Lucent Technologies
Bell Labs Innovations

Navis™ Optical Element Management System (EMS) Release 8.0

Applications and Planning Guide

190-224-160R8.0
Issue 1
April 2002

Notice

Every effort was made to ensure that the information in this document was complete and accurate at the time of printing. Information is subject to change; however, Lucent Technologies assumes no responsibility for any errors that may appear in this document.

Mandatory customer information

FCC Warning Statement

This equipment generates, uses, and can radiate radio frequency energy. If not installed, used, and maintained in accordance with the instruction manual, it may cause interference to radio communications. Operation of this equipment in a residential area may cause interference, in which case users will be required to take whatever measures may be required to correct the interference as their own expense.

Trademarks

NetCare, SLC, and WaveStar are registered trademarks of Lucent Technologies.

http://www.lucent.com, LambdaRouter, Lucent, Lucent Technologies, Lucent Technologies NetCare, Metropolis, Navis, and We Make The Things That Make Communications Work are trademarks of Lucent Technologies.

CORBA is a trademark of the Object Management Group.

Hewlett-Packard, HP, HP-UX, GlancePlus, JetDirect, OpenView, PA-RISC, and PerfView are registered U.S. trademarks of the Hewlett-Packard Company.

INFORMIX is a registered trademark of Informix Software, Inc.

Internet Explorer, Microsoft, Windows, and Windows NT are U.S. registered trademarks of the Microsoft Corporation.

Netscape Communicator and Netscape Navigator are U.S trademarks of Netscape Communications Corporation.

Orbix is a registered trademark of IONA Technologies.

Pentium is a trademark of Intel Corporation.

Persistence is a trademark of Persistence Software, Inc.

PostScript is a registered trademark of Adobe Systems Incorporated.

SCSI is a registered trademark of Security Control Systems, Inc.

SPARC is a registered trademark of SPARC, International, Inc. Products bearing the SPARC trademark are based on architecture developed by Sun Microsystems, Inc.

Sun Microsystems and Sun Workstation are registered trademarks of Sun Microsystems, Inc licensed to Sunsoft, Inc; and Java is a trademark of Sun Microsystems, Inc.

UNIX is a registered trademark of the Open Group.

Limited Warranty

Lucent Technologies provides a limited warranty for this product. For more information, consult your local Account Representative.

Ordering information

The ordering number for this document is 190-224-160. When ordering from within the United States, call 1-888-LUCENT8 (1–888–582–3688); from within Canada or North America, call 1–317–322–6615; from other locations around the world, call 1–317–322–6416.

Support

Information product support

You can call the toll-free hotline at 1-800-225-4672 for customer assistance and troubleshooting 24 hours a day. See your Lucent Technologies account representative for further details.

Technical support

For technical assistance in the United States call Lucent's Technical Support Center at 1-866-LUCENT8 (1-866-582-3688). For technical assistance outside of the United States, contact your Local Customer Support (LCS) or the support organization designated by your Lucent customer team representative. If you are unsure of who to call, contact the Global TSS Contact Center at 1-630-224-4672.

Contents

5 NE Interworking

6 Product Services and Support

List of Figures

2 Features

List of Tables

6 Product Services and Support

About this information product

Purpose

The *Navis™ Optical EMS Applications and Planning Guide* (this guide) provides an overview of the Navis™ Optical EMS application, explains its capabilities, and describes the planning that is necessary before a system can be installed.

Reason for reissue

The *Navis™ Optical EMS Applications and Planning Guide*, Issue 1.0, is a new document that supports the Navis™ Optical EMS, Release 8.0.

Safety labels

Safety labels are not applicable to this document.

Intended audience

This guide has been written for network management professionals who need specific information about the features, applications, and operations of the Navis™ Optical EMS.

How to use this information product

The frontmatter and backmatter of this document consist of a table of contents and an index to facilitate finding information quickly.

This document is organized into the following chapters:

- Chapter 1, “System Overview” provides a system overview of the Navis™ Optical EMS application.
- Chapter 2, “Features” describes the features of the Navis™ Optical EMS, which are grouped into Configuration Management, Provisioning, NE Software Management, Fault Management, Performance Management, Application Security Management, and the User Interface. In addition, Navis™ Optical EMS also offers hardware redundancy.
- Chapter 3, “Software Planning and Engineering” provides planning and engineering information on the software related to the use of the Navis™ Optical EMS.
- Chapter 4, “Hardware Planning and Engineering” explains the supported hardware platform for the Navis™ Optical EMS. The Navis™ Optical EMS hardware platform provides a valid operation environment for all system activities and includes host hardware configurations, GUI workstation configuration, and host/workstation-related software configurations.
- Chapter 5, “NE Interworking” provides an overview of the Network Elements (NEs) that the Navis™ Optical EMS supports and details regarding the interworking of each NE and the Navis™ Optical EMS.
- Chapter 6, “Product Services and Support” provides an overview of the services and support offered for the Navis™ Optical EMS.

Conventions used

In this document, any words that are being defined/and or emphasized are shown in ***italic*** type.

How to comment

To comment on this information product online, go to *http://www.lucent-info.com/comments* or email your comments to ctiphotline@lucent.com (mailto:ctiphotline@lucent.com).

Customer satisfaction is extremely important to Lucent Technologies. Users are encouraged to provide feedback on the Navis™ Optical EMS documents.

1 System Overview

Overview

Purpose

This chapter provides a system overview of *Lucent Technologies*™ Navis™ Optical Element Management System (EMS) Application.

Contents

The Navis™ Optical EMS Product

Navis™ Optical EMS Defined

The *Lucent*™ Navis™ Optical Element Management System (EMS) is an Element Management System (EMS) that supports a new generation of Lucent optical transmission products: the WaveStar®, the Metropolis™, and the Lambda product families, which consist of intelligent Network Elements (NEs) that can discover and report their configuration (including physical equipage) and connectivity within the network.

The Navis™ Optical EMS operates as an enhanced graphical tool and as a general configuration management aid. It capitalizes on the capabilities of the NEs and optimizes the management functions of the NEs to create an intelligent operations environment.

Navis™ Optical EMS Features at a Glance

Just as the NEs solve network transport needs, the Navis™ Optical EMS answers the NE's network management needs:

- ***Guaranteed accuracy of management data—***Lucent Technologies' patented Dynamic Network Operations (DNO) process automatically gathers and maintains network configuration information directly from the NEs. This process provides hands-off,, error-free administration of the Navis™ Optical EMS database, guarantees consistency between the database and the actual network configuration, and ensures that Navis™ Optical EMS management functions operate using the actual network configuration.
- ***Centralized, secure, remote administration of NE subnetworks—***from a single work center, a Navis™ Optical EMS user can easily manage multiple networks of NEs that can be arranged in various and geographically dispersed topologies. The Navis™ Optical EMS guarantees a high level of security for this remote access because it enables users to be restricted to management functions and portions of the network that are appropriate for their particular responsibilities.
- ***Evolving optical switching technologies and services support—***the module architecture and object-oriented platform of the Navis™ Optical EMS is ideal for the graceful introduction of new NE types and releases, as well as for new network architectures/topologies, such as Synchronous Transfer Mode via Synchronous Optical Networks (SONET)/Synchronous Digital

Hierarchy (SDH), and Dense Wavelength Division Multiplexing (DWDM). The Navis™ Optical EMS capitalizes on the intelligence of the particular optical NEs for network discovery and network configuration management through its DNO process. In addition, the modular architecture and object-oriented platform of the Navis™ Optical EMS accommodates the graceful introduction of new NE features and services. The Navis™ Optical EMS architecture can accommodate the introduction of new voice and data transport features and services, such as Internet Protocol (IP) and Asynchronous Transfer Mode (ATM).

- ***Support of diverse customer operating environments—***the Navis™ Optical EMS can manage the existing transport infrastructure of large service providers who have management users specialized by function and/or who have their network physically partitioned among management system users; it can manage small start-up networks with end-to-end, single-seat management; and it can meet the needs of private customers who manage their own transport networks.
- ***Scaleable platform—***the Navis™ Optical EMS application and its hardware and software platforms are scaleable and can economically support networks of varying complexity. Sizing guidelines, based on Lucent Technologies' field experience and testing, are available that take into account the size and composition of various customer networks, and the customers' expected usage characteristics.
- ***Higher level TMN support—***for customers who now have, or plan to implement, the Telecommunication Management Network (TMN) architecture, the Navis™ Optical EMS fulfills the role of an EMS, performing the element management functions for the WaveStar™, Metropolis™, and Lambda NEs, and it offers an interface to the Navis™ Optical NMS for network management.

- ***Network transmission protocols—*** The Navis™ Optical EMS supports 7-layer Open Systems Interconnection (OSI) as well as OSI over Transmission Control Protocol/Internet Protocol (TCP/IP) communication protocols over local area network (LAN) physical interfaces.
- ***Application protocols—*** The Navis™ Optical EMS supports Translation Language One (TL1); File Transfer Protocol (FTP); and File Transfer, Access, and Management (FTAM) application protocols. The Navis™ Optical EMS provides a TL1 cut-through capability, allowing the user to access an NE through a native command set.

□

The NE Product Families

The Product Family Vision and Goal

The vision of the WaveStar®, Metropolis™, and Lambda product families is to meet customers' diverse, potentially complex, and rapidly evolving network transport needs.

The goal of these product families is to support any service, at any bandwidth, for any sized network efficiently and economically. This goal is realized through an architecture that provides flexibility and scalability:

- To achieve ***flexibility***, the product families are based on a layered architecture that includes a DWDM optical wave division layer, an STM time division layer—such as SONET and Synchronous Digital Hierarchy (SDH)—and an optical cross-connect system that interconnects the DWDM and STM layers. This flexible, layered approach enables the WaveStar®, Metropolis™, and Lambda product families to acknowledge networks with multiple network layers that can efficiently provide the desired services at the desired bandwidths.
- ***Scalability*** is achieved through an architecture that includes several NE types, each with a modular design using common platform components. This scalability enables the products to be used economically in small and large, complex networks.

The flexibility and scalability of the NE architectures enables the product families to meet the needs of service providers, which differ in the end services to be provided, the service bandwidth requirements, and the size and complexity of the overall network.

Supported NEs

The Navis™ Optical EMS is a management system for the WaveStar®, Metropolis™, and Lambda product families that provides Element Management Layer (EML) functions for all products. The Navis™ Optical EMS management functions include configuration management, fault management, performance management, and security management functions.

As of this writing, the Navis™ Optical EMS currently supports the following NEs:

- LambdaRouter™ All Optical Switch 128/256 (LambdaRouter™ AOS)
- LambdaUnite™ MultiService Switch (LambdaUnite™ MSS)

- LambdaXtreme™ Transport
- Metropolis™ DMX Access Multiplexer (Metropolis™ DMX)
- Metropolis™ DMXpress Access Multiplexer (Metropolis™ DMXpress)
- Metropolis™ Enhanced Optical Networking (EON)
- WaveStar® BandWidth Manager (WaveStar® BWM)
- WaveStar® OLS 1.6T
- WaveStar® TDM 2.5G (OC-48 2F) (WaveStar® TDM 2.5G)
- WaveStar® TDM 10G (OC-192 2F) (WaveStar® TDM 10G)
- WaveStar® TDM 10G (STM-64) (WaveStar® TDM 10G)

Refer to Chapter 5, “NE Interworking” for descriptions of each NE, for the current releases supported, and for a discussion of interworking considerations and constraints.

□

Hardware Architecture

Hardware Components

The Navis™ Optical EMS hardware platform provides an operational environment for all Navis™ Optical EMS activities. It consists the following hardware components:

- *Hewlett-Packard*® (HP) 9000 Enterprise servers, which function as host processors
- user desktops, which enable end users to access the Navis™ Optical EMS GUI and system administrators to administer the system
- system console, which enables installers and/or system administrators to run UNIX commands and install the system

WAN/PSN Connectivity

The Navis™ Optical EMS hardware platform is connected via an Ethernet LAN, with the option to interface via a Wide Area Network (WAN).

A WAN and/or a Packet Switched Network (PSN) is recommended for large, geographically dispersed configurations to concentrate access from the Navis™ Optical EMS to the managed subnetworks. The same WAN/PSN can also be used to access other network management systems or other hosts. Every Navis™ Optical EMS installation requires data connections to each managed subnetwork. The southbound WAN from the Navis™ Optical EMS to the NEs must support an OSI/LAN interface and/or an IP/LAN interface.

HP 9000 Enterprise Server Family

The Navis™ Optical EMS relies these members of the *HP*® ***9000 Enterprise Server Family*** to process user requests:

- ***L-Class server*** is a scalable, entry-level computing device that incorporates features found on HP's mid-range and high-end servers.
- ***N-Class server*** is a scalable, mid-range computing device that provides best-in-class performance, connectivity, and availability.

These servers run on HP's operating system, *HP-UX*® 11.0.

User Desktops

The Navis™ Optical EMS supports three different user desktop platforms for running the GUI client:

- a Windows NT 4.0 PC or Windows 2000 PC
- HP B2000 Workstation running HP-UX 10.20 or 11.0
- Sun Ultra 5 Workstation running Solaris 2.6/2.7

System Console

The system console enables installers and system administrators to run *UNIX*® commands and to install and initialize the system.

The L-Class and N-Class servers can support a typical system console; however, they are shipped with HP's WebConsole.

The WebConsole, which resides at the back of the L-Class or N-Class server, enables installers and administrators to access the server remotely via a LAN connection and an IP address.

□

Software Architecture

Software Components

The Navis™ Optical EMS software architecture is platform based and relies on object-oriented design. The Navis™ Optical EMS software consist of these components:

- the Navis™ Optical EMS Application Program from Lucent Technologies
- integrated software from third parties
- operating systems (OSs) and Internet browsers from third parties

The Navis™ Optical EMS Application Program

The Navis™ Optical EMS software architecture can be divided into the following major subsystems:

- Configuration Management
- Fault Management
- NE Event Handler
- EMS Security Management
- Southbound Application protocol support
  - TL1
  - FTAM
  - FTP

  Southbound Interface protocol support
  - OSI LAN based interface
  - OSI over TCP/IP based interface
  - TCP/IP based interface
- Log Management
- Operation, Administration, and Maintenance
  - Log and trace
  - Scheduler
- *JAVA*®-based GUI

GUI

The Navis™ Optical EMS incorporates a platform independent, Java-based Graphical User Interface (GUI) that is a common interface to all NEs, regardless of type. It provides a powerful, flexible user interface to execute the most frequently used actions. The GUI also supports numerous customization options so users can tailor displays to their preferences.

The GUI provides graphical features such as:

- multilevel displays of the network
- an automatically generated map of the overall managed domain
- hierarchically arranged equipment displays down to the shelf level
- a graphical representation of the cross connection configuration with point and click provisioning
- form and menu-based provisioning for viewing and setting provisional parameters.
- the ability to initiate a cut-through session to directly send TL1 commands to NEs

The recommended platform for the Navis™ Optical EMS Java GUI client is a personal computer (PC) running *Windows NT®* 4.0 with Service Pack 4 or Windows 2000. The Java GUI software is installed on the PC as a standalone application.

Transaction requests are issued by the GUI software to the EMS host. The host returns responses associated with these transactions to the PC. The interface to the PC is an 802.3 LAN link. The GUI application messages and GUI cut-through data traffic are transported using this interface.

□

OA&M

Script-Based Software Installation and Upgrade

The Navis™ Optical EMS has interactive, script-assisted procedures for first time software installation and for subsequent upgrades. These script-based procedures minimize the software installation and upgrade effort. The interactive and menu driven scripts alert users when discrepancies exist and prompt them for the appropriate actions to be taken.

Having a scaleable Navis™ Optical EMS platform enables customers to upgrade as an option and at their convenience. As networks grow, as element management functions are added through new application releases, or as third-party hardware and software platforms are modified, customers must protect the investment they have made in the Navis™ Optical EMS. To that end, Lucent Technologies has created a graceful migration plan from one platform to another. This plan is backed by Lucent's extensive internal testing prior to field deployment.

Self-Monitoring Capabilities

The Navis™ Optical EMS has administrative and self-monitoring capabilities for the application in addition to the basic logging of application errors. These capabilities, such as displaying a color-coded Navis™ Optical EMS host icon and corresponding alarm list, provide the system administrator with real-time information to manage the application proactively.

Startup/Shutdow

The Navis™ Optical EMS provides the system administrator with a means to shut down the application gracefully, which includes saving the data in memory to disk for later startup or comparison. The requesting user is informed of the progress of the shutdown. The application is gracefully shutdown and then restarted when the host HP-UX operating system is rebooted.

As GUI users exit the application, they can save the window settings if they have been changed during the session. Users who exceed the provisionable time-out period are automatically logged off the application.

Data Storage

The Navis™ Optical EMS maintains logs of autonomous messages received from the NEs (Alarm/Event Log and Database Change Notification Log) and paired command/response messages to/from the NEs (Command/Response Log). The application also maintains an activity log and an alarm log of application-originated error/status messages. Each log can be sized to support a user settable maximum number of days for recording. A Navis™ Optical EMS automated process runs on a schedule to purge the logs. The logs are maintained within the application database, in addition to the network configuration data and the PM data collected from the network. The administrator can backup and restore the Navis™ Optical EMS database to and from both disk and tape.

□

System Interfaces

Definition

The Navis™ Optical EMS provides two types of interfaces:

- ***Southbound interfaces*** are required so the Navis™ Optical EMS can communicate with the supported NEs.
- ***Northbound interfaces*** are required so the Navis™ Optical EMS can communicate with other OSs, such as the Navis™ Optical Network Management System (NMS).

Southbound Interfaces

The Navis™ Optical EMS southbound interface contains the required functionality to connect to the NEs, to manage these connections, and to forward and receive the messages between the NEs and Navis™ Optical EMS for all supported communication protocols.

The Navis™ Optical EMS southbound interface supports pure OSI, OSI over TCP/IP, and pure TCP/IP communications with the NEs. However, some limitations exist. Refer to Chapter 5, "NE Interworking" for details.

CM Process

The Connection Manager (CM) process centralizes the functions of sending, receiving, routing, and processing the connections needed for responses and autonomous messages going in, and coming from, the TL1 Southbound subsystems. CM handles the following functions:

- At start up, CM loads external configurative parameters from a configuration file.
- CM creates and terminates associations to all NEs.
- CM staggers association requests to minimize the impact of the connection processes on the network.
- CM implements association recovery mechanisms.
- CM receives connection-related indication messages from TL1 southbound subsystems, updates association status in memory, and forwards notifications to the Navis™ Optical EMS.
- CM creates/modifies/deletes NEs, and stores and forwards related information.
- CM notifies the Navis™ Optical EMS of any incorrect NE types.

TL1 Southbound

TL1 Southbound is supported by the TL1-Manager process, which is responsible for command/response handling.

SONET Directory Services

The SONET Directory Services (SDS) subsystem resides in the southbound system. All system applications access the shared memory contained in SDS to retrieve information. The shared memory contains the status, last update time, and various directory information. The Navis™ Optical EMS relies on two agents to manage this information:

- Directory Services Agent (DSA), which maintains the Directory Information Base
- Directory User Agent (DUA), which retrieves and transfers information to and from the Directory Information Base

The DSA organizes NEs into a structure known as the ***Management Information Tree (MIT)***. The DUA accesses the DSA for any new NEs registered in the MIT and notifies other Navis™ Optical EMS processes of the existence of the new NE. The Navis™ Optical EMS then logs into the new NE and, via the Dynamic Network Operations (DNO) process, gathers the internal configuration and external connectivity relationships from the NE, which ensures that the Navis™ Optical EMS management functions operate using the actual network configuration.

Northbound Interfaces

The Navis™ Optical EMS northbound interfaces include the following:

- Common Object Request Brokered Architecture (CORBA) Northbound Interface
- Northbound TL1
- Navis™ Optical Capacity Analyzer and Navis™ Optical Performance Analyzer Interface
- Data Extraction for File Transfer

CORBA

The Navis™ Optical EMS is designed as an EMS within the Telecommunications Management Network (TMN) layered management model for network management. In addition, the Navis™ Optical EMS provides element management functions (and some subnetwork management functions) for the WaveStar® product line. To provide network level management support, Lucent Technologies offers the Navis™ Optical EMS, which provides end-to-end transport network integration across multiple element management domains.

The Navis™ Optical NMS provides state-of-the-art network management capabilities including:

- end-to-end STM (SDH) circuit provisioning (automatic, semi-automatic, and manual routing)
- end-to-end DWDM optical channel provisioning (automatic, semi-automatic, and manual routing)
- STM (SDH) circuit fault and performance management
- optical channel fault and performance management
- protection switch management

For the northbound interface to the Navis™ Optical NMS, the Navis™ Optical EMS supports a standard northbound interface based on CORBA/IDL. This interface is based on the TeleManagement Forum (TMF) NML-to-EML Interface G7 Version 2.0. In addition, to the transaction oriented CORBA interface to Navis™ Optical NMS, a GUI cut-through capability exists between the Navis™ Optical NMS and the Navis™ Optical EMS that gives Navis™ Optical NMS users direct access to the Navis™ Optical EMS EML screens/functions.

Northbound TL1 Interface

The Navis™ Optical EMS provides a northbound TL1 interface over TCP/IP so other management systems can access the network without having their own interfaces to the NEs. Northbound systems can send TL1 commands and receive responses, and can receive autonomous TL1 messages from the NEs over this interface.

The Navis™ Optical EMS provides both gateway and security functions for this interface:

- The Navis™ Optical EMS provides a gateway function. The northbound system only has to support a TCP/IP interface and have a single IP connection to the Navis™ Optical EMS. The Navis™ Optical EMS maintains IP and OSI connections to the NEs as needed and serves as a TL1 gateway by mapping messages and responses from the northbound IP connection to the various NE connection types. The northbound system also benefits from the EMS' redundant communications paths to the NEs and its robust connection management capabilities.
- The Navis™ Optical EMS enforces security over the interface. Northbound systems use a login on the Navis™ Optical EMS, which is similar to Navis™ Optical EMS user logins, which are subject to Command and Target Group screening. This login authenticates the northbound system and identifies its access and command privileges.

Navis™ Optical CA and PA Interfaces

The Navis™ Optical EMS provides a northbound interface to Navis™ Optical Capacity Analyzer (CA) and the Navis™ Optical Performance Analyzer (PA). The Navis Optical CA and PA are report generation systems that enable users to access, query, and analyze managed network data. The connections that these interfaces afford enable the user to query and retrieve information remotely from the Navis™ Optical EMS database.

Data Extraction for File Transfer

The Navis™ Optical EMS includes a command line feature that enables users to extract data from the Navis™ Optical EMS database and to create a set of predefined data files. These files are structured for convenience in order to generate reports and for transference to other systems (using FTP).

The following four file types are supported:

- an NE data file
- an NE inventory file
- an alarm file
- 15 minute and 24 hour PM data files

□

Navis™ Optical EMS Release 8.0

Highlights of the Navis™ Optical EMS Release 8.0

The highlights of Release 8.0 of the Navis™ Optical EMS include:

- The system supports Release 1.0 of Lucent's next generation DWDM NE, the LambdaXtreme™ Transport. In addition, the system continues to support the NEs that are described in Chapter 5 of this document.
- The system supports the use of ranges in cross-connections for the Metropolis™ DMX and the Metropolis™ DMXpress.
- Significant performance improvements have been made to the system's DNO process. Details on a DNO item on the displayed Status window now show the progress of the DNO job request when the DNO item is selected and the Details button is clicked on the Status window.
- The system PM reports only show parameters with values.
- The system provides operational status for software management file transfer functions.
- The system no longer requires the use of Persistence software.
- The system no longer supports the CMISE protocol for the WaveStar® OLS 1.6T R6.0 and beyond.
- The system no longer supports applications that manage the Metropolis™ EON over X.25 PSNs for R8.1 and beyond.
- As with every release of the Navis™ Optical EMS, the installation of the system has become more streamlined and easy to implement.

□

2 Features

Overview

Purpose

This chapter describes the features of the Navis™ Optical Element Management System (EMS). The Navis™ Optical EMS (the system) is an element management system that provides a set of standard and value-added features that are needed to administer the supported NEs in the WaveStar®, Metropolis™, and Lambda product families. These features are grouped into Configuration Management, Provisioning, NE Software Management, Fault Management, Performance Management, Application Security Management, and the User Interface. In addition, the Navis™ Optical EMS also offers hardware redundancy.

Contents

Configuration Management

The Basis of All Configuration Management Features

The Navis™ Optical EMS automatically creates and dynamically maintains an accurate network model with minimal user input, using Lucent Technologies' patented ***Dynamic Network Operations*** (DNO) process. This model includes the configurations of:

- the entire network, which includes the set of managed NEs and their interconnectivity
- each NE within the network and the internal configuration of each NE

This data is the basis of all configuration management features.

Users can make configuration changes via the system GUI. These changes are translated into the appropriate southbound messages and sent to the NEs. Upon receiving confirmation of the change, the system updates its database to reflect the new configuration.

Configuration changes made to the network other than through the system, such as through the NE craft interface terminals (CITs), are autonomously reported to the system by the NEs, and the system again automatically updates its database.

Subnetwork Initialization

With the DNO process, the NEs are the source of the Navis™ Optical EMS database information. The DNO process consists of two parts:

- discovering the NEs and their associated connectivity
- discovering the internal configuration and the status of each NE

The Navis™ Optical EMS performs the DNO process through communication with the intelligent NEs. DNO ensures that all functions operate using accurate information.

The Navis™ Optical EMS can discover NEs through communication with either of the following:

- central directory
- neighboring NEs

The Navis™ Optical EMS architecture includes a directory with automatic registration of NEs in the directory. This directory includes the NEs by name and address so data connections can be initiated

Note: The directory can also be manually provisioned. Therefore, it is an option to use the directory even for NEs that cannot automatically

register themselves in the directory. The LambdaRouter™ AOS, Metropolis™ DMX, and Metropolis™ EON (40G/80G) cannot automatically register in the directory.

The system administrator must enter sufficient information for the Navis™ Optical EMS to begin communication with the directory—such as identifying the Navis™ Optical EMS as the directory. The Navis™ Optical EMS then automatically initiates DNO and begins the network discovery process. For NEs that do not support a directory or when a directory does not exist in the network, the system administrator must enter sufficient information for the system to begin communication with at least one NE.

Note: NEs can report their OSI neighbors. Thus, all NEs in an OSI-connected set can be discovered through adding any NE within the set. The system can manage multiple independent sets of OSI-connected NEs; and for these instances, the system administrator must enter sufficient information for the system to begin communication with at least one NE in each OSI-connected set.

The LambdaRouter™ AOS, WaveStar®, and Metropolis™ NEs can report the names and addresses of their neighboring NEs. Thus even without a directory, the system can sequentially discover the NEs in the network.

The automatic discovery process discovers the following:

- the network configuration (the nodes in the network and their interconnection)
- the internal configuration of each NE

When an NE is discovered, the Navis™ Optical EMS communicates with each NE to learn its internal configuration—such as its equipage, NE and port parameters, cross-connection configuration—and its connectivity to neighboring NEs. Once the system initially captures the configuration data when it discovers each NE, it uses autonomous messages from the NE's reporting configuration changes to keep its database current. This method ensures the database accuracy regardless of the source of NE configuration changes. Furthermore, the Navis™ Optical EMS incorporates features—such as automatically querying the NEs notification message logs upon a temporary loss of communication with an NE and periodically auditing its own database against the NEs' internal configurations—as additional safeguards to ensure that its own database is current and accurate.

NE Configuration Change Logging

The Navis™ Optical EMS stores all configuration change autonomous messages, which includes database change messages and protection switching notifications, from the NEs in a Notification Log. The Notification Log provides users with a historical record of all configuration changes made on the NEs and it supplements the current configuration data maintained in the system database.

The Notification Log includes all configuration changes, which include those changes made from the craft interface terminal (CIT) and other operation systems. This information is stored online for a user definable number of days. (The maximum value is 45 days.) Users can query, filter, and sort the Notification Log for a display based on the NE, the time period, and the notification type. Users can configure the display to accommodate personal preferences and direct the output to a printer or a file.

Graphical Network and NE Displays

Graphical network and NE displays consist of the following:

- network topology display
- NE equipment displays
- NE graphical display of cross-connects

Network Topology Display

The Navis™ Optical EMS graphically displays its managed subnetworks, which includes the following:

- the NEs
- the facilities (trails) interconnecting the NEs

A subnetwork is a set of NEs connected with transmission interfaces for which a Data Communication Channel (DCC) is active. From the Navis™ Optical EMS perspective, a subnetwork is a set of NEs that can be accessed from the same access NE; that is, the NE can be accessed with a physical OSI LAN or TCP/IP connection to the Navis™ Optical EMS. Via this single access point, the Navis™ Optical EMS can establish connections to all NEs in the subnetwork and initiate the DNO process on the entire subnetwork.

The Map Window

The Navis™ Optical EMS network display enables users to view the layout and status of the entire network via the Map Window. Users can customize the Map Window to match the physical topology of their network and they can tailor the look-and-feel of the display to their preferences. The following table explains the preference

categories.

Table 2-1 Map Window Customization

Preference Category	Allows users to ...
Nodes and Lines	choose the size of the NE and the thickness of the trail lines between the NEs
Labels	choose the size, content, and alignment of the Map item labels
Colors	choose the colors associated with alarms and cross connects
Shapes	choose the shapes used for Map items
Fault	set the preferences associated with how alarms are displayed in the Map and Alarm Notification windows
Other	set the display of various system entities, such as tooltips, to on or off

For a complete representation of any network, the Navis™ Optical EMS allows users to add the following to the Map Window:

- unmanaged NEs, which are any NEs that communicate with the Navis™ Optical EMS, but are not managed by Navis™ Optical EMS
- the physical connections between unmanaged NEs, and unmanaged NEs and managed NEs

The Navis™ Optical EMS can automatically discover NEs that it cannot manage through the T1.245 directory or a neighboring managed NE.

Note: NEs can be manually entered into the T1.245 directory.

The graphical depictions distinguish managed and unmanaged NEs. Users who want to restrict the Map Window to managed NEs can suppress the display of unmanaged NEs.

NE Equipment Display

The Navis™ Optical EMS graphically displays the physical NE equipment, which consists of bays and shelves with slots (either equipped with circuit packs or unequipped). The equipment displays are hierarchically arranged so users can navigate from the complete system view, to bay views, to views of individual shelves. Based on

NE-provided information, this data is updated (via DNO), as equipment is installed or removed in the field.

By selecting a specific entity, such as a pack in the shelf display, users can do the following:

- display the current detailed inventory information such as the software version number, Common Language Equipment Identifier (CLEI™) code, and serial number
- generate inventory reports enumerating the equipment within an NE along with the detailed inventory information
  Example: Users can generate a report of all circuit packs (CPs) in a shelf or all shelves and CPs in a bay. This type of report is useful to check installation jobs remotely because it provides accurate, real-time equipment inventory data.

NE Graphical Display of Cross-Connects

The Navis™ Optical EMS graphically displays a logical view of the NE cross-connection configuration, with dynamically updated information about cross-connections and the ports/time slots that are currently used in cross-connections. The display shows the following:

- ***Ring interfaces*** are depicted on the left and right sides of the window, with the East and West sides of the ring interface on opposites sides of the window.
- ***Non-ring interfaces*** are depicted along the top and/or bottom. Users select the interfaces for display.
- ***Timeslots*** (tributaries) are represented as subdivisions within the ring and non-ring interfaces.
- ***Cross-connects*** are represented as lines between the timeslots (tributaries) of the selected interfaces.

Example: a selected OC-48 interface is subdivided into four STS-12 subdivisions, which in turn are subdivided into four STS-3 subdivisions, which in turn are subdivided into three STS-1 subdivisions. A cross-connect is represented by a line connecting two subdivisions of the same rate. Using this logical view, users can visualize the current cross-connection status—meaning, they can readily identify which ports/time slots already have cross-connects and which are still available. Using this view, users can set up additional cross-connections or modify or remove existing ones.

□

Provisioning

Overview

Provisioning the Navis™ Optical EMS consists of the following:

- date/time synchronization
- scheduling
- NE provisioning

Date/Time Synchronization

The Navis™ Optical EMS uses Network Time Protocol (NTP) to ensure the accuracy of its internal clock. The Navis™ Optical EMS in turn provides centralized, remote date/time synchronization between its internal clock and those of the managed NEs. Synchronization can be performed on-demand or set up on a periodic schedule using the Navis™ Optical EMS Scheduler for the following:

- a single NE
- an aggregate of NEs
- all of NEs in a user Target Group

The time can be set to the Navis™ Optical EMS local time or any other time zone. The transition from standard time to daylight savings time is also supported as a user selected option.

Scheduler

The Navis™ Optical EMS Scheduler enables users to schedule functions to be performed at the following intervals:

- ***Periodic scheduling*** is used for functions that are typically performed on a regular basis. DNO, NE memory backup, and date and time synchronization can be periodically scheduled.
- ***Specific future date and time scheduling*** is generally used for performing time-consuming functions during off-peak hours. Software download and software activation can be scheduled to be performed at specific future dates and times.

The Navis™ Optical EMS monitors the execution of scheduled jobs and attempts to complete failed jobs using re-try algorithms that are incorporated in the corresponding applications. The Scheduler provides a method to have routine tasks done automatically, and it improves performance by moving resource intensive tasks to off-peak hours and staggering them in time.

NE Provisioning

Users can display the current values for NE parameters as set at the NE and modify those parameters that can be administered remotely. The parameters displayed on the NE provisioning window vary depending on the NE type and release number. As with most Navis™ Optical EMS provisioning features, users specify parameter values by selecting a set of allowable values.

Equipment Provisioning

The LambdaXtreme™ Transport, LambdaRouter™ AOS, WaveStar®, and Metropolis™ NEs have modular architectures so they can be economically configured to meet service demands. Through equipment provisioning, additional bays, shelves, and circuit packs can be added to the system to provide additional capacity; or the parameters of existing equipment can be modified.

The NE, and Navis™ Optical EMS support equipment pre-provisioning; so, equipment can be defined and provisioned in the software prior to its physical installation, which minimizes service turn-up times. The Navis™ Optical EMS maintains the equipment status; and in the graphical displays of the equipment, it distinguishes between equipment that is physically installed from that which is software defined—equipment that is defined in software is provisionable along with the physically installed equipment.

Equipment provisioning is supported with windows that display the current provisioned values, typically with lists of allowable values for making configuration changes. Using these features, users can create new equipment for pre-provisioning and provision existing equipment.

Refer to Chapter 5, “NE Interworking” for special considerations regarding the optical allocation provisioning for the WaveStar® OLS 1.6T NE.

Protection Group Provisioning

Protection groups include the following groups:

- equipment protection groups
- transmission interface (port) protection groups
- path protection groups, which are made through establishing path protected or merged cross-connects on TDM NEs and making associations to optical path protection circuit packs on DWDM NEs

Protection group provisioning for equipment and path protection groups is generally limited to modifying parameters. (The protection group members are fixed.) However, to support protected transport

services, the WaveStar® and LambdaUnite™ MSS NEs allow for the flexible organization of their ports into protection groups.

Most WaveStar® NEs allow users to create port protection groups and to assign ports to roles in those protection groups, including both ring and linear port protection groups.

Example: a user can create a 4-fiber, bi-directional line-switched ring (BLSR) protection group and assign any four ports on a shelf to the four roles in that protection group, which are the East Service member, the East Protection member, the West Service member, and the West Protection member. Thus, while equipment and path protection groups are typically limited to modifying parameters, port protection groups can also be created, deleted, and the members of the group can be modified. Also, with the introduction of nonpreemptive protection access (also called ***nonpreemptive unprotected traffic***), individual tributaries can be excluded from participating in BLSR/MS-SPRing protection groups.

NE Protection Group Provisioning

The flexible and configurable protection groups supported by the WaveStar® and the LambdaUnite™ MSS NEs coupled with the Navis™ Optical EMS protection group provisioning capabilities, enable users to perform many network re-arrangements remotely with only software changes.

The Navis™ Optical EMS protection group provisioning features enable users to display, create, delete, and modify the protection groups for WaveStar® and LambdaUnite™ MSS NEs.

Important! The exact capabilities of a protection group are a function of the protection group type. Equipment and path protection groups are limited to modifying parameters. Port protection groups include the capability to create, delete, and modify the members of the group.

Navis™ Optical EMS features limit the user to valid choices based on the current NE configuration and apply constraints based on the NE and protection group type.

Example: To create a new 4-fiber BLSR protection group on the WaveStar® BWM, the Navis™ Optical EMS provides selection choices based on constraints such as: a port can only be in a single protection group, all ports in a protection group must be at the same line rate (e.g., OC-48), or all ports in a protection group must reside on the same shelf. These features help users to manage the

WaveStar® NEs' protection groups efficiently and accurately. The non-preemptible protection access (also called non-preemptible unprotected traffic) feature enables individual tributaries to be excluded from participating in BLSR/MS-SPRing protection groups.

NE Protection Switch Status Management

The Navis™ Optical EMS maintains the current protection switch status of all protection groups. Besides letting users retrieve and display the current protection switch status of a protection group at any time, the system notifies users of each automatic protection switch event. From the system GUI, users can also request a manual protection switch or request to release a protection switch.

Port/Tributary Provisioning

Navis™ Optical EMS features support port (SONET OC-48 ports, SDH STM-16o ports, DWDM optical lines, and DWDM OTU ports) and tributary (SONET STS-1 tributaries, SDH VC-4 tributaries, and DWDM optical channels) provisioning. Users can display the current values for port and tributary parameters as set at the NE, and modify any parameters that can be administered remotely.

Examples: port parameters are port mode and signal degrade threshold; tributary parameters are tributary monitoring mode and path trace.

The Navis™ Optical EMS also supports port and tributary aliases, which allow users to identify ports and tributaries using their own naming schemes instead of using the native identifiers that the NEs support. Once provisioned, an alias is accessible in the Network Element Explorer (the hierarchically organized list of all provisional objects in an NE) and the Alarm List.

Port and tributary provisioning features use a form-based display of the current values, typically with selections that can be made from lists of allowed values. Users can provision the parameters on selected ports and tributaries and they can also apply this provisioning to other ports or tributaries.

Point and Click Cross-Connect Provisioning

From the graphical cross-connect display, users can add, modify, and delete cross-connects. The Navis™ Optical EMS also provides functions for the following:

- to convert cross-connections to and from path-protected cross-connections
- to mark a cross-connection as red-lined, which prevents its removal unless the red-line indication is first removed
- to roll a cross-connection from one source address to another to support bridge and roll operations

Note: Bridging and rolling moves a circuit to different facilities within the network without disrupting service (for example: to change the route a circuit uses across a network, while the endpoints remain the same). The circuit is first bridged at the source, and additional connections are then added through the network so the signal is simultaneously carried on both the old route and the new route through the network. (At this point, the receiver is still taking the signal from the original source.) The circuit is then rolled at the sink (at the receiver) from the original source to the new source. With the roll, the circuit is now using the new route, and the connections associated with the original route can be removed. Not all NE types support rolling cross-connects.

Users are limited to choices based on the system's cross-connection algorithms and knowledge of the current configuration of the NE. These algorithms apply NE specific constraints regarding cross-connects, such as allowable cross-connection rates and types, and restrictions based on the NE's cross-connection capabilities, equipage, and current cross-connection status. The cross-connect action is displayed as a ***pending*** state until NE confirmation is received.

The Navis™ Optical EMS also allows users to have an additional descriptive field with each cross-connection. This field is maintained on the Navis™ Optical EMS and can be used to keep additional information with each cross-connect.

Example: Additional descriptive information that could be kept on hand would be an alternate cross-connect name or a note to associate a circuit ID with the cross connect.

The WaveStar® BWM, WaveStar® TDM 2.5G/10G (OC-48), WaveStar® 10G (STM-64), and the LambdaUnite™ MSS NEs support

low-level atomic cross-connections. These cross-connection can be flexibly combined to realize a variety of services; however, several cross-connections must be made at a single NE to realize any additional services.

Example: Provisioning path-protected circuits requires three atomic cross-connections at the originating and terminating NEs of the circuit—only a single cross-connection is required at the intermediary NEs.

To simply this provisioning, the Navis™ Optical EMS provides a special template to enable users to create path-protected cross-connections for these NEs in a single operation (for example: create and delete the set of three cross-connections that make up a path-protected cross-connection in a single operation.

Ethernet Layer 2 Routing Provisioning

The STM time division NEs have Gigabit Ethernet and Fast Ethernet circuit packs that include Ethernet packet switches. These packet switches, which perform layer 2 packet routing, route packets between the Ethernet ports and internal Virtual Concatenation Group (VCG) tributaries for transport across a SONET/SDH network. Depending on the NE type, the Ethernet circuit packs support one or more modes of operation—such as the IEEE 802.1q tagging mode where the Ethernet switches perform routing functions by a Virtual LAN (VLAN) identifier. The Navis™ Optical EMS provides features to configure the packet routing for these Ethernet switches.

Example: The packet routing between Ethernet port and VCG tributaries is configured by a VLAN identifier in IEEE 802.1q tagging mode. To support this tagging mode, the Navis™ Optical EMS provides a feature that enables users to assign a VLAN identifier to Ethernet ports and VCG tributaries so the Ethernet layer 2 routing and features can be configured.

To work efficiently, Ethernet bridges and routers use spanning tree algorithms to create and maintain routing tables with a tree-like structure within a mesh network—in other words, they locate a routing structure that eliminates loops within a mesh-based network. Spanning tree provisioning is used to put VCGs into spanning tree groups and to identify priorities. The Navis™ Optical EMS supports this provisioning with friendly menus and forms.

DCN Provisioning

The Navis™ Optical EMS provides GUI based functions for Data Communications Network (DCN) provisioning for supported NEs.

WaveStar®, Metropolis™, LambdaUnite™ MSS NEs support external LAN interfaces and provide embedded data communications channels (DCCs) within their transmission interfaces. DCN provisioning includes provisioning for LAN and DCC interfaces. For these interfaces, DCN provisioning includes multiple aspects of data communications and data communications protocol provisioning, including the following:

- provisioning OSI and IP addresses
- provisioning IP and OSI stack parameters (for example: OSI transport and network layer parameters)
- provisioning TARP parameters
- enabling and disabling DCC interfaces
- resetting LAN interfaces

The DCN provisioning features use a form-based display of the current values, typically with selections that can be made from lists of allowed values.

Synchronization Management

The Navis™ Optical EMS provides a Synchronization Management feature to facilitate user operations for the configuration, management, and control of timing sources and the distribution of outgoing timing. TDM NEs support external timing references, support (OC-n/STM-n) link timing, and have their own internal clocks.

The Synchronization Management feature includes functions to do the following:

- to provision incoming and outgoing external timing ports
- to establish timing references and their relative priority
- to provision system timing parameters
- to display the current synchronization status
- to support the remote execution of manual synchronization controls, such as forcing switches in the selected source of synchronization timing and changing clock modes

As with other system provisioning features, the Synchronization Management feature uses a form-based display of current values, typically with selection form lists of allowable values to make configuration changes.

□

NE Software Management

NE Memory Backup and Restoration

For the WaveStar®, Metropolis™, and Lambda product families, the Navis™ Optical EMS provides remote NE memory backup and restoration using the file transfer of a binary image of the NEs' complete memory.

The Navis™ Optical EMS supports the following file transfer protocols:

- the file transfer protocol (FTP) for TCP/IP-connected NEs
- file transfer, access, and management (FTAM) for OSI-connected and OSI over TCP/IP-connected NEs

If a catastrophic failure occurs, NE Memory Backup and Restoration replaces manual record keeping and manual data entry to reconstruct the NE database. For NEs that also have a secondary storage device for local backup and restoration of its primary memory, the Navis™ Optical EMS also supports memory backup and restoration to and from the NE's secondary storage.

The backup procedure can be executed:

- on-demand
- scheduled via the Navis™ Optical EMS Scheduler

Up to seven backup files can be saved per NE, with the oldest file overwritten once the limit is reached.

Major Capabilities of NE Memory Backup and Restoration

NE Memory Backup and Restoration provides the following major capabilities:

- Compatibility with TCP/IP and OSI networks.
- A user-selectable ***Intelligent Backup*** mode option for on-demand and scheduled backup operations. With the ***Intelligent Backup*** mode, memory backups are performed only if the NE configuration has changed since the most recent backup. (The Navis™ Optical EMS tracks configuration changes that have occurred since the last backup and only proceeds with the memory backup if changes have occurred.)

- If a command that could change any parameter setting that is backed-up is executed while the NE memory backup is in progress, the Navis™ Optical EMS displays a warning message upon completion of the backup.
- A warning is provided if a mismatch occurs between the NE type or NE release of the backup file and the NE to be restored upon a memory restoration request.

NE Generic Software Management

NE Generic Software Management provides for the following:

- the management of NE software releases on the Navis™ Optical EMS
- the high speed download of generic NE software from the Navis™ Optical EMS to the NE via the intraoffice LAN (IOA LAN), which can be an OSI LAN, a TCP/IP LAN, or a combination a TCP/IP and an OSI LAN)
- remote software activation

The following major functions are provided:

- copy NE software from source media to the Navis™ Optical EMS file system
- perform high speed download of a selected NE software version from the Navis™ Optical EMS to the NE
- copy software from NE to NE for most NE types
- activate (install) software in the NE
- delete NE software from the Navis™ Optical EMS file system

These functions can be initiated manually via the GUI. In addition, downloading software to an NE, copying software from NE to NE, and activating NE software can be scheduled. The Navis™ Optical EMS maintains the current software version of the NE in its database and verifies the compatibility of the software version for the download, copy, or activate with the NE type and current software version.

Important! Not all NEs support remote software downloads or software copies between NEs. Refer to Chapter 5, “NE Interworking” for details of what a particular NE supports.

□

Fault Management

Alarm Collection

The Navis™ Optical EMS provides for autonomous and on demand collection of alarms (and non-alarmed standing conditions).

The Navis™ Optical EMS collects the following:

- all facility and equipment alarms (including environmental alarms), alarm clearing messages, and event messages that the NEs autonomously generate
- all internally detected Navis™ Optical EMS alarms
- all communication alarms from the NE to the Navis™ Optical EMS

The Navis™ Optical EMS keeps its alarm database current to reflect the real-time alarm state of the network.

Alarm Display

Alarms (and non-alarmed standing conditions) are displayed in graphical and textual formats.

The alarm status in all graphical and textual formats is dynamically maintained as new alarms are received and existing alarms clear.

Graphical Format

The Graphical User Interface (GUI) provides a color-coded control panel, with counts of alarms per severity type, that changes as alarms are received and cleared. These alarms include those originated by NEs as well as alarms detected by the Navis™ Optical EMS (self-detected Navis™ Optical EMS failures and Navis™ Optical EMS detected data communication failures between the Navis™ Optical EMS and the managed NEs).

The following table shows the default colors used for each alarm severity level.

Table 2-2 Default Colors Used for Alarm Severity Levels

Default Alarm Color	Alarm Severity Level for SONET Transport	Alarm Severity Level for SDH Transport
Red	Critical	Prompt
Yellow	Major	Deferred
Cyan	Minor	N/A
Gray	Throttled	N/A

Table 2-2 Default Colors Used for Alarm Severity Levels (continued)

Default Alarm Color	Alarm Severity Level for SONET Transport	Alarm Severity Level for SDH Transport
Green	No Active Alarms	No Active Alarms
Magenta	Loss of Communication	N/A
White	Not Alarmed State	Not Alarmed State

The GUI also displays a color-coded logical Map Window with icons representing each managed NE and the Navis™ Optical EMS host. In the Map Window, NEs can be grouped into user-definable groups called ***aggregates,*** and the Navis™ Optical EMS displays the color code that represents the highest-severity, currently-active alarm for each entity displayed on the map (aggregate, NE, Navis™ Optical EMS, and optical trail/facility). **GUI**

Important! Aggregates are used to simplify the complexity of the Map Window. NEs can be grouped to form an aggregate so an icon for the aggregate can be displayed in place of the NEs on the Map Window. Aggregates on the Map Window can be ***exploded*** to illustrate their entities. ***Example:*** the NEs of a ring can be grouped to form an aggregate that represents the ring. The aggregate can be represented as an icon on the map, or the aggregate may be expanded on the Map Window so each NE within it is represented by an icon. Aggregates can be placed in other aggregates in a hierarchical fashion, which results in a Map Window that has multiple levels.

In addition to the Map Window, the Navis™ Optical EMS also provides color-coded NE equipment displays to represent the highest-severity, currently-active alarm on each piece of equipment.

Example: the shelf level displays indicate the highest severity alarm for each circuit pack. This nested set of displays allows users to ***drill down*** from aggregates to individual NEs to bays and shelves of the NEs to view the source of the alarm. Users can also navigate directly from the Alarm List to the equipment view with the alarmed item (the shelf view with the alarmed circuit pack).

Textual Format

The Navis™ Optical EMS provides textual alarm summaries and listings, which include tabular equivalents to the graphical alarm

displays, that are dynamically updated as alarms are received and cleared.

These tabular listings:

- provide summaries and/or exhaustive listings of active alarms in the network (or selected aggregate or NE)
- provide access to the complete message of each alarm
- support sorting so users can group and order lists to meet their needs
- support filtering so users can choose a subset of alarms to display—for example: only the set of service affecting or unacknowledged alarms

Transient Event Display

The Transient Event Display provides users with a notification of transient events along with a dynamically maintained display of incoming transient events. The notification triggers users to open the display of transient events.

The display includes all events that were received since the display was last closed:

- While open, the display is automatically updated with each new incoming transient event.
- After closing, the display automatically clears. (The Alarm Log continues to provide a persistent record of all incoming transient events.) An indicator in the GUI notifies users of new transient events while the transient event display is closed. Displaying the transient event list turns off the indicator. This capability is coupled with the existing event-per-time (EPT) filter so only transient events that exceed the EPT filter are forwarded to the GUI for notification and display.

Alarm Processing and Volume Reduction

Alarm processing applies to both the GUI and, when applicable, forwarding alarms, conditions, and events to northbound OSs. Alarm processing reduces the volume of alarms that the users and other systems must handle.

User-Settable Alarm Monitoring

The Navis™ Optical EMS allows users to predefine a ***throttle level*** for alarm monitoring. When the rate of alarms from an NE reaches the predefined throttle level, the Navis™ Optical EMS automatically adjusts its mode of alarm processing and monitoring for that NE—it

logs all alarms, but passes only critical alarms to be processed and displayed.

This feature provides overload protection and is useful during events such as initial turn-up, where an NE generates numerous messages, which are typically not service-affecting. This feature can also be manually invoked.

Aging

The Navis™ Optical EMS receives alarms and holds them for a user-defined period of time, and logs them before displaying them on the GUI. If a clear message is received within this period of time, the alarm is not shown. Alarm aging suppresses transient alarms. The duration of holding time, which includes an option for no aging, is administrator tunable.

SAF

To conform with SONET, SDH, and other standards, NEs generate directly detected and symptomatic alarms. The Navis™ Optical EMS provides Symptomatic Alarm Filtering (SAF) to suppress symptomatic alarms, which are typically generated to make users aware of problems that can affect their services, but that have occurred in another management domain. With SAF, the system only displays directly detected root cause alarms and it allows users to display the filtered or unfiltered view of the network's current alarm status.

Example: NEs generate Alarm Indication Signals (AISs) and Remote Failure Indications (RFIs) when they detect certain incoming failure conditions. Therefore, AISs and RFIs are symptomatic of other failure conditions within the network, such as a loss of signal (LOS) that results from a fiber cut.

Event Per Time (EPT) Thresholds

The Navis™ Optical EMS receives transient event messages, such as Threshold Crossing Alerts (TCAs), and counts them over a pre-set time period. Different threshold levels can be set for each event type. If the incoming rate of transient events exceeds a user-specified frequency, the Navis™ Optical EMS forwards the event to subscribed northbound systems and to the GUI for display. EPT thresholding identifies chronic performance problems or ***bad actors***.

Audible Alarm Alerting

The Navis™ Optical EMS provides an audible signal for new alarm conditions that apply to a particular user Target Group. The audible

signal persists for a configurable interval, and periodically repeats until:

- the user acknowledges the audible signal
- the alarm condition(s) clears

The severity of the highest displayed alarm on a GUI dictates the sound that is generated. The new alarm conditions include alarms generated by the NEs for network failures, environmental alarms, and alarms generated by the Navis™ Optical EMS host. This feature can be enabled/disabled per host and per user GUI.

Non-alarmed events do not generate audible signals. The audible signal's parameters (sound, duration, and interval between repetitions) can be administered globally for each Navis™ Optical EMS host.

Visible Alarm Alerting and Acknowledgment

The Visible Alarm Altering and Acknowledgement feature indicates the receipt of a new alarm by flashing the impacted icon on the GUI. These new alarms stop flashing when users acknowledge the alarm or the alarm is cleared.

The Navis™ Optical EMS supports options for the following types of alarm acknowledgement:

- ***Single acknowledgement*** provides for one acknowledgement of an alarm.
- ***Double acknowledgement*** provides for an acknowledgement of both the setting and clearing of alarms.
- ***No acknowledgement*** of alarms does not acknowledge any alarms and disables visible alarm alerting.

If the receipt of the alarm is acknowledged when double acknowledgement is enabled, the clear must also be acknowledged to remove the alarm from the active alarm list. With single and double acknowledgement, the ID of the person who acknowledges the alarm is logged in the Navis™ Optical EMS database and is displayed as a field in the alarm list display.

The Navis™ Optical EMS also provides an option for ***alarm latching***, which requires an alarm to be acknowledged before it is removed from the active alarm list. Thus, an alarm that sets and clears without any user intervention cannot quietly disappear from the active alarm list without user acknowledgement. Along with single or double alarm acknowledgement, alarm latching ensures that every alarmed condition is brought to the user's attention.

The Navis™ Optical EMS suite of alarm alerting and acknowledgement features provides a powerful and flexible system for bringing alarms to the user's attention and tracking and managing the alarm handling process.

Automatic Alarm Resynchronization

The Navis™ Optical EMS automatically uploads the NE's current alarm (and non-alarmed standing condition) status when a connection is first established with an NE, and when a connection is re-established with a NE following any data communications failure. (In addition, the user can initiate an on-demand alarm resynchronization with a specified NE.)

This automatic alarm resynchronization ensures that the Navis™ Optical EMS has an accurate view of the current alarm status if autonomous messages are not received because of a communications failure. The alarm resynchronization feature updates the Navis™ Optical EMS database and the GUI alarm displays as a part of the resynchronization process.

Alarm Logging and Storage

The Navis™ Optical EMS receives and stores every NE-generated ***alarm***, ***condition***, ***alarm/condition clear***, and ***event*** message in an alarm/event log. The set and clear messages for alarms and standing conditions are linked as a single record, along with user acknowledgement information. Thus, the alarm/event log provides a complete record of all alarm related activity and allows users to see the current status of the alarms and a history of their disposition. Threshold Cross Alerts (TCAs) and other transient events are also maintained in the log.

This information is stored online for a user definable number of days, the maximum of which is 45 days. The number of days for which information is stored is also subject to system storage capacity and the received alarm/event traffic. If insufficient storage capacity exists for the volume of received alarms/events, the oldest alarm/event messages are overwritten regardless of their age.

Users can query, filter, and sort the Alarm/Event Log for display based on the NE, the time period, the message type (alarm, event, or both) and several other parameters that are associated with alarm and events. Users can configure the display to accommodate personal preferences and direct the output to a printer or a file.

Environmental Alarms

The Navis™ Optical EMS receives environmental alarms, which are alarms that typically indicate central office related failures as opposed to NE specific abnormal conditions. These alarms are forwarded by the NEs and are displayed graphically with the other NE generated alarms. They are color-coded to match their severity.

The description of the environmental alarms (also called ***scan points*** or ***miscellaneous discrete inputs***) is provisionable on each NE.

In addition, the provisioning of control points (also called ***miscellaneous discrete outputs***) is supported using a menu and forms based interface. Most NE types provide control points to control miscellaneous equipment in the central office remotely. Similar to scan points, the description to identify the function of control points is provisionable.

Alarm Severity Provisioning

Rather than setting alarm severities individually for every object within the NE that can emit an alarm, the WaveStar® NEs use ***alarm profiles*** to set alarm severities.

Example: An OC-n port has an alarm profile, which specifies the alarm severities for various port failure conditions, such as a service-affecting loss-of-signal (SA-LOS). Individual OC-n ports are assigned to an OC-n port alarm profile to set their alarm severities, which enables the alarm severities to be changed for numerous ports by changing the alarm profile to which they are assigned.

The Navis™ Optical EMS supports remote provisioning to view, create, delete, and modify the alarm profiles. Using this feature, users can display the set of alarm profiles on one or more selected NEs, and select an alarm profile to view, modify, or delete.

Alternatively, users can create a new alarm profile for the NE. As with other Navis™ Optical EMS features, provisioning is through user-friendly screens that provide a set of provisionable parameters and offer selection from sets of allowed values. The assignment of alarm profiles to objects, such as ports or protection groups, is a part of the corresponding provisioning function—that is, it is a part of port provisioning or protection group provisioning.

Test Access Management

Test access management consists of test access configuration management and loopbacks. Test access configuration management, along with loopback management capabilities, enable remote network testing and fault isolation.

Both test access connection management and loopback status are maintained in the Navis™ Optical EMS database and are integrated into the system's cross-connection features so circuit provisioning users know which tributaries and/or timeslots are currently involved in the test access connection or the loopback.

Test Access Connection Management

Test access connections provide access for external test systems to monitor and test signal paths. The Navis™ Optical EMS test access connection management feature enables users to do the following:

- display the current set of test access connections
- create new test access connections
- change test access modes
- release existing test access connections

The Navis™ Optical EMS test access connection management feature graphically illustrates the types of test access connections, which are:

- Monitor E-Tributary (MONE)
- Split E-tributary (SPLTE)

Loopbacks

NEs support various types of loopback capabilities. Along with test sets and test access capabilities, these loopback capabilities enable users to inject and monitor test signals to verify system performance and isolate faults.

Fundamentally two types of loopbacks exist:

- loopbacks on an entire facility called ***facility loopbacks***
- loopbacks on individual tributaries (***timeslots***) called ***cross-connect loopbacks***. The cross-connect loopback status is maintained in the system database and is integrated into the system's cross-connection features, so circuit provisioning users are aware of tributaries/timeslots that are currently involved in a cross-connect loopback.

The Navis™ Optical EMS manages loopbacks by type. The system's loopback management features enable users to display the current set of loopbacks on an NE, create additional loopbacks, and release loopbacks.

As with other Navis™ Optical EMS features, these capabilities are supported with forms and menu-based selection.

Example: to remove a loopback, the user is presented with the current set of active loopbacks and selects the loopback to be released.

□

Performance Management

Exception Reporting

The Navis™ Optical EMS provides performance exceptions by logging Threshold Crossing Alerts (TCAs) received from the NEs. TCAs, which are in the form of reported events, are generated whenever an administered performance threshold is exceeded in the NE. TCAs are an example of a transient event and are handled as a part of transient event reporting.

In addition, transient events are available as a subset of the Alarm Log. Refer to the previous section in this chapter titled "Alarm Logging and Storage" (2-22).

PM Data Collection and Reporting

The Navis™ Optical EMS enables users to collect and store Performance Monitoring (PM) data from the NEs' 15 minute and daily registers.

The primary role of the Navis™ Optical EMS in collecting PM data is to be an intermediary storage point and to provide centralized access to PM data for performance data report generation systems at the network management layer, such as Lucent Technologies ITM DNA. However, the system also provides basic queries and reports of the stored PM data.

Users have two options to select to collect PM data. They can select one option for 15 minute PM data collection and the other option for 24 hour PM data collection:

- With ***PM data collection by a termination point type***, users can specify the NE and the port and tributary types (OC-3, STM-1o, STS-1) for which PM data is to be collected. PM data is then collected for all termination points of that type on the NE. This option best suits operators who want universal or near universal PM data collection across their network.
- With ***PM data collection by an individual termination point***, users can specify the NE and the exact ports and tributaries of that NE for which PM data is to be collected. PM data is then collected only for those specific points. This option suits the needs of operators who want to collect PM data for specific services or in response to specific complaints or problems.

With either option, the Navis™ Optical EMS periodically collects the requested PM data. The collected PM data is stored in the system

database and is accessible by users. The Navis™ Optical EMS can provide storage for up to 30 days of PM data.

In addition, the Navis™ Optical EMS provides two types of queries and reports to view all PM data. The system provides the following:

- reports to view all PM data of a ***given type*** (all OC-3 ports of an NE) for a single collection interval.
  Example: Navis™ Optical EMS users can query the PM database by NE, PM interface type, PM data type (24 hour or 15-minute), and date and time (time only applies to 15-minute data) to display the PM data for this interval in a tabular format.
- reports to view all PM data for up to ***two collection points*** (a single OC-3 port) across multiple collection intervals.
  Example: Navis™ Optical EMS users can query the PM database by NE, specific collection point, PM data type (24 hour or 15-minute), start date and time, and end date and time to produce a PM report.

Users can display PM reports with either of the following:

- the raw PM counts (the number of errored seconds)
- the raw counts and the percentages of the counts relative to the maximum values (percentage of errored seconds)

Remote Administration of PM Parameters and Thresholds

The Navis™ Optical EMS supports the remote administration of performance monitoring (PM) parameters for the WaveStar® NEs.

The Navis™ Optical EMS supports remote provisioning to view, create, delete, and modify the Threshold Crossing Alerts (TCA) threshold profiles. Using this feature, a user can display the set of TCA threshold profiles on one or more selected NEs (that use the concept of TCA profiles for each type of object); and then select a TCA threshold profile to view, modify, or delete.

As with other Navis™ Optical EMS features, provisioning is done through user-friendly screens that provide the set of thresholds and offer selection from sets of allowable threshold levels. For digital performance monitoring (PM) parameters, the system supports viewing and setting the threshold values as either of the following:

- raw counts (the number of errored seconds)
- a percentage of the maximum value (the percentage of errored seconds)

The assignment of TCA threshold profiles to objects, such as ports, is done as a part of the corresponding provisioning function (such as a part of port provisioning).

□

Security Management

Overview

The Navis™ Optical EMS maintains a set of NE connections that all users share. In this environment, administration of individual user logins and passwords is centralized on the Navis™ Optical EMS rather than distributed across the managed NEs. The system provides two levels of login security:

- one for access to the desktop (for example, the Windows PC)
- one for access to the Navis™ Optical EMS application

Network access through the Navis™ Optical EMS affords users more robust and flexible security management than is afforded to them when they access the NE though its craft interface terminal (CIT).

Global Password Administration

The Navis™ Optical EMS provides enhanced security over its southbound interfaces to the NEs, which is achieved by supporting global password administration for the NE login IDs used by the Navis™ Optical EMS.

Global password administration enables the Navis™ Optical EMS system administrators to change passwords easily for numerous NEs in a single operation.

Example: In a single operation, system administrators can change all NEs, all NEs of a selected NE type, or all NEs in an aggregate of NEs.

Global password administration coordinates changing the information in the NE's local security system and in the Navis™ Optical EMS database as a single user operation.

Target and Command Group Partitioning

The Navis™ Optical EMS provides a powerful and flexible permission scheme using the following configurable groups to which users can be partitioned:

- ***NE Target Groups***, which define the NEs that users can access
- ***Command Groups***, which define the Navis™ Optical EMS functions and TL1 commands that users can execute

With this flexible partitioning, users can be assigned to a combination of technologies (SONET/STM NEs only), geographies, and job functions (provisioning versus maintenance).

Only the Navis™ Optical EMS system administrator can create user logins, and administer NE Target Groups and Command Groups. The Navis™ Optical EMS supports a maximum of 32 Command Groups and 32 Target Groups.

Navis™ Optical EMS User Login Management

Besides standard desktop-based security, the Navis™ Optical EMS provides these additional user security management features:

- With ***login aging***, user logins are deleted after a period of non-use. The time period for login aging is administrator tunable.
- With ***password aging***, users are required to change passwords after a specified time period. The time period for password aging is administrator tunable.
- With ***inactivity sensing***, the system automatically logs off users from the application after a period of inactivity. The time period for inactivity sensing is administrator tunable.
- With ***administrator control***, the Navis™ Optical EMS administrator can enable/disable user logins, display all active user sessions, and terminate active user sessions.

NE Login Management

The Navis™ Optical EMS supports remote provisioning to view, create, delete, and modify (change the user's privileges) the user logins maintained on the NEs. With this feature, a user can display the set of user logins on a selected NE. Alternatively, the user can create a new user login on the NE.

NE Command Response Log

The Navis™ Optical EMS maintains a ***Command Response Log***, which logs all commands and their associated responses that occur between the Navis™ Optical EMS and the NEs. This log records all Navis™ Optical EMS originated management operations on the NEs. The log includes the NE name, date and time stamps, the originating user ID, the command name, the affected entity within the NE (the AID), and the final disposition of the request. Users can query, filter, and sort the Command/Response Log for a display based on the NE name, time period, or user name (originating user). Users can configure the display to accommodate personal preferences and direct the output to a printer or a file.

Navis™ Optical EMS Activity Log

The Navis™ Optical EMS Activity Log provides a historical record of all functions that have been executed on the system, including functions that are:

- local to the Navis™ Optical EMS, such as adding a new user
- involve interaction with an NE, such as adding a new cross-connect

Both user initiated and system initiated activities, such as scheduled activities, are logged.

This Activity Log, which enables all management activities to be accounted for and to be traced, includes the following information:

- a date and time stamp
- the user ID
- the final disposition of the request
- the activity category
- the activity name
- a description of the activity (for example: deleted cross-connect between source address x and destination address y on NE XYZ)

Users can query, filter, and sort the Activity Log for a display that is based on time period, user names, and activities (provisioning, security, software management). Users can configure the display to accommodate personal preferences and direct the output to a printer or a file.

The Activity Log supplements the Command/Response Log, which logs the details of all command/response transactions over the interface to the NEs.

□

OA&M

Platform Upgrades

Having a scalable Navis™ Optical EMS platform enables customers to upgrade at their convenience. As networks grow in size, as element management functions are added through new releases, or as third-party hardware and software platforms are modified, customers must protect their investment. To that end, Lucent Technologies has created a graceful migration plan from one platform to another. This plan is backed by Lucent Technologies' extensive internal testing prior to field deployment.

Installations and Software Upgrades

The Navis™ Optical EMS uses script-based procedures for first-time software installation and for subsequent upgrades. These scripts, which are interactive and menu-driven, minimize the time and effort required to install and upgrade software. The scripts alert users of discrepancies and prompt users for the appropriate actions to be taken.

Self-Monitoring Capabilities

Besides error logging, the Navis™ Optical EMS has administrative and self-monitoring capabilities, such as displaying a color-coded Navis™ Optical EMS host icon and corresponding alarm list. These capabilities provide the system administrator with real-time information to manage the application proactively.

Startup/Shutdown

The Navis™ Optical EMS enables the system administrator to shutdown the application gracefully, write the data in memory to disk for later startup and comparison, and restart the application when the host HP-UX operating system is rebooted. The administrator is informed of the shutdown progress.

GUI users who exit the application can save any changed window settings. Users who exceed the provisionable timeout period are automatically logged off.

Data Storage

The Navis™ Optical EMS maintains logs of autonomous messages received from the NEs (Alarm/Event Log and Database Change Notification Log) and paired command/response messages to/from the NEs (Command/Response Log). The Navis™ Optical EMS also maintains an activity log and an alarm log of originated error/status messages. Each log can be sized to support a user-definable maximum number of days for recording. A Navis™ Optical EMS automated process runs on a schedule to purge the logs.

Note: The logs are maintained within the Navis™ Optical EMS database, in addition to the network configuration data, and the PM data collected from the network. The administrator can backup and restore the Navis™ Optical EMS database to and from disk and tape.

□

User Interface

GUI

The Navis™ Optical EMS has a platform-independent, Java-based graphical user interface (GUI), whose design:

- follows the Windows Interface Guidelines
- conforms to TMN architecture (ITU-T M.30 SG 10 Human Machine interface)
- is intended to provide a common look and feel with the ITM product family, the Navis™ Optical NMS, and other Lucent Technologies products.

In particular, the Navis™ Optical EMS GUI has been implemented as a joint development with ITM SNC, and designed in collaboration with the PC-based WaveStar® NE CITs.

Hardware Desktop Platforms Supported

Minimally, the JAVA GUI runs on the following desktops:

- Windows NT 4.0 PC with Service Pack 4 or Windows 2000 PC
- HP B2000 Workstation running HP-UX 10.20 or 11.0
- Sun Ultra 5 Workstation running Solaris 2.6/2.7
- X-terminals (via Windows NT 4.0 terminal servers)

The Java GUI is based upon a client-server architecture, with user-friendly installation of the client software on the desktop. The client-server architecture enhances system performance through an efficient distribution of the processing requirements.

The GUI architecture enables an Navis™ Optical EMS host to support up to 30 simultaneous GUI clients (HP workstations, Sun Workstations, or Windows NT PCs).

GUI Features

The Navis™ Optical EMS GUI is a common interface to all NEs, regardless of type, and provides a graphical interface for the most frequently used actions. Specifically, the GUI provides the following:

- graphical features such as multilevel displays of the network
- an automatically generated map of the overall managed domain
- hierarchically arranged equipment displays down to the shelf level

- a graphical representation of the cross-connection configuration with point-and-click provisioning
- form and menu based provisioning for viewing and setting provisionable parameters
- the ability to initiate a cut-through session to directly send TL1 commands to NEs, providing the NE type supports TL1 messages over their OS interface

GUI Design

Because the Navis™ Optical EMS GUI conforms to Windows Interface Guidelines, it provides a powerful, flexible, and friendly interface. Use of the Windows Interface Guidelines for look and feel, makes the interface intuitive and easy to learn and use, especially for users who are familiar with PC applications.

Example: By incorporating an Explorer for item selection—such as an NE or a port within an NE—the Navis™ Optical EMS GUI takes on the Windows look and feel.

The flexibility of the GUI enables users to choose methods of operation that they find convenient. The GUI also supports numerous customization options so users can tailor displays to their preferences.

North American and International GUI Display Options

The Navis™ Optical EMS manages global transmission products, supporting both STM (SONET and SDH) products and DWDM products, which are global. The Navis™ Optical EMS supports both SONET and SDH terminology, and provides display options to present information to users in typical North American formats or typical international formats.

Specifically, the Navis™ Optical EMS provides a display option to present:

- date information in the North American (month-day-year) format or the international (day-month-year) format
- alarm severities using North American (critical, major, and minor) nomenclature or international (prompt and deferred) nomenclature

TL1 Based Interface

The Navis™ Optical EMS provides a Transaction Language 1 (TL1) cut-through for NEs that support the TL1 syntax for their OS interfaces. The cut-through is a secure interface that allows users to access only the NEs that are in their Target Group and only to execute TL1 commands that are in their Command Group.

Users need the TL1 cut-through for those infrequently used commands that the system GUI does not support and to build custom macros of multiple TL1 commands that can be broadcast to multiple NEs.

Menu Driven TL1 Command Builder

The TL1 cut-through is a GUI-based, menu-driven function that simplifies creating TL1 commands by automatically populating the target identifier (TID) field and selecting menu options for the required fields that are common across all TL1 commands—those up to and including the access identifier (AID) field. Users can select a command (from the commands allowed in their Command Group) and AIDs from scrollable lists.

A filter field lets users scroll to required commands and AIDs respectively. The TID field is populated automatically based on the selected NE on entering the TL1 Command Builder feature. Users manually enter all other command variables.

Upon entering the cut-through mode, the system automatically displays an output window, which initially indicates whether communication has been established with the selected NE and subsequently displays all responses to commands sent to the NE.

TL1 Macro Builder

The TL1 Macro Builder enables users to create and store TL1 command files using the scrollable command and AID lists. The stored files can be restricted for use by the originator or made available to all users.

These TL1 macro files can then be used with the Broadcast Capability so multiple commands can be sent to a single NE or the set of TL1 commands can be repetitively sent to multiple NEs.

Broadcast Capability to Multiple NEs

Navis™ Optical EMS users can select and broadcast TL1 commands, built via the TL1 Macro Builder, to one or more NEs.

The commands included in these files and the targeted NEs are screened by the Navis™ Optical EMS security system to ensure that

the user has permission to issue the commands included in the TL1 macro and to access the targeted NEs.

Example: These commands can be used to perform routine maintenance and provisioning activities.

□

Hardware Redundancy

Overview

The Navis™ Optical EMS hardware redundancy option provides multiple levels of application and host redundancy for backup support and disaster recovery if a failure occurs.

The Navis™ Optical EMS hardware redundancy options include:

- local redundancy
- geographic redundancy

The local and geographic redundancy configurations require two similarly equipped hosts that operate in an active/standby arrangement. The two host computers are linked via a TCP/IP WAN segment and employ data replication to provide near real-time database synchronization of the standby host with the currently active host.

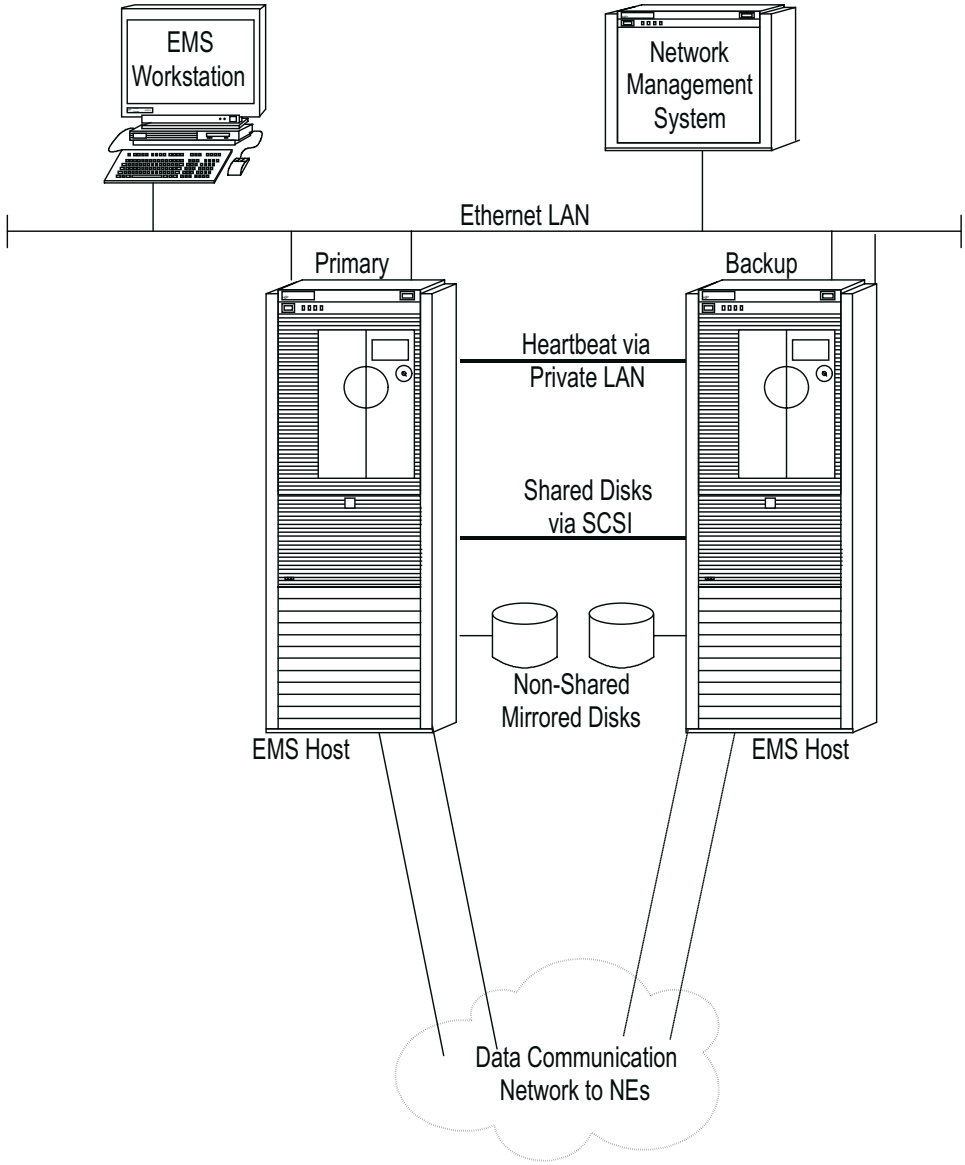
Under normal operating conditions, the Navis™ Optical EMS application is running on the active host, with that host actively monitoring all NEs in the management domain. The backup host is in a hot-standby state, maintaining data connections to the network and using data replication from the active host to keep its database current. If primary host failure occurs, an automatic switchover occurs for both the local and the geographical redundant configuration. Upon switchover, the standby host assumes active control of the network.

Local redundancy

Local redundancy uses two similarly equipped hosts located in the same building (as shown in the following figure). Each host is configured with redundant hardware components. Should the primary

host fail, the backup host is activated automatically without user intervention.

Figure 2-1 EMS Local Redundancy Configuration



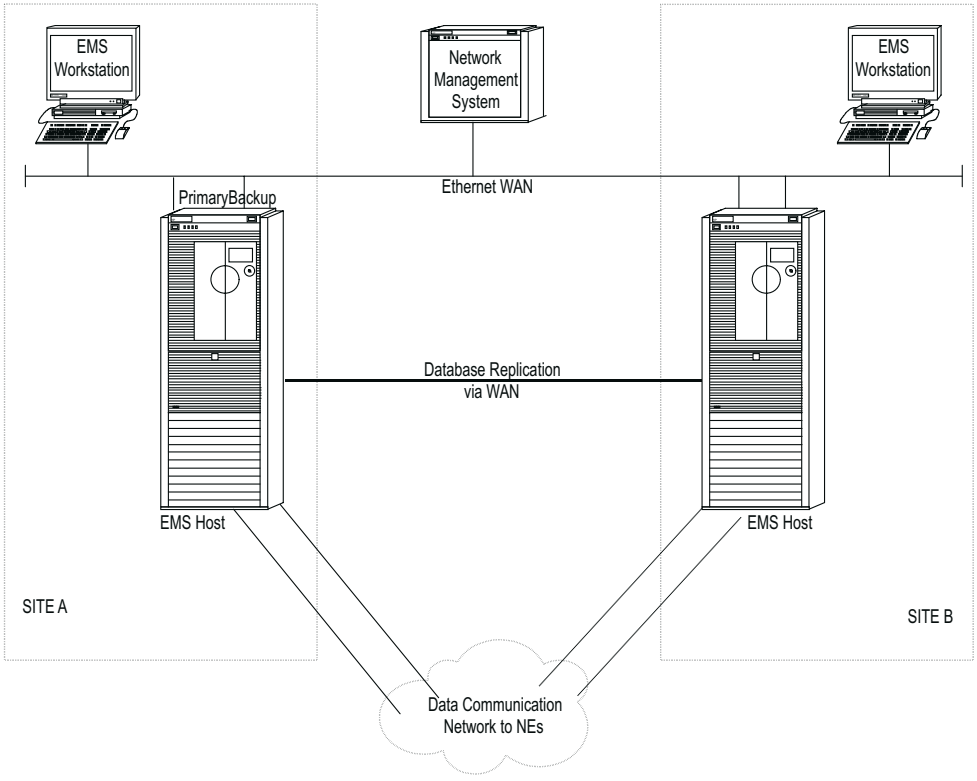
Under normal operating conditions, the Navis™ Optical EMS host is in service (or is active) on the primary host monitoring all NEs in the database. The backup host exists in a passive (or standby) mode. Although the standby host is logged into all network elements, it does not initiate any event to the network or react to any notifications from the network.

Database synchronization is handled using Informix Enterprise Replication, FTP file transfer, and event forwarding from the active host. If a primary host failure occurs, control is automatically switched from the primary to the backup host, changing the Navis™ Optical EMS application from standby to active service without user intervention.

Geographic Redundancy

Geographic redundancy (as shown in the following figure) relies on two similarly equipped hosts located in different geographical locations, for example: Atlanta, Georgia and Denver, Colorado. Each host is configured with redundant hardware components, and resides on a TCP/IP WAN segment. Data replication and event forwarding via WAN are used to maintain EMS database and UNIX file system synchronization.

Figure 2-2 EMS Geographic Redundancy Configuration



Under normal operating conditions, the Navis™ Optical EMS application is in service (or active) on the primary host monitoring all NEs in the database. The backup host exists in a passive (or standby)

mode with the Navis™ Optical EMS application running in a read only mode. Although the standby host is logged into all networks, it does not initiate any event to the network or react to any notification from the network.

Database synchronization is handled using Informix Enterprise Replication, FTP file transfer, and event forwarding from the active host. If a primary host failure occurs, control can be manually switched from the primary to the backup host changing the Navis™ Optical EMS application from standby to active service.

Both local and geographic redundancy provide automatic switchover. For geographically redundant systems, automatic switchover can also be performed via the cluster administration GUI.

Once the primary host failure is repaired, manual intervention is required to synchronize the database and switch control back to the primary host.

□

3 Software Planning and Engineering

Overview

Purpose

This chapter provides planning and engineering information on the software related to the use of the Navis™ Optical EMS.

Contents

Third Party Software

Third Party Software

The following tables show names and the particular releases of the third party software that is required to run the Navis™ Optical EMS R8.0

Table 3-1 Third Party Software Required for the Navis™ Optical EMS R8.0

Software Description	Software Version
Operating System	HP-UX 11.0
Informix - Online DS (32-bit version on HP-UX 11.0)	R7.31uc3–1
IONA OrbixMT	R3.3.2
IONA OrbixWeb (for HP workstation serving as a client)	R3.01
OpenLink (optinal for the Navis™ Optical CA and Navis™ Optical PA interfaces)	A.2.6
RogueWave Thread.h++	R1.3.0
RogueWave Tools.h++	R7.1.0
ATOS OSIAM (OSI Stack) (optional)	R2.6F
HP MC/ServiceGuard (for Redundancy only)*	A.11.09
HP MirrorDisk/UX (for Redundancy/Mirrored Disks only)**	B.11.00
HP EMS (Event Monitoring Services) (for Redundancy only	A.03.20
HP OmniBack II (optional package need for OmniBack DLT tape backup)	A.03.00
Windows JRE (for a Windows PC as a Java GUI client)	1.18
HP JRE (for an HP workstation as a Java GUI client)	1.1.8
SunSoft Java Swing Set	1.1
Driver for HSC 100BT LAN Card	J3514A B.11.00.05**

Table 3-1 Third Party Software Required for the Navis™ Optical EMS R8.0 (continued)

Software Description	Software Version
Driver for PB 100BT LAN Card	J2759BA B.11.00.06**
Driver for PCI 100BT LAN Card	J4253AA B.11.00.05**
Quality Pack	September 2001 version
Hardware Enablement and Critical Bundle	September 2001 version
HP-UX Unlimited User License	B.11.00.02, December 2001 version
* From the HP-UX 11.0 Core OS CD, November 1999 version ** From the HP-UX 11.0 Application Software CD, September 2000 version.	

□

Sizing the System

Guidelines to Sizing the System

System sizing is a function of the following:

- the capacity of the Navis™ Optical EMS application and platform
- the load that the managed NEs place upon the applications and platform

The load generated while managing the network depends on the numbers, types, and equipages of the managed NEs, the manner in which the NEs are connected the Navis™ Optical EMS, and the management operational profile.

Detailed sizing guidelines and a capacity estimation tool are available to configure the Navis™ Optical EMS systems to efficiently meet your needs. These detailed sizing guidelines use, as input, information describing the network to be managed and the NE management operational profile. Load factors are applied based on the input to allow for differences in the size and complexity of the different NEs and the operational profile.

Capacity Affecting NE Parameters

The following parameters have the most impact on overall EMS capacity:

- MFA database size (number of records)
- relative EMS activity required to manage a particular NE type under typical operating and load conditions
- number supported LAN associations
- configuration factor

See your Lucent Technologies' sales representative for details on sizing your system.

□

4 Hardware Planning and Engineering

Overview

Purpose

This chapter explains the supported hardware platform for the Navis™ Optical EMS. The Navis™ Optical EMS hardware platform provides a valid operation environment for all Navis™ Optical EMS activities and includes host hardware configurations, GUI workstation configuration, and host/workstation-related software configurations.

The Navis™ Optical EMS runs on a scalable hardware platform that supports small to large-scale networks. The Navis™ Optical EMS application software and its release are independent of the hardware platform. The characteristics and needs of the customer's network determine choice of the hardware platform.

Contents

Configurations

Architecture Overview

The Navis™ Optical EMS consists of the following hardware devices:

- Hewlett-Packard (HP) ***servers***, which function as Navis™ Optical EMS hosts
- ***workstations*** and/or ***PCs***, which function as the Navis™ Optical EMS GUI client or the Navis™ Optical EMS cluster administration GUI
- ***PCs,*** which function as the system console for HP K-Class servers or ***laptops***, which function as the web console for HP L-Class and N-Class servers
- ***printers***, which provide hardcopies of the Navis™ Optical EMS GUI output

These devices are connected via an 802.3 Ethernet LAN; and optionally, can be interfaced to a WAN. For large, geographically dispersed configurations, a WAN/PSN can concentrate access from the Navis™ Optical EMS to the managed subnetworks (access NEs with OSI LAN, NEs serving as transport bridges, or gateway NEs). The same WAN/PSN can also access other network management systems or OSs. Every Navis™ Optical EMS installation requires data connections to each managed subnetwork. The southbound WAN from the Navis™ Optical EMS to the NEs must support an OSI/LAN interface and/or an IP/LAN interface.

Navis™ Optical EMS Configurations Defined

A Navis™ Optical EMS hardware configuration is a supported set of hardware devices that function with the current release of the Navis™ Optical EMS. In the broadest sense, the Navis™ Optical EMS supports the following two types of hardware configurations:

- ***standalone configurations***, which include any one of the supported HP servers, mirrored disks, and the appropriate number of supported GUI clients
- ***redundant configurations***, which include a minimum of any two supported identical HP servers, along with mirrored disks and the appropriate number of supported GUI clients

Both standalone and redundant hardware configurations have ***Performance Monitoring (PM)*** of data, which measures the quality of service and identifies degrading or marginally operating systems before an alarm can be generated.

In addition, both standalone and redundant hardware configurations can have ***multiple CPUs***, and redundant configurations can be configured for local or geographic (remote) redundancy.

Standalone Configuration Options

Standalone configurations include one HP server, the appropriate number of supported GUI clients, and mirrored disks on the L2000. Standalone configurations are provided with PM and with from one to eight CPUs.

The L-Class and N-Class servers are offered in standalone configurations.

Table 4-1 HP Standalone Server Configurations

Standalone Model	Number of CPUs Supported	Mirrored Disk Supported?
L2000	1	yes
	2	yes
	4	yes
N4000	8	no

Redundant Configuration Options

A redundant configuration includes a minimum of any two supported identical HP servers, along with mirrored disks and the appropriate number of supported GUI clients. Redundant servers are configured with and/or without PM and from two to six CPUs in the following locations:

- ***Local redundancy*** uses two similarly equipped hosts located in the same building. Each host is configured with redundant hardware components. Should the primary host fail, the backup host is activated automatically without user intervention. The shared lock and its mirror disk must be accessible by both servers in a local redundancy configuration.
- ***Geographic redundancy*** relies on two similarly equipped hosts located in different geographical locations, for example: Chicago and Denver. Each host is configured with redundant hardware components and resides on a TCP/IP WAN segment. Data replication and event forwarding via WAN are used to maintain EMS database and UNIX file system synchronization.

The L-Class servers are offered in redundant configurations. The N-Class server is not offered in a redundant configuration.

Table 4-2 HP Redundant Server Configurations

Redundant Model	Number of CPUs Supported	Mirrored Disk Supported?
L2000	2	yes
	4	yes

The kernel setting for a redundant configuration is the same as that for a standalone configuration.

Terminator cables are sometimes used in redundant configurations. If terminator cables are used, the resistors on the HSC SCSI card must be removed. Refer to the appropriate HP support person or documentation for the appropriate procedures.

Supported Disk Enclosures

The SC10 is the disk enclosure that interworks exclusively with the L-Class and N-Class servers.

□

GUI Client

GUI Client Platforms

The Navis™ Optical EMS GUI Client can be run on an industry-standard personal computer (PC), an HP B2000 workstation, or a SUN Ultra5 workstation.

In addition, the Navis™ Optical EMS supports the use of Citrix Metaframe software to export the display of a Navis™ Optical EMS GUI client running on a Windows NT and/or a Windows 2000 terminal server to a client workstation.

PCs as the Primary GUI Client Platform

PCs are the primary GUI platform for the current release of the Navis™ Optical EMS. PCs with the recommended configuration are available from different vendors; however, each vendor manufactures its equipment differently. To avoid problems on various PC platforms, only the following PC vendors are supported:

- Compaq—visit them at *www.compaq.com*
- Dell—visit them at *www.dell.com*
- HP—visit them at *www.hp.com*

The following table lists the primary configuration for the GUI client platform, which is an industry standard PC.

Table 4-3 Primary GUI Client Platform (PCs)

Item	Supported PC (Compaq, Dell, or HP)
CPU	450 MHz processor or better
RAM	256MB or more
Disk	6GB or more
Video	video card with at least 8MB VRAM
Network Card	10/100BaseT
Monitor	19 inch or larger
Sound Card	sound card with speakers
CD_ROM	24X
OS	Windows NT 4.0 ServicePack 4 or Windows 2000
Other	floppy drive, keyboard, and mouse

Workstations as the Secondary GUI Client Platform

The following table lists the secondary configuration for the GUI client platform, which is an HP or Sun workstation.

Table 4-4 Secondary GUI Client Platforms (Workstations)

Item	HP B2000 Workstation	Sun Ultra 5 Workstation
CPU	300 MHz	360 MHz UltaSPARC
RAM	256MB	256MB
Disk	8GB	8GB
Video	built in	built in
Network Card	10/100 Ethernet NIC	10/100 Ethernet NIC
Monitor	21 inch	21 inch
Sound Card	built in	built in
CD-ROM	Fast	Fast
OS	HP-UX 10.20/11.0	Solaris 2.6/2.7
Other	keyboard and mouse	keyboard and mouse

Secure WebConsole

Overview

The L-Class and N-Class servers can support a typical system console; however, HP ships these servers with its secure WebConsole.

The WebConsole, which, resides at the back of the L-Class or N-Class server, enables installers and administrators to access the server remotely via a laptop, a LAN connection, a Web browser, and an IP address.

The WebConsole is connected to the office LAN and has a unique IP address—meaning, its IP address is different from the server's IP address. It is connected to the server by a serial cable.

Security Features

The WebConsole has built-in security features that include the following:

- password encryption
- scrambling of data
- download protection

The WebConsole's security features do not compromise or replace the original security features of the server.

Access

The WebConsole enables up to four operators in different locations to access the HP server; but, only one user, who has the highest privilege, can interact with the server at any given time.

□

L2000 Configurations

L2000 (1 CPU) Specifications

This table lists the specifications for a standalone L2000 with one CPU.

Table 4-5 L2000 (1 CPU) Standalone Specifications

Item	Standalone without Mirrored Disk	Standalone with Mirrored Disk
Number of CPUs	1	1
HP-UX Version	HP-UX 11.0 (64 bit)	HP-UX 11.0 (64 bit)
Memory	1GB	2GB
Swap/Dump Space	2248MB	2248MB
Internal Disk	0	0
Navis™ Optical EMS Disk Space	90GB	360GB
Number of Disk Drives	five, 18GB drives	ten, 36GB drives
Additional Disk Space for TMF	Included (2GB)	Included (2GB)
DAT	DDS3x1	DDS3x1
CD-ROM Drive	DVDx1	DVDx1
SCSI Controller	2	2
PCI LAN (100BaseT)	2	2
Disk Enclosure	SC10	SC10
Bus Mode	Split Bus/Dual Connection	Split Bus/Dual Connection
Jumper Setting	01111	01111

L2000 (2 CPUs) Specifications

This table lists the specifications for a standalone and redundant L2000 with two CPUs.

Table 4-6 L2000 (2 CPUs) Standalone Specifications

Item	Standalone with Mirrored Disk	Redundant Specifications
Number of CPUs	2	2

Table 4-6 L2000 (2 CPUs) Standalone Specifications (continued)

Item	Standalone with Mirrored Disk	Redundant Specifications
HP-UX Version	HP-UX 11.0 (64 bit)	HP-UX 11.0 (64 bit)
Memory	2GB	2GB
Swap/Dump Space	2248MB	2248MB
Internal Disk	0	0
Navis™ Optical EMS Disk Space	360GB	180GBx2
Number of Disk Drives	ten, 36GB drives	ten, 36GB drives
Additional Disk Space for TMF	Included (2GB)	Included
DAT	DDS3x1	12GB DDS
CD-ROM Drive	DVDx1	DVD
SCSI Controller	2	5
PCI LAN (100BaseT)	2	5
Disk Enclosure	SC10	SC10
Bus Mode	Split Bus/Dual Connection	Split Bus/Dual Connection
Jumper Setting	01111	01111

L2000 (4 CPUs) Standalone and Redundant Specifications

This table lists the specifications for a standalone and redundant L2000 with four CPUs.

Table 4-7 L2000 (4 CPUs) Standalone and Redundant Specifications

Item	Mirrored Standalone Configuration	Mirrored Redundant Configuration
HP System Model	L2000	L2000-440
Number of CPUs	4	4
HP-UX Version	Release 11.0 (64 bit)	Release 11.0 (64 bit)
Memory	4GB	4GB
Swap/Dump Space	4296MB	4296MB

Table 4-7 L2000 (4 CPUs) Standalone and Redundant Specifications (continued)

Item	Mirrored Standalone Configuration	Mirrored Redundant Configuration
Internal Disk	0	0
Navis™ Optical EMS Disk Space	504GB	252GB x 2
Number of drives with PM	fourteen, 36GB drives	fourteen, 36GB drives
Additional Disk Space for TMF	Included (4GB)	Included
DAT	DDS 3 x 1	12GB DDS
CD-ROM Drive	DVD x 1	DVD
SCSI Controller	2	7
PCI LAN (100Base T)	2	5
Cabinet	1.25m	1.25m, 1/host
Disk Enclosure	SC10	SC10
Bus Mode	Split Bus/Dual Connection	Split Bus/Dual Connection
Jumper Setting	0111	0111

N4000 Configuration

Standalone Specifications

This table lists the specifications for a standalone N4000 with eight CPUs.

Table 4-8 N4000 (8 CPUs) Standalone Specifications

Item	Standalone Specifications
HP System Model	N4000
Number of CPUs	8
HP-UX Version	HP-UX 11.0 (64 bit)
Memory	8GB
Swap/Dump Space	8392MB
Internal Disk	36GB/9GB
Navis™ Optical EMS Disk Space	288GB
Number of Disk Drives	eight, 36GB
Additional Disk Space for TMF	Included (8GB)
DAT	DDS3x1
CD-ROM Drive	DVDx1
SCSI Controller	2
PCI LAN (100BaseT)	2
Disk Enclosure	SC10
Bus Mode	Split Bus/Dual Connection
Jumper Settings	01111

N4000 Racking Specifications

HP has three specifications for server cabinets, which can be one of the following:

- E25 (25EIA units)
- E33 (33 EIA units)
- E41 (41 EIA units)

To better use floor space, the following table provides the racking specifications for N4000 server configuration. As an example, based upon the following specifications, two of any kind of N4000 configuration can be put in one E33.

Table 4-9 N4000 (8 CPUs) Physical and Electrical Specifications

Item	Specification
Server	10 EIA
Smart Storage	2 EIA
Disk Enclosure	4 EIA
Total EIA Height	16 EIA
Total Power (at 220V)	< 20 Amps

N4000 SC10 Disk Enclosure

The SC10 is the disk enclosure that interworks exclusively with the N4000 servers.

□

5 NE Interworking

Overview

Purpose

This chapter provides a overview of the Network Elements (NEs) that the Navis™ Optical EMS supports and details regarding the interworking of each NE and the Navis™ Optical EMS.

Contents

LambdaRouter™ AOS

Overview

The LambdaRouter™ All Optical Switch 128/256 (LambdaRouter™ AOS) is a true optical cross-connect system that makes cross-connections in the optical domain. Because it operates in the optical domain, the LambdaRouter™ AOS is bit rate and format independent:

- With its bit rate independence, the LambdaRouter™ AOS can handle today's 10Gbps signal rates and operate at any optical layer rate including 40Gbps and beyond.
- With its format independence, the LambdaRouter™ AOS is not limited to SONET and SDH data streams. It can also can cross-connect Asynchronous Transfer Mode (ATM), Internet Protocol (IP), and gigabit Ethernet data streams.

The LambdaRouter™ AOS has an optical switch fabric based on Micro-ElectroMechanical Systems (MEMs) technology.

Supported Releases

The Navis™ Optical EMS R8.0 supports 3.0 of the LambdaRouter™ AOS.

In addition, the Navis™ Optical EMS R8.0 is backward compatible with R1.0 and R2.0 of the LambdaRouter™ AOS.

Support in General

The Navis™ Optical EMS provides full support for the LambdaRouter™ AOS. However, in terms of configuration management, keep in mind that the LambdaRouter™ AOS is an optical bandwidth management element.

In addition, cross-connection provisioning is a function unique to the LambdaRouter™ AOS.

Important! Because the LambdaRouter™ AOS operates solely in the optical domain, it does not collect PM data.

Southbound Protocols

The LambdaRouter™ AOS supports TL1 and FTP application protocols and TCP/IP interface protocol.

NE User Login Management

NE user login management with form and menu based screens is now supported for the LambdaRouter™ AOS.

Network Discovery

The LambdaRouter™ AOS connects to OSs using IP connections. Therefore, the LambdaRouter™ AOS is not compatible with the OSI directory.

The LambdaRouter™ AOS initiates network discovery by adding the NE—supplying the information needed for the Navis™ Optical EMS to make a connection to the LambdaRouter™ AOS—into the Navis™ Optical EMS via the **Add-an-NE** screen. The LambdaRouter™ AOS does not have an embedded DCC or operations interworking; thus, the connection information for each LambdaRouter™ AOS must be manually entered into the Navis™ Optical EMS database.

File Transfer Protocol Supported

The LambdaRouter™ AOS supports file transfer protocol (FTP) file transfer protocol.

No Support for Embedded DCC

The LambdaRouter™ AOS does not support an embedded Data Communications Channel (DCC); each LambdaRouter™ AOS must have a LAN/WAN connection to the Navis™ Optical EMS.

Provisioned via TL1 Cut-Through

The LambdaRouter™ AOS relies on the Navis™ Optical EMS' TL1 cut-through capability to provision the following on each NE:

- the description of the environmental alarms (also called ***scan points*** or ***miscellaneous discrete inputs***)
- control points (also called ***miscellaneous discrete outputs***)

□

LambdaUnite™ MSS

Overview

The LambdaUnite™ MultiService Switch (LambdaUnite™ MSS) is a global (SONET/SDH) NE that supports the highest capacity services from 10G up to 40G as well as Gigabyte Ethernet services from one NE in a single shelf footprint, for both ring and meshed topologies.

The LambdaUnite™ MSS offers:

- WaveStar® OLS 1.6T compatible optics
- WaveStar® TDM 10G compatible optics
- WaveStar® TDM 2.5G intraoffice interface
- WaveStar® TDM 10G 2-Fiber MS-SPRing/BLSR protection
- WaveStar® TDM 2.5G 2-Fiber MS-SPRing/BLSR preemptive protection access
- synchronization support
- PM data collection on section/path level

LambdaUnite™ MSS acts as a fully flexible optical switch that offers a superior solution compared to traditional central office solutions such as dedicated high-speed TDM multiplexers or cross connects. LambdaUnite™ MSS offers full standards compliance, which makes it fit perfectly into an undersea and/or terrestrial backbone and into metro core networks.

Due to its high density, LambdaUnite™ MSS occupies very little floor space. Two complete systems fit in one rack, which equals 640Gbps per second, or even 1.28Tbps per second of capacity. The system architecture is based on a large doublecated 320G switch matrix enabling pipe handling from 10G down to STS-1 granularity (320G equals 6144 x 6144 STS1s, or 2048 x 2048 VC4s). Combined with 32 I/O slots (each of which can be filled with a variety of I/O cards), a range of configuration possibilities is available, which enables service providers to tailor the system to meet their needs. Within a half bay, numerous service interface cards, ranging from 155Mbps up to 40Gbps, are available.

LambdaUnite™ MSS also offers flexibility by supporting dedicated data interfaces such as 1GbE or 10GbE. The full potential of LambdaUnite™ MSS is reached when it is combined with the core networks and with Lucent's DWDM solutions via direct optics. For

metropolitan networks, direct optics into a passive WDM solution are also supported.

Supported Releases

The Navis™ Optical EMS R8.0 supports R2.1 of the LambdaUnite™ MSS.

Southbound Protocols

The LambdaUnite™ MSS supports TL1 and FTAM application protocols and OSI interface protocol.

□

LambdaXtreme™ Transport

Overview

The LambdaXtreme™ Transport is a Dense Wavelength Division Multiplexing (DWDM) optical NE that offers one common platform for ultra high capacity (up to 2.56 Tbps) and ultra long reach (up to 4000 km without electrical regeneration) optical transport.

The LambdaXtreme™ Transport is designed for regional and high capacity backbone applications. It relies on a platform of common amplifiers, common element and network management, common controller packs, and common physical design. Long haul, ultra long haul, and ultra high capacity applications are addressed by selecting different transponders that support 2.5G, 10G, 10GbE and 40G client side rates.

The LambdaXtreme™ Transport operates in the UltraBand (single, extended L-band) of the optical spectrum. Since splitters and/or combiners (as in a multiband C+L system) are not used, the system features a smaller footprint, enhanced system margins, simpler system growth, and easier operations management. This modular and scalable design supports future network demands through in-service upgrades to higher channel counts.

The LambdaXtreme™ Transport relies on leading-edge Bell Labs technologies such as Raman amplification, soliton transmission, dynamic channel equalization, strong forward error correction (FEC), and automatic power equalization.

Supported Releases

The Navis™ Optical EMS R8.0 supports R1.0 of the LambdaXtreme™ Transport.

Support in General

In general, the Navis™ Optical EMS supports the following for the LambdaXtreme™ Transport.

- TCP/IP Data Communications Network (DCN) connectivity
- Gateway Network Element (GNE) functionality for TCP/IP connected NEs
- the manual addition and deletion of trails
- fault management, including miscellaneous discretes
- software management
- system and port level provisioning
- optical channel connection provisioning via a cut-through

- performance management (PM) data collection and reporting
- security management

No Cross Connection Support

The Navis™ Optical EMS does not support cross connections for the LambdaXtreme™ Transport.

□

Metropolis™ DMX

Overview

The Metropolis™ DMX Access Multiplexer (Metropolis™ DMX) is a single shelf network multiplexer that is designed primarily for access transport, business access, and regional interoffice applications that transport voice and data at the OC-48 level via unidirectional path switched rings.

The Metropolis™ DMX supports wideband and broadband transport, including the traditional SONET transport of DS1, DS3, EC-1, OC-3, OC-12, and OC-48 signals as well as 10/100/1000 Mbs LAN transport. The shelf can be equipped to serve many diverse network applications and supports a variety of operations interfaces for current and evolving network operations.

Metropolis™ DMX enables reliable transport, a smooth transition from TDM to IP Services, and a cost-point architecture that provides a low ***first cost*** while enabling support for high-margin services necessary for survival in today's competitive service provider marketplace.

Releases Supported

The Navis™ Optical EMS R8.0 supports R2.1 of the Metropolis™ DMX.

Southbound Protocols

The Metropolis™ DMX supports the TL1 and FTP application protocols and OSI and TCP/IP interface protocols.

File Transfers and Remote Software Downloads

The Metropolis™ DMX does not support file transfer over the OS interface; consequently, it does not support remote software downloads.

Software Copying between NEs

The Metropolis™ DMX supports copying software between NEs, which is a more efficient use of network bandwidth because it allows software to be copied from nearby NEs rather than from a possibly remote EMS.

Port Protection Group Constraint

With the Metropolis™ DMX, protection groups are fixed in accordance with associated circuit pack slots. The Metropolis™ DMX has a service CP slot and a protection CP slot. The configurability is limited to identifying whether the port pairs associated with those slots are independent and unprotected, or whether they are in a protection arrangement with each other.

Example: The port pairs can be provisioned to be independent, 1+1 protection group, or UPSR protection group. This provisioning is done as a part of port provisioning.

FTP File Transfers Not Supported for R1.1

The Metropolis™ DMX R1.1 does not support file transfers of a binary image of its memory. The Navis™ Optical EMS does not support memory backup and restore for the Metropolis™ DMX R1.1.

The Metropolis™ DMX R2.0 will support FTP and the Navis™ Optical EMS will support memory backup and restore for that release.

Loopback Management Support

The Navis™ Optical EMS supports loopback management for the Metropolis™ DMX with the TL1 cut-through only, not with menus and forms.

Subnetwork Initialization

The Metropolis™ DMX cannot automatically register itself in the Navis™ Optical EMS central directory—that directory in which the Navis™ Optical EMS uses to automatically discovery NEs. Therefore, it is an option to use this directory

Provisioning of Ethernet Layer 2 Packet Routing

Ethernet circuit packs (CPs) can support one or more modes of operation, such as the port-tagged mode in which the Ethernet packet switches route by port tag or IEEE 802.1q tagged mode in which the Ethernet packet switches route by VLAN identifier. The Metropolis™ DMX and the Metropolis™ DMXpress are the only NE types that support configurable Ethernet routing. The Metropolis™ DMX supports port tags and IEEE 802.1q VLAN tags.

□

Metropolis™ DMXpress

Overview

The Metropolis™ DMXpress Access Multiplexer (Metropolis™ DMXpress) is the industry's most compact OC-48 mini point-of-presence (POP) solution. The Metropolis™ DMXpress is optimized for last mile access for Internet service growth while maintaining high-revenue voice and private line services. It proves ultra low-cost optical bandwidth to the edge while providing SONET interoperability. Because of its ability to offer low-cost, high revenue, protected transport for both voice and data, Metropolis™ DMXpress is an ideal solution for fiber-to-the-business applications. Metropolis™ DMXpress eliminates the need for a LAN/WAN boundary and simplifies broadband data service delivery. Plus the Metropolis™ DMXpress has the transmission capability to send signals directly from a multi-tenant unit (MTU) to a central office (CO).

The Metropolis™ DMXpress offers an OC-48 UPSR as a standard high-speed interface. The Metropolis™ DMXpress can also be equipped with a standard TDM card offering either 16 DS1 ports and one DS3 port, which can be removed if not needed, or 12 DS3 ports. At the same time, the Metropolis™ DMXpress can be equipped with a 16–port Fast Ethernet (10/100Base-TX) or 2–port Gigabit Ethernet (GbE) Ethernet option pack that provides a provisionable 10/200–TX or GbE packet ring that can eliminate last-mile bottlenecks and accommodate the growing demand for data services.

The low speed tributaries on the Metropolis™ DMXpress are unprotected and the system can be managed by the same operations systems used for the Metropolis™ DMXpress, including the PC-CIT and the Navis™ Optical EMS.

The Metropolis™ DMXpress is NEBS Level 3 complaint and can be outfitted with a choice of power—48 VDC or 110 volts ACs. The Metropolis™ DMXpress, which is 2–rack units high, can be wall mounted, rack/bay mounted, or reside on a table.

Releases Supported

The Navis™ Optical EMS R8.0 supports R1.0 of the Metropolis™ DMXpress.

Southbound Protocols

The Metropolis™ DMXpress supports the TL1 application protocol and OSI and TCP/IP interface protocols.

Software Management

The Metropolis™ DMXpress does not currently support file transfers for memory backup and restore.

Software Copying between NEs

The Metropolis™ DMXpress supports copying software between NEs, which is a more efficient use of network bandwidth because it allows software to be copied from nearby NEs rather than from a possibly remote EMS.

Synchronization Management

The Metropolis™ DMXpress can be line timed or free running. External timing inputs or outputs are not required.

Fault Management

The Metropolis™ DMXpress does not use ASAPs. Alarm severity provisioning is supported as part of other provisioning (port provisioning).

Performance Management

The Metropolis™ DMXpress does not use TCA thresholds. PM thresholds are set per port/tributary. PM is supported for SONET section and line (OC-48), SONET path (STS-12c, STS-3c, STS-1, VT1.5), DS3, and Ethernet.

Subnetwork Initialization

The Metropolis™ DMX cannot automatically register itself in the Navis™ Optical EMS central directory—that directory in which the Navis™ Optical EMS uses to automatically discovery NEs. Therefore, it is an option to use this directory. (The Metropolis™ DMXpress does not support history logs that are sufficient for log-based DNO.)

Provisioning of Ethernet Layer 2 Packet Routing

Ethernet circuit packs (CPs) can support one or more modes of operation, such as the port-tagged mode in which the Ethernet packet switches route by port tag or IEEE 802.1q tagged mode in which the Ethernet packet switches route by VLAN identifier. The Metropolis™ DMX and the Metropolis™ DMXpress are the only NE types that support configurable Ethernet routing. The Metropolis™ DMXpress supports IEEE 802.1q VLAN tags.

□

Metropolis™ EON

Overview

The Metropolis™ Enhanced Optical Networking (Metropolis™ EON) (OLS40G/80G) NE is a flexible, high capacity lightwave system comprised of end terminals that multiplex digitally encoded information (contained in up to 16 different wavelengths) on one end, transmit the resulting combined signal through the optical fibers, and then demultiplex the information at the other end. Repeater terminals re-amplify the optical signal on an optical line between adjacent end terminal and repeater sites or between adjacent repeater sites.

Metropolis™ EON supports applications that need to expand to accommodate increasing amounts of information. Metropolis™ EON supports wavelength growth and, when equipped with the Optical Translator (OT), a highly flexible form of Wavelength Add/Drop (WAD) is also possible. Wavelength growth increases capacity and decreases the need for fibers, which is especially useful in cases of fiber exhaust. Utilizing Dense Wave Division Multiplexing (DWDM) technology, the Metropolis™ EON can tansmit up to 16 wavelengths over a single fiber; each channel can be equipped in any order.

The Metropolis™ EON addresses an application domain that extends from long haul transport to regional/interoffice facility transport. The Metropolis™ EON system, with its higher capacity and support for up to 80 wavelengths, primarily addresses long haul transport applications.

Supported Releases

The Navis™ Optical EMS R8.0 supports R8.2 of the Metropolis™ EON.

Southbound Protocols

The Metropolis™ EON supports TL1 and FTP application protocols and OSI and TCP/IP interface protocols.

File Transfers and Remote Software Downloads

The Metropolis™ EON supports FTP for file transfers an remote software downloads.

Software Copying between NEs

The Metropolis™ EON supports copying software between NEs, which is a more efficient use of network bandwidth because it allows software to be copied from nearby NEs rather than from a possibly remote EMS.

Optical Association Provisioning Consideration

The optical association provisioning feature for the Metropolis™ EON includes associations that can be specified during provisioning for alarm correlation (to suppress symptomatic alarms). Their use is optional. These associations are provisioned using the TL1–based interface.

File Transfer Protocol

The Metropolis™ EON does not support file transfer of a binary image of its memory. Instead of using file transfer for the Metropolis™ EON, the Navis™ Optical EMS provides memory backup and restore using the NE's TL1 command/response interface; issuing TL1 retrieve commands to backup the NEs' current configuration data; and reformatting this information into the corresponding TL1 **enter** and **set** commands to restore the NE to that configuration.

Subnetwork Initialization

The Metropolis™ EON cannot automatically register itself in the Navis™ Optical EMS central directory—that directory in which the Navis™ Optical EMS uses to automatically discovery NEs. Therefore, it is an option to use this directory

□

WaveStar® BWM

Overview

The WaveStar® BandWidth Manager (WaveStar® BWM) integrates the multiplexing capabilities of a traditional Add/Drop Multiplexer (ADM), which includes supporting rings, and the cross connection capabilities and capacity of a traditional Digital Cross Connect System (DCS). In addition, the WaveStar® BWM provides flexible bandwidth management at the Synchronous Transfer Mode (STM)—the SONET/SDH—layer.

The WaveStar® BWM is a modular product with a 4608 STS-1 and/or 1536 STM-1 capacity switching fabric and up to 24 I/O shelves for transmission interfaces. It has the following:

- WaveStar® TDM 2.5G (OC-48/STM-16o) shelves supporting transmission rates up to 2.5G
- WaveStar® TDM 10G (OC-192/STM-64o) I/O shelves supporting the 10G interfaces

Supported Releases

The Navis™ Optical EMS R8.0 supports R4.1.2 of the WaveStar® BWM.

In addition, the Navis™ Optical EMS R8.0 is backward compatible with WaveStar® BMS R4.0.2 and R4.1.1.

Support in General

The Navis™ Optical EMS provides full support for the WaveStar® BWM. However, in terms of configuration management, keep in mind that the WaveStar® BWM, is an STM bandwidth management element.

Southbound Interfaces

The Navis™ Optical EMS southbound interface supports OSI and OSI over TCP/IP communications with the NEs. The WaveStar® BWM only supports an OSI interface and an OSI over TCP/IP interface with the WaveStar® BWM functioning as a transport bridge.

File Transfer Protocol Supported

The WaveStar® BWM supports the File Transfer, Access, and Management (FTAM) file transfer protocol. In addition, for file transfers over TCP/IP LANs and WANs (for software downloads and for NE memory backup) and as an alternative to provisioning IP tunnels through the OSI subnetworks, the Navis™ Optical EMS supports the WaveStar® BWM as an FTP/FTAM gateway.

NE User Login Management

Currently, NE user login management with form and menu based screens is now supported for the WaveStar® BWM.

Provisioned via TL1 Cut-Through

The WaveStar® BWM relies on the Navis™ Optical EMS' TL1 cut-through capability to provision the following on each NE:

- the description of the environmental alarms (also called ***scan points*** or ***miscellaneous discrete inputs***)
- control points (also called ***miscellaneous discrete outputs***)

Synchronization Management

The Navis™ Optical EMS provides Synchronization Management functions to facilitate user operations for configuring, managing, and controlling the timing sources and distribution of outgoing timing for the WaveStar® BWM.

WaveStar® TDM NEs support external timing references, support (OC-n/STM-n) line timing, and have their own internal clocks. Synchronization management includes functions to:

- provision incoming and outgoing external timing ports
- establish timing references and their relative priority
- provision system timing parameters
- display the current synchronization status
- support the remote execution of manual synchronization controls such as forcing switches in the selected source of synchronization timing and changing clock modes

As with other Navis™ Optical EMS provisioning features, synchronization management features use a form-based display of the current values, typically with selection from lists of allowable values to make configuration changes.

Test Access Connection Management

The Navis™ Optical EMS supports test access connection management for the WaveStar® BWM.

The WaveStar® BWM supports test access connections, which provide access for external test systems to both monitor and test signal paths. The WaveStar® BWM supports non-intrusive monitoring and provides intrusive access to inject test signals and monitor outputs.

BLSR Ring Map

Line switched rings (BLSR/MS-SPRing) require the knowledge of all the nodes in the ring and their sequence to perform ring loopback protection switching and to suppress connections to portions of the ring that become isolated by failures. Lucent's TDM NEs support automatic ring discovery, which ensures the accuracy of this information and avoids manual provisioning. However to interwork in rings of other vendor NEs that do not support automatic discovery, the WaveStar® BWM also supports the manual provisioning of ring maps. The Navis™ Optical EMS provides a GUI based feature to support his provisioning.

The ***Bi–directional Line-Switched (BLSR) Ring Map*** for the WaveStar® BWM NEs is the GUI feature that allows the user to view a list of NEs and protection groups in a 2-Fiber or 4-Fiber BLSR ring. The user can also create a new ring map, which is built on the target identifier (TID) and protection group access identifier (AID) of a local NE, and define a list of NEs by TID that are connected to the local NE on the ring. A new view of each ring map can be obtained by providing the TID of a different NE in the ring.

Password Aging Feature

To ensure network security, the WaveStar® BWM has a password aging feature that relies on the use of two default passwords. The Navis™ Optical EMS interworks with the WaveStar® BWM by using these default passwords along with two if its own alternate default passwords. During the natural lifecyle of a password and during the software upgrade process, the Navis™ Optical EMS relies on these passwords to access the NE. Refer to the *Provisioning Guide* and the *Administration Guide* for details on this interworking.

□

WaveStar® OLS 1.6T

Overview

The WaveStar® OLS 1.6T System is the latest generation in Lucent's Optical Line System (OLS) Long Hall Product.

The WaveStar® OLS 1.6T is a modular optical transmission system that offers up to 160Gps (Gigabits per second) wavelengths, for a total capacity of 1.6Tbps (Terabits per second) over a single strand of fiber, which is the equivalent of sending 320 million one page e-mails per second.

The WaveStar® OLS 1.6T architecture provides a scalable, flexible solution for long-haul applications.

Supported Releases

The Navis™ Optical EMS R8.0 supports the R6.1 of the WaveStar® OLS 1.6T.

The Navis™ Optical EMS R8.0 is backward compatible with R6.1 of WaveStar® OLS 1.6T.

Support in General

The Navis™ Optical EMS provides full support for the WaveStar® OLS 1.6T. However, in terms of configuration management, keep in mind that the WaveStar® OLS 1.6T is a DWDM bandwidth management element. In addition, association provisioning is unique to the WaveStar® OLS 1.6T.

Southbound Protocols

TheWaveStar® OLS 1.6T supports TL1 and FTAM application protocols and OSI, OSI over TCP/IP interface protocols.

NE User Login Management

Currently, NE user login management with form and menu based screens is only supported for the WaveStar® OLS 1.6T.

File Transfer Protocol Supported

The WaveStar® OLS 1.6T supports File Transfer, Access, and Management (FTAM) file transfer protocol.

TCA Profiles

The WaveStar® OLS 1.6T does not support the concept of TCA profiles. PM thresholds are set for each termination point.

Optical Association Provisioning Consideration

The WaveStar® OLS 1.6T NEs require associations to be provisioned that specify the connectivity between external terminals, Optical Translator Unit (OTU) ports, Optical Multiplexer Unit (OMU) ports, Optical Demultiplexer Unit (ODU) ports, and Wavelength Add/Drop (WAD) ports. These associations are used for internal alarm correlation and to enable OTU outputs.

The Navis™ Optical EMS provides a GUI based function to create, delete, and view these associations. As with other functions, Navis™ Optical EMS supports this provisioning with user-friendly windows with selection from lists of allowable choices, which ensures that only available ports in valid combinations are selected for a new association. Deleting an association is done by simply selecting from the set of existing associations.

Besides providing a capability to create and delete individual optical associations, the Navis™ Optical EMS enables users to establish a complete optical connection through an WaveStar® OLS 1.6T NE. This function supports the user in establishing all optical associations for the complete connection of an optical wavelength through the NE. Similar to the function for creating an individual optical association, this function ensures that only valid ports in valid combinations are selected for each optical association that comprises the complete optical connection.

Software Copying between NEs

The WaveStar® OLS 1.6T supports copying software between NEs, which is a more efficient use of network bandwidth because it allows software to be copied from nearby NEs rather than from a possibly remote EMS.

Provisioned via TL1 Cut-Through

The WaveStar® OLS 1.6T relies on Navis™ Optical EMS' TL1 cut-through capability to provision the following on each NE:

- the description of the environmental alarms (also called ***scan points*** or ***miscellaneous discrete inputs***)
- control points (also called ***miscellaneous discrete outputs***)

□

WaveStar® TDM 2.5G and WaveStar® TDM 10G

Overview

The WaveStar® TDM 2.5G (OC–24 2F) and the WaveStar® TDM 10G (OC-192 2F) are modular Add/Drop Multiplexers (ADMs) for cost-effective bandwidth management at the STM (SONET) layer.

Architecturally, each NE has a modular design that consists of the following:

- a 2.5G shelf, which supports OC-48, 2-fiber BLSR rings
- 10G shelves, which support OC-192, 2-fiber BLSR rings

This flexible architecture allows configurations from a single standalone 2.5G shelf (which is a single, low speed shelf) up to a configuration with a 10G shelf and two 2.5G shelves, and economically supports a wide range of application sizes.

These NEs re-use WaveStar® BWM hardware (I/O shelves and circuit packs) and software assets; thus, they reduce costs and simplify product interworking and operations.

Supported Releases

The Navis™ Optical EMS R8.0 supports R6.1.5 of the WaveStar® TDM 2.5G and the WaveStar® TDM 10G.

The Navis™ Optical EMS R8.0 is backward compatible with R6.0 and R6.1 of both NEs.

Support in General

The Navis™ Optical EMS provides full support for the WaveStar® TDM 2.5G/10G (SONET). However, in terms of configuration management, keep in mind that the WaveStar® TDM 2.5G/10G (SONET) is an STM bandwidth management element.

Southbound Interfaces

The Navis™ Optical EMS southbound interface supports OSI and OSI over TCP/IP communications with the NEs. The WaveStar® TDM 2.5G/10G (SONET) only supports an OSI interface and OSI over TCP/IP with the WaveStar® TDM 2.5G/10G (SONET) functioning as a transport bridge.

NE User Login Management

Currently, NE user login management with form and menu based screens is now supported for the WaveStar® TDM 2.5G/10G (SONET).

File Transfer Protocol Supported

The WaveStar® TDM 2.5G/10G (SONET) supports File Transfer, Access, and Management (FTAM) file transfer protocol. In addition, for file transfers over TCP/IP LANs and WANs (for software downloads and for NE memory backup) and as an alternative to provisioning IP tunnels through the OSI subnetworks, the Navis™ Optical EMS supports the WaveStar® TDM 2.5/10G as an FTP/FTAM gateway.

Provisioned via TL1 Cut-Through

The WaveStar® TDM 2.5G/10G (SONET) relies on Navis™ Optical EMS' TL1 cut-through capability to provision the following on each NE:

- the description of the environmental alarms (also called ***scan points*** or ***miscellaneous discrete inputs***)
- control points (also called ***miscellaneous discrete outputs***)

Test Access Connection Management

The Navis™ Optical EMS supports test access connection management for the WaveStar® TDM 2.5G/10G (SONET).

Provisioning of Ethernet Layer 2 Packet Routing

Ethernet circuit packs (CPs) can support one or more modes of operation, such as the port-tagged mode in which the Ethernet packet switches route by port tag or IEEE 802.1q tagged mode in which the Ethernet packet switches route by VLAN identifier. The WaveStar® TDM 2.5G (OC–24 2F) and the WaveStar® TDM 10G (OC-192 2F) support Gigabit Ethernet, but their Ethernet packet switches have a fixed configuration.

□

WaveStar® TDM 10G (STM-64)

Overview

The WaveStar® 10G Time Division Multiplexer (TDM) (STM-64) is a two shelf Add/Drop Multiplexer (ADM) that consists of the following:

- a main shelf
- an optional second shelf for larger applications

The WaveStar® TDM 10G (SDH) provides cost-effective bandwidth management at the STM (SDH) layer, supporting both 2-fiber STM-64o MS-SPRings and 2-fiber STM-16o MS-SPRings.

The WaveStar® TDM 10G (SDH) re-uses WaveStar® BWM hardware (circuit packs) and software assets, thus it reduces costs and simplifies product interworking and operations.

Supported Releases

The Navis™ Optical EMS R8.0 supports R4.0.5 of the WaveStar® TDM 10G (STM-64).

The Navis™ Optical EMS R8.0 is backward compatible with R4.0 of the WaveStar® TDM 10G (STM-64).

Support in General

The Navis™ Optical EMS provides full support for the WaveStar® TDM 10G (STM-64). However, in terms of configuration management, keep in mind that the WaveStar® TDM 10G is an STM bandwidth management element.

NE User Login Management

NE user login management with form and menu based screens is currently supported for the WaveStar® TDM 10G (STM-64).

File Transfer Protocol Supported

The WaveStar® TDM 10G (STM-64) supports File Transfer, Access, and Management (FTAM) file transfer protocol.

Provisioned via TL1 Cut-Through

The WaveStar® TDM 10G (SDH) relies on the Navis™ Optical EMS' TL1 cut-through capability to provision the following on each NE:

- the description of the environmental alarms (also called ***scan points*** or ***miscellaneous discrete inputs***)
- control points (also called ***miscellaneous discrete outputs***)

Password Aging Feature

To ensure network security, the WaveStar® TDM 10G (SDH) has a password aging feature that relies on the use of two default passwords. The Navis™ Optical EMS interworks with the WaveStar® BWM by using these default passwords along with two if its own alternate default passwords. Be aware that during the natural lifecyle of a password and during the software upgrade process, the Navis™ Optical EMS relies on these passwords to access the NE. Refer to the *Provisioning Guide* and the *Administration Guide* for details on this interworking.

Provisioning of Ethernet Layer 2 Packet Routing

Ethernet circuit packs (CPs) can support one or more modes of operation, such as the port-tagged mode in which the Ethernet packet switches route by port tag or IEEE 802.1q tagged mode in which the Ethernet packet switches route by VLAN identifier. The WaveStar® TDM 10G (SDH) supports Gigabit Ethernet, but its Ethernet packet switches have a fixed configuration.

□

6 Product Services and Support

Overview

Purpose

This chapter provides and overview of the services and support offered for the Navis™ Optical EMS.

Contents

Purchasing Lucent Products

How to Buy

Lucent is dedicated to providing a streamlined buying experience:

- Companies who have a direct purchase agreement with Lucent can use our CustomerCenter and our BusinessPartner Center to select, configure, price, and order products directly online.
- Companies who do not have a direct purchase agreement can purchase Lucent products and solutions through Lucent authorized resellers.
- Prospective customers can also contact a Lucent account executive to establish an account.

Visit the *www:lucent.com/products/howtobuy* site for more information.

Buying Direct

Lucent customers can buy direct with the help of our CustomerCenter and our BusinessPartner Center.

Lucent customers can have a personalized ***CustomerCenter*** account. Customers simply can log in to get convenient access to Lucent products, services, and solutions. The CustomerCenter also makes product pricing, ordering, and configuration fast and easy.

Lucent BusinessPartners receive privileged access to our ***BusinessPartner Center***. This comprehensive storehouse of specialized tools and information gives our BusinessPartners quick access to Lucent products, services, and solutions. The BusinessPartner Center also leverages the Web to streamline product pricing, ordering, configuration, installation, training, and certification.

With a Lucent CustomerCenter or BusinessPartner account, customers can:

- view the entire Lucent catalog of communication products and services
- find the solutions to their business problems by matching their specific business needs with our expertise in data network design, implementation, management, and support
- collaborate with colleagues to enhance their team’s cooperation and efficiency
- manage product lists

- get alerts, news, and events
- download important documents such as case studies, white papers, catalogs, and expert articles
- obtain industry intelligence, which includes articles, white papers, and other documents that we have selected for their relevance to, and impact on, the customer's specific industry.

Buying through a Reseller

Those companies who do not have a direct purchase agreement can purchase Lucent products through an authorized Lucent reseller:

- To purchase products through a reseller in the United States, call 1-888-4-LUCENT.
- To purchase products through a reseller outside of the United States, call 1-314-317-6869.

□

Warranties and Maintenance

Warranty Definition

Under a warranty, the provider replaces or repairs any equipment or software found defective within a specified period of time without charge to the customer. Labor required to isolate and repair the defect is also supplied without extra cost during the warranty period.

Lucent Technologies passes on to Navis™ Optical EMS customers all warranties received by outside vendors.

Hardware Warranties

The major hardware suppliers for the Navis™ Optical EMS are:

- Hewlett-Packard Company (HP)
- Sun Microsystems
- PC vendors

Each supplier has its own warranty.

HP Warranties

HP furnishes the servers, the associated HP server consoles, and the any associated printers.

HP warrants its hardware for one year from arrival at the customer location. The location can be the operational site or a warehouse. The warranty provides on-site, four-hour response time Monday through Friday for the server and integrated peripherals, and on-site repair with a guaranteed response time of within 72 hours for stand-alone peripherals. Customers requiring a faster response should order a system support option.

Sun Microsystems Warranties

Sun Microsystems furnishes the workstations used as desktops.

Sun Microsystems warrants its hardware for one year from its ship date to the customer location. The warranty is a ***return to factory*** type of warranty. Customers requiring a faster response can order a system service agreement.

Hardware Maintenance and Repair

The customer is responsible for all hardware maintenance, which is performed through a specific contract or through a time and materials arrangement. Maintenance includes both preventive procedures as well as reactive maintenance as a result of a failure. Navis™ Optical EMS customers are urged to contact hardware vendors regarding their hardware maintenance arrangements soon after the hardware is installed and operable, before any warranties expire.

Both HP and Sun Microsystems offer hardware maintenance contracts on their equipment. Contracts should be negotiated during the warranty period to assure continual coverage after warranty expiration.

A major design consideration of the Navis™ Optical EMS system is to provide high availability. The server configuration can be redundant and a sufficient number of desktops allow temporary swapping with an unused unit. In general, faulty hardware can be swapped from the system and operations can continue until the faulty unit can be repaired.

Software Warranties

Lucent Technologies warrants the its application software for 90 days from its installation on any HP server or desktop. Integrated third party software is warranted for one year.

The software warranty includes fixes to all reported severity 1 and 2 defects and work-arounds for severity 3 and 4 defects.

Lucent Technologies does not warrant any general purpose software.

Software Maintenance

Software maintenance is the modification and the subsequent installation and/or re-installation of software programs that is required to maintain current system operations. Software maintenance does not include major functional changes or enhancements that are made to the product.

Software maintenance is performed through a specific contract that includes application software and integrated third party software as ***separate line items***. Negotiations for software not included in a software maintenance contract should be held with the particular vendor.

Navis™ Optical EMS customers should contact their Lucent Account Representatives regarding software maintenance arrangements:

- soon after their system is installed and operable
- ***and*** before any warranties expire

Software Maintenance Releases

Lucent issues periodic software maintenance releases for the Navis™ Optical EMS product, which are also known as ***point releases***. Releases contain core maintenance updates, minor enhancements, and fixes to problems reported by the user community.

Maintenance releases are included as part of the service contract or can be purchased separately. Individual fixes or enhancements cannot be purchased separately. A maintenance release is designed, tested, and documented as a package.

□

Technical Assistance

Lucent's New One Number Interface

As Lucent restructures to become a smaller and more efficient company, US customers in need of technical assistance only have to dial one number to reach 24-hour support from Lucent experts:

1-866-LUCENT8 (1-866-582-3688)

Lucent's new ***one number interface*** pairs customers with Lucent professionals from the Technical Assistance Centers (TACs), product support teams, and all US call centers to integrate different and emerging technologies.

For technical assistance outside of the United States, customers can contact their Local Customer Support (LCS) or the support organization designated by their Lucent customer team representative. Customers who are unsure of whom to call, can contact the Global TSS Contact Center at 1-630-224-4672.

□

Training

Training Courses Available

The Navis™ Optical EMS offers instructor-led training courses for end users and system administrators.

The Navis™ Optical EMS courses are conducted by the ***Lucent Learning*** Organization at the following locations:

- Lucent's Training Facility in Altamonte Springs, Florida
- Lucent's Training Facility in Nuremberg, Germany
- the customer's site

In all courses, students input and manipulate data on desktops to become familiar with the aspect of the Navis™ Optical EMS that is appropriate to their job function and the particular course.

Training Course Materials

Each course provides the student with the following training materials:

- A ***student guide*** is provided to each student that presents the material taught. The student guide is divided into modules or sections, which contain objectives, the material associated with the topic, and related exercises.
- Other appropriate ***customer documentation*** pertaining to the particular course is provided.

Product Training Catalog

Lucent's on-line ***Product Training Catalog*** lists the courses that are offered to our customers for our product lines.

To find a course number or course description in the ***Product Training Catalog,*** visit the *http://www.lucent-product-training.com/SabaWeb* web site.

The course descriptions that appear in the ***Product Training Catalog*** contain the following information:

- an explanation of the intended audience for the course
- a course overview
- course objectives
- course prerequisites
- media used in the course
- equipment required for suitcasing the course or for self-paced learning
- any related courses

- curriculum paths to follow
- the duration of the course

Scheduling through 1-888-LUCENT8

The courses listed in the following table can be scheduled by calling:

1-888-LUCENT8, prompt 2, prompt 2.

Outside the continental United States, customers can dial the following number:

1-407-767-2798

All customers can call from:

8 to 6 Eastern Standard Time (EST), Monday through Friday

Table 6-1 Courses to be Scheduled Through 1-888-LUCENT8

Course ID	Course Title	Conducted At
TR4510	Navis™ Optical EMS System User Training	Altamonte Springs Training Facility and/or Customer Site
TR4511	Navis™ Optical EMS System Administration Training Using the GUI	Altamonte Springs Training Facility and/or Customer Site

Registration Information

When calling to schedule training, the registrar requires the following information:

Table 6-2 Checklist of Information Needed to Schedule Training

Check?	Item
	Course number
	Course name
	Approximate dates or actual course dates
	Location of training
	Number of students
	Student name(s)
	Student social security number(s)
	Student telephone(s) and FAX number(s)

Table 6-2 Checklist of Information Needed to Schedule Training (continued)

Check?	Item
	Payment method(s) (credit card, contract number, organization number, purchase order number)

Customer Documentation

Types of Documentation

The Navis™ Optical EMS documentation library consists of the following documents:

- Customer documents that accompany the product
- Student Guides that are furnished during Navis™ Optical EMS classes

These documents are created and maintained by the ***Lucent Learning*** organization.

Customer Documents

The following customer documents are available for the Navis™ Optical EMS R8.0:

- *Navis™ Optical Element Management System (EMS) Provisioning Guide*
- *Navis™ Optical Element Management System (EMS) Maintenance Guide*
- *Navis™ Optical Element Management System (EMS) Administration Guide*
- *Navis™ Optical Element Management System (EMS) Installation Guide*
- *Navis™ Optical Element Management System (EMS) Applications and Planning Guide*
- *Navis™ Optical Element Management System (EMS) Terminology Guide*

Documents Included with Purchase

Customer documentation is included on-line with the Application Software media. Optionally, hardcopies or a CD-ROM can be ordered. Refer to the section titled "Document Ordering Information" (6-11).

Document Ordering Information

Documents can be ordered from Lucent Learning by Comcode. Refer to "List of Orderable Items" (6-13) for a list of document Comcodes.

Table 6-3 Document Ordering Information

Lucent Learning Web Site	*http://www.lucent8.com* —or— *http://www.lucentdocs.com*
Origin of Request	***Phone Numbers and Email Addresses***

Table 6-3 Document Ordering Information (continued)

United States	call: 1-888-LUCENT8 (1-888-582-3688) fax: 1-800-566-9568
Canada and North America	call:: 1-317-322-6615 email: intlnaorders@lucent.com fax: 1-317-322-6699
Africa, Asia, China, the Carribean, Europe, Latin America, the Middle East, and the Pacific	call: 1-317-322-6416 email: intlorders@lucent.com fax: 1-317-322-6699

Ordering and Installation

Product Ordering

For all orders of the Navis™ Optical EMS, contact your local sales representative. Customers are responsible for ordering PCs for the Navis™ Optical EMS GUI client.

Purchasing Responsibilities

For international installations of the Navis™ Optical EMS, Lucent recommends that HP equipment is purchased locally in the country of the particular installation.

The customer must purchase all desktops. The desktop must have the minimum configuration supported, which is explained in Chapter 4, "Hardware Planning and Engineering".

Installation Responsibilities

The following parties are responsible for the particular installations cited:

- HP installs all HP servers.
- Lucent installs the Navis™ Optical EMS Application Software and all third party software.
- The customer installs the communications network between the NEs and the HP server, and the Navis™ Optical EMS GUI client and the HP servers.

List of Orderable Items

The Navis™ Optical EMS application is ordered by calling a Lucent sales representative.

The following table lists the items that can be ordered for the Navis™ Optical EMS R8.0:

Table 6-4 Navis™ Optical EMS Orderable Items for Release 8.0

Description	Mdse Class/IOC Code	Comcode
Application Software		
Navis™ Optical EMS Application Software R8.0	37873/0850	109232058

Table 6-4 Navis™ Optical EMS Orderable Items for Release 8.0 (continued)

Description	Mdse Class/IOC Code	Comcode
Navis™ Optical EMS Application Northbound TMF CORBA Application Software for R8.0	37873/0850	109232066
Navis™ Optical EMS Data Extraction Tool for R8.0	37873/0850	109232074
Navis™ Optical EMS RTU for Metropolis™ DMX	37873/0850	109161349
Navis™ Optical EMS RTU for WaveStar® BWM	37873/0850	109165225
Navis™ Optical EMS RTU for WaveStar® OLS 1.6T	37873/0850	109165233
Navis™ Optical EMS RTU for WaveStar® TDM 2.5G/10G	37873/0850	109165241
HP Servers - L-Class		
L2000 1 CPU Server with OSI Interface (rp5450)	80224/0851	408552800
L2000 1 CPU with Mirrored Disks and OSI Interface (rp5450)	80224/0851	408651198
L2000 2 CPU Server with Mirrored Disks and OSI Interface (rp5450)	80224/0851	408651206
L2000 4 CPU Server with Mirrored Disks and OSI Interface (rp5450)	80224/0851	408651214
Redundant L2000 2 CPU Server with OSI Interface (rp5450)	80224/0851	408651222
Redundant L2000 4 CPU Server with OSI Interface (rp5450)	80224/0851	408552834

Table 6-4 Navis™ Optical EMS Orderable Items for Release 8.0 (continued)

Description	Mdse Class/IOC Code	Comcode
Redundant L2000 4 CPU Server with OSI Interface; two servers in a single cabinet <special configuration> (rp5450)	80224/0851	408533974
HP Servers - N-Class		
N4000 8 CPU Server with OSI Interface (rp7400)	80224/0851	408552842
Third Party Software		
Informix for all servers (Runtime) R7.31uc3 (For R5.0 and beyond)	80224/0851	408560969
Informix for all servers (Assurance) R7.31uc3 (For R5.0 and beyond)	80224/0851	408560985
Informix for a K380 Server R7.31uc2 (Runtime and Assurance)	80224/0851	408389013 & 408389120
Informix for a K580 Server R7.31uc2 (Runtime and Assurance)	80224/0851	408389138 & 408389153
IONA Orbix MT Runtime R3.3.2 (required for every CPU; for R8.0 and beyond)	80224/0851	408673614
ATOS Stack Runtime R2.6F	80224/0851	408164655
Rouge Wave SourcePro Core R8.0 (required for every CPU; for R4.2 and beyond)	80224/0851	408646107

Table 6-4 Navis™ Optical EMS Orderable Items for Release 8.0 (continued)

Description	Mdse Class/IOC Code	Comcode
Citrix Metaframe R1.8 for Windows NT/2000; one user license (order the Comcode 15 times)	80224/0851	109152074
Citrix Metaframe R1.8 for Windows NT/2000; media on CD-ROM	80224/0851	408649259
Services		
Custom Services (Site or Customer Specific)	80225/0851	108098245
Application Software Upgrade Installation	45750/NA	108098351
Custom Development	80225/0851	108098435
Consulting Services	80225/0851	108098195
Professional Services Organization	80225/0851	108098500
Application Software and Installation & Hardware Integration performed by NDID	12594/1499	108998329
Training		
Navis™ Optical EMS User Level Training (TR4510) 3 days	80225/0851	108456948
Navis™ Optical EMS Administration Level Training (TR4511) 2 days	80225/0851	108456914
TMF/G7 Integration and Support Packages		

Table 6-4 Navis™ Optical EMS Orderable Items for Release 8.0 (continued)

Description	Mdse Class/IOC Code	Comcode
TMF Integration Package	37407/0851	109193664
TMF Introduction Training	37407/0851	109193672
TMF Client Simulator (Server Test Tool)	37407/0851	109192864
TMF Server Simulator (Client Test Tool)	37407/0851	109192872
Simulator Support and Training	37407/0851	109193680
Partner Support Program	37407/0851	109193698
Documentation		
Navis™ Optical EMS Element Management System Documentation CD-ROM, 190-224-162R8.0	37873/0850	109211268
Navis™ Optical EMS Element Management System (EMS) Provisioning Guide, 190-224-156R8.0	37873/0850	109211292
Navis™ Optical EMS Element Management System (EMS) Maintenance Guide, 190-224-157R8.0	37873/0850	109211342
Navis™ Optical EMS Element Management System (EMS) Administration Guide, 190-224-158R8.0	37873/0850	109211383
Navis™ Optical EMS Element Management System (EMS) Installation Guide, 190-224-159R8.0	37873/0850	109211433

Table 6-4 Navis™ Optical EMS Orderable Items for Release 8.0 (continued)

Description	Mdse Class/IOC Code	Comcode
Navis™ Optical EMS Element Management System (EMS) Applications and Planning Guide, 190-224-160R8.0	37873/0850	109211458
Navis™ Optical EMS Element Management System (EMS) Terminology Guide, 190-224-161R8.0	37873/0850	109211540
Software Support Agreements		
24 Hour/7 Day Coverage (Gold Uplift Level)	37874/0851	108097262
Monday through Friday 8AM to 5PM (Gold Level)	37876/0851	108097312

Index