, four driver cards, and eight buffer cards. Each digroup, using the Address control card, can access every line on every shelf of the RCT. Each driver card controls four buffer cards, and these buffer cards control the eight line cards of the shelf (32 subscribers). Because each card has an area of control, fault patterns can be analyzed to isolate a particular type of card.

Following are the three diagnostics that are used to help locate common equipment faults:

- Background
- Initialization
- Fault Finding

Figure 10-1
Logical configuration of the RCT



Diagnostics used by the audits

Although these audits are invoked at different times to accomplish specific tasks, certain diagnostic sequences (or what one may call subaudits) are shared among the audits. The following sections describe these sequences.

Single line test

The single line test is used to perform the line test portion for all three audits. This test performs three supervision tests using the following sequence:

- 1 Check for off-hook status (to determine if the test can be run)
- 2 Digroup A
 - a. Set up channel on Digroup A
 - b. Check for off-hook status
 - c. Take down channel on Digroup A
- 3 Digroup B
 - a. Set up channel on Digroup B
 - b. Check for off-hook status
 - c. Take down channel on Digroup B

The single line test can be performed only under the following circumstances:

- The line is in service and idle.
- The DS-1 channel is available for the test.
- There is no SMR-RCT messaging problem.
- There is no digroup failure.
- The RCT LTA relay must be set up on the buffer card. The following conditions must be met for this to occur:
 - There is no ringing on the RCT shelf.

The ringing bus is on a per shelf basis and must be disconnected to perform the supervision test; if ringing is in progress on the same shelf as the line to be tested, the line test is cancelled.

- There is no SL TD test in progress on any RCT.

If the SLTD and line test occur simultaneously, the test results from either could be inaccurate; the SLTD takes precedence.

- There is no SL TA ringing test on the same shelf.

The SLTA ringing test requires access to the ringing bus, which is configured per shelf. Since the line test takes down the ringing bus, both tests cannot be run simultaneously on the same shelf; if the ringing test is being set up or run at the same time a line test is invoked, the line test is cancelled.

Note that in all three cases, the test that is in progress takes precedence over the line test (and therefore the common equipment audits).

RCT timing bus (waveform) switch

The RCT Timing bus switch switches the RCT timing buses for Digroup A and B to help determine whether there are any fault with an RCT timing bus.

This audit is used as both a part of the initialization, fault finding, and background audits, as well as its own audit, as explained in the rest of this part.

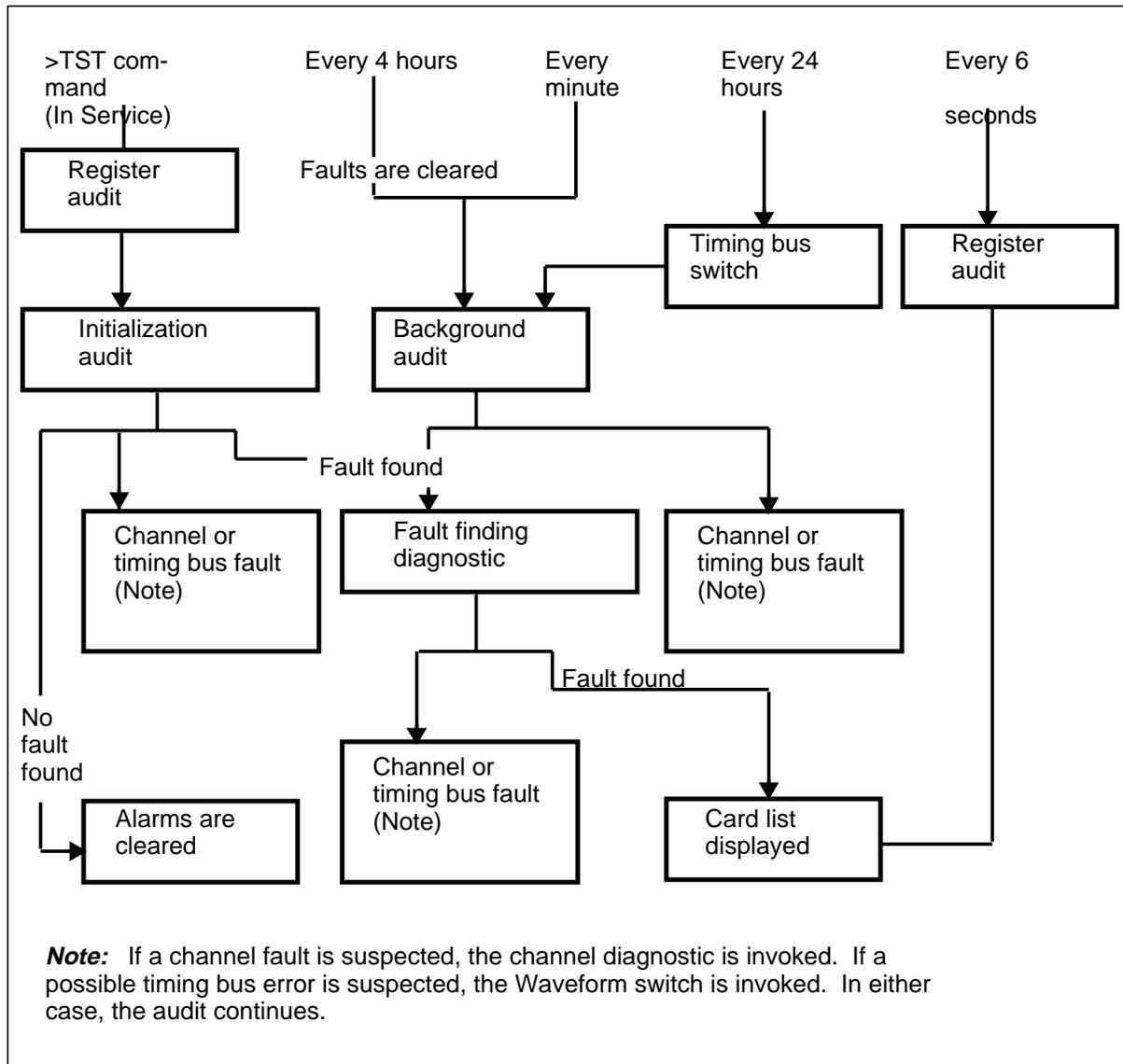
Channel diagnostic

With this diagnostic, the auxiliary or connection memory is read back after a channel has been set up. If this diagnostic fails, there is a fault with the address control.

Audit interaction

Refer to Figure 10-2 which shows the relationship between the common equipment audits.

Figure 10-2
How the RCT line audits are invoked



Background audit

The background audit runs automatically and continuously; it runs single line test on each RCT every minute; with 256 lines per RCT, all lines can be tested in approximately four hours.

Sequence of events

Figure 10-3 shows the order in which lines are tested.

Figure 10-3
Order in which lines are tested (background audit)

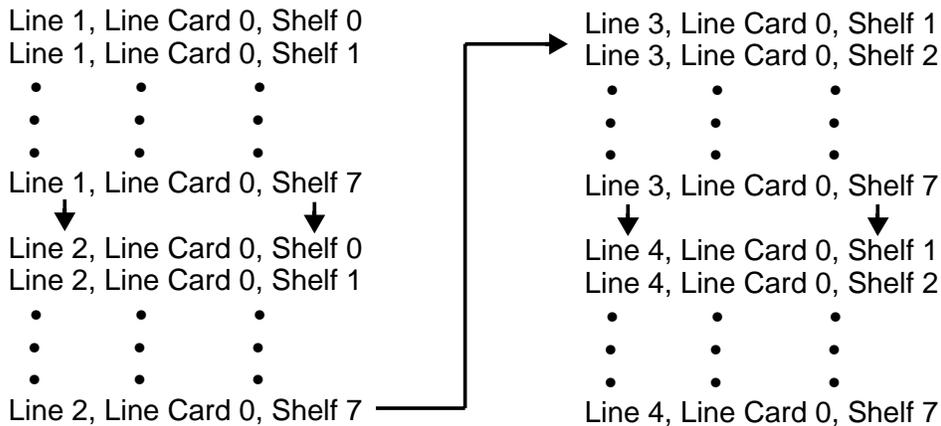
Note: Numbers show the order in which lines are tested, which make the pattern shown below

	Line Card 0	Line Card 1	Line Card 2	Line Card 3	Line Card 4	Line Card 5	Line Card 6	Line Card 7	
Line 1	1	33	65	97	129	161	194	226	Shelf 0
Line 2		41	73	105	137	169	202	234	
Line 3	9	49	81	113	145	177	210	242	
Line 4		57	89	121	153	185	218	249	
	17								
	25								

Line 1	2	34	66	98	130	162	195	227	Shelf 1
Line 2		42	74	106	138	170	203	135	
Line 3	10	50	82	114	146	178	211	243	
Line 4	18	58	90	122	154	186	219	250	
	26								

• • • • • • • •
 • • • • • • • •
 • • • • • • • •

Line 1	8	40	72	104	136	168	201	233	Shelf 7
Line 2	16	48	80	112	144	176	209	241	
Line 3	24	56	88	120	152	184	217	249	
Line 4	31	64	96	128	160	192	225	256	



This pattern repeats for each line card.

With the background diagnostic, single line tests are run until all in service idle lines have been checked. Note that a line is not checked if it is busy (not idle).

The background diagnostic is responsible for switching the waveforms at the RCT. This is requested by the SMR, and occurs during the background diagnostic if traffic does not exceed a threshold value.

Every four hours after a fault has been found, alarms are cleared and the background diagnostic is begun again to test the lines.

When a single line test fails, the same line is retested immediately. The line is retested several times to ensure that problems are not due to noise or intermittent faults. If a line is still failing, the background diagnostic is suspended and the fault finding diagnostic is invoked.

Every four hours after a fault has been found, alarms are cleared and the background diagnostic is begun again to test the lines.

RCT register audit (or channel audit)

This audit performs a dual function:

- 1 Checks the RCT registers every six seconds and restores data that may have corrupted by noise.
- 2 Sends B-words to write what should be stored in the RCT registers and then reads these registers back. If, after several tries, discrepancies still exist, register faults are analyzed to help determine the following RCT common equipment faults:
 - Alarm card (QPP420)
 - SLT card - SLTD (QPP423) or SLTA (QPP568)
 - Address control card (QPP417)

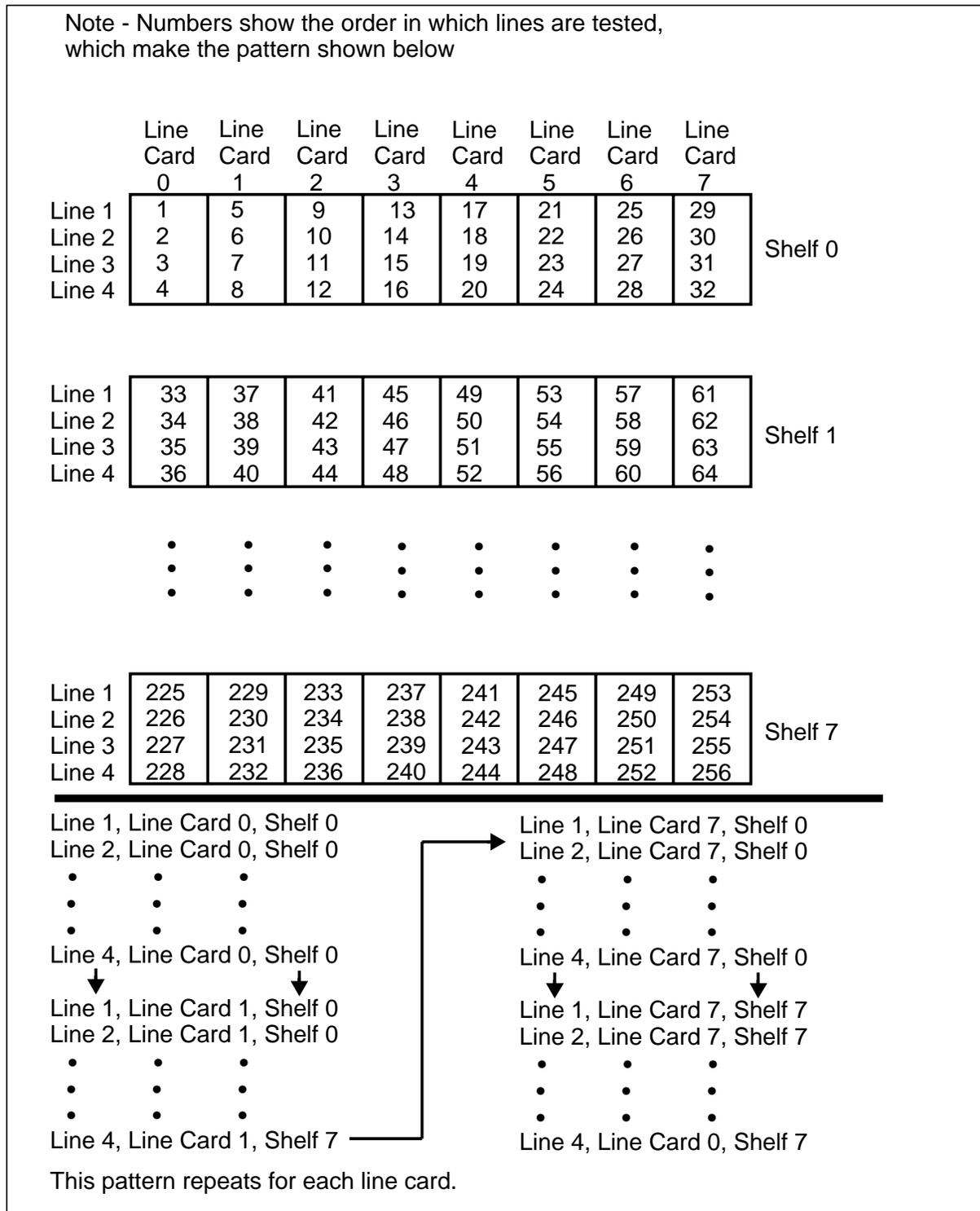
Initialization diagnostic

This diagnostic is invoked when the TST command is entered at the PM level of the MAP for an in service RCT.

Sequence of events

When this diagnostic is run, the Single line test is performed rapidly on all lines and shelves. Figure 10-4 shows the order in which the lines are tested.

Figure 10-4
Order in which lines are tested (initialization audit)



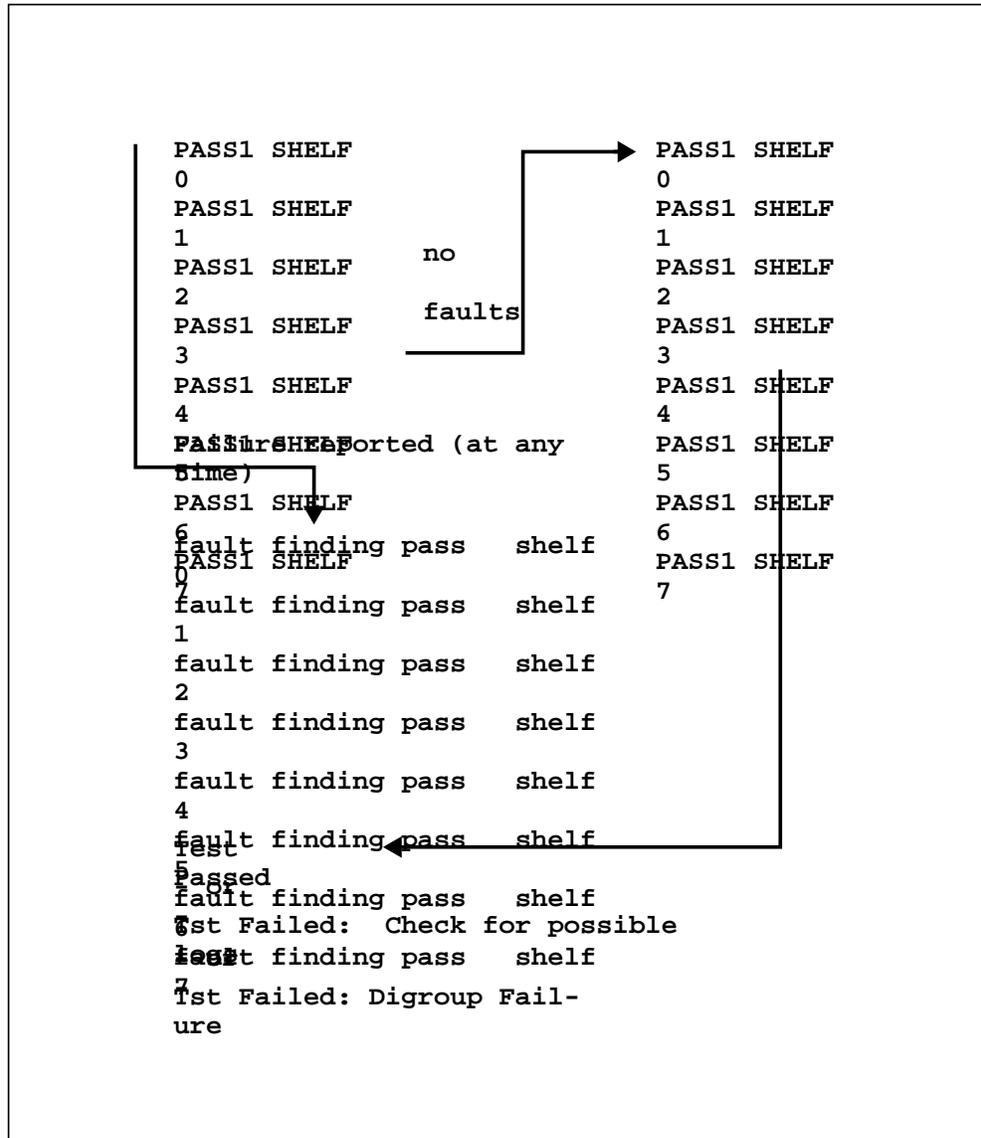
When all of the lines have been tested, the RCT timing buses are switched and the lines are retested. This is to test for any faults due to the timing bus.

When this test is invoked, any RCT alarms are cleared before the test is run. If any faults are found, alarms will then be reported.

When a single line test fails, the same line is retested immediately. If the retest also fails, two minutes elapse and the line is tested two more times. If the line is still failing, the initialization diagnostic is suspended and the fault finding diagnostic is invoked.

While these events are occurring, messages appear at the MAP to inform the craftsperson of the progress of these audits. Figure 10-5 shows the sequence of messages when the TST command is given at the RCT level.

Figure 10-5
Progress messages for >TST (initialization audit)



RCT timing bus audit

This audit is run every 24 hours if the traffic on the RCT does not exceed a threshold value. This value is an approximation of the low hourly traffic on the RCT. This is done to prevent an RCT timing bus switch during a period of high traffic.

This audit is also used if requested by the initialization or fault finding diagnostic. It is used by the background diagnostic to determine any RCT timing bus faults, which would indicate a fault on the Address Control card or one of the digroups. Note that with the background diagnostic, the timing

busses are switched only if the traffic threshold, as just explained, has not been exceeded.

Fault finding diagnostic

This diagnostic is performed when either the initialization diagnostic or background audit have detected a fault.

When this diagnostic is run, all lines and shelves are tested rapidly, and fault patterns are analyzed. If a fault has been found, the appropriate alarm is raised.

The sequence of line testing is similar to the initialization diagnostic, as shown in Figure 10-4. As with the other audits, if a line circuit is busy (not idle), the line circuit is not checked.

The pattern of failed lines is used to identify faults with the following cards:

- Shelf (Buffer) card

This would be the most likely fault if failed lines were occurring on more than one line card on a shelf and the fault occurred on both digroups. Faults that occur with both digroups are referred to as digroup-independent faults.

- Driver card

This would be the most likely fault if more than one line card shelf in the lower (0-3) or upper (4-7) shelves has a fault and the fault occurs on either digroup A or B. Faults that occur with one digroup are referred to as digroup dependent faults.

- Digroup/Address control fault

This would be the most likely fault if more than one line card shelf in the lower (0-3) and upper (4-7) shelves has a fault and the faults occur on either digroup A or B (digroup dependent faults).

MAP display and logs associated with line audits

If the audits, once activated, have not found any possible faults, the MAP display at the RCT level is unchanged and no audit-related logs are produced. However, if a potential fault has been detected, the following occurs:

- The RCT changes its state to ISTb. If the craftsperson accesses the RCT level of the MAP and inputs >QUERYPM FLT, messages appear that tell the craftsperson the most likely problem.
- Audit-related logs are output. The logs also contain messages that help determine the most likely problem.

The next two sections list and explain these messages.

RCT querying (>QUERYPM FAULT)

When the craftsperson accesses the RCT level of the MAP and inputs >QUERYPM FLT, one or more of the following messages may appear.

- Multiple card failure
- Line card failed on Shelf x card y
- Line card tested on Shelf x card y
- Buffer card tested on Shelf x
- Buffer card failure on Shelf 0
- Buffer card failure on Shelf 1
- Buffer card failure on Shelf 2
- Buffer card failure on Shelf 3
- Buffer card failure on Shelf 4
- Buffer card failure on Shelf 5
- Buffer card failure on Shelf 6
- Buffer card failure on Shelf 7
- Driver card (0-3) failure on Digroup A
- Driver card (4-7) failure on Digroup A
- Driver card (0-3) failure on Digroup B
- Driver card (4-7) failure on Digroup B
- Alarm card failure
- SLT card failure
- Address Control card failure
- Address Control card failure on Digroup A
- Address Control card failure on Digroup B
- Digroup A card failure
- Digroup B card failure

Figure 10-6 shows a sample MAP display after the craftsperson has input >QUERYPM FLT.

Figure 10-6
Example >QUERYPM FLT display

```

          CC      CMC      IOD      Net      PM      CCS      Lns      Trks      Ext      EIO
          •      •      •      •      •      •      •      •      •      •

0      RCT
1      Quit_      PM      x      x      x      x      x      x
2      Post_      RCT      x      x      x      x      x      x
3
4      RCT      RCT0 00 0 IsTb      LINKS_OOS Cside 0
5      Trnsl      RGen      RMJ
6      Tst      QueryPM flt
7      Bsy      RCT Inservice Troubles Exist:
8      RTS      Driver Card (0-3) Failure on Digroup A
9      Offl
10
11     Disp_
12     Next
13
14     QueryPM
15
16
17
18

      Userid
TIME  hh  mm>

```

SMR testing

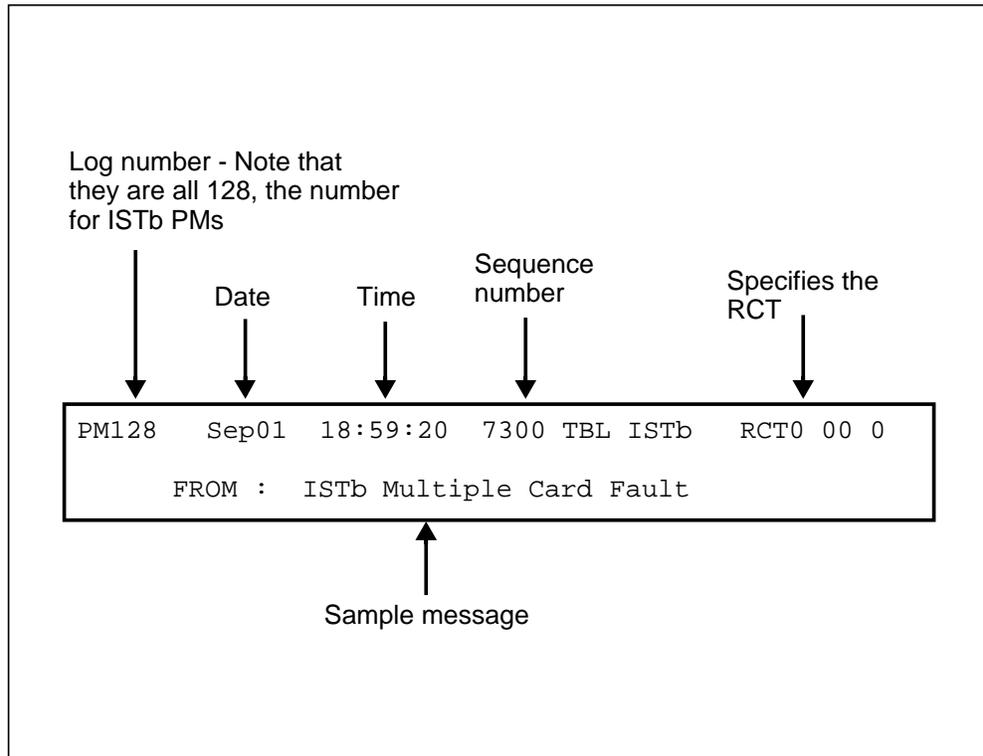
The TST command is used to see whether replacing a card that was shown as a result of >QUERYPM FLT has fixed the problem. When the test command is issued, the following occurs:

- 1 All fault indicators at the MAP related to line audits are cleared.
- 2 The RCT register audit is run
- 3 The RCT initialization diagnostic is run.

Log reports (PM128)

All log reports associated with the audits are PM128. Figure 10-7 shows a sample log and explains certain fields.

Figure 10-7
Sample PM128 log produced by the line audits



Following are the messages that can be associated with this log. Note that all of these messages correspond to a message that can appear when the craftsperson does a >QUERYPM FLT fault.

- ISTB Multiple Card Fault
- ISTB Line Card Tested on Shelf x, Card y
- ISTB Line Card Fault on Shelf x, Card y
- ISTB Driver Card Fault on Digroup z
- ISTB Buffer Card Tested on Shelf x
- ISTB Buffer Card Fault on Shelf x
- ISTB Address Control Fault on Digroup z
- ISTB Digroup z Card Fault
- ISTB Alarm Card Fault
- ISTB SLT Card Fault

Example maintenance scenarios

Monitoring for logs

In most cases, the operating company is first aware that the line audits have discovered a possible fault through the monitoring of logs. When a PM128 is produced, the craftsperson should access the RCT that was indicated by the log.

Using the >QUERY PM and >TST commands

After issuing the QUERYPM FLT command at the RCT level, the craftsperson should replace the first card that the MAP display indicated.

When replacing a digroup dependent card (digroup, address control, or driver), the associated link should be busied first and returned to service after the card has been replaced. This ensures that the SMR will take that side (A or B) out of service and know when to place that side back in service. This also ensures that personnel at the host and remote locations are in communication with each other.

The craftsperson should then TST the RCT to see whether replacing the card has cleared the fault. If it has not, replace the next card that was listed for the QUERYPM FLT command. Continue to do this until the faulty card has been found.

Universal line card audit (QPP407)

This audit clears possible latching problems on universal line cards. This is done by setting up or taking down a channel on this card.

The audit examines one line every 12 seconds; the entire RCT can be cycled through every 50 minutes. The sequence is the same as the fault finding diagnostic.

When the audit comes across a QPP407 line, a channel is set up and then taken down to clear possible latching problems. The audit is performed only when the line of the QPP407 is in service and idle.

List of terms

A bit

Data used to pass message and control information between the SMR and RCT.

A-bit scanner

Part of the A-bit facility located in the signaling processor that scans the A-bits in the A-bit/B-word circuit pack, checking for onhook and flash, RCT responses to ANI/coin requests, and digits. It also times for answer, disconnect, flash, and digit collection. Performs ringing.

A-bit/B-word circuit pack

SMR circuit pack that inserts A bits and B words into the PCM data stream, and extracts A bits and B words from the data stream. Performs inactive supervision on subscriber lines.

Address Control circuit pack

RCT circuit pack that encodes and decodes B words.

Attenuation pad test

Test performed in conjunction with the Trans-hybrid loss test. The attenuation pads in the line circuit pack are set for up to 2 dB loss. The Trans-hybrid loss test is performed and the DMS-100 switch compares measured loss values for the reflected tones at each attenuation pad setting with established limits.

Audible ringing

Formerly called Ringback tone, this tone is sent to a calling subscriber to indicate that the called line is connected and ringing applied.

Automatic line test level (ALT)

Level of line maintenance accessed from the LNS level of the MAP.

Automatic Number Identification (ANI)

Process by which a subscriber number is identified automatically and transmitted to a CAMA office equipment for billing.

Battery feed resistors test

Test that directly checks the correctness of both battery feed resistor values.

Bipolar violation (BpV)

Line fault in the DS-1 Carrier protocol. When two 1-bits occur with the same polarity (for example, when a regenerator fails or impulse noise causes a 0-bit to be converted into a 1-bit or a 1-bit is lost), a bipolar violation has occurred.

Bridged ringing

Any system where the ringers on a line are connected across that line (that is, between the tip and ring of a telephone line). Usually, single-party lines are connected in this manner. To avoid shunting the dc component, a capacitor is placed in series with each ringer.

Business set

Also called P-phone, proprietary phone, or IBN Business set. Business sets can provide certain features that are not available on non-proprietary phones by assigning nonstandard functions to special keys on the set. P-phones may require special interfaces to the system to implement these features.

Busy tone

Signal that a called line is busy, indicated by low tone (480 plus 620 Hz transmitted at -24 dBm per frequency) interrupted 60 times per minute.

B word

Control bits formed into a 24-bit word used by the SMR to pass commands to the RCT.

B-word facility (BWF)

Facility that notifies call processing of offhooks during inactive supervision and services requests from call processing and maintenance to send out B-word commands.

Call waiting tone

Tone alerting a subscriber in the talking state that another caller is attempting to complete a call to that station. Audible ringing is returned to the originating line. A hold feature, activated by a switchhook flash, allows the customer with the service activated to talk alternately with the original and new calling party.

Capability

Part of the MAP display for the TRANSLATE (TRNSL) command. It indicates whether links can carry message or speech signals.

CCS (one hundred call seconds)

Measurement used in traffic studies. The average number of calls during busy hour multiplied by the average holding time in seconds divided by 100 gives CCS. Both a single call lasting 100 seconds and two calls lasting 50 seconds equal one CCS.

Channel supervision message (CSM)

A 40-bit message received and transmitted every 5 milliseconds on connected voice channels of two peripherals. The CSM ensures call path integrity, including network path integrity.

Channel Supervision Message circuit pack

Circuit pack that performs all required functions for CSM messaging between peripherals, such as parity generation, integrity checking, and insertion and extraction of the CSM.

Clock signal

Output of a device that generates periodic signals that are used for system synchronization.

Coded ringing

Ringing employed on party lines in which all stations on a called line ring simultaneously, with each subscriber having an assigned code.

Coin operation

Coin telephone operation is divided into three categories:

- Prepay, or Coin first (CCF). A coin must be deposited before a dial tone is returned. The coins are collected or returned at the end of the call.
- Semipostpay (CSP). Dial tone is provided to the coin telephone when the handset is lifted. A call is dialed, and when the called party answers, a line reversal is applied to the coin telephone set to block voice transmission until the initial rate is deposited. On calls to free numbers, no reversal signal is returned to the coin station. All deposited coins proceed directly to the coin box and cannot be returned to the caller.
- Dial tone first (CDF). Coin service that uses a loop start line to provide dial tone with no prior coin deposit. After sufficient digits are dialed, the central office makes a ground test for initial deposit and tests to determine whether or not the call is directed to a free number. If the initial rate is satisfied or if the call is directed to a free number, the connection is completed. The coins are returned or collected at the end of the call or at the end of dialing, depending on the type of call.

Coin test

Test performed at the LTPLTA MAP level that checks the operation of the coin collect and coin return mechanism of a coin station connected to the line in the control position.

Command interpreter (CI) level

Initial MAP level from where commands are entered.

Connection memory

Area for storing addresses of speech samples.

Control Concentrator Terminal (CCT)

Central office equipment of the DMS-1R system. It controls the system and interfaces to the RCT via two or three DS-1 lines. It encodes and decodes voice signals into an 8-bit PCM format. The SMR replaces the CCT.

C-side

Side of module toward the Central control complex. Links from an SMR to a Network Module are C-side from the standpoint of the SMR; links to a RCT from the SMR are P-side viewed from the SMR.

Cutoff relay test

Test in which the cutoff relay opens the tip and ring leads. When the CO relay is operated and a current is sent through the circuit, the dc voltage measurement between ring and ground leads should be zero.

Decibel (dB)

A unit for measuring the relative strength of a signal parameter, such as power or voltage. It is normally used in measuring the loss or gain of power in a device or channel.

Dial pulse

System of dc pulsing in which the signaling digits are transmitted by interrupting the dc circuit a number of times. One to ten interruptions correspond to numbers 1 through 0 on the dial.

Dial tone

Continuous audible tone sent to a subscriber to signify readiness of the system to receive digits.

Dial Tone Speed Recording (DTSR)

Measurement of the DMS-100 ability to return dial tone within a specified time (three seconds).

Digit test

Test performed at the Line test position MAP level that checks the quality of digits produced by the Digitone keypad of the station connected to the line in the control position.

Digital Trunk Controller (DTC)

Peripheral module that replaces the Digital Carrier Module. It interfaces interoffice trunks to the Central control, terminating up to 20 DS-1 lines with 24 channels per line. It thus serves up to 480 digital trunks.

Digitone

Type of calling device that generates standard tone signals upon the manual depression of nonlocking buttons. Each Digitone signal is composed of two tones, the frequency of which is used to decode the digits at the receiving end.

Digroup circuit pack

RCT circuit pack that performs bipolar/unipolar conversions and extracts the clock signal, frame pulse, and B word from the incoming digital signals.

Divided ringing

Line configuration in which ringer connections are divided between two-party lines or among multi-party lines. One party or group of parties connects to the line's tip lead and to ground; the other party or group of parties, to the line's ring lead and to ground. Single frequency ringing can be used for two parties. Selective ringing must be used on lines shared by more than two stations.

DMS-1R RCT

Remote concentrator terminal providing service for up to 256 subscriber lines. It acts as a remote switch to concentrate subscriber line signals onto 24 or 48 digital transmission channels.

DS-1 Interface circuit pack

Circuit pack that provides the interface between DMS-100 equipment and standard DS-1 units, such as office repeaters and channel banks. Two DS-1 lines are provided per card.

DS-1 line

Digital line carrying multiplexed data at 1.544 Megabits/second on 24 channels.

DS-30 Interface circuit pack

Circuit pack that interfaces the C-side of the Common Peripheral Module through up to 16 ports on each plane, providing both pulse code modulation and messaging.

DS-30 link

Line that connects peripheral nodes in a DMS switch. It has 30 channels for speech and two channels for messages.

DS-30A link

Digital line carrying multiplexed data on 32 channels.

Exception report

Report generated for software errors.

Extended diagnostic

Diagnostic performed at the Line test position or Automatic line test levels of the MAP that checks most of a line circuit for correct operation.

Flux cancellation test

Test that checks the flux cancellation circuitry on the line circuit pack. This circuitry consists of the flux balance winding of the VF transformers and circuitry in the line circuit pack supervision network.

Frame loss

Loss of one complete cycle of events (193 bits) in time division multiplexing, including the voice channels and control bits.

Frame Supervisory Panel (FSP)

Equipment that accepts the frame battery feed and ground return from the Power distribution center and distributes battery feed, by subsidiary fuses and feeds, to the shelves of the frame on which it is mounted. The FSP also contains alarm circuits and frame battery control.

Frequency selective ringing

System allowing only the called station on a party line to be rung. Usually, each subscriber station is tuned specifically to one frequency of a set of five frequencies. When ringing voltage at any one of the five frequencies is applied to the line, only the ringer tuned to that frequency is activated.

Three sets of five frequencies are commonly used:

- Decimonic 20.00 30.00 40.00 50.00 60.00 Hz
- Harmonic 16.67 25.00 33.33 50.00 66.67 Hz
- Synchronomic 20.00 30.00 42.00 54.00 66.00 Hz

Ground start relay test

Test that checks for TP relay release in line interface circuit pack.

Ground to start detector test

Test that checks the ability of the line circuit to recognize an offhook on a ground start loop.

High tone

480 Hz transmitted at -24 dBm.

HISCAN

Scan duration of ten seconds used for operational measurements.

In-service test

Test in which a null B word is sent on a DS-1 link from a SMR to a RCT. If the RCT fails to send a reply, a timeout occurs indicating a faulty link.

Key telephone set (KS)

A multi-line telephone set where each line may be selected or placed on hold by push buttons. The DMS-100 family uses a logic 10 or logic 20 KS as part of the equipment at the MAP. Features of the system include pickup and holding, intercommunications, visible and audible signals, cutoff, exclusion, and signaling.

Line and Trunk Controller (LTC)

Peripheral module that is a combination of the LGC and DTC, providing support for LCM and AB trunks.

Line Control Feature (LCF)

SMR feature that schedules and controls ringing, automatic number identification, coin functions, maintenance (SLT-D), and line loss pad control.

Line equipment number (LEN)

Seven-digit number preceded by an alphanumeric site designation. It provides physical location information on equipment: site, frame number, unit number, line subgroup (shelf), and circuit pack.

Line Group Controller (LGC)

Peripheral module that connects with host LCM through two to six DS-30A lines and with remote LCM through two to 20 DS-1 lines. It provides all the features of a Line Module other than the line interface and low-level functions performed by the LCM. When connected to a remote LCM, it performs all the functions of a Remote Line Module (RLM) and DCM other than those performed by the remote equipment itself.

Line insulation test

Test performed on the ALT MAP level that checks a subscriber loop to determine the existence and magnitude of foreign potential and leakage resistance from and between conductors.

Line test

Test performed at the LTPLTA MAP level that measures dc voltage, ac voltage, resistance, and capacitance on subscriber loops.

Line test position (LTP)

A level of the MAP for testing circuit packs and subscriber loops.

Line test position line test access (LTPLTA)

Maintenance MAP level accessed from the LTP level. Specific line tests and other operations are available at this level.

Line test position manual (LTPMAN)

Maintenance MAP level accessed from the LTP level. Specific line tests and other operations are available from this level.

Loop detector test

Test that checks the ability of a line circuit to detect an offhook condition.

Looparound diagnostic

Test circuit for the A-bit/B-word circuit pack, where the transmit path is connected to the receive path. An outgoing test byte is used to test the circuit pack. The byte is looped around from the outgoing to the incoming data path during spare channel times and stored in incoming data memory. The 8085 Microprocessor in the A-bit/B-word circuit pack periodically checks the two values and reports an error if the two values do not match.

Loss

Decrease in transmitted signal power.

Low tone

Audible signal consisting of 480 Hz and 620 Hz transmitted at -24 dBm per frequency level.

LTC inventory table (LTCINV)

Data table containing physical location, load, exec, and C-side link information for all new peripherals: LGC, DTC, LTC, and SMR.

LTC P-side inventory table (LTCPSINV)

Data table containing P-side link information for all new peripherals.

Maintenance level (MTC)

MAP level used to access several areas of the switch: CC, NET, PM, LNS, TRKS, and others.

MAP command interpreter (MAPCI)

MAP level for accessing maintenance and other functional levels.

Master Processor circuit pack

Circuit pack that handles most of computation involved in switching and routing calls.

Master Processor Memory circuit pack

Circuit pack that contains memory for the Master Processor circuit pack.

Message condition (MSGCOND)

Ability of a link to carry messages; status is either open or closed.

Message Interface circuit pack

Circuit pack that provides tones such as dial tone and busy tone and collects CC messages. These messages are accessed by the Signaling Processor.

MonLTA

Maintenance command that allows the switch operator to listen to audible signals on a subscriber line (subscribers are aware that their lines are being monitored).

Noise test

Test that checks the level of noise in a line circuit pack.

On-board task (8085) microprocessor

Microprocessor in the A-bit/B-word circuit pack that automatically scans RCT lines, provides online and offline diagnostics, and times RCT responses to B-word commands. It sets a flag for the B-word facility when an RCT has sent a response or when it has not replied, which results in a timeout, and ensures that RCT responses are received twice.

Out of service test

Test that checks the Address Control circuit pack of a RCT.

Peg count

Number of times an event occurs. For example, the number of telephone calls originated during a specified period of time.

Port

Point at which a speech or message link is connected to a hardware module, PM, NM, Input/Output Controller, or Central Message Controller. Each port on the foregoing components connects a two-way (four-wire) link, carrying 32-channel serial data. The exception is the DS-1 line on the P-side of the PM, which has 24 channels.

Power Converter circuit pack

Circuit pack that provides a regulated power supply having output voltages referred to a common ground.

RCT

See Remote Concentrator Terminal.

RCT alarm table (RCTALM)

Data table containing information on 14 types of alarms supported for the RCT. Four switch operator assignable alarms are optional and require input by the user.

RCT inventory table (RCTINV)

Data table containing information on the physical location of the RCT, C-side links, SMR to which they connect, whether or not the RCT are equipped for protection switching, and ringing and maintenance data.

Receiver offhook tone

Fast busy tone initiated when a subscriber's phone is offhook for a specified period and no digits are dialed.

Release connection (RLSCONN)

Maintenance command that releases test equipment connected to a line.

Remote Concentrator Terminal (RCT)

Generic term for several types of remote concentrating devices. In this document, it refers to the DMS-1R RCT.

Reorder tone

Audible signal for all trunks busy that is indicated by low tone interrupted at 60 ipm.

Repeater

Device that restores signals distorted by attenuation to their original shape and transmission level.

Reversal (RV) relay test

Test that checks the reversal (RV) relay for correct operation and release in the appropriate line circuit packs.

REX

Routine exercise test. A series of tests performed on an SMR unit.

Ring test

Test performed on the LTPLTA MAP level that checks the operation of the station ringers connected to a line in the control position.

Ringback tone

See Audible ringing.

Ringling generator

RCT generator that provides ac/dc ringing power; positive ringing generators supplement the ac/dc ringing generators for superimposed ringing circuits.

Ringling and supervision test

Test to check if ringing is sent to the tip and ring leads of a subscriber loop.

Ring/Pad circuit pack

SMR circuit pack that receives parallel speech PCM from the Formatter circuit pack, modifies it, and reinjects the PCM into the Time Switch circuit pack. It provides PCM samples of any four of the existing thirteen frequencies and four dc control voltages. It also provides losses (0 to 7 dB) to the speech PCM on a per call basis.

Short diagnostic test

Test performed on the ALT MAP level that checks the operation of the RCT line circuit pack and the PCM path between the pack and the network.

Signaling Processor circuit pack

Circuit pack that controls SMR circuit packs and handles message routing.

Signaling Processor Memory circuit pack

Circuit pack that contains memory required by the Signaling Processor.

Silent switchman test (SSMAN)

Test enabling an individual to condition a subscriber loop for testing from a station without involvement by personnel at the central office. This test operates a cutoff relay in the line circuit, disconnecting the subscriber loop from the office battery and ground so that the loop can be checked for faults.

Slip (Slp)

Line fault that occurs when a change takes place in the normal transmission rates of bits between two connected digital facilities. Buffers handle short-term variations, but if the change is great enough, it may result in impulse noise on voice connections or data errors on data connections.

Speech Bus Formatter circuit pack

Circuit pack that converts parallel pulse code modulated (PCM) signals to serial and vice versa. It also generates shelf and clock signals.

Station ringer test (SRT)

Test performed on station equipment, usually a residential telephone station or a coin station, by a person at that station without the involvement of the switch operator at the central office. The SRT checks digit collection, coin return, and onhook and offhook ground.

Subscriber Carrier Module-100 (SCM-100)

Generic name for family of peripheral modules based on LTC architecture. These peripherals provide direct digital interface between the DMS-100 or DMS-100/200 and a remote peripheral module. Three peripherals in the family are:

- Subscriber Module Remote (SMR). Connects a DMS-1R RCT.
- Subscriber Module Urban (SMU). Connects a DMS-1U Remote Terminal.
- Subscriber Module SLC-96 (SMS). Connects a SLC-96. Remote Terminal.

Subscriber loop test

Test that determines if failure of any extended diagnostic subtest is due to a fault on the loop.

Subscriber loop test digital (SLT-D)

Facilities that employ a test head in the DMS-1R RCT to which any subscriber loop can be connected. The digital test head is digital hardware, controlled by B words, that tests such line parameters as resistance, capacitance, and line insulation.

Subscriber loop test extended (SLT-E)

Facilities use office equipment, such as a line test unit, to conduct subscriber loop tests. The test equipment is connected to a Metallic Test Access that in turn connects to subscriber lines, thus establishing a direct dc path between office equipment and subscriber loops. Not supported for SMR-RCT.

Superimposed ringing

Ringing in which the 90-V/20-Hz ringing current is biased through superimposition on (connected in series with) 48 V dc power.

SWACT

An activity switch from a failed active SMR unit to the standby or inactive unit.

TalkLTA

Maintenance command that allows Telco personnel to listen to audible signals on a subscriber line and converse with the customer.

Test access relay test

Test to check that the test access relay on a line circuit pack releases.

Test head

See Subscriber loop test digital.

Time Switch circuit pack

Circuit pack that switches speech channels in time by rearranging the order of channels in a time division multiplexed bit stream. It enables any network-side channel to connect to any peripheral-side channel. The time switch also robs the least significant bits from the speech channels and inserts A and B bits in their place.

Timeout

Action taken when equipment receives no response from an addressed location within a specified time.

ToneGen

Maintenance command that transmits a tone on a subscriber loop.

Trans-hybrid loss test

Test that establishes a path, through the digital network, between the Transmission Test Unit (TTU) and a line circuit. It sends 304, 704, 1504, and 3204 Hz tones separately from the TTU to the line circuit and measures the reflected tone signal at the TTU for each. The DMS-100 compares the actual measurements with those expected. Measured losses less than or equal to the established threshold pass this test; those exceeding the threshold values fail.

Unit

Portion of the SMR capable of processing and controlling voice and signaling information between the RCT and a DMS switch. The SMR has two units: an active unit and an inactive unit. The active unit does all the processing while the inactive unit is on standby.

Unsolicited message

Report indicating an error or fault condition.

DMS-100 Family

Subscriber Carrier Module 100 Rural

General Description

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