297-2101-102

DMS-100 Family

Remote Line Module (RLM)

Description

BCS27 and up   Standard 01.03   March 1991

northern telecom

DMS-100 Family

Remote Line Module (RLM)

Description

Publication number: 297-2101-102
Product release: BCS27 and up
Document release: Standard 01.03
Date: March 1991

Revision history

BCS	Date	Revisions
BCS32	March 1991	Converted to new Interleaf software and released as Standard.
BCS27	February 1983	Revised the description of link assignments in an RLM with IAS option.

About this document

This document describes the function, organization, structure, and operation of the Remote Line Module (RLM). The descriptions are supported by details of the internal components of the RLM and by references to auxiliary equipment with which the RLM operates.

Applicability of this document

This document applies to all DMS-100 Family offices.

To determine whether you have the latest version of this document, check the release information in *Northern Telecom publications master index, 297-1001-001*.

How the RLM documents relate to other documents

RLM documents are intended to be used with other documents in the DMS-100 Family library.

To fully understand the content of the RLM documents, you require documents in these layers:

- DMS-100 basic documents in the 297-1001 layer
- Line Module documents in the 297-2101 layer

Where to find information

Documents that you require to understand the content of this document, or to do the tasks it describes, are referred to in the appropriate places in the text.

These documents, and others that contain related information, are listed in this section.

> ***Note***: 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 *Northern Telecom publications master index, 297-1001-001*.

Document	**Title**
297-1001-106	Maintenance System
297-1001-110	Maintenance and Administration Position
297-1001-156	Power Distribution and Grounding Systems
297-1001-112	DMS-100 Family Documentation System
297-1001-120	Equipment Labelling, Numbering and Referencing
297-1001-122	DMS-100 Family Alarm System
297-1001-451	DMS-100 Family Customer Data Schema
297-1001-510	Output Report Manual
297-1001-515	PM Man-Machine Interface Description
297-2101-116	Line Testing
297-2101-451	DMS-100 Local Office Customer Data Schema
297-2101-516	Lines (Lns) Man-Machine Interface Description
GS0X10	Scan Card
GS0X29	Frame Supervisory Panel (LM)
GS2X05	+24V Converter and Ringing Generator
GS2X06	5V, 40A Power Converter
GS2X09	Multioutput Power Converter
GS2X10	LTU Analog Card
GS2X11	LTU Digital Card
GS2X17	Line Circuit TYPE A
GS2X18	Line Circuit TYPE B
GS2X31	Digital Carrier Module
GS2X46	Metallic Test Access Unit
GS2X48	DIGITONE Receiver *(DIGITONE is a trademark of Northern Telecom Limited)*

Document	**Title**
GS2X50	Minibar Driver
GS2X55	Signal Distribution Card TYPE II
GS2X57	Signal Distribution Card TYPE I
GS2X58	Remote Service Module
GS2X70	±5V/±12V Power Converter
GS2X90	Test Trunk Card
GS3X48	DS1 Interface Card

NT and BNR trademarks and the products they represent

The following chart lists all NT and BNR trademarks that occur in this document, and associates them with the products they represent.

Trademark	**Product**
DMS	*Digital multiplex system* telephone switching equipment
DMS SuperNode	telecommunications switching equipment
MAP	*Maintenance and administration position* telephone communication equipment

Contents

List of figures

List of tables

Introduction

Purpose of an RLM

The RLM is a type of Peripheral Module (PM) which is located at a site remote from the DMS-100 (local) or DMS-100/200 (local/toll) central office, of which it is a part. The office to which an RLM is thus connected is referred to as the 'host' office. An RLM is a specially-equipped Line Module (LM) which connects its subscribers through the host office network via DS1 carrier links instead of via direct 4-wire speech links.

The RLM permits service to be provided to subscribers up to 50 miles (80 Km) distance from the host office, at a transmission quality equal to local subscribers connected to the Line Modules (LM).

The status of LM and RLM in the hierarchy of the hardware modules of the DMS-100 Family of digital switching systems is described in Sections 297-1001-100 and 297-1001-103. The functions, structure and operation of LM are described in Section 297-2101-101.

RLM configurations

An RLM consists of a pair of bays, joined together as a double-bay frame, similar to the Line Module Equipment (LME) frame, but having different shelf and equipment configurations. The following configurations of remote site equipment are available:

1 **Basic RLM Package**. The equipment in the basic RLM package consists of one or more double-bay RLM frames which interface with up to 1216 or 1280 subscriber lines per frame (608 or 640 lines per bay), and a Remote Service Equipment (RSE) single-bay frame.

2 **RLM with Intraswitching (IAS) Option**. The IAS option enables calls between subscribers connected to the same double-bay RLM frame to be completed locally via the RLM circuits, thus relieving the load on the DS1 links and host office network.

3 **RLM with Emergency Stand-Alone (ESA) Option**. In the event of a failure of the DS1 carrier links to the host office, ESA enables ordinary telephone service (POTS) to be provided between subscribers connected to the same bays of a 1216-line frame.

The features of the basic and optional configurations of RLM are described fully in Part 2. Optional features are activated when the proper hardware is provisioned and the proper software is present. The software feature package applicable to a particular host office and its remote sites is contained in the Office Release Record (ORR) documents (refer to 297-1001-112).

Functions and features

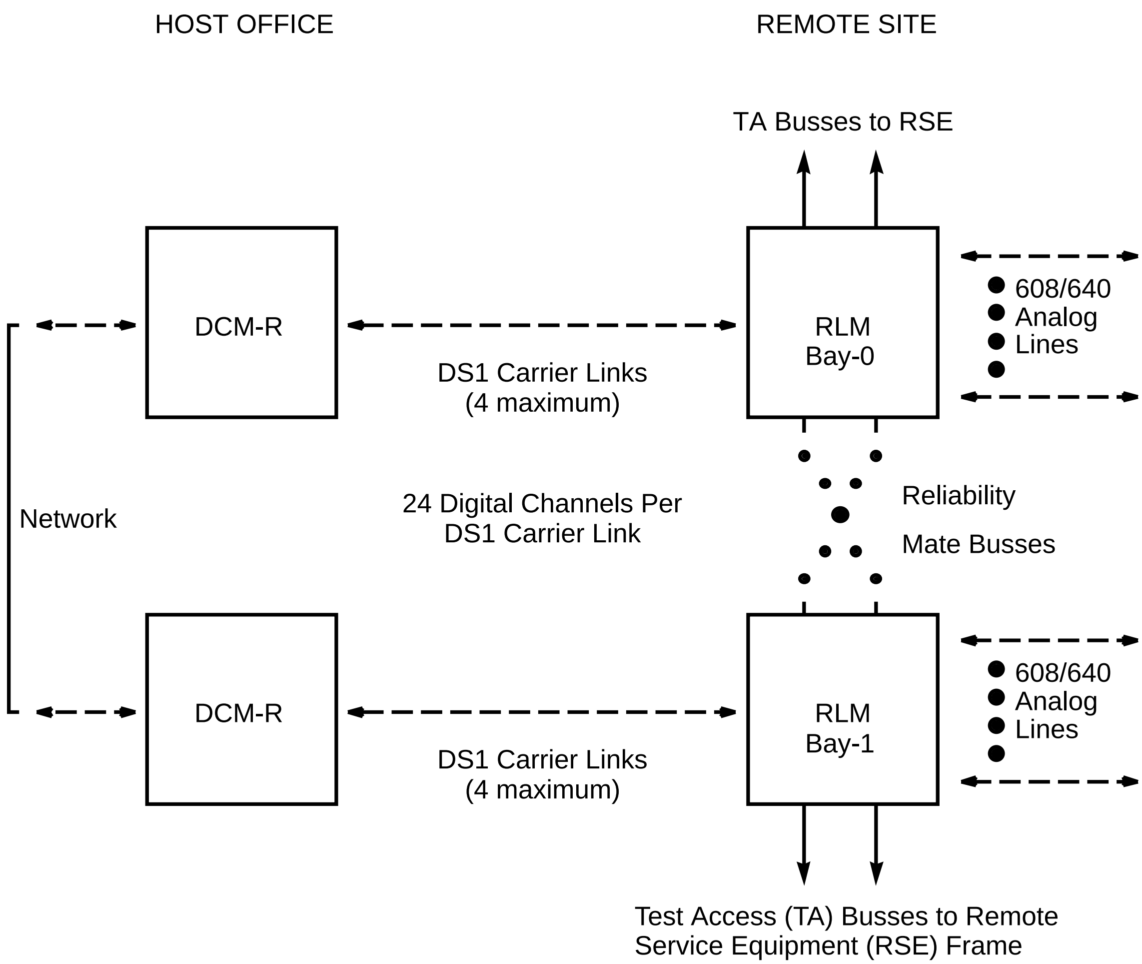
RLM functions

Refer to Figure 2-1 on page 2-2 , which illustrates the relationship between the host office and the remote site. The analog side of each bay of an RLM (0 or 1) interfaces with up to 608 or 640 two-wire analog lines to the subscriber's equipment. The requirement for an RLM with 608 or 640-line bays is dependent on the remote site equipment configuration. The digital side of each RLM bay is assigned to one to four DS1 carrier links to a specially-equipped Digital Carrier Module (DCM-R) in the host office. Refer to GS2X31 for details of the DCM and DCM-R. A DS1 link carries 24, two-way, pulse code modulated (PCM) channels of multiplexed serial data at 1.544 Mbits per second.

Each RLM bay provides mutual support to its mate in the adjacent bay via reliability mate busses between the Remote Line Controllers (RLC) in each bay of the pair. If the RLC in one bay malfunctions, the mate RLC in the other bay is instructed to take over the call-processing load for all 1216 or 1280 lines connected to both bays. Calls in progress via the failing RLC at the time of entering the takeover mode are dropped.

Metallic connections to the subscriber's lines on each RLM bay are accessible via the test access (TA) busses (2 per bay). The TA busses are connected to the Remote Service Equipment (RSE) frame which contains equipment enabling the host office maintenance system to conduct line test procedures remotely.

Figure 2-1xxx
Block diagram of host office/remote site relationship



RLM features

The RLM performs the following functions as routine tasks assigned to it by the Central Control (CC) of the host office. RLM functions are performed by peripheral processor (PP) programs (execs.) contained in an executive store area of the RLM. Each exec. is identified by a sequence number which is sent to the PP from the host office CC. Receipt of the sequence number causes the associated program to be executed. By performing these tasks within the RLM, the PP function relieves the load on the Central Processing Unit (CPU) in the CC, enabling it to concentrate on higher-level activities.

With types A or B line circuit cards (see Chapter 6)

- Scanning of subscriber's lines for off-hook (origination), on-hook, or hook flashes.
- Connection of subscribers to speech channels via the host office network or internal connections.
- Generation and application of digitally-simulated call progress tones to subscriber's lines (dial tone, audible ringing, busy tone, idle tone).
- Collection of dial pulses.
- Accepts DIGITONE dialing (collection of digits is performed by the host).
- Generation and application of selected types of ringing waveforms to called-party subscribers terminated on them.
- Remote maintenance of RLM hardware (see Chapter 4).
- Remote performance of loop and subscriber's apparatus tests (see Chapter 4).
- Automatic Number Identification (ANI).

With type B line circuit cards only (see Chapter 6)

- Generation and application of various coin box control voltages. DIGITONE disabling for coin boxes. Detection of various subscriber apparatus and loop conditions, such as: ground start, coin present.

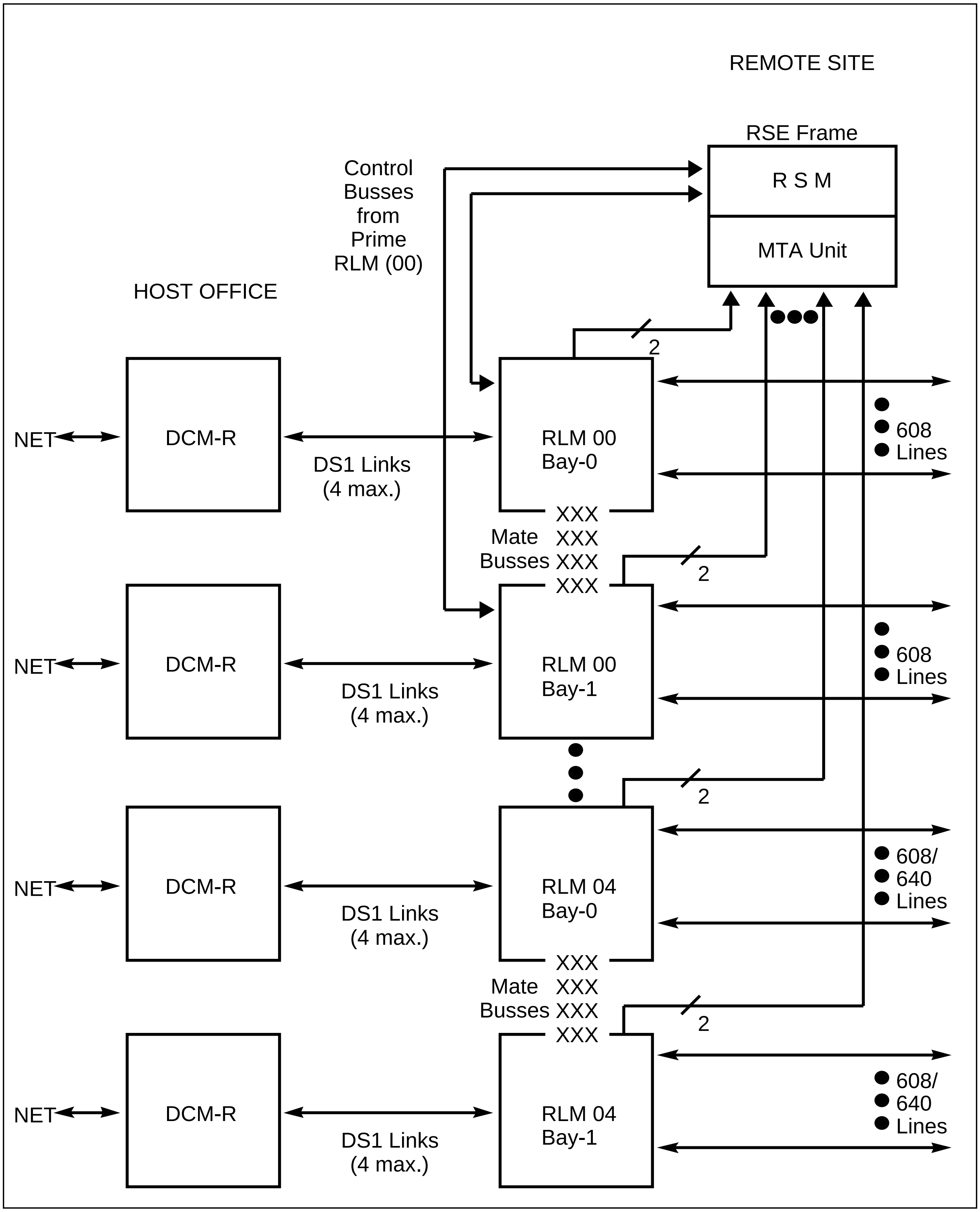
Basic RLM configuration

Refer to Figure 2-2 on page 2-4. The basic RLM configuration consists of a cluster of up to five double-bay RLM frames (RLM-00 to RLM-04), and one single-bay RSE frame. RLM-00 interfaces with 1216 two-wire analog lines (608 per bay), and also provides two control busses for the Remote Service Module (RSM), which is located in the RSE frame.

The RSE frame contains a Metallic Test Access (MTA) unit which accepts the TA busses (2 per bay) from RLM-00 and from the other four RLM in the cluster. The equipment in the RSE frame is described in Chapters 3 and 7.

RLM-00, which controls the remote service facilities for the cluster, is referred to as the 'prime' RLM and is always a 1216-line type. The other four RLM (01 to 04) can be either 1216-line or 1280-line types depending on the options selected.

Figure 2-2xxx
Basic arrangement of RLM cluster and RSE frame



Each of the five 608/640-line RLM bays provide mutual support to their mates by taking over the call-processing load for all 1216/1280 lines if one of the RLC in the mate pair fails.

RLM with IAS option

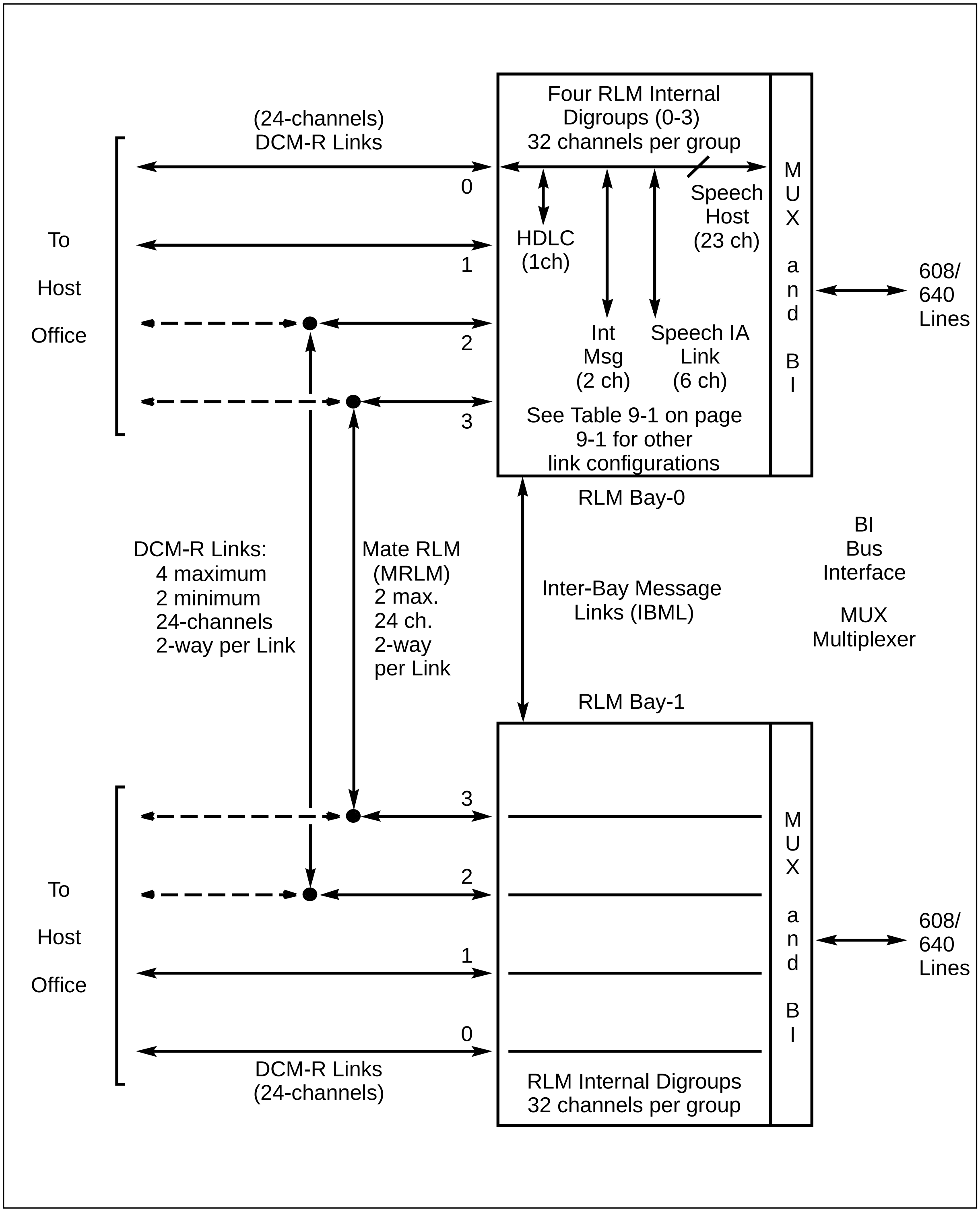
Refer to Figure 2-3 on page 2-6. Intraswitching (IAS) is an optional feature which allows calls to be switched within one double-bay RLM frame, instead of using the host office switching network. If the originator and terminator of the call are connected to the same bay, the call is referred to as an intra-bay (IA) call. If the originator and terminator are connected to different bays of the same RLM frame, the call is referred to as an inter-bay (IR) call.

In addition to the DS1 links to the host office (referred to as DCM-R links), IAS requires the use of other links within the RLM bays, and between RLM bays. Such links are of three types.

- **Mate RLM (MRLM) Links**. An MRLM link provides 24-channel, two-way connections for IR calls between bays 0 and 1. Up to two MRLM links (ports 2 and 3) can be assigned to IR service, at the expense of the DCM-R links to the host office.
- **Intra-Bay (IA) Links**. An IA link provides a minimum of 6 and a maximum of 30 speech channels (2 channels required per call) through a time/space switch within each bay.
- **Inter-Bay Message Link (IBML)**. The IBML provides a two-way path between mate bays for message traffic involved with processing IAS calls, and for supervision of the originating and terminating lines.

Within the RLM bay, the channels on the various links are assigned to four 32-channel digroups. The digroups connect speech channels to the appropriate line circuits, via the multiplexers and bus interfaces (BI), and also carry control messages to the RLM internal processors.

Figure 2-3xxx
Remote line module (RLM) link configurations



In the example (see Figure 2-3 on page 2-6), the 32 channels of digroup-0, RLM bay-0, are assigned as follows:

		Qty. Chan.
▪	**High-Level Data Link Control (HDLC)**. Channel 1 of the first 24-channel DCM-R link (0) is assigned to carry HDLC data between the RLM bay and the host office CC:	1
▪	**Internal Message Channels**. Carry internal control signals from the various processors in the RLM:	3
▪	**DCM-R or MRLM Speech Channels**. Maximum of 24 speech channels per DCM-R or MRLM link are available. In this example, channel 1 has been assigned to HDLC leaving the balance of the channels for DCM-R speech channels to the host office.	23
▪	I**A Link Speech Channels**. Digroup channels not assigned for DCM-R (host) or MRLM speech, or internal messages, are available for IA usage. If no DCM-R or MRLM links are in use on a digroup, all 30 channels are used for IA speech. In the example, where 24 channels are assigned to host usage, only the balance of 6 channels is available for IA:	6
		—
▪	Total channel assignment on digroup-0:	32

The required numbers of MRLM and IA links for a specific RLM are provisionable, depending on traffic requirements, and affect the provisioning of DCM-R links to the host. The possible combinations of DCM-R, MRLM and IA links and channels are tabulated in Table 9-1 on page 9-1. The IBML is always required for any IAS combination. IAS is activated when the proper software load is present in both bays.

The IAS option is applicable only to simple line-to-line calls where the originating and terminating lines are both connected to the same double-bay RLM frame. It is not applicable to any call that may require a connection back to the host, such as network connections to utilize service circuits at the host. Features incompatible with IAS are:

- Calls waiting.
- Three-way calling.
- Call forwarding.
- Calls where service analysis is operating.
- Calls to emergency service lines.

When a line connected to an RLM with IAS option, goes off-hook (originates), a channel on a DSI link to the host is assigned to it, and a corresponding appearance on the host office network occurs. The originating line then dials, and the host office collects the digits. When all digits have been dialed, a check is made by the host office CC to see if the origination is from a line on an RLM equipped for IAS. If the originating line is confirmed to be on an IAS-equipped RLM, and the terminating line digits are identified as those of a line on the same RLM bay, or its mate, an attempt is made to complete the call via IAS channels.

If free IAS channels can be found for the call, and the lines are not assigned features incompatible with IAS, the following events occur:

- The originating line network appearance is freed.
- The free IAS channels are assigned to the originating and terminating lines.
- The connection is completed and supervision of originating and terminating lines is established.

If no free IAS channels are available, the call is completed via the host office network, using free channels on the DS1 links.

RLM with ESA Option

The ESA option can be provided independently of the IAS option, and consists of a special package of hardware and software. The hardware configuration requires a specially-equipped RLC, and a specially-equipped RSM dedicated to each RLM having ESA. The software package activates and loads the ESA data into an additional memory card in the RLC, and also activates the time/space switch (also used with IAS option).

ESA provides POTS between subscribers connected to each bay of the same RLM in the event of the loss of all DS1 signaling channels to the host office. The RLM frame operates in the takeover mode during ESA. The RLC in bay-0 is equipped with the additional memory card, and takes over the call handling for all 1216 lines connected to bays-0 and -1.

Entry to, and exit from, the ESA mode occurs under the following circumstances:

1 **ESA Entry**.

When complete failure of the digital facility, carrying a signaling or standby signaling channel from both bays to the host office, has been detected. ESA entry does not occur immediately, but is controlled by a parameter (ESAENTRY) in one of the office parameter tables (OFCENG). See 297-1001-451 (section 1/030). The delay time is set to suit the requirements of the telephone company, and is usually 60 seconds. Other values can be set within the range specified in table OFCENG.

2 **ESA Exit**.

When communication with the host office is restored, the RLM does not immediately exit from the ESA mode. The CC at the host office commences timing immediately communication is restored, and compares the elapsed time since restoration with a parameter (ESAEXIT) in table OFCENG. ESAEXIT is a delay time which is set to suit the requirements of the telephone company, in units of 10 seconds, up to a maximum of 1000 seconds. When the elapsed time is equal to the value of ESAEXIT, normal RLM service is automatically restored. If ESAEXIT is set to zero, the RLM does not exit from ESA automatically, but must be returned to service manually, using the RTS command as described in 297-1001-515.

ESA features

Features provided when the ESA option is activated, are as follows:

- Local calls for DP and DIGITONE subscribers, basic PBX with sequential line hunting, multi-party , revertive calling.
- 7-digit dialing to directory numbers (DN) within the RLM.
- Specific digit strings can be rerouted to re-order tone, or T elco-assigned DN located at that RLM.
- Calls to ‘911’ and ‘0’ are routed to pre-designated Telco-defined local DN, appearing on the same RLM.
- Calls which are to be routed to reorder tone or a Telco-defined DN, during the ESA modes of suitably-equipped RLM, are entered in the host office customer data schema control table ESA, and in the RLM memory. See 297-2101-451 (section 1/109).
- Ringing and tones are the same as those provided by the basic RLM. ESA does not provide ROH tone, Recorded Announcement or other features which originate at the host office.
- All maintenance and administrative functions associated with the RLM are suspended during ESA operation.
- Basic Operational Measurements (OM) (peg counts only) continue.
- Coin return active on coin lines. No coin collect.

During inactive periods, the ESA option maintains its readiness as follows:

- The ESA hardware is subjected to continuous routine exercising in order to ensure its sanity.
- Daily automatic of the data base of both the host office and the RLM emergency package. Or can be updated manually via the ESALOAD command (see 297-1001-515).

Organization and hardware structure

Organization

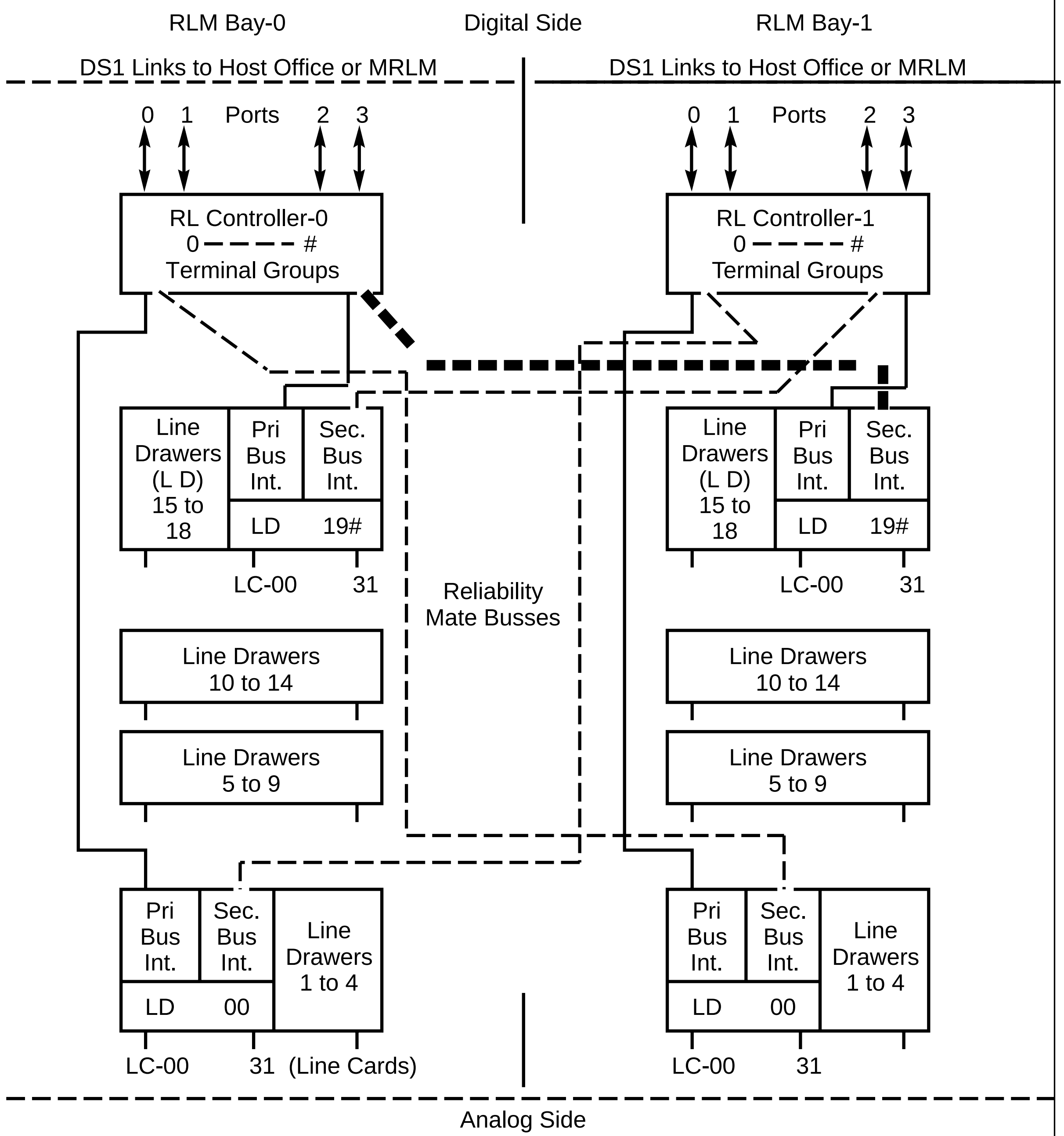
Refer to Figure 3-1 on page 3-2. The digital side of each RLM bay is connected to the host office via up to four DS1 digital carrier links, each providing 24, 2-way, Pulse-Code Modulated (PCM) channels. Channel 1 of the first DS1 link is assigned for communications with the Central Control (CC) of the host office, and channel 1 of the second DS1 link is reserved for use as a standby communications channel, leaving 23 channels of these two links available for speech. On the analog side, each RLM bay accommodates up to 640 or 608 2-wire subscriber line circuits. The number of DS1 links to the host office is provisionable as listed in Table 9-1 on page 9-1, depending on traffic requirements. The circumstances under which 1216 or 1280-line RLM are used are described in Chapter 2.

The concentration of 640 or 608 lines onto the DS1 link speech channels is performed, as in other PM, by a peripheral processor (PP) function. In the RLM, the PP function is performed by a master processor and two subordinate processors, located in the Remote Line Controller (RLC) shelf. The RLC and the processors are described in detail in Chapter 5.

To improve reliability, RLM are organized so that each bay of the RLM has its own RLC, but the two bays of the double-bay RLM frame always operate in pairs. Each bay of the pair interfaces with its own set of line circuits, but the RLC in each bay supports the other via secondary bus interfaces and busses (dashed lines) to the mate RLC in the event of failure in either. Traffic and call-handling capabilities are reduced while one RLC is out of service because the in-service RLC is handling up to 1280 lines, but both bays can continue to operate. Calls in progress on the failing bay at the time of takeover are dropped.

The line interface circuits of an RLM bay are organized into four shelves of Line Drawers (LD). In the 640-line RLM configuration each shelf contains five LD for a total of 20 (numbered 0 through 19) per bay. In the 608-line RLM, the three lowest shelves each contain five LD, but the highest shelf contains only four LD for a total of 19. The 20th LD space is occupied by the connectors and cables to the nearby RSE frame.

Figure 3-1xxx
Block diagram of remote line module (RLM)



\# If the RLM has: 1280 Lines there are 640 LC/bay in 20 LD (0-19).
1216 Lines there are 608 LC/bay in 19 LD (0-18).
Terminal Group 19 controls the Remote Service Module (RSM).

Each LD can accommodate up to 32 (0-31) Line Circuit (LC) cards, each LC containing one interface circuit to a subscriber's line. One line circuit (LC-00 in LD-00) in each RLM bay can be assigned for test purposes and is cabled to the distribution frame (DF) but not assigned to a subscriber line. In this case, the actual capability of an RLM is reduced to 1214 or 1278 lines (607 or 639 lines per bay). The applicable test procedures are described in 297-2101-116 and 297-2101-516. LC types are selected to match the requirements of the subscriber's service (see Chapter 6).

Each LD also contains a Ringing Bus Multiplexer function which distributes ringing voltages to the 32 LC on command from the RLC, and two Bus Interface (BI) functions. One BI (designated 'primary') multiplexes the LD to one of the terminal di-groups on its own RLC, while the other BI function (designated 'secondary') multiplexes to a corresponding digroup on the mate RLC.

Hardware structure

RLM Double-Bay Frame. Refer to Figure 3-2 on page 3-4. Viewed from the front, the two bays of an RLM double-bay frame are identified by -0 (left bay) and -1 (right bay). The '640-line' RLM structure is similar to the LME frame (297-2101-101).

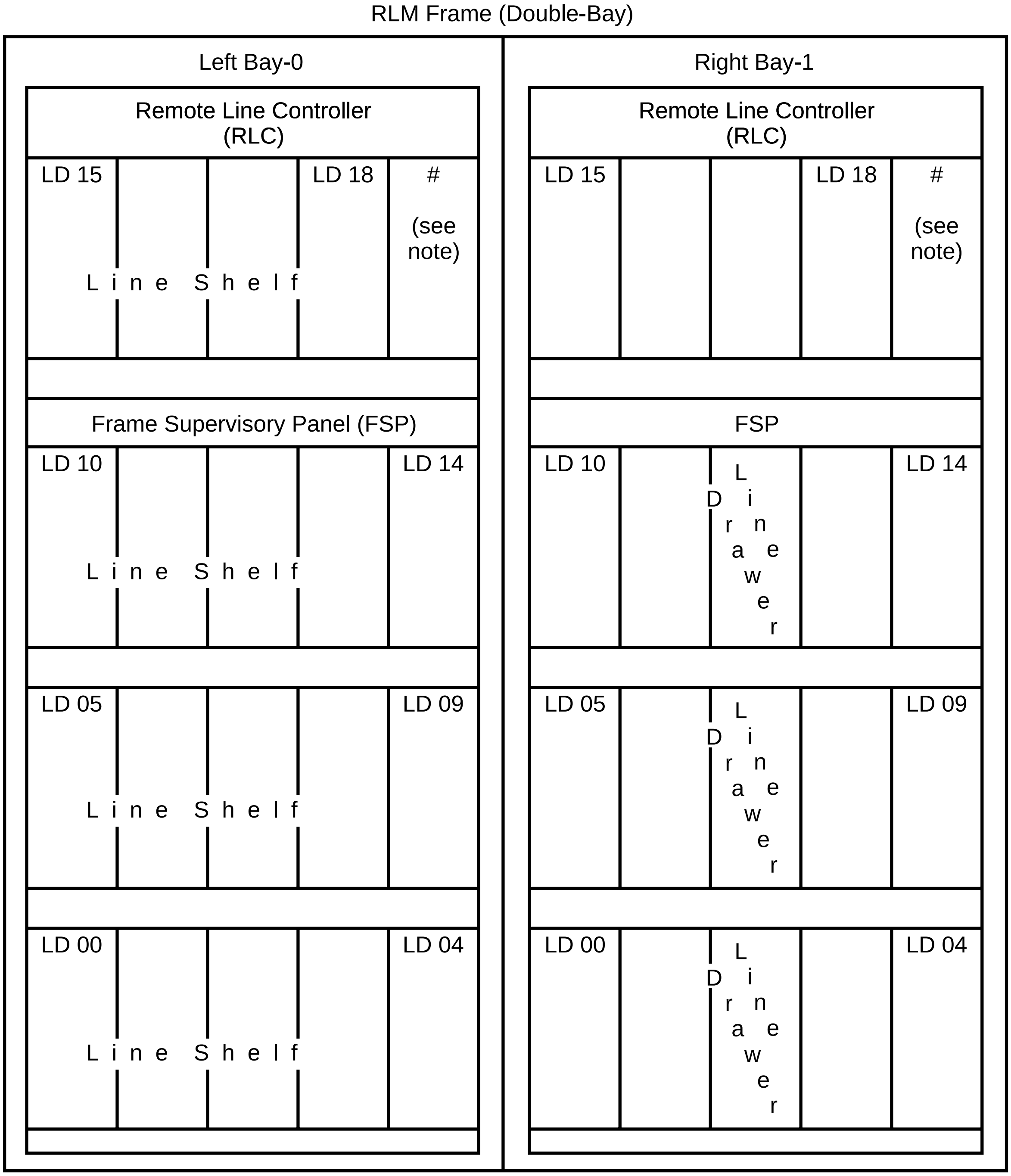
The identification scheme for components of an RLM is as follows:

	RLM ID NO. (00-99)	Bay	LD	LC
(Example)	00	0	00	00 (Test LC)
	00	0	18	31
	00	1	00	00
	00	1	18	31

Further details of the identification scheme for RLM and their relationship to the host office equipment, are contained in 297-1001-120.

Each RLM bay also contains a Frame Supervisory Panel (FSP), which distributes office battery power feeds to the RLM and also contains power control and alarm circuitry. The FSP is described in GS0X29.

Figure 3-2xxx
Remote line module (RLM) hardware structure



Note: # is for LD19 if this is a 1280-Line RLM, or for RSM Interface Connector if it is a 1216-Line RLM.

Structure of Line Drawers. The structure of the shelf housing the Line Drawer is illustrated in Figure 3-3 on page 3-6 and Figure 3-4 on page 3-7. Each LD can be withdrawn, but not removed, from the shelf (e.g.: LD-00) for maintenance purposes and still remain operative because all electrical connections between the L and its shelf are carried in flexible cables.

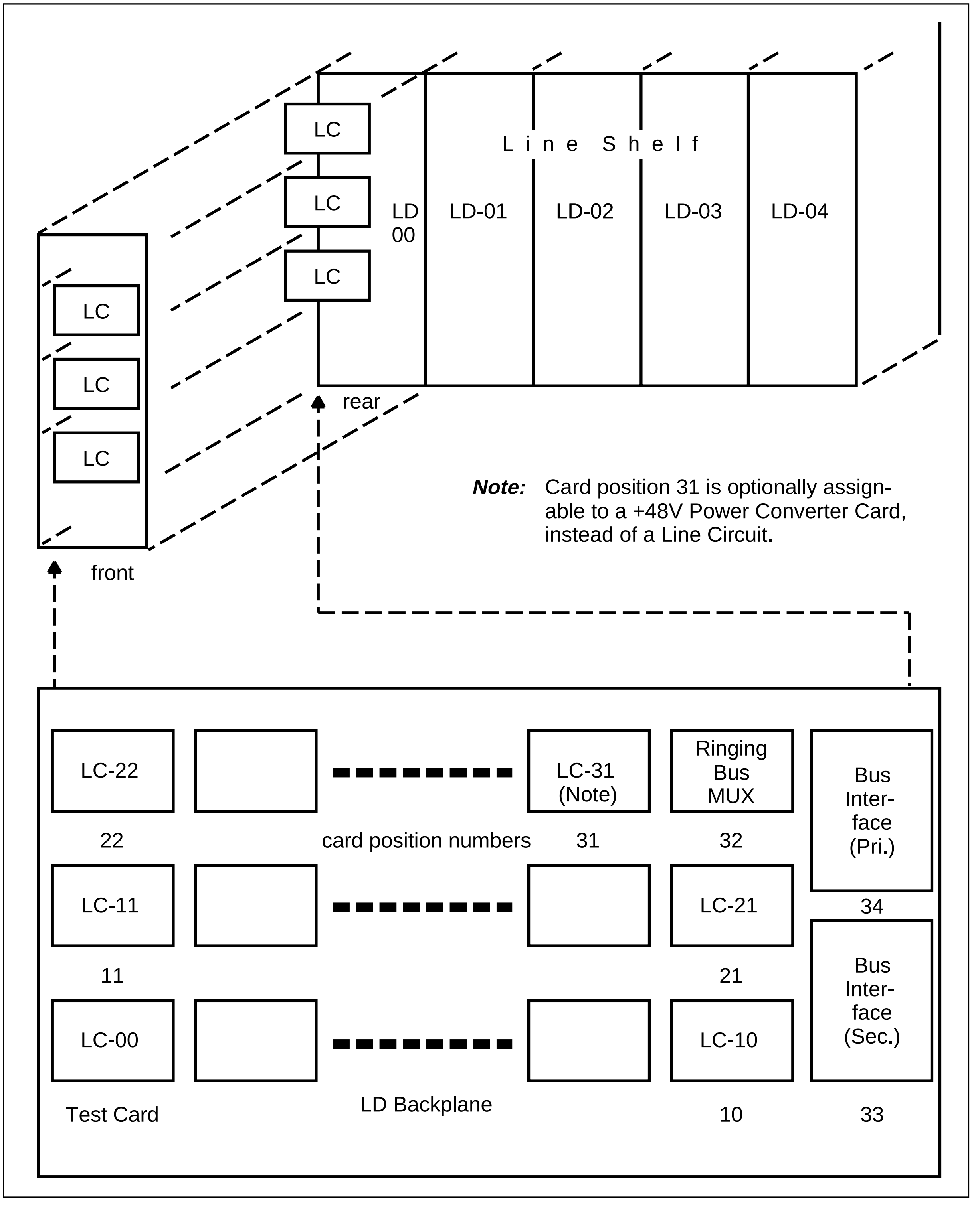
LD are available in two configurations, performing the same functions, but having different hardware structures. The two types of LD are identified by Northern Telecom (NT) product codes, as follows:

1 **Line Drawer NT2X19AA**. This type of LD is of all-metal frame construction, with card sockets arranged as illustrated in Figure 3-3 on page 3-6. There are 35 card positions (00-34), of which positions 00 to 31 are assigned to LC cards. Position 32 is assigned to the ringing bus multiplexer card, and positions 33 and 34 to the bus interface (BI) cards. Position 34 accommodates the primary BI to the “own” RLC, while position 33 is for the secondary BI to the mate RLC.

2 **Line Drawer NT2X19AC**. The frame of this type of LC is moulded from non-metallic material, and has card socket arrangements as illustrated in Figure 3-4 on page 3-7. There are 33 card positions (00-32), of which 32 positions (00-31) are assigned to LC cards. The functions of ringing bus multiplexer, primary BI, and secondary BI are performed by the Line Drawer Interface (LDI) card. The LDI card is located in position 32 at the front of the LD. In Chapter 4 (OPERATION), the references to the functions of primary and secondary BI, and ringing bus MUX are equally applicable when these functions are contained in the LDI card.

In both types of LD, as a provisionable option, when the DIGIT ONE disabling feature is applied to an NT2X18AD line circuit, card position 31 is assigned to an NT2X03AA +48V Power Converter card instead of a line circuit. The number of line circuits for that LD is then reduced by one. DIGIT ONE disable is only required for tip-only coin control.

Figure 3-3xxx
Line drawer (LD) and shelf structure (NT2X19AA)



Note: Card position 31 is optionally assignable to a +48V Power Converter Card, instead of a Line Circuit.

Figure 3-4xxx
Line drawer (LD) and shelf structure (NT2X19AC)

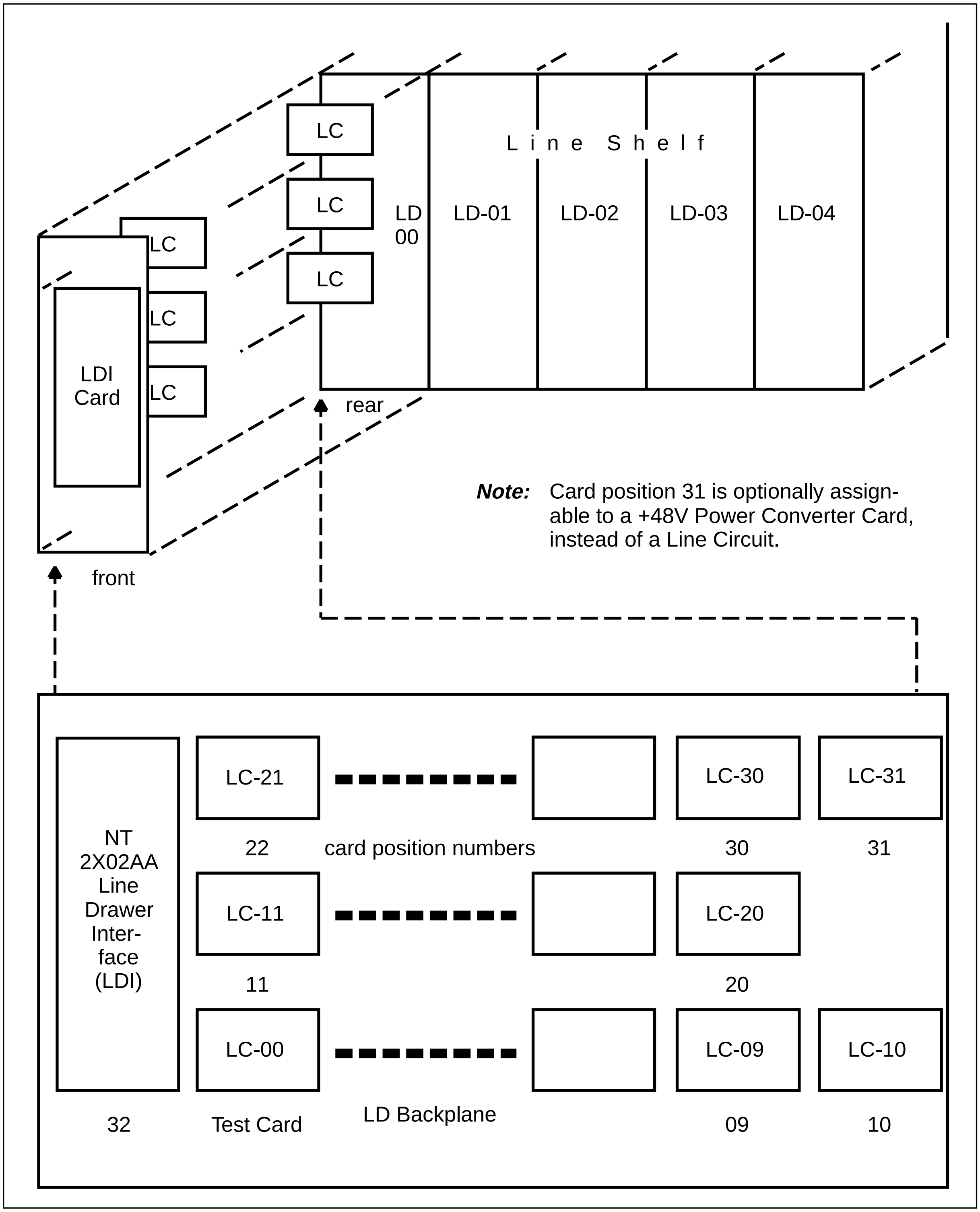
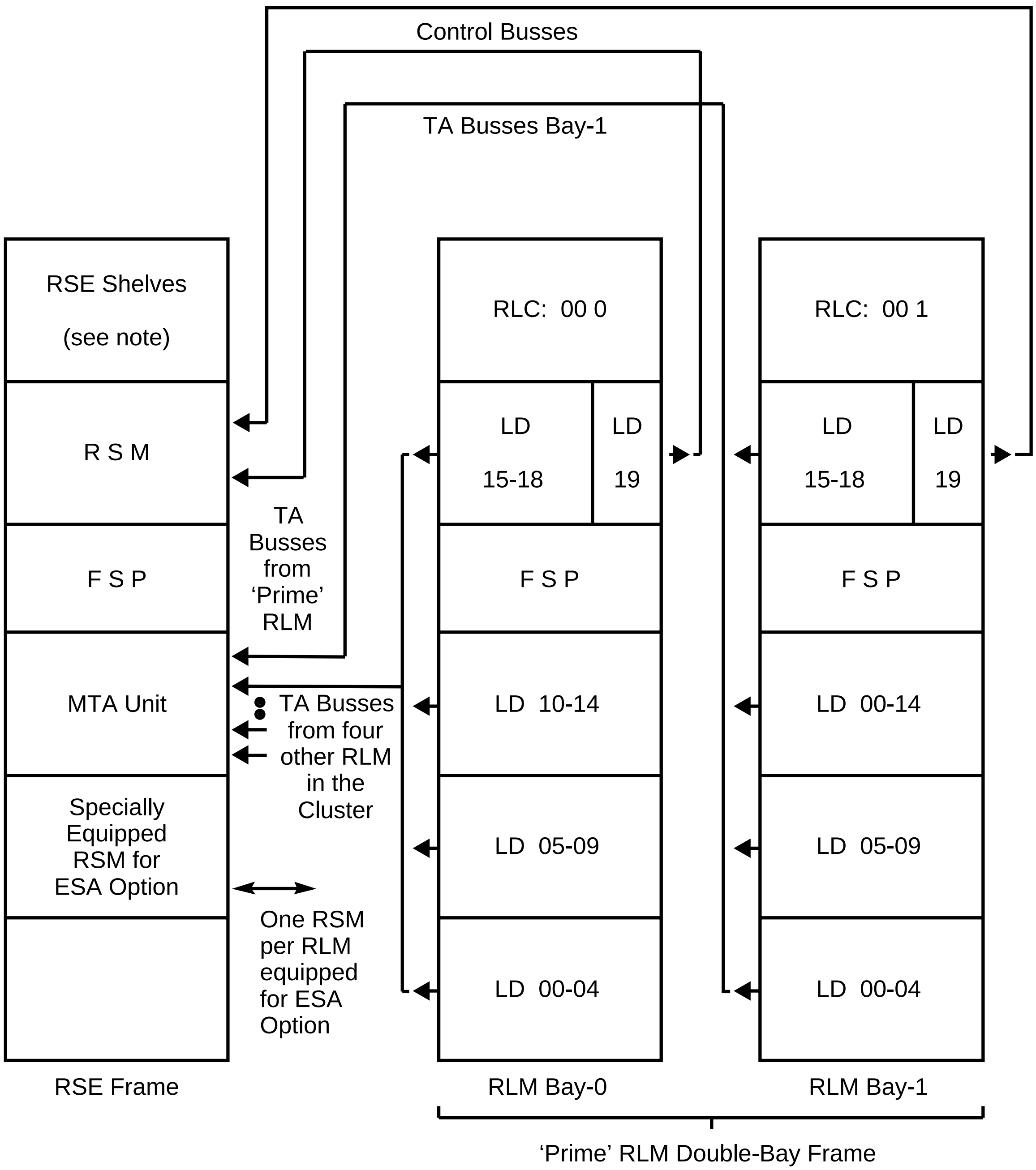


Figure 3-5xxx
Remote service equipment (RSE) frame



Note: Base mounting positions of RSE shelves are determined by job engineering.

Remote service equipment frame

Refer to Figure 3-5 on page 3-8. The Remote Service Equipment (RSE) frame is located at an RLM site in such a position that the length of cable between the RSE and the RLM which it serves (including cabling within LD19), does not exceed 15 ft. (4.6 m).

The RSE contains Remote Service Module (RSM) shelves, each of which interfaces with a cluster of up to five RLM.

An RLM equipped for Emergency Stand Alone (ESA) option requires a dedicated RSM shelf.

See Chapter 7 for details of the RSM. The arrangement of shelves in an RSE varies depending on job engineering requirements.

Operation

General

This part describes the various operations which occur within one bay of a 1216-line RLM, equipped to interface with an RSM. The description follows the paths of speech and control signals passing from the DS1 interfaces to the line circuits (receive) and from the line circuits to the DS1 interfaces (transmit). Also described are the internal activities of the master and subsidiary processors, maintenance circuits and ringing system. Figure 4-1 on page 4-3 illustrates the Remote Line Controller (RLC) functions, while Figure 4-2 on page 4-4 illustrates the LD functions. The description is applicable to both types of LD.

The following description is also applicable to one bay of a 1280-line RLM, the only difference being that the RSM connector space is used instead by the 20th Line Drawer (LD-19).

DS1 interfaces

Up to four DS1 carrier links from the host office enter the RLM bay at the RLM ports on the two DS1 interface cards. These cards each accept two DS1 links in 24-channel format at 1.544 mB/s and convert the data to 32-channel format at 2.56 Mb/s (receive), and vice-versa from 2.56 Mb/s to 1.544 Mb/s (transmit). See GS3X48 for details of the DS1 Interface Cards. The ports are identified as -0 to 3. Channel 1 of the first DS1 link (port 0) is assigned to carry messages between the RLM and the Central Control (CC) in the host office. Channel 1 of the second DS1 link, (port-1) is assigned as a standby CC message channel. Such messages are handled by the High-Level Data Link Control (HDLC) processor.

Ports 2 and 3 can be used either for DCM-R links to the host office or as MRLM links to the DS1 interface cards in the mate RLM bay. See Chapter 2 for details of channel assignments for the IAS option.

Call processing and supervision messages for inter-bay calls (RLM with IAS option) are handled between mate RLC via their Universal Asynchronous Receiver-Transmitters (UART) and the IBML. The UART is controlled by the Master Processor, but is located on the HDLC Processor card.

As part of the IAS and ESA options the Time/Space (T/S) switch function is activated. Under Master Processor (MP) Control, the T/S switch provides up to 30 IA channels for connecting calls within the same RLM bay. See Chapter 2 for details of IA channel assignments.

The four ‘receive’ digroups from the DS1 interfaces each carry 30 speech channels from the DCM-R links to the host office and/or MRLM from the mate RLM bay, and/or IA channels from the T/S switch; as well as two internal message channels. The four digroups carrying these channels from various sources are then applied to the inputs of the ‘receive’ multiplexer (R-MUX). See Chapter 2 and Figure 2-3 on page 2-6 for details of link configuration.

Figure 4-1xxx
Functional diagram of remote line controller (RLC)

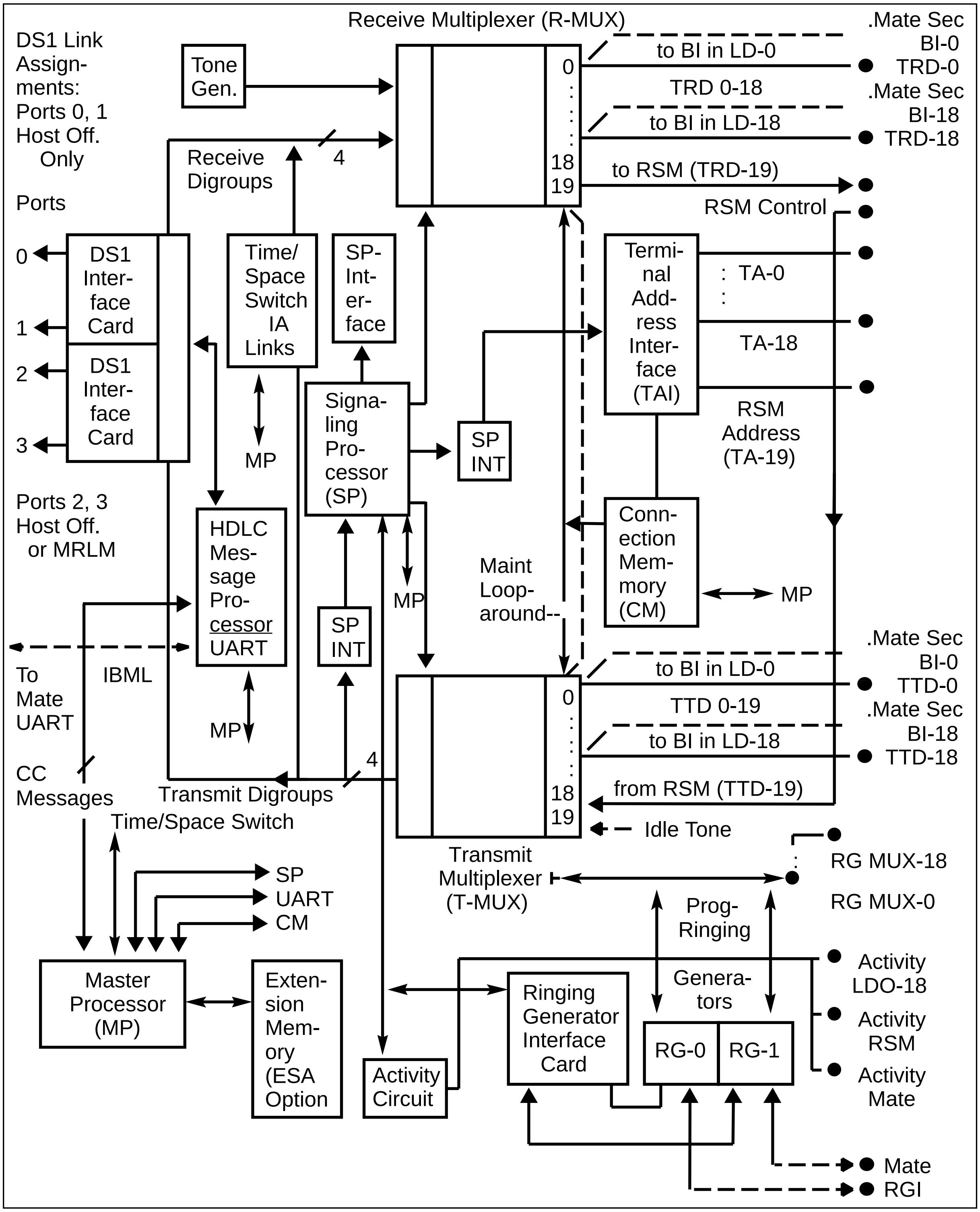
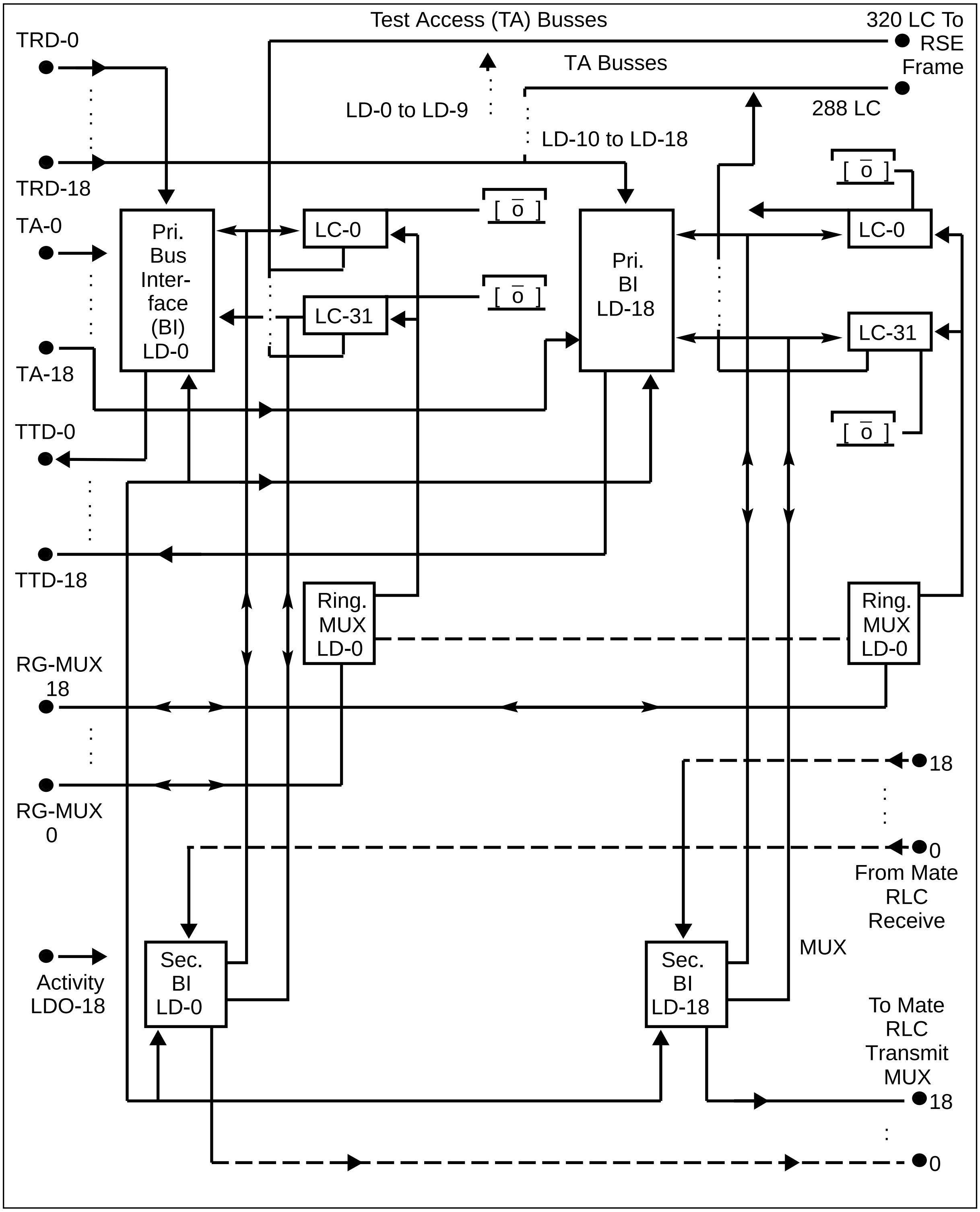


Figure 4-2xxx
Functional diagram of line drawers (LD)



Speech signal paths

In addition to the inputs from the four digroups, other service and control signals are also input to the R-MUX. The service signals comprise standard audible tones in digital form from the tone generator (dial, audible ring, busy), or idle code. The Signaling Processor (SP) inputs control signals which are addressed to specific line cards to operate their ringing relays.

'Receive' Path. The R-MUX, under control of the Connection Memory (CM), selects four of its receive digroup inputs every channel time and connects them to four of its terminal receive digroup outputs. The R-MUX has 20 (0 through 19) terminal receive digroups (TRD) which communicate with the Line Drawers (LD), while the 20th terminal receive digroup (TRD19) communicates with the Remote Service Module (RSM) control circuits. A special maintenance terminal receive digroup provides a looparound output to the Transmit Multiplexer (T-MUX) for test purposes. Terminal receive digroups (TRD 0 through 18) carry the four selected channels to the Bus Interfaces (BI) in the associated Line Drawers (LD). Unselected terminal receive digroups carry no intelligence and remain in a fixed logical state until selected at the appropriate channel time. Which line circuits in the selected LD will receive these four signals is determined by the Connection Memory (CM), acting via the Terminal Address Interface (TAI). The PCM speech samples pass through the primary BI card in the line drawer (e.g. LD-0), which sends them to the appropriate line circuit, using terminal address information (TA-0 through TA-18) obtained from the TAI card. On each line card that receives speech samples, the samples are decoded from PCM into analog form and output to the subscriber's lines.

'Transmit' Path. At the same time as the 'receive' path events, the analog speech coming from the subscriber's line to the line circuit is encoded into PCM, and output from the line circuit together with supervision status information. The outputs from the line circuits are collected by the primary BI in each LD (e.g. LD-0) where they are switched, under control of the connection memory and terminal address interface onto terminal transmit digroups (TTD). The selected terminal transmit digroup carries the signal to the input of the Transmit MUX.

In addition to the 19 terminal transmit digroups, the 20th TTD carries communications from the RSM control circuits. A maintenance input (looparound) from the Receive MUX, and an idle tone input, are also applied to the input of the Transmit MUX. Four of these input signals are connected at any channel time, under Connection Memory control, to four 'transmit' digroups.

The four 'transmit' digroups then enter the DS1 Interfaces. There, outgoing messages for the CC (reports), which the HDLC Message Processor outputs, are inserted into the CC message channel and the signals on the four transmit digroups are converted from unipolar serial data to DS1 format. The converted signals are then output to DCM-R links to the host office or to MRLM links (IAS option) to the mate RLM bay. See Chapter 2 for details of link selection.

The supervision status of active lines (those line circuits that are connected to a channel on a digroup) is automatically collected by the Signaling Processor through its interface to the transmit digroups.

Control signal paths

Channel 1 of DS1 link -0 (Port 0) is assigned to host office CC messages. In the 'receive' direction (from CC), the contents of this channel are extracted in the DS1 Interface card and sent to the HDLC Message Processor. In the transmit direction (to CC), the output of the HDLC Message Processor is inserted into the same channel of the DS1 Interface card. If channel 1 of the first DS1 link fails, CC messages are automatically transferred to channel 1 of the standby DS1 link (Port 1).

Within the RLM, the two internal message channel times are used to pass control words to, and responses from the line circuits and ringing multiplexers. Control words are output by, and responses are stored in, the Signaling Processor.

On 'receive', 10-bit control words are output by the Signaling Processor and brought to the input of the Receive MUX. During control channel times, this input is connected (under control of the Signaling Processor) to one of the terminal receive digroups 0-18. The control word then passes through the same units and paths as the PCM speech samples. The control word is carried on a terminal receive digroup to a Bus Interface, and then to a selected line circuit. The address which selects the line circuit originates in the Signaling Processor, and is converted in the Terminal Address Interface card to an instruction (TA-0 through TA-18) which tells the Bus Interface which line circuit to select. The addressed line circuit responds with 10 bits of data (8 bits of response to the control word, 1 bit spare, and 1 supervision bit). This response travels through the Bus Interface, the corresponding terminal transmit digroup, and is connected in the transmit MUX to a transmit digroup. The response, as well as the supervision status of the line circuit accessed, are collected by the Signaling Processor and stored in its memory. Control words addressed to, and responses from, the RSM are routed via TRD-19 and TTD-19.

Interprocessor communication

The Master Processor (MP) communicates with its subordinate processors, and with the Connection Memory, through mutually-accessible sections of memory located on each subordinate card. Some control signals: reset, interrupts, and interrupt clear, are also exchanged between the Master Processor and its subordinate units. The processors, their subordinate units, the Receive MUX and Transmit MUX, and other cards are located in the Remote Line Controller (RLC) shelf, which is described in Chapter 5.

RLM maintenance

The functioning of each RLM bay and its units is periodically monitored. If a fault is detected, it is verified, and the host office Central Control is notified. Depending on the severity of the fault,the RLM bay either continues in service, or has control of its lines transferred to the mate RLC bay.

The RLM bay hardware is monitored in several ways as follows:

1 **Activity Circuit.** The activity circuit contains a 200 msec 'sanity' timer which is normally prevented from timing-out by periodic reset signals from the SP . The activity line broadcasts the 'sane' status of the timer , and thus of the RLC to the bus interfaces (BI) in the LD as long as no timeout occurs.

   If a fault of sufficient severity occurs in the RLC, the reset signal is not given by the SP, sanity timeout occurs, and an 'Inoperative' signal appears on the activity line to the LD. Locking logic in the activity circuit prevents accidental random resetting of the sanity timer by requiring a specific sequence of accesses before reset can occur. The busses from the alternative BI in each LD are connected to the corresponding terminal receive and transmit digroups in the mate RLC. Each RLC continuously monitors the activity line of its mate via its alternative BI. If an 'Inoperative' signal appears on the activity line, the mate notifies the CC in the host office of the failure. The CC then issues a 'takeover' command to the mate RLC to start servicing all the lines connected to the failed RLM bay as well as its own. This command deactivates the primary BI in the LD of the failing RLM bay and activates its secondary BI to the mate RLM bay. Also, one of the Programmable Ringing Generators (RG-0, RG-1) in the failing RLC is placed under control of the mate Ringing Generator Interface (RGI). Calls in progress and calls in process of set-up are dropped whenever the takeover action occurs. When the failed RLM bay is serviceable, the SP applies the proper sequence of accesses to the activity circuit and the sanity timer is reset. The host office CC is notified of the readiness for service, via the mate activity line. Since the transfer back to normal operation (each RLC serving its own RLM bay) also causes calls to be dropped, this action does not occur automatically. The transfer is performed manually at a low-traffic time by using the return-to-service (R TS) command. Refer to 297-1001-515 for details.

2 **DS1 Link Maintenance.** The DS1 side of the RLM bay (i.e., DS1 Interface, HDLC Message Processor, Master Processor) is monitored by the host office via the DS1 links and the maintenance circuits of the DCM-R at the host office.

3 **Digital LC Components.** Digital components in the line circuits of an RLM bay are monitored within each bay, using various diagnostic paths (such as looparound) provided by the RLM hardware. Diagnostic tests are supervised by the Signaling Processor in each RLC.

4 **Analog Component Maintenance.** Analog units and components (such as the Programmable Ringing Generators, Ringing MUX, and the analog parts of the line circuits) are monitored within each RLM bay by tests such as ringer continuity, stuck ringing relay, etc.

5 **Line Maintenance via MTA.** See Figure 4-2 on page 4-4. Other analog components in the LC cards are periodically checked via two test access (TA) busses in each RLM bay, which provide metallic test connections to the tip and ring leads of any of the 608 LC in the associated RLM bay. One TA bus connects to the 320 LC in LD-0 through LD-9, while the other TA connects to the 288 LC in LD-10 through LD-18. The TA busses in each RLM bay are connected to the Metallic Test Access (MTA) unit, which is controlled via the RSM. The MTA unit accepts TA busses from up to five RLM frames (4 busses per frame), for a total of 20. Refer to 297-2101-116 for details of the line testing equipment and procedures. The relationship between the RLM, the RSM and the MTA unit is described in Chapter 7.

6 **RSM Maintenance.** Each RSM is accessible to a Repair Service Bureau (RSB) via Test Trunks to the Trunk Test Position (TTP). The circuit cards in the RSM shelves (including the DIGITONE receiver cards used in the ESA option) can be tested using the TTP facilities described in 297-1001-116 (Manual Trunk Testing), and 297-1001-121 (Automatic Trunk Testing). The commands necessary to implement these tests are described in the Trunk Subsystem Man-Machine Interface (297-1001-516).

Maintenance Status. The maintenance status of each RLM bay, up to the line circuits, is reported to the host office maintenance system, which displays the state of the RLM circuits (‘In Service’, ‘System Busy’, or ‘Man Busy’) under the ‘PM’ header on the Visual Display Unit (VDU). The RLM bay performs various tests on itself when instructed to do so by the host office CC. If test results show faults of sufficient severity, the CC would declare the RLM bay ‘System Busy’, and ‘take-over’ by the mate RLM bay would occur. The various types of RLM faults which can occur are reported to the host office log system, and appear as output reports. Refer to 297-1001-510 for details of output reports. Refer to 297-1001-106 for details of the host office maintenance system, and to 297-1001-110 for details of the Maintenance and Administrative Position (MAP), of which the VDU is a part. The commands and responses required to obtain status information on an RLM via the MAP are described in detail in 297-1001-515.

The status of the subscriber’s loop and the analog portion of the line card circuit connected to the loop is displayed under the ‘Lns’ header of the host office maintenance system, using the Line Test Position (L TP) described in 297-2101-116. See also 297-2101-516 for associated commands and responses.

Some of the ‘PM’ and ‘Lns’ reports to the maintenance system are associated with alarm conditions ranging in severity from ‘minor’ to ‘critical’. The association of RLM status to alarm conditions is described in 297-1001-515. The following alarm situations are detected by the RLM and reported to the host office:

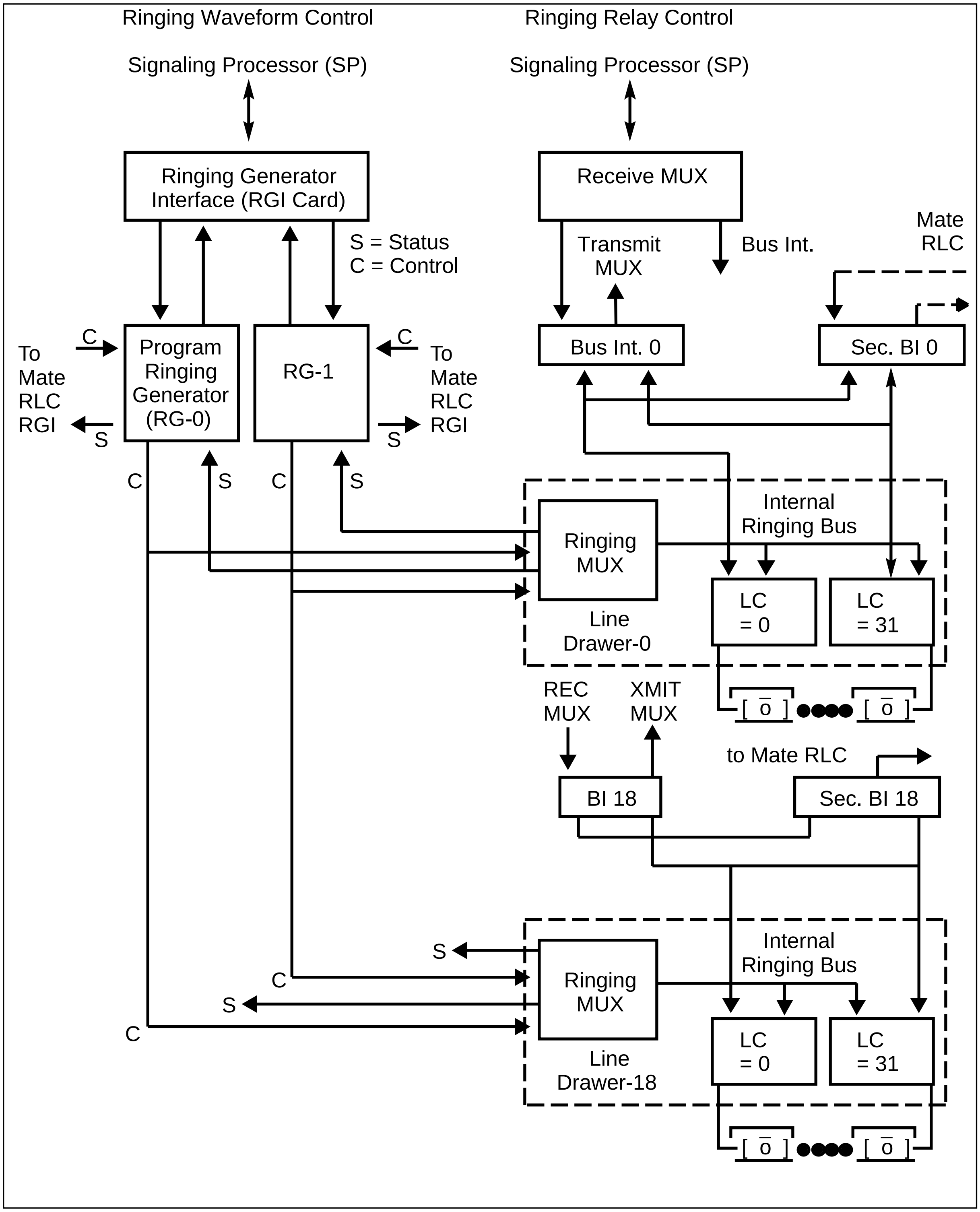
- Digital link trouble (error rate threshold, loss of sync)
- DS-1 interface failure
- RLM hardware and firmware failures

Other Alarm conditions at the remote site (such as FSP aisle alarm) are detected by ‘scan’ circuits in the RSM and reported via the RLC to the maintenance system. These conditions appear under the ‘Ext’ header on the host office VDU. Refer to 297-1001-122 for details of the host office alarm system.

Ringing

Refer to Figure 4-3 on page 4-10. Ringing in the RLM is generated and applied separately from speech and control signals. In each RLM bay, there are two programmable generators which can output a variety of ringing waveforms on receipt of a suitable drive signal. When ringing is to be applied to a subscriber’s loop, the Signaling Processor loads the appropriate code for the desired ringing waveform into the Ringing Generator Interface (RGI) card. This card drives the Programmable Ringing Generators (RG-0, RG-1) to output the selected ringing waveform. The Ringing Multiplexer in the Line Drawer where the line circuit to the called subscriber is located, is instructed to connect the drawer’s internal ringing bus to the output of one of the Programmable Ringing Generators. The ringing relay on the line circuit that serves the called subscriber is then operated via the bi-directional bus from the Bus Interface. Commands that control the ringing relays on the line circuits and ringing multiplexers originate in the Master Processor and are output by the Signaling Processor, via the Receive MUX and Bus Interface.

Figure 4-3xxx
Ringing circuits



The type of ringing scheme which is output by the RG is controlled by entries in the Ring Table in the customer data schema (see 297-2101-451, section 1/115). Also, a suitable type of RGI card is selected to match the ringing scheme, and is installed in the RLC. Available RGI types are as follows:

NT Code	Ringing Scheme
2X27AA	20 Hz Bell
2X27AB	Decimonic MF
2X27AC	Harmonic MF
2X27AD	Synchronomic 16 Hz
2X27AE	Synchronomic MF

At the end of the ringing phase (when the called subscriber goes off-hook), the ringing relay is released by another command. The programmable ringing generator can now be re-programmed to output another type of waveform (e.g., coin control voltage) if required. Since the ringing load is shared between the two Programmable Ringing Generators, on the next command the ringing multiplexer may be instructed to connect to the output of the other generator.

Refer to Figure 4-4 on page 4-13. State 1 shows the normal operation of the ringing circuits, as just described, with the RLC of each bay controlling its own RGI and RG, via its own SP. The RGI card in each bay contains two RGI circuits (RGI-0, RGI-1), which provide interfaces between RG-0 and RG-1 respectively.

States 2 and 3 show a situation where, due to a fault in Bay 1, the RLC in Bay-0 has received a takeover command from the CC. RG-0 and RG-1 in Bay-1 are still operable, because they contain their own power supplies, but control signals via the SP and RGI card in Bay-1 are not available. The SP in Bay-0 selects at random, one or the other of its RGI circuits (RGI-0 or RGI-1) to control one of the RG in Bay 1.

State 2 shows the condition where Bay-0 is using its RGI-1 to control RG-1 in Bay-1, and RGI-0 to control its own RG-0. State 3 shows the opposite condition with Bay-0 using RGI-0 to control RG-0 in Bay-1, and RGI-1 to control its own RG-1.

A similar pair of situations occurs oppositely if Bay-1 takes over Bay-0. In all takeover situations, only two out of the four RG in the two RLM bays are operable as long as the takeover is in effect. All the possible RG and RGI states are tabulated and described in detail from the maintenance point of view in 297-1001-515.

Each programmable ringing generator card also contains sensor and protection circuits which send status signals back to the Ringing Generator Interface card. The status signals are available to the Signaling Processor for action or information as required. The sensor is used for the ANI test, the coin-present test, and the loop-to-ground resistance test. The protection circuits monitor current and voltage on the ringing busses, and will turn off the ringing generator if either becomes excessive. This condition is designated as the ‘shutback’ mode of the ringing generator, and causes a fault report to appear under the ‘PM’ header of the MAP. (See ‘Maintenance Status’.)

Figure 4-4xxx
RGI and RG takeover states

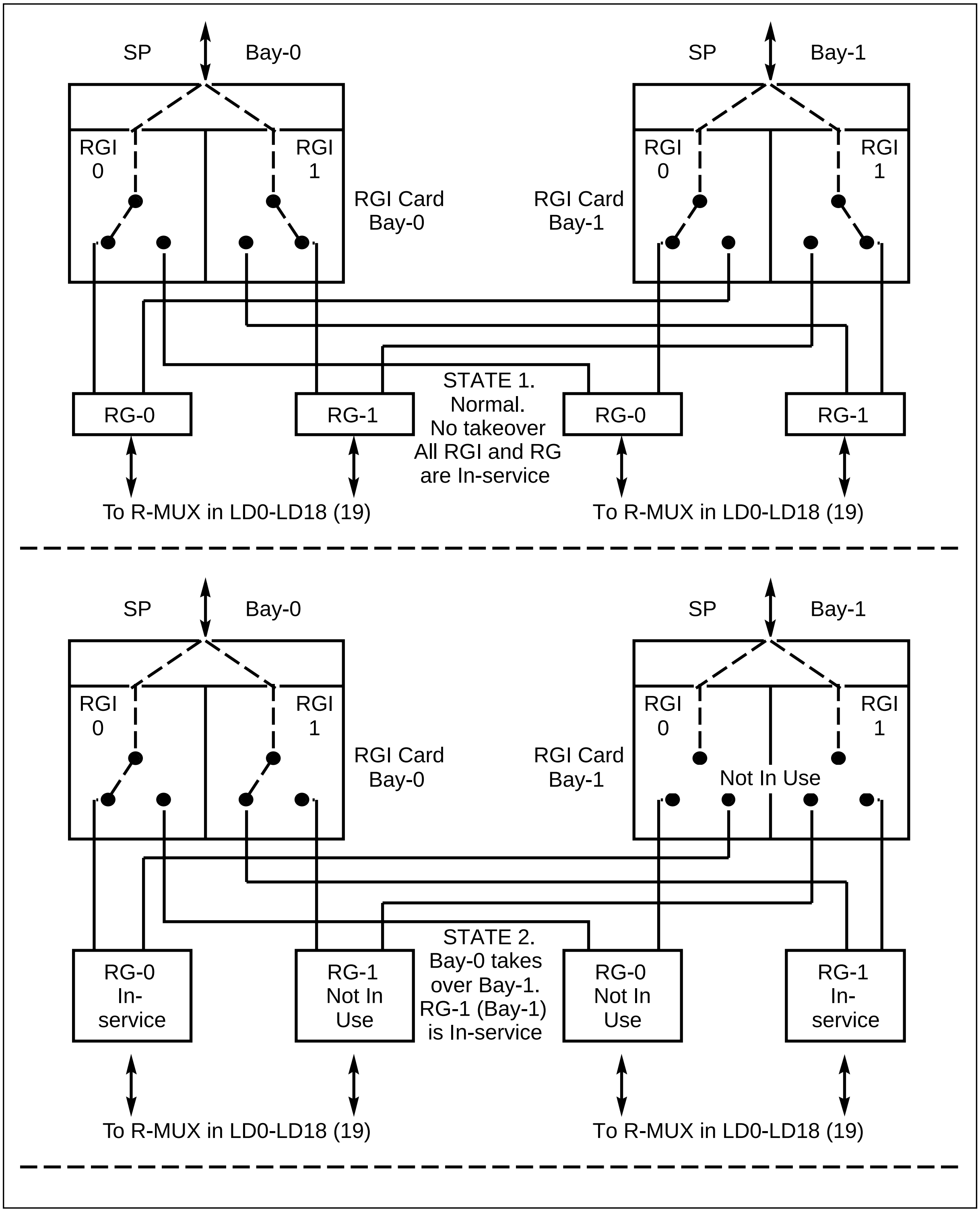
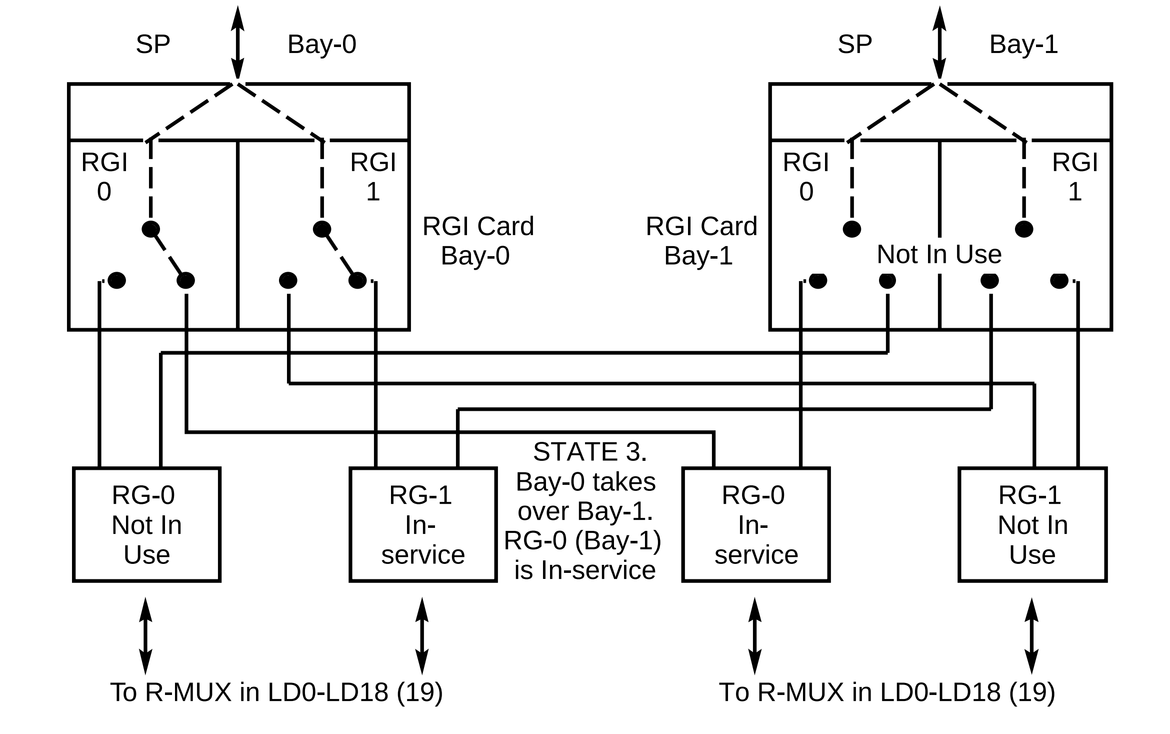


Figure 4-4xxx
RGI and RG takeover states (continued)



Remote line controller (RLC) description

RLC shelf layout

Refer to Figure 5-1 on page 5-3. The following functions described in OPERATION are located in the RLC shelf as plug-in printed circuit cards. The hardware identities of the cards closely parallel their functions, except that some cards contain additional circuits and perform functions not yet mentioned. From left to right (front view) the RLC shelf card assignments, and their Northern Telecom product codes, are:

1 **+24V Converter and Ringing Generator NT2X05AA (qty 2).** In addition to performing the functions of Programmable Ringing Generators -0 and -1, these cards each contain a power converter section. The power converter circuits receive the office battery input from the Power Distribution Center (PDC) and convert it to +24V for relays and other circuits in the RLM. Power distribution to the RLM from the PDC is similar to LM power distribution, described in 297-1001-156. The ringing generator section is capable of any output in the range of 0 to ±240V, dc to 60 Hz, as directed by commands from the signaling processor via the RGI. Details of this card are contained in GS2X05.

2 **Ringing Generator Interface. NT2X27AA-AE.** Function is as described in OPERATION. Provides an interface between the Signaling Processor and the Ringing Generators. Also contains the activity monitoring circuit.

3 **Signaling Processor. NT2X24AB.** Function is as described in OPERATION and in RLC PROCESSOR HIERARCHY .

4 **Signaling Processor Interface. NT2X25AB.** Provides an interface between the Signaling Processor, the Receive and Transmit MUX and the Connection memory. Handles the insertion and extraction of signaling information into and from the terminal digroups.

5 **Extension Memory (Optional). NT3X49AA.** Provides extra memory capability for the Master Processor when the ESA option is in use.

6 **Master Processor. NT2X26AB.** Function is as described in OPERATION and in RLC PROCESSOR HIERARCHY .

7 **HDLC Message Processor. NT3X47AA.** Function is as described in OPERATION and in RLC PROCESSOR HIERARCHY . Also houses the UART which operates the IBML to the mate RLC.

8 **DS1 Interface. NT3X48AA.** One or two cards, depending on the number of DS1 or MRLM links required (2 links per card). Function is as described in OPERATION. Each card provides two ports to the DS1 or MRLM links.

9 **Connection Memory, Transmit MUX, and Optional Time/Space Switch. NT2X22AB.** These functions are combined on one hardware unit. The Time/Space switch function is required only if intra-bay (IA) link option is to be used, and is activated when the proper software is present. Other functions are as described in OPERATION.

10 **Receive MUX. NT2X23AA.** The Receive MUX functions as described in OPERATION.

11 **Terminal Address Interface and Tone Generator. NT2X21AA-AC.** Combined on one hardware unit, but operate independently. The Terminal Address Interface functions as described in OPERATION. The Tone Generator contains the audible tones encoded digitally in a ROM. Tones are applied as required via the R-MUX, under control of the Signaling Processor.

12 **Power Converter. NT2X70AA.** Provides multi-purpose DC voltages (± 12V, ±5V) from an office battery feed via the PDC (see 297-1001-156). Refer to GS2X70 for details of this card.

Figure 5-1xxx
Remote line controller (RLC) shelf layout

Card Position		NT Product Code
1.	+24V Power Converter and Ringing Generator	NT2X05AA
2.	+24V Power Converter and Ringing Generator	NT2X05AA
3.	Ringing Generator Interface	NT2X27AA-AE
4.	Signaling Processor	NT2X24AB
5.	Signaling Processor Interface	NT2X25AB
6.		
* 7.	RLM Extension Memory	NT3X49AA
8.	RLM Master Processor	NT2X26AB
9.	RLM Message Controller	NT3X47AA
10.	DS1 Interface	NT3X48AA
11.	DS1 Interface	NT3X48AA
** 12.	RLM Connect. Mem., T-MUX, Time/Space Switch	NT2X22AB
13.	Receive Multiplexer (R-MUX)	NT2X23AA
14.		
15.	Terminal Address Interface & Tone Generator	NT2X21AA, AC
16.	±5V/±12V Power Converter	NT2X70AA

* Extension memory required for ESA option only.
** Time/Space Switch active only when Intra-Bay (IA) Link software is present.

RLC processor hierarchy

Refer to Figure 5-2 on page 5-5. The three processors in the RLC operate as a hierarchy with the Master Processor being at the highest level, and the two other processors operating under instructions from the Master Processor. The subordinate processors each issue subsidiary instructions to control those functions within their own fields of activity.

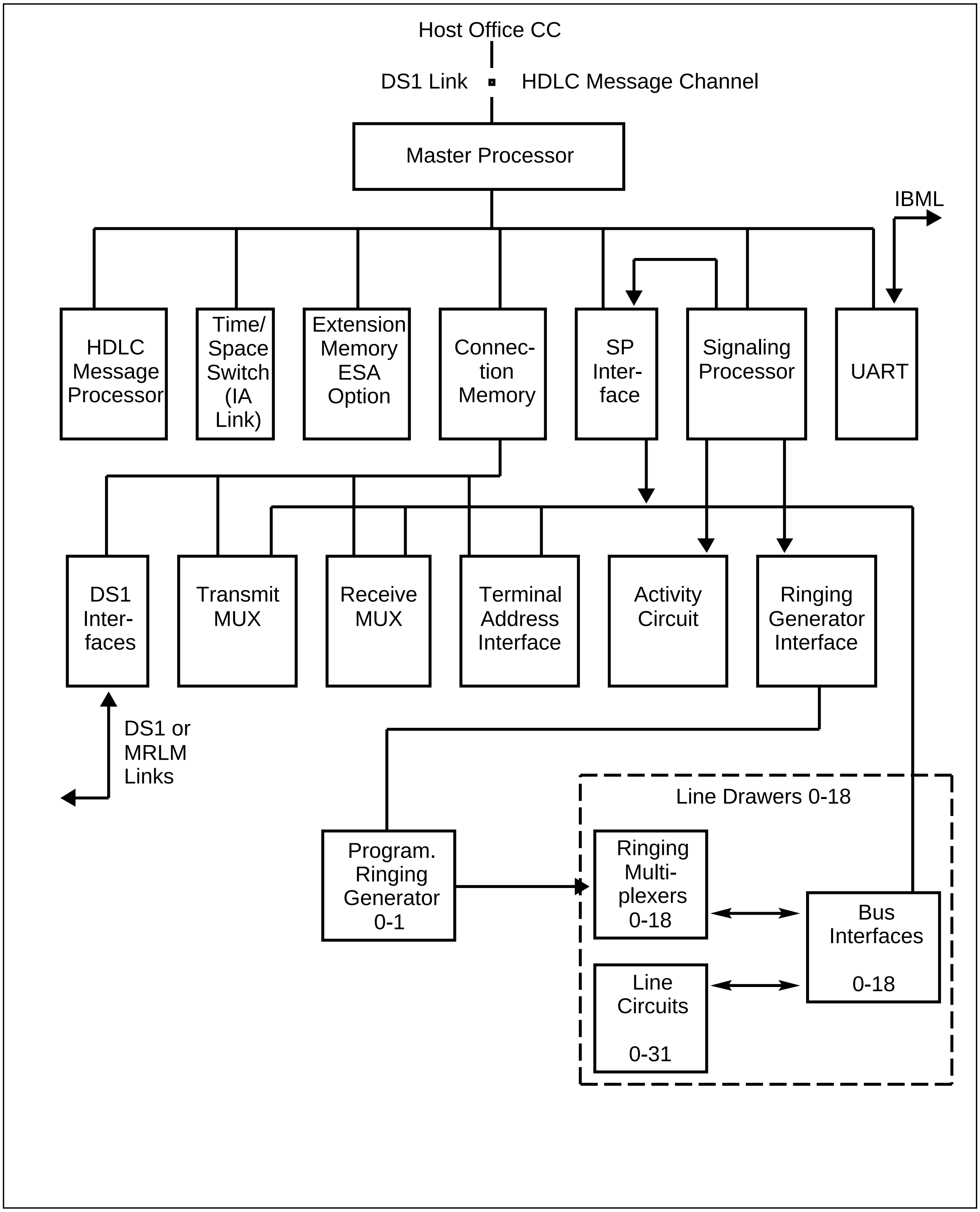
Master processor

The Master Processor is the only processor in the RLC which communicates directly with the CC in the host office. This processor contains the instruction sets (execs.) which implement the tasks assigned to the RLM by the CC software. (See Chapter 1. PURPOSE). The Master Processor carries out, under instructions from the CC, all high level tasks. It executes routines that control the processing and supervision of a call. It sends instructions to subordinate units to control hardware, and it receives reports about messages received or events observed in the hardware. It controls maintenance and traffic measurement activities.

The Master Processor is a microprocessor unit with 80 Kbytes of dynamic Random Access Memory (RAM) and 2 Kbytes of Erasable Programmable Read-Only Memory (EPROM). For the ESA option, its memory is expanded by adding the Memory Extension card containing 64 Kbytes of additional memory capability.

Directly subordinate to the Master Processor are the HDLC Message Processor, the UART, the Signaling Processor (SP) and the Connection Memory (CM).

Figure 5-2xxx
Hierarchic diagram of the remote line controller (RLC)



HDLC message processor

The HDLC Message Processor is the interface between the Master Processor and the message channel to the CC in the host office. In addition, it handles the reception and transmission of PP to PP messages between the RLM and other connected PM via the host office DCM-R. These tasks are performed by a processor section and a controller (HDLC) section. Also included are timing and control circuits which provide synchronization between the RLM circuits (2.56 MHz) and the clock signal extracted from the DS1 links (1.544 MHz). The processor section contains a microprocessor unit with 8 Kbytes of EPROM, 2 Kbytes of RAM, 1 Kbyte of which is mutually accessible to the MP and is used for inter-processor communication.

Communication with the CC in the host office takes place over channel 1 of one of the DS1 links. The HDLC section selects the appropriate communication link and implements the reception of messages from the CC to the MP, and the transmission of reports from the MP to the CC. The exchange of messages is governed by the protocol described in 297-1001-104 (I/O Message System).

Signaling processor

The Signaling Processor (SP) is the interface between the Master Processor and the control circuits in the line side of the RLM. Through the SP, the line circuits, ringing multiplexers, programmable ringing generators and the activity circuit are controlled, and their status is reported.

The SP consists of a microprocessor with 2 Kbytes of EPROM, 11 Kbytes of private RAM and 1 Kbyte of RAM as an interface to the Master Processor. The SP can interrupt the Master Processor and can be reset by it.

To control the subordinate hardware, the SP operates in three functional areas:

1 Line circuit control. Via the SP Interface and Bus Interface cards.

2 Programmable Ringing Generator Control. Via the Ringing Generator Interface.

3 Activity Control. Via the activity circuit and sanity timer .

Line circuit cards

General

The Line Circuit (LC) card is the final interface between the subscriber 's line and the RLM digital circuitry. The location of the LC in the Line Drawers is illustrated in Figure 3-3 on page 3-6 and Figure 3-4 on page 3-7 (depending on LD type) and, the functional relationship of the LC to the RLM is illustrated in Figure 4-2 on page 4-4.

Through the LC, office battery and control voltages, ringing and tones are applied to the loop; loop status is supervised; outgoing speech samples are converted to analog waveforms (and vice-versa) and test access is realized. Loop loss control is exercised by remote selection of loss pads in the digital/analog (receive) speech path (range 0-7 dB in 1 dB steps). Loop balance is achieved by remotely selecting a balance network to match the cable type.

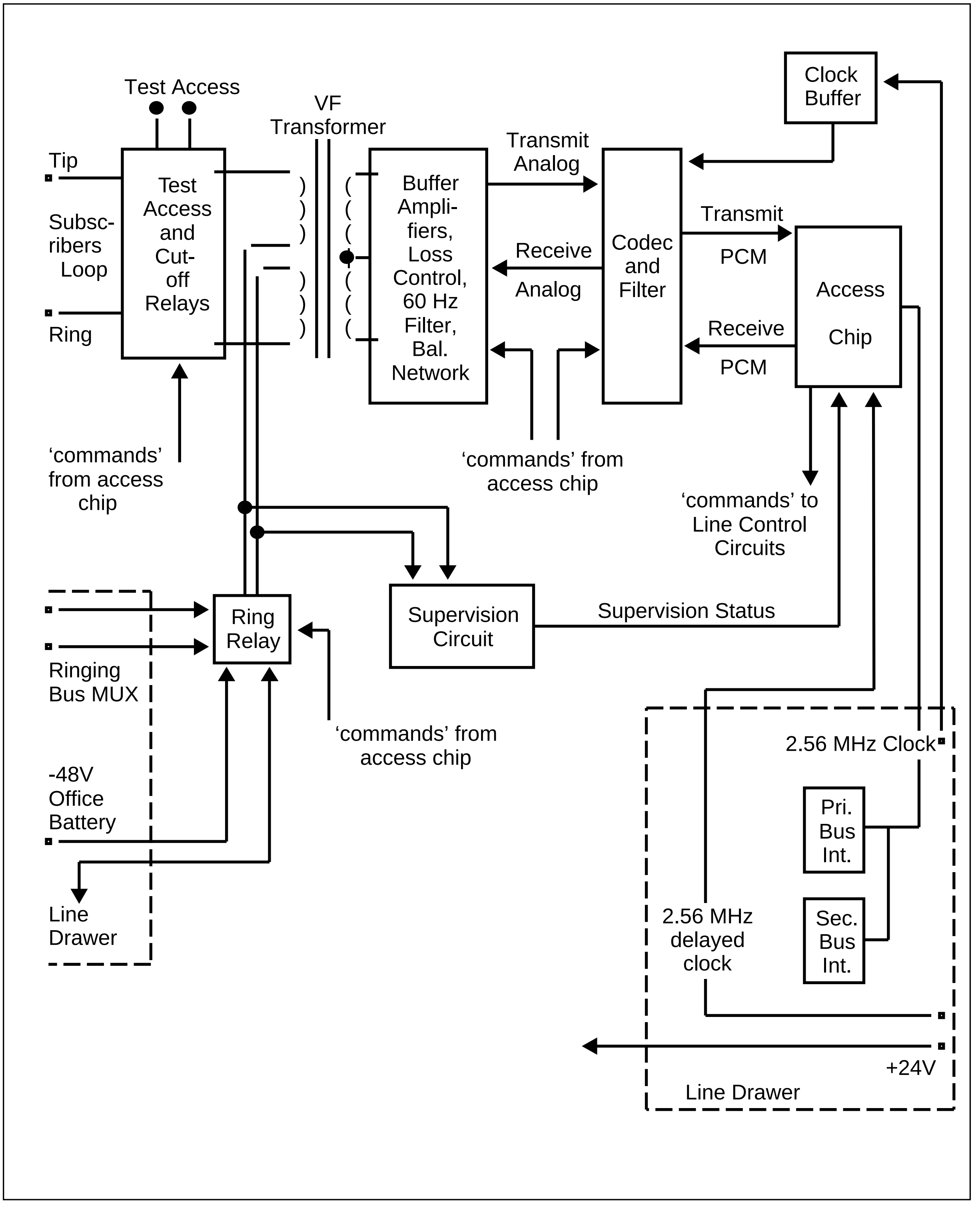
Line circuit types

Two types of line circuits are available for use in the LD. Card types are interchangeable and can be mixed in any LD to meet the office provisioning requirements. The most typical LC is the Type A line circuit, which is covered in simplified form in the following description. The Type B line circuit operates similarly, but has additional circuitry to enable it to operate with more sophisticated subscriber equipment such as ground-start/loop-start coin-operated apparatus and PABX. Refer to GS2X17 for details of the features and characteristics of the Type A line circuit, and to GS2X18 for the Type B line circuit.

Typical line circuit

Refer to Figure 6-1 on page 6-2. The subscriber's loop is connected to the Tip and Ring terminals of the line circuit analog side. The digital side of the line circuit interfaces with the Line Drawer bi-directional bus to the bus interface cards. The other Line Drawer connections are to office battery and ringing bus MUX. The metallic test access points, for bridged monitor or test-out, are connected to the TA busses (see Chapter 4). Bridged monitor enables test access to the VF transformer and subscriber loop leads. Test-out enables the subscriber's loop only to be accessed.

Figure 6-1xxx
Typical line circuit - Simplified block diagram



The RLM bay communicates with its line circuits over the bi-directional bus. The line circuit access chip is normally in the 'receive' state. Data is sent to a line circuit via the bus interface in the associated line drawer. The data consists of 10 bits, of which the first bit is 0 and serves as the 'start' bit. The second bit is the 'mode' bit, which indicates whether the next 8 bits are to be interpreted as PCM speech (mode = 0) or as control (mode = 1). In speech mode, these 8 data bits are directed by the access chip to the codec and filter for transformation into analog speech signals. In the control mode, the 8 bits are divided into two groups of four bits. The most significant four bits are an address which selects the group of commands, and the least significant four bits select one command out of the group specified in the address.

The control codes are latched into registers in the access chip, and output command signals to components within the LC. In the following examples of typical control codes, the 8-bit code is expressed as a two-digit hexadecimal (HEX) number, where the left digit represents the most significant four bits (group address), and the right digit the least significant four bits (command selection).

Hex. code

Address	Command	Group	Operation
2	6	LOSS CONTROL	Select 0 dB loss
2	E	LOSS CONTROL	Select 1 dB loss
2	2	LOSS CONTROL	Select 2 dB loss
2	A	LOSS CONTROL	Select 3 dB loss
2	4	LOSS CONTROL	Select 4 dB loss
2	C	LOSS CONTROL	Select 5 dB loss
2	0	LOSS CONTROL	Select 6 dB loss
2	8	LOSS CONTROL	Select 7 dB loss
7	8	BALANCE NETWORK	Select balance network for loaded subscriber loop. When code 78 is not present the nonloaded balance network is selected.
3	8	RELAY CONTROL	Arm ring relay.
3	4	RELAY CONTROL	Operate test access relay for bridged monitor connection.
3	2	RELAY CONTROL	Operate cut-off relay to disconnect subscriber's loop.

Control codes such as the above are generated automatically by the signaling processor whenever the appropriate message is received from the host office CC. The above control codes are typical examples only, and are not a complete list. Actual codes depend on the software load and may differ from the examples.

When the 10th bit has been received, the bi-directional bus goes to the 'transmit' state. The line circuit responds by an output of 10 bits of data from the access chip registers. If the incoming data was PCM speech, the first 8 bits transmitted are also a PCM speech sample of incoming analog speech signals. If the incoming data was a control code, the first 8 bits transmitted are a response from the access chip data register. The 9th bit is not used and the 10th bit indicates the status (off-hook, on-hook) of the subscriber’s line connected to the line circuit.

Remote service module

General

A general description of the purpose of the Remote Service Module (RSM) is contained in Chapters 2 and 3. This part contains details of the relationship of the RSM to the RLM bays and MTA unit, also the physical layout of the RSM shelf. For more details of the RSM refer to GS2X58.

RSM shelf connections

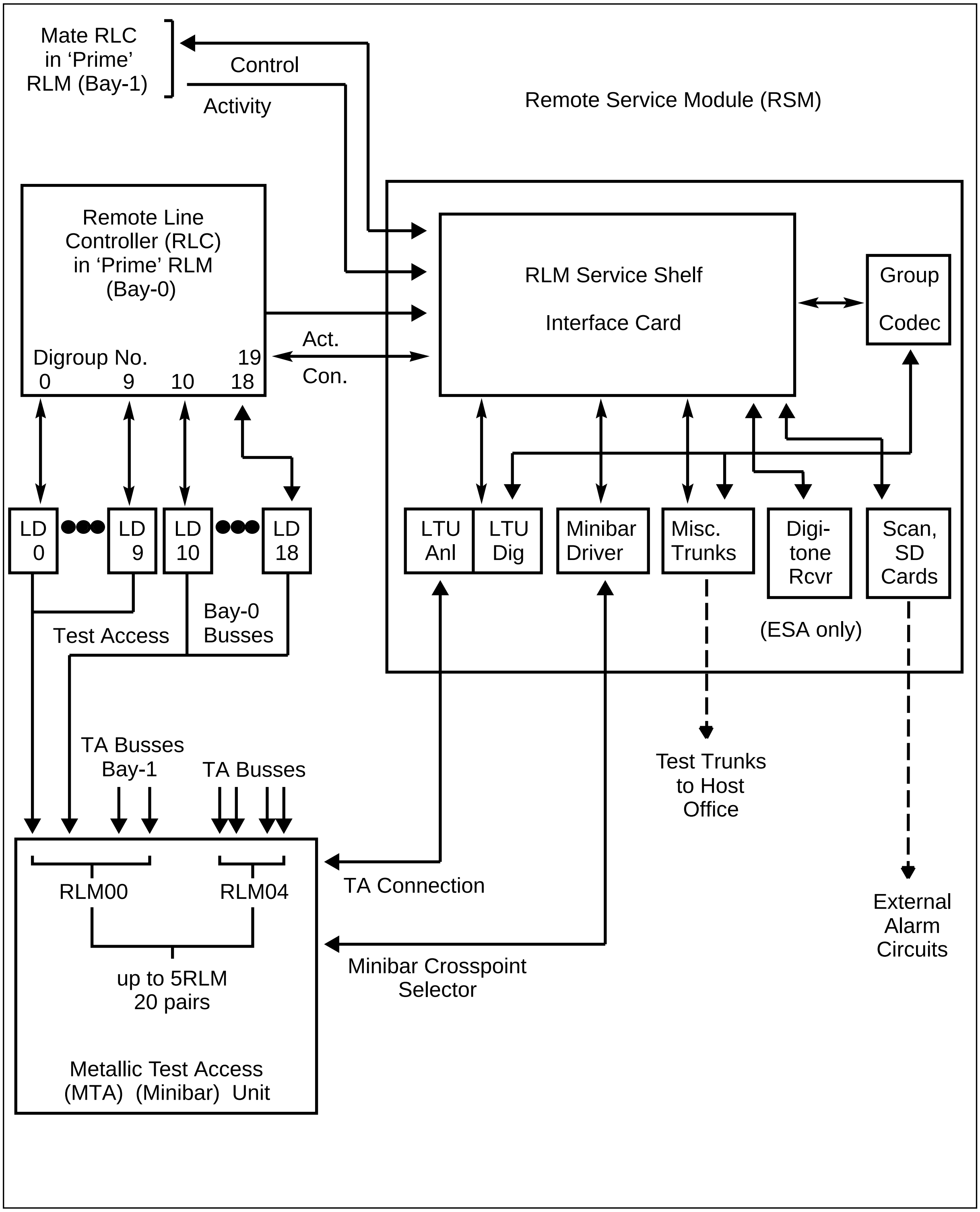
Refer to Figure 7-1 on page 7-2. The RSM operates in conjunction with the Metallic Test Access (MTA) Unit (ref. GS2X46), which it controls. The MTA Unit contains a Minibar switching matrix which provides an interface between the TA busses (four busses per RLM) from a cluster of up to five RLM (00 through 04), and the Line Test Unit (LTU) cards in the RSM.

The RSM itself is controlled via the 20th terminal digroup (¬ 19) of the RLC. Normally, the RLC in the ‘prime’ RLM bay (e.g., bay -0) exercises control of the RSM via the Service Module Interface card in the RSM, but in the event of failure of the RLC, the activity circuit (ref. Chapter 4) causes control to be transferred to the mate RLC in bay -1.

Line test procedures can be performed, and results sent back to the host office CC via the RLC (terminal digroup 19), and the message channel of the first DS1 link. For testing, the Minibar driver card (ref. GS2X50) is instructed, via the service module interface card, to select a specific crosspoint on the MTA unit which is associated with the test access bus to which the group of line drawers containing the line circuit under test is connected. Test conditions are applied by the LTU analog (ref. GS2X10) and LTU digital cards (ref. GS2X11) under control of the service module interface card. The line circuit to be tested is selected by control words addressed to it via its associated BI card. See Chapters 4 and 6.

The RSM also provides a talk monitor circuit using the group codec and test trunk cards. With this circuit, the operation of the speech paths on any selected subscriber’s loop and line circuit can be accessed and checked via test trunks (ref. GS2X90) to the host office.

Figure 7-1xxx
Remote service module (RSM) shelf connections



The signal distribution (SD) cards provide an interface between the RLM digital circuits and external relay-controlled devices at the remote site. The host office CC can activate any relay in the SD card via a message on the DS1 message channel, the RLC digroup -19 and the Service Module Interface card. Each SD card interfaces with up to 14 devices. Ref. GS2X55, 2X57 for details of the SD cards.

The scan cards detect contact states at the remote site, and convey this information to the host office CC via the Service Module Interface card, the RLC and the DS1 message channel. Each scan card interfaces with up to 14 circuits. The main purpose of the scan card is to detect external alarm conditions (e.g., aisle alarm on the FSP). Refer to GS0X10 for details of the scan cards.

ESA option

Refer to Chapter 2, which describes the features of the Emer gency Stand-Alone (ESA) option. With the ESA option, card positions 6 and 7 on the RSM shelf are pre-empted to accommodate a DIGITONE Receiver card (refer to GS2X48 for details). For the ESA option, this card is required to replace the DIGITONE receiver in the host office which has been made inaccessible due to failure of the DS1 links. The common cards in the RSM; the Service Module Interface, the Group Codec, and the Power Converter cards are not pre-empted but any of the others may be. The Minibar Driver, and associated cards may then be located in another RSM shelf or even an adjacent RSE frame. Each RLM with ESA option this requires a dedicated RSM shelf to perform its functions, and the RSM does not service any other RLM.

RSM shelf layout

Refer to Figure 7-2 on page 7-4. The physical locations of the various cards in an RSM shelf vary considerably, depending on the options and number of RLM at the remote site. Provisioning of RSM cards forms part of the job engineering process for each office. The following description covers the common cards that are always provided in fixed shelf locations, and explains the rules applicable to the provisionable cards.

Figure 7-2xxx
Remote service module (RSM) shelf layout

Card Position		NT Product Code
1.	Filler Panel	
2.	Filler Panel	
3.	RLM Service Shelf Interface	NT3X51AA
4.	Group Codec	NT2X59AA
5.	Minibar Driver	NT2X50AB
6.	Digitone (ESA only) ** or any other provisionable cards	NT2X48AB
7.		NT0X10AA
8.	Scan or SD Card	NT2X55, 2X57AA
9.	LTU Analog *	NT2X10AA
10.	LTU Digital *	NT2X11AA
11.	Test Trunk	NT2X90AB
12.		
13.	Provisionable Cards	
14.		
15.		
16.		
17.	Multi-output Power Converter	NT2X09AA
18.		
19.	Filler Panel	
20.	Power Converter 5V, 40A	NT2X06AB
21.		

* LTU Analog card is always in odd-numbered card position.
LTU Digital card is always in the next adjacent position.

** Digitone Receiver Card (ESA option only) must be assigned to card positions 6 and 7.

Card Position Number	NT Product Code	Card Function	Remarks
1, 2		-	Filler faceplates.
3	NT3X51AA	Service Module Interface	This is a common card required for all RSM, and is always located in position 3.
4	NT2X59AA	Group Codec	Common card. Always in position 4.
5	NT2X50AB	Minibar Driver	One card per MTA Unit. Each MTA unit serves one cluster of five double-bay RLM. No restrictions on position, but position 5 is a typical location. The Service Module Interface will accept inputs from several Minibar Driver cards, if more than one 5-RLM cluster is served by the RSM.
6, 7	NT2X48AB	DIGITONE. (ESA only) or Any other provisionable function cards: e.g. NT0X10AA NT2X55AA NT2X57AA	For the ESA option, these positions must be assigned to the DIGITONE card. Each DIGITONE card provides four receiver functions, and physically occupies two card positions. When not required for ESA option, these positions are available for additional provisionable cards.
8	NT0X10AA NT2X55AA NT2X57AA	Scan Card or SD Card	One scan card is always provided for external alarm feedback to the host office. Position 8 is a typical location for scan or SD cards, but provisioning requirements may cause them to be located in any other even-numbered position.
9, 10	NT2X10AA NT2X11AA	LTU Analog LTU Digital	The LTU consists of two provisionable cards, LTU (analog) and LTU (digital) which always operate as a pair in adjacent locations. The LTU (analog) must be located in an odd-numbered card position. In this example, card positions 9 and 10 are used, but other positions which conform to the rules above could be used.
11, 12	NT2X90AB	Test Trunk	One test trunk card is provisioned per LTU pair. Provides talk monitor facilities. Usually positioned next to the LTU pair.

Card Position Number	NT Product Code	Card Function	Remarks
13 thru 16	-	-	Space available for additional provisionable cards.
17, 18	NT2X09AA	Power Converter (Multioutput)	This is a common card which converts office battery to multiple DC outputs for the RSM circuits. Always occupies these two card positions. Refer to GS2X09 for details.
19	-	-	Filler faceplate.
20, 21	NT2X06AA	Power Converter 5V, 40A	This is a common card which converts office battery to a 5V, 40A output for the RSM circuits. Always occupies these two card positions. Refer to GS2X06 for details

List of terms

Abbreviations

ANI
Automatic Number Identification

BI
Bus Interface

CC
Central Control

CM
Connection Memory

CPU
Central Processing Unit

CSM
Channel Supervision Message

DCM-R
Digital Carrier Module-Remote

DMO
Data Modification Order

DMS
Digital Multiplex Switching

DN
Directory Number

DP
Dial Pulse

DS1
Digital Standard-1 (Northern Telecom T-1 carrier system)

EPROM
Erasable Programmable ROM

ESA
Emergency Stand-Alone

FIFO
First In, First Out

FSP
Frame Supervisory Panel

HDLC
High-level Data Link Control

HEX
Hexadecimal

IA
Intra (bay link)

IAS
Intra-Switching

I/O
Input/Output

IBML
Inter-Bay Message Link

LC
Line Circuit

LD
Line Drawer

LM
Line Module

LME
Line Module Equipment (frame)

Lns
Lines (header)

LTP
Line Test Position

LTU
Line Test Unit

MAP
Maintenance and Administrative Position

MTA
Metallic Test Access (unit)

MP
Master Processor

MRLM
Mate RLM (bay link)

MUX
Multiplexer

OM
Operational Measurements

ORR
Office Release Record

PABX
Private Automatic Branch Exchange

PCM
Pulse-Code Modulation

PDC
Power Distribution Centre

PM
Peripheral Module

POTS
Plain Ordinary Telephone Service

PP
Peripheral Processor

RAM
Random Access Memory

RG
Ringing Generator

RGI
Ringing Generator Interface

RLC
Remote Line Controller

RLM
Remote Line Module

R-MUX
Receive Multiplexer

ROH
Receiver Off-Hook (tone)

ROM
Read-Only Memory

RSB
Repair Service Bureau

RSE
Remote Service Equipment (frame)

RSM
Remote Service Module

RTS
Return to Service

SD
Signal Distribution

SP
Signaling Processor

TA
Test Access

TAI
Terminal Address Interface

T-MUX
Transmit Multiplexer

TRD
Terminal Receive Digroup

T/S
Time/Space (switch)

TTD
Terminal Transmit Digroup

UART
Universal Asynchronous Receiver-Transmitter

VDU
Visual Display Unit

VF
Voice Frequency

Appendix A: **RLM channel configurations**

Table 9-1xxx
RLM channel configurations (per bay)

DS1	Speech Chan.		Four RLM Internal Digroups (32 Ch. Per Group)					
			HDLC	Int. Msg	Speech Ch. DS30		Tot. Ch.	Tot. All
Link	Host	MRLM	Chan.	Chan.	IA	Host/MRLM	Speech	Chan.
0	23	0	1	2	6	23	29	32
1	23	0	1	2	6	23	29	32
2	24	0	0	2	6	24	30	32
3	24	0	0	2	6	24	30	32
0	23	0	1	2	6	23	29	32
1	23	0	1	2	6	23	29	32
2	0	24	0	2	6	24	30	32
3	0	24	0	2	6	24	30	32
0	23	0	1	2	6	23	29	32
1	23	0	1	2	6	23	29	32
2	0	24	0	2	6	24	30	32
3	0	0	0	2	30	0	30	32
0	23	0	1	2	6	23	29	32
1	23	0	1	2	6	23	29	32
2	0	0	0	2	30	0	30	32
3	0	0	0	2	30	0	30	32

Page 1 of 1

DMS-100 Family

Remote Line Module (RLM)

Description

Publication number: 297-2101-102
Product release: BCS27 and up
Document release: Standard 01.03
Date: March 1991

Published simultaneously in Canada and the United States by Northern Telecom.

northern telecom