297-1771-130

Digital Switching Systems

DMS-Spectrum Peripheral Module

General Description

SP14 (CSP13/14) Standard 05.06 January 2001

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Digital Switching Systems

DMS-Spectrum Peripheral Module

General Description

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October 2000
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- Added section entitled "Control of SPM carrier provisioning" to Chapter 1, "Introduction", based on feature 59018431.
- Added section entitled "Effects of the roving spare strategy of device maintenance on resource management" to Chapter 5, "Operational characteristics", due to SR 10342332.

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- added SPM Capacity section to Chapter 1, "Introduction"
- updated DSP provisioning section in Chapter 5, "Operational characteristics"
- updated Resource sparing section in Chapter 5, "Operational characteristics"

July 2000

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- Feature 59007841 and SME's email dated April 13, 2000 updated the following figures in Chapter 1, "Introduction:"
  - updated figures, "Position of an SPM in a telecom network" and "Various links of a DMSCP SPM"
  - added figures, "Various links of an IW SPM" and "Various links of an MG4000 SPM"
- SME's email dated April 13 2000 also changed the following:
  - added Figure titles throughout the NTP
  - changed references of Distributed Access (DA) class of SPM to Succession Multi-Service Gateway 4000 (MG4000)
  - updated DMSCP and ATM information in Chapter 1, "Introduction," and Chapter 2, "Functional Description"

January 2000

Standard 03.02 for release with SPM12 (CSP12). The following list provides the updates for this release:

- Added more updates based on SR 50134298.
- Corrected the minimum and maximum numbers of VSP required for the ECAN capability in Chapter 5, "Operational characteristics."

December 1999

Preliminary 03.01 for release with SPM12 (CSP12). The following list provides the updates for this release:

- Feature 59007814 introduces two types of SPMs called classes in Chapter 1, "Introduction:" InterWorking (IW) SPM class and Succession Multi-Service Gateway 4000 (MG4000) SPM class.

  Note: With the introduction of the two additional SPM classes, the original SPM used for call processing on the DMS switch is either referred to as SPM or DMSCP SPM class in this NTP.

- Chapter 1, "Introduction," provides two new figures showing the position of the IW and MG4000 classes of SPMs on the DMS switch.

- Feature 60006714 provides enhanced echo cancellation (ECAN) capability available with the SPMECMON command in Chapter 5, “Operational characteristics."
- Added editorial changes based on SR 50134298.

July 1999
Standard 02.03 for release with SPM11 (CSP11).

Made editorial changes

June 1999
Upissued to Preliminary 02.02 to correct the Publication history information for SPM11 (CSP11). The following list provides the correct updates for this release. Updated the following in Chapter 5, “Operational characteristics:"

- echo cancellation (ECAN) capability information
- Clock sychronization section
- Resource module sparing section

June 1999
Preliminary 02.01 for release with SPM11 (CSP11). Incorporated the following changes based on SME comments:

- Corrected DSP and VSP information in Chapter 2, “Functional Description"
- Updated the following in Chapter 2, “Operational characteristics:"
  - ECAN capability information
  - Clock sychronization section
  - Resource module sparing section

February 1999
Standard 01.04 for release with SPM01 (CSP09). The following changes were incorporated:

- Changed the product name to DMS-Spectrum Peripheral Module.
- Added “DSP provisioning rule" to Chapter 5, “Operational characteristics."
- Added “OM reporting" to Chapter 5, “Operational characteristics."

December 1998
Standard 01.03 for release with SPM01 (CSP09). Information about sparing limitations was added to Chapter 5, “Operational characteristics," paragraph heading “Sparing restrictions."

October 1998

Standard 01.02 for release with SPM01 (CSP09). Information about synchronization was added to Chapter 5, “Operational characteristics."

October 1998

Standard 01.01 for release with SPM01 (CSP09).

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About this document

When to use this document

Use this document when you need general information about the DMS-Spectrum Peripheral Module (SPM).

How this document is organized

This document is organized into the following chapters:

- “Introduction" describes the SPM hardware and software in general terms.
- “Functional description" describes what the SPM does in a telecommunications network..
- “Hardware overview" describes the SPM hardware in general terms.
- “Software overview" describes the SPM software in general terms.
- “Operational characteristics" describes how the SPM performs various functions.
- “SONET overview" provides a summary description of the principles of synchronous optical networks (SONET).
- “List of terms" includes definitions of the terms used with the SPM.

How to check the version and issue of this document

The version and issue of the document are indicated by numbers, for example, 01.01.

The first two digits indicate the version. The version number increases each time the document is updated to support a new software release. For example, the first release of a document is 01.01. In the *next* software release cycle, the first release of the same document is 02.01.

The second two digits indicate the issue. The issue number increases each time the document is revised but released again in the *same* software release cycle. For example, the second release of a document in the same software release cycle is 01.02.

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

Related NTPs

Refer to the following documents for more information about SPM:

- *DMS-Spectrum Peripheral Module Asynchrounous Transfer Mode (ATM) General Description,* 297-1771-150
- *DMS-Spectrum Peripheral Module Primary Rate Interface (PRI) General Description,* 297-1771-132
- *DMS-Spectrum Peripheral Module Feature Description Reference Manual*, 297-1771-330
- *DMS-Spectrum Peripheral Module Hardware Maintenance Reference Manual*, 297-1771-550
- *DMS-Spectrum Peripheral Module Commands Reference Manual*, 297-1771-819
- SPM information is also included in the following documents:
  - *Alarm Clearing Procedures*
  - *Card Replacement Procedures*
  - *Data Schema tables*
  - *Logs*
  - *Operational Measurements*
  - *Recovery Procedures*
  - *Routine Maintenance Procedures*
  - *Trouble Locating and Clearing Procedures*

1 Introduction

This chapter describes the DMS-Spectrum Peripheral Module (SPM). After reading this section, you will understand what an SPM is, where it fits into a telecommunications network, and what functions it performs.

The SPM is a set of information processing modules that provide telecommunications switches with direct access to optical carrier (OC) networks. The basic mechanical element of the SPM consists of a dual-shelf assembly that is mounted to a common backplane. A shelf assembly contains two identical shelves. Each shelf can contain up to 15 information-processing modules that plug into the backplane. The backplane provides the electrical inter-connection between the modules. The modules contain circuit packs that perform a variety of functions—from supplying electrical power to providing optical connections to a high-speed transport network. SPM modules also provide some call-processing and high-speed carrier capabilities.

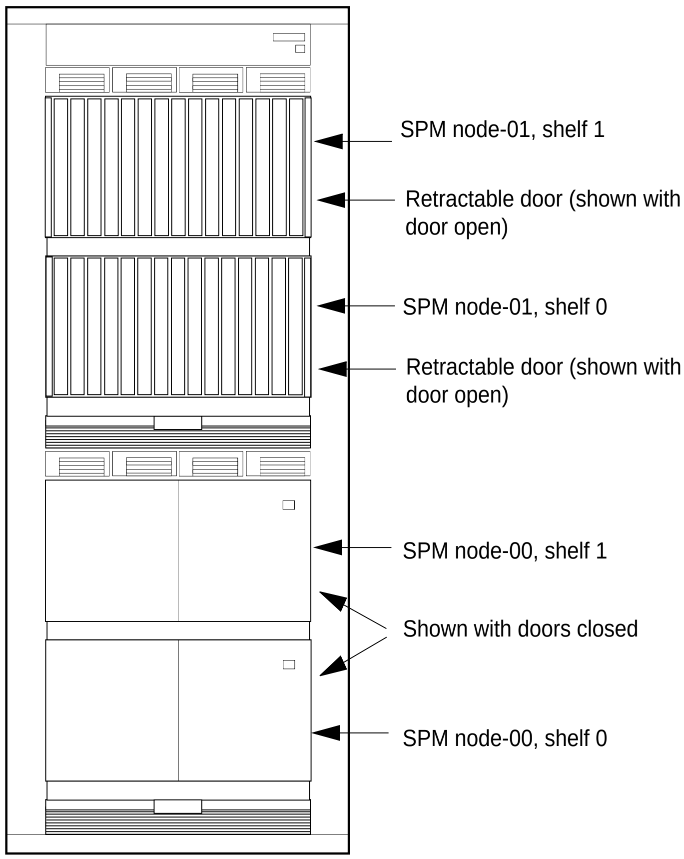
In addition to the SPM used for call processing on the DMS switch, there are two additional types of SPMs called classes.

- InterWorking (IW) SPM class: This type of SPM hosts off the DMS ENET and bridges the ATM traffic into and out of DMS TDM network. The SPM of this class does not perform call processing; it essentially works as a speech path connection server.
- Succession Multi-Service Gateway 4000 (MG4000) SPM class: This type of SPM communicates with the DMS CM through the ATM network, serving as a distributed access point to DMS call processing capability.

Note: With the introduction of the two additional SPM classes, the original SPM used for call processing on the DMS switch is either referred to as SPM or DMSCP SPM class in this NTP.

The dual-shelf assembly of a basic SPM contains all the components required to represent an element or a node in the optical transport network. Therefore, the basic dual-shelf assembly is referred to as an SPM node. A standard telecommunication equipment frame accommodates two dual-shelf assemblies, which provides two SPM nodes.

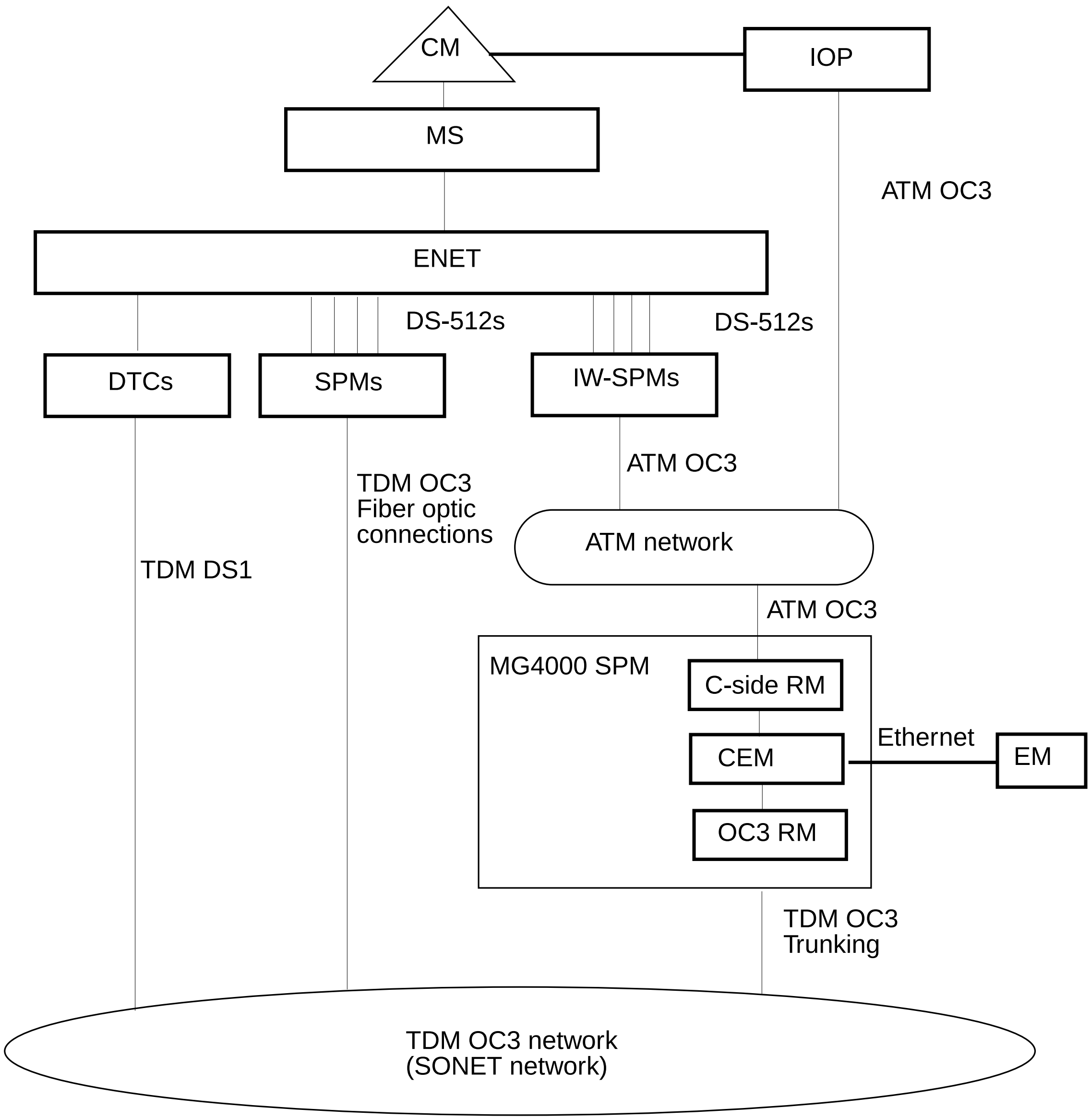
Figure 1-1 Dual-shelf assembly of an SPM



The SPM in a telecom network

In a telecommunications (telecom) network, the SPM is positioned between a telecom switch and the optical carrier (OC) network. Telecom switches are devices like a DMS switch or a GSM wireless switch. The SPM node acts as an interface between a telecom switch and the OC transport network. The OC transport network uses the synchronous optical network (SONET) protocol to transport voice and data traffic to the other telecom switches on the network. The following figure shows the position of SPM nodes in a telecom network.

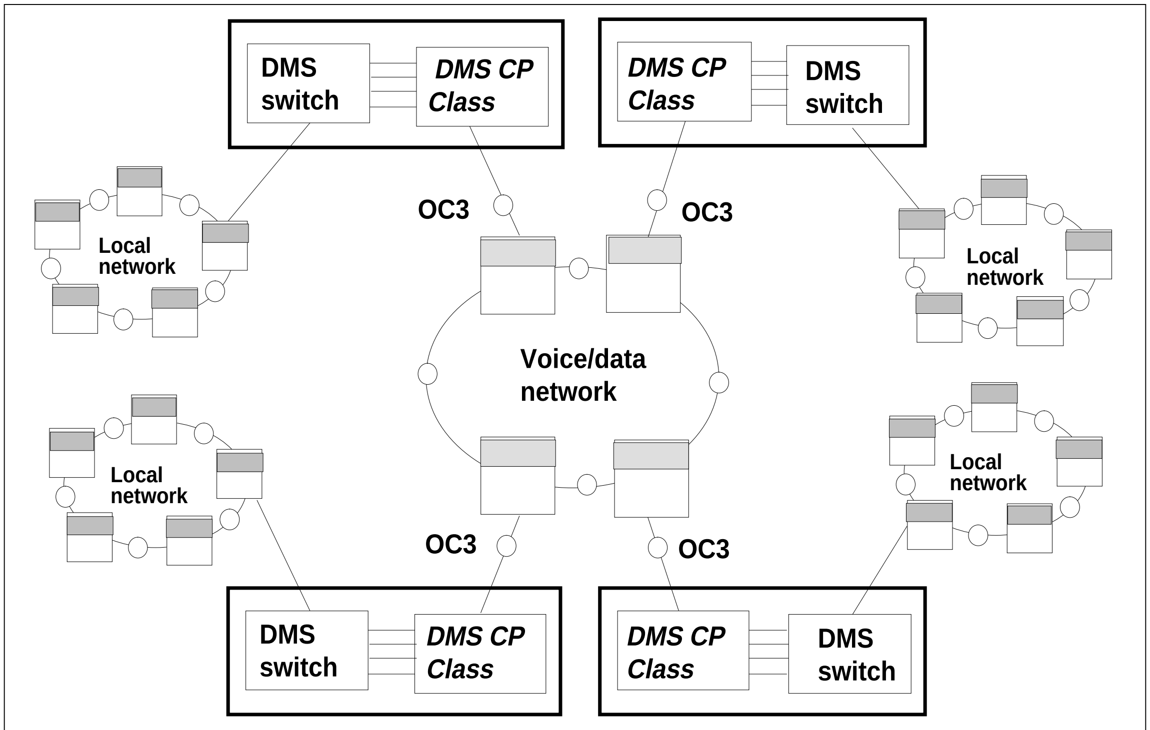
Figure 1-2 Position of an SPM in a telecom network



Using the SPM in a DMS network

The SPM provides a 1 + 1 redundant optical carrier 3 (OC3) trunking interface with integrated echo cancellation (ECAN). The following figure shows the position of the DMS call processing (CP) class of SPM in a DMS switching and transmission network.

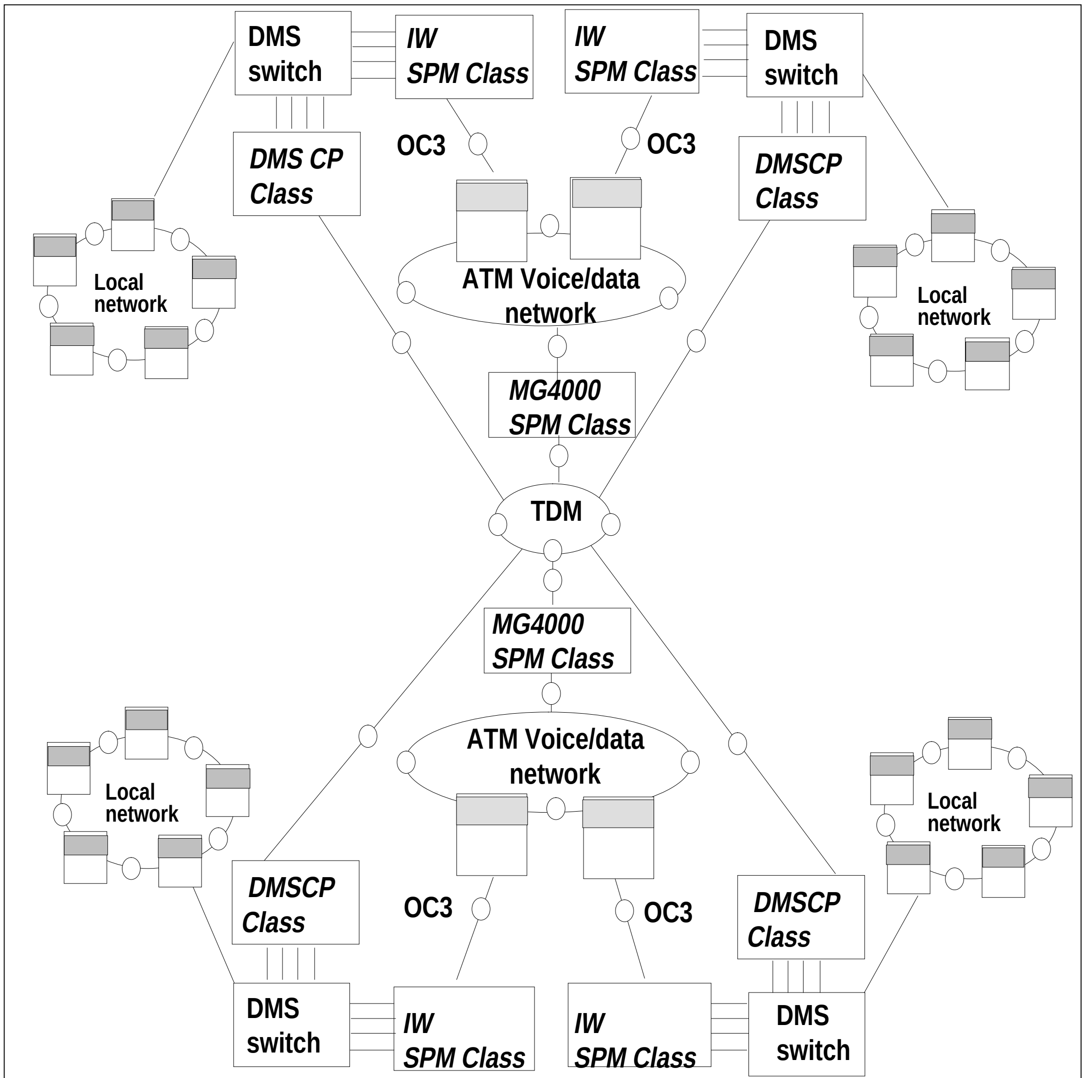
Figure 1-3 DMSCP SPM in a DMS switching and transmission network



Legend:
– **DMSCP SPM class:** DMS call processing SPM class

The following figure shows the position of the InterWorking (IW) class of SPM.

Figure 1-4 IW-SPM in a DMS switching and transmission network

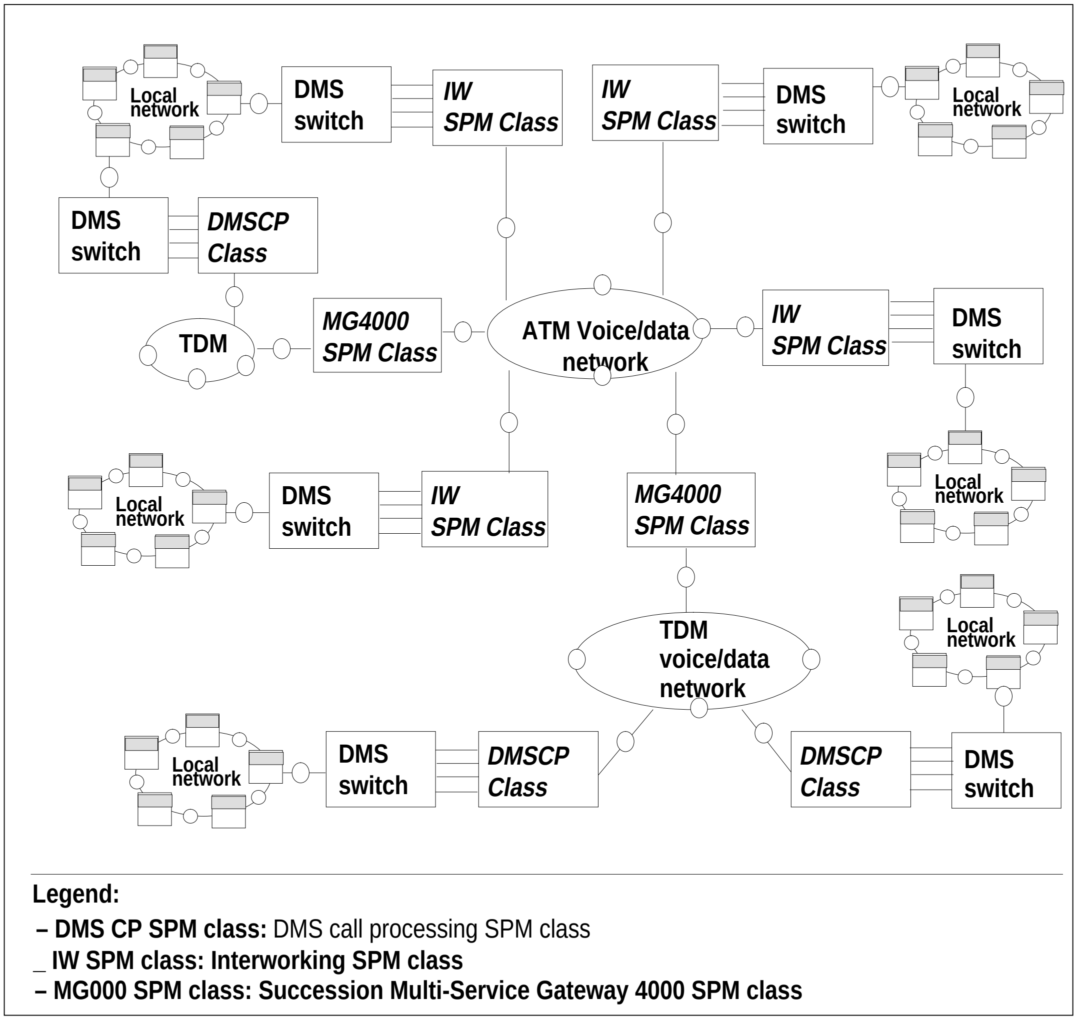


Legend:

- **DMSCP SPM class:** DMS call processing SPM class
- **IW SPM class:** InterWorking SPM class
- **MG000 SPM class:** Succession Multi-Service Gateway 4000 SPM class

The following figure shows the position of the Succession Multi-Service Gateway 4000 (MG4000) class of SPM.

Figure 1-5 MG4000 SPM in a DMS switching and transmission network

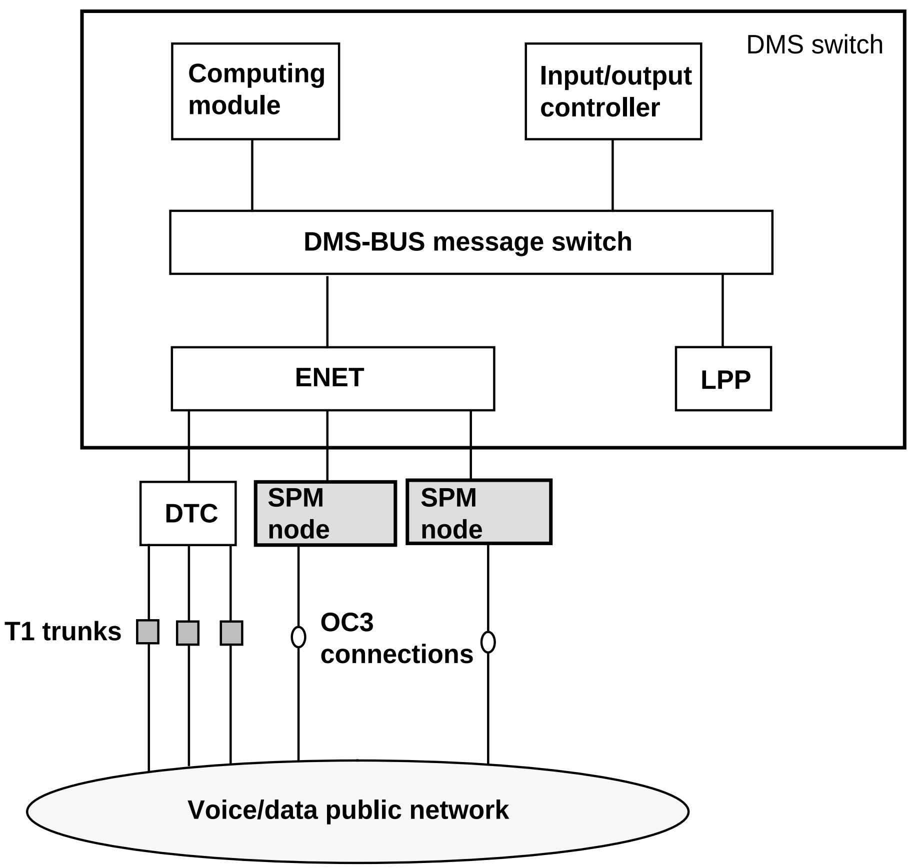


SPM nodes directly terminate an OC3 SONET carrier and feed the individual digital-signal-level-zero (DS-0) traffic from the carrier into the DMS switch.

The DMSCP class SPM occupies a position in the DMS architecture that is similar to that of the digital trunk controller (DTC) peripheral. However, instead of terminating T1 trunks, a DMSCP class SPM node terminates a pair of 1 + 1 redundant OC3 optical-fiber connections. For example, if a DTC supports 20×24 T1 trunks, an SPM node can replace it and support 84×24 T1 trunks. This represents more than four times as many trunks as a single DTC.

The following figure illustrates both the position of the DMSCP class SPM node and the position of the DTC within the DMS switching architecture.

Figure 1-6 The DMSCP class SPM and the DTC within the DMS switching architecture



Legend:
DTC = digital trunk controller
ENET = enhanced network
LPP = link peripheral processor

SPM interface to the DMS switch

The OC3 module in the SPM breaks down the incoming OC3 SONET time division multiplex (TDM) signals into their composite DS-0 timeslots. The OC3 module sends the signals to the 12K-port timeswitch in the SPM common equipment module (CEM). In the DMSCP and IW classes SPMs, the CEM can route the signals to other modules, such as the digital signal processor (DSP) resource modules (RM) on the SPM shelf for additional processing. The CEM can also route the signals directly to the DMS enhanced network (ENET) for call processing. The signals pass through four DS-512 host links that are supported on the DMS switch by an ENET paddleboard. The MG4000 class SPM connects to the ATM switch through the ATM RMs.

The DS-512 links provide the ENET with 2048 channels of bandwidth, which accommodates a full OC3 payload (2016 DS-0 channels) plus the messaging between the SPM node and the DMS computing module (CM). These links provide full communication capability without bandwidth constraints. The following diagram shows the optical links to the external network, the internal electrical links between the various SPM modules, and the optical links to the DMS switch.

Figure 1-7 Various links of a DMSCP SPM

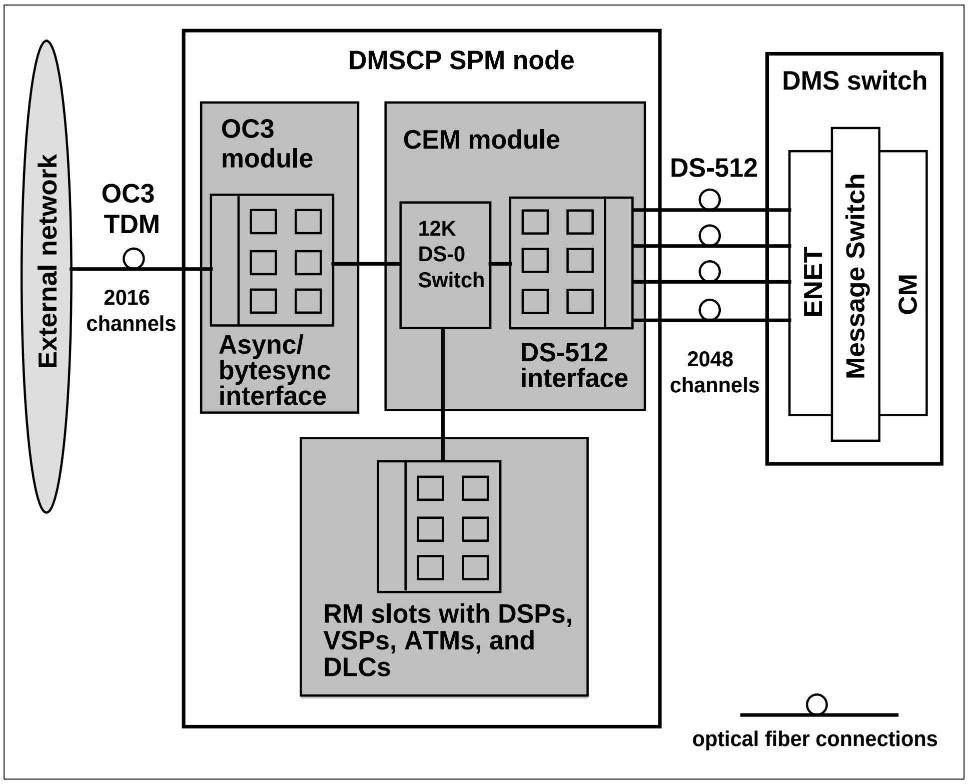


Figure 1-8 Various links of an IW SPM

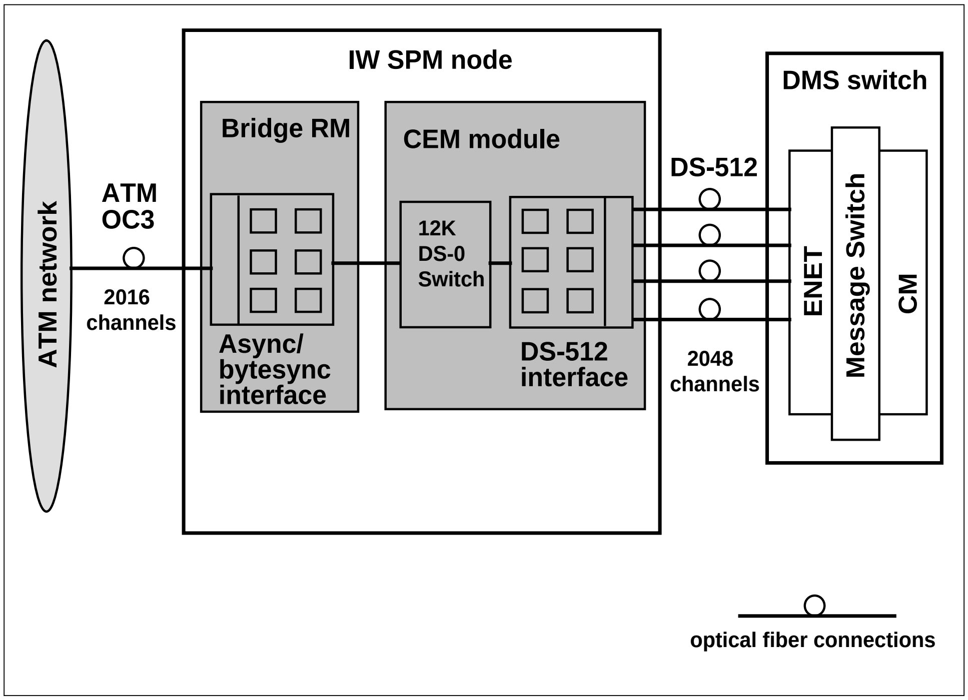
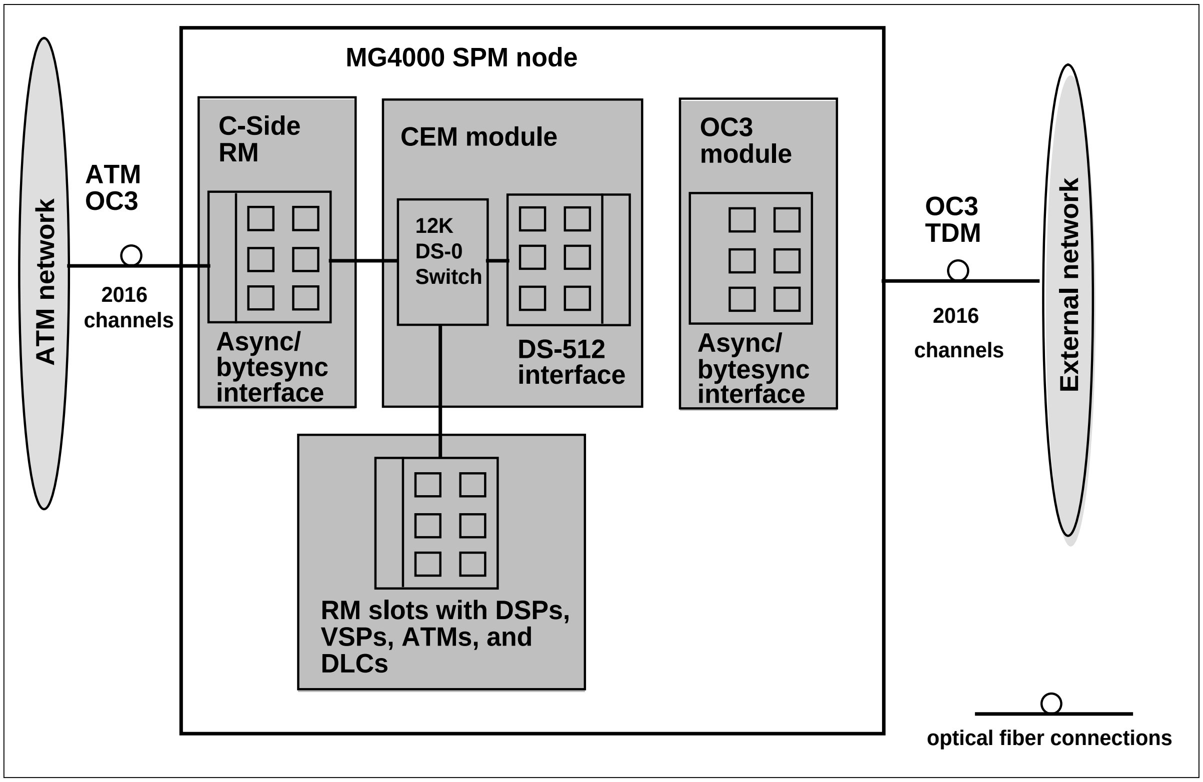


Figure 1-9 Various links of an MG4000 SPM



For more information about SPM modules, refer to the *DMS-Spectrum Peripheral Module Hardware Maintenance Reference Manual* (297-1771-550).

SPM capacity

The SPM supports a call rate of 13.44 half calls per second (h-CPS) for any combination of signaling types. Some examples of those signaling types include ISUP, PTS, and PRI. The 13.44 h-CPS rate can be viewed as corresponding to a typical scenario of 24 calls/port/hour at 0.8 Erlang port utilization level. Any combination of call attempt rate and port utilization that does not exceed 13.44 h-CPS is supported.

A full call corresponds to two half calls (origination and termination). For example, a mix of 50% originations and 50% terminations implies that the 13.44 h-CPS rate corresponds to 6.72 originations/sec and 6.72 terminations/sec on the given SPM. Any mix in the range from 0% originations (100% terminations) to 100% originations (0% terminations), can be supported.

SPM capabilities

The SPM can be equipped with various types of modules to provide a variety of capabilities. Each module contains application specific integrated circuits (ASIC) and other components designed to provide specific capabilities.

SPMs provide

- OC3 interfaces with SONET transport networks
- signal processing
- routine call processing in conjunction with telecom switches like the DMS switch
- replacements for, or adjuncts to, DMS digital trunk controllers (DTC) and ISDN digital trunk controllers (DTCI)
- call processing for ISUP and per trunk signaling (PTS)
- echo cancelling (ECAN) with redundancy features
- an open module-interface that supports integrated modules from licensed third party developers, such as Tellabs and coherent
- tone-generation and reception, and ISUP continuity-test (COT) testing

Control of SPM carrier provisioning

Prior to this feature, a password protected CI command was used to set or query an office wide parameter. The value returned represents the maximum number of SPM DS1P carriers that can be assigned to table MNHSCARR in a given office. This solution was introduced in NA013.

This feature addresses the following requirements to control SPM carrier provisioning:

- Provides the capability for the customer to purchase fewer carriers than the full capacity of the SPMs installed in the office.
- Provides a methodology that allows Nortel to control the number of carriers assigned to SPMs in a single office by way of two new office parameters (SPM_MAX_MSGTRK_CARRIER and SPM_MAX_PRITRK_CARRIER). Office parameter SPM_MAX_MSGTRK_CARRIER controls the provisioned SPM carriers with assigned ISUP and PTS trunks. Office parameter SPM_MAX_PRITRK_CARRIER controls the provisioned SPM carriers with assigned PRI trunks.
- Provides the ability to query the number of SPM carriers assigned with PTS/ISUP or PRI trunks. The total number of SPM carriers provisioned can not exceed the total of the two values set by the office parameters. A local utility CARRUTIL is available to query the maximum number of ISUP/PTS or PRI trunks assigned.
- A warning message is displayed when the value of carriers provisioned reaches 75% of the limit of either office parameter or the total of the two office parameters.
- An error message is displayed when the value of carriers provisioned reaches the maximum limit of either office parameter or the total of the two office parameters.

2 Functional description

This chapter describes the DMS-Spectrum Peripheral Module (SPM) in functional terms. After reading this chapter, you will understand the functional elements of the SPM-system hardware and software, how these elements interact with each other, and how these elements interact with the external network.

SPMs consist of five basic elements: hardware, software, the user interface, connections to a telecom switch, and connections to the transmission network.

- hardware
- software
- user interface
- connections to a telecom switch
- connections to the transmission network

SPM hardware

The SPM platform consists of mechanical shelving and circuit packs contained in modules. All modules share common mechanical features and the modules plug into a dual-shelf assembly with a single backplane, which is designed to fit either an American National Standards Institute (ANSI) or European Telecommunications Standards Institute (ETSI) equipment rack. The two shelves of a dual-shelf assembly contain the basic elements of an SPM node. All the modules are metal-box type enclosures with plastic faceplates. The boxes provide heat dissipation and electromagnetic compatibility (EMC) protection. Each module contains a single printed circuit pack (PCP). The modules connect to the backplane using a pin-and-box connector system. The backplane provides the electrical connections between the various modules on the two shelves of an SPM node. The backplane connections are referred to as serial links (S-links).

SPM hardware provides a fully duplicated architecture that permits a high level of system uptime and fault tolerance. SPM hardware modules consist of

- common equipment modules (CEM)—two modules on each node
- OC3 modules—two modules on each node
- digital signal processor (DSP) resource modules—0 to 24 modules on each node
- voice signal processor (VSP) resource modules—0 to 24 modules on each node
- shelf interface modules (SIM)—one module on each shelf (two on each node)
- blank filler (FIL) modules—0 to 24 on each node
- asynchronous transfer mode (ATM)—2 modules on each node

ATTENTION
The asynchronous transfer mode (ATM) does not apply to all markets.

When SPMs are used with DMS switches, two DMS ENET paddleboards are required to provide the DS-512 links for each SPM node.

The two CEMs use dedicated slots on a lower SPM shelf, and both CEMs are always provisioned. Likewise, the two OC3s also use dedicated slots on a lower shelf and both OC3s are always provisioned. There are also dedicated slots on each shelf for the two shelf interface modules (SIM). ATMs also use dedicated slots. Resource modules (RM) cannot be used in these dedicated slots.

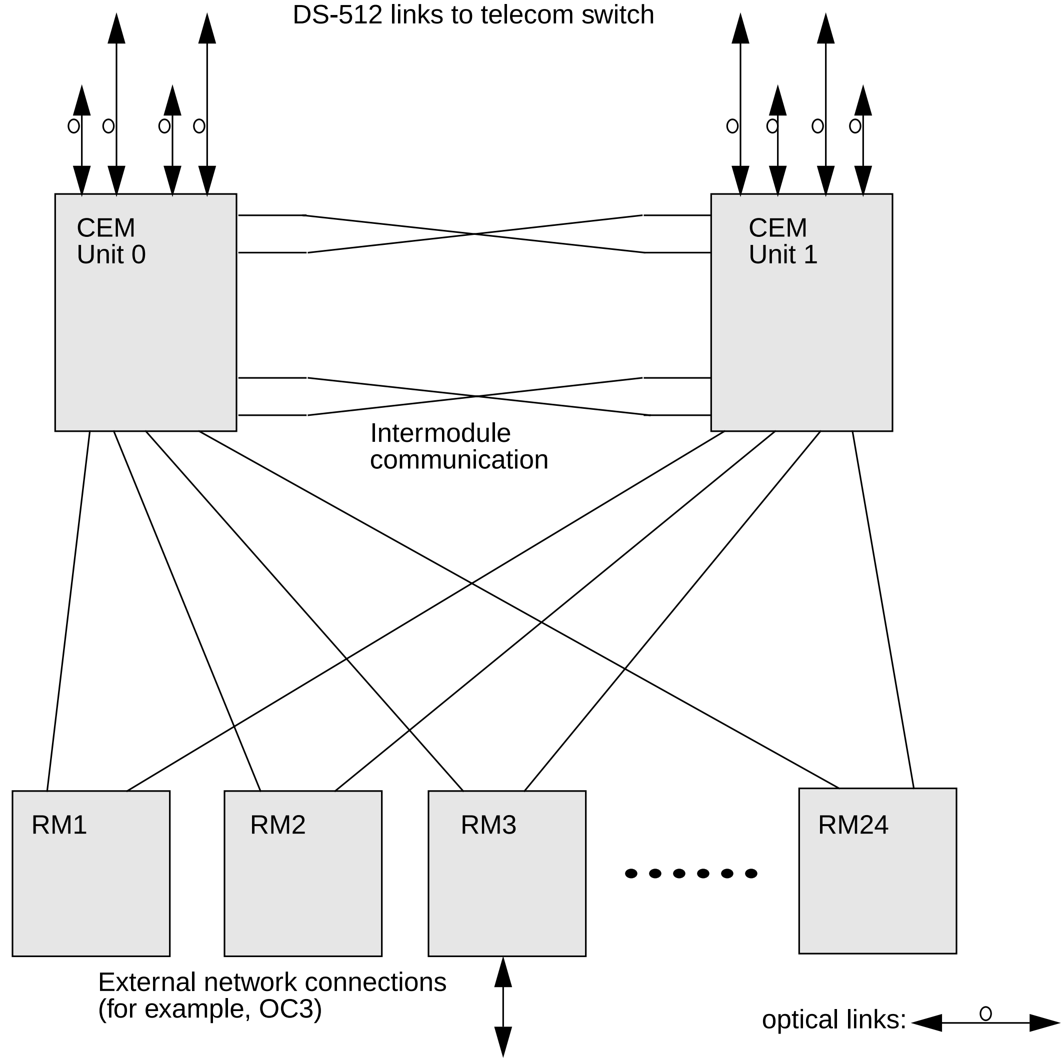
All RM slots have similar physical and logical interfaces. Since all slots (with the exception of CEM, OC3, and SIM) have the same characteristics, RMs can be inserted at random until all slots are occupied.

The SPM architecture is based on duplicated CEMs. Each CEM provides control functions, traffic-switching functions, and half of the redundant DS-512 links to the telecom switch. One CEM is active, that is, actually performing call processing functions, while the other is inactive, but ready to take over if the active unit fails.

Up to 26 RMs can be provisioned to provide an SPM node with the functionality required for a particular application. RMs are connected to the CEMs by the backplane S-links, which results in a point-to-point architecture. Point-to-point architectures provide fault containment and isolation properties that are superior to bus architectures.

The following figure provides an overview of the hardware component interconnections for an SPM node. For more detailed information on individual components, see Chapter 3, “Hardware overview."

Figure 2-1 Hardware component interconnections on an SPM



In addition to transporting payload (pulse code modulation) channels, the S-links also transport messaging channels, overhead control, and status bits between the CEMs and the RMs. Each S-link provides 256 timeslots. Each RM slot has access to three S-links (one S-link cluster), or 768 timeslots. With allowances for overhead, each RM slot is capable of accommodating the bandwidth of a synchronous transport signal level-one (STS-1) or a digital signal level-three (DS-3). Two module slots (slots 9 and 10 on shelf 0) have six extra links (two clusters) each. These two slots can terminate the full OC3 payload bandwidth. These two slots are used exclusively for the OC3 modules and ATM modules.

Each CEM module interconnects with a total of 90 S-links (24 RM slots containing three links each plus two RM slots containing nine links each).

For additional information about SPM hardware, see Chapter 3, “Hardware overview," and refer to the *DMS-Spectrum Peripheral Module Hardware Maintenance Reference Manual* (297-1771-550)

SPM software

The SPM system software consists of the following three major components:

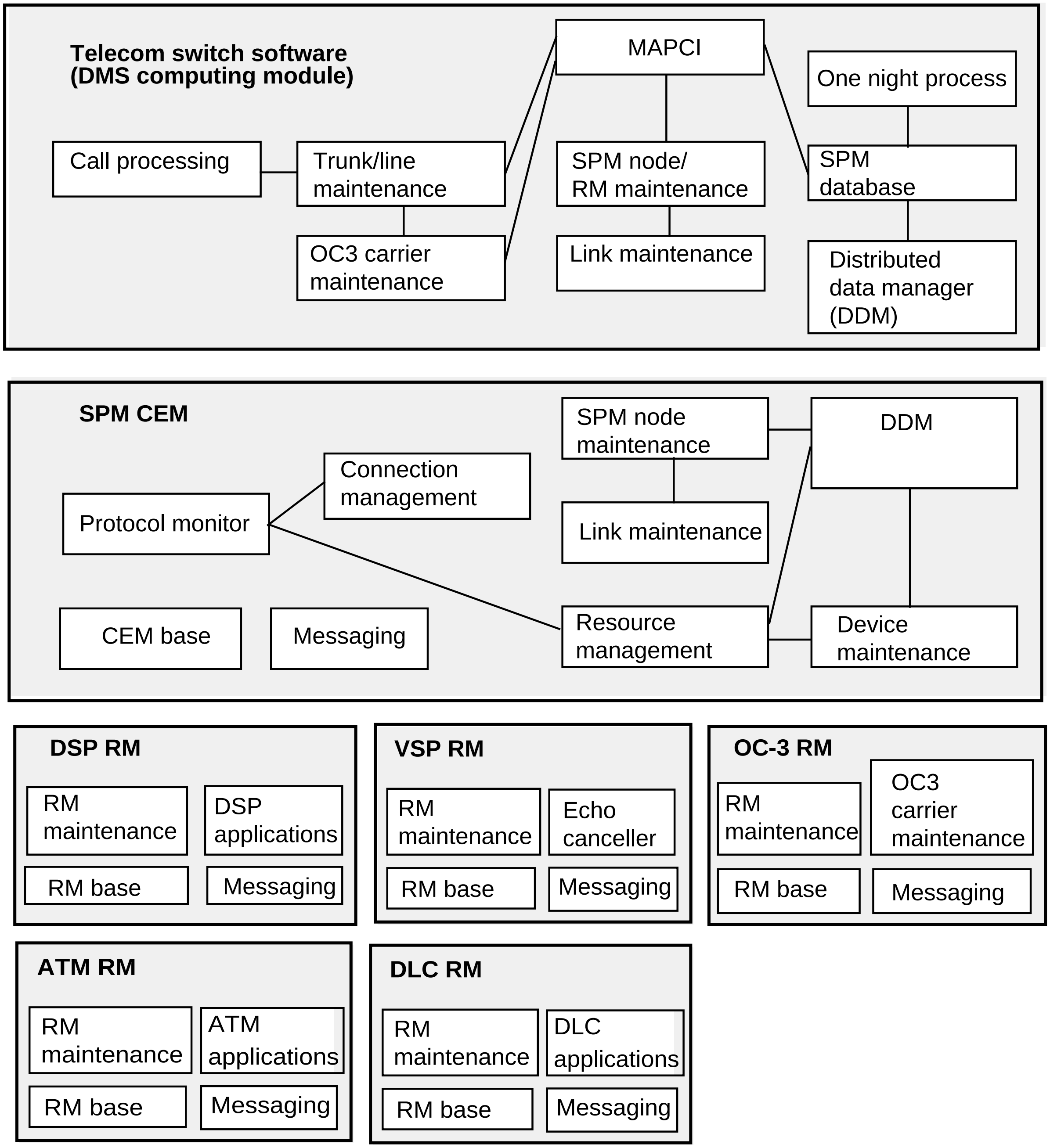
- telecom switch software
  - for DMS switches, this software consists of additions to, and modifications of, the DMS computing module (CM) software
  - for other telecommunications switching applications, application-specific user interfaces are provided
- SPM CEM software
- SPM RM software

The SPM base software functionality consists of the following items:

- link maintenance—integrated link maintenance (ILM)
- device maintenance—integrated node maintenance (INM)
- fault diagnostics and fault isolation
- local call processing
- operations, administration, maintenance, and provisioning (OAM&P) software for the SPM CEM, DSP, and OC3 resources
- local services software
- an interface to the DMS log system for DMS-switch applications
- signal processing for ISUP and per-trunk signaling (PTS), for primary rate interface (PRI) trunks, and for echo cancellation (ECAN)
- trunk and carrier maintenance for the OC3 application
- clock timing
- ENET communication for DMS applications

The following figure shows the major components of the SPM software architecture. For DMS applications, the software includes the SPM components that run on the DMS switch.

Figure 2-2 SPM software architecture



The following types of RMs are available:

- RMs that provide OC3 communications connections
- RMs that provide ATM communications connections
- RMs that provide pulse code modulation (PCM) bit-stream processing services, such as
  - digital signal processing (DSP)
  - voice services processing (VSP)

For detailed information about SPM-system software, see Chapter 4, “Software overview."

User interface

When SPMs are used with DMS switches, the DMS switch-based operations, administration, maintenance, and provisioning (OAM&P) software is used to control the SPM nodes through the MAP-terminal interface. Refer to the *DMS-Spectrum Peripheral Module Commands Reference Manual* (297-1771-819) for detailed information about the SPM commands that are available at the MAP-terminal user interface.

3 Hardware overview

This chapter provides a general overview of the DMS-Spectrum Peripheral Module (SPM) hardware. After reading this chapter you will understand the mechanical elements that make up the SPM, the product engineering codes (PEC) of the major assemblies, and the general mechanical features of each assembly.

For additional information about SPM hardware, refer to the *DMS-Spectrum Peripheral Module Hardware Maintenance Reference Manual* (297-1771-550).

The basic mechanical elements of the SPM consist of a frame with two dual-shelf assemblies that accommodate up to 30 removable circuit-pack modules. All the modules are electrically-shielded metal boxes that have identical dimensions. Each module weighs a maximum of 9 lbs (4 kg). Modules, cable connections, air-filter assemblies, and other maintenance items can be accessed from the front of the frame. Retractable doors and cable-trough covers protect the cable runs and cable connections. The frame can be used with existing earthquake anchors and existing overhead or underfloor cabling systems.

The ANSI frame has the following dimensions:

- Height: 7 ft (2134 mm)
- Width: 2.25 ft (686 mm)
- Depth: 1.5 ft (457 mm)

The circuit-pack modules have the following dimensions:

- Height: 12.4 in. (315 mm)
- Width: 1.22 in. (31 mm)
- Depth: 15.75 in. (400 mm)

The PEC for the frame assembly for the DMS call processing (CP) SPM is NTLX51AA.The PEC for the frame assembly for the Interworking (IW) and Succession Multi-Service Gateway 4000 (MG4000) SPM classes is NTLX51BA, which supports four high speed slots. As shown in the following figure, the frame contains two NTLX51AA or NTLX51BA dual-shelf assemblies and the necessary support equipment. Each NTLX51AA or NTLX51BA dual-shelf assembly is mounted to a 10-layer backplane, which provides the mechanical structure and the electrical connections for one SPM network node.

Note: The IW and MG4000 classes uses NTLX51BA as backplane. However, the DMSCP SPM can use both NTLX51AA or NTLX51BA as backplanes.

Each NTLX51AA or NTLX51BA assembly consists of two shelves with 15 slots each (30 slots total) that accommodate

- two NTLX63AA common equipment modules (CEM) for each NTLX51AA dual-shelf assembly
- two NLX61AA shelf interface modules (SIM) for each NTLX51AA dual-shelf assembly
- two NTLX71AA OC3 interface modules for each NTLX51AA dual-shelf assembly
- two NTLX72AA PRI interface modules for each NTLX72AA dual-shelf assembly
- two NTLX73AA ATM interface modules for each NTLX73AA dual-shelf assembly

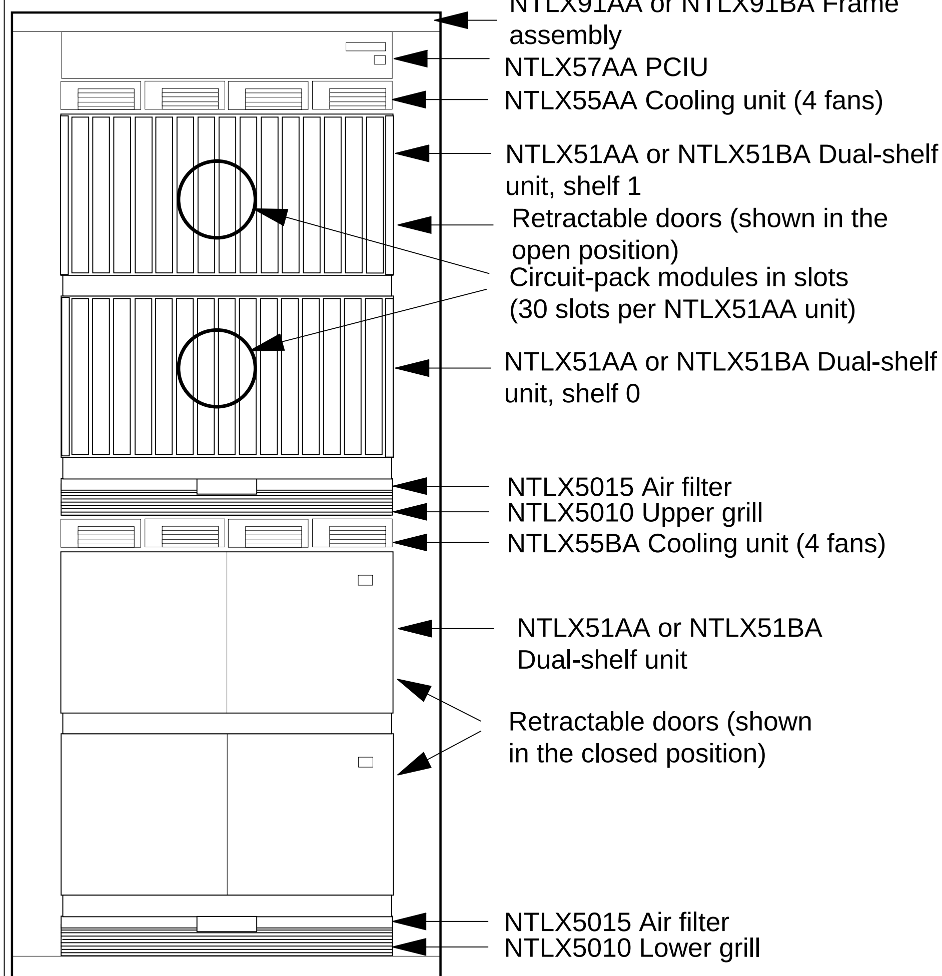
  Note 1: With SPM11 software release, the asynchronous transfer mode (ATM) resource module (RM) is also provided on the SPM. However, ATM module does not apply to all markets.

  Note 2: With SPM12 software release, the primary interface rate (PRI) RM is also provided on the SPM.

- 0 to 24 standard digital signal processor (DSP) resource modules (RM) or voice signal processor (VSP) RMs for each NTLX51AA dual-shelf assembly

Note: NTLX91AA is a replacement of the NTLX50AA Frame assembly, used for the DMSCP SPM class only. NTLX91BA is used for the new IW and MG4000 SPM classes as well as the DMSCP SPM class.

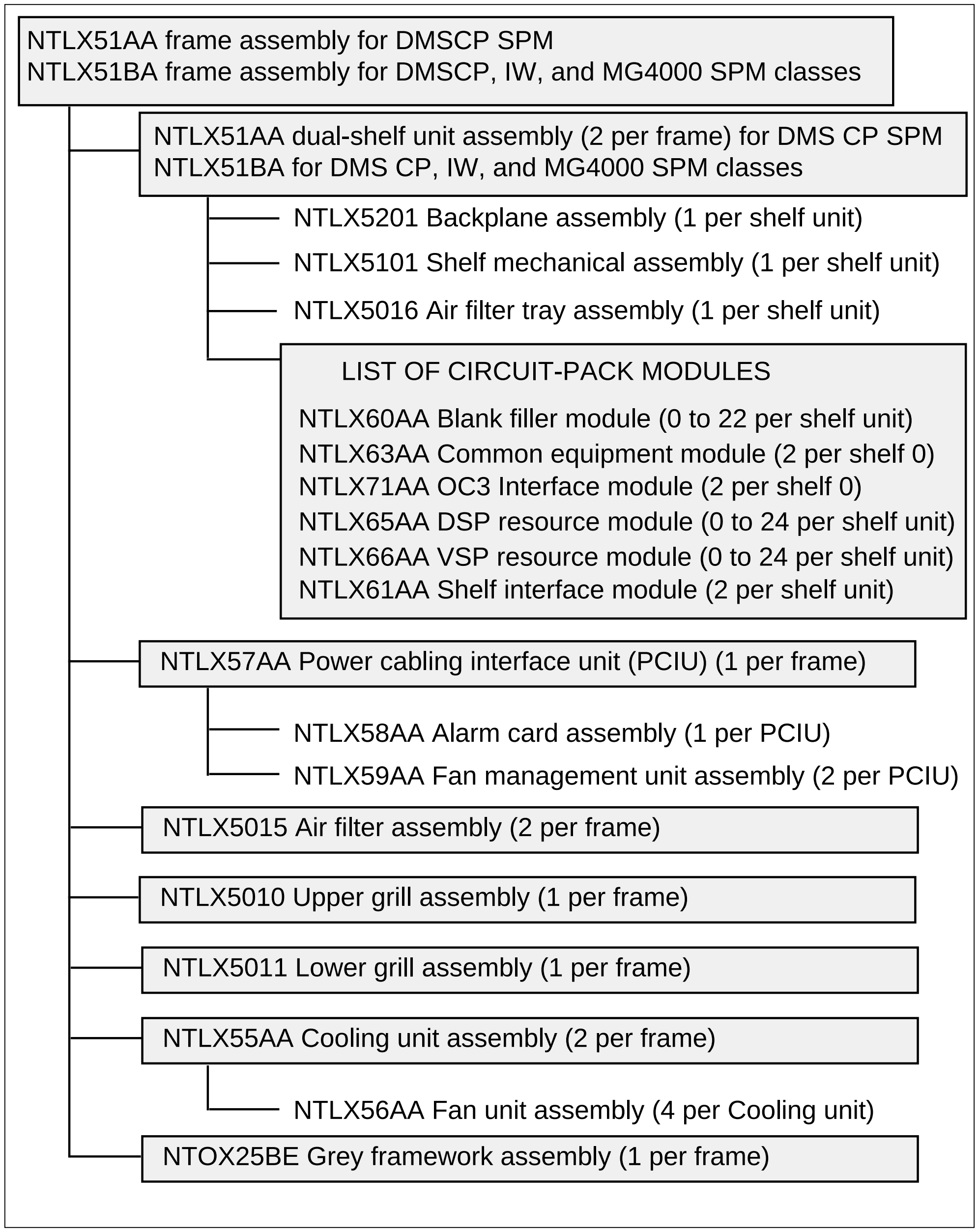
Figure 3-1 Frame assembly of an SPM



Note 1: NTLX91BA Frame assembly is used for all SPM classes: DMSCP, IW, and MG4000 SPM classes.
Note 2: NTLX51BA dual-shelf unit is used for all SPM classes: DMSCP, IW, and MG4000 SPM classes.

Each NTLX91AA or NTLX91BA frame assembly contains two NTLX55AA forced-air cooling units. Each NTLX55AA cooling unit contains four NTLX56AA fan assemblies to provide cooling air to the SPM modules. The NTLX57 PCIU serves as a central gathering point for all power and alarm cabling used within the NTLX91AA frame assembly. The following illustration shows the hierarchy of the major components of SPM.

Figure 3-2 Hierarchy of the SPM components



When an SPM is used, an NT9X40DA paddleboard is installed in the DMS switch. This paddleboard provides an interface to the enhanced network (ENET). The paddleboard supports four DS-512 connections to a common equipment module (CEM) on an SPM node.

4 Software overview

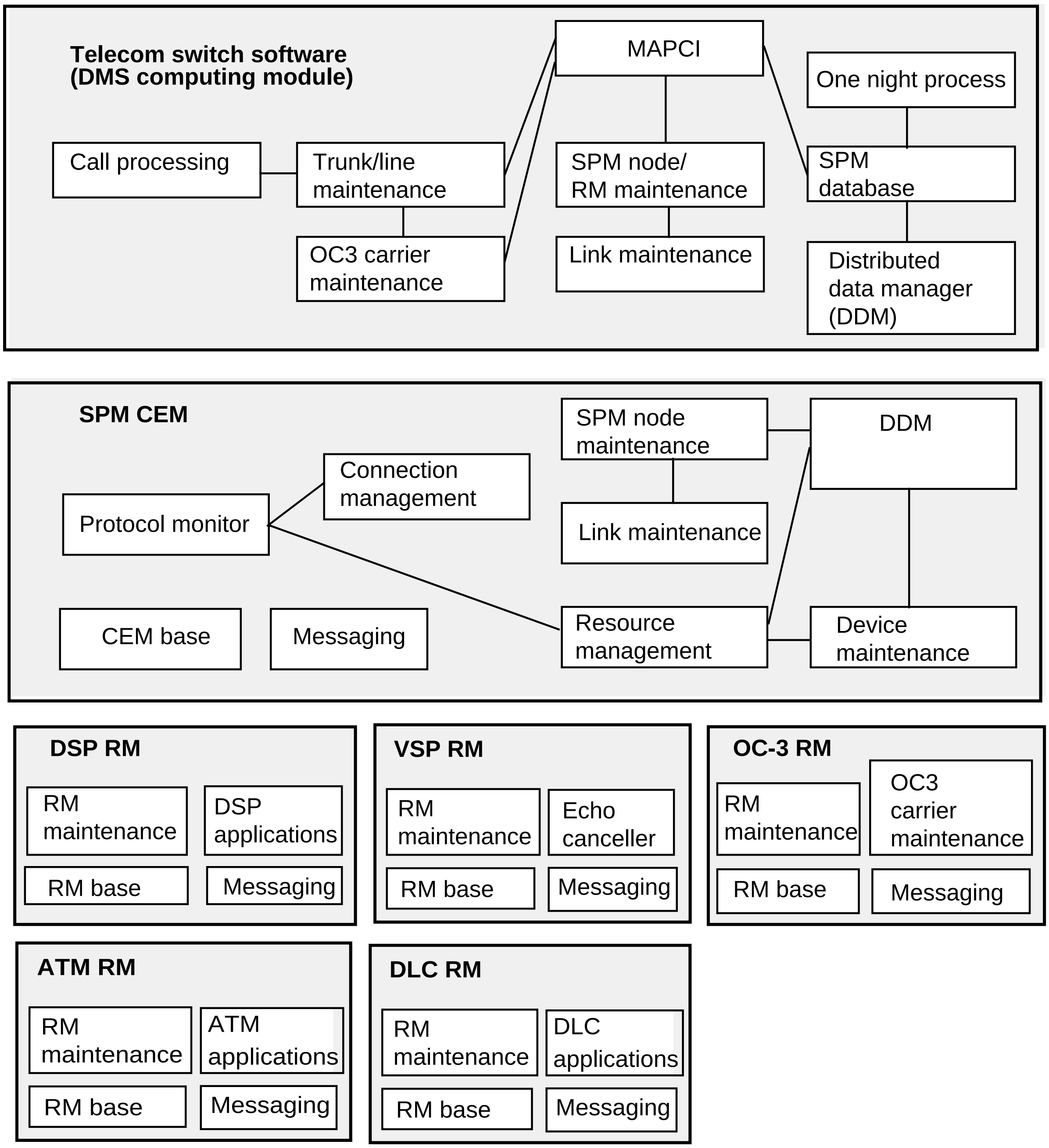
This chapter provides a general overview of the DMS-Spectrum Peripheral Module (SPM) software. After reading this chapter, you will understand how SPM software is organized, where the software elements reside, and what operations the software performs.

SPM software consists of three major components:

- telecommunications-switch software
- SPM common equipment module (CEM) software
- individual software elements that reside on each resource module (RM)

The three-tiered structure of the SPM software is shown in the following diagram.

Figure 4-1 Three-tiered structure of the SPM software



Telecommunications switch software

The DMS computing module (CM) software provides an SPM user interface (the MAP terminal), central database functions, call processing services, system-level maintenance, and for the OC3 application, carrier maintenance functions. In addition, functions such as overload control and system recovery are also provided by the DMS CM. The SPMs also provide local overload control mechanism.

Common equipment module software

The CEM software uses, maintains, and configures the RMs. CEM software has the following capabilities:

- a platform to implement specific ISUP signaling protocols
- path connection services
- resource management for digital signal processor (DSP) and voice signal processor (VSP) RM-based resources. The resources are used by call processing at runtime for call-setup or for services during calls (for example, continuity tone transceiver, dual-tone multifrequency, tone synthesizer, echo canceller, A/B bit handler, and multi-frequency).
- messaging service, which includes CM-to-CEM, CEM-to-RM, and CEM-to-mate-CEM messages
- node maintenance
- link maintenance, including ENET-to-SPM and CEM-to-RM links
- data transfer services from the DMS CM to the CEM and the RMs
- device maintenance that is common to all RMs
- overload control

Resource module software

Each type of RM has its own software structure. All RMs share common software functions such as messaging, module maintenance, and data distribution.

The functions provided by the RMs are either application-specific or real-time intensive. The following sections describe the various types of RM software.

Digital signal processing software

The DSP RM is a hardware platform that provides call-processing software resources that are application-specific programs. The SPM provides the following software resources on the DSP RM:

- dual-tone multi-frequency (DTMF) receiver
  - — The DTMF receiver provides tone detection capabilities on originating trunks. Tone detection is simpler and more efficient than full DTMF detection because DTMF detectors have long holding times (the length of the call). The DTMF receiver provides special tone receiver (STR)

and universal tone receiver (UTR) equivalency. The DTMF receiver does not provide blue box fraud detection.

- continuity (COT) tone transceiver
  - The COT tone transceiver handles complete continuity tests for two-wire and four-wire circuits. The COT receiver provides outgoing or incoming modes, and it may be configured for variations in test frequencies, levels, and protocols. The COT receiver is used on both originating and terminating ISUP trunks.
- programmable tone synthesizer (TONESYN)
  - TONESYN is a programmable tone synthesizer that generates a wide variety of call progress, signaling, and sequence tones that are required for markets outside of North America.
  - TONESYN can generate a wide variety of tones by synthesizing the tones from fundamental parameters (frequency, amplitude, cadence), instead of using wave tables stored in read-only memory. TONESYN generates new types of tones from downloaded parameter values, without the need for wavetables or hardware updates.
  - TONESYN is used on originating trunks for prompt tones (dialtone), call progress tones, and audible ringback. It is used on terminating PTS trunks for digit outpulsing.
- A/B-bit handler
  - The A/B-bit (ABBIT) handler is a software resource type that runs on the DSP RM. The ABBIT handler processes per-trunk signaling (PTS) by extracting the A and B signaling bits from their individual DS-0 trunks and processing the bits independently. The ABBIT handler can be used on all originating and terminating PTS trunks.
- multi-frequency (MF) receiver
  - The MF receiver is a DSP RM application that detects MF digits on PTS trunks. MF signaling uses pairs of frequencies, which are selected from a group of six single frequencies, to provide information on called-number address signaling, calling-number identification, ring back, and coin control. Fifteen possible frequency combinations can represent the digits 0 through 9 and many special control signals and information signals. The MF receiver is used only on PTS originating trunks for MF digit collection.

Voice signal processing software

The VSP RM is a hardware platform that provides call-processing software resources that are real-time intensive applications. The architecture of the VSP RM is similar to that of the DSP RM, but it has a larger real-time processing capacity, which enables it to perform ECAN. The ECAN resource can be used on both originating and terminating trunks for echo cancellation.

OC3 module software

The OC3 RM software is real-time intensive. It provides low-level maintenance functions, performance-measurement data collection, channel-associated signaling processing, and some synchronous optical network (SONET) overhead termination activities. Real-time intensive SONET activities are handled by the OC3 software, which reduces application-related real-time processing on the CEM. The SONET overhead related to performance measurements, alarms, and protection switching are handled by the OC3 RM software.

The SPM collects trunk performance data for the OC3 RM and forwards it to the DMS CM carrier-maintenance function for distribution to the MAP-terminal interface. Alarms are processed on the OC3, but the CM carrier maintenance function provides the information to the MAP interface.

ATM module software

Asynchronous transfer mode (ATM) is a network and multiplexing technology originally developed for Broadband-ISDN. It is a cell relay, fast-packet switching technology, capable of transmitting data, voice, and video over a common infrastructure. However, it provides more than a basic transmission protocol. ATMalso

- supports both private and public networks
- uses the same technology for local and wide area networks
- transports voice, video, and data on a common circuit
- delivers bandwidth on demand
- offers low-cost networking and uses low-cost technology

The ATM-SPM architecturally consists of a newly developed ATM resource module for DMSCP and includes the following features:

- VSP/DSP RM functionality
- echo cancellation
- tone detection and synthesis
- continuity testing for ISUP and service test applications

> ***Note:*** For more information, refer to the *DMS-SPM ATM General Description*, 297-1771-150.

PRI module software

The primary rate interface (PRI) application takes advantage of the existing SPM base components. PRI on the SPM (S-PRI) provides flexible architectural framework so development of features and capabilities requires minimal effort.

> ***Note:*** For more information, refer to the *DMS-SPM PRI General Description*, 297-1771-132.

Software upgrade support

The telecommunications switch component of the SPM software (that is, the DMS switch) is upgraded using the standard DMS one night process (ONP). RM software loads are upgraded before the CEM load. CEM flash memories can be upgraded while in service, which minimizes the time spent in simplex mode. The new load can be moved from flash memory to random access memory by using a command at the DMS MAP terminal. For more information on how to upgrade the SPM, refer to *North American DMS-100 Spectrum Peripheral Module Release Document* 297-1771-598.

5 Operational characteristics

This chapter provides a general overview of the operational characteristics of the DMS-Spectrum Peripheral Module (SPM). After reading this chapter you will understand how SPMs fit into in a telecommunications network, what interfaces SPMs use to communicate with the network, and the operational capabilities that SPMs provide to network communications.

Connections to the DMS switch and the transport network

SPM nodes provide redundant 1 + 1 OC3 transport-network interfaces directly to the DMS switch. This OC3 interface supports byte-synchronous virtual tributary one-point-five (VT1.5) mapping, asynchronous VT1.5 mapping, DS-3 mapping, and STS-1 mapping. Support for byte-synchronous mapping enables SPM nodes to function in a fully-synchronous SONET network.

Up to 26 resource modules (RM) can be used to provide an SPM node with the functionality required for a particular application. The RMs are connected to the CEMs through serial links (S-links) in the common backplane. These backplane connections form a point-to-point architecture, which provides superior fault containment and fault isolation. Within SPM nodes, all traffic is treated as DS-0s (or sets of DS-0s).

Note: The SPM01 product release provides an OC3 interface only.

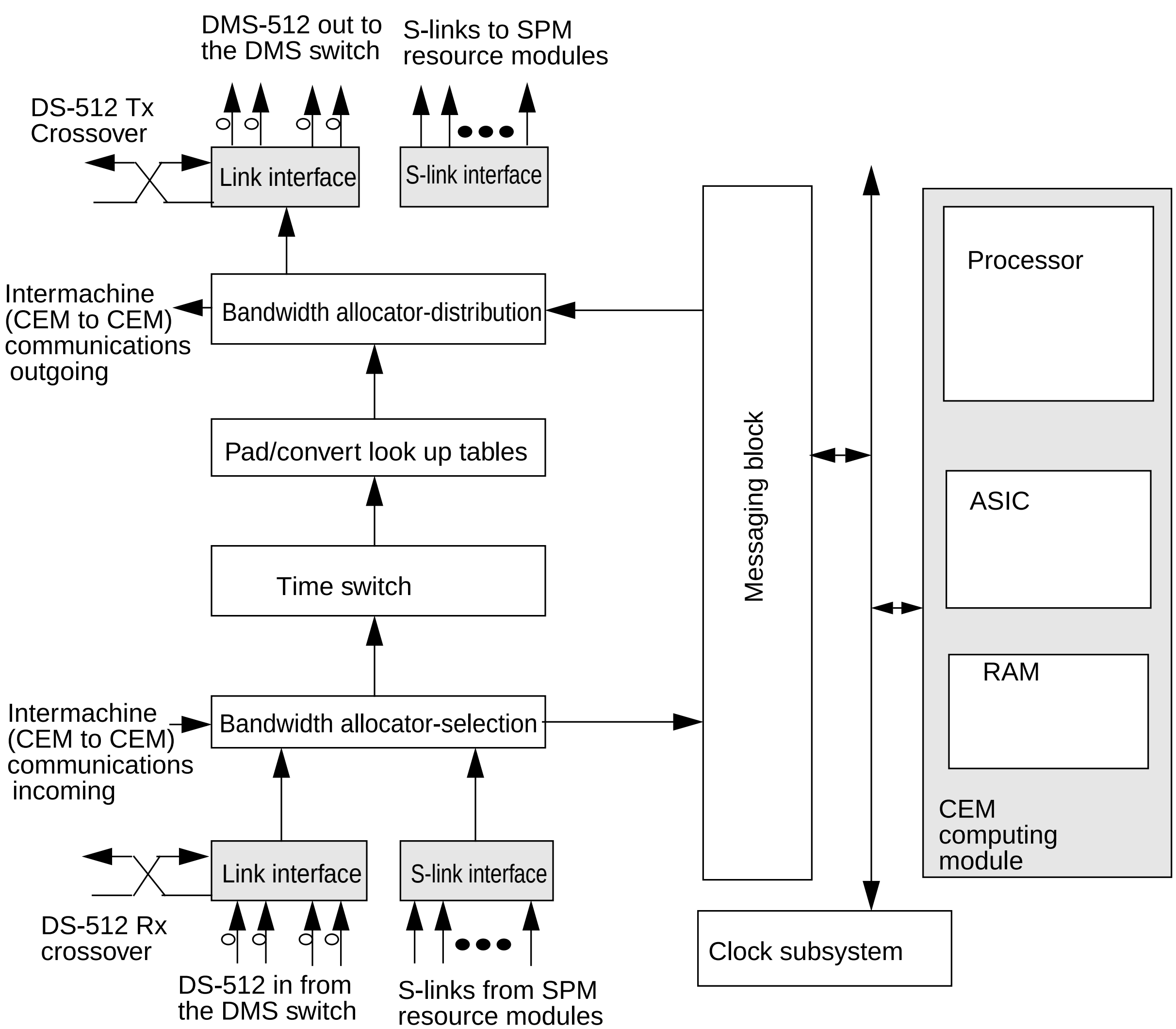
The incoming OC3 SONET time-division multiplexed (TDM) signals are separated into DS-0 timeslots and the signals are routed to the internal 12K-port timeswitch in the CEM. The timeswitch can route the DS-0 timeslots to any RM for bit-stream processing. The DS-0 timeslots can also be routed directly to the ENET for DMS call processing through the DS-512 host links on the CEM module.

The DMS ENET DS-512 links provide each SPM node with 2048 channels of bandwidth. The links carry a full OC3 payload (2016 DS-0 channels) plus the messages between the SPM node and the DMS computing module.

The SPM supports 100% echo cancellation (ECAN) capability on call processing. The ECAN capability requires a minimum of one (plus one spare) and a maximum of eight (plus one spare) voice signal processor (VSP) resource modules (RMs).

The CEM uses DS-512 fiber-optic connections to the DMS ENET. The following figure shows both the receive and transmit sections of the CEM DS-512 interface.

Figure 5-1 CEM DS-512 interface



DS-512 interface

When it is receiving data, the DS-512 interface

- recovers the data and the data frames from the DS-512 link, which includes the optical-to-electrical conversions and 12B10B conversions
- monitors link status
- performs slip buffering to continue operation in the presence of a synchronization fault between an SPM node and the OC3 network
- provides data to the inactive CEM by means of the Rx crossover bus
- accommodates small phase differences between the two CEMs by using variable capacity memory
- extracts the message channel and separates it from the pulse code modulation (PCM) signals, which reduces delay and improves messaging performance
- extracts and detects the channel supervisory message on both ENET planes
- selects the ENET plane for the PCM channels, based on each DS-0 requirement

When it transmits data, the DS-512 interface

- combines host messaging timeslots with those of the mate CEM (when required)
- inserts channel supervisory message data
- accepts PCM timeslots from the active CEM by means of the Tx crossover bus
- performs the 10B12B conversion by inserting the framing channel and performing the electrical-to-optical conversion
- generates the link-transmit clock, which is phase locked to the active CEM system clock—this maintains the operation of the links, even if the system clock in the CEM fails

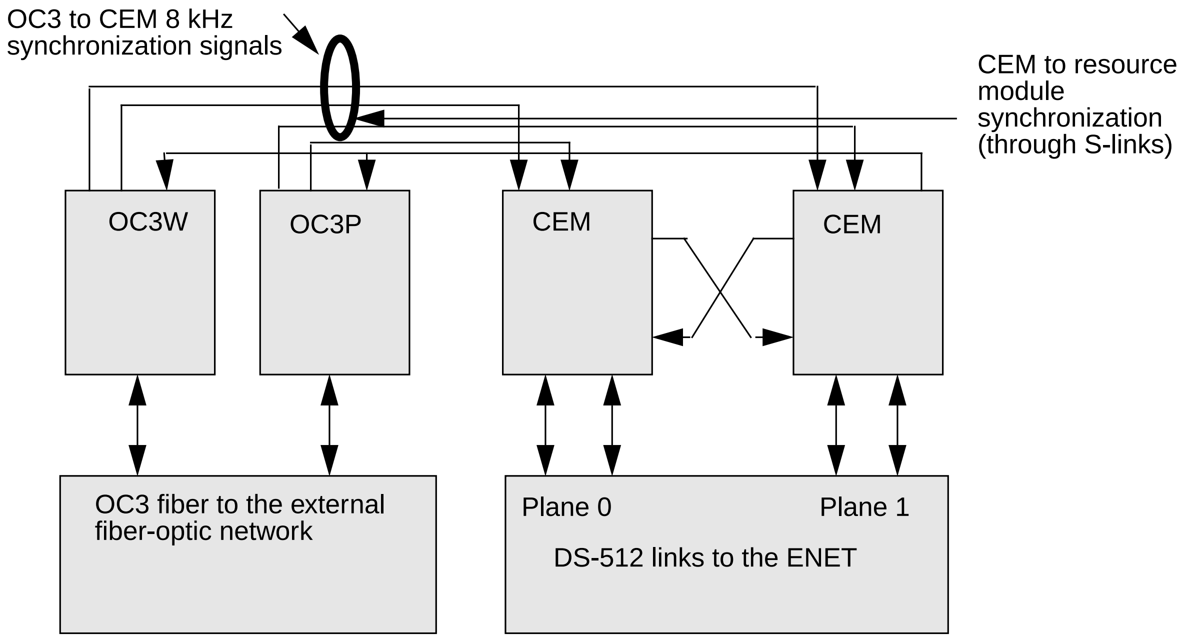
Network transmission

Each CEM receives a copy of PCM traffic from all sources. Outgoing PCM traffic is always provided by the active CEM. Access to the DS-512 host links on the mate CEM is provided by the DS-512 crossover signals. The two CEMs communicate with each other through inter-module messaging links in order to synchronize the call-processing and maintenance states.

Clock synchronization

The following figure shows a logical view of the SPM-system clock synchronization resources and their distribution. This figure shows a fully configured synchronization architecture in an SPM node equipped with OC3 TDM interfaces.

Figure 5-2 SPM-system clock synchronization resources



As shown in the previous figure, the CEMs form the center of a duplicated star topology and the CEMs provide the primary means of transmitting clock synchronization signals through the S-links. RMs derive their system-clock signal from the S-links to the active CEM.

Loop-timing and internal-timing modes

With appropriate software support, the SPM synchronization architecture can operate in loop-timing mode or in internal-timing mode.

Loop-timing mode is the only clock-signal distribution method that is supported for normal operation. Each SPM node individually synchronizes to either of the two OC3 carrier clock signals that terminate on the CEM (one carrier per OC3 RM). The inactive CEM runs in mate synchronization, deriving its clock signal from the active CEM. The SPM node loop-timing source is locked to one of the signals from an RM in an OC3 interface slot; the other OC3 interface slot is available as an alternate clock-signal source. The phase-locked-loop oscillator in the active CEM provides the system clock. The CEM oscillator determines clock quality.

In internal-timing mode, the SPM node clock synchronization is locked to a designated DMS ENET plane; the other ENET plane is available as an alternate source. The phase-locked-loop oscillator in the active CEM provides the system clock. For many applications (for example, low-rate trunks) this provides sufficient clock quality. However, internal mode is not suitable for use with SONET or synchronous digital hierarchy (SDH) interfaces, which carry OC3 traffic.

Synchronization status messaging

SPM nodes can produce and terminate synchronization status messages on the OC3 carriers. This feature has limited functionality. Incoming synchronization messages are not recognized, so they are ignored. Outgoing synchronization status messages are set to “Do not use as a Sync source." These settings cannot be altered.

DS-512 slip buffering

When SPM nodes are configured to lock onto a clock source other than the DMS ENET, out-of-specification conditions may cause excessive synchronous drift. The quad-link controllers in the CEM and the ENET paddleboard have slip buffers. When synchronous drift becomes excessive, the buffers preserve call-traffic continuity—although the presence of controlled slips degrades call traffic.

During normal operation, each SPM node derives its synchronization from the working OC3 carrier (loop-timing mode). If the working clock source derived from the OC3 carrier fails, the SPM node reverts to internal timing. Internal timing draws its synchronization from one of the following sources:

- one of four DS-512 host links (C-side) coming from a DMS ENET on the active CEM (inaccurate for SONET traffic)
- a DS-512 host link (C-side) coming from a DMS ENET on the inactive CEM (C-side only) (inaccurate for SONET traffic)

This method of retaining clock-synchronization signals enables continued messaging and communication between SPM nodes and the DMS computing module. It also ensures that proper alarm signaling and diagnostic capabilities are retained until the fault is rectified.

Note: Internal-timing mode does not provide sufficient clock quality for SONET traffic.

Clock domain selection

The SPM bridges two separate clock domains: the DMS system clock domain and the SONET network clock domain. The SPM master clock selects whether it will synchronize to the DMS system clock domain or to the SONET network clock domain.

When processing traffic, the SPM clock is normally synchronized to the SONET network because the SPM loop times to its incoming OC3 carrier. The criteria for SPM software to select the OC3 carrier as the local clock reference is as follows. These criteria describe normal operating conditions.

- The DMS system clock must be in its SYNC state; that is, visible at the MS at the clock MAP level.
- The SPM node must be in service; that is, at least one CEM must be in service and ready to process traffic.
- At least one OC3 RM must be in service.
- OC3S and STS3L carriers must be in service.
- The SPM clock must be able to achieve synchronization with the OC3 reference.
- The DMS system clock domain and the SONET network clock domain are traceable to a common source, such as an office building integrated timing source (BITS).

When operating normally, the SPM clock synchronizes to the active OC3 optical framing rate. If an OC3 protection switch occurs, either manually or automatically, the SPM clock reference always switches to follow the new active OC3 carrier.

Table MNNODE sets the target clock reference mode. When field CLKREF is set to INTERNAL, the SPM clock selects the DMS system clock as the reference. When field CLKREF is set to LOOP, the SPM clock selects OC3 as the clock reference. Loop timing is a target mode only. The SPM remains in internal timing until all the conditions described in the previous list are true. If all the conditions are true, the SPM enters loop timing and synchronizes to the active OC3. If one of the conditions becomes false, the SPM reverts to internal timing.

Refer to the *Data Schema Reference Manual* or the data schema section of the *Translation Guide*, as appropriate, for more information about table MNNODE.

Synchronization faults

If loop timing is the target synchronization mode and the SPM clock reference is the active OC3 carrier, the clock reference switches back to the DMS system clock if any of the following occur.

1. The DMS clock enters “holdover mode" and a message is sent to all SPMs. The MS clock alarm is raised for holdover mode. All SPMs connected to the DMS system revert to internal timing.
2. The DMS clock is manually removed from SYNC state by using the DropSync MAP command. A warning is posted on the MAP display that

must be manually overwritten. A message is sent to all SPMs. The MS clock alarm is raised. All SPMs connected to the DMS system revert to internal timing.

3. The last active OC3S or STS3L carrier is removed from service either manually or by system intervention. Only the SPM for which this condition is true reverts to internal timing.
4. The OC3 RM terminating the last active OC3 carrier is removed from service either manually or by system intervention. Only the SPM for which this condition is true reverts to internal timing.
5. The SPM node is removed from service either manually or by system intervention. Only the SPM for which this condition is true reverts to internal timing.
6. The SPM clock detects a persistent frequency difference between the DMS system clock domain and the SONET network clock domain. Switching back to the DMS system clock prevents multiple timing islands from being established within the DMS system. All payload slips, if they occur, are forced to happen in the OC3 RM controlled slip buffers (CSBs), where they are fully performance monitored. The location of the condition causing the frequency difference determines which SPMs revert to internal timing mode. If the failure causes the MS clock frequency to drift, all SPMs revert to internal timing mode. If the failure causes the SONET network element to which the SPMs are connected to drift, all SPMs revert to internal timing mode. If the failure causes only one of the OC3 carriers at one of the SPMs to drift, only that SPM reverts to internal timing.

In any of these situations, a “clock out of specification" alarm is raised for all appropriate SPMs. Refer to the appropriate *Alarm Clearing and Performance Monitoring Procedures* to clear the alarm.

Simplified interface between switching and transmission

The SPM, which includes integrated ECAN, simplifies the interface between the external transmission network and the telecom switch. The SPM also reduces the cost of ownership for operating companies by replacing some transmission equipment, by eliminating copper interfaces, and by replacing external ECAN equipment. SPM nodes can accommodate additional ports without requiring the provisioning of additional devices or external ECAN equipment. Although SPMs significantly reduce equipment in the wire centers, they are not intended to provide all transmission functions.

Integrated echo cancellation

SPM nodes provide echo cancellation by using integrated ECAN RMs, which are called voice signal processors (VSP). VSP RMs are plug-in modules that can be provisioned to provide up to 100% of their processing resources to the

ECAN pool. This pooled coverage reduces the number of VSP RMs required because ECAN resources can be allocated individually for each call. Therefore, ECAN resources can be more economically deployed when the proportions of voice and data traffic do not require echo cancellation on all calls.

The SPM also supports the use of RMs from licensed third-party vendors. Licensed third-party products are fully compatible with all SPM physical, logical, and software-support systems.

SPM provides the following methods of echo canceller (EC) performance monitoring using the SPMECMON command:

- immediate, one-time reading of echo canceller performance data

  The immediate read function requests ERL and ERLE readings for the specified trunk from an SPM. The SPM returns the requested data for the specified trunk, if valid, or the reason the requested data was not supplied. SPMECMON outputs the returned ERL/ERLE data to the MAP terminal, along with an evaluation of the quality of performance based on this data. If the data is not returned by the SPM, SPMECMON displays an explanation of why the data was not displayed.

- continuous echo canceller performance monitoring

  — Continuous performance monitoring enables the user to continuously monitor echo canceller performance for the specified trunk or a range of trunk members. For each answered call placed over the monitored trunk, the SPM sends ERL and ERLE data to the computing module (CM). The CM uses the logs system to output an SPM 660 log containing the received data. The CM also has the capability to output to the MAP display, or both log and MAP.

  — Continuous performance monitoring capabilities activated on a specific Resource Module Number (RM#) and Resource Number (RN) on an SPM basis or for a range of RNs for an RM.

  — Capability of disabling continuous echo canceller performance monitoring based on RM number and RN on an SPM basis or for a range of RNs for an RM.

  — Based on capacity testing, provides the capability of continuously monitoring up to 600 trunk members or 320 echo cancellers (ECANs) at a time.

  — Status reports that list RM# and RN with continuous echo canceller performance monitoring on an SPM basis.

  — AUTO commands to enable/disable/query continuous echo canceller performance monitoring.

Integrated tone detection and generation

SPM nodes detect and generate tones by making use of digital signal processing (DSP) RMs. The DSP RM is a plug-in module like the VSP RM. The DSP RMs can provide pools of resources shared by all SPM trunks. A sufficient number of resources can be provisioned to cover the SPM needs, as determined by the resource usage required by individual calls. The DSPs provide tone functionality equivalent to the special tone receivers (STR) and universal tone receivers (UTR) provided by DMS XPMs.

DSP RMs also provide per-trunk signaling (PTS) functionality.

Provisioning DSP resources for the IEC market

The following paragraphs describe the SPM-DSP provisioning rule for the interexchange carrier (IEC) market.

The number of DSP RMs depends on the call rate, average call holding time (or port utilization) and signaling mix. The worst case scenario for particular DSP resources is either 100% ISUP or 100% PTS. Two generic DSP RM configurations are recommended : 4+1 and 5+1.

In the 4+1 configuration, 4 DSP RMs are active and 1 DSP RM is on warm-standby ready to replace any failing active module. In the 5+1 configuration, 5 DSP RMs are active and 1 DSP RM in on warm-standby. The RM sparing configuration always assumes one warm-standby RM. More specific configurations can be used to address specific requirements.

Note: Underlying assumptions in the RM provisioning calculations are:

- Call rate equal to 13.44 h-CPS
- 100% call originations, since originations require more DSP resources than terminations
- 100% MF on PTS, which is worst case assumption for the MF resources

4+1 DSP Configuration

The 4+1 configuration, shown in the table below, supports the following:

- Up to 100% COT testing
- Up to 80% call reoriginations (worst-case scenario for DTMF resources)

Table 5-1 (Sheet 1 of 2)

Resource	DSP 0	DSP 1	DSP 2	DSP 3	DSP 4	Total	DSPI’s
COT	0	0	80	80	*spare*	160	2
Tonesyn	255	255	0	0	*spare*	510	2

Table 5-1 (Sheet 2 of 2)

Resource	DSP 0	DSP 1	DSP 2	DSP 3	DSP 4	Total	DSPI's
DTMF	320	384	320	320	*spare*	1344	21
ABBIT	14	14	28	28	*spare*	84	6
MF	40	40	40	40	*spare*	160	4
DSPI's	8	9	9	9		Total DSPI's =	35

For the DTMF resources, which provide equivalence to XPM UTR/GTR functionality, there are

- 320 resources occupying 5 islands on DSP 0
- 384 resources occupying 6 islands on DSP 1
- 320 resources occupying 5 islands on DSP 2
- 320 resources occupying 5 islands on DSP 3
- for a grand total of 1344 DTMF resources, which could support up to 1344 originations.

Note: The DTMF resources are also used for mid-call features, such as reorigination, that are shared with mid-call events.

5+1 DSP Configuration

The 5+1 configuration, shown in the table below, supports the following:

- Up to 100% COT testing
- Up to 100% call reoriginations

Table 5-2

Resource	DSP 0	DSP 1	DSP 2	DSP 3	DSP 4	DSP 5	Total	DSPI's
COT	0	80	0	80	0	*spare*	160	2
Tonesyn	255	0	255	0	0	*spare*	510	2
DTMF	320	320	320	320	384	*spare*	1664	26
ABBIT	14	14	14	14	28	*spare*	84	6
MF	40	40	40	40	0	*spare*	160	4
DSPI's	8	8	8	8	8		Total DSPI's =	40

For the DTMF resources there are

- 320 resources occupying 5 islands on DSP 0
- 320 resources occupying 5 islands on DSP 1
- 320 resources occupying 5 islands on DSP 2
- 320 resources occupying 5 islands on DSP 3
- 384 resources occupying 5 islands on DSP 4
- for a grand total of 1664 DTMF resources, which could support up to 1664 originations.

> ***Note:*** The DTMF resources are also used for mid-call features, such as reorigination, that are shared with mid-call event.

Refer to the module description “NTLX65BA DSP RM" in the *Hardware Maintenance Reference Manual* for more information.

Refer to Appendix A, “SONET Overview," for general information about performance parameters.

Resource module sparing

Resource modules (RM) provide call-processing software resources such as echo cancellation (ECAN), continuity testing (COT), dual-tone multifrequency (DTMF) services, and tone synthesis (TONESYN). The availability of the software resources provided by an RM can be protected by using other redundant RMs. When a working RM fails, the resources that were provided on the failed RM are reconfigured to the same specification on a protection RM, and all calls are switched to the resources on the protection RM. The action of protecting the availability of call-processing resources is referred to as “sparing." Sparing occurs automatically when a working RM reports a critical fault. Manual sparing occurs when a command is entered at the user interface.

The following sparing alternatives are supported on the SPM:

- N+1 sparing - N RMs provide sufficient capacity and one RM is on warm-standby, ready to replace any active RM that fails.
- N+M sparing - N active RMs provide sufficient capacity and M RMs are in warm-standby

Fault reporting

There are three RM fault-reporting levels: critical, non-critical, and no-fault. Critical faults cause automatic sparing. Noncritical faults do not cause automatic sparing. No-faults are reports that indicate that a fault has been cleared.

All RM faults generate logs and alarms, regardless of the sparing activity. Successful and unsuccessful sparing actions are reported in separate logs. An alarm generates if an attempted sparing action fails. An alarm also generates when spare RMs are unavailable; this alarm typically occurs when an RM goes out-of-service and the resulting sparing action uses the last RM allocated to a protection group.

Restorable and non-restorable resources

For sparing purposes, RM resources are classified as “restorable" or “non-restorable." Restorable resources are the resources that are essential to maintain calls in progress. Non-restorable resources are the resources required to set up calls. To avoid dropping a call, restorable resources on the protection RM are reconfigured to the call's specifications. Restorable and non-restorable resources are listed in the following table.

Table 5-3 (Sheet 1 of 2)

Resource name	Resource type
ECAN	Restorable
DTMF (reorigination mode)	Restorable
DTMF (digit collection mode)	Non-restorable
COT	Non-restorable
TONESYN	Non-restorable

Table 5-3 (Sheet 2 of 2)

Resource name	Resource type
MF	Non-restorable
A/B bit resources	Non-restorable

Sparing actions

This section discusses how sparing actions are initiated (automatically or manually) and the types of sparing actions (forced or unforced). The section also provides the sequences for forced and unforced sparing.

Sparing actions initiate automatically or manually. The SPM automatically initiates sparing when a critical fault occurs. A command entered at the user interface initiates manual sparing.

Sparing actions occur only under the following conditions:

- The node must be in service, that is, a least one CEM must be In-Service (InSv) or In-Service Trouble Busy (ISTb).
- The RMs involved in the sparing action must be InSv.

Sparing actions can be “forced" or “unforced." Forced sparing occurs when the sparing action is automatically initiated by the SPM. Unforced sparing occurs when the sparing action is manually initiated at the user interface. An option to force manual sparing is also available. RM sparing actions are non-revertive; in other word, once the sparing action is initiated, the configuration does not change until sparing is manually performed.

Sparing action sequences

During a forced sparing action, non-restorable resources are forcibly returned to their respective resource pools. Calls in the process of being set up are denied termination. Restorable resources are reconfigured on the protection RM and calls in progress are switched to these spare resources with minimal effects on the quality of the call.

During unforced sparing, the system waits for non-restorable resources to be released by call processing before beginning the sparing action. Restorable resources are reconfigured on the protection RM in the same manner as a forced sparing action.

Sparing reduces the size of the resource pools during sparing activities. Until a sparing action completes, the capacity of all the free-resource pools involved is reduced by the quantity of resources being spared.

Forced sparing

Forced sparing results in the following sequence of activities:

1. The SPM maintenance system reports an RM fault or the user enters a forced manual-sparing command.
2. The maintenance system marks the RM as “pending out-of-service."
3. The system selects a spare RM.

   Note: If a spare RM is not available, the system continues to take the RM out of service (this happens when the system finds the fault). The system generates an alarm and a log to report and record the failure of the sparing operation. However, if the user enters the sparing command, the system blocks the action.

4. The system initiates a forced sparing operation.
   a. The sparing RM receives a resource configuration message.
   b. The sparing RM complies with the configuration request and returns a confirmation message.
   c. The system reports a successful sparing action or a failed sparing action.
5. The system switches call paths to the protection RM.

   Note: If the sparing action fails, the system generates an alarm and a log.

6. A log generates to record the results of the successful sparing action.

Unforced sparing

Unforced sparing results in the following sequence of activities:

1. The user enters a manual-sparing command that specifies the source RM and the protection RM for the sparing action.

   Note: If the protection RM is not available, the system rejects the sparing action and returns the result to the user. A log does not generate, because the sparing action was not attempted.

2. The system initiates an unforced sparing action.
   a. The system begins an unforced sparing action from the source to the protection RM.
   b. The protection RM receives a resource configuration message.

c. The protection RM complies with the configuration request and returns a confirmation message.

d. The system waits for up to four minutes for all non-restorable resources to be released by call processing.

3. The system switches call paths to the protection RM.
4. A log generates to record the results of the sparing action. If the action is unsuccessful, an alarm also generates.
5. The user receives the results of the sparing action.

Sparing restriction

When a new DMS core image is created for the switch, the datafill must reflect the actual states of the RMs (active, inactive, working, or spare), and the image must be dumped with the correct states.

These changes must be verified at both the MAP level and in the datafill. For example, if the datafill reflects that DSP0 is working and active, the image must be dumped with DSP0 active and working.

If the image is dumped with the incorrect states, resources will not be properly allocated to the RM.

Refer to “SPM VSP NTLX66AA" and “SPM DSP NTLX65AA" in the *Card Replacement Procedures* NTP for procedural information.

Effects of the roving spare strategy of device maintenance on resource management

RMs are placed into Protection Groups which can have 1:1, 1:n, or m:n sparing strategies. One spare for one working RM, one spare for n working RMs, or m spares for n working RMs. As of release 14 and earlier, DSP and VSP RMs are recommended to be in 1:n protection groups. There are several implications and rules for Resource Management and resource configurations on RMs.

Resource Profiles are datafilled against specific working RMs in table MNCKTPAK. A spare RM has no resources datafilled. When the RMs are returned to service, the spare(s) are INACTIVE and the Working RMs are ACTIVE.

Device Maintenance uses a “Roving Spare” strategy for its protection groups. After a sparing operation, the previously working RM becomes INACTIVE and the previously INACTIVE (spare) RM becomes ACTIVE. The spare RM takes on the resources configured on the previously working RM. The previously working RM has no resources configured after becoming INACTIVE. It is then the next “Spare” for the group.

With consecutive sparing actions, The inactive RM moves from RM to RM with consecutive sparing actions. The concept of “Spare” and “Working” is used to describe initial datafill conditions. The Activity State of the RMs are more useful at run time due to sparing actions.

For Resource Management, an active RM has resources configured. An inactive RM has no resources configured and is effectively a “spare” or extra RM. An inactive RM can be used as a spare for the next sparing operation by Device Maintenance.

It is best to view the Resource Profiles (datafill) as belonging to the Protection Group rather than to individual RMs as they are datafilled. This is due to the fact that Resource Profiles can be passed around from RM to RM as a result of sparing. Any RM in the group has to be able to take on the Resource Configuration Profile of any other RM in its group. This means all RMs must be compatible with each other. All RMs must come from the same supplier and within 3 releases of each other.

The procedures for changing the Resource Datafill of an RM are documented in the customer documentaiton for data schema and Table MNCKTPAK.

OM reporting for ISUPUSAG

For SPM01 and SP10, operational measurement (OM) reporting for ISUPUSAG was done when the OM registers reached full capacity.

For SP11, OM reports containing the ISUPUSAG OM group data are sent at fifteen minute intervals to the computing module. The OM reports are sent whether or not the OM registers are full. The availability of a scheduling mechanism for use within the SPM OM software matches the ISUP OM reporting provided by the digital trunk controller for SS7 (DTC7).

6 SONET overview

This appendix provides a summary of synchronous optical networks (SONET). The information describes SONET as an industry standard. It is not to be construed as Nortel Network's implementation of SONET. This section also describes most of the features that are part of the SONET standard.

ATTENTION

The information describes SONET as an industry standard. Some of these features are not supported by the DMS-Spectrum Peripheral Module (SPM).

Introduction

SONET is an industry standard for optical carrier (OC) levels and their electrically equivalent synchronous transport signals (STS) for a hierarchy based on fiber-optic transmission.

SONET defines OC levels and electrically equivalent STSs for the fiber-optic-based transmission hierarchy.

The following SONET features contributed to the international acceptance of the standard:

- compatibility of equipment from different manufacturers
- synchronous networking
- enhanced operations, administration, maintenance, and provisioning (OAM&P)
- enhanced efficiency of add/drop multiplexing
- standards-based survivable rings
- positioning for support of new services, such as asynchronous transfer mode (ATM)

SONET OC3

The OC3 provides the following:

- intermediate reach and short reach-1 compatible optical interface
- 1+1 automatic protection switching (non-revertive for SPM)
- full fill (2016 DS-0) capacity
- supports the following SONET formats:
  - Synchronous Transport Signal-Level 1 (STS-1)
  - embedded Digital Signal Level 3 (DS-3 in M2-3 format)
  - floating asynchronous Virtual Tributary 1.5 (VT1.5)
  - floating byte-synchronous VT1.5
  - DS-1s in asynchronous VT1.5s and DS-3s in superframe or extended superframe

Multiplexing

Any type of service, ranging from voice to high-speed data and video, can be accepted by various types of service adapters. A service adapter maps the signal into the payload envelope of the STS-1 or virtual tributary (VT). New services and signals can be transported by adding new service adapters at the edge of the SONET network.

All inputs are eventually converted to a base format of a synchronous STS-1 signal (51.84 Mbit/s or higher). Lower speed inputs such as DS-1s are first bit- or byte-multiplexed into VTs. Several synchronous STS-1s are then multiplexed together in either a single- or two-stage process to form an electrical STS-n signal (n = one or more).

STS multiplexing is performed at the byte interleave synchronous multiplexer. Basically, the bytes are interleaved together in a format such that the low-speed signals are visible. No additional signal processing occurs except a direct conversion from electrical to optical to form an OC-n signal.

Transport

SONET provides the necessary bandwidth to transport information from one broadband ISDN switch (or terminal) to another. For example, an OC3 (155 Mbit/s) rate may be used to transport an H4 digital broadband channel carrying a broadcast-quality TV signal. Broadband ISDN uses ATM technology.

Asynchronous Transfer Mode (ATM) is the CCITT standard that supports cell-based voice, data, video, and multimedia communication in a public network under broadband ISDN. SONET provides sufficient payload flexibility, so it is used as the underlying transport layer for broadband ISDN ATM cells.

Frame of STS-1 signals

SONET uses a basic transmission rate of STS-1 equivalent to 51.84 Mbit/s. Higher level signals are integer multiples of the base rate.

The frame format of the STS-1 signal can be divided into two main areas: transport overhead and the synchronous payload envelope.

The synchronous payload envelope can also be divided into two parts: the STS path overhead and the payload. The payload is the revenue-producing traffic being transported and routed over the SONET network. Once the payload is multiplexed into the synchronous payload envelope, it can be transported and switched through SONET without having to be examined and possibly demultiplexed at intermediate nodes. Thus, SONET is said to be service-independent or transparent.

The STS-1 payload has the capacity to transport up to

- 28 DS-1s or VT1.5s
- 1 DS-3
- 21 CEPT-1s (2.048 Mbit/s CCITT type signal) or combinations of DS-1s and DS-3
- VT1.5

SONET provides substantial overhead information, which allows simpler multiplexing and greatly expanded OAM&P capabilities. The overhead information has several layers, as follows:

- Section overheadSection overhead is used for communications between adjacent network elements, such as regenerators.
  - — performance monitoring (STS-n signal)
  - — local order wire
  - — data communication channels to carry information for OAM&P
  - — framing
- Line overheadLine overhead is used for the STS-n signal between STS-n multiplexers.
  - — performance monitoring of the individual STS-1s
  - — express orderwire
  - — data channels for OAM&P
  - — pointer to the start of the synchronous payload envelope
  - — protection switching information

- — line alarm indication signal
- — line far-end receive failure indication

- Path overhead Path overhead is carried from end to end. It is added to DS-1 signals when they are mapped into VTs and for STS-1 payloads that travel end to end.
  - — STS path overhead
    - – performance monitoring of the STS synchronous payload envelope
    - – signal label (equipped or unequipped)
    - – path status
    - – path trace
  - — VT path overhead
    - – performance monitoring (VT level)
    - – signal label (equipped or unequipped)
    - – path status
    - – pointer (depending on VT type)

Virtual tributaries

In addition to the STS-1 base format, SONET also defines synchronous formats at sub-STS-1 levels. The STS-1 payload may be subdivided into VTs, which are synchronous signals used to transport lower-speed transmissions. The following table describes the three sizes of VTs.

Table 6-1

Type	Transport for (typically)	VT rate
VT-1.5	1 DS-1 (1.544 Mbit/s)	1.728 Mbit/s
VT-2	1 CEPT 1 (2.048 Mbit/s)	2.304 Mbit/s
VT-6	1 DS-2 (6.312 Mbit/s)	6.912 Mbit/s

Note: SPM does not support VT-2 and VT-6.

VT payloads and VT path overhead comprise the VT's synchronous payload envelope and are similar to the STS payload. Within an STS-1 frame, each VT occupies a number of columns. Within the STS-1, many VT groups can be mixed together to form an STS-1 payload.

SONET network elements

Although network elements are compatible at the OC-n level, they may differ in features from vendor to vendor. SONET does not restrict manufacturers from providing a single type of product, nor require them to provide all types. For example, one vendor might offer an add/drop multiplexer with access at

DS-1 only, whereas another vendor might offer simultaneous access at DS-1 and DS-3 rates.

Add/drop multiplexer

> **ATTENTION**
> SPM does not support this SONET feature.

A single-stage multiplexer/demultiplexer can multiplex various inputs into an OC-n signal. At an add/drop site, only those signals that need to be accessed are dropped or inserted. The remaining traffic continues through the network element without requiring special pass-through units or other signal processing.

In rural applications, an add/drop multiplexer can be deployed at a terminal site or any intermediate location for consolidating traffic from widely separated locations. An add/drop multiplexer can also be configured as a survivable ring.

Drop and repeat

> **ATTENTION**
> SPM does not support this SONET feature.

SONET enables drop and repeat, a key capability in both telephony and cable TV applications. With drop and repeat, a signal terminates at one node, is duplicated (repeated), and then is sent to the next node and to subsequent nodes.

In ring-survivability applications, drop and repeat provides alternate routing for traffic passing through interconnecting rings in a “matched-nodes" configuration. If the connection can not be made through one of the nodes, the signal is repeated and passed along an alternate route to the destination node.

In multinode distribution applications, one transport channel can efficiently carry traffic between multiple distribution nodes. When transporting video, for example, each programming channel is delivered (dropped) at the node and repeated for delivery to the next and subsequent nodes. Not all bandwidth (program channels) need be terminated at all the nodes. Channels not terminating at a node can be passed through without physical intervention to other nodes.

Broadband digital cross-connect

A SONET cross-connect accepts various optical carrier rates, accesses the STS-1 signals, and switches at this level. It is ideally used at a SONET hub. One major difference between a cross-connect and an add-drop multiplexer is that a cross-connect may be used to interconnect a much larger number of STS-1s. The broadband cross-connect can be used for grooming (consolidating or segregating) of STS-1s or for broadband traffic management. For example, it may be used to segregate high bandwidth from low bandwidth traffic and send them separately to the high bandwidth (for example, video) switch and a low bandwidth (voice) switch. It is the synchronous equivalent of a DS-3 digital cross-connect and supports hubbed network architectures.

Wideband digital cross-connect

This type is similar to the broadband cross-connect except that the switching is done at VT levels (similar to DS-1/DS-2 levels). It is similar to a DS-3/1 cross-connect because it accepts DS-1s, DS-3s, and is equipped with optical interfaces to accept optical carrier signals. It is suitable for DS-1 level grooming applications at hub locations. One major advantage of wideband digital cross-connects is that less demultiplexing and multiplexing is required because only the required tributaries are accessed and switched.

Comparisons of asynchronous, synchronous, and SONET

Traditionally, transmission systems have been asynchronous, with each terminal in the network running on its own clock. In digital transmission, “clocking" is one of the most important considerations. Since these clocks are totally free-running and not synchronized, large variations occur in the clock rate and, thus, the signal bit rate.

Asynchronous

Asynchronous multiplexing uses multiple stages. Signals such as asynchronous DS-1s are multiplexed, extra bits are added (bit-stuffing) to account for the variations of each individual stream. These bits are combined with other bits (framing bits) to form a DS-2 stream. Bit-stuffing is used again to multiplex up to DS-3. The DS-1s are neither visible nor accessible within a DS-3 frame. DS-3s are multiplexed up to higher rates in the same manner. At the higher asynchronous rate, they cannot be accessed without demultiplexing.

Synchronous

In a synchronous system, such as SONET, the average frequency of all clocks in the system are the same (synchronous) or nearly the same (plesiochronous). Every clock can be traced back to a highly stable reference supply. The STS-1 rate remains at a nominal 51.84 Mbit/s, allowing many synchronous STS-1 signals to be stacked together when multiplexed without any bit-stuffing. Thus, the STS-1s are easily accessed at a higher STS-n rate.

Transport network using SONET

The transport network using SONET provides much more powerful networking capabilities than existing asynchronous systems. The following are provided by SONET:

- multipoint configurations reduce capital
  - grooming
  - reduced back-to-back terminals and muxes
  - reduced cabling and DSX panels
- enhanced OAM&P
  - OAM&P integration lower costs
  - enhanced performance monitoring lowers costs and add revenue
- concurrent network monitoring and analysis, and operations systems
- intelligent network element operation lower costs
- new services add revenue
- optical interconnect reduce capital, lower costs, and add revenue

These items are described in detail in the following paragraphs.

Multipoint configurations

Most existing asynchronous systems are suitable only for point-to-point, whereas SONET supports a multipoint or hub configuration. Hubbing reduces requirements for back-to-back multiplexing and demultiplexing, and helps realize the benefits of traffic grooming.

Grooming

Grooming refers to either consolidating or segregating traffic to make more efficient use of the facilities. Consolidation means combining traffic from different locations onto one facility. Segregation is the separation of traffic.

It is possible to groom traffic on asynchronous systems; however, to do so requires expensive back-to-back configurations and manual DSX panels or electronic cross-connects. By contrast, a SONET system can segregate traffic at either an STS-1 or VT level to send it to the appropriate nodes.

Reduced back-to-back multiplexing

In the existing asynchronous format, care must be taken when routing circuits in order to avoid multiplexing and demultiplexing too many times because electronics (and their associated capital cost) are required every time a DS-1 signal is processed. With SONET, DS-1s can be multiplexed directly to the OC-n rate in a single process, which results in better quality of service. Because of synchronization, an entire optical signal does not have to be demultiplexed, only the VT or STS signals that need to be accessed.

Reduced cabling and elimination of DSX panels

Asynchronous systems are dominated by back-to-back terminals because the asynchronous Fiber Optic Transmission System architecture is inefficient for other than point-to-point networks.

The corresponding SONET system allows a hub configuration, reducing the need for back-to-back terminals. Grooming is performed electronically so DSX panels are not used except when required to interface with existing asynchronous equipment.

Enhanced OAM&P

SONET allows integrated network OAM&P resulting in benefits of single-ended maintenance. One connection can reach all network elements. Separate links are not required for each network element. Remote provisioning provides centralized maintenance and reduced travel for maintenance personnel. These advantages translate into expense savings.

Enhanced performance monitoring

Substantial overhead information is provided in SONET to allow quicker troubleshooting and detection of failures before they degrade to serious levels. Alarm information such as remote failure indication and remote alarm indication is provided through the SONET network.

New services

ATTENTION

SPM does not support this SONET feature.

SONET can position the network for carrying new revenue-generating services. With its modular, service independent architecture, SONET provides vast capabilities in terms of services flexibility. High speed packet-switched services, LAN transport, and high definition television are examples of services supported by SONET.

Many of these broadband services may use ATM—a fast packet switching technique using short, fixed-length packets called cells.

Optical interconnect

ATTENTION
SPM does not support this SONET feature.

Because of different optical formats among vendors' asynchronous products, it is not possible to optically connect one vendor's fiber terminal to another.

However, SONET allows optical interconnection between network providers, regardless of who makes the equipment. The network provider can purchase one vendor's equipment and conveniently interface with other vendors' SONET equipment at either the different carrier locations or customer premises sites.

Operations, administration, maintenance, and provisioning

Because the transmission network is continuously growing and there are many vendors and types of equipment, network providers must be able to administer, monitor, provision, and control the network from a central location.

SONET improves network management by providing extra bandwidth and functionality in the overhead structure. It supports OAM&P data channels, enabling communications between intelligent controllers and individual network nodes, as well as internode communications. These OAM&P channels are known as data communications channels.

Remote provisioning and reconfiguration

SONET allows circuits to be remotely enabled or disabled to carry or remove traffic. This flexibility allows the network to be dynamically reconfigured due to trouble situations (network restoration), traffic variations, or customer needs (for example, time-of-day service). Other benefits include faster installation of circuits, which is important for special services needs; reduced need to dispatch personnel for circuit provisioning; and ease of reconfiguration, which makes the system more responsive to changes.

Operating systems compatibility

SONET supports the evolution of operations systems (OS), such as those being developed by Bellcore. It is compatible with the Telecommunications Network Manager architecture for OAM&P data communications.

Integrated OAM&P

The following drawbacks are associated with asynchronous networks:

- Separate OSs are used to provide centralized single-ended maintenance.
- A separate data link network is used to connect the OS to each network elements.
- OAM&P bandwidth and information are limited.

SONET addresses these issues through the following:

- making OAM&P an integral part of the transmission standard by broadening bandwidth and information for OAM&P
- providing more operations-level information to simplify activities such as performance monitoring
- consisting of an integral data communications/LAN network
- simplifying implementation of centralized OAM&P

Enhanced performance monitoring

SONET overhead is organized into three layers: section, line, and path overhead. These layers provide abundant information for alarm surveillance and performance monitoring. Many bytes in the SONET overhead are allocated for Bit Interleave Parity-8 (BIP-8), a method of error monitoring. This BIP-8 is actually a byte (eight bits) which creates an even parity over a sequence of bits in the transmitting signal. A full set of performance monitoring statistics can be generated with the format, helping to locate degraded conditions before they become serious.

With SONET's enhanced performance monitoring and surveillance, the time necessary to restore service is reduced. In addition, fewer maintenance actions are required since faults can be more easily sectionalized. Added to this are the advantages of SONET's built-in data communications networking.

Telecommunications management network architecture

> **ATTENTION**
> SPM does not support this SONET feature.

The architecture for OAM&P communications provides a framework for an OS to communicate with the network and vice versa. An OS is a sophisticated application software that manages the whole network.

The OS communicates with the network elements either directly or through mediation devices. Mediation devices can support multiple functions such as consolidation of communication links to the various network elements at the same location, conversion of protocols back and forth, and management of performance monitoring data.

With SONET, the data communication channel can be used as part of the data communications network.

SONET networking

Trends

Increases in demand for services, such as nonswitched private lines, mean more and more T1 multiplexers (intelligent channel banks) are being deployed by large end users. Some implement T3 (DS-3) fiber services to meet these demands.

ISDN and broadband ISDN allow a multitude of new services to provide bandwidth on demand. Users of an integrated services network, which offers voice, data, and video onto a single network, have requirements including variable bandwidth, high bandwidth, user control, measurement of traffic performance, and rapid service provisioning. To provide the necessary bandwidth, fiber has been deployed increasingly in the access area (connections between a service provider's node and the user).

Traditional networks

Traditional networks can be divided into two main areas: access and internode.

Access

The access network (local loop) is composed mostly of twisted copper pairs connecting a switch to a telephone or other terminating equipment. In some areas, T1 lines or fiber are used to connect a switch to a remote (digital loop carrier) terminal. The digital loop carrier terminal, in turn, connects copper pairs to the individual users in a carrier serving area.

Internode

ATTENTION

SPM does not support this SONET feature.

The internode network consists of trunks used to interconnect service provider nodes or to connect those nodes with carrier locations. Fiber routes consist of point-to-point systems with cross-connections at the DSX-3 panel. The fiber system is symmetrical with one terminal end of the system a mirror image of the other. DS-3s enter at one end, leave at the other, and occasionally may be accessed at intermediate drop/insert sites. Current deployments are SONET fiber terminals configured as point-to-point, ring, or 1:n systems.

SONET next generation digital loop carriers combine the access functionality available from DS-0s with SONET transmission capabilities from DS-1 through OC-n.

The transport network is evolving toward a multipoint architecture. SONET enables new configurations to support this evolution. SONET add/drop multiplexer and hub configurations provide efficient traffic management capabilities, both in the access and internode environments.

Enhanced survivability/bidirectional line-switched rings

ATTENTION

SPM does not support this SONET feature.

Network survivability is another important trend. Survivable rings and route diversity are cost-effective solutions for the metropolitan environment. SONET implements (with higher efficiency) the restoration schemes already in place with asynchronous systems. These include 1 + 1 diverse routing, self-healing rings, and digital cross-connects.

SONET-based bidirectional line-switched rings (BLSR) provide “reusable bandwidth" for more efficient internode transport in “meshed" networks. A meshed network means the traffic is more or less evenly distributed among all the nodes rather than being funneled through a few hubbing locations.

Half the available bandwidth in a BLSR is allocated as a working route, and the other half is reserved for protection routing.

SONET supports BLSRs for both internode networks and unidirectional path-switched rings used in access networks. SONET can be easily deployed in the internode network since it is compatible with DS-3, a signal on which existing asynchronous fiber transport systems are based.

List of terms

10B12B

converting 10 bits to 12 bits

12B10B

converting 12 bits to 10 bits

ANSI

American National Standards Institute

application-specific integrated circuit (ASIC)

An integrated circuit designed for a specific application process

ASIC

See *application specific integrated circuit (ASIC)*

automatic protection switch

The process by which a protection channel takes over from a failed working channel or back again.

BLSR

bidirectional line-switched rings

CCS7

See *Common Channel Signaling System 7*.

CEM

common equipment module

circuit pack

In DMS-Supernode, consists of multilayer printed circuit board, through-hole electronic components, backplane connector, faceplate, lock latches, and stiffeners.

CM

See *computing module*.

command interpreter

A support operating system component that functions as the main interface between machine and user. Its principal roles are to read lines entered by a terminal user, to break each line into recognizable units, to analyze the units, to recognize command item-numbers on the input lines, and to invoke these commands.

Common Channel Signaling 7

A digital, message-based network signaling standard defined by the CCITT that separates call signaling information from voice channels so that interoffice signaling is exchanged over a separate signaling link.

computing module

The processor and memory of the dual-plane combined core used by the DMS SuperNode switch. It coordinates call processing functions of the switch, including the actions of the network and peripheral modules. Each computing module consists of a pair of central processing units with associated memory that operate in a synchronous matched mode on two separate planes. Only one plane is active; it maintains overall control of the system while the other plane is on standby.

controlled slip buffer

The controlled slip buffers keeps track of the clock slips. They reside in the OMaR chip on the OC3 resource module (RM).

CSB

see *controlled slip buffer*.

digital signal 1

The 8-bit 24-channel 1.544 Mbits digital signaling format used in the DMS Family. DS-1 is the North American standard for digital trunks. A closely specified bipolar pulse stream with a bit rate of 1.544 Mbit/s. It is the standard signal used to interconnect Nortel digital systems. The DS-1 signal carries 24 information channels with 64 kbits for each channel (DS-0).

digital signal processor

Performs calculations on digital signals that were converted from analog and then sends the results forward.

digital trunk controller

A peripheral module that connects DS-30 links from the network to digital trunk circuits. Supports T1 interface to outside world.

DMS

Digital multiplex system. Telephone switching equipment, namely, digital switching units for interconnecting telephone subscribers, and control terminals. A Nortel trademark.

DMSCP

Digital multiplex system call processing

DMS SuperNode

A central control complex for the DMS Family. The two major components of DMS SuperNode are the computing module and the message switch. Both are compatible with the DMS Family network module, the input/output controller, and the XMS-based peripheral modules.

DMS-Bus subsystem

A Nortel trademark for a transaction bus of DMS SuperNode switch. The DMS-bus consists of a pair of message switches.

DMS-Core subsystem

A Nortel trademark for the computing and control core of DMS SuperNode switch. It is the call management and system control component of a DMS SuperNode and consists of a computing module and a system load module. The 32-bit Motorola MC68020 microprocessor-based replacement for the NT40 based computing module. The DMS-Core is part of the SuperNode technology used to upgrade to a DMS-SuperNode.

DS1

See *digital signal 1*. 1.544 Mbits/sec

DS-512 fiber link

The fiber-optic transmission link implemented in DMS SuperNode switch. The DS-512 connects the computing module to the message switch. One DS-512 link is the equivalent of 16 DS-30 links.

DSP

See *digital signal processor*.

DSP RM

digital signal processor resource module

DSPI

DSP island

DTC

See *digital trunk controller*.

DTCI

digital trunk controller integrated services digital network

DTMF

See *dual-tone multifrequency*.

dual-tone multifrequency

A signaling method that uses set combinations of two specific voice-band frequencies. One of these voice-band frequencies is selected from a group of four low frequencies, and the other is selected from a group of three or four relatively high frequencies.

dynamic random-access memory

A random access memory system that employs transistor capacitor storage cells. The logic state is stored in the capacitor and buffered by the transistor. The capacitive charge must be refreshed at a periodic rate to maintain its programmed state.

ECAN

Echo cancellation

ENET

See *enhanced network*.

enhanced network

Channel-matrixed time switch that provides pulse code modulated voice and data connections between peripheral modules. It also provides message paths to the DMS-bus components.

Ethernet interface unit

An SOS-based peripheral node providing Ethernet interface to non-SOS nodes. It connects the DMS SuperNode to the local area network.

ETSI

European Telecommunications Standards Institute

input/output controller

An equipment shelf that provides an interface between up to 36 input/output devices and the central message controller. The input/output controller contains a peripheral processor that independently performs local tasks, thus relieving the load on the central processing unit.

Integrated Services Digital Network

A set of standards proposed by the CCITT to establish compatibility between the telephone network and various data terminals and devices. ISDN is a fully digital network. It provides end-to-end connectivity to support a wide range of services including circuit-switched voice, circuit-switched data, and packet-switched data over the same local facility.

IOC

See *input/output controller*.

ISDN

See *Integrated Services Digital Network*.

ISUP

See *ISDN User Part*.

ISDN User Part

A Common Channel Signaling 7 message-based signaling protocol that acts as a transport carrier for ISDN services. It provides the functionality in a CCS7 network for voice and data services.

IW SPM

Interworking SPM

link peripheral processor

The DMS SuperNode equipment frame or cabinet that contains two types of peripheral modules: a link interface module and one or more application-specific units. See also application-specific unit, CCS7 link interface unit, and link interface module.

LPP

See link peripheral processor

MAP

A Nortel trademark for testing and maintenance center for telco switching equipment An example of correct use is *MAP terminal or MAP workstation*.

MAPCI

See *MAP Command Interpreter*.

MAP Command Interpreter

A MAP level for accessing maintenance and other functional levels.

MAP terminal or workstation

The maintenance and administration position. It is a group of components that provide a user interface between operating company personnel and the DMS Family systems. It consists of a visual display unit and keyboard, a voice communications module, test facilities, and MAP furniture. MAP is a trademark of Nortel.

MG4000

Multi-Service Gateway 4000

OC3

optical carrier 3

OC3S

see *optical carrier level 3 section*.

optical carrier level 3 section

This is the optical fiber portion of a transmission facility including the termination points. The termination points can be between a terminal network element and a regenerator, or it can be between two regenerators. A terminating point is the point after the signal regeneration at which performance monitoring is (or maybe) done.

ONP

one night process

per-trunk signaling

A conventional telephony method of signaling that multiplexes the control signal of a call with voice or data over the same trunk.

product engineering code

An eight-character unique identifier for each marketable hardware item manufactured by Nortel.

PSOS

peripheral switch operating system

PTS

See *per-trunk signaling*.

RAM

See *random access memory*.

random access memory

A static read/write memory system in which information is stored in discrete individually addressable locations such that access time is independent of location.

read-only memory

A solid state storage chip that is programmed at the time of its manufacture and that cannot be reprogrammed by the computer user.

SIM

shelf interface module

S-Link or SLink

serial link

SONET

See *synchronous optical network*.

SPM
DMS-Spectrum Peripheral Module

STS
synchronous transport signal

STS3L
see *synchronous transport signal level 3 line*.

synchronous transport signal level 3 line
The STS3L is the electrical transmission medium, together with the associated line terminating equipment (LTE), required to provide the means of transporting information between two consecutive line terminating network elements, one of which originates the line signal and the other terminates the line signal.

SWACT
See *switch of activity*.

switch of activity
1) Activity switch between CPUs for maintenance purposes.

2) In a DMS fault-tolerant system, a reversal of the states of two identical devices devoted to the same function. A SWACT makes an active device inactive and an inactive device active.

synchronous optical network
A standard for optical transport that defines optical carrier levels and their electrically equivalent synchronous transport signals. The SONET standard allows for a multivendor environment, positioning of the network for transport of new services, synchronous network, and enhanced operation, administration, and maintenance.

TONESYN
Tone Synthesizer

UI
See *user interface*.

user interface
The series of commands and responses used by operating company personnel to communicate with the DMS-100 Family switches. Communication takes place through the MAP terminal and other input/output devices. Formerly known as human-machine interface.

VSP
voice signal processor

VSP RM

voice signal processor resource module

Digital Switching Systems

DMS-Spectrum Peripheral Module

General Description

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