Lucent Technologies
Bell Labs Innovations



WaveStar® BandWidth Manager, Release 4.1

Applications and Planning Guide

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About this Information Product

Purpose

This Applications and Planning Guide (APG) provides the following information about WaveStar BandWidth Manager:

- Features
- Applications
- Product description
- Operations and maintenance
- System engineering
- Product support
- Technical and reliability specifications

Reason for reissue

This *WaveStar BandWidth Manager, Release 4.1 Applications and Planning Guide* contains the following changes to the material.

Changes

Effective June 1, 2002, all standard footprint equipment (bays and floorplans) will be Discontinued Availability (DA).

Because floor space is very critical to our customers, Lucent is taking advantage of leading edge technologies in cabling to reduce the footprint of WaveStar BandWidth Manager. Therefore, the original standard footprints are no longer necessary and they will be DA effective June 1, 2002. Customers will save significant floor space by purchasing the new reduced footprints. When compared to the floor space occupied by the standard footprints:

- The new reduced footprint NEBS 2-bay Control/Switch Complex (without I/O bays) reduces the amount of floor space by approximately 13.5%.
- The new reduced footprint ETSI 2-bay Control/Switch Complex (without I/O bays) reduces the amount of floor space by approximately 30%.
- The new reduced footprint ETSI I/O Bays reduces the amount of floor space by approximately 16.7%.

  Important! The floor space savings stated above does not apply to the ETSI Universal I/O Bays and the 10G/Universal I/O Bays if those bays are equipped with DS3EC1/8 port units and therefore DS3EC1 Connect Panels.

Additions

Major changes to this book since the Release 4.0 version, Issue 9, June, 2001 include the addition of the Release 4.1 features.
Refer to Chapter 1, “Introduction” for a list of the R4.1 features.

Revisions

The following changes were made for Issue 13 of this document:

- Corrected Optical Pack Specifications - change POUs (incorrectly identified as WDM packs) to correct identify per Ordering.
- Changed specifications in Table C-62 Transmission Specs LEY14 Data Sheet - for transmitter wavelength minimum (from 1298 to 1274)/maximum (from 1325 to 1356) and spectral width (from 2.0nm to 2.5nm).

- Corrected Data Sheets (LEY201-LEY240) - reference from universal build-out blocks to LC connectors.
- Verified maximum number of SWIF pair is 48.
- Corrected the fitrates for the following packs

  OC48/STM16/1.3LRI LEY7/AE (7500)

  OC48/STM16/1.5LRI LEY8 /AE (7500)

  OC48/STM16/DWDM01-16 LEY50-65 /AE (7500)

Safety labels

This section is not applicable to this book.

Audience

The WaveStar BandWidth Manager Applications and Planning Guide is written primarily for network planners and engineers. In addition, others who need specific information about the features, applications, operation, and engineering of WaveStar BandWidth Manager may find the information in this manual useful.

Conventions used

This section lists common conventions maintained throughout this document.

Typographical conventions

The following typographical conventions are used throughout this document:

- *BOLD* face type is used for emphasis
- **Courier** identifies WaveStar CIT menu-option displays and user responses

Related documentation The following table lists the documents included in the WaveStar BandWidth Manager documentation set.

Table 1 WaveStar BandWidth Manager Documentation Set

Comcode	Document Number	Title
NA	365-370-100	*WaveStar BandWidth Manager Installation Manual*
109 128 090	365-370-101 R4.1	*WaveStar BandWidth Manager Applications and Planning Guide*
109 142 315	365-370-133	*WaveStar BandWidth Manager TL-1 Message Details (formerly the Operations System Engineering Guide)*
109 128 108	365-370-109 R4.1	*WaveStar BandWidth Manager User Operations Guide*
109 128 116	365-370-110 R4.1	*WaveStar BandWidth Manager Alarm Messages and Troubleclearing Guide*
NA	365-370-125 R4.1	*WaveStar BandWidth Manager Stand-Alone Installation Test Manual (4608/1536) SONET Release 4.1*
109 153 866	CD-ROM	*WaveStar BandWidth Manager Release 4.1 Documents*

Description of documentation set

This section briefly describes the documents that are included in the WaveStar BandWidth Manager documentation set.

Installation Manual

The *WaveStar BandWidth Manager Installation Manual* is a step-by-step guide to system installation and setup. It also includes information needed for pre-installation site planning and post-installation acceptance testing.

Applications and Planning Guide

The *WaveStar BandWidth Manager Applications and Planning Guide* (APG) is for use by network planners, analysts and managers. It is also for use by the Lucent Account Team. It presents a detailed overview of the system, describes its applications, gives planning requirements, engineering rules, ordering information, and technical specifications.

User Operations Guide

The *WaveStar BandWidth Manager User Operations Guide* (UOG) provides step-by-step information for use in daily system operations. The manual demonstrates how to perform system provisioning, operations, and administrative tasks.

Alarm Messages and Trouble Clearing Guide

The *WaveStar BandWidth Manager Alarm Messages and Trouble Clearing Guide* (AMTCG) provides detailed information on maintenance and trouble clearing, a list of the systems's alarm messages, and procedures for routine maintenance, troubleshooting, diagnostics, and component replacement.

TL-1 Messaging Guide

The *WaveStar BandWidth Manager TL-1 Messaging Guide* provides detailed information on TL1 commands, messages, and error codes.

Chapter Descriptions The following table briefly describes the information in each chapter.

Table 2 Chapter Descriptions

Chapter	Title	Description
Preface	About This Document	• describes the guide's purpose, intended audience, and organization • references related documentation • explains how to comment on this document
1	Introduction	• presents network application solutions • provides a high-level product overview • describes the product family • lists product features by release
2	Features	describes the features available in Release 4.1
3	Applications	describes the main applications possible with WaveStar BandWidth Manager
4	Product Description	describes the hardware and configurations available for the WaveStar BandWidth Manager
5	Operations, Administration, Maintenance, and Provisioning	describes OAM&P features (such as alarms, operation interfaces, security, and performance monitoring)
6	System Planning and Engineering	provides planning information necessary to deploy the WaveStar BandWidth Manager
7	Ordering	provides ordering and sparing information for WaveStar BandWidth Manager
8	Product Support	• describes engineering and installation services • explains documentation and technical support • lists training courses
9	Quality and Reliability	• provides the Lucent Technologies quality policy • lists the reliability specifications
10	Technical Specifications	lists the technical specifications
Appendix A	A SONET Overview	describes the Synchronous Optical Network
Appendix B	An SDH Overview	describes the Synchronous Digital Hierarchy
Appendix C	Port Unit Data Sheets	provides technical information about the port units
	Glossary	• expands common telecommunication abbreviations and acronyms • defines telecommunication terms
	Index	lists specific subjects and their corresponding page numbers

Documentation Ordering Information

This section describes how to order

- Additional copies of this document
- Electronic documentation (CD-ROMs)
- Product drawings

RBOC/BOC Customers

RBOC/BOC customers should process orders through your Company Documentation Coordinator.

Commercial Customers

Table 3, "Placing an Order" provides the information necessary for commercial customers to order standard documentation or request placement on the standing order list (for reissues of any document) by mail, internet, email, telephone, or fax.

Table 3. Placing an Order

Mailing, Internet and email Addresses	Telephone Numbers	Fax Numbers
Mailing address: Lucent Technologies Attention: Order Entry 2855 N. Franklin Road P.O. Box 19901 Indianapolis, IN 46219	From USA: 1-888-LUCENT8 (1-888-582-3688)	1-800-566-9568
	From Canada, North American Region (NAR): 1-317-322-6615	1-317-322-6699
Internet address: www.lucentdocs.com or www.lucent8.com email address for international orders: intlnaorders@lucent.com	From Europe, the Middle East, Africa (EMEA Region); Asia/Pacific Region and China; and Caribbean/Latin America Region (CALA): 1-317-322-6416	1-317-322-6699

Ordering CD-ROMs

Documentation for WaveStar BandWidth Manager is available on CD-ROM. The following table lists the contacts for specific information about CD-ROM documentation.

Table 4 Ordering CD-ROM Documentation

IF you wish to...	THEN contact...
order an annual subscription	Your Account Executive.
obtain pricing information	Lucent Technologies Customer Information Center. Contact information is provided in previous table.
obtain a list of documents available on CD-ROM	

Ordering Drawings

To order any of the drawings listed in the following table, contact the Lucent Technologies Customer Information Center.

Available Drawings

The following table lists the available drawings. These drawings provide valuable product information.

Table 5 Drawings Available from CIC

Drawing Number	NEBS/ ETSI	Description	Note
Using ED9C280-28 with original cables			DA: Effective 6/01/02 Replaced by: ED9C280-12
801-802-001-2	NEBS	NEBS Original Footprint 3-Aisle Floor Plan Data Sheet (3-Bay Control/Switch Complex)	DA: Effective 4/01/02
801-802-001-3	NEBS	NEBS Original Footprint 4-Aisle Floor Plan Data Sheet (3-Bay Control/Switch Complex)	DA: Effective 4/01/02
801-802-001-4	ETSI	ETSI Original Footprint 3-Aisle Floor Plan Data Sheet (3-Bay Control/Switch Complex)	DA: Effective 4/01/02
801-802-001-5	ETSI	ETSI Original Footprint 4-Aisle Floor Plan Data Sheet (3-Bay Control/Switch Complex)	DA: Effective 4/01/02

Drawing Number	NEBS/ ETSI	Description	Note
801-802-001-10	NEBS	NEBS Original Footprint 3-Aisle Floor Plan Data Sheet (2-Bay Control/Switch Complex)	DA: Effective 6/01/02 Replaced by: 801-802-001-30
801-802-001-11	NEBS	NEBS Original Footprint 4-Aisle Floor Plan Data Sheet (2-Bay Control/Switch Complex)	DA: Effective 6/01/02 Replaced by: 801-802-001-31
801-802-001-12	ETSI	ETSI Original Footprint 3-Aisle Floor Plan Data Sheet (2-Bay Control/Switch Complex)	DA: Effective 6/01/02 Replaced by: 801-802-001-32
801-802-001-13	ETSI	ETSI Original Footprint 4-Aisle Floor Plan Data Sheet (2-Bay Control/Switch Complex)	DA: Effective 6/01/02 Replaced by: 801-802-001-33
Using ED9C280-11 for reduced footprints with reduced cables or ED9C280-13 for reduced footprints with reduced cables with the cable racking greater than 11.5 ft/3.5 m above the floor or for raised-floor platforms with cable-rack depths of greater than 1 ft/305 mm			Available 7/01/01
801-802-001-15	NEBS	NEBS Reduced Footprint 4-Aisle Floor Plan Data Sheet (2-Bay Control/Switch Complex)	Available 7/01/01
801-802-001-17	NEBS	NEBS Reduced Footprint 3-Aisle Floor Plan Data Sheet (2-Bay Control/Switch Complex)	Available 7/01/01
801-802-001-19	ETSI	ETSI Reduced Footprint 4-Aisle Floor Plan Data Sheet (2-Bay Control/Switch Complex)	Available 7/01/01
801-802-001-21	ETSI	ETSI Reduced Footprint 3-Aisle Floor Plan Data Sheet (2-Bay Control/Switch Complex)	Available 7/01/01
Using ED9C280-12 for standard footprints with reduced cables			Available 7/01/01
801-802-001-22	NEBS	NEBS Standard Footprint 3-Aisle Floor Plan Data Sheet (3-Bay Control/Switch Complex)	DA: Effective 4/01/02
801-802-001-23	NEBS	NEBS Standard Footprint 4-Aisle Floor Plan Data Sheet (3-Bay Control/Switch Complex)	DA: Effective 4/01/02

Drawing Number	NEBS/ ETSI	Description	Note
801-802-001-24	ETSI	ETSI Standard Footprint 3-Aisle Floor Plan Data Sheet (3-Bay Control/Switch Complex)	DA: Effective 4/01/02
801-802-001-25	ETSI	ETSI Standard Footprint 4-Aisle Floor Plan Data Sheet (3-Bay Control/Switch Complex)	DA: Effective 4/01/02
801-802-001-30	NEBS	NEBS Standard Footprint 3-Aisle Floor Plan Data Sheet (2-Bay Control/Switch Complex)	Available 7/01/01
801-802-001-31	NEBS	NEBS Standard Footprint 4-Aisle Floor Plan Data Sheet (2-Bay Control/Switch Complex)	Available 7/01/01
801-802-001-32	ETSI	ETSI Standard Footprint 3-Aisle Floor Plan Data Sheet (2-Bay Control/Switch Complex)	Available 7/01/01
801-802-001-33	ETSI	ETSI Standard Footprint 4-Aisle Floor Plan Data Sheet (2-Bay Control/Switch Complex)	Available 7/01/01
Control/Switch Complexes and Bays for Standard Footprint			
ED9C280-30	NEBS/ETSI	Control/Switch Complex: Three Bays	DA: Effective 4/01/02
ED9C280-60	NEBS/ETSI	Control/Switch Complex: Two Bays	
ED9C280-31	NEBS/ETSI	Universal I/O Bay	
ED9C280-39	NEBS/ETSI	10G I/O Bay	
ED9C280-39	NEBS/ETSI	10G/Universal I/O Bay	
ED9C280-65	NEBS/ETSI	SDH I/O Bay	
ED9C280-65	NEBS/ETSI	10G/SDH I/O Bay	
Control/Switch Complexes and Bays for Reduced Footprint			Available 7/01/01
ED9C280-60	NEBS/ETSI	Control/Switch Complex: Two Bays	Available 7/01/01
ED9C280-31	NEBS/ETSI	Universal I/O Bay	Available 7/01/01
ED9C280-39	NEBS/ETSI	10G I/O Bay	Available 7/01/01
ED9C280-39	NEBS/ETSI	10G/Universal I/O Bay	Available 7/01/01
ED9C280-65	NEBS/ETSI	SDH I/O Bay	Available 7/01/01

Drawing Number	NEBS/ ETSI	Description	Note
ED9C280-65	NEBS/ETSI	10G/SDH I/O Bay	Available 7/01/01
ED9C280-42	ETSI	ETSI Cable Management Bays	Available 7/01/01
Software			
ED9C280-40	NEBS/ETSI	WaveStar BandWidth Manager Software	

Methods of Payment

For commercial customers, use one of the following methods of payment:

- Credit card is required for orders totaling $1000 or less. Visa, MasterCard, and American Express are accepted. Prepayment by check is also accepted.
- Orders totaling over $1000 may be paid by credit card, check, or invoice upon receipt of a purchase order. Purchase orders may be faxed or mailed using the information in Table 3 - Placing an Order.

Orders placed by Lucent associates are billed to a cost center.

How to comment

Because customer satisfaction is extremely important to Lucent Technologies, every attempt is made to encourage feedback from customers about our information products.

Customer comment form

A customer comment form is located immediately after the title page of this document. Please fill out the form and fax it to the number provided on the form.

Is the form missing?

If the customer comment form is missing, you may submit comments by fax, email, or on-line.

Fax: +1-407-767-2760

Email: ctiphotline@lucent.com

URL: http://www.lucent-info.com/comments/

□



1 Introduction

Overview

Purpose This chapter provides detailed descriptions and illustrations of the WaveStar BandWidth Manager equipment.

Contents The following topics are discussed in this chapter:

Overview of WaveStar BandWidth Manager, Release 4.1	1 - 2
The WaveStar Product Family	1 - 7
4608/1536 Platform	1 - 9
Transmission Interfaces	1 - 18
System Growth	1 - 21
Key Features	1 - 23

Overview of WaveStar BandWidth Manager, Release 4.1

Overview

WaveStar BandWidth Manager provides customers with creative and flexible solutions to network problems.

WaveStar BandWidth Manager

WaveStar BandWidth Manager is a platform for bandwidth management and integrated 2-fiber and 4-fiber Bidirectional Line-Switch Ring (BLSR)/Multiple Section - Shared Protection Ring (MS-SPRing) applications, as well as Unidirectional Path-Switch Ring (UPSR) and Sub-Network Connection Protection (SNCP) ring applications. WaveStar BandWidth Manager is a modular networking system capable of integrating multiple interoffice transport and broadband digital cross-connect facilities into a single network element.

WaveStar BandWidth Manager is available in a 4608/1536 platform which provides a switch fabric capable of cross-connecting 4608 STS-1/1536 STM-1 equivalents.

Customer needs

The major customer need addressed by the WaveStar BandWidth Manager is the need to provide a cost-effective, flexible, and upgradeable system. Other customer needs met by WaveStar BandWidth Manager include

- Reduced cost
- Greater add/drop termination capacity
- Efficient bandwidth management
- Relief of fiber exhaust on BLSRs/MS-SPRings
- Preservation of embedded fiber base
- Reduction in network costs

Central office consolidation

By using WaveStar BandWidth Manager, customers can

- Terminate multiple 2-fiber and 4-fiber BLSR/MS-SPRing lightwave facilities on a single WaveStar BandWidth Manager
- Conserve office space and minimize equipment expenses by using a next generation technology lightwave facility and a cross-connect consolidation design
- Increase network reliability by eliminating port units, cables, fibers and cross-connect bays normally required to move traffic between multiple stand-alone lightwave terminating facilities
- Simplify network management through centralized control of bandwidth management and lightwave provisioning within a single equipment platform

Multiple BLSR/MS-SPRing terminations

When WaveStar BandWidth Manager is integrated into a central office, the need for numerous stand-alone ADMs is eliminated. A single WaveStar BandWidth Manager is capable of performing cross-connects between rings and terminating multiple 2-fiber and 4-fiber BLSRs/MS-SPRings with the following benefits:

- Multiple nodes on independent
  - 2-fiber OC-192 BLSRs/STM-64 MS-SPRings
  - 4-fiber OC-192 BLSRs/STM-64 MS-SPRings
  - 2-fiber OC-48 BLSRs/STM-16 MS-SPRings
  - 4-fiber OC-48 BLSRs/STM-16 MS-SPRings
- Lower rate tributary port units may be connected to the OC-192/STM-64 and OC-48/STM-16 facilities through the either the main or shelf-based cross-connect fabric
- BLSR/MS-SPRing through-connections are handled in the shelf-based switch fabrics and do not consume capacity of the main switch fabric
- Modular I/O (shelf and port unit) growth

Flexible bandwidth management

WaveStar BandWidth Manager provides flexible bandwidth management by using

- Integrated broadband cross-connect fabric that allows efficient movement and re-routing of traffic among OC-192/STM-64, OC-48/STM-16, OC-12/STM-4, OC-3/STM-1, DS3/EC-1, and STM-1e facilities on different shelves
- A 4608/1536 capacity cross-connect fabric with highly reliable electronic (rather than manual) cross-connections and OAM&P functions
- Provisionable DS3, STS-1/VC-3, STS-3c/VC-4, STS-12c/ VC-4-4c, and STS-48c/VC-4-16c cross-connect capabilities

Product interworking (transmission and communication)

WaveStar BandWidth Manager supports transmission and communication (via DCC) interworking between

- WaveStar BandWidth Managers over
  - 2-fiber OC-48 BLSRs/STM-16 MS-SPRings
  - 2-fiber OC-192 BLSRs/STM-64 MS-SPRings
  - 4-fiber OC-48 BLSRs/STM-16 MS-SPRings
  - 4-fiber OC-192 BLSRs/STM-64 MS-SPRings
  - 4-fiber STM-16 MS-SPRings with transoceanic protocol
  - 4-fiber STM-64 MS-SPRings with transoceanic protocol
  - OC-48 UPSRs
  - OC-192/STM-64 (1+1 protected interfaces)
  - OC-48/STM-16 (1+1 protected interfaces)
  - OC-12/STM-4 (1+1 protected interfaces)
  - OC-3/STM-1 (1+1 protected interfaces)
- WaveStar BandWidth Manager and WaveStar TDM 2.5G/10G (2-Fiber), Release 5.0 over 2-fiber OC-192 BLSRs, 2-fiber OC-48 BLSRs, as well as OC-3 and OC-12 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive), and OC-48 interfaces: 1+1 protected (unidirectional, non-revertive)
- WaveStar BandWidth Manager and FT-2000 OC-48 Add/Drop Rings Terminal, Release 9.1 over 2-fiber OC-48 BLSRs, as well as OC-3 and OC-12 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)

- WaveStar BandWidth Manager and Fujitsu FLM 150 ADM, Release 15 over OC-3 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)
- WaveStar BandWidth Manager and Fujitsu FLM 2400 ADM, Release 14.2 and 15 over 2-fiber OC-48 BLSRs and OC-48 UPSRs
- WaveStar BandWidth Manager and DDM-2000 OC-3 Multiplexer, Release 13 over OC-12 UPSRs, as well as OC-3 and OC-12 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)
- WaveStar BandWidth Manager and DDM-2000 OC-12 Multiplexer, Release 7 over OC-12 UPSRs, as well as OC-3 and OC-12 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)
- WaveStar BandWidth Manager and Metropolis™ DMX Access Multiplexer, Release 1.1 over OC-48 UPSRs
- WaveStar BandWidth Manager and WaveStar TDM 10G (STM-64), Release 3.0 over 2-fiber STM-16 and STM-64 MS-SPRings, as well as STM-1 and STM-4 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive) and STM-16 interfaces: 1+1 protected (unidirectional, non-revertive)
- WaveStar BandWidth Manager and WaveStar ADM 16/1 (Ruby II Release) over 2-fiber STM-16 MS-SPRings and STM-4 and STM-16 SNCPs, as well as STM-1 and STM-4 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive and bidirectional, non-revertive) and STM-16 interfaces: 1+1 protected (unidirectional, non-revertive and bidirectional, non-revertive)
- WaveStar BandWidth Manager and Nortel Networks TransportNode TN-4T STM-4 Terminal Multiplexer, H1.00, over STM-4 SNCPs, as well as STM-1 and STM-4 interfaces: 1+1 protected (bidirectional, non-revertive)
- WaveStar BandWidth Manager and Nortel Networks TransportNode TN-16X, Release H2.00, over STM-4 and STM-16 SNCPs, as well as STM-1, STM-4, and STM-16 interfaces; 1+1 protected (bidirectional, non-revertive)
- WaveStar BandWidth Manager and Marconi SMA 16/4, Series 3, over STM-4 and STM-16 SNCPs, as well as STM-1, STM-4, and STM-16 interfaces: 1+1 protected (bidirectional, non-revertive)

Transmission interfacing

WaveStar BandWidth Manager supports optical transmission interfacing between

- WaveStar BandWidth Manager and WaveStar Optical Line System (OLS) 40G/80G over OC-48/STM-16 optics via the OC48/STM16/DWDM01-16 port units
- WaveStar BandWidth Manager and WaveStar Optical Line System (OLS) 400G, Release 3 over OC-192/STM-64 optics via the OC192/STM64/WDM port units (40 wavelengths) and OC-48/STM-16 optics via the OC48/STM16/WDM port units (80 wavelengths)
- WaveStar BandWidth Manager and Lucent (Ascend) GX 550 Multiservice WAN, Release Jade M2 (2.2.1.2) Switch over OC-48/STM-16 and OC-12/STM-4 interfaces: 1+1 protected (bidirectional, non-revertive)
- WaveStar BandWidth Manager and Lucent (Ascend) CBX 500 Multiservice WAN, Release Jade M2 (4.2) Switch over OC-12/STM-4 interfaces: 1+1 protected (bidirectional, non-revertive)
- WaveStar BandWidth Manager supports optical transmission interfacing between Cisco ONS 15454 system and WaveStar BandWidth Manager over OC-48 UPSRs, as well as OC-3 and OC-12 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)
- WaveStar BandWidth Manager and Marconi MSH 84/86, Series 3, over STM-1, STM-4, and STM-16 interfaces: 1+1 protected (bidirectional, non-revertive)

Reference

For more information about WaveStar BandWidth Manager network application solutions, refer to Chapter 3, “Applications.”

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The WaveStar Product Family

Overview

The WaveStar product family is designed to offer telecommunications service providers advanced services and revenue-generating capabilities.

Lucent products

Lucent Technologies offers the industry's widest range of high-quality transport systems designed to provide total network solutions.

Family members

The WaveStar product family offers a series of products designed to enhance customers' networks. The product family includes

- WaveStar® BandWidth Manager (SONET/SDH)
- WaveStar® TDM 2.5G/10G (2-Fiber) (SONET)
- WaveStar® TDM 10G (STM-64) (SDH)
- WaveStar® Optical Line System (OLS) 40G (SONET)
- WaveStar® Optical Line System (OLS) 80G (SDH)
- WaveStar® Optical Line System (OLS) 1.6T (400/800G) (SONET/SDH)
- WaveStar® OptiGate™ Subsystem (SONET/SDH)
- WaveStar® LambdaRouter (256/1024)
- WaveStar® LambdaUnite
- WaveStar® LambdaXtreme
- WaveStar® AM 1 (SDH)
- WaveStar® TM 1 (SDH)
- WaveStar® Add/Drop Multiplexer 16/1 (SDH)
- WaveStar® Add/Drop Multiplexer 4/1 (SDH)
- WaveStar® DACS 4/4/1 (SDH)
- WaveStar® Digital Video Systems (SONET/SDH)
- WaveStar® ITM-SC (SONET/SDH)
- WaveStar® Network Management System (SONET/SDH)
- WaveStar® SNMS (SONET/SDH)
- WaveStar® TransLAN™ Card (SONET/SDH)

Family features

The WaveStar product family offers customers

- SONET-based and SDH-based services
- Scalable cross-connect, multiplex, and transport services
- Network consolidation and reliability
- Interoperability with other vendors' products
- Coordination of network element and element management services

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4608/1536 Platform

Overview

This section briefly introduces the 4608/1536 platform available in WaveStar BandWidth Manager. The remaining chapters provide specific details about the product.

4608/1536 platform description

With the WaveStar BandWidth Manager 4608/1536 platform, Lucent enables customers to add capacity to their network as needed without wasting equipment and incurring unnecessary costs. (4608/1536 represents the size of the platform's switch, 4608 STS-1/1536 STM-1 equivalents.)

Because the different I/O Bays house different types of shelves (which may include one to four SWIF pairs), the number of equipped I/O Bays in a 4608/1536 local I/O Complex may vary. The 4608/1536 platform can support a maximum of 48 SWIF pairs. In R4.1, the 4608/1536 platform can support a maximum of 36 I/O Shelves with a maximum of 48 SWIF pairs.

The WaveStar BandWidth Manager 4608/1536 platform includes either a 2-bay or 3-bay Control/Switch Complex, an I/O Complex (maximum of 36 I/O Shelves), and the required cable management bays.

Control/Switch Complex

A 2-bay or 3-bay Control/Switch Complex provides fully-duplicated main control, memory, and timing for the platform and a fully-duplicated, single-stage, N^2, 4608x4608/1536x1536 cross-connect switch fabric.

> **Important!** The reduced footprint floor plans with the reduced cabling for 2-bay Control/Switch Complexes (Figure 1-1 [NEBs] and Figure 1-2 [ETSI]) are available as of July 1, 2001.
>
> Effective June 1, 2002, the standard footprint (Figure 1-3 and Figure 1-5 [NEBs] and Figure 1-4 and Figure 1-6 [ETSI]) will be Discontinued Availability (DA).
>
> Contact your Account Executive for more information.

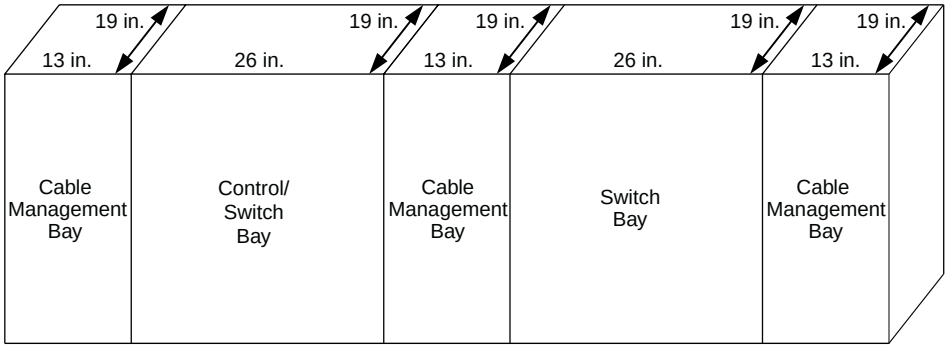
2-bay Control/Switch Complex

A 2-bay Control/Switch Complex comprises one Control/Switch Bay, one Switch Bay, and three required cable management bays.

Figure 1-1 (NEBs) and Figure 1-2 (ETSI) illustrate the 2-bay Control/Switch Complexes for the reduced footprints.

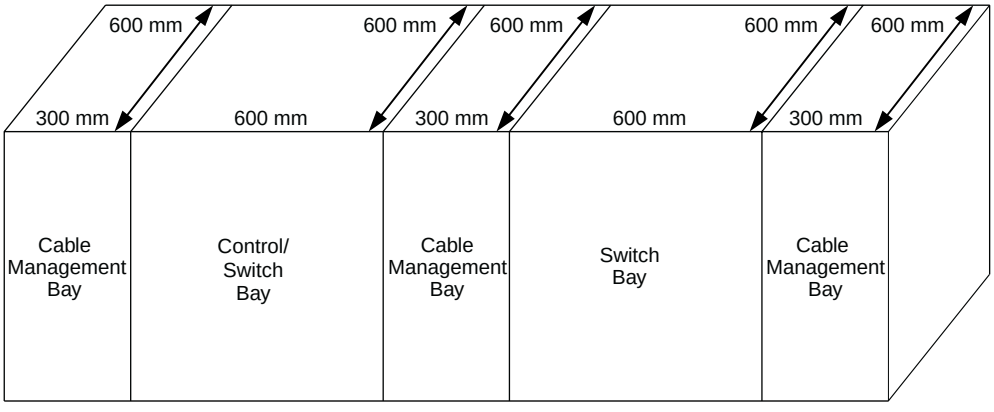
> **Important!** Because the 3-bay Control/Switch Complexes will be DA effective April 1, 2002, the reduced footprint floor plans will only be available with 2-bay Control/Switch Complexes. Please contact you account executive for more information.

Figure 1-1 NEBS 2-Bay Control/Switch Complex - Reduced Footprints



wbwm04257

Figure 1-2 ETSI 2-Bay Control Switch Complex - Reduced Footprints



wbwm04258

Figure 1-3 (NEBs) and Figure 1-4 (ETSI) illustrate the 2-bay Control/Switch Complexes for the standard footprints.

Figure 1-3 NEBS 2-Bay Control/Switch Complex -Standard Footprints

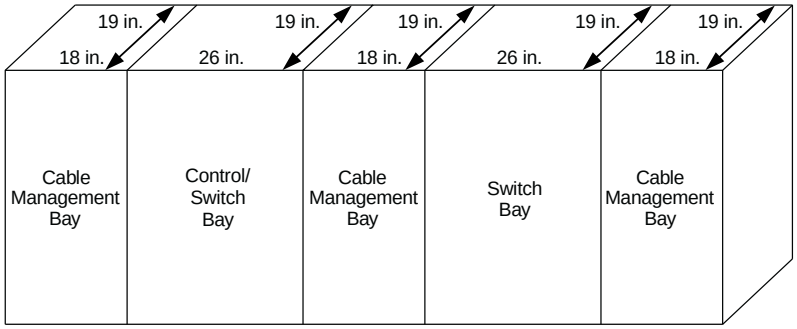
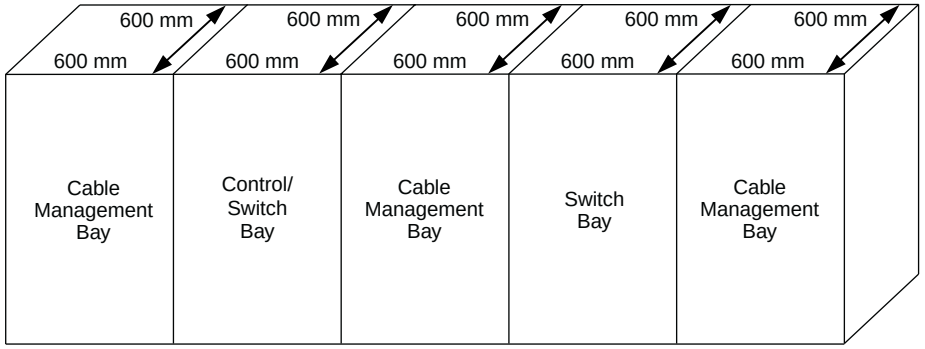


Figure 1-4 ETSI 2-Bay Control Switch Complex - Standard Footprints



3-bay Control/Switch Complex

A 3-bay Control/Switch Complex comprises one System Controller Bay, two Switch Bays, and four required cable management bays.

Figure 1-5 (NEBs) and Figure 1-6 (ETSI) illustrate the 3-bay Control/Switch Complexes for the standard footprints.

Figure 1-5 NEBS 3-Bay Control/Switch Complex - Standard Footprints

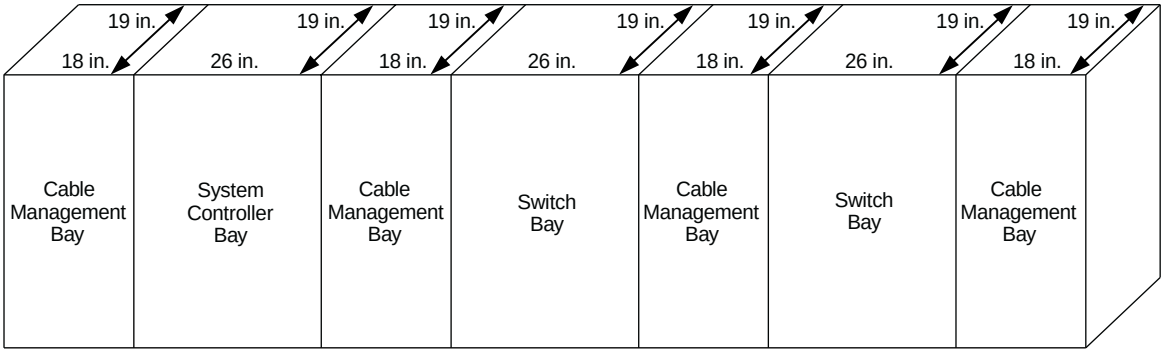
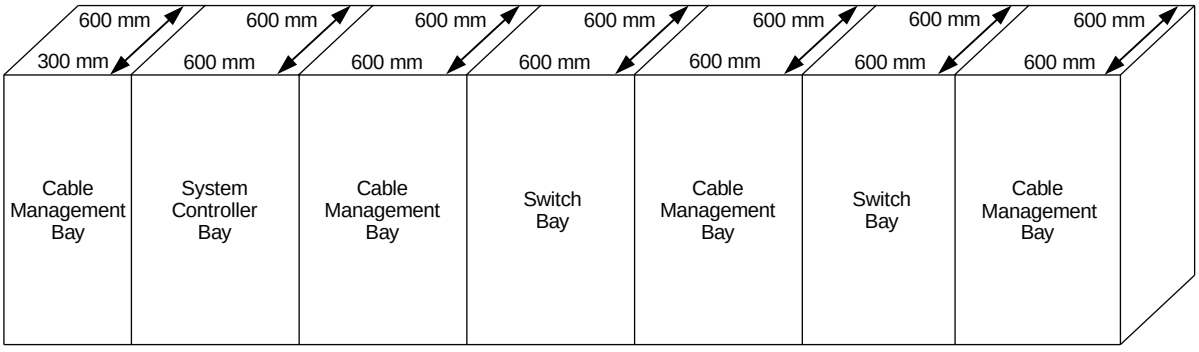


Figure 1-6 ETSI 3-Bay Control/Switch Complex - Standard Footprints



I/O Complex

An I/O Complex provides electrical and optical transmission interfaces that are housed in Universal I/O Shelves, STM1e Universal I/O Shelves, and/or 10G I/O Shelves.
All transmission port units (hardware) are capable of transmitting and receiving SDH-rate and SONET-rate signals. The WaveStar BandWidth Manager software allows you to provision the port unit to accept the appropriate type of signal.

Universal I/O Shelves

The Universal I/O Shelves are capable of terminating

- 2-fiber OC-48 BLSRs/STM-16 MS-SPRings via OC48/STM16 port units
- 4-fiber OC-48 BLSRs/STM-16 MS-SPRings (open and closed) via OC48/STM16 port units
- 4-fiber STM-16 MS-SPRings with transoceanic protocol/shortened loop via the OC48/STM16 port units
- OC-48 and OC-12 Unidirectional Path-Switch Rings (UPSRs)
- STM-N Sub-Network Connection Protection (SNCP) rings
- Long reach OC-48/STM-16 signals via OC48/STM16 port units
- Short and long reach OC-12/STM-4 signals via OC12/STM4 port units
- Short and long reach OC-3/STM-1 signals via OC3/STM1 port units
- DS3 and EC-1 signals via DS3EC1/8 port units

SDH Universal I/O Shelves

The SDH Universal I/O Shelves are capable of terminating

- 2-fiber OC-48 BLSRs/STM-16 MS-SPRings via OC48/STM16 port units
- 4-fiber OC-48 BLSRs/STM-16 MS-SPRings (open and closed) via OC48/STM16 port units
- 4-fiber STM-16 MS-SPRings with transoceanic protocol (open and closed) via OC48/STM16 port units
- OC-48 and OC-12 unidirectional path-switch rings (UPSRs)
- STM-N Sub-Network Connection Protection (SNCP) rings
- Long reach OC-48/STM-16 signals via OC48/STM16 port units
- Short and long reach OC-12/STM-4 signals via OC12/STM4 port units
- Short and long reach OC-3/STM-1 signals via OC3/STM1 port units
- STM-1e signals via STM1E/4 port units

10G I/O Shelves

The 10G I/O Shelves are capable of terminating

- 2-fiber OC-192 BLSRs/STM-64 MS-SPRings via OC192/STM64 port units
- 4-fiber OC-192 BLSRs/STM-64 MS-SPRings (open and closed) via OC192/STM64 port units
- 4-fiber STM-64 MS-SPRings with transoceanic protocol (open and closed) via OC192/STM64 port units
- Intermediate and extended intermediate reach OC-192/STM-64 signals via OC192/STM64 port units

Spacers between I/O Bays

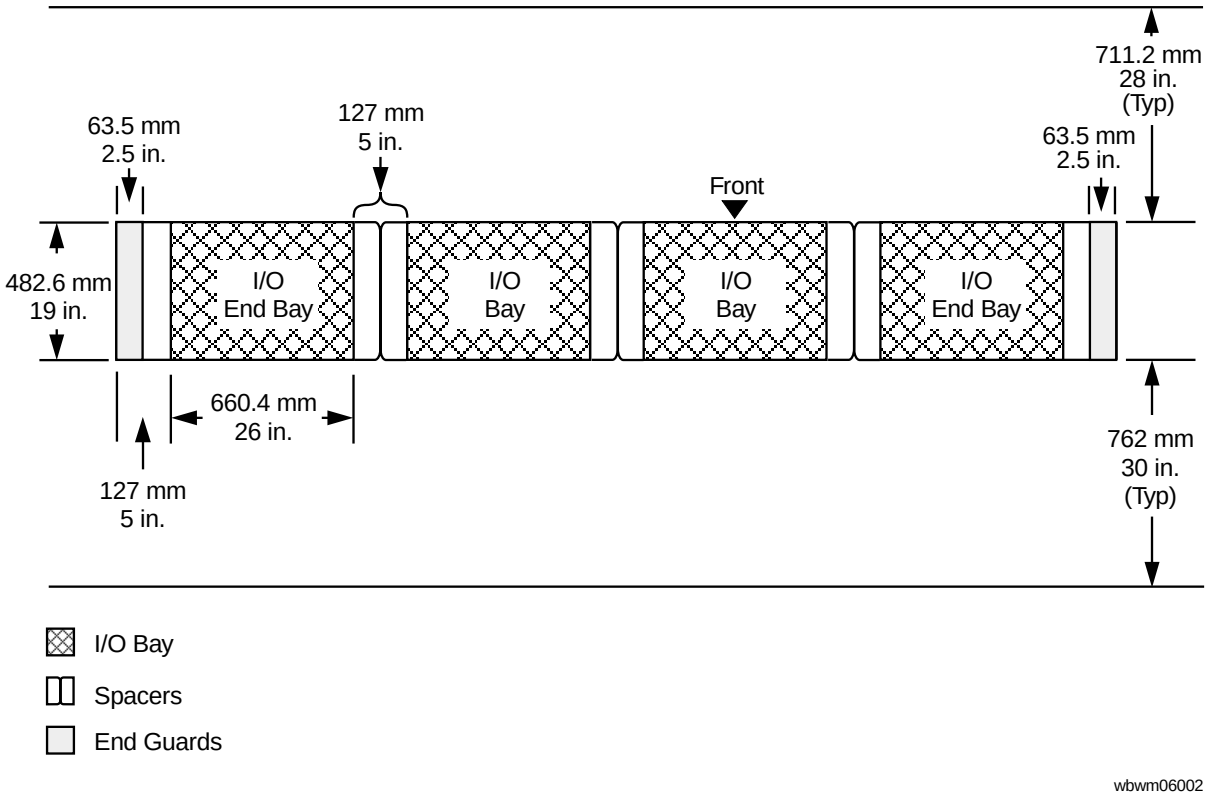
The NEBS I/O Complexes require spacers between the I/O Bays. The ETSI I/O Complexes require cable management bays between the I/O Bays.

NEBS I/O Complexes

Figure 1-7 (NEBS) illustrates the spacers required between I/O Bays in NEBS I/O Complexes.

> **Important!** The NEBS I/O Complex is physical the same in the standard and reduced footprints.

Figure 1-7 NEBS I/O Complex



ETSI I/O Complexes

Figure 1-8 (standard footprints) and Figure 1-9 (reduced footprints) illustrate the cable management bays required between I/O Bays in ETSI I/O Complexes.

Important! The cable management bays in ETSI I/O Complexes (reduced footprints) vary in size depending on the type of connector panels on the I/O Shelves in the adjacent I/O Bays.

Figure 1-8 ETSI I/O Complex (Standard Footprints)

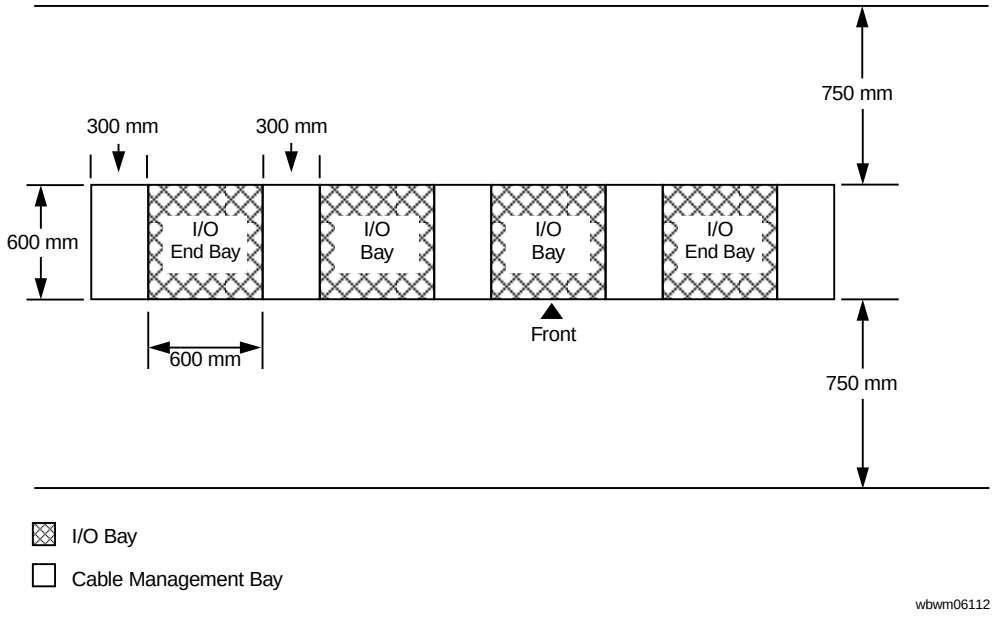
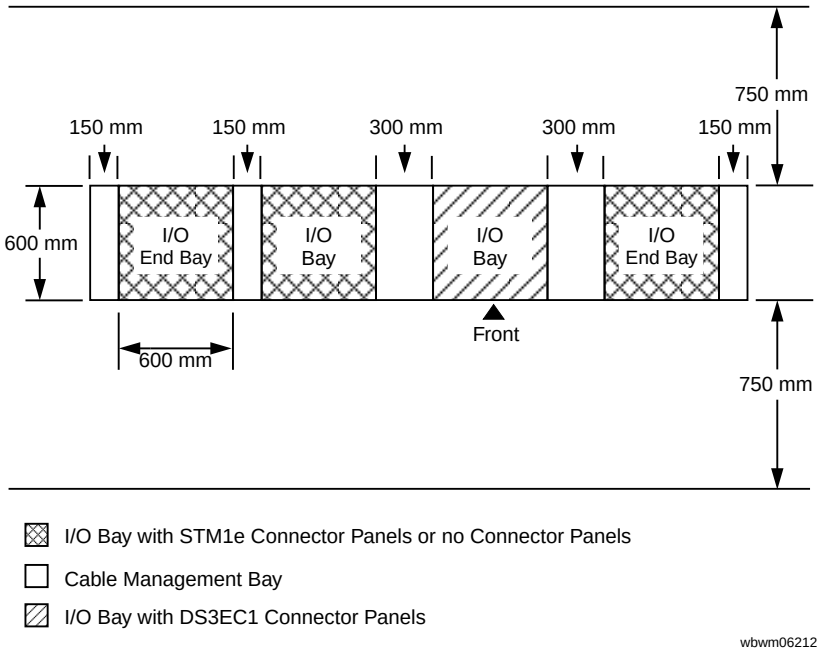


Figure 1-8 and illustrates the cable management bays required between I/O Bays in ETSI platforms (reduced footprints).

Important! The cable management bays between or adjacent to I/O Bays with STM1e Connector Panels or no connector panels are 150 mm wide. The cable management bays between or adjacent to I/O Bays with DS3EC1 Connector Panels are 300 mm wide. For example, a single 300 mm cable management bay between an I/O bay with DS3EC1 Connector Panels and an I/O Bay with no connector panels is sufficient.
For example, an I/O Bay with a single DS3EC1 Connector Panel on the right side of the bay only requires one 300 mm wide cable management bay on the right side of the bay. The cable management on the left side of the bay should be 150 mm wide.

Figure 1-9 ETSI I/O Complexes (Reduced Footprints)



Reference For more information about the cable management bays and the standard and reduced footprints, refer to Chapter 6, “System Planning and Engineering.”

Transmission Interfaces

Introduction

WaveStar BandWidth Manager provides electrical and optical transmission interfaces that are housed in the Universal I/O Shelves, SDH Universal I/O Shelves, and 10G I/O Shelves.

Optical interfaces

WaveStar BandWidth Manager provides a variety of optical port units. All transmission port units (hardware) are capable of transmitting and receiving SDH-rate and SONET-rate signals. The software allows you to provision the port unit to accept the appropriate type of signal.

OC192/STM64 port units

The OC192/STM64 port units each contain one bidirectional port (transmit and receive).
Four port units are necessary to terminate one 4-fiber BLSR/MS-SPRing (closed). Two port units are necessary to terminate one 2-fiber BLSR/MS-SPRing or 4-fiber BLSR/MS-SPRing (open) in an end terminal.

WaveStar BandWidth Manager provides the following OC192/STM64 port units:

- OC192/STM64/1.5IR1 port units capable of transmitting and receiving one extended intermediate reach OC-192/STM-64 signal with strong forward error correction (SFEC) in the 1.5 µm range (up to 60 km).
- OC192/STM64/1.5IRS1 port units capable of transmitting and receiving one extended intermediate reach OC-192/STM-64 signal with SFEC in the 1.5 µm range (up to 30 km).
- OC192/STM64/POU passive optic port units, compatible with 16 wavelengths of the ITU standard for dense wavelength division multiplexing (DWDM), capable of transmitting and receiving one long reach OC-192/STM-64 signal in the 1.5 µm range (up to 40 km with the Passive Optics Boxes).
- OC192/STM64/WDM port units, compatible with 40 wavelengths of the ITU standard for dense wavelength division multiplexing (DWDM), capable of transmitting and receiving one long reach OC-192/STM-64 signal in the 1.5 µm range. Because the OC192/STM64/WDM port units are designed to work with the WaveStar OLS 400G systems without OTUs, the maximum transmission distance is dependant upon the OLS system (up to 25 km with Lucent's WaveStar OLS 400G).

OC48/STM16 port units

The OC48/STM16 port units each contain one bidirectional port (transmit and receive).
Four port units are necessary to terminate one 4-fiber BLSR/MS-SPRing (closed). Two port units are necessary to terminate one 2-fiber BLSR/MS-SPRing or 4-fiber BLSR/MS-SPRing (open) in an end terminal.

WaveStar BandWidth Manager provides the following OC48/STM64 port units:

- OC48/STM16/1.3LR1 port units capable of transmitting and receiving one long reach OC-48/STM-16 signal in the 1.3 μm range (up to 51 km).
- OC48/STM16/1.5LR1 port units capable of transmitting and receiving one long reach OC-48/STM-16 signal in the 1.5 μm range (up to 80 km).
- OC48/STM16/DWDM01-16 port units, compatible with 16 wavelengths of the ITU standard for dense wavelength division multiplexing (DWDM), capable of transmitting and receiving one long reach OC-48/STM-16 signal in the 1.5 μm range. Because the OC48/STM16/DWDM01-16 port units are designed to work with the WaveStar OLS 40G/80G systems without OTUs, the maximum transmission distance is dependant upon the OLS system (up to 25 km with Lucent's WaveStar OLS 40G/80G).
- OC48/STM16/POU passive optic port units, compatible with 16 wavelengths of the ITU standard for dense wavelength division multiplexing (DWDM), capable of transmitting and receiving one long reach OC-48/STM-16 signal in the 1.5 μm range (up to 55 km with the Passive Optics Boxes).
- OC48/STM16/WDM port units, compatible with 80 wavelengths of the ITU standard for dense wavelength division multiplexing (DWDM), capable of transmitting and receiving one long reach OC-48/STM-16 signal in the 1.5 μm range. Because the OC48/STM16/WDM port units are designed to work with the WaveStar OLS 400G systems without OTUs, the maximum transmission distance is dependant upon the OLS system (up to 25 km with Lucent's WaveStar OLS 400G).

OC12/STM4 port units

Each OC12/STM4 port unit contains two independent bidirectional ports (transmit and receive).

WaveStar BandWidth Manager provides the following OC12/STM4 port units:

- OC12/STM4/1.3SR2 port units capable of transmitting and receiving two short or intermediate reach OC-12/STM-4 signals in the 1.3 μm range (up to 15 km).
- OC12/STM4/1.3LR2 port units capable of transmitting and receiving two long reach OC-12/STM-4 signals in the 1.3 μm range (up to 51 km).

OC3/STM1 port units

Each OC3/STM1 port unit contains four independent bidirectional ports (transmit and receive).

WaveStar BandWidth Manager provides the following OC3/STM1 port units:

- OC3/STM1/1.3SR4 port units capable of transmitting and receiving four short or intermediate reach OC-3/STM-1 signals in the 1.3 μm range (up to 15 km).
- OC3/STM1/1.3LR4 port units capable of transmitting and receiving four long reach OC-3/STM-1 signals in the 1.3 μm range (up to 51 km).

Electrical interfaces

WaveStar BandWidth Manager provides two electrical port units.

DS3EC1/8 port units

The DS3EC1/8 port units are capable of transmitting and receiving signals at either the DS3-rate or EC-1-rate (user-provisionable). Each port unit contains eight independent bidirectional ports (transmit and receive).

STM1E/4 port units

The STM1E/4 port units are capable of transmitting and receiving signals at the STM-1e-rate (SDH). Each port unit contains four independent bidirectional ports (transmit and receive).

□

System Growth

Overview

WaveStar BandWidth Manager can be grown modularly by increasing the size of the main and shelf-based switch fabrics and/or adding additional I/O Shelves as additional transmission capacity is required.

Switch capacity

The switch fabric provided by two fully-equipped Switch Shelves in the 4608/1536 platform is able to cross-connect up to 4608 STS-1/1536 STM-1 equivalents of capacity.

> **Important!** The two Switch Shelves may be housed in two Switch Bays (3-bay Control/Switch Complex) or in a Control/Switch Bay and a Switch Bay (2-bay Control/Switch Complex).

Modular growth

System transmission capacity can be increased modularly by adding additional I/O Shelves (either Universal I/O Shelves, STM1e Universal I/O Shelves, or 10G I/O Shelves).

> **Important!** The amount of main switch fabric capacity consumed by each I/O Bay depends on how the shelves in the bay are equipped (namely, the number of SWIF pairs used). Each Universal I/O Shelf or STM1e Universal I/O Shelf may consume either 96 or 192 STS-1/32 or 64 STM-1 equivalents of the available switch fabric. Each 10G I/O Shelf may consumes either 96, 192, 288, or 384 STS-1/32, 64, 96, or 128 STM-1 equivalents of the available switch fabric.

4608/1536 platform

As greater transmission capacity is needed for the 4608/1536 platform, additional I/O Shelves may be added to the I/O Complex.

Because the different I/O Bays house different types of shelves (which may include one to four SWIF pairs), the number of equipped I/O Bays in an 4608/1536 local I/O Complex may vary. In R4.1, the 4608/1536 platform can support a maximum of 36 I/O Shelves with a maximum of 48 SWIF pairs for the platform.

References

For more information about planning for each platform, refer to Chapter 6, “System Planning and Engineering.”

For additional information about the equipment available in WaveStar BandWidth Manager, refer to Chapter 4, “Product Description.”

□

Key Features

Overview

This section lists the key features available in WaveStar BandWidth Manager, R1.3, R2.0, R2.1, R3.0, R3.1, R4.0, and R4.1. The major features are discussed in detail in Chapter 2, “Features.”

Major R1.3 features

WaveStar BandWidth Manager provides the following major features in Release 1.3:

- 4608/1536 platform with a 4608 STS-1/1536 STM-1 equivalent cross-connect and a 3-bay Control/Switch Complex
- Errorless, N^2, non-blocking 4608/1536 switch fabric architecture
- Fully-duplicated 4608/1536 switch fabric
- Modular I/O growth with the 4608/1536 platform
- Duplicated system and shelf controllers and Stratum 3 synchronization
- Non-revertive 1+1 timing protection
- STS-1/STM-1 I/O capabilities
- STS-1 and STS-3c cross-connect capabilities
- VC-3 and VC-4 cross-connect capabilities
- DS3/STS-1, DS3/VC-3, STS-1/VC-3, and STS-3c/VC-4 interworking
- Long reach OC-48/STM-16 (1.3 μm and 1.5 μm)
- Four-fiber OC-48 BLSR interface
- Four-fiber STM-16 MS-SPRing (closed) interface
- Four-fiber STM-16 MS-SPRing with transoceanic protocol (open and closed) interface
- Long reach STM-16 optics (1+1 protected)
- Short and long reach OC-12/STM-4 optics (0x1 and 1+1 protected)
- Short and long reach OC-3/STM-1 optics (0x1 and 1+1 protected)
- DS3 (0x1, 1xN protected) electrical interfaces (EC-1 ready)
- DCC on OC-48/STM-16 interfaces
- STS-N preemptible protection access on 4-fiber OC-48 BLSRs
- VC-N preemptible protection access on 4-fiber STM-16 MS-SPRing

- Flexible interface mixing using universal interface slots
- External timing from an office BITS clock
- Limited OC-48/STM-16 line timing
- Free-running, holdover, and locked (external) synchronization modes
- DS1 timing inputs
- Cross-connect loopback
- STS-1 granularity, non-blocking TSA
- VC-3 and VC-4 granularity, non-blocking TSA
- Bridging and rolling cross-connections
- Standard SONET transmission maintenance signals
- Standard DS3 transmission maintenance signals
- DS3 performance monitoring
- Standard SDH transmission maintenance signals
- Limited SDH regenerator section, multiplex section, and high order intermediate path performance monitoring
- DS3/VC-3 path trace (for DS3/VC-3 gateways)
- STS-1 path trace (for DS3/STS-1 gateways)
- Limited test access on DS3 and EC-1 ports
- Configuration management and equipment inventory
- Security features
- WaveStar Sub-Network Management System (WaveStar SNMS) support
- AT&T NEDS compliance: AT&T Practice 801-900-160, AT&T Network Equipment Design Standards and Requirements for Physical and Electrical design
- NEBS compliance:Telcordia Technologies' GR-63-CORE and GR-1089-CORE Network Building Systems Generic Requirements for NEBS Level II and NEBS Level III
- Zone 4 earthquake compliance
- ITU and ETSI compliance
- CE marking
- ETSI ETS 300 019 earthquake compliance
- External LAN interface on I/O Shelves
- WaveStar CIT GUI on Windows® NT

- NCC R3.0 or later support
- Software download/backup and restore using OSI
- Operations interworking (transmission and communication) between
  - WaveStar BandWidth Managers over 4-fiber OC-48 BLSRs, 4-fiber STM-16 MS-SPRings, and 4-fiber STM-16 MS-SPRings with transoceanic protocol
  - WaveStar BandWidth Manager and WaveStar ADM 16/1, (Platinum II) over STM-1 interfaces

Major R2.0 features

WaveStar BandWidth Manager provides the following major features in Release 2.0:

- 4608/1536 platform with a 4608 STS-1/1536 STM-1 equivalent cross-connect and a 2-bay Control/Switch Complex
- Modular I/O growth with the 4608/1536 platform
- 10G I/O Shelf electrically connected (OC-192/STM-64 interfaces)
- Intermediate reach OC-192/STM-64 optics (0x1 protected)
- Four-fiber OC-192 BLSR/STM-64 MS-SPRings interfaces (open and closed)
- Two-fiber OC-48 BLSR interfaces
- OC-48 1+1 protected interfaces
- Two-fiber STM-64 MS-SPRing interfaces
- Four-fiber STM-16 MS-SPRing (open) interfaces
- Four-fiber STM-64 MS-SPRing with transoceanic protocol
- STS-N preemptible protection access on 2-fiber OC-48 BLSRs and 4-fiber OC-192 BLSRs
- VC-N preemptible protection access on 2-fiber and 4-fiber STM-64 MS-SPRings
- SONET section and line performance monitoring
- SDH regenerator section, multiplex section, and high order intermediate path performance monitoring
- NEBS compliance:Telcordia Technologies' GR-63-CORE and GR-1089-CORE Network Building Systems Generic Requirements NEBS Level III, including requirements for EMI and ESD with open door, Zone 4 earthquake compliance
- Limited DS1 timing outputs
- STS-12c/VC-4-4c cross-connect capabilities

- STS-12c/VC-4-4c interworking
- EC-1 (1xN protected) electrical interfaces
- DCC on OC-192/STM-64, OC-12/STM-4, and OC-3/STM-1 interfaces
- Operations interworking (transmission and communication) between
  - WaveStar BandWidth Managers over 4-fiber OC-192 BLSRs, 2-fiber OC-48 BLSRs, and OC-48, OC-12, and OC-3 interfaces: 1+1 protected
  - WaveStar BandWidth Manager and WaveStar TDM 2.5G/10G (2-Fiber), Release 4 over 2-fiber OC-48 BLSRs, as well as OC-3 and OC-12 (0x1 protected) interfaces
  - WaveStar BandWidth Manager and FT-2000 OC-48 Add/Drop Rings Terminal, Release 9.1 over 2-fiber OC-48 BLSRs, as well as OC-3 and OC-12 (0x1 protected) interfaces
  - WaveStar BandWidth Manager and DDM-2000 OC-3 Multiplexer, Release 13 over OC-3 and OC-12 (0x1 protected) interfaces
  - WaveStar BandWidth Manager and DDM-2000 OC-12 Multiplexer, Release 7 over OC-3 and OC-12 (0x1 protected) interfaces

Major R2.1 features

WaveStar BandWidth Manager provides the following major features in Release 2.1:

- OC-48/STM-16 (1.5 μm) DWDM optics (16 wavelengths)
- Operations interworking (transmission and communication) between
  - WaveStar BandWidth Managers over 2-fiber STM-64 MS-SPRings
  - WaveStar BandWidth Manager and WaveStar TDM 10G (STM-64), Release 1.1 over 2-fiber STM-64 MS-SPRings
  - WaveStar BandWidth Manager and WaveStar ADM 16/1 (Sapphire III) over 2-fiber STM-16 MS-SPRings
- Transmission interfacing between WaveStar BandWidth Manager and WaveStar Optical Line System 40G/80G (WaveStar OLS 40G/80G) over OC-48/STM-16 optics via the OC48/STM16/DWDM01-16 port units

- EC-1 (0x1 protected) electrical interfaces

Major R3.0 features

WaveStar BandWidth Manager provides the following major features in Release 3.0:

- Two-fiber OC-192 BLSR interfaces
- Two-fiber STM-16 MS-SPRing interfaces
- Extended intermediate reach OC-192/STM-64 1.5 μm optical interface with strong forward error correction (SFEC)
- OC-192/STM-64 (1.5 μm) passive optics (16 wavelengths)
- OC-192/STM-64 (1.5 μm) WDM optics (40 wavelengths, compatible with WaveStar OLS 400G)
- OC-48/STM-16 (1.5 μm) passive optics (16 wavelengths)
- Full 1+1 protection on OC-48/STM-16 interfaces
- STS-N preemptible protection access on 2-fiber OC-192 BLSRs
- VC-N preemptible protection access on 2-fiber STM-16 MS-SPRings
- STS-48c/VC-4-16c cross-connect capabilities
- STS-48c/VC-4-16c interworking
- SONET intermediate and terminated path performance monitoring
- Inactivity logout
- Password aging
- Operations interworking (transmission and communication) between
  - WaveStar BandWidth Managers over 2-fiber OC-192 BLSRs and 2-fiber STM-16 MS-SPRings and STM-16 interfaces: 1+1 protected
  - WaveStar BandWidth Manager and WaveStar TDM 2.5G/10G (2-Fiber), Release 4 over 2-fiber OC-192 BLSRs
  - WaveStar BandWidth Manager and Fujitsu FLM 150 ADM over OC-3 (0x1 protected) interfaces
- Transmission interfacing between WaveStar BandWidth Manager and WaveStar Optical Line System 400G, Release 2.0 over OC-192/STM-64 optics via the new OC192/STM64/WDM port units (40 wavelengths)

Major R3.1 features

WaveStar BandWidth Manager provides the following major features in Release 3.1:

- STM-1e electrical interface via the STM1E/4 port units
- OC192/STM64 1+1 protection (unidirectional and non-revertive)
- Extended intermediate reach OC-192/STM-64 1.5 μm optical interface with strong forward error correction (SFEC)
- OC-48/STM-16 (1.5 μm) WDM optics (80 wavelengths, compatible with WaveStar OLS 400G)
- OC-48 Unidirectional Path Switch Rings (UPSRs) with STS-1 granularity
- Outgoing OC-48/STM-16 S1 byte synchronization messaging
- Outgoing OC-192/STM-64 S1 byte synchronization messaging
- Enhanced test access
- Multiple protected LAN interfaces/DCC controllers (additional ADJCTL/DCC circuit pack in the System Controller Shelf) Active-Standby
- Login aging
- Additional operations (transmission and communications) interworking between
  - WaveStar BandWidth Managers over OC-48 UPSRs (STS-1 only) and OC-192/STM-64 interfaces: 1+1 protected
  - WaveStar BandWidth Manager and Fujitsu FLM 2400 ADM over OC-48 UPSRs (STS-1 only)
  - WaveStar BandWidth Manager and FT-2000 OC-48 Add/Drop Rings Terminal, Release 9.1 over OC-3 and OC-12 interfaces: 1+1 protected (unidirectional, non-revertive)
  - WaveStar BandWidth Manager and WaveStar ADM 16/1 (Sapphire III) over STM-1 and STM-4 (0x1 protected) interfaces
- Additional transmission interfacing between WaveStar BandWidth Manager and WaveStar Optical Line System (OLS) 400G over OC-48/STM-16 optics via the new OC48/STM16/WDM port units (80 wavelengths)

Major R4.0 features

WaveStar BandWidth Manager provides the following major features in Release 4.0:

- Modular interface growth with a maximum of 36 I/O shelves with a maximum of 48 SWIF pairs
- Sub-Network Connection Protection (SNCP) rings
- Manual ring configuration for start-up
- Full OC-48 Unidirectional Path Switch Rings (UPSRs)
- OC-12 UPSRs with STS-1 granularity
- STS-3, STS-12, and STS-48 adaptive-rate cross-connects (pipe mode)
- ANSI and Telcordia-compliant dual ring interworking (DRI) with interconnect rings
- Basic OC-48 DRI (no interconnected rings)
- Additional cross-connect capacity via the on-shelf cross-connect capacity provided by the SWITCH/STS576 and SWITCH/STS768 packs)
- Additional operations interworking (transmission and communication) between
  - WaveStar BandWidth Managers over STM-4 interfaces: 1+1 protected
  - WaveStar BandWidth Manager and WaveStar TDM 2.5G/10G (2-Fiber), Release 5.0 over OC-3, OC-12, and OC-48 interfaces: 1+1 protected (unidirectional, non-revertive)
  - WaveStar BandWidth Manager and DDM-2000 OC-3 Multiplexer, Release 13 over OC-12 UPSRs, as well as OC-3 and OC-12 interfaces: 1+1 protected (unidirectional, non-revertive
  - WaveStar BandWidth Manager and DDM-2000 OC-12 Multiplexer, Release 7 over OC-12 UPSRs, as well as OC-3 and OC-12 interfaces: 1+1 protected (unidirectional, non-revertive)
  - WaveStar BandWidth Manager and DMX Access Multiplexer, Release 1.1 over OC-48 UPSRs
  - WaveStar BandWidth Manager and Fujitsu FLM 150 ADM, Release 15 over OC-3interfaces: 1+1 protected (unidirectional, non-revertive)

  - WaveStar BandWidth Manager and Fujitsu FLM 2400 ADM, Release 14.2 and 15 over OC-48 UPSRs (full)
  - WaveStar BandWidth Manager and WaveStar TDM 10G (STM-64), Release 3 over 2-fiber STM-16 MS-SPRings and STM-1, STM-4, and STM-16 interfaces: 1+1 protected (unidirectional, non-revertive)
  - WaveStar BandWidth Manager and WaveStar ADM 16/1 (Ruby II) over 2-fiber STM-16 MS-SPRing, as well as STM-1, STM-4, and STM-16 interfaces: 1+1 protected (unidirectional, non-revertive and bidirectional, non-revertive)
- Additional transmission interfacing between WaveStar BandWidth Manager and Lucent (Ascend) GX 550 Multiservice WAN, Release Jade M2 (2.2.1.2) Switch over OC-48 interfaces: 1+1 protected (bidirectional, non-revertive)
- Facility loopback
- 30-minute system recovery
- Direct TCP/IP interface on the NE
- Duplex ADJCTL/DCC packs (Active-Active) in the System Controller Shelf
- Maximum sub-network size (1000 NSAPs)
- SDH equipment clock (SEC)
- DS1 timing outputs
- E1 timing inputs
- E1 line timing outputs
- OC-192/STM-64 line timing (with SSM)
- OC-48/STM-16 line timing (with SSM)
- Outgoing OC-12/STM-4 S1 byte synchronization messaging
- Outgoing OC-3/STM-1 S1 byte synchronization messaging
- Incoming OC-192/STM-64 S1 byte synchronization messaging
- Incoming OC-48/STM-16 S1 byte synchronization messaging
- Synchronization mode automatic reconfiguration based on the S1 byte
- Timing reference selection according to ETS 300 417.1.1

Major R4.1 features

WaveStar BandWidth Manager provides the following major features in Release 4.1:

- Sub-Network Connection Protection (SNCP) rings - generalized path-level protection for individual VC-N circuits in SDH input port types
- Duplicated RS-232 on the System Controller Shelf, providing access to raw ASCII TL1 commands via an ASCII terminal or a PC running HyperTerminal
- TCP/IP interface that provides an FTP/FTAM gateway
- Autonomuous fault messages
- Additional operations interworking (transmission and communication) between
  - WaveStar BandWidth Manager and Fujitsu FLM 2400 ADM, Release 14.2 and 15 over 2-fiber OC-48 BLSRs
  - WaveStar BandWidth Manager and WaveStar ADM 16/1 (Ruby II) over STM-4 and STM-16 SNCPs
  - WaveStar BandWidth Manager and Nortel Networks TransportNode TN-4T STM-4 Terminal Multiplexer, Release H1.00, over STM-4 SNCPs, STM-1 and STM-4 interfaces: 1+1 protected (bidirectional, non-revertive)
  - WaveStar BandWidth Manager and Nortel Networks TransportNode TN-16X, Release H2.00, over STM-4 and STM-16 SNCPs, as well as STM-1, STM-4, and STM-16 interfaces: 1+1 protected (bidirectional, non-revertive)
  - WaveStar BandWidth Manager and Marconi SMA 16/4, Series 3, over STM-4 and STM-16 SNCPs, as well as STM-1, STM-4, and STM-16 interfaces: 1+1 protected (bidirectional, non-revertive)
- Additional transmission interfacing between
  - WaveStar BandWidth Manager and Lucent (Ascend) GX 550 Multiservice WAN, Release Jade M2 (2.2.1.2) Switch over STM-16 and OC-12/STM-4 interfaces: 1+1 protected (bidirectional, non-revertive)
  - WaveStar BandWidth Manager and Lucent (Ascend) CBX 500 Multiservice WAN, Release Jade M2 (4.2) Switch over OC-12/STM-4 interfaces: 1+1 protected (bidirectional, non-revertive)

- WaveStar BandWidth Manager supports optical transmission interfacing between Cisco ONS 15454 system and WaveStar BandWidth Manager over OC-48 UPSRs, as well as OC-3 and OC-12 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)
- WaveStar BandWidth Manager supports optical transmission interfacing between Cisco ONS 15454 system and WaveStar BandWidth Manager over OC-48 UPSRs, as well as OC-3 and OC-12 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)
- WaveStar BandWidth Manager and Marconi MSH 84/86, Series 3, over STM-1, STM-4, and STM-16 interfaces: 1+1 protected (bidirectional, non-revertive)

□

2 Features

Overview

Purpose This chapter describes the variety of flexible features available in WaveStar BandWidth Manager.

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Overview of Features

Modular growth

WaveStar BandWidth Manager provides customers with an economical network element that enables central office consolidation, simplified bandwidth management, and consolidated OAM&P features. The product is positioned to exceed the demands of today's growing telecommunication networks and can be expanded and upgraded modularly as new features are added and additional capacity is required. Therefore, the customer is able to shape WaveStar BandWidth Manager into a customized network solution.

Transmission interfaces

WaveStar BandWidth Manager provides optical and electrical transmission interfaces. These interfaces support OC-192/STM-64, OC-48/STM-16, OC-12/STM-4, OC-3/STM-1, DS3, EC-1 and STM-1e intra-office connectivity.

Protection arrangements

The transmission port units can be provisioned in different protection arrangements, including

- 2- and 4-fiber OC-48 BLSRs/STM-16 MS-SPRings
- 2- and 4-fiber OC-192 BLSRs/STM-64 MS-SPRings
- OC-48 and OC-12 UPSRs
- STM-N SNCP rings
- 1+1 protected for the optical interfaces (depending on the interface the 1+1 protection can be either unidirectional, non-revertive; bidirectional, non-revertive; or bidirectional non-revertive)
- 1xN for the electrical interfaces
- 0x1 (unprotected) for all interfaces

Cross-connect flexibility

WaveStar BandWidth Manager offers a 4608/1536 (4608 STS-1 equivalents/1536 STM-1 equivalents) platform with a 4608x4608/1536x1536 switch fabric. Multiple user-provisionable cross-connection types are available to meet the various needs of the customer.

OAM&P When compared to central offices today, central offices with WaveStar BandWidth Manager have greatly simplified and consolidated OAM&P functions.

SONET

WaveStar BandWidth Manager offers SONET-based OAM&P functions.

SDH

WaveStar BandWidth Manager offers SDH-based OAM&P functions.

□

Standards Compliance

Overview

WaveStar BandWidth Manager adheres to the national and international standards noted in this section.

National standards

WaveStar BandWidth Manager complies with

- the Synchronous Optical Network (SONET) standard
- American National Standards Institute (ANSI) T1.105
- AT&T NEDS: AT&T Practice 801-900-160
- AT&T Network Equipment Design Standards and Requirements for Physical and Electrical design
- Telcordia (Bellcore) generic requirement (GR) standards on SONET
- Asynchronous interface standards
- Technical advisories (TAs) and technical requirements (TRs) on OAM&P functions
- NEBS Zone 4 earthquake generic requirements
- NEBS Level 3 compliance per Telcordia Technologies' GR-63-CORE and GR-1089-CORE

WaveStar BandWidth Manager is

- Underwriters Laboratories Inc. (UL) listed (UL-950)
- Canadian Standards Association (CSA) certified

International standards

WaveStar BandWidth Manager complies with

- the Synchronous Digital Hierarchy (SDH) standard
- European Telecommunications Standards Institute (ETSI) standards
- International Telecommunications Union (ITU) standards

ETSI

WaveStar BandWidth Manager complies with the following ETSI standards for physical, environmental, and power requirements:

- ETSI footprint and bay mounting as per ETS 300 119-2
- ETSI earthquake-proved bay according to ETS 300 019-1-3
- -48 VDC/-60 VDC operating voltage as per ETS 300 132-2
- Low voltage alarm on the primary power and operation in temperature controlled locations as per ETS 300 019 class 3.1

- Transportation as per ETS 300 019 class 2.3
- Storage as per ETS 300 019 class 1.2
- Mesh bonding and power supply filter as per ETS 300 132-2
- Acoustic noise generation according to ETS 300 753, October 1997

CE marking WaveStar BandWidth Manager complies with the

- Safety requirements pertaining to telecommunications equipment according to BS EN 60950
- Radio interference characteristics according to EN 55022, September 1998
- EMC/EMI requirements according to EN 300 386 V1.1.3 (1997-12)
- Radiated, radio-frequency, electromagnetic field immunity tests as per EN 61000-4-3, 1996
- Electrical fast transient/burst immunity tests as per EN 61000-4-4, 1995
- Surge immunity tests as per EN 61000-4-5, 1995
- Conducted disturbances induced by radio-frequency fields tests as per EN 61000-4-6, 1996

NEBS WaveStar BandWidth Manager is designed to meet Telcordia (Bellcore) Network Equipment Building Systems (NEBS) requirements (GR-63-Core and GR-1089-Core) for use in central office environments.

EMC The unique door assembly and shelves are designed to meet the electromagnetic compatibility (EMC) requirements of

- FCC Title 47, Part 15, Subpart J for Class A equipment
- CE standards for EMC (ETS 300 386-2-2) and EMI (ETS 300 386-1)

ESD WaveStar BandWidth Manager complies with the IEC 801-2 electrostatic discharge (ESD) recommendation for exchange carriers. Shelf-mounting hardware is used to ground the shelves to the uprights. An ESD jack is provided at the front of each shelf (on the user panel) and at the rear of each bay for grounding straps.

□

Introduction to the Switch Fabrics

Overview

This section describes the switch fabrics in WaveStar BandWidth Manager.

Main switch fabric

Two Switch Shelves with BSW (byte switch) circuit packs and their associated redundant SWIEX circuit packs mounted in two different bays comprise the main switch fabric.

4608/1536 switch fabric

The 4608/1536 switch fabric (two Switch Shelves) includes two 4608/1536 switch centers, one service and one protection.

The 4608/1536 switch fabric can be housed in a Control/Switch Bay and a Switch Bay (2-bay Control/Switch Complex), or two Switch Bays (3-bay Control/Switch Complex).

4608/1536 switch center

A 4608/1536 switch center is a fully-equipped Switch Shelf (16 BSW packs).

Duplicated switch

By utilizing a fully-duplicated, cross-coupled, single-stage (N^2) switch, WaveStar BandWidth Manager is able to provide the highest possible reliability. WaveStar BandWidth Manager provides redundant main switch fabrics (two Switch Shelves that are housed in separate bays) to provide maximum reliability.

Active-active standby

The two switch sides operate in an active-active mode and are additionally cross-coupled onto the I/O Shelves, thus providing superior transmission reliability as well as manual and autonomous errorless protection switching.

Cross-coupling

Multiple levels of cross-coupling (between the two switch sides [1-1 and 2-1], the SWIF packs, and the transmission interfaces) additionally enhance the excellent reliability performance of WaveStar BandWidth Manager.

Timing and control

In addition to duplicating the entire Switch Shelf, WaveStar BandWidth Manager provides fully-duplicated timing and control functions and power feeds within each of the two Switch Shelves.

> **Important!** The duplication of control, timing and power in the System Controller Shelf and the I/O Shelves further enhances the reliability of all the major sub-systems in WaveStar BandWidth Manager.

Shelf-based switch fabric

WaveStar Bandwidth Manager offers two types of shelf-based switch fabrics, provided by SWITCH/STS576 packs and SWITCH/STS768 packs.

> **Important!** Because the shelf-based switch fabrics handle any ring through-connections, port unit protection switching, and on-shelf cross-connections, valuable cross-connect capacity on the main switch fabric is not wasted.

SWITCH/STS576 packs

The SWITCH/STS576 (576x576 STS-1/192x192 STM-1 switch) packs comprise a 576x576 STS-1/192x192 STM-1 equivalent shelf-based switch fabric.

Two SWITCH/STS576 packs are located in the Universal I/O Shelves and the SDH Universal I/O Shelves (all modules of the Facility Interface Sub-Shelves).

The traffic from the transmission port units that is dropped to the main switch fabric (via a maximum of two SWIF pairs) consumes maximum of 192 STS-1s/64 STM-1 equivalents of the shelf-based switch fabric.

The remaining 384 STS-1/128 STM-1 equivalents of the shelf-based switch fabric provide ring through-connections, port unit protection switching, and on-shelf cross-connections.

SWITCH/STS768 packs

The SWITCH/STS768 (768x768 STS-1/256x256 STM-1 switch) packs comprise an 1152x1152/384x384 equivalent shelf-based switch fabric.

Ten SWITCH/STS768 packs are located in the 10G I/O Shelves (all modules of the CTL/Switch Interface Sub-Shelves).

The traffic from the OC192/STM64 port units that is dropped to the main switch fabric (via a maximum of four SWIF pairs) consumes a maximum of 384 STS-1s/128 STM-1 equivalents of the shelf-based switch fabric.

The remaining 768 STS-1/256 STM-1 equivalents of the shelf-based switch fabric provide ring through-connections, port unit protection switching, and on-shelf cross-connections.

SWIF packs

The SWIF (switch interface) pairs provide interfaces between the shelf-based switch fabric (in the I/O Shelves) and the main switch fabric (Switch Shelves) for all transmission traffic that is not either cross-connect directly on the I/O Shelf or through-connected.

Capacity

The number of SWIF pairs (≤2 pairs per Universal I/O Shelf or SDH Universal I/O Shelf, ≤4 pairs per 10G I/O Shelf) multiplied by 96 STS-1/32 STM-1 equivalents can not exceed the 4608 STS-1/1536 STM-1 equivalents of capacity provided by the main switch fabric.

□

Switch Fabric Capacity

Overview

WaveStar BandWidth Manager is a highly flexible product designed to adapt as additional switch capacity is required.

4608/1536 platform

A 4608/1536 platform comprises a Control/Switch Complex with the required cable management bays and a minimum of one equipped I/O Bay. WaveStar BandWidth Manager, R4.1 can accommodate a maximum of 36 I/O Shelves.

An equipped I/O Bay could be a

- Universal I/O Bay equipped with two Universal I/O Shelves
- 10G I/O Bay equipped with one or two 10G I/O Shelves
- 10G/Universal I/O Bay equipped with one Universal I/O Shelf and one 10G I/O Shelf
- 10G/SDH I/O Bay equipped with one SDH I/O Shelf and one 10G I/O Shelf
- SDH I/O Bay equipped with two SDH I/O Shelves

2-bay Control/Switch Complex

The 2-bay Control/Switch Complex comprises the required cable management bays and

- One Control/Switch Bay that is equipped with a System Controller Shelf and a 4608/1536 Switch Shelf
- One Switch Bay that is equipped with a 4608/1536 Switch Shelf

Important! The two fully-equipped Switch Shelves (SW1-1 and SW2-1) each contain 16 BSW packs.

3-bay Control/Switch Complex

Important! As of April 1, 2002, the 3-bay Control/Switch Complexes will be Discontinued Availability (DA).

The 3-bay Control/Switch Complex comprises the required cable management bays and

- One System Controller Bay that is equipped with a System Controller Shelf
- Two Switch Bays that are each equipped with a 4608/1536 Switch Shelf

Important! The two fully-equipped Switch Shelves (SW1-1 and SW2-1) each contain 16 BSW packs.

Main switch fabric capacity used

The I/O Shelves each use a provisionable amount of the capacity on the 4608/1536 main switch fabric.

Universal I/O Shelf

Depending on the port units and number of SWIF packs used, an equipped Universal I/O Shelf consumes either 96 or 192 STS-1/32 or 64 STM-1 equivalents of the available switch fabric.

SDH I/O Shelf

Depending on the port units and number of SWIF packs used, an equipped SDH Universal I/O Shelf consumes either 96 or 192 STS-1/32 or 64 STM-1 equivalents of the available switch fabric.

10G 1/0 Shelf

Depending on the port units and number SWIF packs used, an equipped 10G I/O Shelf consumes either 96, 192, 288, or 384 STS-1/32, 64, 96, or 128 STM-1 equivalents of the available switch fabric.

On-shelf cross-connections

The ability to perform cross-connections directly on the I/O Shelves further enhances the robust switch fabric of WaveStar BandWidth Manager. The on-shelf cross-connections, when provisioned efficiently can increase the total switching fabric for WaveStar BandWidth Manager (including the 4608/1536 main switch fabric), by a factor of two or more.

The shelf-based switch fabrics provided the following switch fabrics for on-shelf cross-connections.

576/192 shelf-based switch fabric

The 576x576 STS-1/192x192 STM-1 shelf-based switch fabric (two SWITCH/STS576 packs in the Universal I/O Shelves and the SDH Universal I/O Shelves) provides a 384 STS-1/128 STM-1 equivalents for on-shelf cross-connections, ring through connections, and port unit protection switching.

1152/384 shelf-based switch fabrics

The 1152x1152 STS-1/384x384 STM-1 shelf-based switch fabric (ten SWITCH/STS768 packs in the 10G I/O Shelves) provides 768 STS-1/256 STM-1 equivalents for on-shelf cross-connections, ring through connections, and port unit protection switching.

Benefits of the shelf-based switch fabric

WaveStar BandWidth Manager automatically optimizes cross-connection placement to minimize consumption of the main switch fabric capacity. Therefore, whenever it is possible to perform cross-connections directly on the I/O Shelf using the shelf-based switch fabric, WaveStar BandWidth Manager will do so.

All point-to-point cross-connections, including bridged connections, and path-protected cross-connections that have cross-connection legs between ports that reside on the same I/O Shelf are cross-connected on that I/O Shelf.

Bridged connections to outputs that are on the same shelf are cross-connected on the output I/O Shelf.

The path selector function that chooses between inputs of a path protected cross-connection is located on I/O Shelves. Because path-protection is performed on the I/O Shelves, main switch fabric capacity is not consumed.

> **Important!** The user can query whether a cross-connection is via the shelf-based switch fabric or the main switch fabric. If a point-to-point cross-connection (established prior to R4.0) is going through the main switch fabric, but qualifies to be completed by the shelf-based switch fabric, the user can perform a roll. By rolling the cross-connection to the same input port and then deleting the original cross-connection, WaveStar BandWidth Manager moves that cross-connection leg to the shelf-based switch fabric, thereby freeing up valuable capacity on the main switch fabric.

□

Non-Blocking Cross-Connection

Overview

The high reliability of the switch fabric in WaveStar BandWidth Manager is enhanced by the N^2 switch fabric.

N^2 switch fabric

Because WaveStar BandWidth Manager provides a N^2 switch fabric, every input has a dedicated path to every output. Therefore, path hunt within the switch fabric is eliminated. The N^2 switch fabric allows for strictly non-blocking cross-connections.

Non-blocking STS-1/VC-N granular cross-connection

The main cross-connection fabric, by virtue of its N^2 architecture, is strictly non-blocking for any mix of supported cross-connection rates (STS-1/VC-3 and above) and topologies (one-way, two-way, bridging).

Bandwidth shedding

WaveStar BandWidth Manager allows for conservation of the main fabric bandwidth by "shedding" bandwidth on the I/O Shelves.

WaveStar BandWidth Manager performs all facility protection switching (linear and BLSR/MS-SPRing) on the I/O Shelves via the shelf-based switch fabrics, rather than the main switch fabric. For example, the bandwidth of the protection lines in a 1+1 configuration, does not consume capacity on the main switch fabric. Similarly, since BLSR/MS-SPRing protection switching is done within the I/O Shelf, only the BLSR/MS-SPRing traffic that needs to add/drop through the main switch fabric consumes capacity on the main switch fabric (the remaining capacity may be through-connected).

WaveStar BandWidth Manager also allows the user to modularly equip switch interface capacity in increments of 96 STS-1/32 STM-1 equivalents, so that there is flexibility in selecting the amount of connectivity to the main fabric from each I/O Shelf. For example, a fully-equipped OC3/STM1 Optical Module only consumes 96 STS-1/32 STM-1 equivalents of capacity on the main switch fabric. Even though a Universal I/O Shelf can drop 192 STS-1/64 STM-1 equivalents of capacity to the main switch fabric, an OC3/STM1 Optical Module requires only one pair of SWIF packs (96 STS-1/32 STM-1 equivalents).

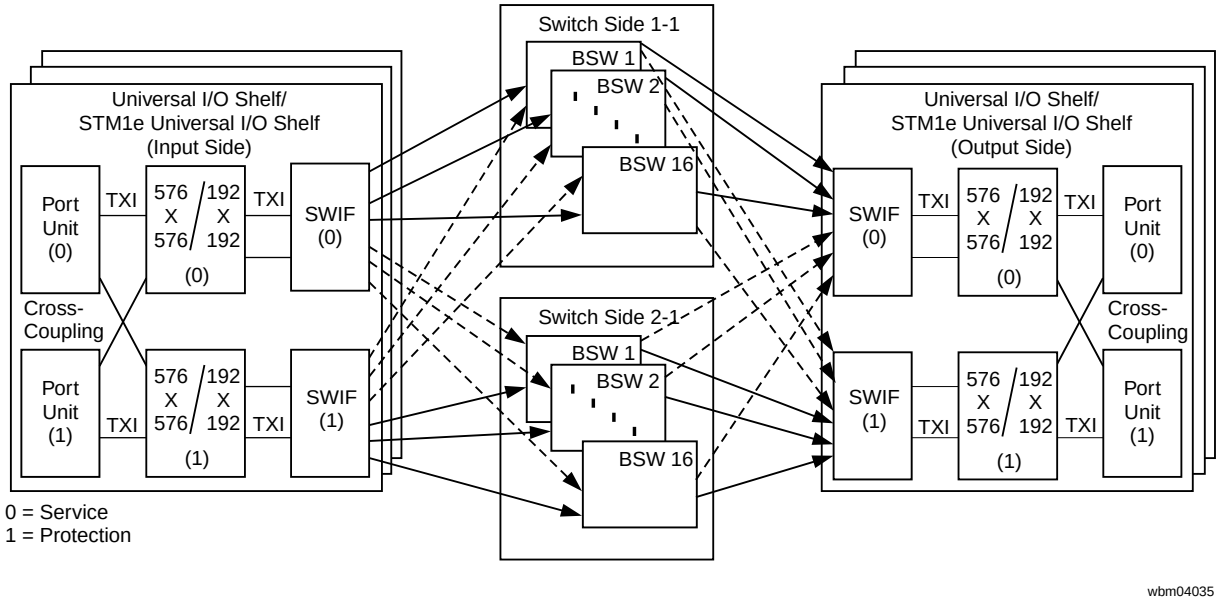
□

Functional View of the 4608/1536 Switch Fabric

Switch fabric with Universal I/O Shelves and SDH Universal I/O Shelves

Figure 2-1 provides a functional view of the 4608/1536 switch fabric interfacing with Universal I/O Shelves and/or SDH Universal I/O Shelves.

Figure 2-1 4608/1536 Switch Fabric with Universal I/O Shelves and/or SDH Universal I/O Shelves - Functional View

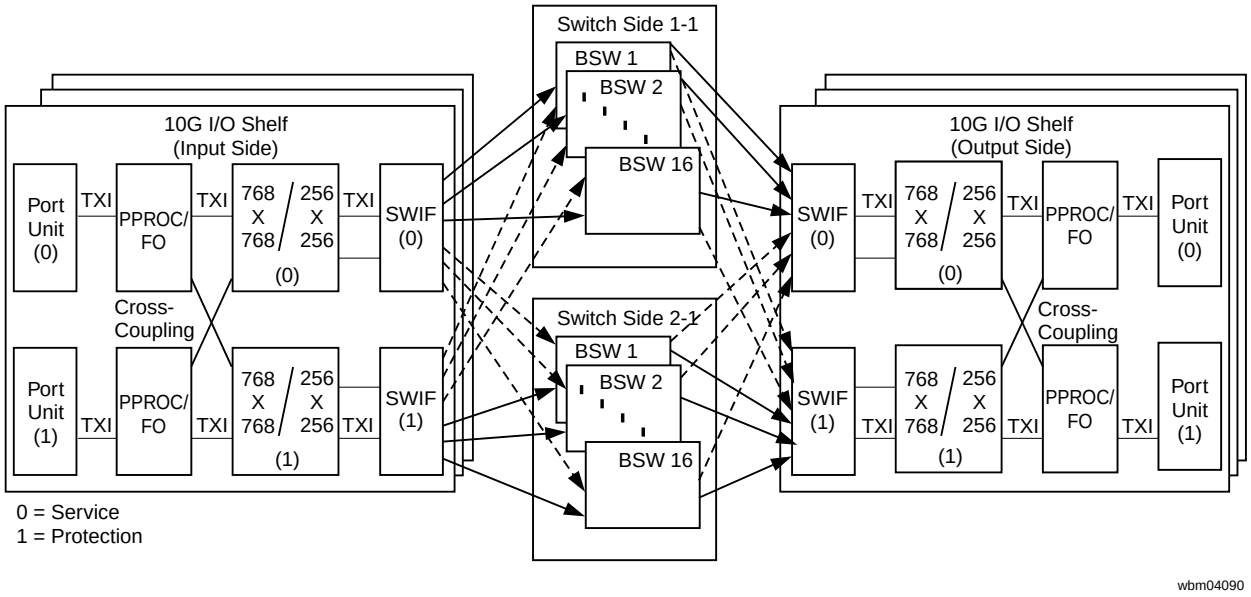


Important! The two SWITCH/STS576 circuit packs in the Universal I/O Shelves and SDH Universal I/O Shelves provide a 576x576/192x192 shelf-based switch fabric.

Switch fabric with 10G I/O Shelves

Figure 2-2 provides a functional view of the 4608/1536 switch fabric interfacing with 10G I/O Shelves.

Figure 2-2 4608/1536 Switch Fabric with 10G I/O Shelves - Functional View



Important! The ten SWITCH/STS768 circuit packs in the 10G I/O Shelves provide an 1152x1152/384x384 shelf-based switch fabric.

□

Cross-Connection Tributaries

Cross-connections

Cross-connections are SONET or SDH path-level connections between logical input and output tributaries of specific ports. The logical input and output tributaries in each type of port or port protection group are the only entities from and to which the user can provision cross-connections.

The transmission connectivity required for line protection switching is determined automatically by the provisioning and current state of the port protection group.

Port tributary

A port tributary is a path-level unit of bandwidth within a port, or the constituent signal(s) being carried in this unit of bandwidth (for example, an STS-1/VC-3, STS-3c/VC-4, STS-12c/VC-4-4C, or STS-48c/VC-4-16c tributary within an OC-N/STM-N port). A port tributary is an STS-1/VC-3 tributary unless specified otherwise. For a port which is not in a port protection group (for example, an unprotected optical port), a port tributary is the same entity as a logical tributary.

Logical tributary

A logical tributary is a path-level unit of bandwidth within a port or in the signal(s) being carried in the path-level unit of bandwidth. For example, a logical tributary may be an STS-1/VC-3, STS-3c/VC-4, STS-12c/VC-4-4C, or STS-48c/VC-4-16c tributary within an OC-N/STM-N line in a port protection group. A logical tributary is generally an STS-1/VC-3 tributary unless otherwise specified.

A logical tributary is associated with a particular service (unit of traffic) carried to or from another network element. The operations on a logical tributary include cross-connections and path-level fault and performance monitoring. Some operations apply to logical input and/or output tributaries, and others to logical input tributaries only. The operations which apply to a port tributary can apply to a logical tributary only when it is the same entity.

> **Important!** For a port that is not part of a port protection group, a logical tributary is the same entity as a port tributary. For a port that is part of a port protection group, the logical tributary refers to the port tributary used for normal transmission in the absence of a line protection switch.

Working tributary A working tributary is a port tributary carrying traffic that can be protected in a port protection group. A working tributary may also be a logical tributary associated with a port tributary.

Protection tributary A protection tributary can be used to protect the traffic carried by a working tributary in a port protection group. A protection tributary may also be a logical tributary associated with a port tributary if protection access is supported in the port protection group.

Protection access Protection access is the ability to provide traffic on protection tributaries when the port tributaries are not being used to carry the protected working traffic.



Cross-Connection Rates

Overview

This section describes the cross-connection rates supported by WaveStar BandWidth Manager.

Cross-connection rates

The system cross-connects SONET signal Synchronous Payload Envelopes (SPE) and SDH High Order (HO) virtual containers intact with no bits altered. Cross-connection rate defines the path-level bandwidth that a given cross-connection can carry.

The following table lists the SONET and SDH cross-connection rates. The SONET and SDH rates that fall within the same column are functional equivalents, for example VC-3/STS-1.

Table 2-1 Cross-Connection Rates

Standard	Rate			
SDH	VC-3	VC-4	VC-4-4c	VC-4-16c
SONET	STS-1	STS-3	STS-12	STS-48

Fixed-rate tributary operation

SONET ports can be provisioned for either fixed-rate or adaptive-rate tributary operation. SDH ports always operate as fixed-rate. For ports with fixed-rate tributary operation, the rate of each cross-connection must match the rate of each provisioned input and output tributary on that port.

Fault and performance monitoring

If the incoming signal associated with a specific STS-N cross-connection is other than STS-Nc, then the system considers this a defect and takes consequent actions. For example, if an OC-12 input port is provisioned for one STS-12c signal, and the port receives four STS-3c signals, then the system considers this situation a defect, and declares a loss of pointer (LOP) and inserts an alarm indication signal (AIS). Fixed-rate tributary operation is beneficial for services providers who are selling their services at specific rates and do not want their end-users modifying those predefined rates.

Adaptive-rate tributary operation

With adaptive-rate operation, tributaries are not provisioned for a particular expected rate, rather they adapt to the concatenation structure of the incoming signal. Adaptive-rate cross-connections (also known as pipe cross-connections) may be provisioned at any cross-connection rate that is supported for the logical tributaries associated with the input and output ports. A cross-connection leg can carry any set of constituent signals for which the total of the constituent signal rates does not exceed the cross-connection rate. Cross-connection legs in opposite directions, from an input tributary and to an output tributary, can be provisioned independently and at different rates.

Adaptive-rate cross-connections enable the user to avoid provisioning the signal rate for each tributary. Any allowable combination of signals is cross-connected without planning and provisioning the input and output tributaries of the ports.

Fault and performance monitoring

When an STS-N cross-connection is set up on a port, the system allows the constituency of that incoming STS-N to be any mix of signals consistent with the SONET standard; an STS-12 cross-connection can have one STS-12c, four STS-3cs, or twelve STS-1s, or a mix of STS-1s and STS-3cs. The system does signal maintenance, fault management, performance monitoring and path protection switching (when supported) on each of the detected constituent signals. If the constituent structure of the STS-N pipe changes, then the system adapts to the change. The user can query for the current constituent signal structure and can provision the system to issue an autonomous message when/if there is a change in the constituency.

STS-3 adaptive-rate cross-connections

WaveStar BandWidth Manager supports a user-provisioned STS-3 cross-connection where the contents of this STS-3 “pipe” can be either STS-3c or three STS-1s, and where transitions between these contents can take place.

STS-12 adaptive-rate cross-connection

WaveStar BandWidth Manager supports a user-provisioned STS-12 cross-connection where the contents of this STS-12 “pipe” can be either STS-12c or a combination of STS-3cs and STS-1s, and where transitions between these contents can take place.

STS-48 adaptive-rate cross-connection

WaveStar BandWidth Manager supports a user-provisioned STS-48 cross-connection where the contents of this STS-48 “pipe” can be either STS-48c or a combination of STS12cs, STS-3cs, and STS-1s, and where transitions between these contents can take place.

SONET/SDH interconnectivity

WaveStar BandWidth Manager supports SONET/SDH cross-connection interworking between ports provisioned with an interface standard of SDH or SONET.

□

AU-3/AU-4 Adaptation

Overview

There are two methods of multiplexing a VC-3 signal into an STM-N signal. One is called *SONET mode mapping* and one is called *SDH mode mapping*.

SONET mode mapping packages one VC-3 signal into an AU-3 signal and then maps three AU-3s into an STM-1. SDH mode mapping packages three VC-3 signals into an AU-4 signal and then maps one AU-4 into an STM-1.

The SONET and SDH mode mappings are incompatible. Equipment implementing one of the methods cannot locate VC-3s within a signal that has been produced by equipment using the other method. AU-3 to AU-4 adaptation allows a signal multiplexed by SONET mode mapping to be demultiplexed by equipment that uses SDH mode mapping. AU-4 to AU-3 adaptation allows a signal multiplexed by SDH mode mapping to be demultiplexed by equipment that uses SONET mode mapping.

Main application

The main application for the AU-3/AU-4 adaptation feature is in the international transportation of DS3s. In spite of the fact that the DS3 signal is considered part of the North American transmission hierarchy, and thus more closely associated with SONET networks than SDH networks, a growing number of DS3s originate/terminate outside North America, and are transported, all or part of the way, over SDH networks. DS3s are carried in VC-3s. Depending on the equipment where the VC-3 originates, SONET or SDH mode mapping may be applied to prepare the VC-3s for transport across the network or networks. An adaptation function is needed when the terminating equipment does not support the same VC-3 mapping mode as the originating equipment.

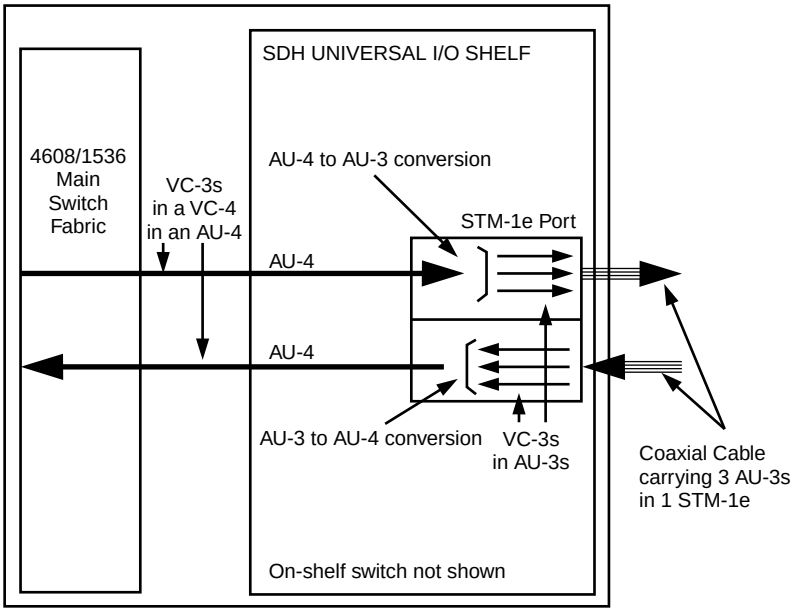
Basic adaptation

WaveStar BandWidth Manager provides a SONET-to-SDH mode adaptation at the input port. When the adaptation feature is enabled in the input direction, WaveStar BandWidth Manager recovers VC-3s from (up to three) AU-3s contained within the incoming STM-1e signal. It then re-maps/re-multiplexes the VC-3s, by SDH mode mapping, into a high-order VC-4 which is placed within an AU-4. The resulting VC-4/AU-4 is directed (by the shelf-based switch fabric) to the main switch fabric where it can be cross-connected to an outgoing VC-4/AU-4 tributary of an STM-N port. However, if the ports are located on the same I/O Shelf, the cross-connection can be performed

by the shelf-based switch fabric; the cross-connection does not have to performed by the main switch fabric.

WaveStar BandWidth Manager provides a SDH-to-SONET mode adaptation at the output port. When the adaptation feature is enabled in the output direction, an AU-4 signal is received from the WaveStar BandWidth Manager main switch fabric (where it has presumably entered via an STM-N port), and the high-order VC-4 contained within the AU-4 is terminated. The adaptation function recovers the VC-3s that were contained in the high-order VC-4, and then re-maps each recovered VC-3 into an AU-3. The AU-3s are mapped into the STM-1e signal exiting the port.

Figure 2-3 Basic AU-3/AU-4 Adaptation Architecture



Important! Figure 2-3 illustrates the signal going through the main switch fabric to connect to an STM-N port on a different I/O Shelf. However, if the ports are located on the same I/O Shelf, the STM-N signal can be cross-connect directly on the I/O Shelf via the shelf-based switch fabric without consuming valuable capacity on the main switch fabric.

Generalized adaptation

When SONET mode-mapped VC-3s (VC-3 in AU-3s) enter/exit WaveStar BandWidth Manager via ports other than STM-1e ports (for example, STM-N optical ports, or via DS3 ports which map DS3s into VC-3s in AU-3s), the signals can still be adapted. However, it requires additional engineering and resources.

In Figure 2-4, VC-3s contained within AU-3s enter WaveStar BandWidth Manager through one or more of the STM-N optical ports. Up to three of these VC-3s are cross-connected through WaveStar BandWidth Manager to the outgoing VC-3 tributaries of a single STM-1e port, referred to here as Port 1. Adaptation is not enabled on this port.

Therefore, the STM-1e signal leaving WaveStar BandWidth Manager from Port 1 contains VC-3s in AU-3s. The output of Port 1 is cabled to the input of a second STM-1e port, referred to here as Port 2. (Port 2 may reside on the same I/O Shelf, and even on the same port unit as Port 1.)

Figure 2-4 illustrates the generalized adaptation architecture.

Figure 2-4 Generalized AU-3/AU-4 Adaptation Architecture

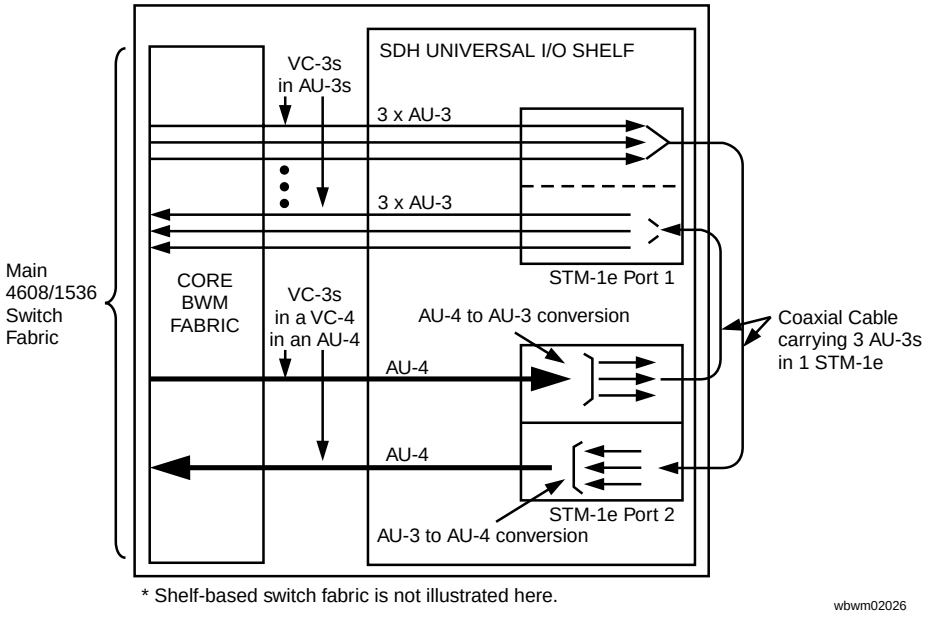


Figure 2-4 illustrates the signal going through the main switch fabric to connect to an STM-N port on a different I/O Shelf. However, if the ports are located on the same I/O Shelf, the STM-N signal can be cross-connect directly on the I/O Shelf via the shelf-based switch fabric without consuming valuable capacity on the main switch fabric.

Because the AU-3/AU-4 adaptation functionality is enabled in the input direction on Port 2, Port 2 converts the incoming SONET mode mapped signal (VC-3s in AU-3s) to an SDH mode mapped signal (VC-3s contained in a high-order VC-4 in an AU-4). The high-order VC-4 that is formed is then cross-connected through the main switch fabric to an outgoing VC-4 tributary on an STM-N port where it exits WaveStar BandWidth Manager.

In the opposite direction of transmission, up to three VC-3s may be contained within an higher-order VC-4 in an AU-4 as it enters WaveStar BandWidth Manager through an STM-N port. The higher-order VC-4 containing the VC-3s is cross-connected through the main switch fabric to the outgoing VC-4 tributary on STM-1e Port 2. Because AU-4/AU-3 adaptation is enabled in the egress direction on Port 2, the STM-1e signal exiting WaveStar BandWidth Manager from Port 2 has VC-3s contained in AU-3s. The output of Port 2 is cabled to the input of STM-1e Port 1. Adaptation is not enabled on Port 1. Therefore, the signal being transported toward the core of BandWidth Manager from Port 1 has VC-3s in AU-3s. These VC-3s in AU-3s are cross-connected to outgoing VC-3 tributaries in up to three different STM-N ports.

> **Important!** Although two STM-1e ports are used in the generalized adaptation capability, only one port is enabled for adaptation.

□

Gateway Cross-Connections

Overview

Ports can be provisioned as either SONET or SDH. WaveStar BandWidth Manager supports global default provisioning and per-port provisioning. Tributary provisioning is supported on ports for the expected signal rate of the cross-connection that will be made to that set of tributaries.

Users can request cross-connections using either SONET or SDH terminology for the cross-connection rate. WaveStar BandWidth Manager treats the following cross-connection rates as equivalents:

- VC-3 and STS-1
- VC-4 and STS-3
- VC-4-4c and STS-12
- VC-4-16c and STS-48

Reporting can be either SONET or SDH terminology depending on the cross-connection mode provisioned (for example, STS-N or VC-N cross-connections).

Gateway between DS3 and STS-1

WaveStar BandWidth Manager supports cross-connections between DS3 ports and STS-1 tributaries of a SONET interface (OC-N) via STS-1 cross-connections, thereby providing for DS3/STS-1 gateways. The DS3 signal is cross-connected intact within the STS-1 payload.

Gateway between DS3 and VC-3

WaveStar BandWidth Manager supports DS3/VC-3 interworking by cross-connecting a VC-3 signal from a DS3 port to a VC-3 tributary on an SDH-provisioned port.

Interworking between VC-3 and STS-1

WaveStar BandWidth Manager supports VC-3/STS-1 interworking by treating the VC-3s with AU-3 mappings and the STS-1 SPEs in the same manner within the cross-connect fabric. The signal can enter/exit on an OC-N interface as an STS-1 and enter/exit on an STM-N interface as a VC-3; thus providing a gateway function.

Interworking between VC-4 and STS-3

WaveStar BandWidth Manager supports VC-4/STS-3 interworking by treating the VC-4s with AU-4 mappings and the STS-3 SPEs in the same manner within the cross-connect fabric. The signal can enter/exit on an OC-N interface as an STS-3 and enter/exit on an STM-N interface as a VC-4; thus providing a gateway function.

Interworking between VC-4-4c and STS-12

WaveStar BandWidth Manager supports VC-4-4c/STS-12 interworking by treating the VC-4-4cs with AU-4-4c mappings and the STS-12 SPEs in the same manner within the cross-connect fabric. The signal can enter/exit on an OC-N interface as an STS-12 and enter/exit on an STM-N interface as a VC-4-4c; thus providing a gateway function.

Interworking between VC-4-16c and STS-48

WaveStar BandWidth Manager supports VC-4-16c/STS-48 interworking by treating the VC-4-16cs with AU-4-16c mappings and the STS-48c SPEs in the same manner within the cross-connect fabric. The signal can enter/exit on an OC-N interface as an STS-48 and enter/exit on an STM-N interface as a VC-4-16c; thus providing a gateway function.

□

Atomic Cross-Connection Types

Overview

WaveStar BandWidth Manager supports the following atomic cross-connection types:

- 1-way point-to-point
- 1-way path-protected
- 1-way adjunct path-protected

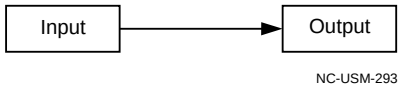
Atomic cross-connections

An atomic cross-connection is a one-way cross-connection topology that can be set up and taken down by one command at the network element, but which cannot have a smaller part of it set up or taken down. WaveStar BandWidth Manager supports three atomic cross-connections: point-to-point, path-protected, and adjunct path-protected. Because atomic cross-connections are the building blocks of compound cross-connections, the user can modify the individual atomic cross-connections within the compound cross-connection (for example, bridging and rolling) which allows customization or in-service rearrangements of traffic.

1-way) point-to-point

A 1-way point-to-point cross-connection consists of a single leg connecting an input tributary to an output tributary at the selected cross-connection rate. A single command to the network element sets up or takes down a 1-way point-to-point cross-connection.

Figure 2-5 1-Way Point-to-Point Cross-Connection

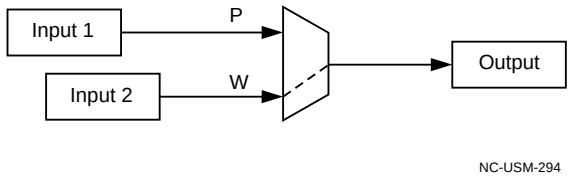


Important! If one direction of a tributary of a port is provisioned as a 1-way cross-connection, the signal in the other direction can either be terminated with no cross-connection or it can be cross-connected independently to a tributary on another port.

1-way path-protected

A 1-way path-protected cross-connection consists of a working leg from one input tributary and a protection leg from a second input tributary to the same output tributary. These legs make up a path protection group.

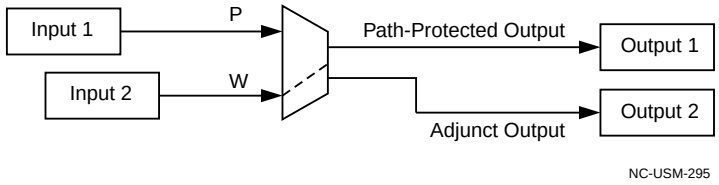
Figure 2-6 1-Way Path-Protected Cross-Connection



1-way adjunct path-protected

A 1-way adjunct path-protected cross-connection consists of an adjunct working leg from one input tributary and an adjunct protection leg from a second input tributary to the same adjunct output tributary. A 1-way adjunct path-protected cross-connection is created by selecting an existing path-protected cross-connection and then selecting an adjunct output tributary. The result is a signal that goes to both the original path-protected output tributary and the new adjunct path-protected output tributary.

Figure 2-7 1-Way Adjunct Path-Protected Cross-Connection



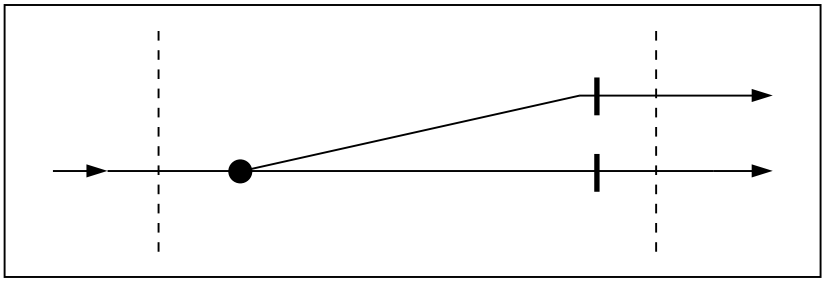
Bridge cross-connections

A bridge is a cross-connection leg with the same input tributary as that of an existing cross-connection leg, thereby forming a 1:2 “bridge” from an input tributary to two output tributaries.

Bridging is generally used for facility rolling and testing. Bridging is also used at the add node (head-end bridge) of UPSRs and SNCP paths. Bridging is supported for each of the supported cross-connect rates. Any existing cross-connection can be bridged to a second output tributary without impairing the existing signal. Conversely, either half of a bridged signal may be taken down without impairing the remaining cross-connected signal.

Figure 2-8 illustrates a bridge cross-connection.

Figure 2-8 Bridge Cross-Connection



WaveStar BandWidth Manager supports the following requests for 1:2 bridging:

- Add a 1-way cross-connection from the input leg of an existing 1-way or 2-way cross-connection to a new output to form a 1:2 cross-connection in one direction
- Remove either leg of an existing 1:2 cross-connection, independent of the order in which the legs were originally set up in one direction
- Bridged cross-connections involving a DS3 port as the input or a DS3 port as one or both of the outputs
- Bridged cross-connections among any combinations of supported ports (for example, SDH and SONET) if the individual cross-connection legs are required to be supported between port combinations.

Facility roll

A roll operation consists of moving the input of any existing leg of any cross-connection from a given tributary to a second tributary, while leaving the output unchanged. A roll is used as a tail-end switch in a “facility or tributary rolling” operation, whereby traffic is moved from one facility to another or from one tributary to another on a facility. The head-end side of a facility or tributary roll usually has a bridge established in one NE so that the traffic flows on both the old and new facilities, minimizing the signal interruption time when the roll is carried out to that introduced by the roll itself in the other NE. All necessary cross-connection paths must be completed on the new facility before performing this operation.

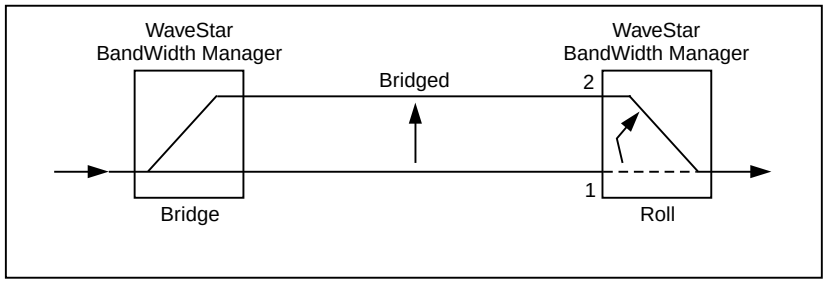
WaveStar BandWidth Manager supports a one-way roll operation for all supported cross-connection rates. The roll is completed with a signal interruption of ≤2.25 ms.

The one-way roll operation proceeds as follows:

1. Disconnection of the cross-connection from input tributary ‘1’ to output tributary
2. Cross-connection of new input tributary ‘2’ to output tributary

Figure 2-9 illustrates a facility bridge and roll application.

Figure 2-9 Facility Bridge and Roll



Compound Cross-Connection Types

Overview

WaveStar BandWidth Manager supports the following compound cross-connection types:

- 2-way point-to-point (default)
- ring interworking, drop & continue, BLSR/MS-SPRing primary node
- ring interworking, drop & continue, BLSR/MS-SPRing primary nodes in same NE
- UPSR/SNCP ring add, drop
- UPSR/SNCP ring-to-ring, single node interconnection, same NE

Signals in a BLSR/MS-SPRing are protected by the fact that the entire ring is a single protection group. For this reason, cross-connections within the ring are generally point-to-point instead of path-protected. Signals in a UPSR and a SNCP ring are protected by the fact that each cross-connection into or out of the ring is path-protected. Each working signal has a protection signal going around the ring in the opposite direction.

Compound cross-connections

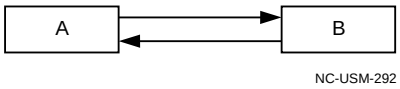
A compound cross-connection is one or more atomic cross-connections between input and output tributaries in a network element for a circuit in a specific network application. The WaveStar CIT enables the user to set up, take down, and/or display a compound cross-connection in a single step.

The atomic connections are identified by specific parameters that are generated by the WaveStar CIT and stored within the NE. This identification process allows the user to manage many different, complex sets of connections needed for the various applications involving path protection (for example, Dual Node Ring Interworking, UPSR, or SNCP), while also allowing the user to manage connections at the atomic level (for example, bridging and rolling).

2-way point-to-point

A 2-way point-to-point cross-connection consists of two legs that provide a bidirectional connection between two tributaries. Each leg, or direction, must be at the same cross-connection rate. A 2-way point-to-point cross-connection could be viewed as two 1-way point-to-point cross-connections, except that the 2-way cross-connection is set up or taken down with a single TL1 command.

Figure 2-10 "2-Way Point-to-Point" Cross-Connection



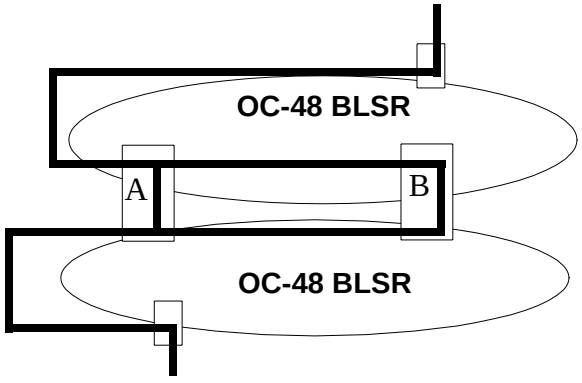
DRI

Dual Ring Interworking (DRI) is a SONET network topology in which two rings are interconnected at two nodes in each ring. The topology operates so that a failure at any of these four nodes does not result in the loss of working traffic.

WaveStar BandWidth Manager supports 2-fiber and 4-fiber OC-48 BLSR DRI when the two DRI nodes are BandWidth Managers. A service selector is provided for each STS-N tributary provisioned for DRI. The service selector selects the better of two received path-level signals according to a given hierarchy of conditions.

Figure 2-11 illustrates DRI between OC-48 BLSRs with BandWidth Managers as the DRI nodes. Drop and Continue is on working tributaries.

Figure 2-11 DRI between BLSRs with two BandWidth Managers



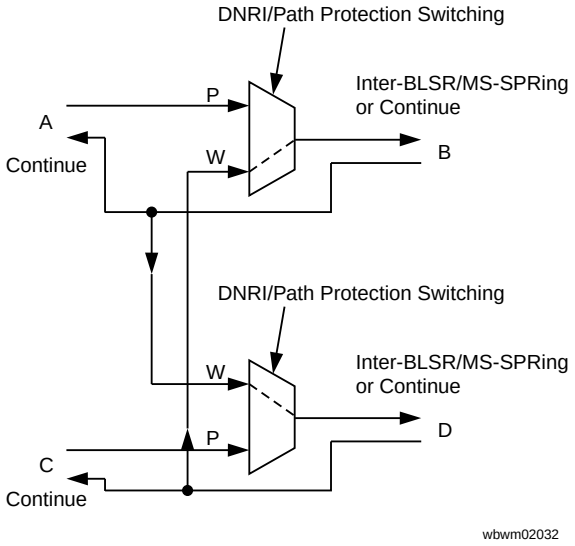
Network Elements A and B are BandWidth Managers.

DRI with drop-and-continue in BLSRs/MS-SPRings

DRI with a drop-and-continue cross-connection in a BLSR/MS-SPRing primary node (different NEs) could be viewed as one path protected cross-connection coming into a BLSR/MS-SPRing from another ring and a point-to-point cross-connection dropping out of the BLSR/MS-SPRing into the other ring.

Figure 2-12 illustrates the detail of the drop-and-continue cross-connection in a primary node when the DRI involves rings from the same NE.

Figure 2-12 DRI with Drop-and-Continue in a BLSR/MS-SPRing-Same NE



For additional details, see Chapter 7 of the *WaveStar BandWidth Manager User Operations Guide, Release 4.1*.

Add/drop in UPSRs/SNCP rings

An add/drop cross-connection in a SONET Unidirectional Path-Switch Ring (UPSR) or an SDH Sub-Network Connection Protection (SNCP) ring could be viewed as a combination of the following 1-way cross-connections:

- Two point-to-point cross-connections into the ring (or one bridged cross-connection into the ring) sending an equal signal in each direction around the ring, providing the two legs of the path protection group
- One path-protected cross-connection out of the ring

Figure 2-13 illustrates a UPSR or an SNCP ring.

Figure 2-13 UPSR or SNCP Ring

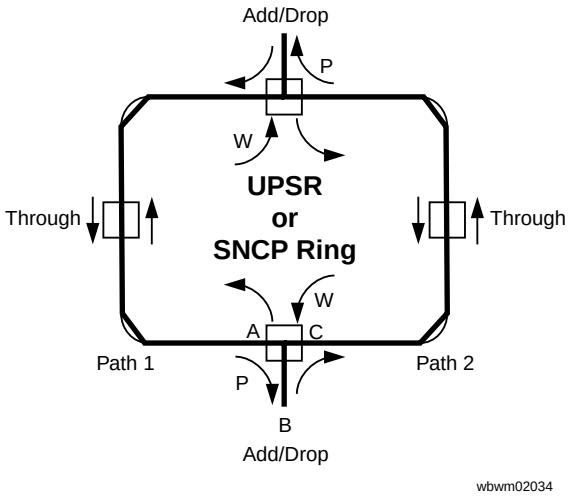
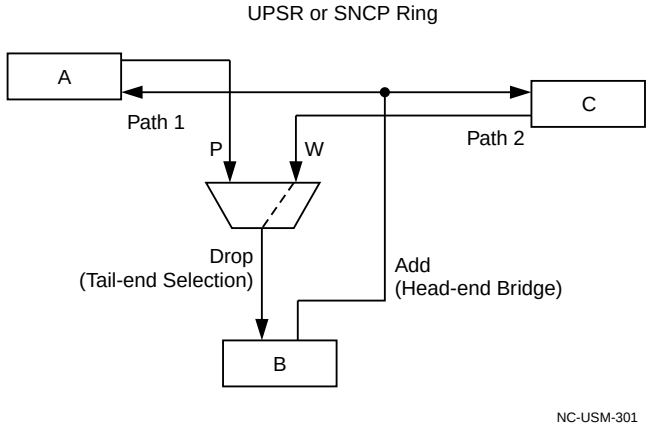


Figure 2-14 illustrates the Add and Drop that occurs in an UPSR or SNCP ring:

- The Add (sometimes called the *head-end bridge*) consists of two 1-way point-to-point cross-connections – one from B to A and one from B to C
- The Drop (sometimes called the *tail-end selection*) consists of one 1-way path-protected cross-connection with A and C as the inputs and B as the output

Figure 2-14 Add/Drop in an UPSR or SNCP Ring



Important! A through cross-connection in a UPSR or SNCP ring is a point-to-point cross-connection.

Optical and Electrical Interfaces

Overview

This section describes the optical and electrical interfaces that are available in the WaveStar BandWidth Manager 4608/1536 platform. Transmission interfaces may be located in either the Facility Interface Sub-Shelves (Universal I/O Shelves/SDH Universal I/O Shelves) or the Facility/SWIF Interface Sub-Shelves (10G I/O Shelves).

OC-192/STM-64 interfaces

WaveStar BandWidth Manager provides the following types of OC-192/STM-64 interfaces (totaling 58 different codes):

- Each OC192/STM64/1.5IR1 (LEY69/LEY69AE) port unit terminates one extended intermediate reach OC-192/STM-64 signal with multibit forward error (FEC) or strong forward error correction (SFEC) in the 1.5 µm range (up to 60 km).
- Each OC192/STM64/1.5IRS1 (LET97/LEY97AE) port unit terminates one extended intermediate reach OC-192/STM-64 signal with multibit forward error correction (FEC) or strong forward error correction (SFEC) in the 1.5 µm range (up to 30 km).
- The OC192/STM64/POU (LEY284-299/LEY284AE-299AE) port units: 16 different passive optic port units provide 16 ITU-compatible OC-192/STM-64 wavelengths in the 1.5 µm range (up to 40 km with the Passive Optics Boxes).
- The OC192/STM64/WDM (LEY201-240/LEY201AE-240AE) port units: 40 different port units provide 40 ITU-compatible OC-192/STM-64 wavelengths in the 1.5 µm range for use with WaveStar OLS 400G (up to 25 km with Lucent's WaveStar OLS 400G).

  Important! Four OC192/STM64 port units are required to terminate each 4-fiber OC-192 BLSR/STM-64 MS-SPRing (closed). Only two OC192/STM64 port units are required to terminate a 4-fiber OC-192 BLSR/STM-64 MS-SPRing (open) in an end node. Two OC192/STM64 port units are required to terminate each 2-fiber OC-192 BLSR/STM-64 MS-SPRing.

OC-48/STM-16 interfaces

WaveStar BandWidth Manager provides the following types of OC-48/STM-16 interfaces (totaling 114 different codes):

- Each OC48/STM16/1.3LR1 (LEY7/LEY7AE) port unit terminates one long reach OC-48/STM-16 signal in the 1.3 μm range (up to 51 km).
- Each OC48/STM16/1.5LR1 (LEY8/LEY8AE) port unit terminates one long reach OC-48/STM-16 signal in the 1.5 μm range (up to 80 km).
- The OC48/STM16/DWDM01-16 (LEY50-65/LEY50AE-65AE) port units: 16 different port units provide 16 ITU-compatible OC-48/STM-16 wavelengths in the 1.5 μm range for use with DWDM equipment. The OC48/STM16/DWDM01-16 port units are designed to interface with Lucent WaveStar Optical Line System [OLS] 40G/80G without OTUs (up to 25 km with Lucent's WaveStar OLS 40G/80G).
- The OC48/STM16/POU (LEY80-95/LEY80AE-95AE) port units:16 different passive optic port units provide 16 ITU-compatible OC-48/STM-16 wavelengths in the 1.5 μm range (up to 55 km with the Passive Optics Boxes).
- The OC48/STM16/WDM (LEY101-180/LEY101AE-180AE) port units: 80 different port units provide 80 ITU-compatible in OC-48/STM-16 wavelengths in the 1.5 μm range for use with DWDM equipment. The OC192/STM64/WDM port units are designed to interface with Lucent WaveStar Optical Line System [OLS] 400G without OTUs (up to 25 km with Lucent's WaveStar OLS 400G).

  Important! Four OC48/STM16 port units are required to terminate each 4-fiber OC-48 BLSR/STM-16 MS-SPRing. Only two OC48/STM16 port units are required to terminate a 4-fiber OC-48 BLSR/STM-16 MS-SPRing (open) in an end terminal. Two OC48/STM16 port units are required to terminate each 2-fiber OC-48 BLSR/STM-16 MS-SPRing.

OC-12/STM-4 interfaces

WaveStar BandWidth Manager provides the following types of OC-12/STM-4 interfaces (two different codes):

- Each OC12/STM4/1.3LR2 (LEY13/LEY13AE) port unit terminates two long reach OC-12/STM-4 signals in the 1.3 µm range (up to 15 km).
- Each OC12/STM4/1.3SR2 (LEY14/LEY14AE) port unit terminates two short reach OC-12/STM-4 signals in the 1.3 µm range (up to 51 km).

OC-3/STM-1 interfaces

WaveStar BandWidth Manager provides the following types of OC-3/STM-1 interfaces (two different codes):

- Each OC3/STM1/1.3LR4 (LEY15/LEY15AE) port unit terminates two long reach OC-3/STM-1 signals in the 1.3 µm range (up to 15 km).
- Each OC3/STM1/1.3SR4 (LEY16/LEY16AE) port unit terminates two short reach OC-3/STM-1 signals in the 1.3 µm range (up to 51 km).

DS3EC1/8 interfaces

WaveStar BandWidth Manager provides DS3EC1/8 (LEY17/LEY17AE) port units that enable the system to interface with existing embedded base networks at the standard DS3- or EC-1-rate.

STM1E/4 interfaces

WaveStar BandWidth Manager provides STM1E/4 (LEY43/LEY43AE) port units that enable the system to interface with existing embedded base networks at the standard STM-1e-rate.

Available interfaces

WaveStar BandWidth Manager offers the following SONET/SDH-compatible DS3, EC-1, STM-1e, OC-192/STM-64, OC-48/STM-16, OC-12/STM-4, OC-3/STM-1 interfaces via the corresponding port units listed in the following table.

Table 2-2 Optical and Electrical Interfaces and Corresponding Port Units

Interface	Port Unit	Apparatus Codes
OC-192/STM-64 1.5 μm (extended intermediate reach with strong forward error correction)	OC192/STM64/1.5IR1	LEY69/LEY69AE
OC-192/STM-64 1.5 μm (extended intermediate reach with strong forward error correction)	OC192/STM64/1.5IRS1	LEY97/LEY97AE
OC-192/STM-64 1.5 μm (40 wavelength division multiplexing wavelengths)	OC192/STM64/WDM	LEY201-240/ LEY201-240AE
OC-192/STM-64 1.5 μm (16 passive optical unit wavelengths)	OC192/STM64/POU	LEY284-299/ LEY284-299AE
OC-48/STM-16 1.3 μm (long reach)	OC48/STM16/1.3LR1	LEY7/LEY7AE
OC-48/STM-16 1.5 μm (long reach)	OC48/STM16/1.5LR1	LEY8/LEY8AE
OC-48/STM-16 1.5 μm (16 ITU-compatible wavelengths)	OC48/STM16/DWDM01-16	LEY50-65/ LEY50-65AE
OC-48/STM-16 1.5 μm (16 passive optical unit wavelengths)	OC48/STM16/POU	LEY80-95/ LEY80-95AE
OC-48/STM-16 1.5 μm (80 wavelength division multiplexing wavelengths)	OC48/STM16/WDM	LEY101-180/ LEY101-108AE
OC-12/STM-4 1.3 μm (long reach)	OC12/STM4/1.3LR2	LEY13/LEY13AE
OC-12/STM-4 1.3 μm (short/intermediate reach)	OC12/STM4/1.3SR2	LEY14/LEY14AE
OC-3/STM-1 1.3 μm (long reach)	OC3/STM1/1.3LR4	LEY15/LEY15AE
OC-3/STM-1 1.3 μm (short/intermediate reach)	OC3/STM1/1.3SR4	LEY16/LEY16AE
DS3, EC-1	DS3EC1/8	LEY17/LEY17AE
STM-1e	STM1E/4	LEY43/LEY43AE

4-Fiber BLSR/MS-SPRing Interface

Overview

This section describes the integration of 4-fiber Bidirectional Line-Switched Rings (BLSRs)/Multiplex Section - Shared Protection Rings (MS-SPRings) in WaveStar BandWidth Manager.

Ring definition

A ring is a collection of nodes that form a closed loop, where each node is connected to the adjacent nodes. BLSRs/MS-SPRings provide redundant bandwidth and/or equipment to ensure system integrity in the event of any transmission failure, including a fiber cut or node failure

4-fiber BLSR definition

A 4-fiber OC-48 BLSR includes 96 STS-1 equivalents of service traffic and 96 STS-1 equivalents of protection traffic.

A 4-fiber OC-192 BLSR includes 384 STS-1 equivalents of service traffic and 384 STS-1 equivalents of protection traffic.

4-fiber MS-SPRing definition

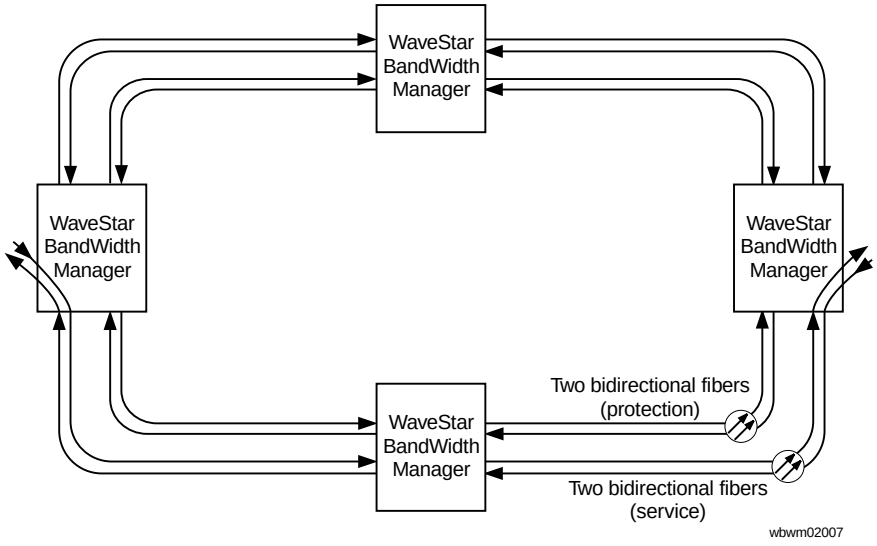
A 4-fiber STM-16 MS-SPRing includes 32 STM-1 equivalents of service traffic and 32 STM-1 equivalents of protection traffic.

A 4-fiber STM-64 MS-SPRing includes 128 STM-1 equivalents of service traffic and 128 STM-1 equivalents of protection traffic.

Closed BLSR/MS-SPRing

Figure 2-15 illustrates normal (non-protection-switched) traffic in a 4-fiber BLSR/MS-SPRing (closed). (Up to 12 additional nodes, for a total of 16 nodes on the ring, could be supported.) Each span of the ring consists of two bidirectional lines: two fibers dedicated to service and two to protection. All WaveStar BandWidth Manager nodes on this 4-fiber BLSR/MS-SPRing are equipped with four port units. Each port unit supports a fiber pair: two fiber pairs for service (East and West) and two fiber pairs for protection (East and West).

Figure 2-15 Normal Traffic Flow in a 4-Fiber BLSR/MS-SPRing (Closed))



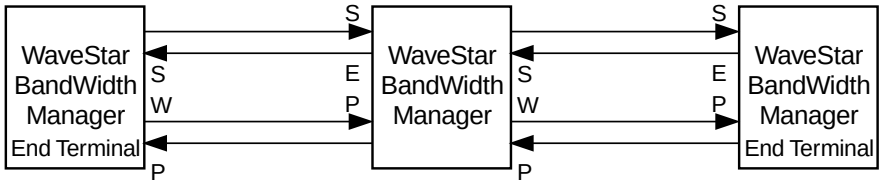
Important! It is recommended that all WaveStar BandWidth Managers in a ring be equipped with the same release of software.

Open BLSR/MS-SPRing

Figure 2-16 illustrates normal (non-protection-switched) traffic in a 4-fiber BLSR/MS-SPRing (open) with two end nodes and one intermediate site. (Up to 13 additional intermediate sites, for a total of 16 nodes on the ring, could be supported.)

From left to right in the figure, the first end node is equipped with two port units in the west direction, the intermediate site is equipped with four port units in both directions: east and west, the second end terminal is equipped with two port units in the east direction. Four-fiber BLSRs/MS-SPRings (open) provide flexible routing arrangements for end-node to end-node traffic, end-node to intermediate-site traffic, and intermediate-site to intermediate-site traffic over a common system.

Figure 2-16 Normal Traffic Flow in a 4-Fiber BLSR/MS-SPRing (Open)



Important! It is recommended that all WaveStar BandWidth Managers in a ring be equipped with the same release of software.

The designation of East and West for the paired service and protection fibers in Figure 2-16 is used illustration purposes. The user determines how the ports on the ring are designated, (for example service/protection, East/West).

4-fiber OC-48 BLSR/STM-16 MS-SPRing interface

The port units are located in either an OC48/STM16 Optical Module or a Mixed Module of a Facility Interface Sub-Shelf (the lower portion of a Universal I/O Shelf or an SDH Universal I/O Shelf). A single WaveStar BandWidth Manager platform is able to terminate multiple 4-fiber OC-48 BLSRs/STM-16 MS-SPRings (maximum of two per Universal I/O Shelf or SHD Universal I/O Shelf), therefore enabling equipment consolidation in central offices.

Closed BLSR/MS-SPRing

In WaveStar BandWidth Manager, four OC48/STM16 port units terminate a 4-fiber OC-48 BLSR/STM-16 MS-SPRing.

Open BLSR/MS-SPRing

In an end node of an open ring, only two OC48/STM16 port units are required to terminate a 4-fiber OC-48 BLSR/STM-16 MS-SPRing (open). In an intermediate node of an open ring, four OC48/STM16 port units are required terminate a 2-fiber OC-48 BLSR/STM-16 MS-SPRing.

4-fiber OC-192 BLSR/STM-64 MS-SPRing interface

The port units are located in an OC192/STM64 Optical Module of a Facility/SWIF Interface Sub-Shelf (the lower portion of a 10G I/O Shelf). A single WaveStar BandWidth Manager platform is able to terminate multiple 4-fiber OC-192 BLSRs/STM-64 MS-SPRings, therefore enabling equipment consolidation in central offices.

Closed BLSR

In WaveStar BandWidth Manager, four OC192/STM64 port units terminate a 4-fiber OC-192 BLSR/STM-64 MS-SPRing.

Open BLSR

In a WaveStar BandWidth Manager end terminal, only two OC192/STM64 port units are required to terminate a 4-fiber OC-192 BLSR/STM-64 MS-SPRing (open). In an intermediate node, four OC48/STM16 port units are required terminate a 2-fiber OC-192 BLSR/STM-64 MS-SPRing.

□

Protection Switching in 4-Fiber BLSRs/MS-SPRings

Overview

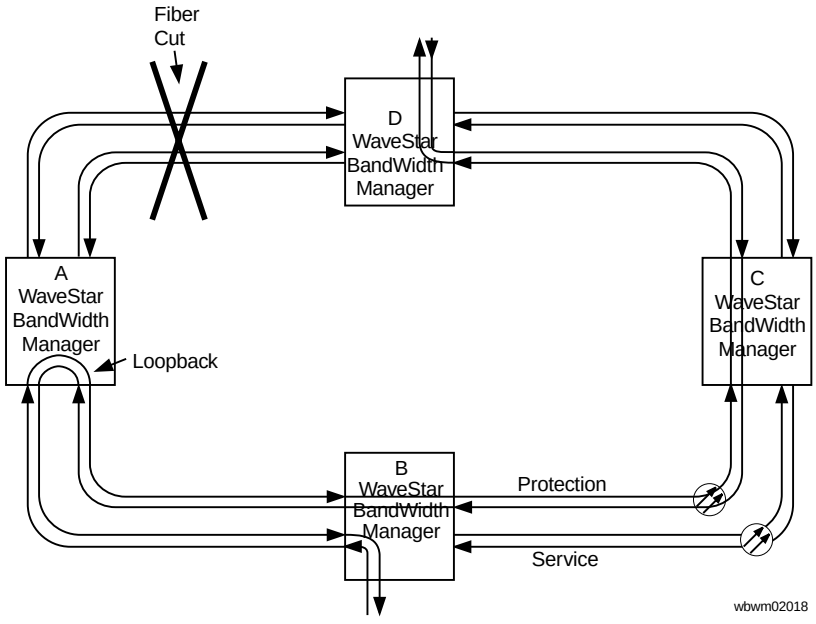
This section describes and illustrates loopback and span protection switching in 4-fiber BLSRs/MS-SPRings.

Protection traffic flow in a loopback

Four-fiber BLSRs/MS-SPRings (closed) use ring loopback protection switching. If the service and protection lines of a single span fail or if a node fails, the nodes adjacent to the failure switch traffic from the failed lines/node to the protection line in the opposite direction. When the fault clears, the traffic automatically switches back (reverts) to the original service line.

Figure 2-17 illustrates a 4-fiber BLSR/MS-SPRing loopback protection switch that results from a fiber cut. The traffic going from Node B to Node D that normally passes through Node A on service capacity is switched at Node A on to the protection capacity leaving Node A in the direction of Node B. The traffic loops back through Nodes B and C to Node D (on the protection fibers) where is dropped.

Figure 2-17 Loopback Protection Switch in a 4-Fiber BLSR/MS-SPRing (Closed)

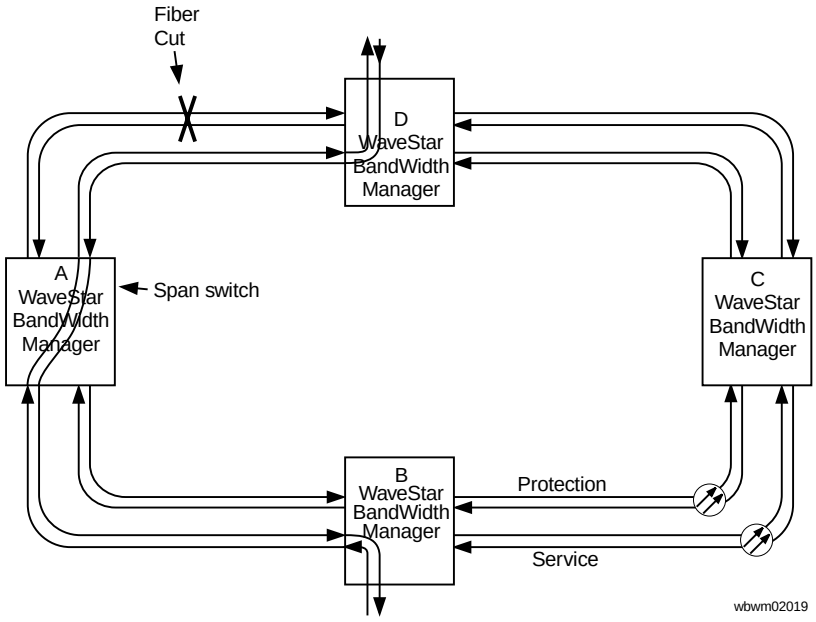


Protection traffic flow in a span switch

Open and closed BLSRs/MS-SPRings use revertive span protection switching. If a fault occurs on a service line, the traffic is switched from that service line to the associated protection line. When the fault clears, the traffic automatically switches back (reverts) to the service line.

Figure 2-18 illustrates a 4-fiber BLSR/MS-SPRing span protection switch that results from a fiber cut. Traffic going from Node B to Node D that normally passes through Node A on service capacity is span switched at Node A on to the protection capacity leaving Node A in the direction of Node D. The traffic is then dropped at Node D (on the protection fibers).

Figure 2-18 Span Protection Switch in a 4-Fiber BLSR/MS-SPRing (Closed)



Important! A 4-fiber BLSR/MS-SPRing can support simultaneous span protection switches.

Protection switching

For catastrophic failures in rings without existing protection switches or extra traffic, service is reestablished on the protection capacity in ≤60 milliseconds (50 ms for the protection switch and 10 ms for the detection of the failure).

Transoceanic protocol

Transoceanic protocol/shortened path shortens the protection path in rings with a circumference greater than 1200 kilometers, greatly reducing the impact of propagation delay on the signal quality. The 4-fiber MS-SPRings (closed) with transoceanic protocol provide redundant bandwidth and/or equipment to ensure system integrity in the event of any transmission or timing failure, including a fiber cut or node failure.

In 4-fiber MS-SPRings with transoceanic protocol, the responsibility for establishing protection paths is distributed to all nodes in the application (rather than just the adjacent nodes as in a loopback switch).

In the event of a failure between two nodes on different sides of the ocean, the nodes adjacent to the failure are still responsible for detecting the failure and initiating the protection switch request. Intermediate nodes in a ring with transoceanic protocol play a different role in a ring switch. In response to the signaling, each node on the ring bridges any signal it sources that has been impacted by the failure and is restorable into the protection line away from the failure. The protection path is significantly shortened.

While the emphasis in the transoceanic protocol is on shortening the length of the protection path, there are also some differences in the ring switching actions. In response to a ring switch request, a switching node would only bridge and switch those services which it is adding/dropping or through connecting.

Transoceanic protocol does not affect span switching.

> **Important!** Transoceanic protocol/shortened loop is intended for MS-SPRings with circumferences greater than 1200 km. Because the switching time for a failure in a transoceanic application is longer than the switching time for a loopback protection switch in a traditional MS-SPRing (less than 60 ms), transoceanic protocol is only beneficial (entire recovery time and signal degradation are reduced) in long haul applications.

Preemptible traffic on protection fibers

In a 4-fiber BLSR/MS-SPRing, two fibers are normally used to carry service traffic and two fibers are reserved for protection. When a protection switch occurs, the protection capacity is used to protect the service traffic. Extra traffic can be provisioned using the protection capacity. However, the extra traffic is unprotected and is preempted (lost) if a protection switch is activated. The extra traffic is reestablished when the protection switch clears.

> **Important!** WaveStar BandWidth Manager supports preemptible protection access on 2-fiber and 4-fiber BLSRs/MS-SPRings.

□

2-Fiber BLSR/MS-SPRing Interface

Overview

This section describes the integration of 2-fiber OC-48 and OC-192 Bidirectional Line-Switched Rings (BLSRs)/STM-16 and STM-64 Multiplex Section - Shared Protection Rings (MS-SPRings) in WaveStar BandWidth Manager.

Ring definition

A ring is a collection of nodes that form a closed loop, where each node is connected to the adjacent nodes. BLSRs/MS-SPRings provide redundant bandwidth and/or equipment to ensure system integrity in the event of any transmission failure, including a fiber cut or node failure.

2-fiber BLSR/ MS-SPRing definition

A 2-fiber BLSR/MS-SPRing is a self-healing (transport is automatically restored after node or fiber failures) ring configuration in which traffic is bidirectional between each pair of adjacent nodes and is protected by redundant bandwidth on the bidirectional lines that interconnect the nodes in the ring. Because traffic flow is bidirectional between the nodes, traffic can be added at one node and dropped at the next without traveling around the entire ring. This capability leaves the spans between other nodes available for additional traffic. Therefore, with distributed traffic patterns, a bidirectional line-switched ring can carry more traffic than the same facilities could carry if configured for a unidirectional path-switched ring. Additionally, you can use the protection capacity to provide unprotected transport for extra traffic when no failures are present. Up to 16 nodes are supported on a ring.

2-fiber BLSR definition

A 2-fiber OC-48 BLSR includes 48 STS-1 equivalents of service traffic and 48 STS-1 equivalents of protection traffic.

A 2-fiber OC-192 BLSR includes 192 STS-1 equivalents of service traffic and 192 STS-1 equivalents of protection traffic.

2-fiber MS-SPRing definition

A 2-fiber STM-16 MS-SPRing includes 16 STM-1 equivalents of service traffic and 16 STM-1 equivalents of protection traffic.

A 2-fiber STM-64 MS-SPRing includes 64 STM-1 equivalents of service traffic and 64 STM-1 equivalents of protection traffic.

2-fiber OC-48 BLSR/ STM-16 MS-SPRing

In WaveStar BandWidth Manager, two OC48/STM16 port units terminate a 2-fiber OC-48 BLSR/STM-16 MS-SPRing. The port units are located in either an OC48/STM16 Optical Module or a Mixed Module of a Facility Interface Sub-Shelf (the lower portion of a Universal I/O Shelf or an SDH Universal I/O Shelf). Using eight OC48/STM16 port units, WaveStar BandWidth Manager is able to terminate up to four 2-fiber OC-48 BLSRs/STM-16 MS-SPRings per I/O Shelf. A single WaveStar BandWidth Manager platform is able to terminate multiple 2-fiber OC-48 BLSRs/STM-16 MS-SPRings, therefore enabling equipment consolidation in central offices.

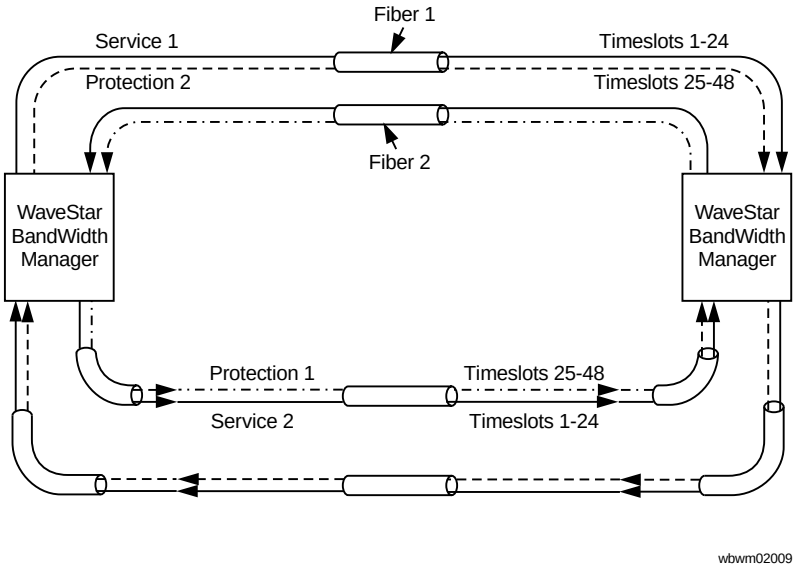
In the event of a fiber or node failure, service is restored by switching traffic from the service capacity of the failed line to the protection capacity in the opposite direction around the ring. (See Figure 2-23 and Figure 2-24.)

2-fiber OC-48 BLSR figure

In a 2-fiber OC-48 BLSR, each bidirectional OC-48 line carries 24 STS-1 equivalent timeslots of service capacity and 24 STS-1 equivalent timeslots of protection capacity.

Figure 2-19 illustrates a 2-fiber OC-48 BLSR.

Figure 2-19 2-Fiber OC-48 BLSR

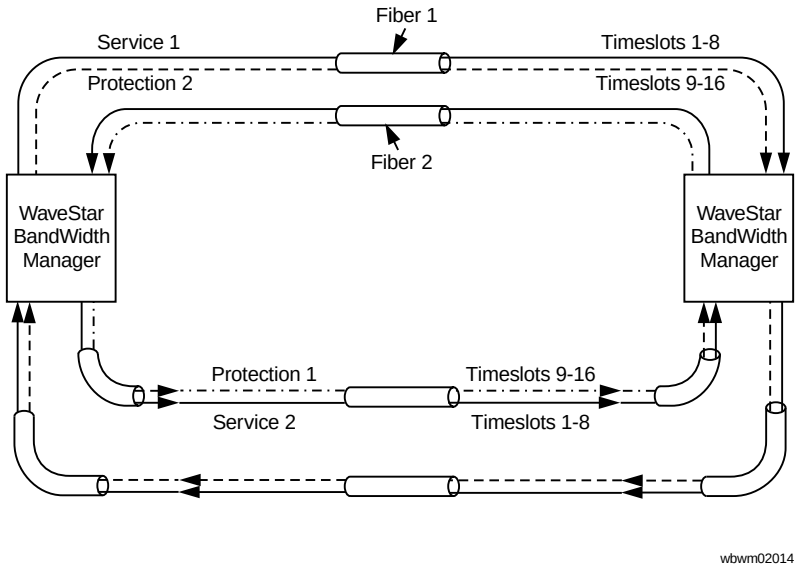


2-fiber STM-16 MS-SPRing figure

In a 2-fiber STM-16 MS-SPRing, each bidirectional STM-16 line carries 8 STM-1 equivalent timeslots of service capacity and 8 STM-1 equivalent timeslots of protection capacity.

Figure 2-20 illustrates a 2-fiber STM-16 MS-SPRing.

Figure 2-20 2-Fiber STM-16 MS-SPRing



2-fiber 0C-192 BLSR/ STM-64 MS-SPRing

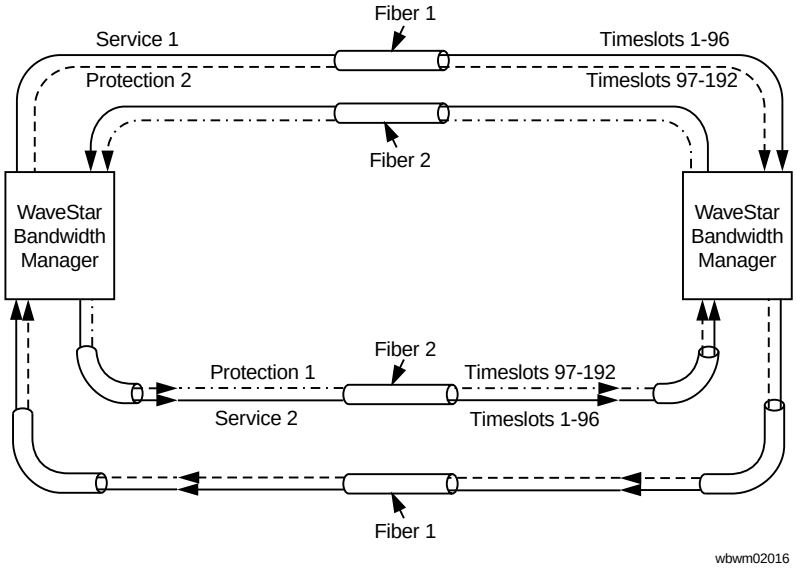
In WaveStar BandWidth Manager, two OC192/STM64 port units terminate a 2-fiber OC-192 BLSR/STM-64 MS-SPRing. The port units are located in an OC192/STM64 Optical Module of a Facility/SWIF Interface Sub-Shelf (the lower portion of a 10G I/O Shelf). Using four OC192/STM64 port units, WaveStar BandWidth Manager is able to terminate up to two 2-fiber OC-192 BLSRs/STM-64 MS-SPRings per 10G I/O Shelf. A single WaveStar BandWidth Manager platform is able to terminate multiple 2-fiber OC-192 BLSRs/STM-64 MS-SPRings, therefore enabling equipment consolidation in central offices.

In the event of a fiber or node failure, service is restored by switching traffic from the service capacity of the failed line to the protection capacity in the opposite direction around the ring. (See Figure 2-23 and Figure 2-24.)

2-fiber OC-192 BLSR example

Figure 2-21 illustrates a 2-fiber OC-192 BLSR. Each bidirectional OC-192 line carries 96 STS-1 equivalent timeslots of service capacity and 96 STS-1 equivalent timeslots of protection capacity.

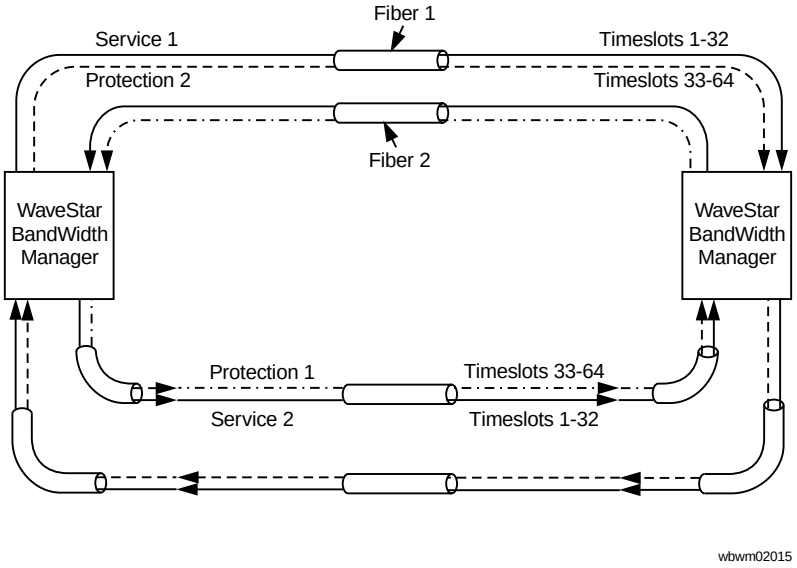
Figure 2-21 2-Fiber OC-192 BLSR



2-fiber STM-64 MS-SPRing example

Figure 2-22 illustrates a 2-fiber STM-16 MS-SPRing. Each bidirectional STM-64 line carries 32 STM-1 equivalent timeslots of service capacity and 32 STM-1 equivalent timeslots of protection capacity.

Figure 2-22 2-Fiber STM-64 MS-SPRing



Protection Switching in 2-Fiber BLSRs/MS-SPRings

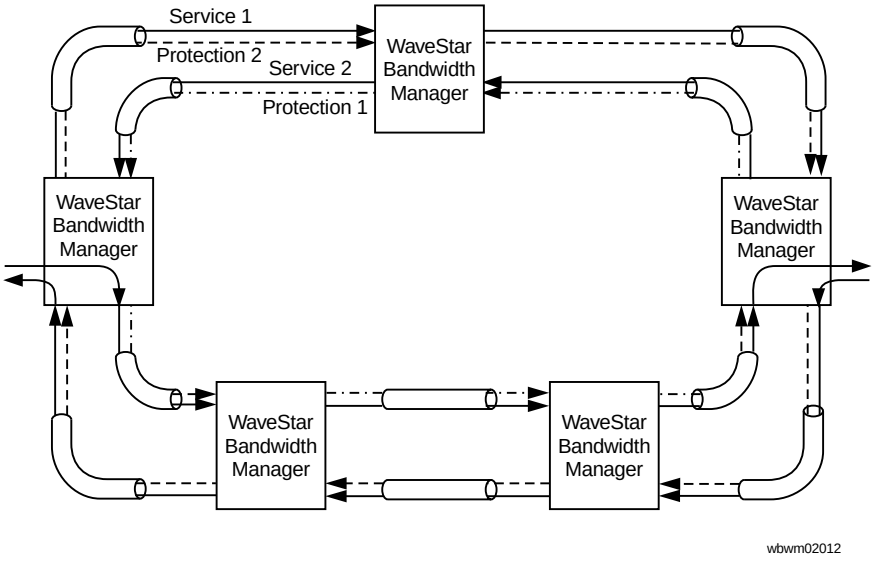
Overview

This section describes and illustrates loopback and span protection switching in 2-fiber BLSRs/MS-SPRings.

2-fiber BLSR/MS-SPRing traffic flow

Figure 2-23 illustrates normal (non-protection-switched) traffic flow in 2-fiber BLSR/MS-SPRing.

Figure 2-23 Normal Traffic Flow in a 2-Fiber BLSR/MS-SPRing



Protection switching

When a line failure triggers a protection switch, the nodes adjacent to the failure switch traffic on to protection capacity. Traffic heading toward the failure is looped back on to the protection capacity traveling away from the failure to reach its destination by traveling the opposite way around the ring. (See Figure 2-24.) For catastrophic failures in rings without existing protection switches or extra traffic, service is reestablished on the protection capacity in ≤60 milliseconds (50 ms for the protection switch and 10 ms for the detection of the failure).

Protection traffic flow

In Figure 2-24, traffic going from Node A to Node C that normally passes through Node E and Node D on “service 2” capacity is switched at Node E on to the “protection 2” capacity of the line leaving Node E in the direction of Node A. The traffic loops back through Nodes A, B, and C to Node D where it is looped back to Node C. Similarly, traffic going from Node C to Node A that normally passes through Node D and Node E on “service 1” capacity is switched at Node D on to the “protection 1” capacity of the line leaving Node D in the direction of

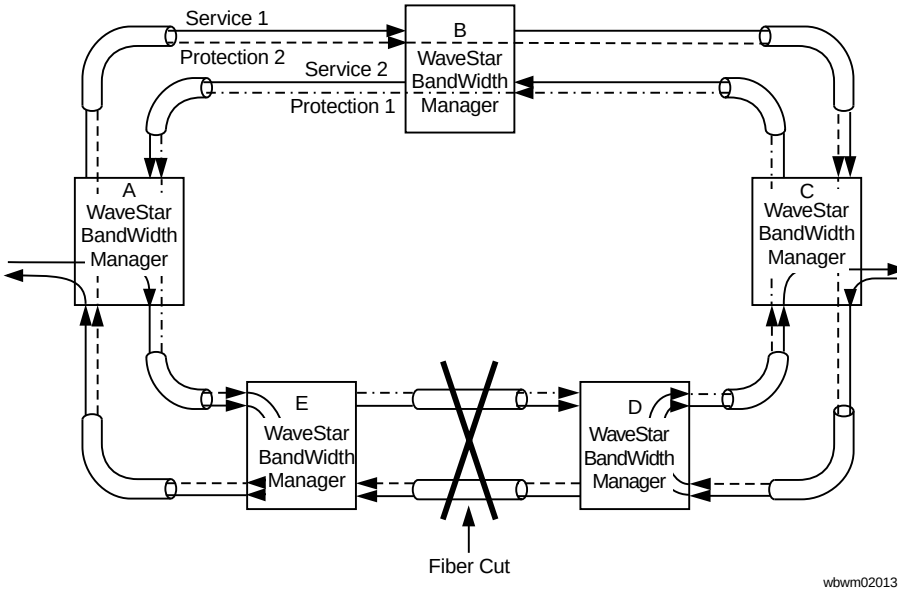
Node C. The traffic loops back through Nodes C, B, and A to Node E where it is looped back to Node A. Note that only the nodes adjacent to the failure perform loopback protection switches.

The same approach is used for a node failure. For example, if Node D fails, Nodes C and E perform loopback protection switches to provide an alternate route for ring traffic.

Fiber cut example

Figure 2-24 illustrates a 2-fiber BLSR/MS-SPRing protection switch that results from a fiber cut.

Figure 2-24 Loopback Protection Switch in a 2-Fiber BLSR/MS-SPRing



Preemptible traffic on protection capacity

In a 2-fiber BLSR/MS-SPRing, both fibers are normally used to carry service and protection traffic. When a protection switch occurs, the protection capacity of the other span is used to protect the service traffic of the failed span. Extra traffic can be provisioned using the protection capacity on the protection span. However, the extra traffic is unprotected and is preempted (lost) if a protection switch is activated. Preempted traffic is reestablished when the protection switch clears.

> **Important!** WaveStar BandWidth Manager, supports preemptible protection access on 2-fiber and 4-fiber BLSRs/MS-SPRings.

□

Unidirectional Path-Switched Rings (UPSRs)

Overview

WaveStar BandWidth Manager supports OC-48 and OC-12 UPSRs. SNCP rings are the SDH functional equivalent to UPSRs.

Definition of an UPSR

A Unidirectional Path-Switched Ring (UPSR) provides path-level protection for STS-N circuits within a physical ring network. The ring is usually comprised of unprotected (0x1) lines at the same OC-N-rate which are connected in a ring topology. Typically all (or most) of the circuits within the ring are path-protected. Each direction of a circuit is bridged onto opposite tributaries at an add node (head-end), passed through intermediate nodes on both sides of the ring, and selected at a drop node (tail-end). Each two-way circuit uses a timeslot of bandwidth all the way around the ring since both a working and protection path are dedicated to it. The term “unidirectional” (the U in UPSR) refers to the fact that every circuit is normally selected from the same direction (for example, either clockwise or counter-clockwise), although the protection may typically be non-revertive. “Path-switched” means that if the working fiber fails, the path switches to the protection fiber.

Benefits

UPSRs operate in an integrated, single-ended fashion, therefore negating the need for complex network-level coordination in order to restore traffic.

UPSR interface

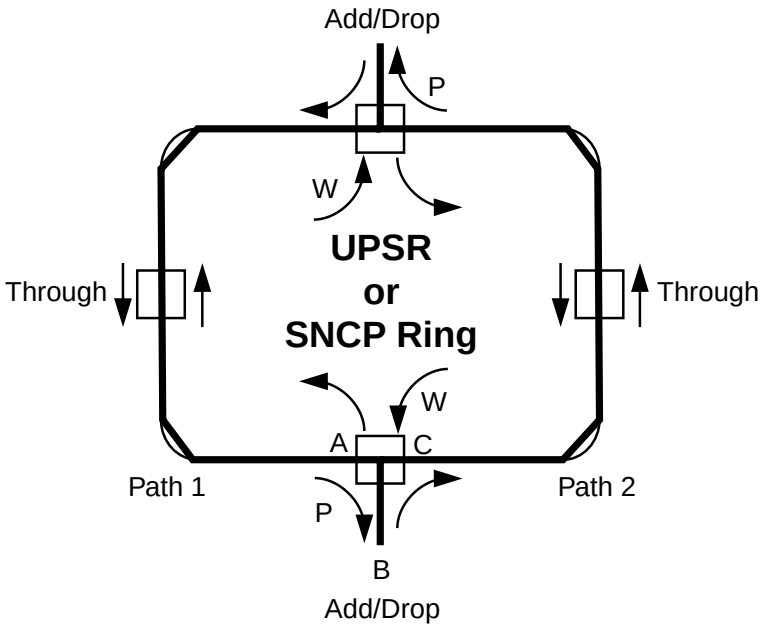
In WaveStar BandWidth Manager, two OC48/STM16 port units terminate an OC-48 UPSR and two OC12/STM4 port units to terminate an OC-12 UPSR. The port units are located in an Optical Module of a Facility Interface Sub-Shelf of a Universal I/O Shelf or a Mixed Module of a Facility Interface Sub-Shelf of an SDH Universal I/O Shelf. A single WaveStar BandWidth Manager platform is able to terminate multiple UPSRs, therefore enabling equipment consolidation in central offices.

UPSR normal traffic flow

Figure 2-25 illustrates normal (non-path-switched) traffic flow in a UPSR.

At the add node (head-end), the incoming traffic is bridged onto the physical ring in opposite directions. At the drop node (tail-end), the path with the highest level of integrity (based on SONET path information) is selected and dropped as outgoing traffic. At intermediate nodes, the traffic is “passed-through” without changing the SONET path information. In normal traffic flow, the working path is selected at the tail-end.

Figure 2-25 Normal Traffic Flow in a UPSR

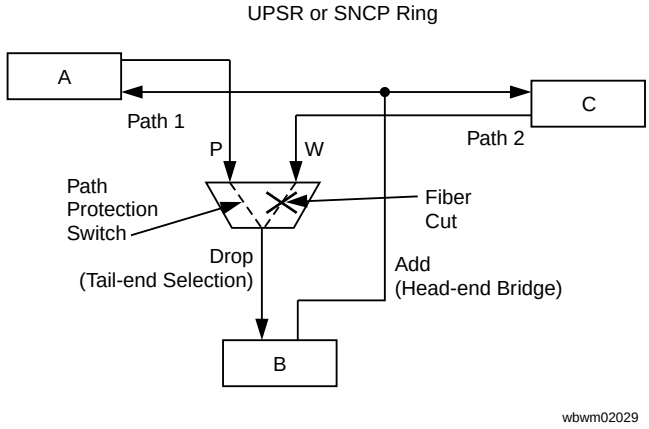


Protection traffic flow in a path switch

Figure 2-26 illustrates a path switched in a UPSR.

In UPSRs, traffic is automatically restored after a node or fiber failure. In this instance, the fiber cut occurring between C and B causes node C to switch from the working path to the protection path; thus maintaining service.

Figure 2-26 Path Switch in a UPSR



Sub-Network Connection Protection (SNCP) Rings

Overview

This section briefly describes the SNCP rings as supported by WaveStar BandWidth Manager. UPSRs are the SONET functional equivalent to SNCP rings.

SNCP

Sub-Network Connection Protection (SNCP) rings provides path-level protection for VC-N circuits that are routed along two diverse paths in a network. First, each direction of the circuit is bridged onto two paths at the add-node (head-end), then carried through multiple facilities of any type, and finally selected from the two paths at the drop-node (tail-end). The path selection at the tail-end may be between any two tributaries from any SDH port. (Because of the different switching criteria used in the two standards, the two ports cannot be a mix of SONET and SDH.) WaveStar BandWidth Manager supports STM-1, STM-4, STM-16, and STM-64 SNCP rings, with ports that are provisioned as 0x1 (unprotected).

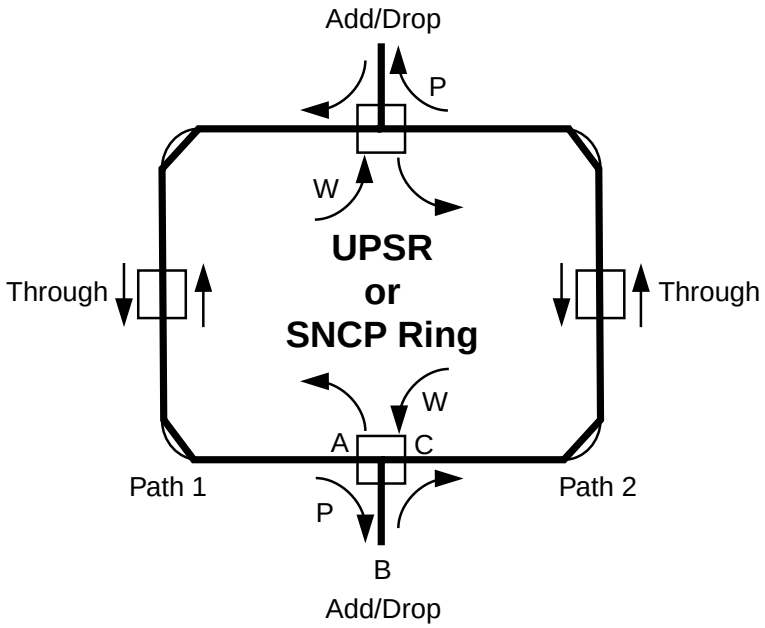
> **Important!** Due to the limitations of the SWIF capacity in the 10G I/O Shelf (384 STS-1/128/STM-1 equivalents), only two port unit slots (TR1 and TR3) can be equipped with OC192/STM64 port units if they are provisioned as an STM-64 SNCP.

SNCP ring normal traffic flow

Figure 2-27 illustrates normal (non-path-switched) traffic flow in a an SNCP ring.

At the add node (head-end), the incoming traffic is bridged onto the physical ring in opposite directions. At the drop node (tail-end), the path with the highest level of integrity (based on SDH path information) is selected and dropped as outgoing traffic. At intermediate nodes, the traffic is “passed-through” without changing the SDH path information. In normal traffic flow, the working path is selected at the tail-end.

Figure 2-27 Normal Traffic Flow in an SNCP Ring



Cross-connections

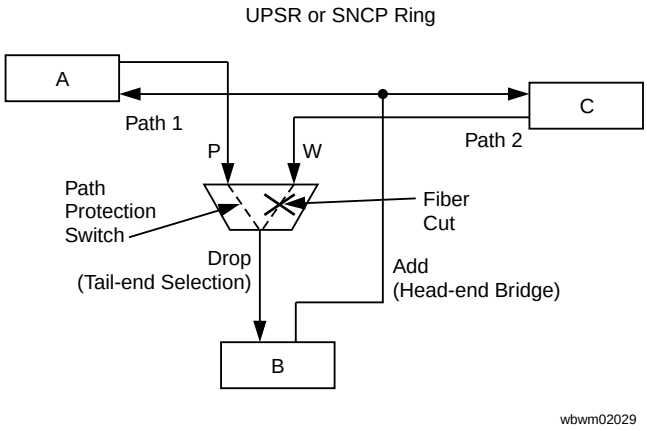
Cross-connections for SNCP applications can be made at all rates supported by the provisioned ports. WaveStar BandWidth Manager supports single node interconnection (where one node in each of two rings is interconnected) via add/drop connections from one SNCP ring to another in the same NE.

Protection traffic flow in a path switch

Figure 2-28 illustrates a path switched in an SNCP ring.

In SNCP rings, traffic is automatically restored after a node or fiber failure. In this instance, the fiber cut occurring between C and B causes node C to switch from the working path to the protection path; thus maintaining service.

Figure 2-28 Path Switch in an SNCP Ring



Path selection

In WaveStar BandWidth Manager, path selection for the SNCP rings occurs on the I/0 Shelves. The algorithm for locating the path selection function in the ingress (input) I/O Shelf or the egress (output) I/O shelf is based on minimizing the intershelf bandwidth utilization for a given path protected cross-connection. Therefore, if both inputs of a path protected cross-connection are located in the same shelf then the path selection function is located in the ingress shelf. Otherwise the path selection function is located in the egress shelf.

Rolling restrictions

Once a path protected cross-connection is established, the location of the path selection function cannot be changed. Requests to roll the input of a path protected cross-connection that would result in moving the path selector based on a violation of the path selection location rules will be denied. However, WaveStar BandWidth Manager supports the ability to convert between path protected cross-connections and point-to-point cross-connections. Using this capability, the user can convert the path protected cross-connection to a point-to-point cross-connection, execute the roll, and then convert the point-to-point cross-connection back to a path protected cross-connection using the new input aid of the roll command as the second (protection) input of the path protected cross-connection.

□

Passive Optic Equipment

Overview

WaveStar BandWidth Manager offers OC192/STM64/POU and OC48/STM16/POU passive optic port units that are compatible with the SONET and SDH standards.

> **Important!** All the information provided for the OC192/STM64 port units is also applicable to the OC192/STM64/POU port units. All the information provided fro the OC48/STM16 port units is also applicable to the OC48/STM16/POU port units.

Description

The Lucent Passive Optics Boxes do not require any additional power, software, or operations support. However, they must be used with the OC48/STM16/POU or OC192/STM64/POU port units. By using the passive optic port units and the Passive Optic Boxes, you are able to increase fiber capacity by a factor of 16.

Port units

The OC192/STM64/POU and OC48/STM16/POU port units are both available in 16 different wavelengths (for a total of 32 passive optic port units). Each set of port units is designated by a 16 different 4-digit numeric suffixes that correspond to the frequency of each optical signal.

Passive Optic Boxes

The Passive Optics Boxes provide a low-cost solution for transmitting large amount of traffic over one fiber. The Passive Optics Boxes are capable of multiplexing and demultiplexing up to 16 colors together for transmission over a single fiber. The boxes are not dependent upon the rate of the signal; OC-192/STM-64 and OC-48/STM-16 wavelengths may be multiplexed by a single box. The boxes do not require any electricity.

Lucent offers the following options for the Passive Optics Boxes:

- 8-Mux/8-Demux Passive Optics Box: A single box is capable of multiplexing 8 colors and demultiplexing eight colors within the same box. Two boxes are required; one on each side of transmission. The two boxes are capable of multiplexing and demultiplexing 8 colors for transmission over a single fiber.
- 16-Mux + 16-Demux Passive Optics Boxes: The 16-Mux box is capable of multiplexing 16 colors and the 16-Demux box is capable of demultiplexing 16 colors. Two boxes are required in each direction, one for multiplexing and one for demultiplexing. Each box is capable of either multiplexing or demultiplexing 16 colors in a for transmission over a single fiber.

Dimensions

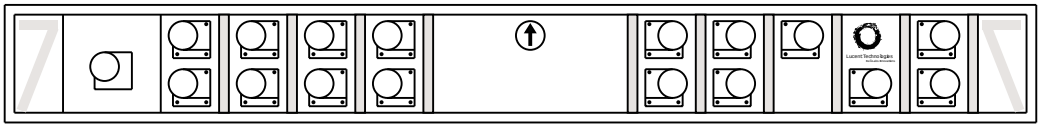
The dimensions of the Passive Optics Boxes are

- 76.2 mm/3 in. high
- 533.4 mm/21 in. wide
- 482.6 mm/19 in. deep

Figure

Figure 2-29 illustrates a Passive Optics Box.

Figure 2-29 Passive Optics Box



nc2510g038

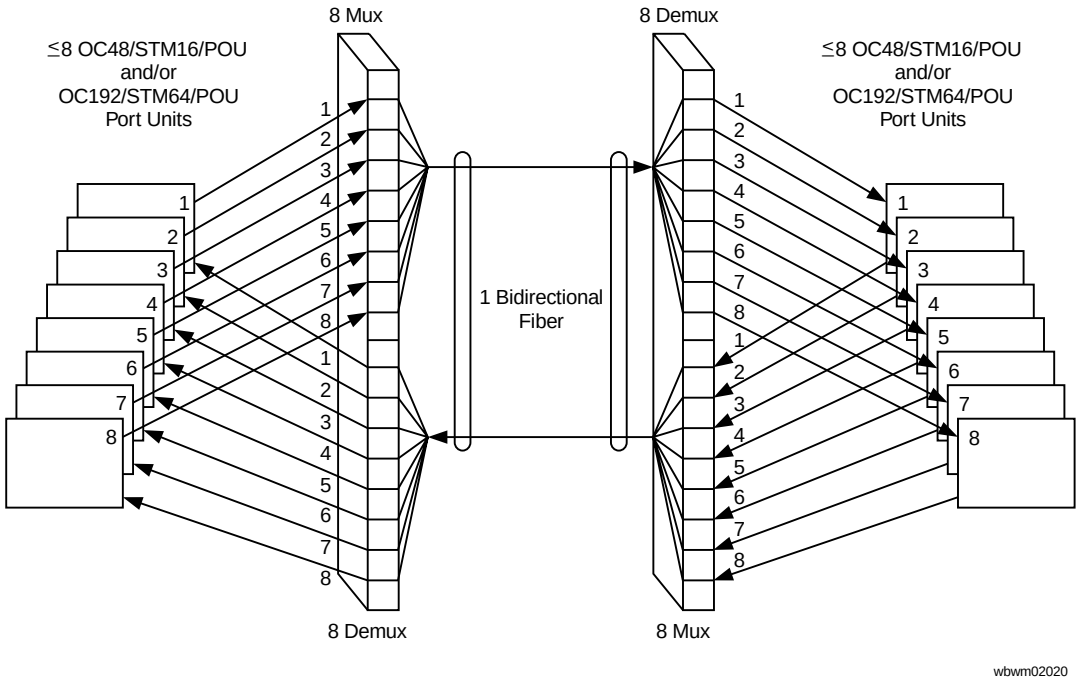
Protection

The passive optic port units support the same protection modes as the standard port units. For example, both sets of passive port units support BLSR/MS-SPRing and 0x1 protection. The OC48/STM16/POU port units also support 1+1 protection.

8-Mux/8-Demux

Figure 2-30 illustrates two 8-Mux/8-Demux Passive Optics Boxes. The eight port units on each side of transmission may be a combination of OC192/STM64/POU and/or OC48/STM16/POU port units. Each passive port unit is equipped with a bidirectional port (both transmit and receive). The fiber between the two Passive Optics Boxes is bidirectional (transmit and receive).

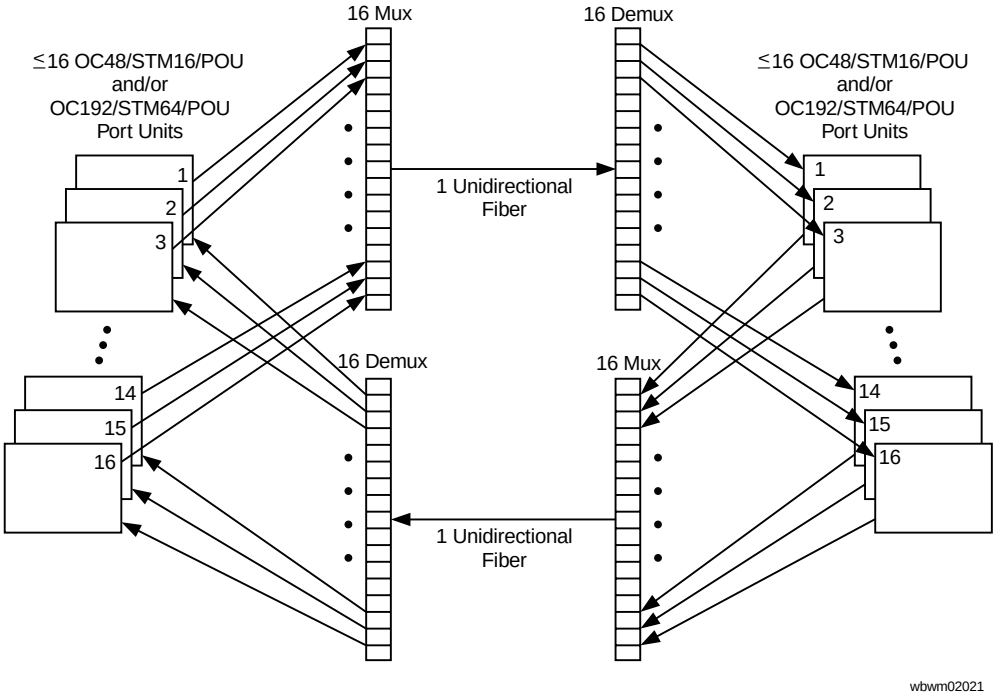
Figure 2-30 8-Mux/8-Demux Passive Optics Box (Functional Diagram)



16-Mux + 16-Demux

Figure 2-31 illustrates four 16-Mux + 16-Demux Passive Optics Boxes; two boxes in each direction. The sixteen port units on each side of transmission may be a combination of OC192/STM64/POU and/or OC48/STM16/POU port units. Each passive port unit is equipped with a bidirectional port (both transmit and receive). The fiber between the two Passive Optics Boxes on the upper portion of the figure is unidirectional in the east direction. The fiber between the two Passive Optics Boxes on the lower portion of the figure is unidirectional in the west direction.

Figure 2-31 16-Mux + 16-Demux Passive Optics Box (Functional Diagram)



OC192/STM64 Port Units

Overview

This section describes the OC192/STM64 port units available in WaveStar BandWidth Manager.

Types of port units

WaveStar BandWidth Manager provides OC-192/STM64 (user-provisionable) interfaces via the following 58 different OC192-STM64 port units:

- OC192/STM64/1.5IR1 port unit (single color)
- OC192/STM64/1.5IRS1 port unit (single color)
- OC192/STM64/POU port units (16 wavelengths)
- OC192/STM64/WDM port units (40 wavelengths)

Important! Four OC192/STM64 port units are required to terminate each 4-fiber OC-192 BLSR/STM-64 MS-SPRing (closed). In a WaveStar BandWidth Manager end node, only two OC192/STM64 port units are required to terminate a 4-fiber OC-192 BLSR/STM-64 MS-SPRing (open). Two OC192/STM64 port units are required to terminate each 2-fiber OC-192 BLSR/STM-64 MS-SPRing.

Location

The OC192/STM64 port units are used in the Facility/SWIF Interface Sub-Shelves (OC192/STM64 Optical Modules) of the 10G I/O Shelves.

Capacity

Each OC192/STM64 port unit supports one bidirectional (transmit and receive) SONET/SDH-compatible OC-192/STM-64 interface.

Transmission rate

The OC192/STM64 port units are capable of receiving and transmitting signals at the standard OC-192/STM-64 transmission rate of 9.953 Gb/s.

Optical port protection

The protection modes for the OC192/STM64 optical port units in WaveStar BandWidth Manager are

- 2-fiber OC-192 BLSR/STM-64 MS-SPRing
- 4-fiber OC-192 BLSR/STM-64 MS-SPRing (open and closed)
- 4-fiber STM-64 MS-SPRing with transoceanic protocol
- STM-64 SNCP
- 1+1 protected (two port units providing 1+1 unidirectional, non-revertive protection)
- 0x1 (unprotected)

Important! Each 2-fiber OC-192 BLSR/STM-64 MS-SPRing provides 192 STS-1/64 STM-1 equivalents of service traffic and 192 STS-1/64 STM-1 equivalents of protection traffic. Each 4-fiber OC-192 BLSR/STM-64 MS-SPRing provides 384 STS-1/128 STM-1 equivalents of service traffic and 384 STS-1/128 STM-1 equivalents of protection traffic.

References

For more information about the OC192/STM64 port units or the possible configurations of the Facility/SWIF Interface Sub-Shelf using OC192/STM64 port units, refer to Chapter 4, “Product Description.”

□

OC192/STM64/WDM Port Units

Overview

This section describes the ability of WaveStar BandWidth Manager to interface with ITU wavelengths and WaveStar™ Optical Line System 400G (WaveStar OLS 400G) without OTUs.

All the information provided for OC192/STM64 port units is also applicable to the OC192/STM64/WDM port units.

> **Important!** The 40 different OC192/STM64/WDM port units are each designated by a 4-digit numeric suffix that corresponds to the frequency of the optical signal.

DWDM

Dense wavelength division multiplexing (DWDM) enables the simultaneous transmission of eight or more signals at different wavelengths over a single fiber. DWDM enables the circuit-carrying capacity of lightguide cable to be increased, thus overcoming fiber exhaust in applications where it is neither operationally nor economically feasible to install new fibers to carry additional traffic.

WaveStar™ OLS 400G definition

WaveStar OLS 400G is part of an optical networking family of products designed to help telecommunications service providers enter a new century of advanced services and revenue generating capabilities. DWDM enables WaveStar OLS 400G to transmit up to 80 wavelengths on a single fiber over longer distances than was previously possible.

Interfacing with WaveStar BandWidth Manager

The 40 OC192/STM64/WDM port units allow WaveStar BandWidth Manager to interface with WaveStar OLS 400G at 40 wavelengths for an equivalent capacity of OC-7680 on a single fiber. The OC192/STM64/WDM port units are used in the Facility/SWIF Interface Sub-Shelf of a 10G I/O Shelf when WaveStar BandWidth Manager interfaces with the WaveStar OLS 400G. The WDM optics create a lower cost WaveStar BandWidth Manager/WaveStar OLS 400G package than is possible with standard optics and Optical Translator Units (OTUs).

Valid applications

If WaveStar BandWidth Manager is interfacing with WaveStar OLS 400G via the OLS 400G-compatible optics (OC192/STM64/WDM port units) with strong forward error correction (SFEC) enabled, then WaveStar BandWidth Managers on either end of the WaveStar OLS 400G span must also be equipped with OC192/STM64/WDM port units with SFEC enabled (no OTUs).

If WaveStar BandWidth Manager is interfacing with a WaveStar OLS 400G equipped with OTUs, then WaveStar BandWidth Manager on either end of the WaveStar OLS 400G span must also be interfacing with a WaveStar OLS 400G equipped with OTUs (no OC192/STM64/WDM port units).

Invalid applications

An application with WaveStar BandWidth Manager equipped with OC192/STM64/WDM port units with SFEC enabled on one end of a WaveStar OLS 400G span, and WaveStar OLS 400G equipped OTUs at the other end of the of WaveStar OLS 400G span is NOT allowed. The scenario described would be an invalid application.

References For more information about WaveStar OLS 400G, refer to WaveStar Optical Line System 400G Applications, Planning, and Ordering Guide (365-370-736).

□

OC48/STM16 Port Units

Overview

This section describes the OC48/STM16 port units available in WaveStar BandWidth Manager.

Types of port units

WaveStar BandWidth Manager provides OC-48/STM-16 (user-provisionable) interfaces via the following 114 different OC48/STM16 port units:

- OC48/STM16/1.3LR1 port unit (single color)
- OC48/STM16/1.5LR1 port unit (single color)
- OC48/STM16/DWDM01-16 port units (16 wavelengths)
- OC48/STM16/POU port units (16 wavelengths)
- OC48/STM16/WDM port units (80 wavelengths)

Important! Four OC48/STM16 port units are required to terminate each 4-fiber OC-48 BLSR/STM-16 MS-SPRing (closed). In a WaveStar BandWidth Manager end node, only two OC48/STM16 port units are required to terminate a 4-fiber OC-48 BLSR/STM-16 MS-SPRing (open). Two OC48/STM16 port units are required to terminate each 2-fiber OC-48 BLSR/STM-16 MS-SPRing.

Location

The OC48/STM16 port units are used in the Facility Interface Sub-Shelves (OC48/STM16 Optical Modules and Mixed Modules) of the Universal I/O Shelves and in the Facility Interface Sub-Shelves of the SDH Universal I/O Shelves (Mixed Modules). Because the OC48/STM16 port units are double-width port units, they must be installed in two adjacent slots.

Important! The possible adjacent slots for OC48/STM16 port units are slots 1/2, 3/4, 5/6, 7/8, 9/10, 11/12, 13/14, 15/16. The adjacent slots must have an odd number on the left. For example, an OC48/STM16 port unit can not be installed in slots 2/3.

Capacity

Each OC48/STM16 port unit supports one bidirectional (transmit and receive) SONET/SDH-compatible OC-48/STM-16.

Transmission rate

The OC48/STM16 port units are capable of receiving and transmitting signals at the standard OC-48/STM-16 transmission rate of 2488.32 Mb/s.

Optical port protection

The protection modes for the OC48/STM16 optical port units in WaveStar BandWidth Manager are

- 2-fiber OC-48 BLSR/STM-16 MS-SPRing
- 4-fiber OC-48 BLSR/STM-16 MS-SPRing (open or closed)
- OC-48 UPSR
- STM-16 SNCP
- 1+1 protected (two port units providing full 1+1 unidirectional or bidirectional, non-revertive protection)
- 0x1 (unprotected)

Important! Each 2-fiber OC-48 BLSR/STM-16 MS-SPRing provides 48 STS-1/16 STM-1 equivalents of service traffic and 48 STS-1/16 STM-1 equivalents of protection traffic. Each 4-fiber OC-48 BLSR/STM-16 MS-SPRing provides 96 STS-1/32 STM-1 equivalents of service traffic and 96 STS-1/32 STM-1 equivalents of protection traffic.

References

For more information about the OC48/STM16 port units or the possible configurations of the Facility Interface Sub-Shelf using OC48/STM16 port units, refer to Chapter 4, “Product Description.”

□

OC48/STM16/DWDM Port Units

Overview

This section describes the ability of WaveStar BandWidth Manager to interface with ITU wavelengths and WaveStar™ Optical Line System 40G/80G (WaveStar OLS 40G/80G) without OTUs.

All the information provided for is also applicable to the OC48/STM16/DWDM01-16 port units.

DWDM

Dense wavelength division multiplexing (DWDM) enables the simultaneous transmission of eight or more signals at different wavelengths over a single fiber. DWDM enables the circuit-carrying capacity of lightguide cable to be increased, thus overcoming fiber exhaust in applications where it is neither operationally nor economically feasible to install new fibers to carry additional traffic.

WaveStar™ OLS 40G/80G definition

WaveStar OLS 40G/80G is part of an optical networking family of products designed to help telecommunications service providers enter a new century of advanced services and revenue generating capabilities. DWDM enables WaveStar OLS 40G/80G to transmit up to 16 wavelengths on a single fiber over longer distances than was previously possible.

Interfacing with WaveStar BandWidth Manager

The 16 OC48/STM16/DWDM01-16 port units allow WaveStar BandWidth Manager to interface with WaveStar OLS 40G/80G at 16 wavelengths for an equivalent capacity of OC-768/STM-256 on a single fiber. The OC48/STM16/DWDM port units are used in the Facility Interface Sub-Shelf in when WaveStar BandWidth Manager interfaces with the WaveStar OLS 40G/80G. The DWDM optics create a lower cost WaveStar BandWidth Manager/WaveStar OLS 40G/80G package than is possible with standard optics and OTUs.

> **Important!** In OC48/STM16/DWDM01-16, 01-16 represents Wavelengths 1, 2,...16.

References

For more information about WaveStar OLS 40G, refer to WaveStar Optical Line System 40G Applications, Planning, and Ordering Guide (365-575-380).

For more information about WaveStar OLS 80G, refer to WaveStar Optical Line System 80G Applications, Planning, and Ordering Guide (365-575-370).

□

OC48/STM16/WDM Port Units

Overview

This section describes the ability of WaveStar BandWidth Manager to interface with ITU wavelengths and WaveStar™ Optical Line System 400G (WaveStar OLS 400G) without OTUs.

All the information provided for OC48/STM16 port units is also applicable to the OC48/STM16/WDM port units.

> **Important!** The 80 different OC48/STM16/WDM port units are each designated by a 4-digit numeric suffix that corresponds to the frequency of the optical signal.

DWDM

Dense wavelength division multiplexing (DWDM) enables the simultaneous transmission of two or more signals at different wavelengths over a single fiber. DWDM enables the circuit-carrying capacity of lightguide cable to be increased, thus overcoming fiber exhaust in applications where it is neither operationally nor economically feasible to install new fibers to carry additional traffic.

WaveStar™ OLS 400G definition

WaveStar OLS 400G is part of an optical networking family of products designed to help telecommunications service providers enter a new century of advanced services and revenue generating capabilities. DWDM enables WaveStar OLS 400G to transmit up to 80 wavelengths on a single fiber over longer distances than was previously possible.

Interfacing with WaveStar BandWidth Manager

The 80 OC48/STM16/WDM port units allow WaveStar BandWidth Manager to interface with WaveStar OLS 400G at 80 wavelengths for an equivalent capacity of OC-3840/STM-1280 on a single fiber. The OC192/STM64/WDM port units are used in the Facility/SWIF Interface Sub-Shelf of a 10G I/O Shelf when WaveStar BandWidth Manager interfaces with the WaveStar OLS 400G. The WDM optics create a lower cost WaveStar BandWidth Manager/WaveStar OLS 400G package than is possible with standard optics and OTUs.

References

For more information about WaveStar OLS 400G, refer to WaveStar Optical Line System 400G Applications, Planning, and Ordering Guide (365-370-736).

□

OC12/STM4 Port Units

Overview

This section describes the OC12/STM4 port units available in WaveStar BandWidth Manager.

Types of port units

The OC12/STM4 port units are available in two different codes. The OC12/STM4/1.3SR2 port unit operates in the 1.3 µm range for short and intermediate reach signals while the OC12/STM4/1.3LR2 port unit operates in the 1.3 µm range for long reach signals.

Location

The OC12/STM4 port units are used in the Facility Interface Sub-Shelves (OC12/STM4 Optical Modules and Mixed Modules) of the Universal I/O Shelves and in the Facility Interface Sub-Shelves of the SDH Universal I/O Shelves (Mixed Modules).

Capacity

Each OC12/STM4 port unit supports two bidirectional (transmit and receive) SONET/SDH- compatible OC-12/STM-4.

Transmission rate

The OC12/STM4 port units are capable of receiving and transmitting signals at the standard OC-12/STM-4 transmission rate of 622.08 Mb/s.

Optical port protection

The protection mode for the OC12/STM4 port units in WaveStar BandWidth Manager may be provisioned as

- OC-12 UPSR
- STM-4 SNCP
- OC-12: 1+1 protected (two port units providing 1+1 unidirectional, non-revertive protection)
- STM-4: 1+1 protected (two port units providing full 1+1 unidirectional or bidirectional, non-revertive, or bidirectional, revertive protection)
- 0x1 protected (unprotected)

References

For more information about the OC12/STM4 port units or the possible configurations of the Facility Interface Sub-Shelf using OC12/STM4 port units, refer to Chapter 4, “Product Description.”

□

OC3/STM1 Port Units

Overview

This section describes the OC3/STM1 port units available in WaveStar BandWidth Manager.

Types of port units

The OC3/STM1 port units are available in two different codes. The OC3/STM1/1.3SR4 port unit operates in the 1.3 µm range for short and intermediate reach signals while the OC3/STM1/1.3LR4 port unit operates in the 1.3 µm range for long reach signals.

Location

The OC3/STM1 port units are used in the Facility Interface Sub-Shelves (OC3/STM1 Optical Modules and Mixed Modules) of the Universal I/O Shelves and in the Facility Interface Sub-Shelves of the SDH Universal I/O Shelves (Mixed Modules).

Capacity

Each OC3/STM1 port unit supports four bidirectional (transmit and receive) SONET/SDH-compatible OC-3/STM-1 interfaces.

Transmission rate

The OC3/STM1 port units are capable of receiving and transmitting signals at the standard OC-3/STM-1 transmission rate of 155.52 Mb/s.

Optical port protection

The protection mode for the OC3/STM1 port units in WaveStar BandWidth Manager may be provisioned as

- STM-1 SNCP
- OC-3: 1+1 protected (two port units providing 1+1 unidirectional, non-revertive protection)
- STM-1: 1+1 protected (two port units providing full 1+1 unidirectional or bidirectional, non-revertive, or bidirectional, revertive protection)
- 0x1 protected (unprotected)

References

For more information about the OC3/STM1 port units or the possible configurations of the Facility Interface Sub-Shelf using OC3/STM1 port units, refer to Chapter 4, “Product Description.”

□

DS3EC1/8 Port Units

Overview

This section describes the electrical interface provided by the DS3EC1/8 port units available in WaveStar BandWidth Manager.

DS3EC1/8 port units

WaveStar BandWidth Manager is capable of interfacing with existing embedded base networks at the standard DS3-rate or EC-1-rate (user-provisionable) via the DS3EC1/8 port units.

> **Important!** A DS3EC1 Module can support port units that are provisioned for DS3 and/or EC-1 signals. However, all 8 ports on any given port unit must be provisioned as DS3 or EC-1 signals. (A single port unit cannot be provisioned with both DS3 and EC-1 ports.)

Capacity

Each DS3EC1/8 port unit supports eight bidirectional DS3 or EC-1 ports (one transmit and one receive per port).

Transmission rate

The DS3EC1/8 port units are capable of receiving and transmitting signals at the DS3-rate or EC-1-rate. The transmission rate of

- A DS3 signal is 44.736 Mb/s ±895 b/s (±20 ppm)
- An EC-1 signal is 51.840 Mb/s ±1037 b/s (±20 ppm)

Location

The DS3EC1/8 port units are used in the Facility Interface Sub-Shelves (DS3EC1 Electrical Modules and Mixed Modules) of the Universal I/O Shelves. Because only six DS3EC1/8 port units are required to terminate 48 DS3 or EC-1 signals, slots 7, 8, 9, and 10 are not used for DS3EC1/8 port units. Therefore, even though there are 4 empty slots, an Electrical Module that contains 13 (12 working + 1 protection) DS3EC1/8 port units is considered to be fully-equipped.

> **Important!** Slots 7, 8, 9, and 10 cannot be used for the DS3EC1/8 port units.

DS3 signal

The DS3EC1/8 port unit supports the following DS3 (Digital Signal, Level 3) signal types:

- M23 multiplex formatted DS3 signal
- Asynchronous C-bit formatted DS3 signal
- Unframed clear channel DS3-rate signal (non-standard)

Important! M23-format is sometimes referred to as M13-format without C-bit parity.

Electrical port protection

WaveStar BandWidth Manager provides 1xN (N≤12) equipment protection for the DS3EC1/8 port units.

1xN equipment protection

For 1xN protection, all working DS3EC1/8 port units on a single shelf are protected by one DS3EC1/8 protection port unit. If one port of the eight possible being carried by a single circuit pack shows a defect, all signals on that pack are transferred to the protection pack.

Important! A SWITCH/DS3EC1 circuit pack is required for 1xN protection.

Provisioning 1xN protection

1xN equipment protection is normally revertive with a provisionable Wait to Restore (WTR) interval. In the case of revertive protection switching, a provisionable lock-out period is provided to keep active and stand-by equipment from “bouncing” back and forth due to intermittent failures.

Important! If DS3EC1/8 port units are provisioned as 1xN protected in a Mixed Module, slot 16 must either be equipped with a DS3EC1/8 port unit or left blank.

Unprotected operation

If the protection circuit pack is removed from the shelf, all DS3EC1/8 port units collocated in the same Facility Interface Sub-Shelf are provisioned as unprotected.

Benefits

In an SDH network, customers can use the DS3EC1/8 port units in gateway applications. DS3 signals can be brought into the WaveStar BandWidth Manager via the DS3EC1/8 port units, cross-connected through the switch fabric, and then exit the WaveStar BandWidth Manager via an STM-N port unit.

The DS3 and EC-1 electrical interfaces allow WaveStar BandWidth Manager to provide customers with an interface to embedded base networks. Customers can access existing capacity in older network elements, such as asynchronous and SONET lightwave systems and wideband digital cross-connect systems, while taking advantage of the new technology available in WaveStar BandWidth Manager.

□

STM1E/4 Port Units

Overview

This section describes the electrical interface provided by the STM1E/4 port units available in WaveStar BandWidth Manager.

STM1E/4 port units

WaveStar BandWidth Manager is capable of interfacing with existing embedded base networks at the standard STM-1e-rate via the STM1E/4 port units.

Capacity

Each STM1E/4 port unit supports four bidirectional STM-1e ports (one transmit and one receive per port).

Transmission rate

The STM1E/4 port units are capable of receiving and transmitting signals at the STM-1e-rate of 155.52 Mb/s (±20 ppm).

Location

The STM1E/4 port units are used in the Facility Interface Sub-Shelf (STM1e Electrical Modules and Mixed Modules) of the SDH Universal I/O Shelves. The SDH Universal I/O Shelf accepts STM1E/4 port units in slots 1-4 and 13-16. Any slot may be equipped with OC48/STM16, OC12/STM4, or OC3/STM1 port units.

> **Important!** If STM1E/4 port units are provisioned as 1xN protected in a Mixed Module, slot 16 must either be equipped with an STM1E/4 port unit or left blank.
> Slots 5-8 and 9-12 cannot be equipped with STM1E/4 port units.

Electrical port protection

WaveStar BandWidth Manager provides 1xN (N≤8) equipment protection for the STM1E/4 port units.

1xN equipment protection

For 1xN protection, all working STM1E/4 port units on a single shelf are protected by one STM1E/4 protection port unit. If one port of the four possible being carried by a single port unit shows a defect, all signals on that pack are transferred to the protection pack.

> **Important!** A SWITCH/STM1E4 circuit pack is required for 1xN protection.

Provisioning 1xN protection

1xN equipment protection is normally revertive with a provisionable Wait to Restore (WTR) interval. In the case of revertive protection switching, a provisionable lock-out period is provided to keep active and stand-by equipment from “bouncing” back and forth due to intermittent failures.

Unprotected operation

If the protection circuit pack is removed from the shelf, all STM1E/4 port units collocated in the same Facility Interface Sub-Shelf are provisioned as unprotected.

Benefits

In SDH networks, the STM1E/4 port units provide an SDH-compatible interconnection to other SDH NEs that require electrical connectivity. Customers can access existing capacity in older network elements, while taking advantage of the new technology available in WaveStar BandWidth Manager.

In a SONET network, customers can use the STM1E/4 port units in gateway applications. SDH STM-1e signals can be brought into the WaveStar BandWidth Manager via the STM1E/4 port units, cross-connected through the switch fabric, and then exit the WaveStar BandWidth Manager via an OC-N port unit.

The STM1E/4 port units are also essential for the AU-3/AU-4 adaptation that provides a key gateway function that supports global interworking.

□

Flexible Interface Mixing

Overview

This section describes how WaveStar BandWidth Manager integrates optical and electrical port units within the same shelf.

Universal interface slot

The unique characteristic of a universal slot is its ability to accept multiple types of port units that are available in WaveStar BandWidth Manager.

Universal I/O Shelf

Each Facility Interface Sub-Shelf (Universal I/O Shelf) contains 16 universal interface slots (slots 1-8 and 9-16 on the designation label strip). The Universal I/O Shelves support DS3 and EC-1 electrical interfaces, and OC-48/STM-16, OC-12/STM-4, and OC-3/STM-1 optical interfaces.

> **Important!** The DS3EC1/8 port units can only be placed in slots 1-6 and 11-16.

SDH Universal I/O Shelf

Each Facility Interface Sub-Shelf (SDH Universal I/O Shelf) contains 16 universal interface slots (slots 1-8 and 9-16 on the designation label strip). The SDH Universal I/O Shelves support STM1E/4 electrical interfaces, and OC-48/STM-16, OC-12/STM-4, and OC-3/STM-1 optical interfaces.

> **Important!** The STM1E/4 port units can only be placed in slots 1-4 and 13-16. In future release, eight-port STM1e port units will also be accepted by these slots.

Facility interface slot

WaveStar BandWidth Manager features facility interface slots in the Facility/SWIF Interface Shelves (the lower portion of a 10G I/O Shelf). The four facility interface slots (slots TR1, TR2, TR3, and TR4 on the designation label strip) accept OC192/STM64 port units.

> **Important!** The supported interfaces for a 10G I/O Shelf are the OC-192/STM-64 optical interfaces.

Future interfaces The universal interface slots are designed to accept additional interface types provided by new port units as they become available in future releases of this product. This feature makes upgrading a platform to include the new interfaces types very economical and flexible.

References To see figures illustrating the designation label strip and possible configurations of the Facility Interface Sub-Shelf using electrical and optical interfaces, refer to Chapter 4, “Product Description.”

□

Synchronization

Overview WaveStar BandWidth Manager provides SONET and SDH synchronization and timing features.

Reference Refer to Chapter 6, System Planning and Engineering for information about WaveStar BandWidth Manager synchronization and timing features.

□

OAM&P Features

Overview

This section describes operations features including the hardware and software user interfaces that control administration, maintenance, and provisioning activities.

Two-tier craft interface

Maintenance procedures are built on two tiers of system information and control: the visible/audible alarm indicators and the craft interface terminal (CIT).

Visible/audible alarm indicators

Visible alarm indicators provide the first maintenance tier by visibly or audibly notifying the user of service affecting conditions that may require maintenance tasks (for example, circuit pack replacement).

WaveStar CIT

The second maintenance tier uses the graphical user interface (GUI) on the WaveStar CIT to retrieve detailed information about alarms and status, system configuration for local and remote terminals and performance monitoring. The WaveStar CIT is also used to provision circuit packs.

Operations interfaces

Operations interfaces are any hardware interfaces, such as equipment LEDs, user panel, WaveStar CIT, office alarms, that provide the user with visible or audible indications of the system behavior or control. Operations interfaces may also include LAN connections that provide communication with remote OS systems.

References

For more information about operations features, refer to Chapter 5, “Operations, Administration, Maintenance, and Provisioning.”

□

Administration

Overview

The management functions for the administration of WaveStar BandWidth Manager are

- Security
- Equipment inventory

Security

WaveStar BandWidth Manager provides for secure system access by means of a three-tier mechanism.

Equipment inventory

Each network element provides an inventory of all circuit packs that includes equipment type, version, and serial number. Inventory information is available via user request.

References

For more information about administration features, refer to Chapter 5, “Operations, Administration, Maintenance, and Provisioning.”

□

Maintenance

Overview

This section introduces the maintenance features available in WaveStar BandWidth Manager.

Definition

Maintenance is the platform's capability to continuously monitor its equipment and the signals that it carries in order to notify the user of any current or potential problems. This enables the user to take appropriate proactive (preventative) or reactive (corrective) action.

Types of maintenance

Maintenance information and control are provided by

- Maintenance signals
- Fault detection, isolation, and reporting
- Provisioning consistency audits
- Loopbacks and tests
- Limited test access
- Protection switching
- Performance monitoring
- Reports

References

For more information about maintenance features, refer to Chapter 5, "Operations, Administration, Maintenance, and Provisioning."

□

Provisioning

Overview

This section introduces the provisioning features for WaveStar BandWidth Manager.

Definition

Provisioning refers to assigning values to parameters used for specific functions by network elements, (for example, installing and removing cross-connections). The values of the provisioned parameters determine many operating characteristics of a network element.

Types of provisioning

The types of provisioning supported in WaveStar BandWidth Manager are

- Local or remote provisioning
- Installing and removing cross-connections
- Preprovisioning circuit packs and port units
- Circuit pack and port unit replacement provisioning
- Original value provisioning
- Port modes

References

For more information about provisioning features, refer to Chapter 5, “Operations, Administration, Maintenance, and Provisioning.”

□



3 Applications

Overview

Purpose

The information in this chapter is designed to help you evaluate the benefits of the WaveStar BandWidth Manager 4608/1536 platform in your existing or planned network environment.

This chapter illustrates how WaveStar BandWidth Manager enables central office equipment consolidation. The cost savings that WaveStar BandWidth Manager enables are also explained and illustrated.

This chapter also provides detailed descriptions about the applications available with WaveStar BandWidth Manager.

Contents The following topics are discussed in this chapter:

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Central Office Consolidation and Bandwidth Management

Overview

This section discusses the equipment consolidation and OAM&P simplification realized with WaveStar BandWidth Manager.

Typical central office

Figure 3-1 illustrates a typical central office architecture that requires manual cross-connect signal management and separate network elements for each function in the office.

LGX/DSX

In SONET systems, lightguide cross-connect/digital signal cross-connect (LGX/DSX) patch panels are often used to connect various pieces of equipment in a central office.

ODF/DDF

In SDH systems, optical distribution frames/digital distribution frames (ODF/DDF) patch panels are often used to connect various pieces of equipment in a central office.

ADMs

The interoffice facilities network, in the central office in Figure 3-1 consists of multiple OC-192/STM-64 and OC-48/STM-16 Add/Drop Multiplexers (ADMs). These ADMs terminate on LGX or ODF panels, which must be managed manually within the central office. The addition of WaveStar BandWidth Manager in the central office reduces a large percentage of the LG/DSX or ODF/DDF panels.

Expense in a typical central office

The external interconnection cabling and the signal processing/formatting that must be transmitted among the discrete network elements illustrated in Figure 3-1 are extensive and costly.

Reduced reliability

Because multiple interoffice and access ring NEs in a typical central office require numerous interconnections and network element managers, a traditional network is less reliable. The back-to-back cabling associated with interoffice and access ring NEs increases the risk of failures.

High maintenance cost

The manual cross-connections (LGX/DSX or ODF/DDF panels) require constant provisioning and rearrangement. Multiple types of connections are required to accommodate various service rates.

Trouble reports

A large percentage of all trouble reports for DS1 or higher-rate services (SONET) or low order traffic, for example, PDH rates (SDH) are linked directly to the intra-office interconnections between these discrete network elements.

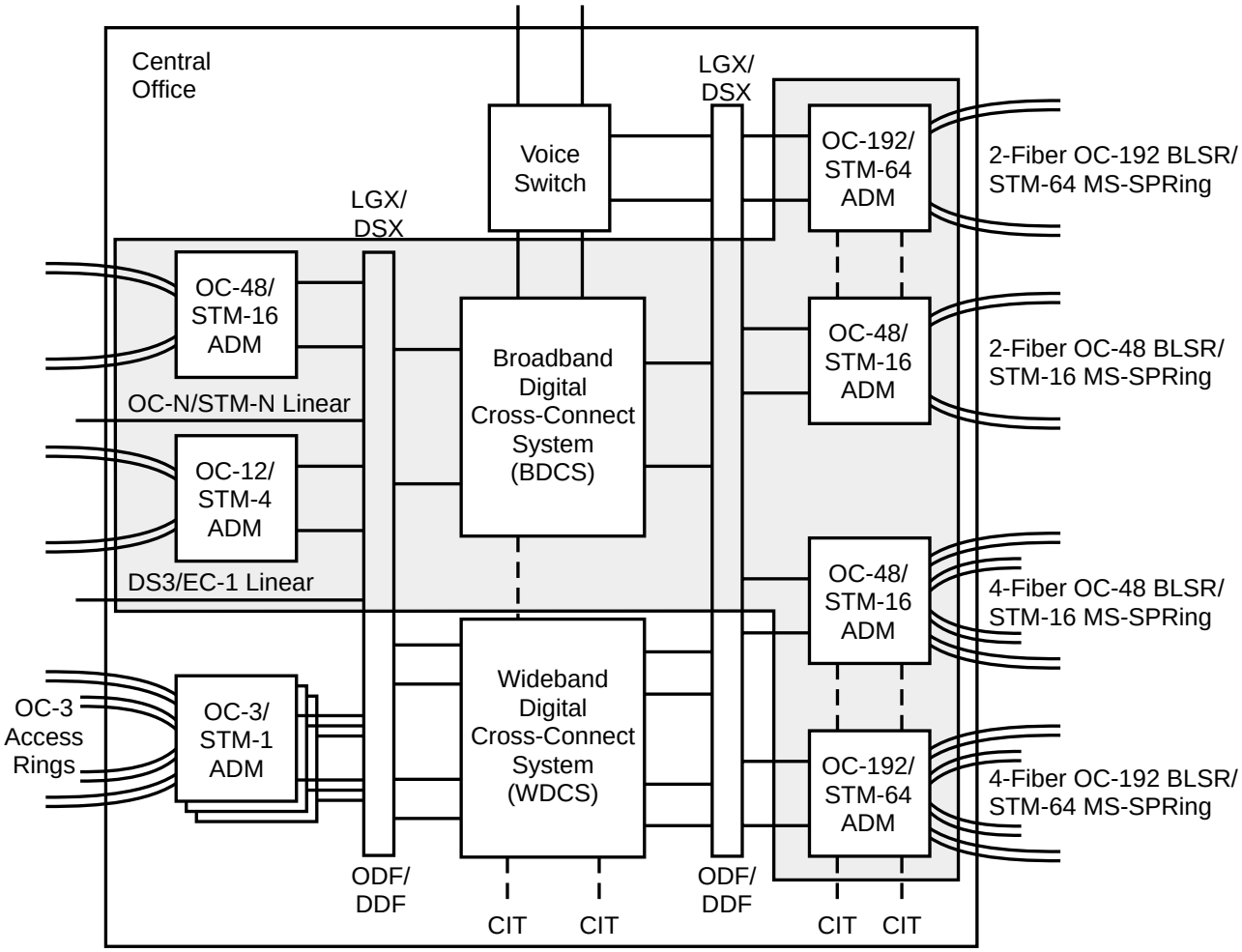
Management of service

The management of OAM&P services across these discrete elements rapidly becomes difficult and error-prone. The multiple discrete NEs each require their own CIT.

CO without WaveStar BandWidth Manager

Figure 3-1 illustrates a typical central office without WaveStar BandWidth Manager. Compare this figure to Figure 3-2 to see the NE reduction realized in a central office with WaveStar BandWidth Manager. The gray area on the right of the figure represents the equipment the WaveStar BandWidth Manager replaces when it is added to the central office.

Figure 3-1 Typical Central Office without WaveStar BandWidth Manager



Consolidated central office

WaveStar BandWidth Manager integrates the OC-192/STM-64 and OC-48/STM-16 ADM functionality, OC-12/STM-4 access rings functionality, the BDCS functionality, and the optical and electrical linear applications, illustrated in Figure 3-1, into a single network element. This equipment consolidation greatly reduces initial equipment costs, improves reliability, and streamlines operations within the central office. The 2-fiber and 4-fiber Bidirectional Line-Switch Rings (BLSRs)/Multiplex-Section - Shared Protection Rings (MS-SPRings) and Unidirectional Path-Switch Rings (UPSRs) are provided by a single WaveStar BandWidth Manager system rather than multiple ADMs.

In addition to providing ADM functionality, WaveStar BandWidth Manager also provides a highly reliable cross-connect, simplified OAM&P, and multiple optical and electrical interfaces in one bay. WaveStar BandWidth Manager integrates SONET and SDH rates and rings in a single NE.

Broadband cross-connect functionality

WaveStar BandWidth Manager provides a broadband digital cross-connect system (BDCS) functionality, such as interconnections among the ring facilities, without going through the manual cross-connect panel (LGX/DSX or ODF/DDF). WaveStar BandWidth Manager provides a fully non-blocking BDCS functionality (via the 4608/1536 switch fabric) within a single network element. Therefore, cabling between back-to-back interfaces and interconnections between back-to-back low-speed interfaces is eliminated.

Embedded base interface

WaveStar BandWidth Manager is able to interface to existing network equipment from multiple vendors at the following rates:

- Electrical rates
  - DS3
  - EC-1
  - STM-1e
- Optical rates
  - OC-192/STM-64
  - OC-48/STM-16
  - OC-12/STM-4
  - OC-3/STM-1

Simplified OAM&P

Because WaveStar BandWidth Manager integrates multiple OC-192/STM-64 and OC-48/STM-16 ADMs, OC-48 and OC-12 UPSRs, and STM-N Sub-Network Connection Protection (SNCP) rings into a single network element, OAM&P operations are streamlined. The element management system support for WaveStar BandWidth Manager is provided by a WaveStar™ Subnetwork Management System (SNMS).

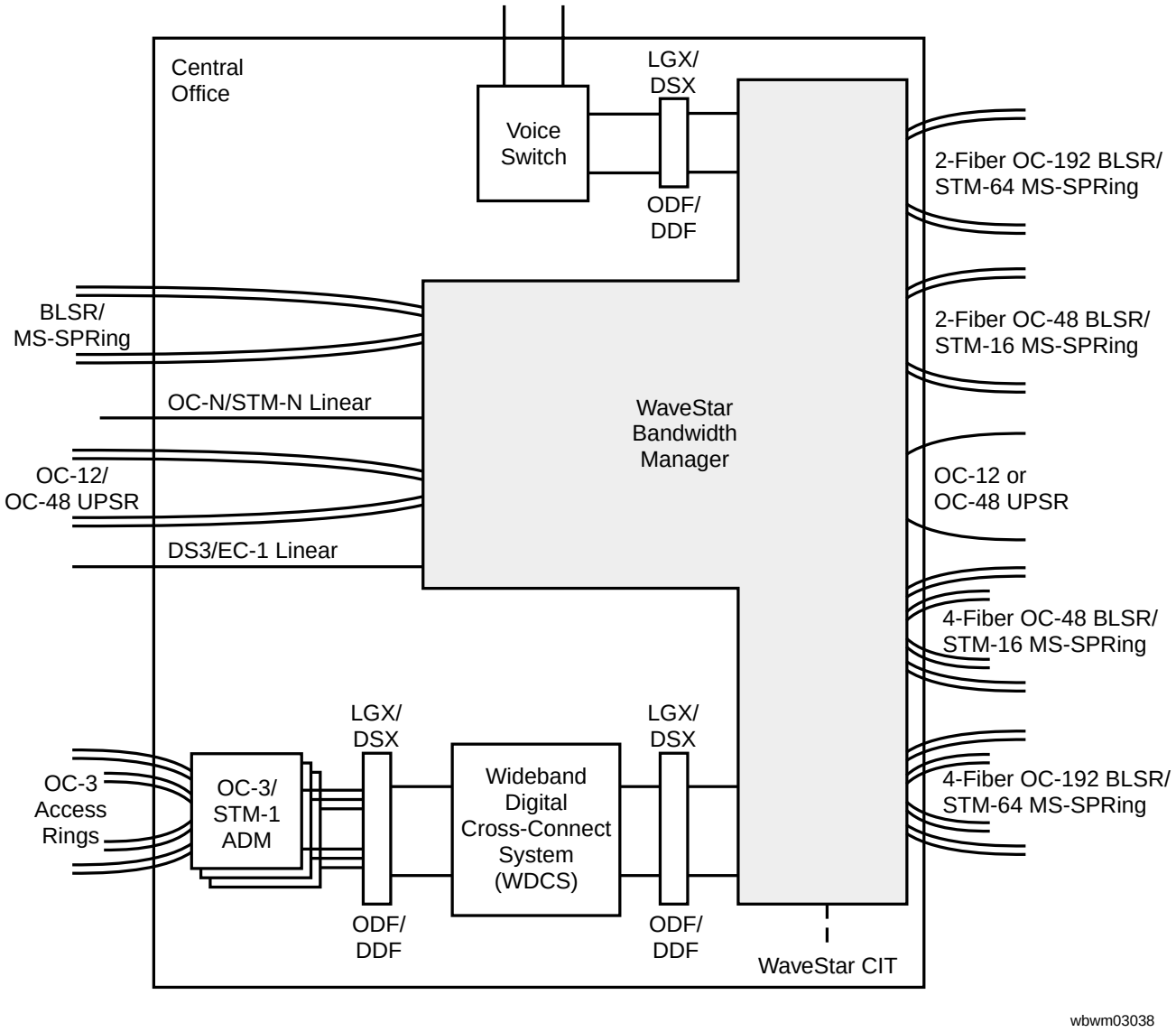
One WaveStar CIT provides access to WaveStar SNMS for the entire WaveStar BandWidth Manager system. In the typical central office Figure 3-1, multiple CITs are needed to manage the multiple ADMs. In Figure 3-2, notice that WaveStar BandWidth Manager only requires a single WaveStar CIT.

Economical capacity growth

Customers can grow the capacity of WaveStar BandWidth Manager in-service. Transmission capacity can be increased modularly and additional interfaces can be added as needed to meet rapidly changing needs, thus minimizing start-up costs. All transmission growth is able to be cross-connected within WaveStar BandWidth Manager, therefore eliminating the need for intra-office cabling and connections that would be necessary in a central office without WaveStar BandWidth Manager.

Figure Figure 3-2 illustrates a central office environment with WaveStar BandWidth Manager. Compare this figure to Figure 3-2 to see the dramatic equipment reduction capable in a central office with WaveStar BandWidth Manager.

Figure 3-2 Consolidated Central Office with WaveStar BandWidth Manager



References For more information about the switch fabric and other system components, refer to Chapter 2, “Features” and Chapter 4, “Product Description.”

Cost Savings

Overview

This section discusses the cost savings that are realized in a consolidated central office with WaveStar BandWidth Manager.

Saving areas

WaveStar BandWidth Manager enables cost savings in the following areas:

- Operations/maintenance
- Equipment
- Central office capacity growth

Operational cost reductions

WaveStar BandWidth Manager provides operational cost savings in the following ways:

- Greater automation in the establishment and maintenance of cross-connections
- Electronic management of intra-office broadband connections, eliminating manual cross-connects
- Elimination of many manual cross-connect panels (LGX/DSX or ODF/DDF panels) and back-to-back inter-equipment cabling
- Automation of broadband service provisioning and avoidance of manual administration
- Flexible support for multiple broadband rates and asynchronous/ synchronous networking
- Preventive maintenance strategies that translate into very low maintenance costs
- Ultra-fast service restoration and fault-tolerance applications ensuring high reliability
- Integration of lightwave interoffice and access lightwave terminals in a signal NE with centralized and consolidated eletronic cross-connects

Equipment reductions

WaveStar BandWidth Manager supports equipment cost savings by

- Consolidating central office equipment into WaveStar BandWidth Manager
- Integrating 2-fiber and 4-fiber OC-48 BLSRs/STM-16 MS-SPRings, and 2-fiber and 4-fiber OC-192 BLSRs/STM-64 MS-SPRings, thus eliminating the need for multiple stand-alone lightwave terminals
- Integrating OC-12/STM-4 access rings, thus eliminating the need for multiple stand-alone OC-12/STM-4 ADMs
- Integrating optical and electrical linear applications
- Lowering the cost of interconnections to existing stand-alone lightwave terminals
- Performing grooming, traffic restoration, and provisioning features for the overall network
- Providing DS3, EC-1, OC-192/STM-64, OC-48/STM-16, OC-12/STM-4, and OC-3/STM-1 connectivity to embedded base systems
- Providing flexible mixing of multiple interfaces within a single shelf
- Interfacing directly to the WaveStar OLS systems without OTUs via the DWDM OC48/STM16 and OC192/STM64 optical port units.
- Enabling interworking between SONET and SDH systems within a single NE

Economical capacity growth

The flexible configurations in WaveStar BandWidth Manager permit cost savings from initial installation and throughout the life of the system. This flexibility translates into savings in the following ways:

- Additional transmission capacity can be added on an in-service basis by adding additional I/O Shelves
- Traffic can be cross-connect via the main switch fabric or cross-connect directly on the individual I/O Shelves without consuming capacity on the main switch fabric.

□

Summary of Benefits

Overview

This section highlights the major benefits of WaveStar BandWidth Manager.

Benefits

WaveStar BandWidth Manager

- Provides a fully non-blocking BDCS that is able to route bandwidth between any transport facility within WaveStar BandWidth Manager
- Reduces OC-192/STM-64 and OC-48/STM-16 ring terminals, office footprint requirements, cabling, and installation costs through high-level equipment integration
- Provides DS3, EC-1, STM-1e, OC-192/STM-64, OC-48/STM-16, OC-12/STM-4, OC-3/STM-4 connectivity to embedded base systems
- Increases reliability by reducing the number of discrete NEs in the network
- Simplifies OAM&P functions and reduces network element complexity by consolidating network element functions
- Positions the central office for future WaveStar BandWidth Manager feature enhancements

References

For information about future releases of WaveStar BandWidth Manager, contact your Account Executive.

□

Interworking Between WaveStar BandWidth Managers

Overview

WaveStar BandWidth Manager supports transmission and communication (via DCC) interworking between WaveStar BandWidth Managers over multiple interfaces.

Figure (SONET)

Figure 3-3 illustrates WaveStar BandWidth Managers interworking over

- Two-fiber OC-192 BLSRs
- Four-fiber OC-192 BLSRs
- Two-fiber OC-48 BLSRs
- Four-fiber OC-48 BLSRs
- OC-48 UPSR
- OC-192 1+1 interfaces
- OC-48 1+1 interfaces
- OC-12 1+1 interfaces
- OC-3 1+1 interfaces

Figure 3-3 Interworking between WaveStar BandWidth Managers (SONET)

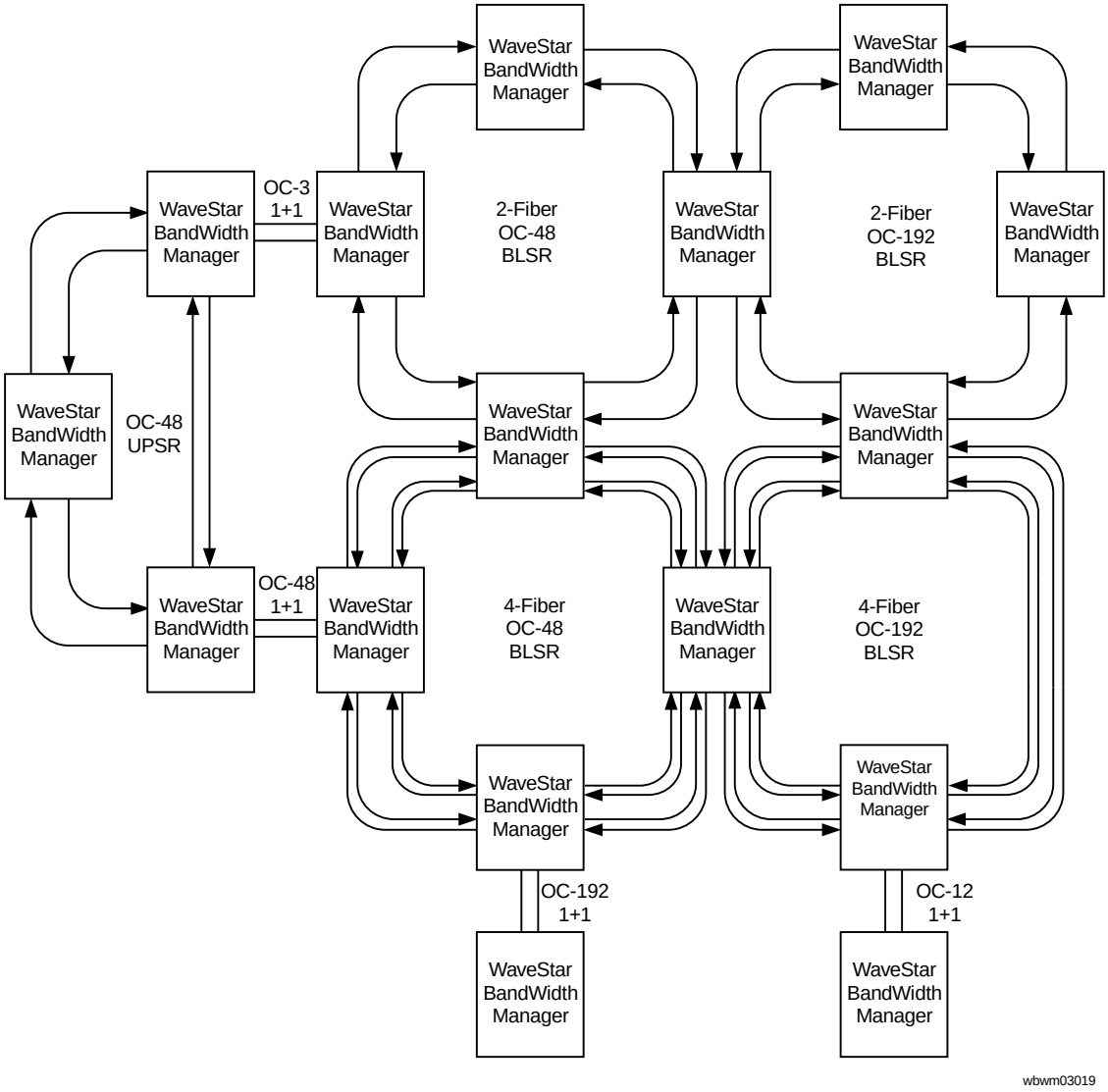


Figure (SDH) Figure 3-4 illustrates multiple WaveStar BandWidth Managers interworking over

- Two-fiber STM-64 MS-SPRings
- Four-fiber STM-64 MS-SPRings with transoceanic protocol
- Two-fiber STM-16 MS-SPRings
- Four-fiber STM-16 MS-SPRings
- Four-fiber STM-16 MS-SPRings with transoceanic protocol
- STM-64 1+1 interfaces
- STM-16 1+1 interfaces
- STM-4 1+1 interfaces
- STM-1 1+1 interfaces

Figure 3-4 Interworking between WaveStar BandWidth Managers (SDH) Example

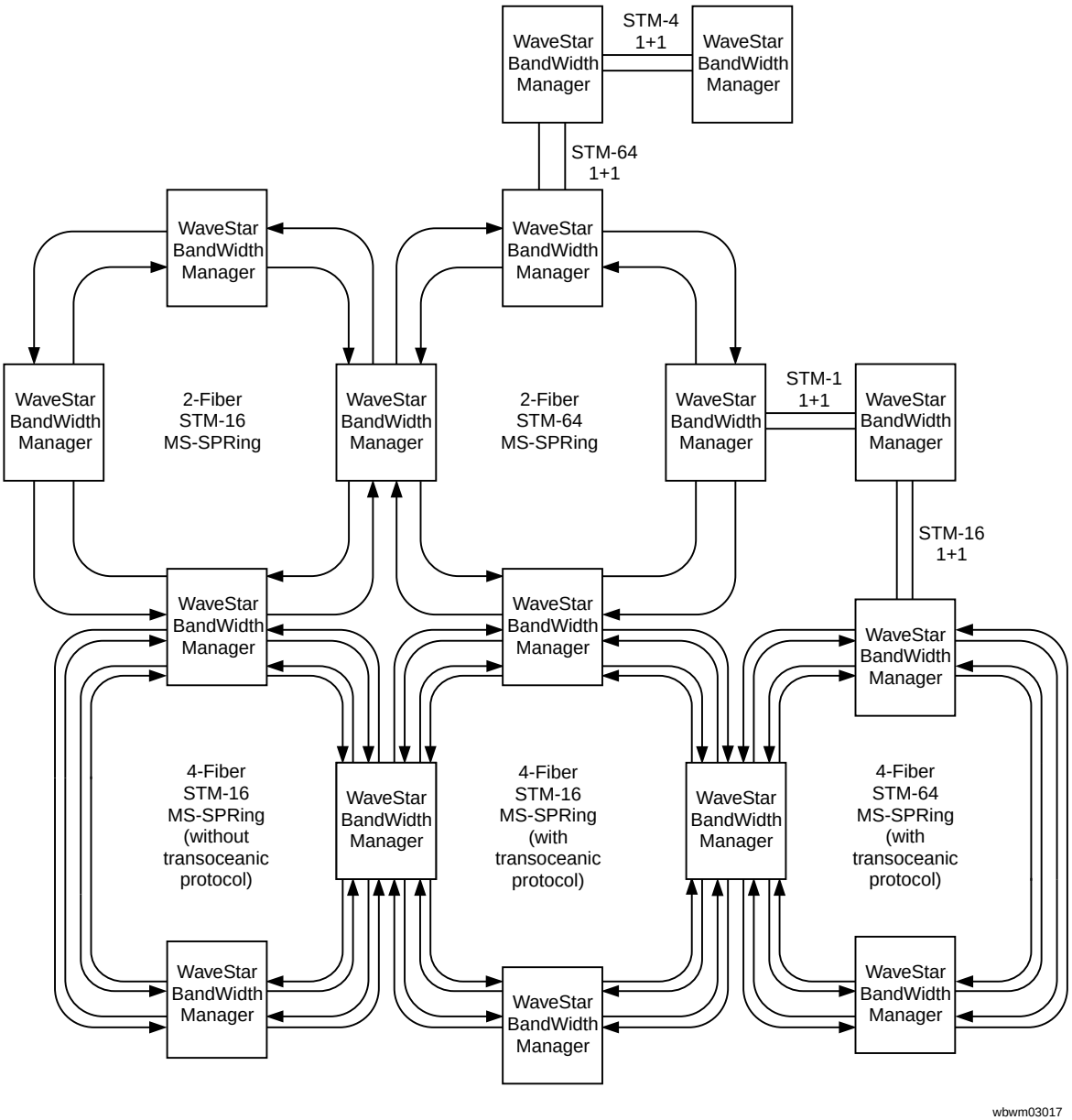
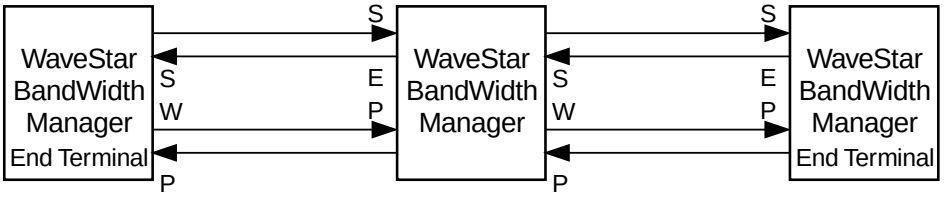


Figure (open rings)

Figure 3-5 illustrates interworking between WaveStar BandWidth Managers over a 4-fiber BLSR/MS-SPRing (open) with two end nodes and one intermediate site. (Up to 13 additional intermediate sites, for a total of 16 nodes on the ring, could be supported.) From left to right in the figure, the first end node is equipped with two port units in the west direction, the intermediate site is equipped with four port units in both directions: east and west, the second end terminal is equipped with two port units in the east direction. Four-fiber BLSRs/MS-SPRings (open) provide flexible routing arrangements for end-node to end-node traffic, end-node to intermediate-site traffic, and intermediate-site to intermediate-site traffic over a common system.

Figure 3-5 could be either a 4-fiber OC-48 or OC-192 BLSR (open) or a 4-fiber STM-16 (open).

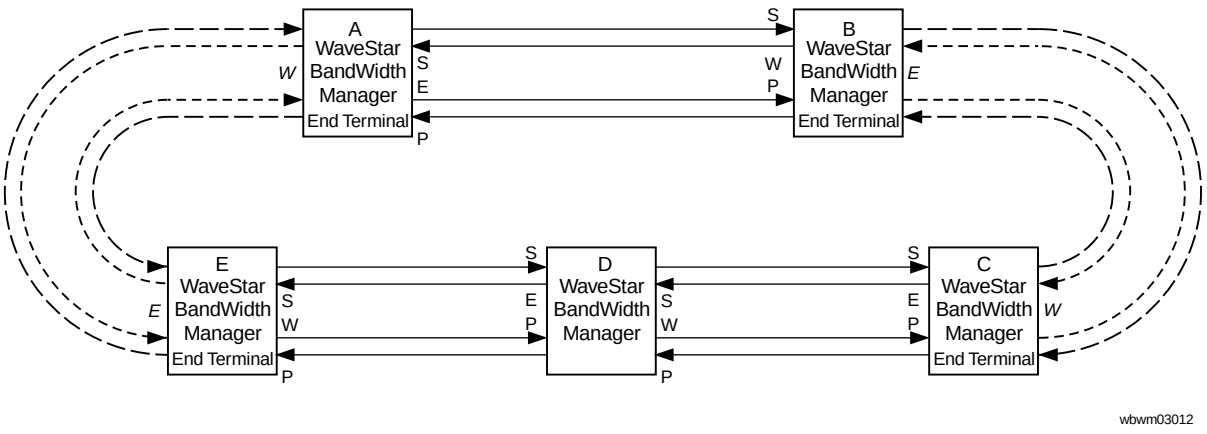
Figure 3-5 Interworking between WaveStar BandWidth Managers over 4-Fiber BLSRs/MS-SPRings (Open) Example



Closing 4-fiber BLSRs/ MS-SPRings (open)

Figure 3-6 illustrates closing two open 4-fiber BLSRs/MS-SPRings. Network Element (NE) A, B, C, and E are all end terminals and NE D is an intermediate site (two open rings). Therefore, these NEs are equipped with only two port units (OC48/STM16 or OC192/STM64) in either the West (W) or East (E) direction. Typically, four port units are required to terminate a 4-fiber BLSR/MS-SPRing because both directions of traffic must be terminated in a closed ring. The dotted lines on either side of the figure illustrate the fiber that must be added in order to close the ring. Two additional port units must be added to NE A, B, C, and E to terminate the W and E traffic on each side of the figure.

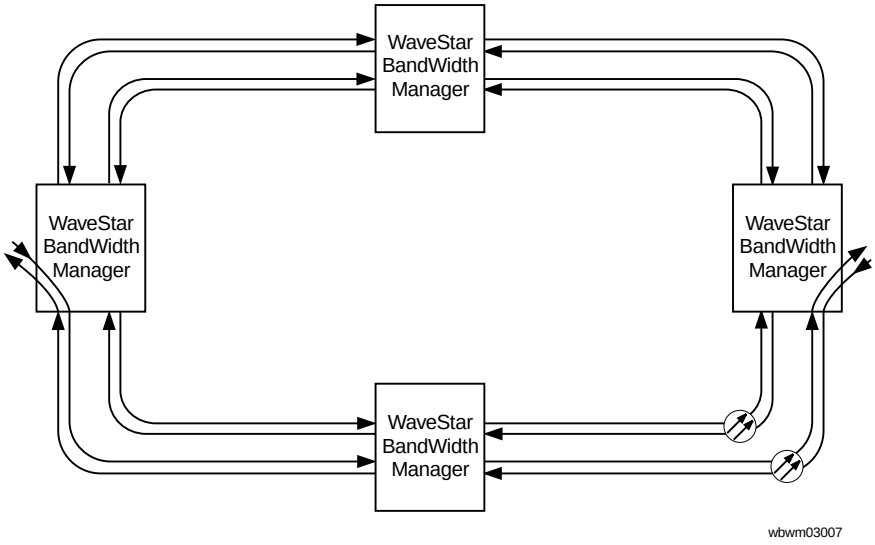
Figure 3-6 Closing 4-Fiber BLSRs/MS-SPRings (Open) Example



Closed 4-fiber BLSR/MS-SPRing

Figure 3-7 illustrates normal (non-protection-switched) traffic in a 4-fiber BLSR/MS-SPRing (closed). (Up to 12 additional nodes, for a total of 16 nodes on the ring, could be supported.) In a 4-fiber BLSR/MS-SPRing, two lines of service and protection traffic travel in two directions (East and West) over a single span between two nodes. Each span of the ring consists of two bidirectional lines: two fibers dedicated to service and two to protection. All nodes on the ring are equipped with four port units: two service (SE and SW) and two protection (PE and PW). Either OC48/STM16 or OC192/STM64 port units may be used.

Figure 3-7 Interworking between WaveStar BandWidth Managers over 4-Fiber BLSRs/MS-SPRing (Closed) Example



Important! It is recommended that all WaveStar BandWidth Managers in a ring be equipped with the same release of software.

Overview of WaveStar BandWidth Manager Interworking

Overview

This section lists the products and interfaces for WaveStar BandWidth Manager interworking.

Interworking with WaveStar BandWidth Manager

WaveStar BandWidth Manager supports transmission and communication (via DCC) interworking between WaveStar BandWidth Manager and various Lucent products, as well as numerous products from other vendors.

Interworking with SONET products

WaveStar BandWidth Manager supports transmission and communication (via DCC) interworking between the following products in the SONET network:

- WaveStar BandWidth Manager and WaveStar TDM 2.5G/10G (2-Fiber), Release 5.0 over
  - 2-fiber OC-48 BLSRs
  - 2-fiber OC-192 BLSRs
  - OC-3 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)
  - OC-12 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)
  - OC-48 interfaces: 1+1 protected (unidirectional, non-revertive)
- WaveStar BandWidth Manager and FT-2000 OC-48 Add/Drop Rings Terminal, Release 9.1 over
  - 2-fiber OC-48 BLSRs
  - OC-3 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)
  - OC-12 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)
- WaveStar BandWidth Manager and Fujitsu FLM 150 ADM, Release 15 over OC-3 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)

- WaveStar BandWidth Manager and Fujitsu FLM 2400 ADM, Release 14.2 and 15 over
  - 2-fiber OC-48 BLSRs
  - OC-48 UPSRs
- WaveStar BandWidth Manager and DDM-2000 OC-3 Multiplexer, Release 13 over
  - OC-12 UPSRs
  - OC-3 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)
  - OC-12 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)
- WaveStar BandWidth Manager and DDM-2000 OC-12 Multiplexer, Release 7 over
  - OC-12 UPSRs
  - OC-3 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)
  - OC-12 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)
- WaveStar BandWidth Manager and Metropolis™ DMX Access Multiplexer, Release 1.1 over OC-48 UPSRs

Interworking with SDH products

WaveStar BandWidth Manager supports transmission and communication (via DCC) interworking between the following products in the SDH network:

- WaveStar BandWidth Manager and WaveStar TDM 10G (STM-64), Release 3.0 over
  - 2-fiber STM-16 MS-SPRings
  - 2-fiber STM-64 MS-SPRings
  - STM-1 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)
  - STM-4 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)
  - STM-16 interfaces: 1+1 protected (unidirectional, non-revertive)

- WaveStar BandWidth Manager and WaveStar ADM 16/1 (Ruby II Release) over
  - 2-fiber STM-16 MS-SPRings
  - STM-4 SNCPs
  - STM-16 SNCPs
  - STM-1 interfaces: 0x1 protected and 1+1 protected (unidirectional, nonrevertive and bidirectional, non-revertive)
  - STM-4 interfaces: 0x1 protected and 1+1 protected (unidirectional, nonrevertive and bidirectional, non-revertive)
  - STM-16 interfaces: 1+1 protected (unidirectional, nonrevertive and bidirectional, non-revertive)
- WaveStar BandWidth Manager and Nortel Networks TransportNode TN-4T STM-4 Terminal Multiplexer, Release H1.00, over
  - STM-4 SNCPs
  - STM-1 interfaces: 1+1 protected (bidirectional, non-revertive)
  - STM-4 interfaces: 1+1 protected (bidirectional, non-revertive)
- WaveStar BandWidth Manager and Nortel Networks TransportNode TN-16X, Release H2.00, over
  - STM-4 SNCPs
  - STM-16 SNCPs
  - STM-1 interfaces: 1+1 protected (bidirectional, non-revertive)
  - STM-4 interfaces: 1+1 protected (bidirectional, non-revertive)
  - STM-16 interfaces: 1+1 protected (bidirectional, non-revertive)

- WaveStar BandWidth Manager and Marconi SMA 16/4, Series 3, over
  - STM-4 SNCPs
  - STM-16 SNCPs
  - STM-1 interfaces: 1+1 protected (bidirectional, non-revertive)
  - STM-4 interfaces: 1+1 protected (bidirectional, non-revertive)
  - STM-16 interfaces: 1+1 protected (bidirectional, non-revertive)

□

Interworking with WaveStar TDM 2.5G/10G (2-Fiber)

Overview

WaveStar BandWidth Manager supports transmission and communication (via DCC) interworking between WaveStar BandWidth Manager and WaveStar TDM 2.5G/10G (2-Fiber), Release 5.0 over

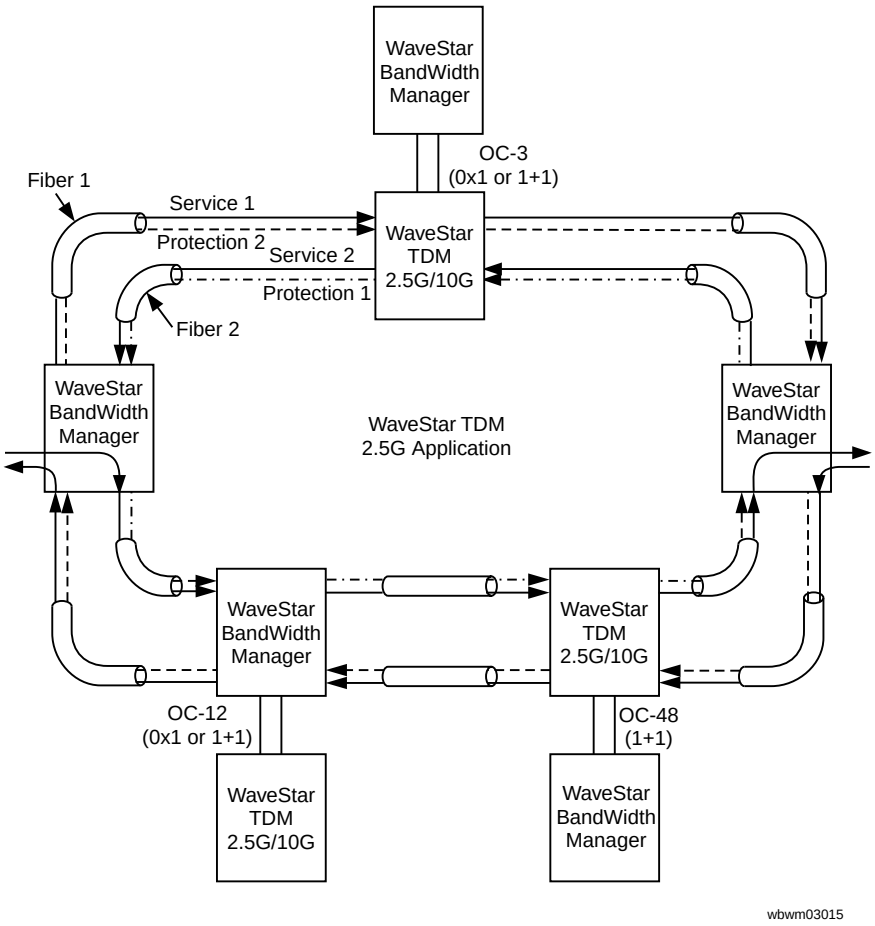
- 2-fiber OC-48 BLSRs
- 2-fiber OC-192 BLSRs
- OC-3 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)
- OC-12 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)
- OC-48 interfaces: 1+1 protected (unidirectional, non-revertive)

Important! As of June 2000, WaveStar TDM 2.5G and WaveStar TDM 10G (OC-192) (2-Fiber) have merged. The new product, WaveStar TDM 2.5G/10G (2-Fiber), supports 2.5G applications and 10G applications.

Figure (2.5G application)

Figure 3-8 illustrates interworking between WaveStar BandWidth Managers and WaveStar TDM 2.5G/10G systems (supporting a 2.5G application) over a 2-fiber OC-48 BLSR, as well as OC-3, OC-12, and OC-48 interfaces.

Figure 3-8 Interworking with WaveStar TDM 2.5G/10G (2.5G Application)

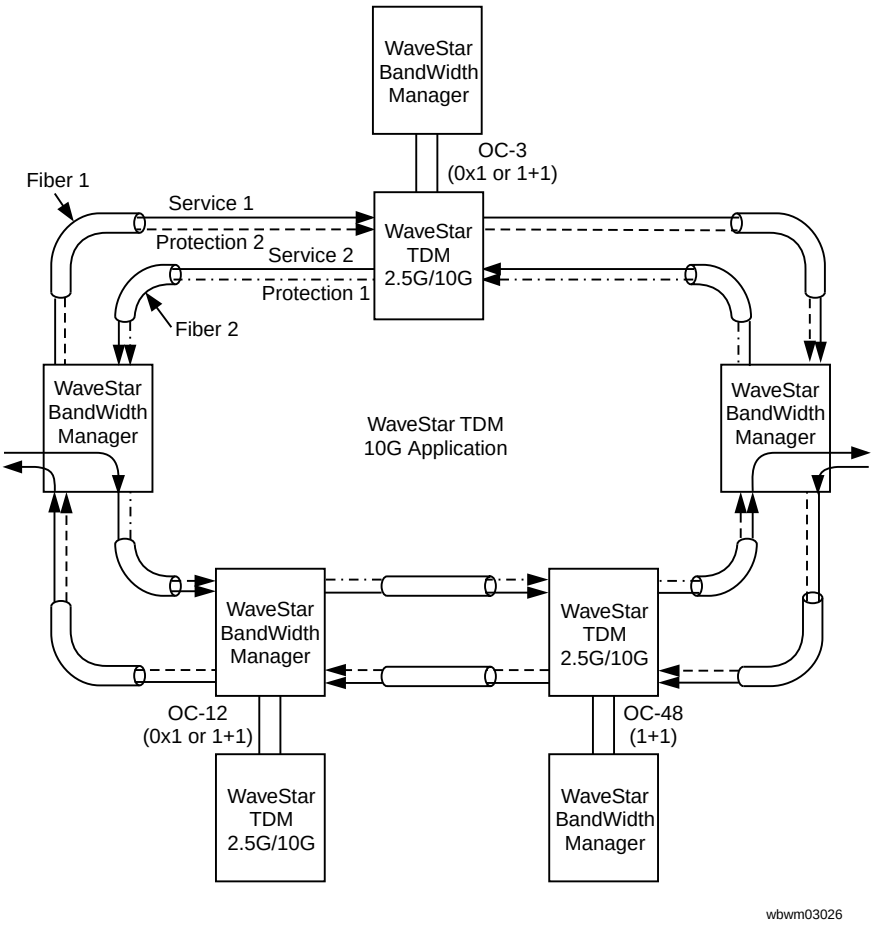


Important! WaveStar BandWidth Manager supports interworking with WaveStar TDM 2.5G/10G, Release 5.0 and greater.

Figure (10G application)

Figure 3-9 illustrates interworking between WaveStar BandWidth Managers and WaveStar TDM 2.5G/10G systems (supporting a 10G application) over a 2-fiber OC-192 BLSR, as well as OC-3, OC-12, and OC-48 interfaces.

Figure 3-9 Interworking with WaveStar TDM 2.5G/10G (10G Application)



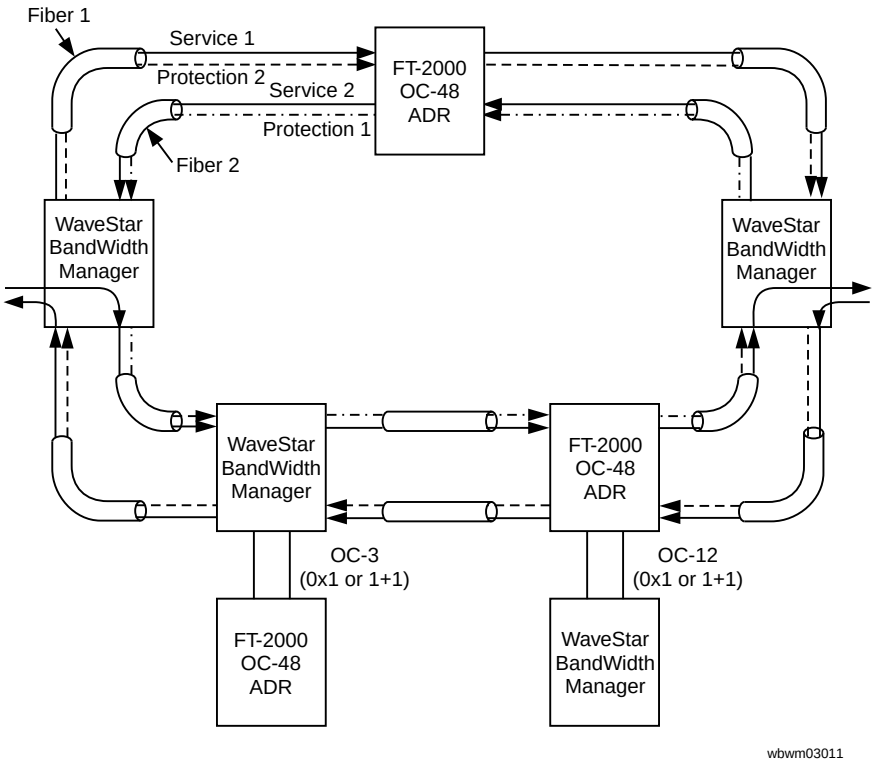
Interworking with FT-2000 OC-48 ADR

Overview WaveStar BandWidth Manager supports transmission and communication (via DCC) interworking between WaveStar BandWidth Managers and FT-2000 OC-48 Add/Drop Ring (ADR) Terminals, Release 9.1 over

- 2-fiber OC-48 BLSRs
- OC-3 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)
- OC-12 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)

Figure Figure 3-10 illustrates interworking between WaveStar BandWidth Managers and FT-2000 OC-48 ADR Terminals over a 2-fiber OC-48 BLSR, as well as OC-3 and OC-12 interfaces.

Figure 3-10 Interworking with FT-2000 OC-48 ADR



Important! WaveStar BandWidth Manager supports interworking with FT-2000 OC-48 ADR, Release 9.1 and greater.

Interworking with Fujitsu FLM ADMs

Overview

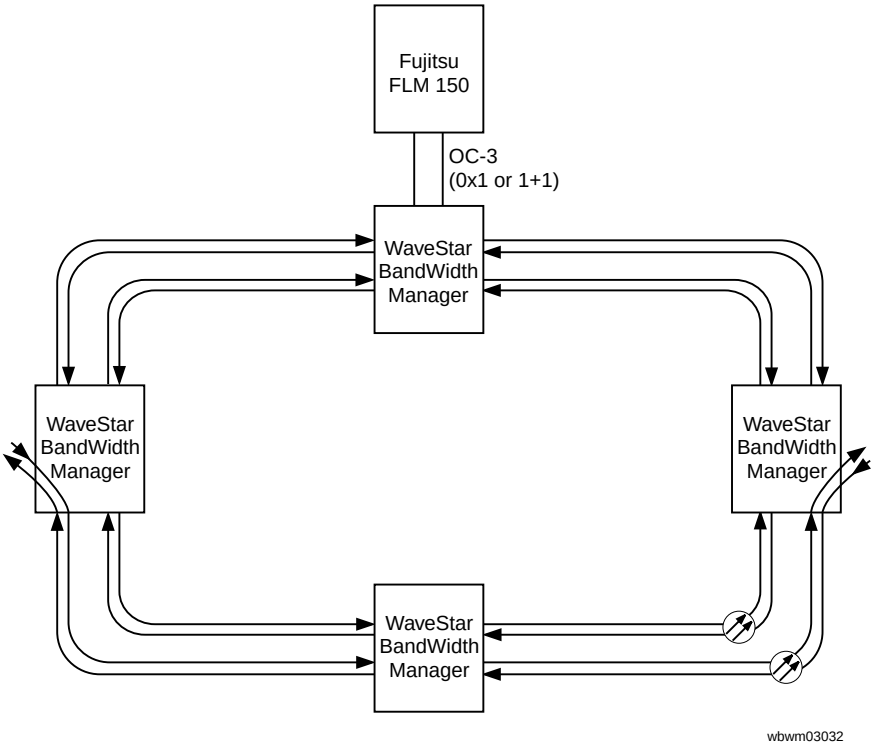
WaveStar BandWidth Manager supports transmission and communication (via DCC) interworking between WaveStar BandWidth Manager and

- Fujitsu FLM 150 ADM, Release 15 over OC-3 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)
- Fujitsu FLM 2400 ADM, Release 14.2 and 15 over
  - 2-fiber OC-48 BLSRs
  - OC-48 UPSRs

Fujitsu FLM 150 ADM

Figure 3-11 illustrates interworking between WaveStar BandWidth Manager and Fujitsu FLM 150 ADM over OC-3 interfaces.

Figure 3-11 Interworking with Fujitsu FLM 150 ADM

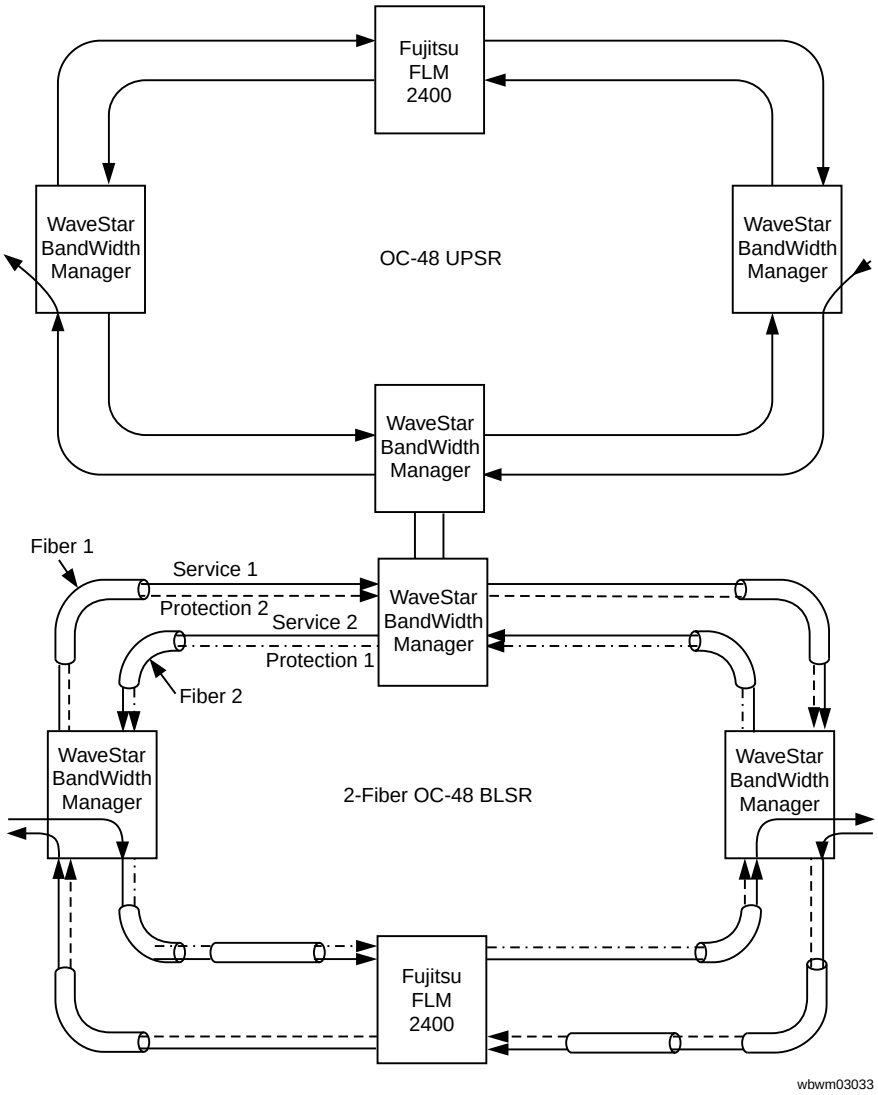


Important! WaveStar BandWidth Manager supports interworking with Fujitsu FLM 150 ADM, Release 15 and greater.

Fujitsu FLM 2400 ADM

Figure 3-12 illustrates interworking between WaveStar BandWidth Managers and Fujitsu FLM 2400 ADMs over an OC-48 UPSR and a 2-fiber OC-48 BLSR.

Figure 3-12 Interworking with Fujitsu FLM 2400 ADM



Important! WaveStar BandWidth Manager supports interworking with Fujitsu FLM 2400 ADM, Release 14.2 and 15 and greater.

□

Interworking with DDM-2000 OC-3 and OC-12 Multiplexers

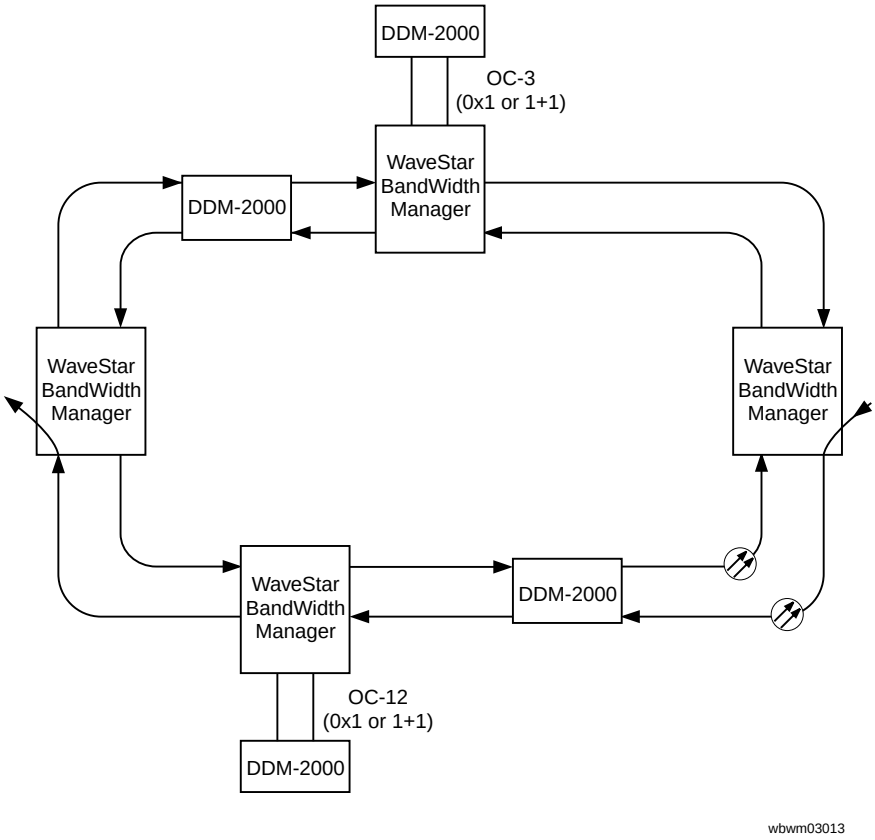
Overview

WaveStar BandWidth Manager supports transmission and communication (via DCC) interworking between

- WaveStar BandWidth Manager and DDM-2000 OC-3 Multiplexer, Release 13 over
  - OC-12 UPSRs
  - OC-3 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)
  - OC-12 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)
- WaveStar BandWidth Manager and DDM-2000 OC-12 Multiplexer, Release 7 over
  - OC-12 UPSRs
  - OC-3 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)
  - OC-12 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)

Figure Figure 3-13 illustrates interworking between WaveStar BandWidth Managers and DDM-2000 multiplexers over an OC-12 UPSR and OC-3 and OC-12 interfaces.

Figure 3-13 Interworking with DDM-2000 OC-3/OC-12 Multiplexers



Important! WaveStar BandWidth Manager supports interworking with DDM-2000 OC-3 Multiplexer, Release 13 and greater and DDM-2000 OC-12 Multiplexer, Release 7 and greater.

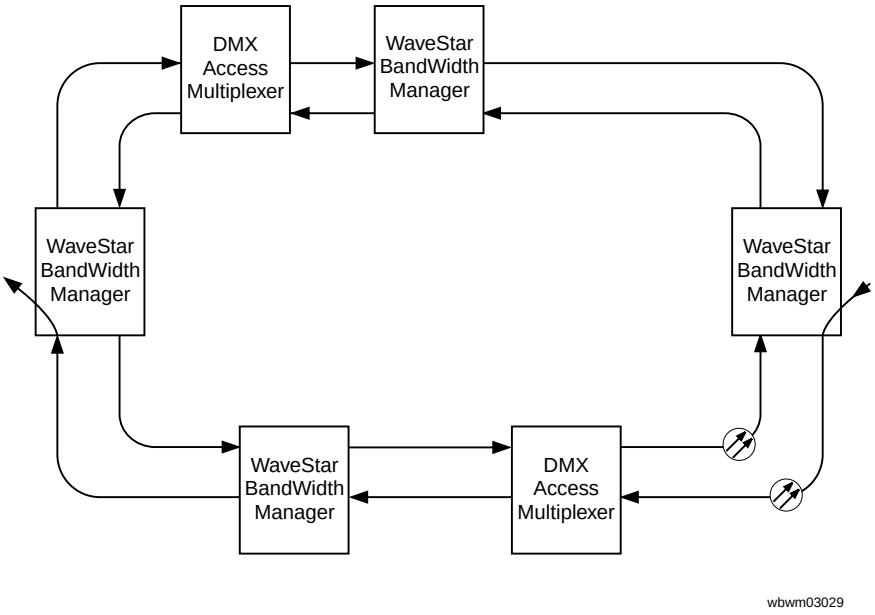
□

Interworking with Metropolis™ DMX Access Multiplexer

Overview WaveStar BandWidth Manager supports transmission and communication (via DCC) interworking between WaveStar BandWidth Manager and Metropolis DMX Access Multiplexer, Release 1.1 over OC-48 UPSRs.

Figure Figure 3-14 illustrates interworking between WaveStar BandWidth Managers and Metropolis DMX Access Multiplexers over an OC-48 UPSR.

Figure 3-14 Interworking with Metropolis DMX Access Multiplexers



Important! WaveStar BandWidth Manager supports interworking with Metropolis DMX Access Multiplexer, Release 1.1 and greater.

Interworking with WaveStar TDM 10G (STM-64)

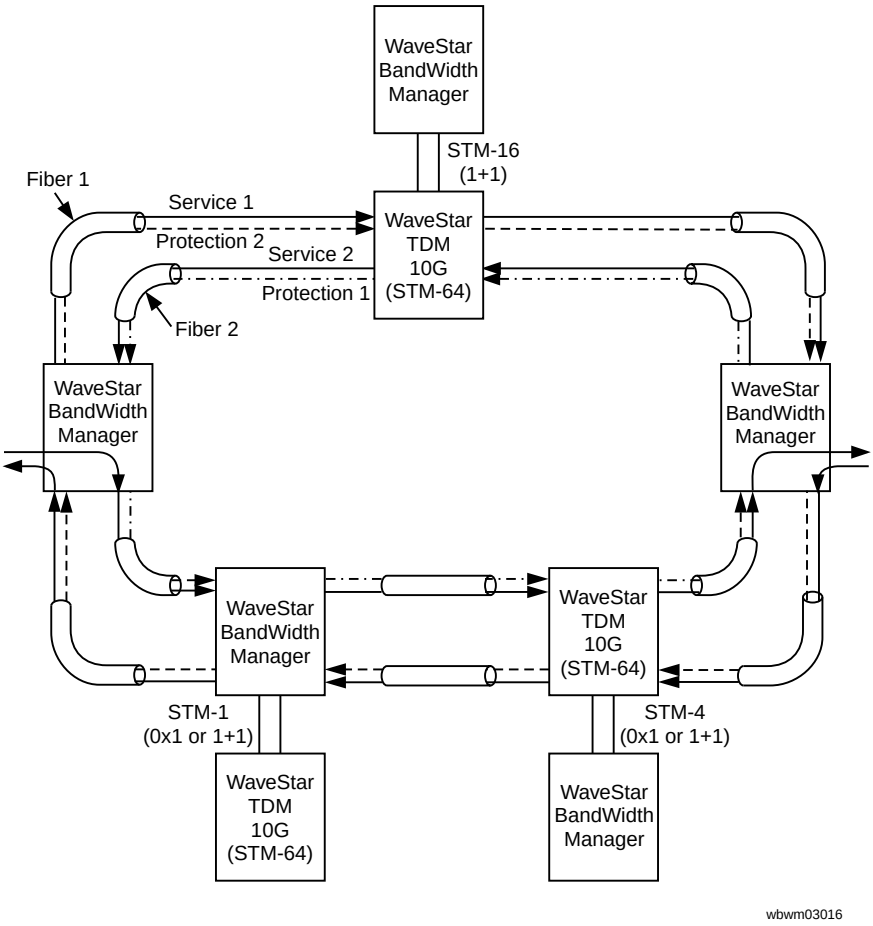
Overview

WaveStar BandWidth Manager supports transmission and communication (via DCC) interworking between WaveStar BandWidth Managers and WaveStar TDM 10G (STM-64), Release 3.0 over

- 2-fiber STM-16 MS-SPRings
- 2-fiber STM-64 MS-SPRings
- STM-1 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)
- STM-4 interfaces: 0x1 protected and 1+1 protected (unidirectional, non-revertive)
- STM-16 interfaces: 1+1 protected (unidirectional, non-revertive)

Figure Figure 3-15 illustrates interworking between WaveStar BandWidth Managers and WaveStar TDM 10G (STM-64) systems over a 2-fiber STM-16 or STM-64 MS-SPRing and STM-1, STM-4, and STM-16 interfaces.

Figure 3-15 Interworking with WaveStar TDM 10G (STM-64)



Important! WaveStar BandWidth Manager supports interworking with WaveStar TDM 10G (STM-64), Release 3.0 and greater.

□

Interworking with WaveStar ADM 16/1 (Ruby II)

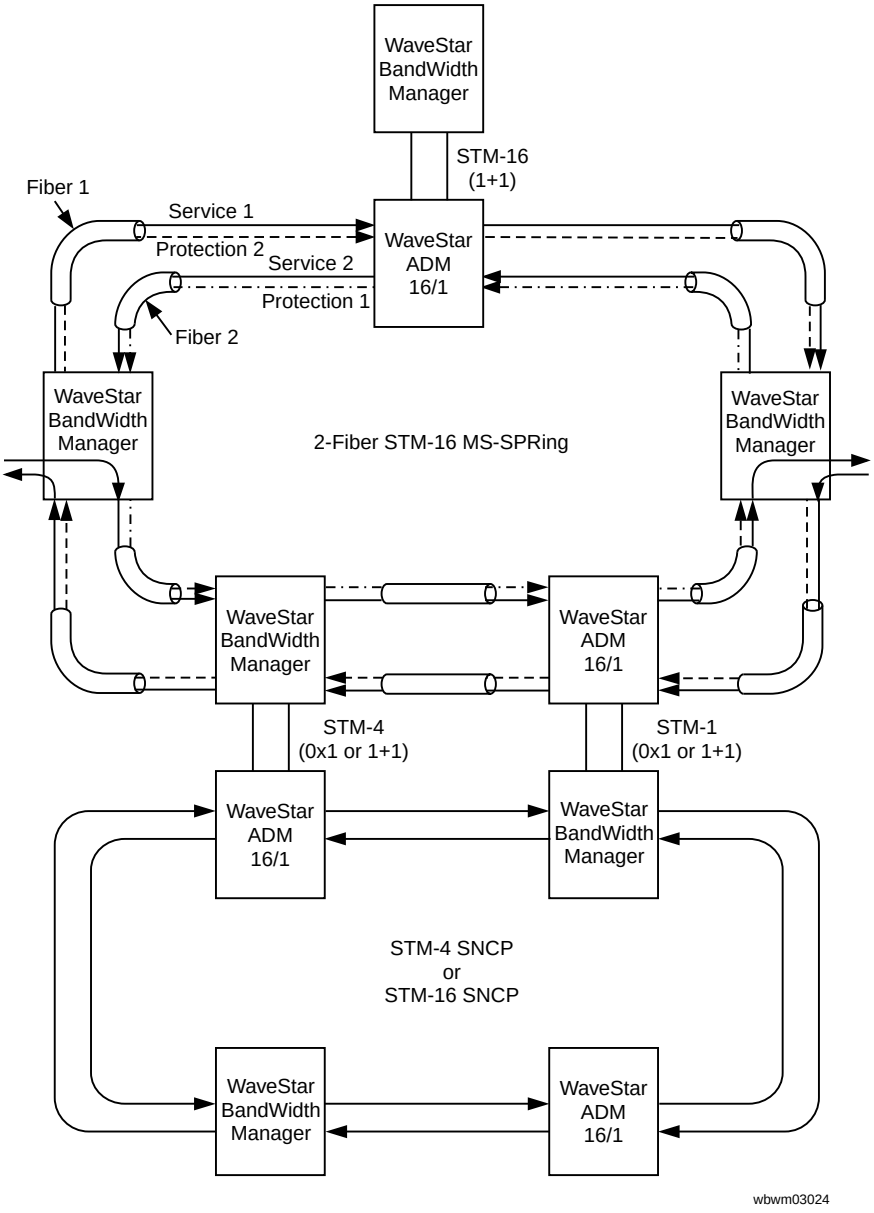
Overview

WaveStar BandWidth Manager supports transmission and communication (via DCC) interworking between WaveStar BandWidth Manager and WaveStar ADM 16/1 (Ruby II) over

- 2-fiber STM-16 MS-SPRings
- STM-4 SNCPs
- STM-16 SNCPs
- STM-1 interfaces: 0x1 protected and 1+1 protected (unidirectional, nonrevertive and bidirectional, non-revertive)
- STM-4 interfaces: 0x1 protected and 1+1 protected (unidirectional, nonrevertive and bidirectional, non-revertive)
- STM-16 interfaces: 1+1 protected (unidirectional, nonrevertive and bidirectional, non-revertive)

Figure Figure 3-16 illustrates interworking between WaveStar BandWidth Managers and WaveStar ADM 16/1 (Ruby II) systems over a 2-fiber STM-16 MS-SPRing and an STM-4 or an STM-16 SNCP, as well as STM-1, STM-4, and STM-16 interfaces.

Figure 3-16 Interworking with WaveStar ADM 16/1 (Ruby II)



Important! WaveStar BandWidth Manager supports interworking with WaveStar ADM 16/1, Ruby II and greater.

Interworking with Nortel Networks TransportNode TN-4T and TN-16X

Overview

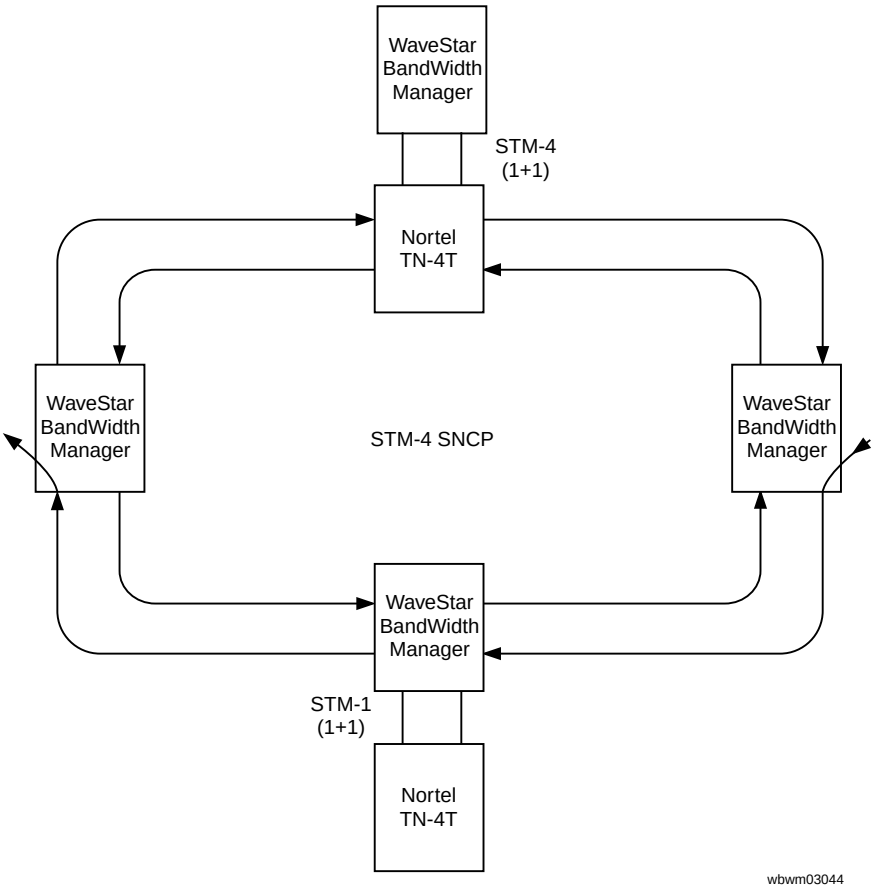
WaveStar BandWidth Manager supports transmission and communication (via DCC) interworking between WaveStar BandWidth Manager and

- Nortel Networks TransportNode TN-4T STM-4 Terminal Multiplexer, Release H1.00, over
  - STM-4 SNCPs
  - STM-1 interfaces: 1+1 protected (bidirectional, non-revertive)
  - STM-4 interfaces: 1+1 protected (bidirectional, non-revertive)
- Nortel Networks TransportNode TN-16X, Release H2.00, over
  - STM-4 SNCPs
  - STM-16 SNCPs
  - STM-1 interfaces: 1+1 protected (bidirectional, non-revertive)
  - STM-4 interfaces: 1+1 protected (bidirectional, non-revertive)
  - STM-16 interfaces: 1+1 protected (bidirectional, non-revertive)

Nortel Networks TransportNode TN-4T STM-4 Terminal Multiplexer

Figure 3-17 illustrates interworking between WaveStar BandWidth Manager and Nortel Networks TransportNode TN-4T STM-4 Terminal Multiplexer over an STM-4 SNCP, as well as STM-1 and STM-4 interfaces.

Figure 3-17 Interworking with Nortel Networks TransportNode TN-4T STM-4 Terminal Multiplexer

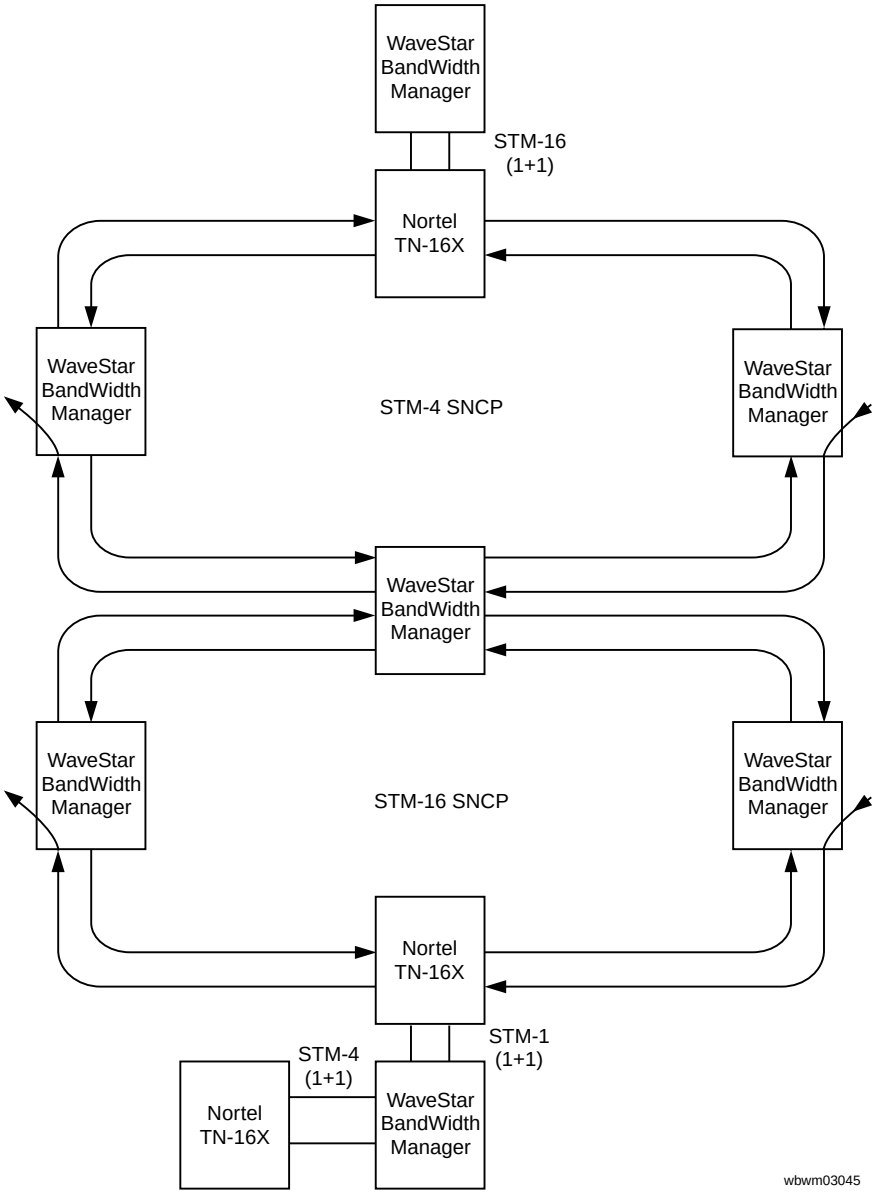


Important! WaveStar BandWidth Manager supports interworking with Nortel Networks TransportNode TN-4T STM-4 Terminal Multiplexer, Release H1.00 and greater.

Nortel Networks TransportNode TN-16X

Figure 3-18 illustrates interworking between WaveStar BandWidth Manager and Nortel Networks TransportNode TN-16X over an STM-4 and STM-16 SNCP, as well as STM-1, STM-4, and STM-16 interfaces.

Figure 3-18 Interworking with Nortel Networks TransportNode TN-16X



Important! WaveStar BandWidth Manager supports interworking with Nortel Networks TransportNode TN-16X, Release H2.00 and greater.

Interworking with Marconi SMA 16/4

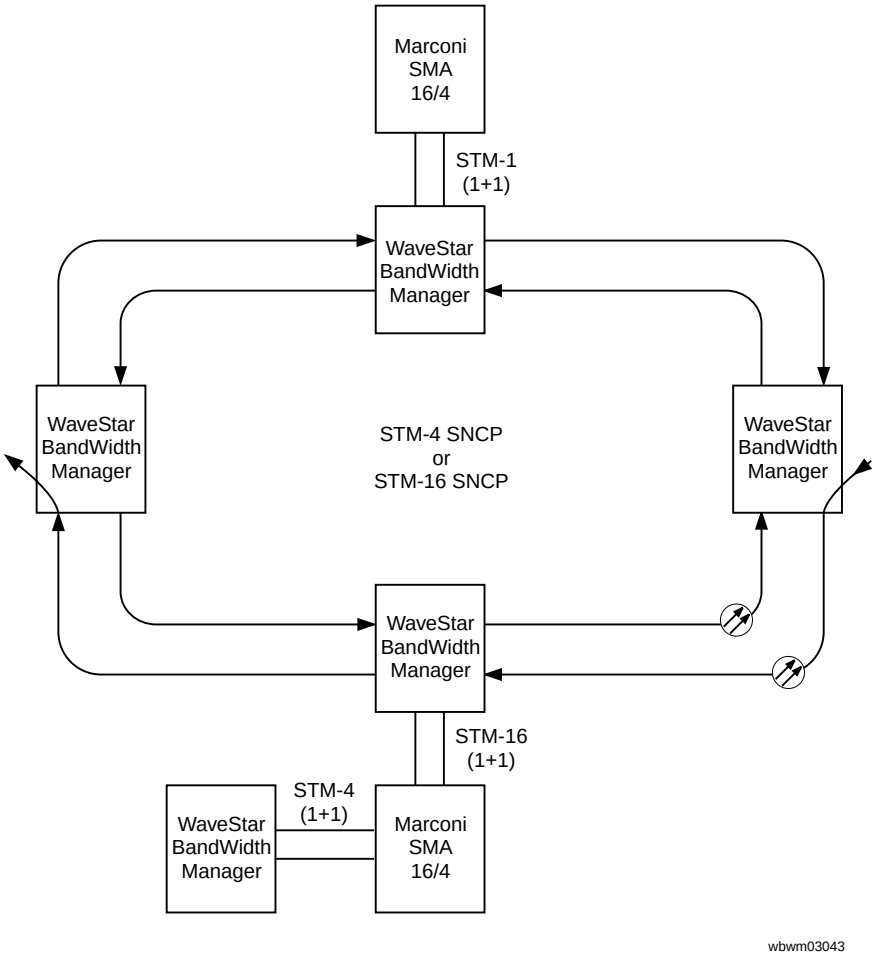
Overview

WaveStar BandWidth Manager supports transmission and communication (via DCC) interworking between WaveStar BandWidth Manager and Marconi SMA 16/4, Series 3, over

- STM-4 SNCPs
- STM-16 SNCPs
- STM-1 interfaces: 1+1 protected (bidirectional, non-revertive)
- STM-4 interfaces: 1+1 protected (bidirectional, non-revertive)
- STM-16 interfaces: 1+1 protected (bidirectional, non-revertive)

Figure Figure 3-19 illustrates optical transmission between WaveStar BandWidth Managers and Marconi SMA 16/4 systems over an STM-4 or an STM-16 SNCP, as well as STM-1, STM-4, and STM-16 interfaces.

Figure 3-19 Interworking with Marconi SMA 16/4



Important! WaveStar BandWidth Manager supports interworking with Marconi SMA 16/4, Series 3 and greater.

□

Overview of WaveStar BandWidth Manager Transmission Interfacing

Overview

WaveStar BandWidth Manager supports transmission interfacing between WaveStar BandWidth Manager and various other products.

Interfacing with WaveStar BandWidth Manager

WaveStar BandWidth Manager supports transmission interfacing between

- WaveStar BandWidth Manager and WaveStar Optical Line System (OLS) 40G/80G over OC-48/STM-16 optics via the OC48/STM16/DWDM01-16 port units
- WaveStar BandWidth Manager and WaveStar Optical Line System (OLS) 400G, Release 3 over OC-192/STM-64 optics via the OC192/STM64/WDM port units (40 wavelengths) and OC-48/STM-16 optics via the OC48/STM16/WDM port units (80 wavelengths)
- WaveStar BandWidth Manager and Lucent (Ascend) GX 550 Multiservice WAN Switch, Release Jade M2 (2.2.1.2) over
  - OC-12/STM-4 interfaces: 1+1 protected (bidirectional, non-revertive)
  - OC-48/STM-16 interfaces: 1+1 protected (bidirectional, non-revertive)
- WaveStar BandWidth Manager and Lucent (Ascend) CBX 500 Multiservice WAN Switch, Release Jade M2 (4.2) over OC-12/STM-4 interfaces: 1+1 protected (bidirectional, non-revertive)
- WaveStar BandWidth Manager supports optical transmission interfacing between Cisco ONS 15454 system and WaveStar BandWidth Manager over
  - OC-48 UPSRs
  - OC-3 interfaces: 0x1 and 1+1 protected (unidirectional, non-revertive)
  - OC-12 interfaces: 0x1 and 1+1 protected (unidirectional, non-revertive)

- WaveStar BandWidth Manager and Marconi MSH 84/86, Series 3, over
  - STM-1 interfaces: 1+1 protected (bidirectional, non-revertive)
  - STM-4 interfaces: 1+1 protected (bidirectional, non-revertive)
  - STM-16 interfaces: 1+1 protected (bidirectional, non-revertive)

□

Transmission Interfacing with WaveStar OLS 40G/80G

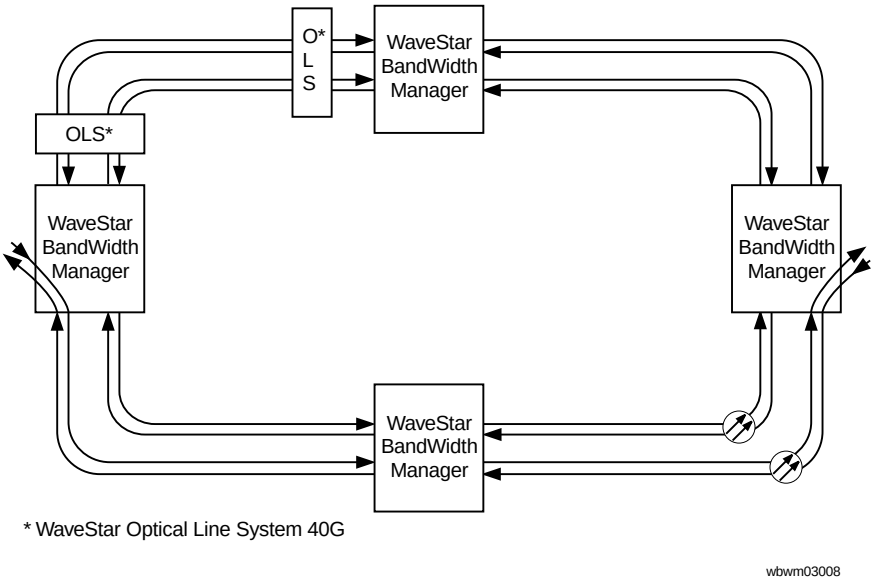
Overview

WaveStar BandWidth Manager supports direct optical transmission interfacing between WaveStar BandWidth Manager and WaveStar Optical Line System (OLS) 40G/80G without OTUs over OC-48/STM-16 interfaces (via the OC48/STM16/DWDM01-16 port units).

OLS 40G

Figure 3-20 illustrates optical transmission between two WaveStar BandWidth Managers and two WaveStar OLS 40G systems without OTUs over OC-48 interfaces. The ring in the following figure is a 4-fiber OC-48 BLSR.

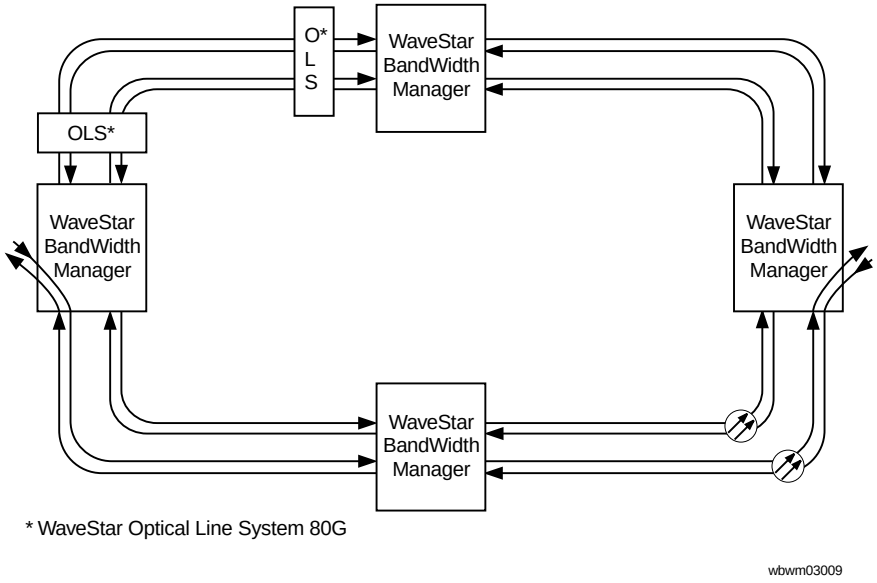
Figure 3-20 Interfacing with WaveStar OLS 40G



Important! WaveStar BandWidth Managers adjacent to the OLS systems must be equipped with OC48/STM16/DWDM01-16 port units in order to eliminate the need for OTUs in the OLS systems.

OLS 80G Figure 3-21 illustrates interworking between two WaveStar BandWidth Managers and two WaveStar OLS 80G systems without OTUs over STM-16 interfaces.The ring in the following figure is a 4-fiber STM-16 MS-SPRing.

Figure 3-21 Interfacing with WaveStar OLS 80G



Important! WaveStar BandWidth Managers adjacent to the OLS systems must be equipped with OC48/STM16/DWDM01-16 port units in order to eliminate the need for OTUs in the OLS systems.

Transmission Interfacing with WaveStar OLS 400G

Overview

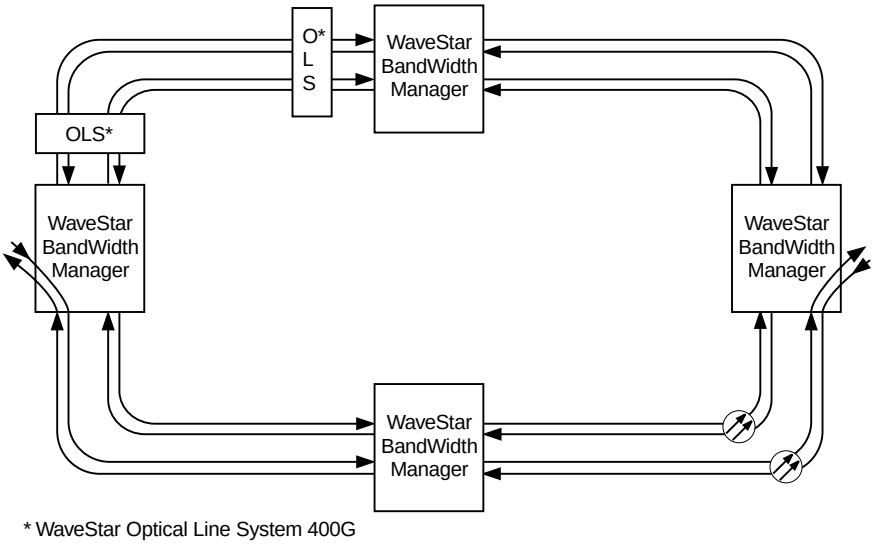
WaveStar BandWidth Manager supports direct optical transmission interfacing between WaveStar BandWidth Manager and WaveStar Optical Line System (OLS) 400G, Release 3 without OTUs over OC-192/STM-64 (via the 40 wavelengths of OC192/STM64/WDM port units), and over OC-48/STM-16 (via the 80 wavelengths of OC48/STM16/WDM port units).

Figure (OLS 400G)

Figure 3-22 illustrates optical transmission between WaveStar BandWidth Managers and WaveStar OLS 400G systems without OTUs over OC-192/STM-64 or OC-48/STM-16 interfaces.
The ring in Figure 3-22 could be either a 4-fiber OC-192 BLSR/STM-64 MS-SPRing or a 4-fiber OC-48 BLSR/STM-16 MS-SPRing.

WaveStar BandWidth Manager supports interworking with Release 3 and greater of WaveStar OLS 400G without OTUs.

Figure 3-22 Interfacing with WaveStar OLS 400G



Important! WaveStar BandWidth Managers adjacent to the OLS systems must be equipped with either OC192/STM64/WDM or OC48/STM16/WDM port units, in order to eliminate the need for OTUs in the OLS systems.

Valid Applications

Figure 3-23 illustrates a valid application using OC192/STM64/WDM port units with strong forward error correction (SFEC) enabled in the WaveStar BandWidth Manager NE and no OTUs in the WaveStar OLS 400G NEs.

Figure 3-23 Valid Application A with WaveStar OLS 400G

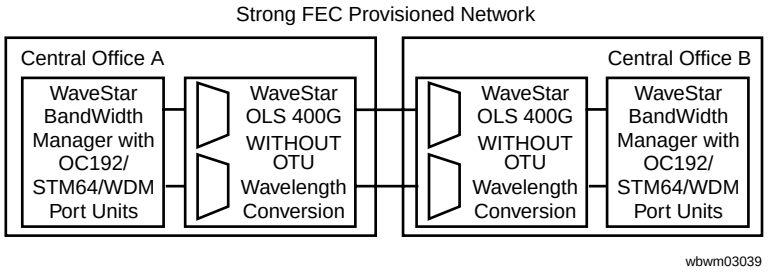
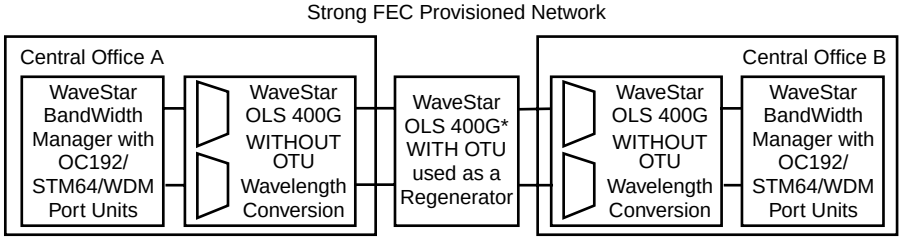


Figure 3-24 illustrates a valid application using OC192/STM64/WDM port units in the WaveStar BandWidth Manager NE and no OTUs in the WaveStar OLS 400G NEs. In this example, it is acceptable to have and WaveStar OLS 400G with OTUs (not directly interfacing with WaveStar BandWidth Managerin the application functioning as a repeater.

Figure 3-24 Valid Application B with WaveStar OLS 400G

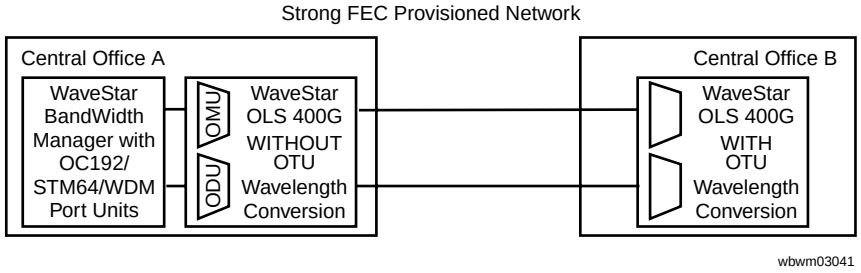


* The B1 byte must be turned off in this application. Monitor uncorredted and corrected errors in the WaveStar OLS 400G digital wrapper overhead for Bit Error Rate information.

Invalid application

Figure 3-25 illustrates an invalid application. When WaveStar BandWidth Manager is interfacing with WaveStar OLS 400G via the OC192/STM64/WDM port units, neither end of the span may be equipped with OTUs (in the WaveStar OLS 400G NE). The OTUs in OLS scramble the optical signal differently than OC192/STM64/WDM port units. Therefore, a span with OTUs in the WaveStar OLS 400G NE and OC192/STM64/WDM port units in the WaveStar BandWidth Manager NE would be an invalid application.

Figure 3-25 Invalid Application with WaveStar OLS 400G



Transmission Interfacing with Lucent GX 550 Multiservice WAN Switch

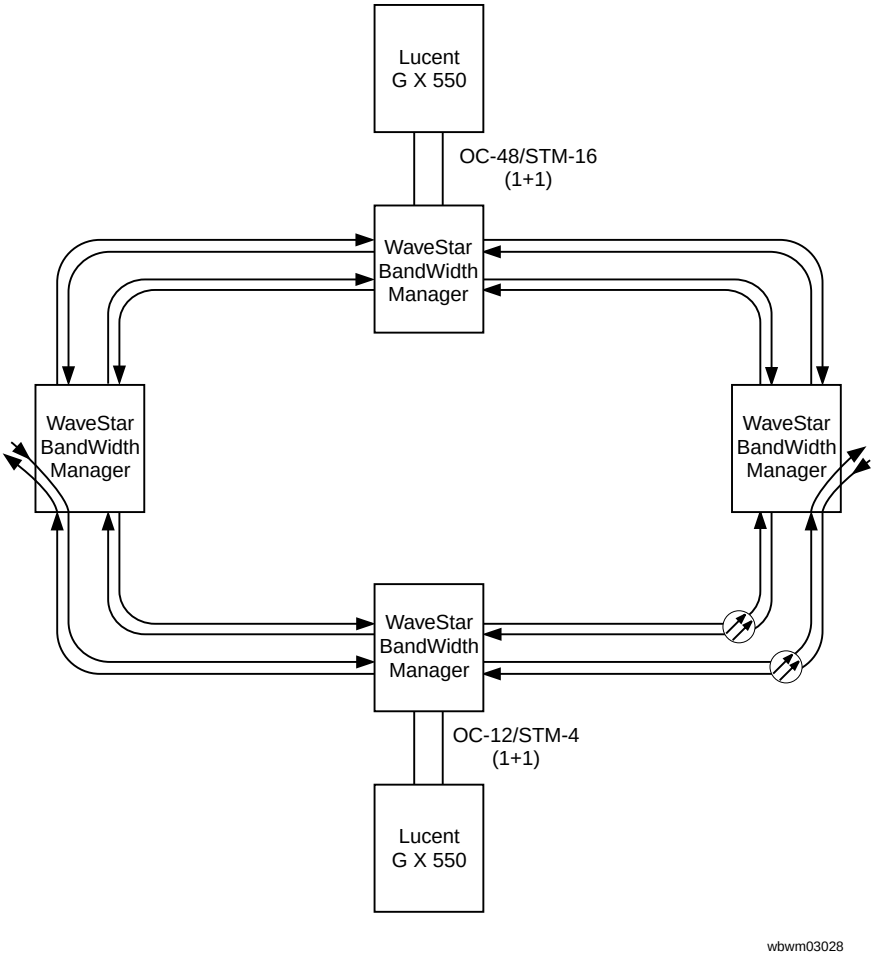
Overview

WaveStar BandWidth Manager supports optical transmission interfacing between Lucent (Ascend) GX 550 Multiservice WAN Switch systems and WaveStar BandWidth Manager over

- OC-12/STM-4 interfaces: 1+1 protected (bidirectional, non-revertive)
- OC-48/STM-16 interfaces: 1+1 protected (bidirectional, non-revertive)

Figure Figure 3-26 illustrates interfacing between WaveStar BandWidth Managers and GX 550 systems via OC-48/STM-16 and OC-12/STM-4 interfaces.

Figure 3-26 Interfacing with Lucent GX 550 Multiservice WAN Switch System



Important! WaveStar BandWidth Manager supports optical transmission between WaveStar BandWidth Manager and Lucent GX 550, Release Jade M2 (2.2.1.2) and greater.

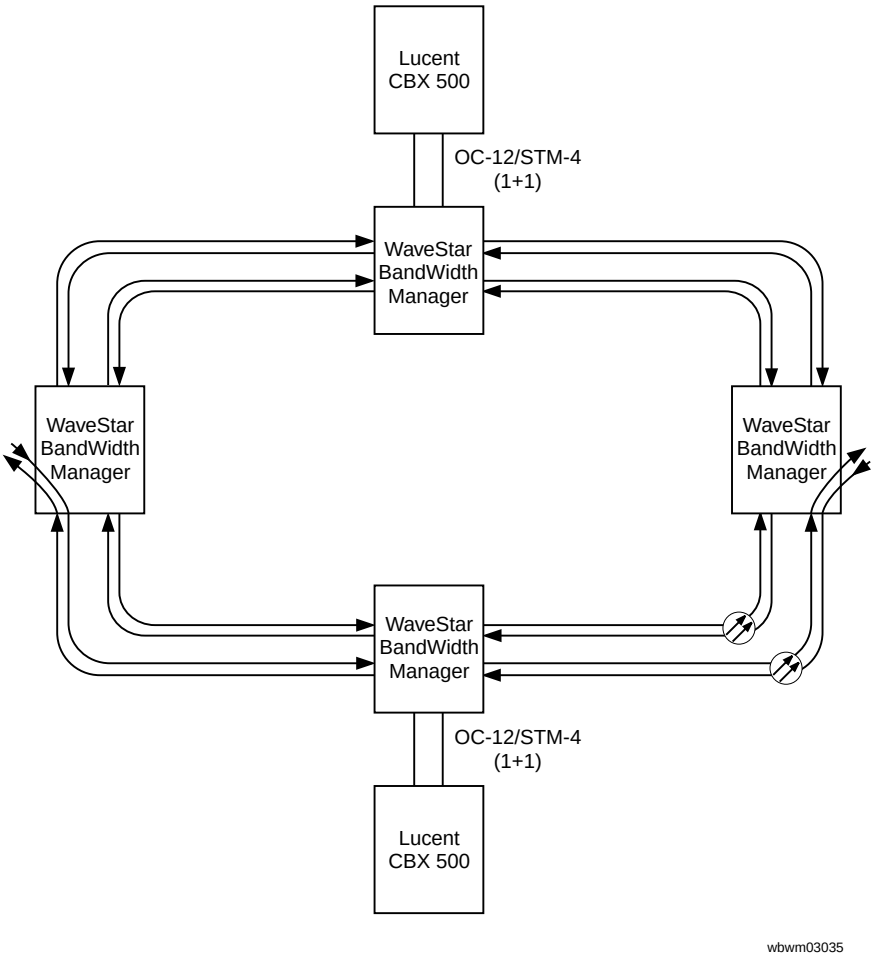
Transmission Interfacing with Lucent CBX 500 Multiservice WAN Switch

Overview

WaveStar BandWidth Manager supports optical transmission interfacing between Lucent CBX 500 Multiservice WAN Switch system and WaveStar BandWidth Manager over OC-12/STM-4 interfaces: 1+1 protected (bidirectional, non-revertive).

Figure Figure 3-27 illustrates optical transmission between WaveStar BandWidth Managers and CBX 500 systems over OC-12/STM-4 interfaces.

Figure 3-27 Interfacing with Lucent CBX 500 Multiservice WAN Switch System



Important! WaveStar BandWidth Manager supports optical transmission between WaveStar BandWidth Manager and Lucent CBX 500, Release Jade M2 (4.2) and greater.

Transmission Interfacing with Cisco ONS 15454

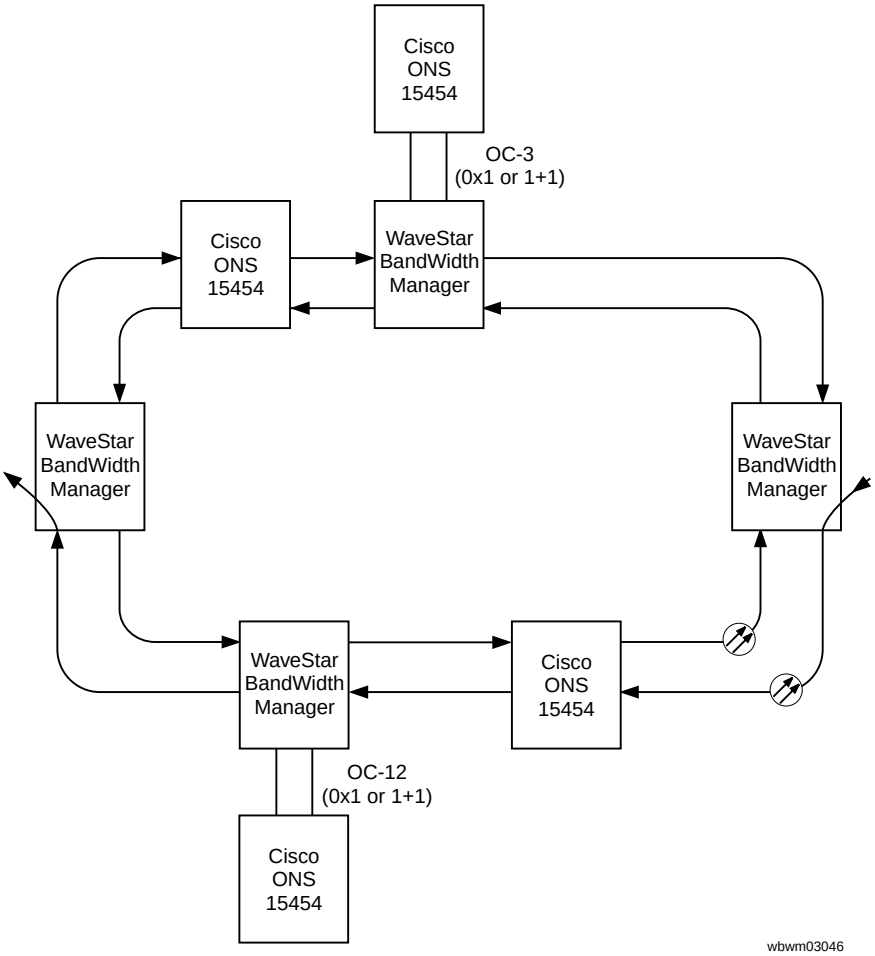
Overview

WaveStar BandWidth Manager supports optical transmission interfacing between Cisco ONS 15454 system and WaveStar BandWidth Manager over

- OC-48 UPSRs
- OC-3 interfaces: 0x1 and 1+1 protected (unidirectional, non-revertive)
- OC-12 interfaces: 0x1 and 1+1 protected (unidirectional, non-revertive)

Figure Figure 3-28 illustrates optical transmission between WaveStar BandWidth Managers and Cisco ONS 15454 systems over an OC-48 UPSR as well as OC-3 and OC-12 interfaces.

Figure 3-28 Interfacing with Cisco ONS 15454



Important! WaveStar BandWidth Manager supports optical transmission between WaveStar BandWidth Manager and Cisco ONS 15454, Release 2.2 and greater.

Transmission Interfacing with Marconi MSH 84/86

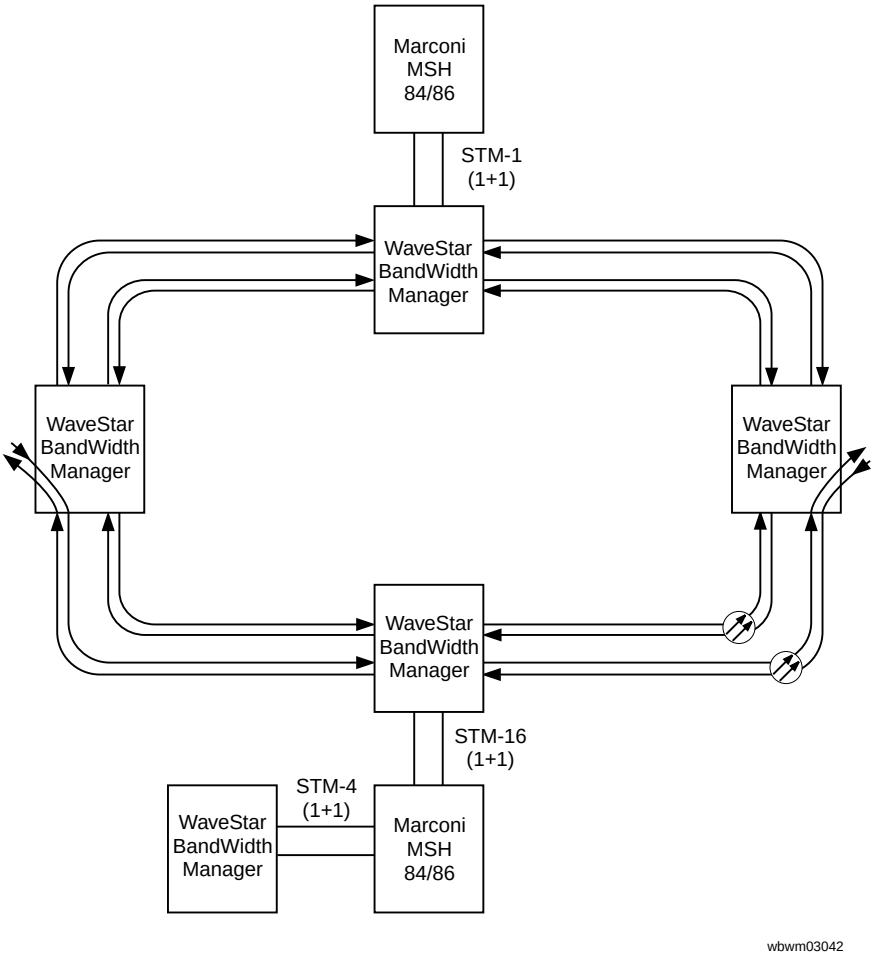
Overview

WaveStar BandWidth Manager supports optical transmission interfacing between Marconi MSH 84/86 and WaveStar BandWidth Manager over

- STM-1 interfaces: 1+1 protected (bidirectional, non-revertive)
- STM-4 interfaces: 1+1 protected (bidirectional, non-revertive)
- STM-16 interfaces: 1+1 protected (bidirectional, non-revertive)

Figure Figure 3-29 illustrates optical transmission between WaveStar BandWidth Managers and Marconi MSH 84/86 systems over STM-1, STM-4, and STM-16 interfaces.

Figure 3-29 Interfacing with Marconi MSH 84/86



Important! WaveStar BandWidth Manager supports optical transmission between WaveStar BandWidth Manager and Marconi MSH 84/86, Series 3 and greater.

□



4 Product Description

Overview

Purpose This section describes WaveStar BandWidth Manager equipment.

Contents The following topics are discussed in this chapter:

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Introduction to WaveStar BandWidth Manager

Overview

This section provides a brief introduction to WaveStar BandWidth Manager.

WaveStar BandWidth Manager

WaveStar BandWidth Manager is a platform for bandwidth management and integrated 2-fiber and 4-fiber Bidirectional Line-Switch Ring (BLSR)/Multiple Section - Shared Protection Ring (MS-SPRing) applications, as well as Unidirectional Path-Switch Ring (UPSR) and Sub-Network Connection Protection (SNCP) ring applications. WaveStar BandWidth Manager is a modular networking system capable of integrating multiple interoffice transport and broadband digital cross-connect facilities into a single network element.

WaveStar BandWidth Manager is available in a 4608/1536 platform which provides a main switch fabric capable of cross-connecting 4608 STS-1/1536 STM-1 equivalents.

Minimum configurations

The WaveStar BandWidth Manager 4608/1536 platform comprises

- The required cable management bays
- Either a 2-bay or 3-bay Control/Switch Complex
- An I/O Complex which may include a combination of Universal I/O Bays, 10G I/O Bays, 10G/Universal I/O Bays, SDH I/O Bays, and/or 10G/SDH I/O Bays

4608/1536 platform

The minimum configuration for the WaveStar BandWidth Manager 4608/1536 platform includes the required cable management bays, either a 2-bay or 3-bay Control/Switch Complex, and an I/O Complex.

Control/Switch Complex

A 2-bay or 3-bay Control Switch/Complex provides fully-duplicated main control, memory, and timing for the platform and a fully-duplicated, single-stage, N^2, 4608x4608/1536x1536 cross-connect main switch fabric for the platform.

> **Important!** A 2-bay Control/Switch Complex comprises one Control/Switch Bay and one Switch Bay. A 3-bay Control/Switch Complex comprises one System Controller Bay and two Switch Bays.

I/O Complex

An I/O Complex provides electrical and optical transmission interfaces that are housed in Universal I/O Shelves, SDH Universal I/O Shelves, and/or 10G I/O Shelves.

All transmission port units (hardware) are capable of transmitting and receiving SDH-rate and SONET-rate signals. The WaveStar BandWidth Manager software allows you to provision the port unit to accept the appropriate type of signal.

□

4608/1536 Platform

Overview

This section briefly introduces the 4608/1536 platform available in WaveStar BandWidth Manager. The remaining chapters provide specific details about the product.

4608/1536 platform description

With the WaveStar BandWidth Manager 4608/1536 platform, Lucent enables customers to add capacity to their network as needed without wasting equipment and incurring unnecessary costs. (4608/1536 represents the size of the platform's main switch, 4608 STS-1/1536 STM-1 equivalents.)

The WaveStar BandWidth Manager 4608/1536 platform includes either a 2-bay or 3-bay Control/Switch Complex, an I/O Complex (maximum of 36 I/O Shelves with a maximum of 48 SWIF pairs), and the required cable management bays.

Control/Switch Complex

A 2-bay or 3-bay Control/Switch Complex provides fully-duplicated main control, memory, and timing for the platform and a fully-duplicated, single-stage, N^2, 4608x4608/1536x1536 cross-connect main switch fabric.

> **Important!** The reduced footprint floor plans with the reduced cabling for 2-bay Control/Switch Complexes (Figure 4-1 [NEBs] and Figure 4-2 [ETSI]) are available as of July 1, 2001.
>
> Effective June 1, 2002, the standard footprints (Figure 4-3 and Figure 4-5 [NEBs] and Figure 4-4 and Figure 4-6 [ETSI]) will be DA.
>
> Contact your Account Executive for more information.

2-bay Control/Switch Complex

A 2-bay Control/Switch Complex comprises one Control/Switch Bay, one Switch Bay, and three required cable management bays.

Figure 4-1 (NEBs) and Figure 4-2 (ETSI) illustrate the 2-bay Control/Switch Complexes for the reduced footprints.

> **Important!** Because the 3-bay Control/Switch Complexes will be DA effective April 1, 2002, the reduced footprint floor plans will only be available with 2-bay Control/Switch Complexes. Please contact you Account Executive for more information.

Figure 4-1 NEBS 2-Bay Control/Switch Complex - Reduced Footprints

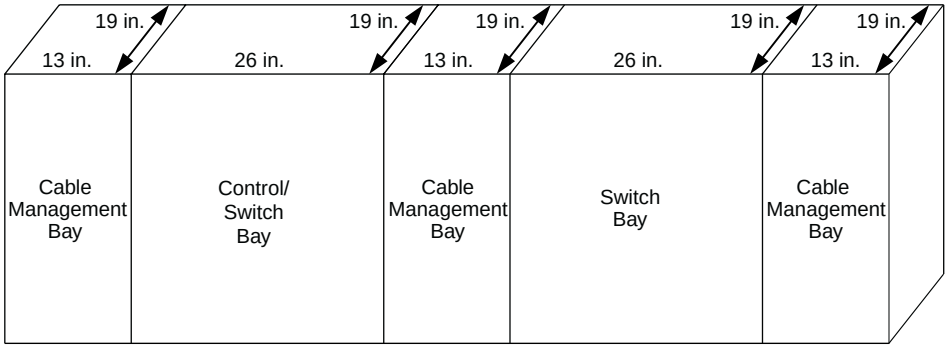


Figure 4-2 ETSI 2-Bay Control Switch Complex - Reduced Footprints

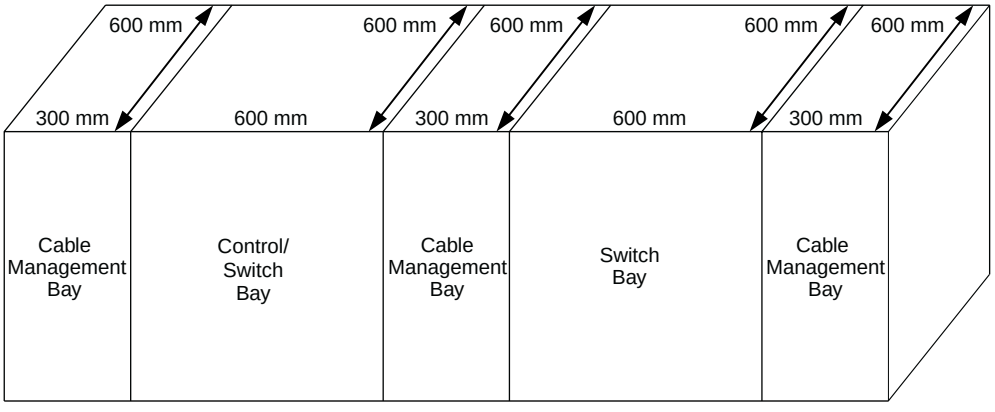


Figure 4-3 (NEBs) and Figure 4-4 (ETSI) illustrate the 2-bay Control/Switch Complexes for the standard footprints.

Important! Effective June 1, 2002, the standard footprints will be DA.

Figure 4-3 NEBS 2-Bay Control/Switch Complex -Standard Footprints

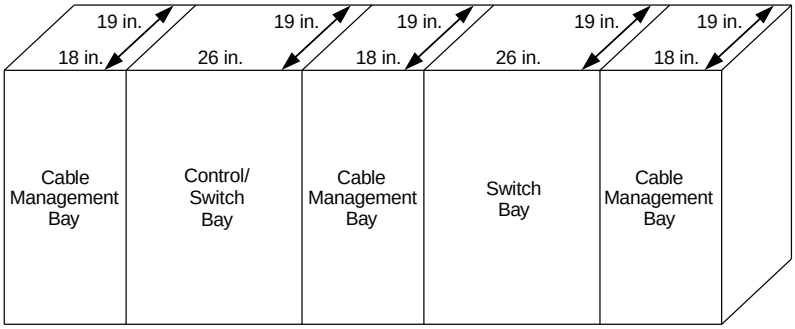
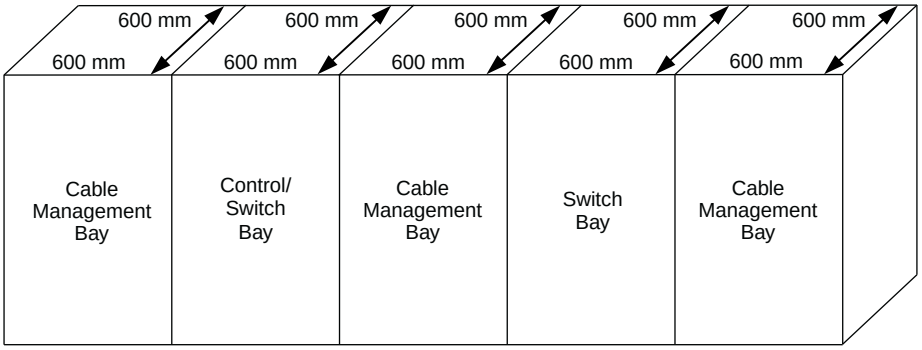


Figure 4-4 ETSI 2-Bay Control Switch Complex - Standard Footprints

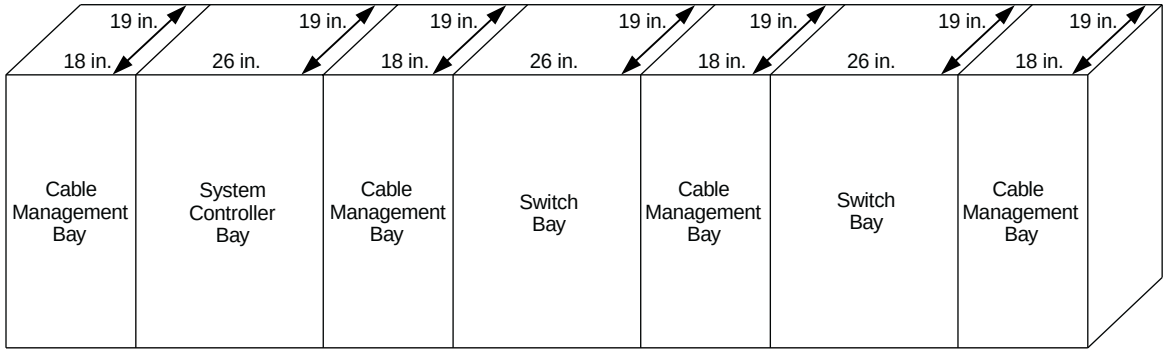


3-bay Control/Switch Complex

A 3-bay Control/Switch Complex comprises one System Controller Bay, two Switch Bays, and four required cable management bays.

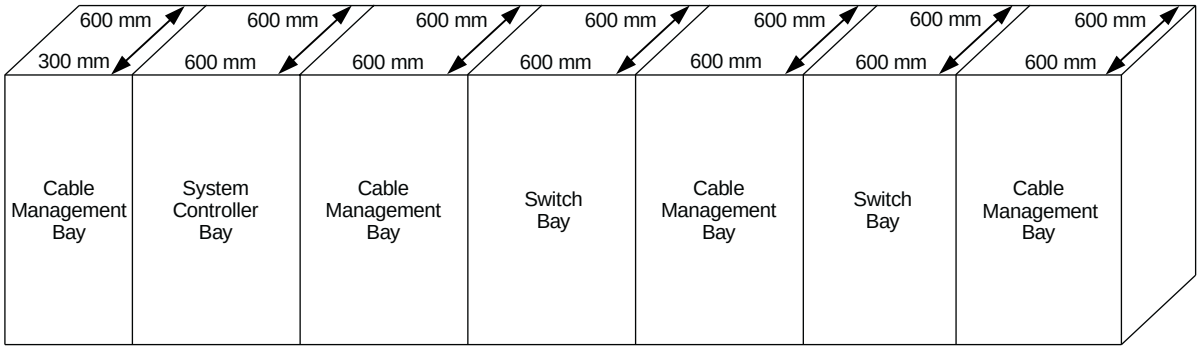
Figure 4-5 (NEBs) and Figure 4-6 (ETSI) illustrate the 3-bay Control/Switch Complexes for the standard footprints.

Figure 4-5 NEBS 3-Bay Control/Switch Complex - Standard Footprints



wbwm04053

Figure 4-6 ETSI 3-Bay Control/Switch Complex - Standard Footprints



wbwm04152

I/O Complex

An I/O Complex provides electrical and optical transmission interfaces that are housed in Universal I/O Shelves, SDH Universal I/O Shelves, and/or 10G I/O Shelves.

All transmission port units (hardware) are capable of transmitting and receiving SDH-rate and SONET-rate signals. The WaveStar BandWidth Manager software allows you to provision the port unit to accept the appropriate type of signal.

Universal I/O Shelves

The Universal I/O Shelves are capable of terminating

- 2-fiber OC-48 BLSRs/STM-16 MS-SPRings via OC48/STM16 port units
- 4-fiber OC-48 BLSRs/STM-16 MS-SPRings (open and closed) via OC48/STM16 port units
- 4-fiber STM-16 MS-SPRings with transoceanic protocol (open and closed) via the OC48/STM16 port units
- OC-48 and OC-12 Unidirectional Path-Switch Rings (UPSRs)
- STM-N Sub-Network Connection Protection (SNCP) rings
- Long reach OC-48/STM-16 signals via OC48/STM16 port units
- Short and long reach OC-12/STM-4 signals via OC12/STM4 port units
- Short and long reach OC-3/STM-1 signals via OC3/STM1 port units
- DS3 and EC-1 signals via DS3EC1/8 port units

SDH Universal I/O Shelves

The SDH Universal I/O Shelves are capable of terminating

- 2-fiber OC-48 BLSRs/STM-16 MS-SPRings via OC48/STM16 port units
- 4-fiber OC-48 BLSRs/STM-16 MS-SPRings (open and closed) via OC48/STM16 port units
- 4-fiber STM-16 MS-SPRings with transoceanic protocol (open and closed) via OC48/STM16 port units
- OC-48 and OC-12 unidirectional path-switch rings (UPSRs)
- STM-N Sub-Network Connection Protection (SNCP) rings
- Long reach OC-48/STM-16 signals via OC48/STM16 port units
- Short and long reach OC-12/STM-4 signals via OC12/STM4 port units
- Short and long reach OC-3/STM-1 signals via OC3/STM1 port units
- STM-1e signals via STM1E/4 port units

10G I/O Shelves

The 10G I/O Shelves are capable of terminating

- 2-fiber OC-192 BLSRs/STM-64 MS-SPRings via OC192/STM64 port units
- 4-fiber OC-192 BLSRs/STM-64 MS-SPRings (open and closed) via OC192/STM64 port units
- 4-fiber STM-64 MS-SPRings with transoceanic protocol (open and closed) via OC192/STM64 port units
- STM-64 Sub-Network Connection Protection (SNCP) rings
- Intermediate and extended intermediate reach OC-192/STM-64 signals via OC192/STM64 port units

Spacers between I/O Bays

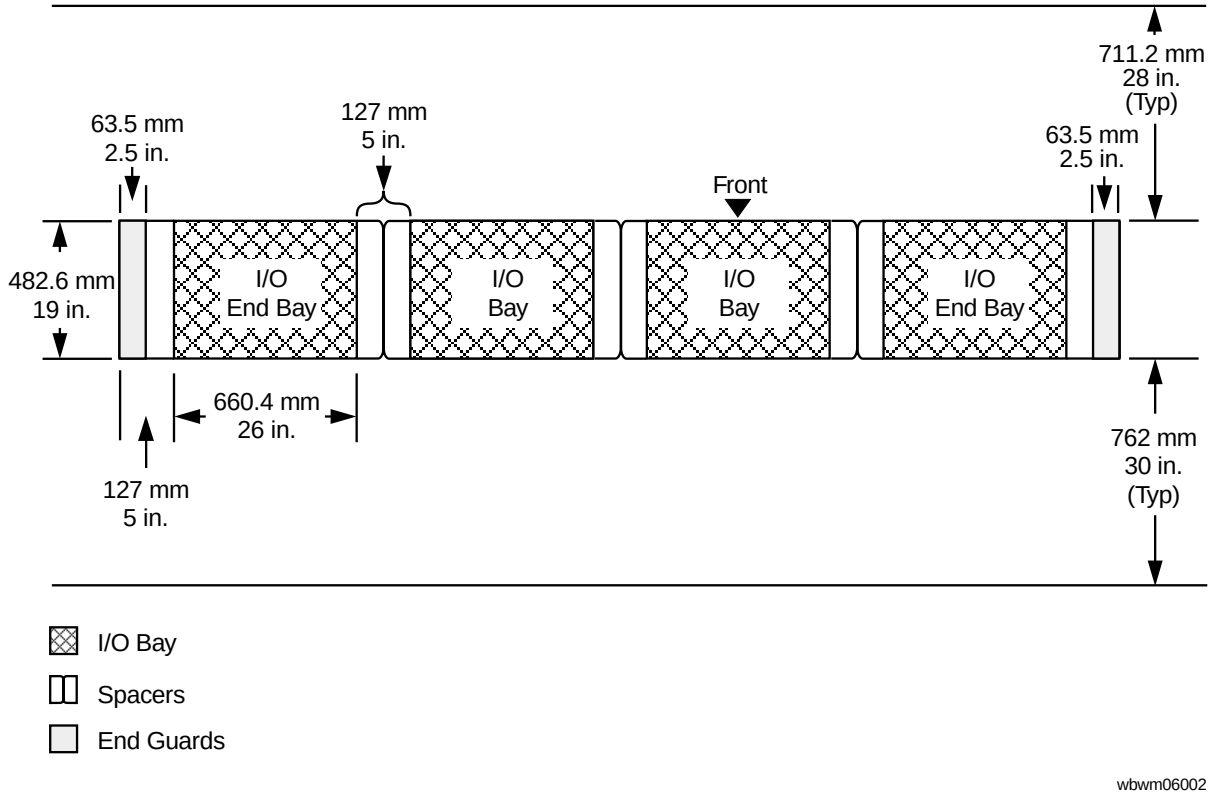
The NEBS I/O Complexes require spacers between the I/O Bays. The ETSI I/O Complexes require cable management bays between the I/O Bays.

NEBS I/O Complexes

Figure 4-7 (NEBS) illustrates the spacers required between I/O Bays in NEBS I/O Complexes.

> **Important!** The NEBS I/O Complex is physical the same in the standard and reduced footprints.

Figure 4-7 NEBS I/O Complexes



ETSI I/O Complexes

Figure 4-8 (standard footprints) and Figure 4-9 (reduced footprints) illustrate the cable management bays required between I/O Bays in ETSI I/O Complexes.

> **Important!** The cable management bays in ETSI I/O Complexes (reduced footprints) vary in size depending on the type of I/O Shelves in the adjacent I/O Bays.

Figure 4-8 ETSI I/O Complexes (Standard Footprints)

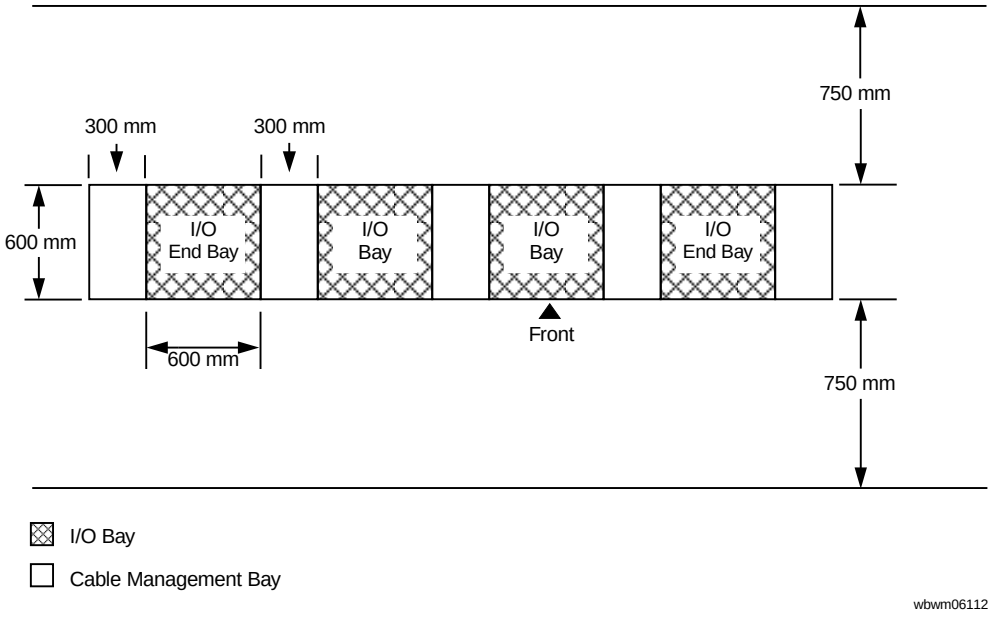
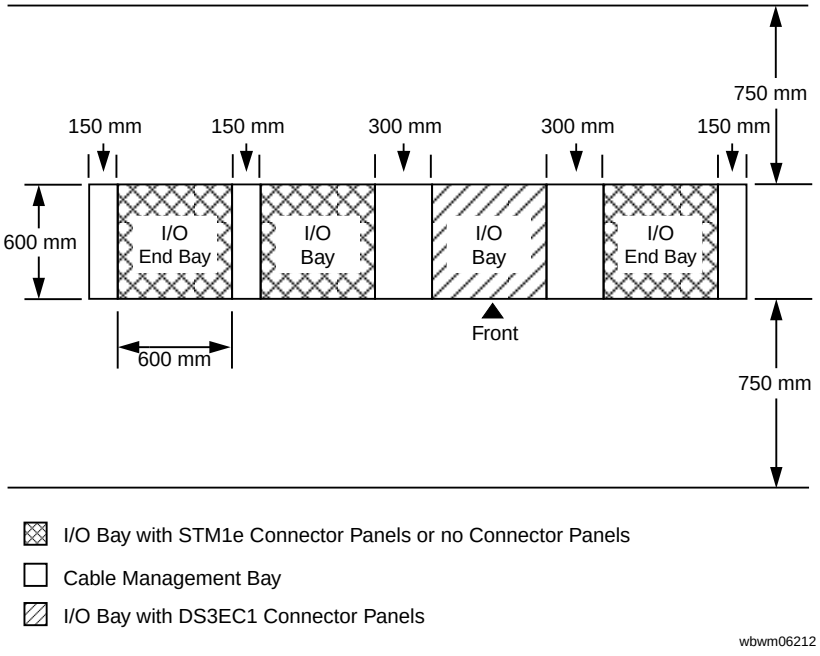


Figure 4-9 and illustrates the cable management bays required between I/O Bays in ETSI platforms (reduced footprints).

Important! The cable management bays between or adjacent to I/O Bays with STM1e Connector Panels or no connector panels are 150 mm wide. The cable management bays between or adjacent to I/O Bays with DS3EC1 Connector Panels are 300 mm wide. For example, a single 300 mm cable management bay between an I/O bay with DS3EC1 Connector Panels and an I/O Bay with no connector panels is sufficient.

For example, an I/O Bay with a single DS3EC1 Connector Panel on the right side of the bay only requires one 300 mm wide cable management bay on the right side of the bay. The cable management on the left side of the bay should be 150 mm wide.

Figure 4-9 ETSI I/O Complexes (Reduced Footprints)



Reference For more information about the cable management bays and the standard and reduced footprints, refer to Chapter 6, “System Planning and Engineering.”

Hardware Overview

Overview

WaveStar BandWidth Manager comprises complexes, bays, shelves, modules, circuit packs, and port units.

Definition of complex

A complex is a grouping of one or more equipped bays with a specific, shared functionality.

Types of complexes

The WaveStar BandWidth Manager platforms may be described and illustrated by the following complexes:

- Control/Switch Complexes (2-bay or 3-bay)
- Switch Complexes
- 4608/1536 local I/O Complex

Definition of bay

A bay is a frame containing one or more shelves. Seven-foot seismic Network Equipment-Building System (NEBS) network frames are available for SONET applications. European Telecommunications Standards Institute (ETSI) frames are available for SDH applications.

Important! The term *bay* is interchangeable with rack.

Types of bays

WaveStar BandWidth Manager platforms include the following types of bays:

- System Controller Bays
- Switch Bays
- Control/Switch Bays
- Universal I/O Bays
- 10G I/O Bays
- 10G/Universal I/O Bays
- SDH I/O Bays
- 10G/SDH I/O Bays

Definition of shelf

A shelf is a small framework (often called a shelf assembly) with cabling that provides slots capable of housing circuit packs and port units. Shelves are mounted in bays.

Important! The term *shelf* is interchangeable with sub-rack.

Types of shelves

The WaveStar BandWidth Manager 4608/1536 platform includes the following types of shelves:

- System Controller Shelves
- Switch Shelves
- Universal I/O Shelves
- 10G I/O Shelves
- SDH Universal I/O Shelves

Circuit packs

The WaveStar BandWidth Manager circuit packs are grouped according to their functionality into the following three categories:

- Control packs
- Switch packs
- Port units

□

Control/Switch Complex

Overview

This section describes the Control/Switch Complexes in WaveStar BandWidth Manager.

Control Complex

The WaveStar BandWidth Manager Control Complex includes one equipped System Controller Shelf, housed in either a Control/Switch Bay (2-bay Control/Switch Complex) or a System Controller Bay (3-bay Control Switch Complex).

Control/Switch Complex

The Control/Switch Complex is the basic core of WaveStar BandWidth Manager.

2-bay Control/Switch Complex

The 2-bay Control/Switch Complex comprises the required cable management bays and

- One Control/Switch Bay that is equipped with a System Controller Shelf and a 4608/1536 Switch Shelf
- One Switch Bay that is equipped with a 4608/1536 Switch Shelf

3-bay Control/Switch Complex

The 3-bay Control/Switch Complex comprises the required cable management bays and

- One System Controller Bay that is equipped with a System Controller Shelf
- Two Switch Bays that are equipped with 4608/1536 Switch Shelves

□

System Controller Bay

Overview

The System Controller Bay provides fully-redundant main controller, timing, and memory functions for WaveStar BandWidth Manager.

Dimensions

The dimensions of a NEBS System Controller Bay are

- 2133.6 mm/84 in. high
- 660.4 mm/26 in. wide
- 482.6 mm/19 in. deep

The dimensions of an ETSI System Controller Bay are

- 2200 mm/86.6 in. high
- 600 mm/23.6 in. wide
- 600 mm/23.6 in. deep

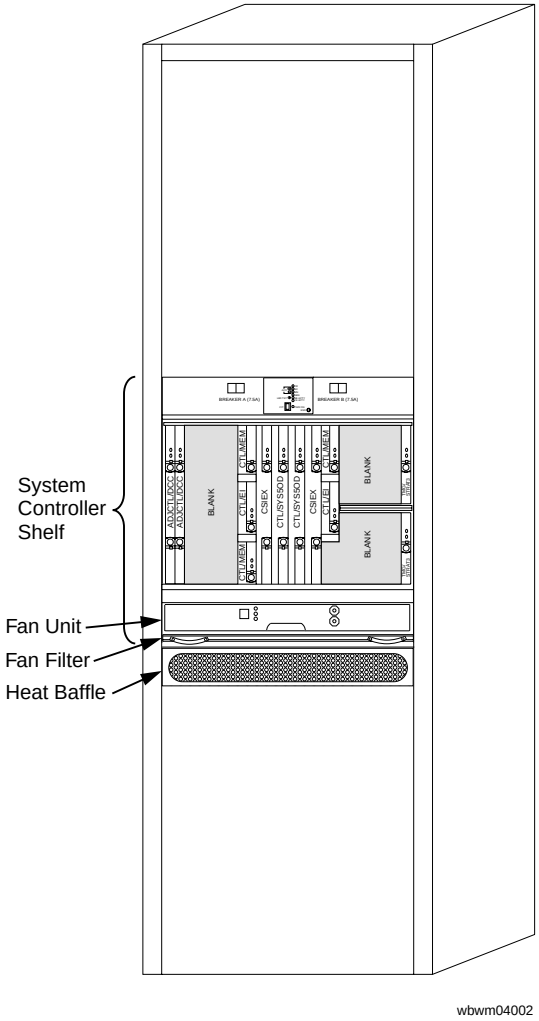
Shelves

The bottom shelf space can be used to mount the optional Network Communications Controller (NCC), the middle shelf is equipped as a System Controller Shelf, and the top shelf space is reserved for future features.

System Controller Bay figure

Figure 4-10 illustrates a System Controller Bay in WaveStar BandWidth Manager.

Figure 4-10 System Controller Bay



Control/Switch Bay

Overview

The Control/Switch Bay provides fully-redundant main controller, timing, and memory functions (System Controller Shelf) and the working side of a 4608/1536 switch center (Switch Shelf) for WaveStar BandWidth Manager.

Dimensions

The dimensions of a NEBS Control/Switch Bay are

- 2133.6 mm/84 in. high
- 660.4 mm/26 in. wide
- 482.6 mm/19 in. deep

The dimensions of an ETSI Control/Switch Bay are

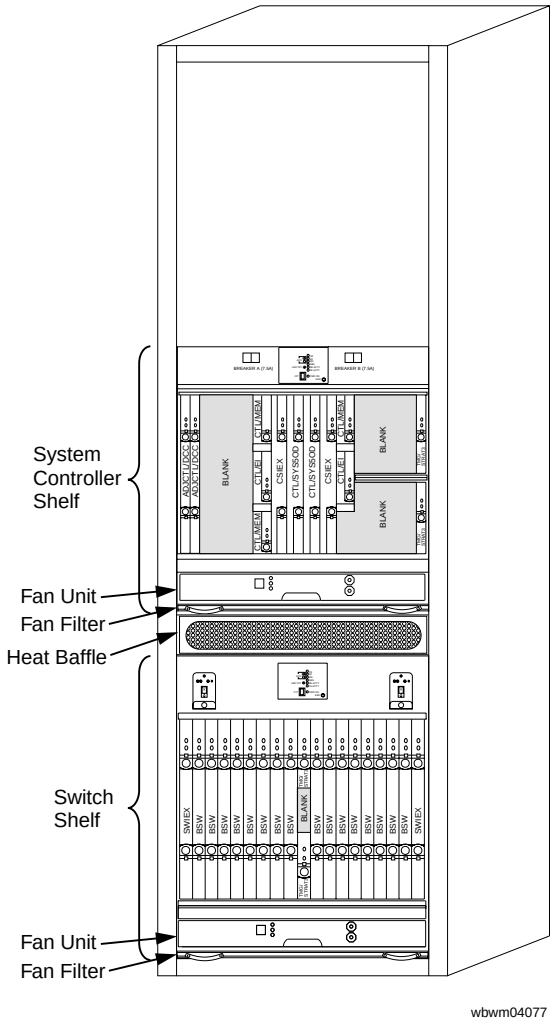
- 2200 mm/86.6 in. high
- 600 mm/23.6 in. wide
- 600 mm/23.6 in. deep

Shelves

The Control/Switch Bay is capable of housing three shelves. The bottom shelf space is equipped with a Switch Shelf, the middle shelf space is equipped with a System Controller Shelf, and the top shelf space can be used to mount the optional Network Communications Controller (NCC).

Control/Switch Bay figure Figure 4-11 illustrates a Control/Switch Bay or a 4608/1536 platform.

Figure 4-11 Control/Switch Bay



Important! If you mount an NCC (optional) in the top shelf space, you must install an additional heat baffle between the NCC and the System Controller Shelf.

System Controller Shelf

Overview

Each WaveStar BandWidth Manager System Controller Bay includes one System Controller Shelf that provides the main control functions for the WaveStar BandWidth Manager 4608/1536 platform.

Circuit packs

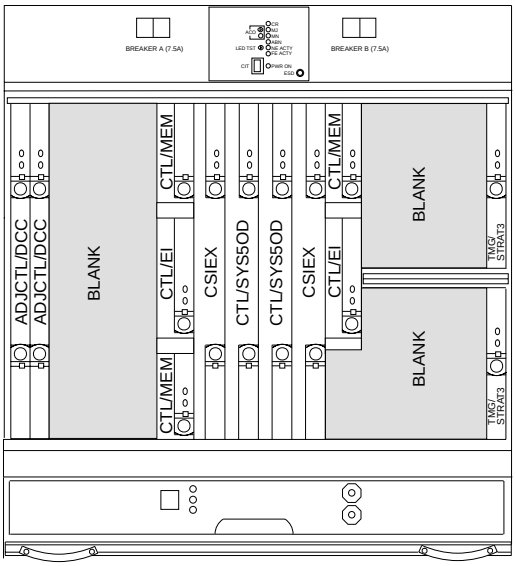
A fully-equipped System Controller Shelf includes the following circuit packs:

- Two ADJCTL/DCC
- Three CTL/MEM
- Two CTL/EI
- Two CSIEX
- Two CTL/SYS50D
- Two TMG/STRAT3

System Controller Shelf figure

Figure 4-12 illustrates a fully-equipped System Controller Shelf.

Figure 4-12 System Controller Shelf

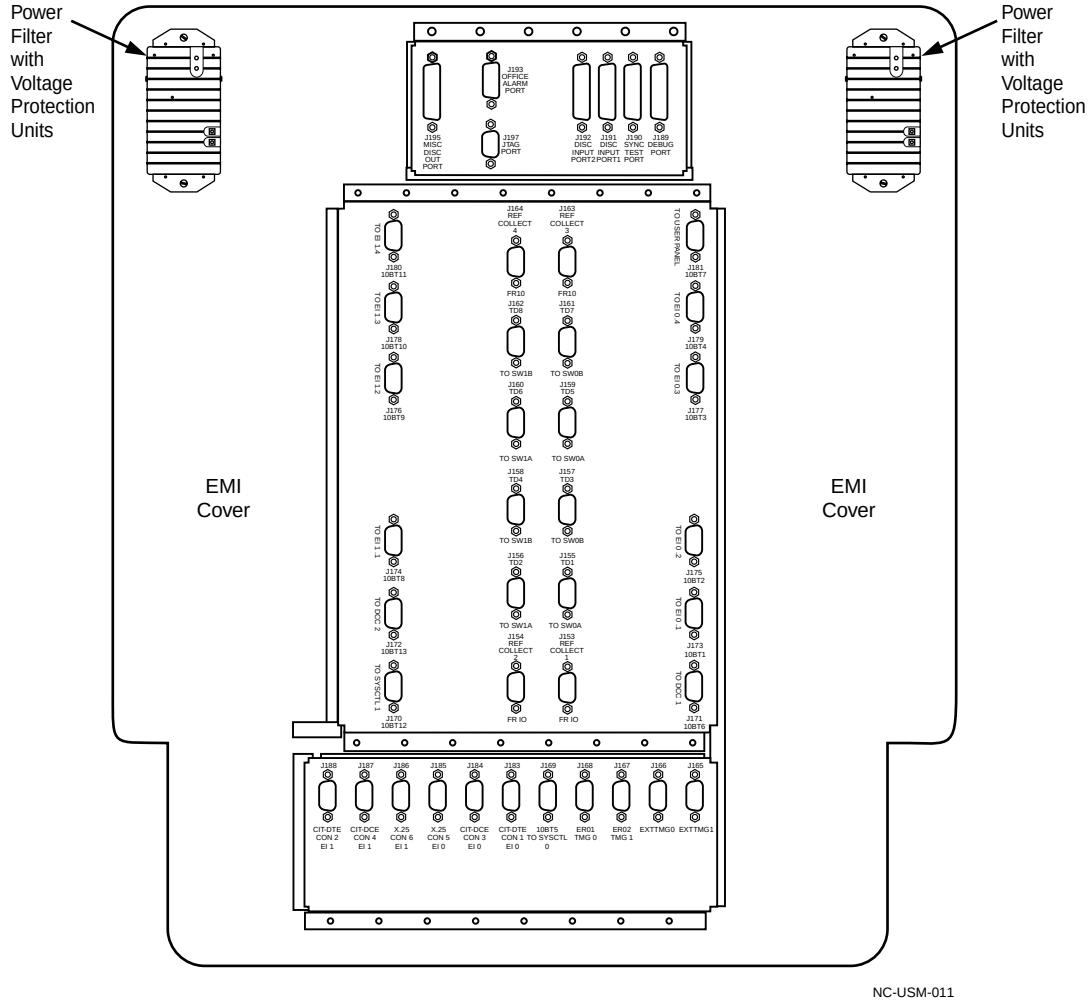


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External shelf backplane interfaces

Figure 4-13 illustrates the System Controller Shelf backplane.

Figure 4-13 System Controller Shelf Backplane



NC-USM-011

The System Controller Shelf backplane provides the following external interfaces:

Table 4-1 System Controller Shelf External Connectors

Connector	Purpose	Status
J197	JTAG Port	NOT USED
J195	Miscellaneous Discrete Output	NOT USED
J193	Office Alarms	
J192	Miscellaneous Discrete Input 1	NOT USED
J191	Miscellaneous Discrete Input 2	NOT USED
J190	Synchronization Test Port	
J189	Debug Port (RS-232 serial interfaces)	
J188	CIT-DTE Connector 2	NOT USED
J187	CIT-DCE Connector 4	NOT USED
J186	X.25 Connector 6	NOT USED
J185	X.25 Connector 5	NOT USED
J184	CIT-DCE Connector 3	NOT USED
J183	CIT-DTE Connector 1	NOT USED
J181	User Panel	
J180	HUB port (EI-1-4)	
J179	HUB port (EI-0-4)	
J178	HUB port (EI-1-3)	
J177	HUB port (EI-0-3)	
J176	HUB port (EI-1-2)	
J175	HUB port (EI-0-2)	
J174	HUB port (EI-1-1)	
J173	HUB port (EI-0-1)	
J172	DCC-1	
J171	DCC-2	
J170	SYSCTL-1	NOT USED
J169	SYSCTL-2	NOT USED
J168	External Timing Reference Out (ERO 1)	
J167	External Timing Reference Out (ERO 2)	

Connector	Purpose	Status
J166	External Timing Reference In (EXTTMG 0)	
J165	External Timing Reference In (EXTTMG 1)	
J164	Timing Collection (Ref Collect 4)	
J163	Timing Collection (Ref Collect 3)	
J162	Timing Distribution (To SW 1B)	NOT USED
J161	Timing Distribution (To SW 0B)	NOT USED
J160	Timing Distribution (To SW 1A)	
J159	Timing Distribution (To SW 0A)	
J158	Timing Distribution (To SW 1B)	NOT USED
J157	Timing Distribution (To SW 0B)	NOT USED
J156	Timing Distribution (To SW 1A)	
J155	Timing Distribution (To SW 0A)	
J154	Timing Collection (Ref Collect 2)	
J153	Timing Collection (Ref Collect 1)	

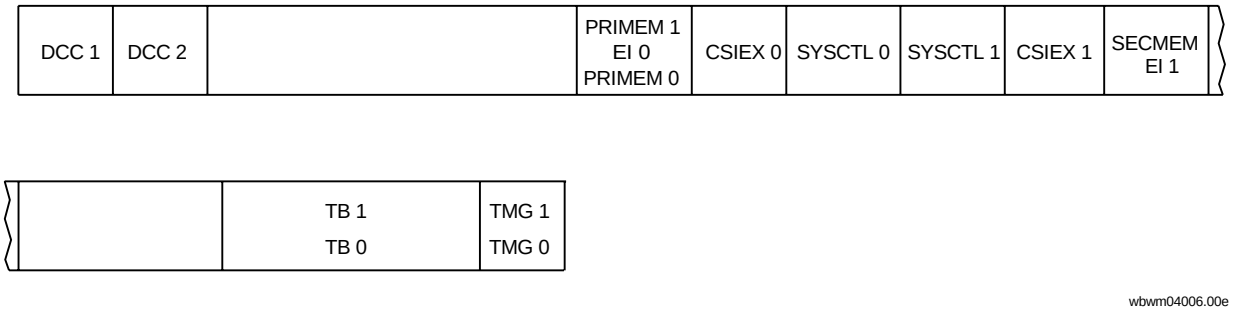
RS-232 interfaces

WaveStar BandWidth Manager, R4.1 provides duplicated RS-232 interfaces. These RS-232 interfaces allow the user an additional method of logging onto the system and entering raw ASCII TL1 commands from an ASCII terminal or a PC that is running an application like HyperTerminal. The Y-cable plugs into the J189 Debug Port on the backplane of the System Controller Shelf (refer to Figure 4-13). The Y-cable provides access to two independent, redundant RS-232 serial ports on the System Controller Shelf.

Designation label strip

The circuit packs used in the System Controller Shelf must be inserted into the appropriate slots according to the designation label strip illustrated in Figure 4-14.

Figure 4-14 System Controller Shelf Designation Label Strip



Equipped slots Circuit packs should be inserted into the slots indicated in the following table.

Table 4-2 Equipped Slots – System Controller Shelf

Slot	Circuit Pack
DCC 1[a]	ADJCTL/DCC
DCC 2[a]	ADJCTL/DCC
PRIMEM 1[b] EI 0 PRIMEM 0	CLT/MEM CLT/EI CTL/MEM
CSIEX 0	CSIEX
SYSCTL 0[c]	CTL/SYS50D
SYSCTL 1[c]	CTL/SYS50D
CSIEX 1	CSIEX
SEC MEM[b] EI 1	CTL/MEM CTL/EI Blank
TB 1 TB 0	Blank
TMG 1[d] TMG 0	TMG/STRAT3 TMG/STRAT3

a) For the DCC slots, the first pack is designated by a 1 and the second pack is designated by a 2. The duplex ADJCTL/DCC packs are Active-Active; both packs carry service.

b) These packs are one third the height of a normal full-sized pack. Therefore, when placed on top of each other, three of these packs can fit in one normal slot.

c) The 0 indicates the service pack of a pair goes in that slot. The 1 indicates the protection pack of a pair goes in that slot.

d) The TMG/STRAT3 packs are half the height of a normal full-sized pack. Therefore, when one pack is placed on top of the other these two packs can fit in one normal slot.

Switch Complexes

Overview

This section describes the Switch Complexes in WaveStar BandWidth Manager.

Switch Complex

A Switch Complex includes two Switch Shelves, which include logical groupings of BSW switch packs, TMG/STRAT3 circuit packs, and SWIEX circuit packs.

4608/1536 Switch Complex

A 4608/1536 Switch Complex (two Switch Shelves) includes two 4608/1536 switch centers, one working and one standby. (A 4608/1536 switch center is a fully-equipped Switch Shelf.) A 4608/1536 Switch Complex can be housed in a Control/Switch Bay and a Switch Bay (2-bay Control/Switch Complex), or two Switch Bays (3-bay Control/Switch Complex).

> **Important!** For WaveStar BandWidth Manager platforms, switch side 1-1 and switch side 2-1 are often used to designate the active and stand-by switch sides, respectively.

References

For information about planning for growth to larger platforms, refer to Chapter 6, “System Engineering and Planning.”

□

Switch Bay

Overview

Two Switch Shelves, housed in either two Switch Bays or a Switch Bay and Control/Switch Bay, provide a fully-redundant, cross-coupled main switch fabric for WaveStar BandWidth Manager.

Dimensions

The dimensions of a NEBS Switch Bay are

- 2133.6 mm/84 in. high
- 660.4 mm/26 in. wide
- 482.6 mm/19 in. deep

The dimensions of an ETSI Switch Bay are

- 2200 mm/86.6 in. high
- 600 mm/23.6 in. wide
- 600 mm/23.6 in. deep

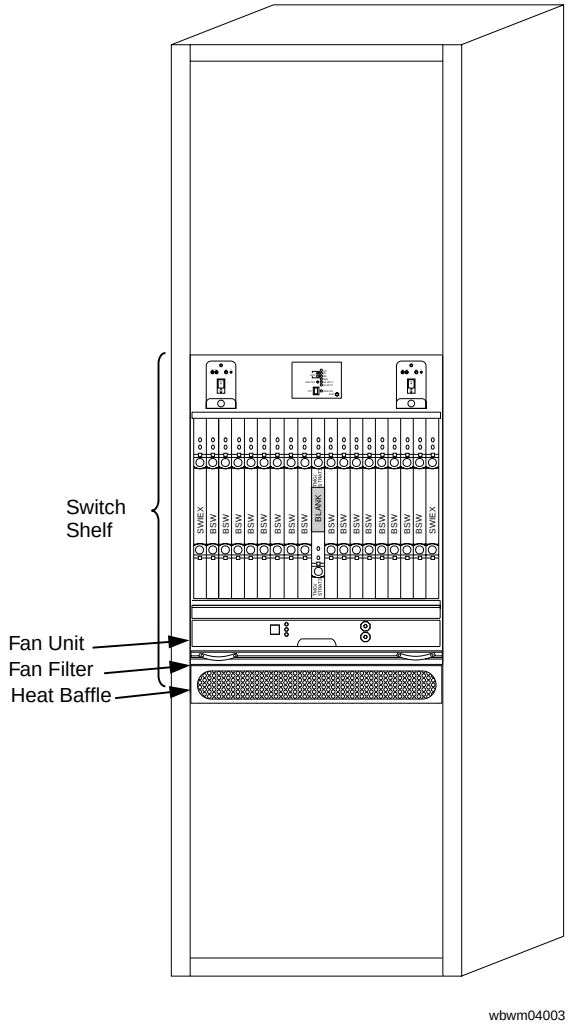
Shelves

In a Switch Bay, the middle shelf is equipped as a 4608/1536 Switch Shelf (fully-equipped). The top and bottom spaces are reserved for future releases.

4608/1536 Switch Bay

Figure 4-15 illustrates one 4608/1536 Switch Bay (one-half of a 4608/1536 Switch Complex) as it would appear in either a 2-bay or 3-bay Control/Switch Complex.

Figure 4-15 4608/1536 Switch Bay



Switch Shelf

Overview

The two Switch Shelves provide a fully-duplicated, cross-coupled, N^2 main switch fabric for WaveStar BandWidth Manager.

Circuit packs

A populated 4608/1536 Switch Shelf includes the following circuit packs:

- Two SWIEX
- 16 BSW
- Two TMG/STRAT3

Important! A 4608/1536 Switch Shelf is a fully-equipped Switch Shelf.

Definition of switch center

A switch center (SWC) is a logical grouping of BSW switch packs, TMG/STRAT3 circuit packs, and SWIEX circuit packs in a Switch Shelf.

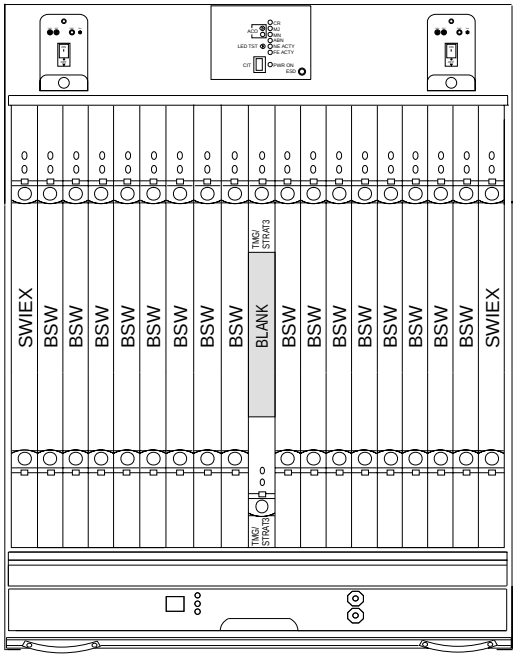
4608/1536 switch center

A 4608/1536 switch center is a fully-equipped Switch Shelf. Therefore, a 4608/1536 Switch Complex (either a Control/Switch Bay and a Switch Bay, or two Switch Bays) includes two 4608/1536 switch centers, one active and one active but in standby-mode.

4608/1536 Switch Shelf

Figure 4-16 illustrates a fully-equipped Switch Shelf.

Figure 4-16 4608/1536 Switch Shelf

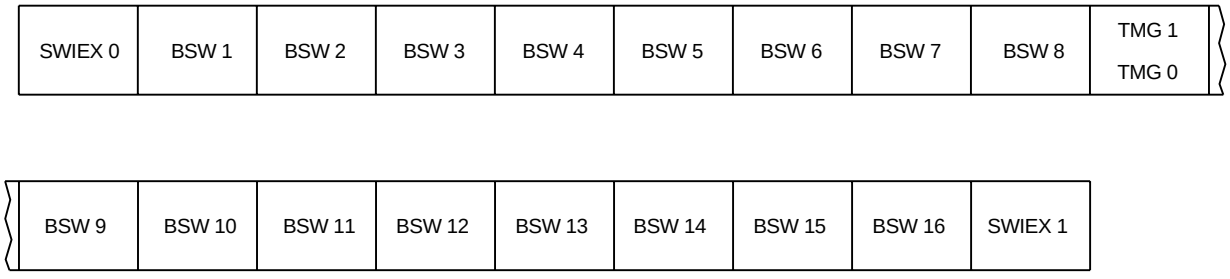


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Designation label strip

The circuit packs used in the Switch Shelf must be inserted into the appropriate slots according to the designation label strip illustrated in Figure 4-17.

Figure 4-17 Switch Shelf Designation Label Strip



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Equipped slots Circuit packs should be inserted into the slots indicated in the following table.

Table 4-3 Equipped Slots – 4608/1536 Switch Shelves

Slot	Circuit Pack
SWIEX 0[a]	SWIEX
BSW 1-8	BSW
TMG 1[b] TMG 0	TMG/STRAT3 TMG/STRAT3
BSW 9-16	BSW
SWIEX 1a	SWIEX

a) The 0 indicates the service pack of a pair goes in that slot. The 1 indicates the protection pack of a pair goes in that slot.

b) The TMG/STRAT3 packs are half the height of a normal full-sized pack. Therefore, when one pack is placed on top of the other these two packs can fit in one extra-high slot with a small, blank faceplate in between the two packs.

4608/1536 main switch fabric

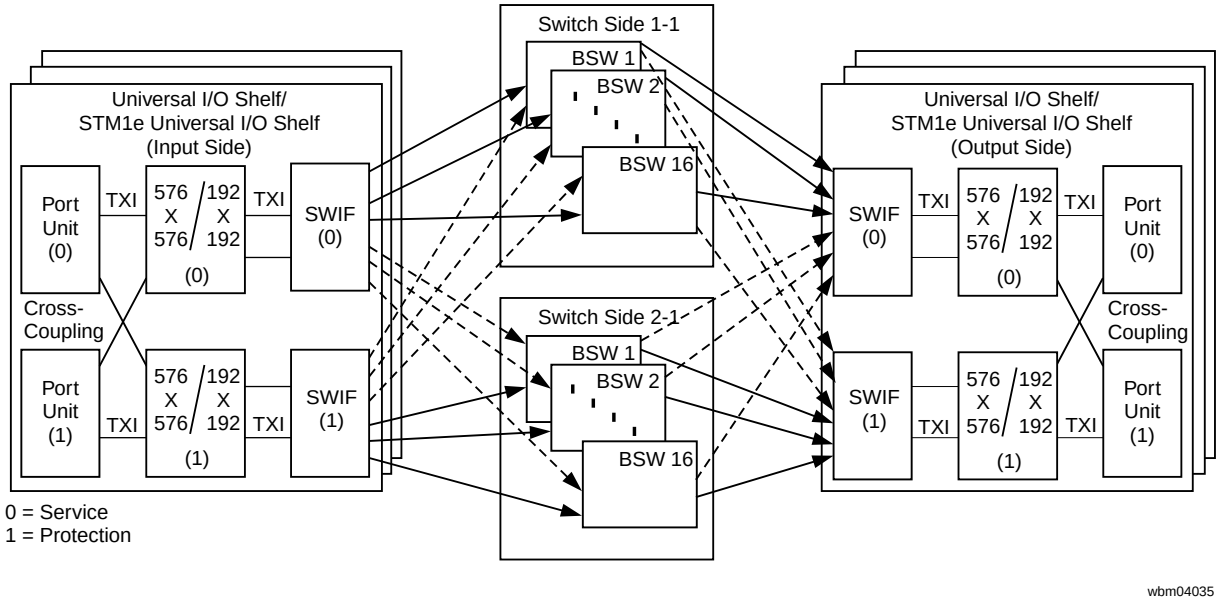
Figure 4-18 and Figure 4-19 illustrate the 4608/1536 main switch fabric with the different types of I/O Shelves and their shelf-based switch fabrics.

Universal I/O Shelves and SDH Universal I/O Shelves

Figure 4-18 provides a functional view of the 4608/1536 main switch fabric interfacing with Universal I/O Shelves or SDH Universal I/O Shelves.

> **Important!** The two SWITCH/STS576 circuit packs in the Universal I/O Shelves and SDH Universal I/O Shelves provide a 576x576/192x192 shelf-based switch fabric.

Figure 4-18 4608/1536 Switch Fabric with Universal I/O Shelves and SDH Universal I/O Shelves – Functional View

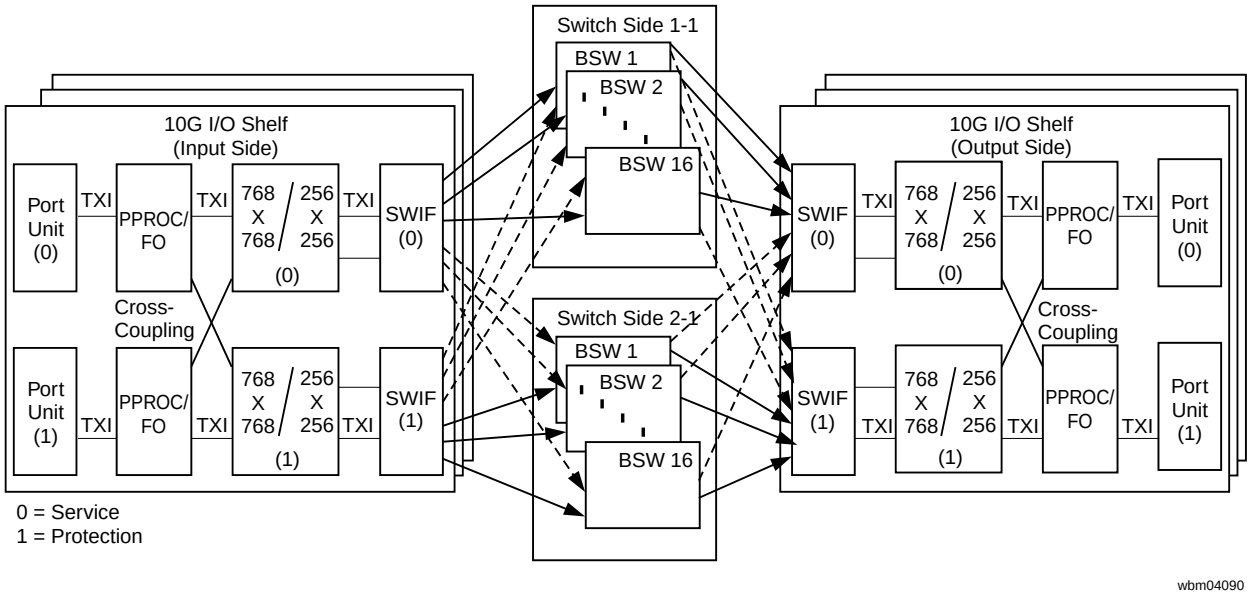


10G I/O Shelves

Figure 4-19 provides a functional view of the 4608/1536 main switch fabric interfacing with 10G I/O Shelves.

> **Important!** The ten SWITCH/STS768 circuit packs in the 10G I/O Shelves provide an 1152x1152/384x384 shelf-based switch fabric.

Figure 4-19 4608/1536 Switch Fabric with 10G I/O Shelves – Functional View



I/O Complexes

Overview

The WaveStar BandWidth Manager local I/O Complexes are groups of equipped I/O Bays (combination of Universal I/O Bays, 10G I/O Bays, 10G/Universal I/O Bays, SDH I/O Bays, and/or 10G/SDH I/O Bays) that are electrically connected to, and collocated with an associated Switch Complex.

4608/1536 local I/O Complex

Because the different I/O Bays house different types of shelves (which may include one to four SWIF pairs), the number of equipped I/O Bays in an 4608/1536 local I/O Complex may vary. However, in R4.1, the total number of I/O Shelves must not exceed 36.

> **Important!** Universal I/O Bays, 10G/Universal I/O Bays, SDH I/O Bays, and 10G/SDH I/O Bays all house two shelves per bay. 10G I/O Bays can house either one or two shelves per bay.

□

I/O Bays

Overview

All transmission interfaces in WaveStar BandWidth Manager are mounted in I/O Bays. A minimum of one I/O Bay (Universal I/O Bay, 10G I/O Bay, 10G/Universal I/O Bay, SDH I/O Bay, or 10G/SDH I/O Bay) is required for the minimum configuration of a 4608/1536 platform. Additional I/O Bays may be added incrementally as needed.

Dimensions

The dimensions of a NEBS I/O Bay are

- 2133.6 mm/84 in. high
- 660.4 mm/26 in. wide
- 482.6 mm/19 in. deep

The dimensions of an ETSI I/O Bay are

- 2200 mm/86.6 in. high
- 600 mm/23.6 in. wide
- 600 mm/23.6 in. deep

Types of I/O Bays

WaveStar BandWidth Manager provides five different I/O Bays. The I/O Bays house different combinations and configurations of the I/O Shelves available.

Universal I/O Bay

Each Universal I/O Bay houses two Universal I/O Shelves. Each Universal I/O Shelf is divided into a Switch Interface Sub-Shelf and a Facility Interface Sub-Shelf.

10G I/O Bay

Each 10G I/O Bay houses either one or two 10G I/O Shelves. Each 10G I/O Shelf is divided into a CTL/Switch Interface Sub-Shelf and a Facility/SWIF Interface Sub-Shelf.

10G/Universal I/O Bay

Each 10G/Universal I/O Bay houses one 10G I/O Shelf and one Universal I/O Shelf.

SDH I/O Bay

Each SDH I/O Bay houses two SDH Universal I/O Shelves. Each SDH Universal I/O Shelf is divided into a Switch Interface Sub-Shelf and a Facility Interface Sub-Shelf.

10G/SDH I/O Bay

Each 10G/SDH I/O Bay houses one 10G I/O Shelf and one SDH Universal I/O Shelf.

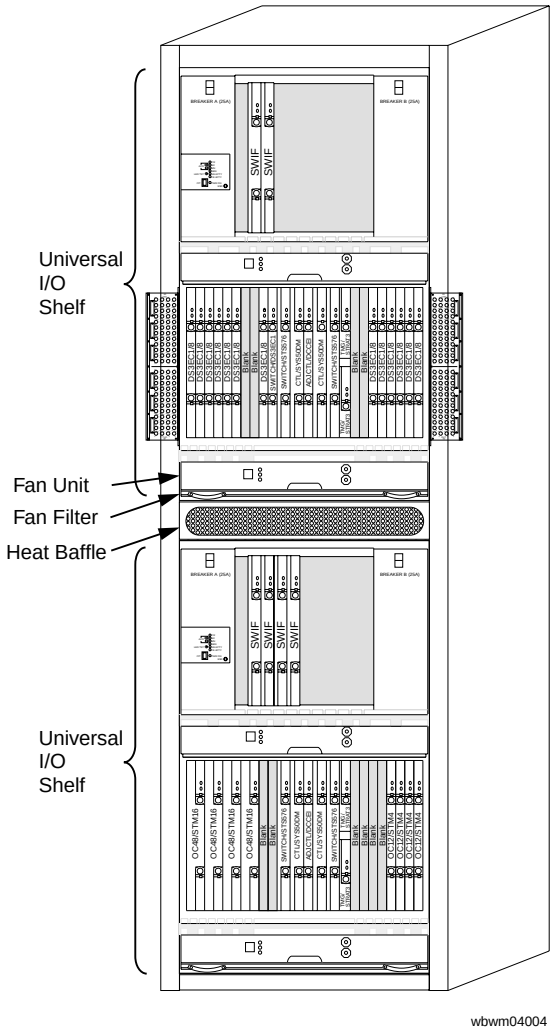
□

Universal I/O Bay

Universal I/O Bay

Figure 4-20 illustrates a Universal I/O Bay as it may appear in WaveStar BandWidth Manager. The two Universal I/O Shelves in the Universal I/O Bay are each divided into a Switch Interface Sub-Shelf and a Facility Interface Sub-Shelf. In this example, both Switch Interface Sub-Shelves are equipped as SWIF Modules and the two Facility Interface Sub-Shelves are equipped as a DS3EC1 Electrical Module (top) and a Mixed Module (bottom).

Figure 4-20 Universal I/O Bay



10G I/O Bay

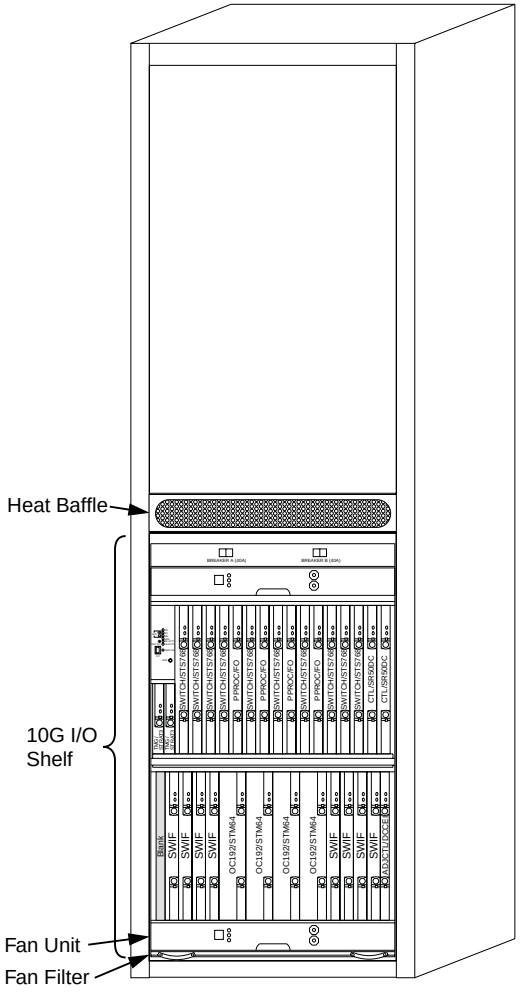
10G I/O Bay

Figure 4-21 and Figure 4-22 illustrate 10G I/O Bays in WaveStar BandWidth Manager.

10G I/O Bay with one 10G I/O Shelf

Figure 4-21 illustrates a 10G I/O Bay with one 10G I/O Shelf as it may appear in WaveStar BandWidth Manager. The 10G I/O Shelf in the 10G I/O Bay is divided into a CTL/Switch Interface Sub-Shelf and a Facility/SWIF Interface Sub-Shelf. In this example, the CTL/Switch Interface Sub-Shelf is equipped as CTL/Switch Module and the Facility/SWIF Interface Sub-Shelf is equipped as an OC192/STM64 Optical Module.

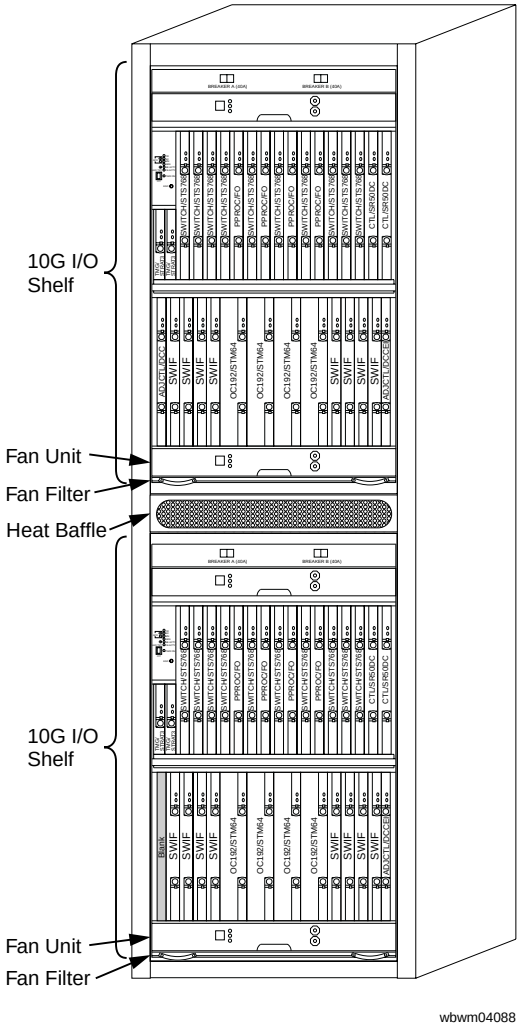
Figure 4-21 10G I/O Bay with one 10G I/O Shelf



10G I/O Bay with two 10G I/O Shelves

Figure 4-22 illustrates a 10G I/O Bay with two 10G I/O Shelves as it may appear in WaveStar BandWidth Manager. Each 10G I/O Shelf in this 10G I/O Bay is divided into a CTL/Switch Interface Sub-Shelf and a Facility/SWIF Interface Sub-Shelf. In this example, both CTL/Switch Interface Sub-Shelves are equipped as CTL/Switch Modules and both Facility/SWIF Interface Sub-Shelves are equipped as OC192/STM64 Optical Modules.

Figure 4-22 10G I/O Bay with Two 10G I/O Shelves

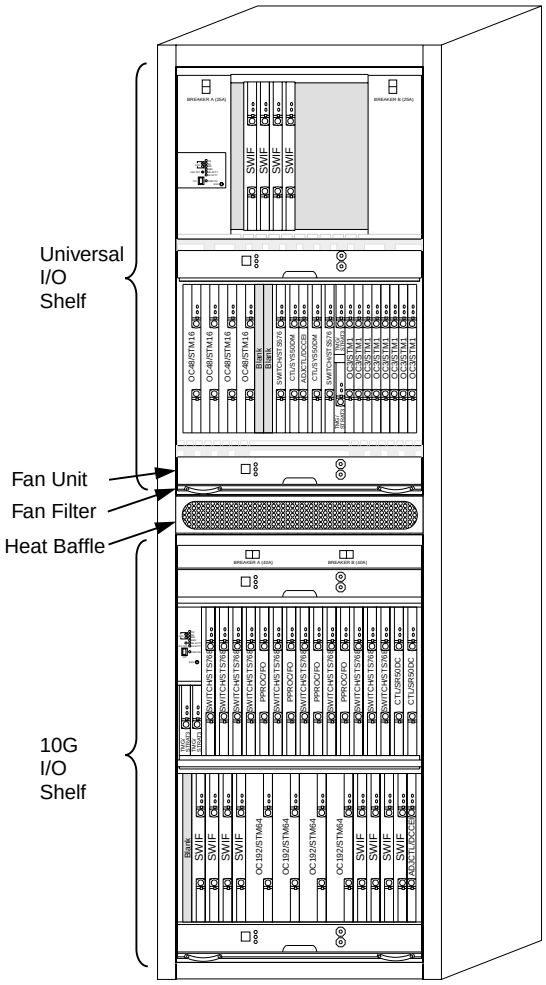


10G/Universal I/O Bay

10G/Universal I/O Bay

Figure 4-23 illustrates a 10G/Universal I/O Bay as it may appear in WaveStar BandWidth Manager. The Universal I/O Shelf (top) is equipped as SWIF Module and an OC48/STM16 Optical Module. The 10G I/O Shelf (bottom) is equipped as a CTL/Switch Module and an OC192/STM64 Optical Module.

Figure 4-23 10G/Universal I/O Bay

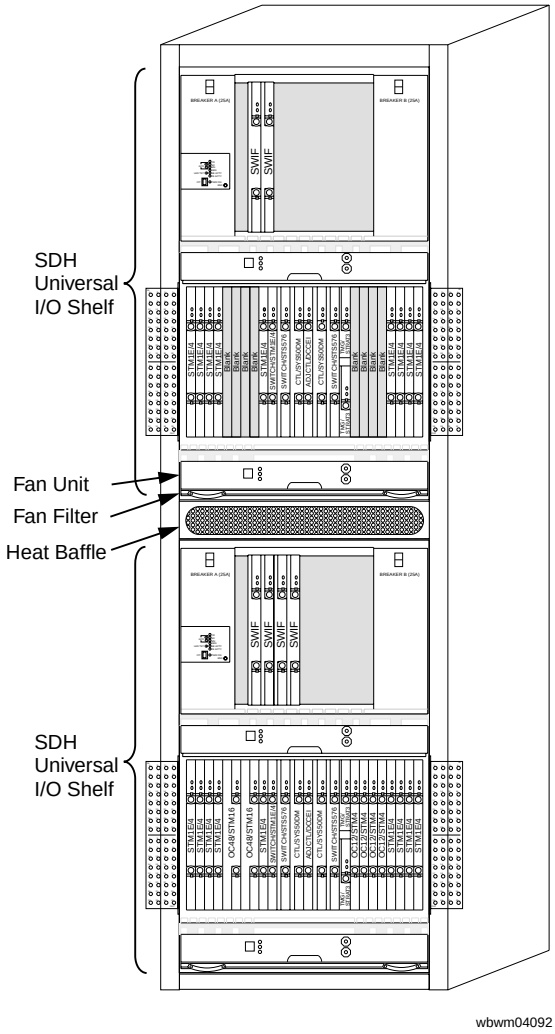


SDH I/O Bay

SDH I/O Bay

Figure 4-24 illustrates an SDH I/O Bay as it may appear in WaveStar BandWidth Manager. The two SDH Universal I/O Shelves in the SDH I/O Bay are each divided into a Switch Interface Sub-Shelf and a Facility Interface Sub-Shelf. In this example, both Switch Interface Sub-Shelves are equipped as SWIF Modules and the two Facility Interface Sub-Shelves are equipped as an STM1e Electrical Module (top) and a Mixed Module (bottom).

Figure 4-24 SDH I/O Bay

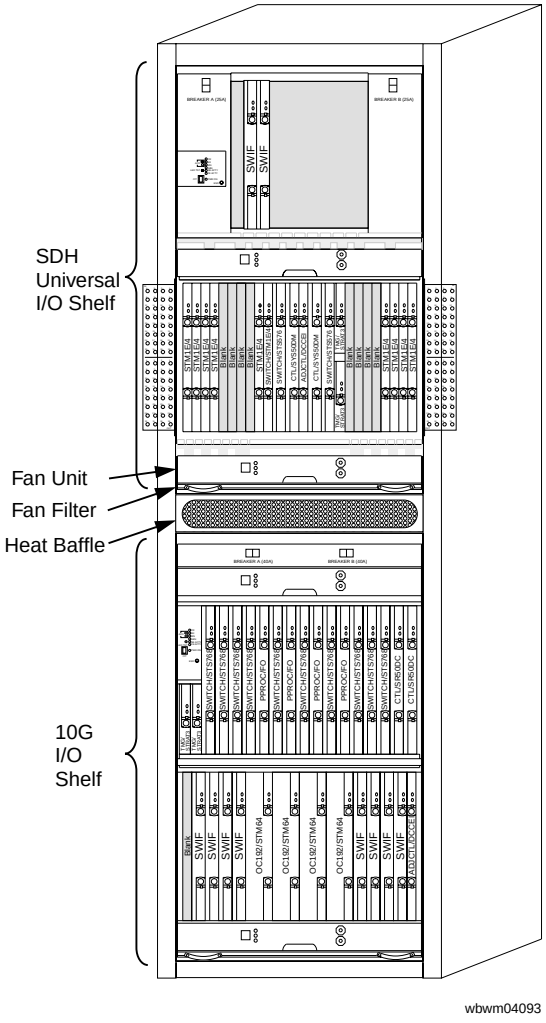


10G/SDH I/O Bay

10G/SDH I/O Bay

Figure 4-25 illustrates a 10G/SDH I/O Bay as it may appear in WaveStar BandWidth Manager. The SDH Universal I/O Shelf (top) is equipped as SWIF Module and an STM1e Electrical Module. The 10G I/O Shelf (bottom) is equipped as a CTL/Switch Module and an OC192/STM64 Optical Module.

Figure 4-25 10G/SDH I/O Bay



Universal I/O Shelf

Overview

The WaveStar BandWidth Manager Universal I/O Shelves house transmission interface port units and switch interface circuit packs. Each shelf is divided into the two following sub-shelves:

- Switch Interface Sub-Shelf (SWIF packs)
- Facility Interface Sub-Shelf (transmission port units)

Switch Interface Sub-Shelf

The upper portion of a Universal I/O Shelf, referred to as a Switch Interface Sub-Shelf, provides eight slots for SWIF packs and two slots for future releases.

Facility Interface Sub-Shelf

The lower portion of a Universal I/O Shelf, referred to as a Facility Interface Sub-Shelf, provides 16 universal slots for port units and 9 slots for the common circuit packs. The Facility Interface Sub-Shelves house OC-48/STM-16, OC-12/STM-4, and OC-3/STM-1 optical transmission interfaces and the DS3 and EC-1 electrical transmission interfaces.

Modules

When equipped with circuit packs and/or port units the sub-shelves are referred to as modules.

Switch Interface

In WaveStar BandWidth Manager, an equipped Switch Interface Sub-Shelf is referred to as a SWIF Module. Depending on the capacity needed by the associated Facility Interface Shelf, a SWIF Module may be equipped with either one pair (96 STS-1/32 STM-1 equivalents) or two pairs (192 STS-1/64 STM-1 equivalents) of SWIF packs. The Switch Interface Sub-Shelves house the packs that provide interfaces between the transmission port units (housed in the Facility Interface Sub-Shelves) and the main switch fabric provided by the Switch Shelves.

Facility Interface

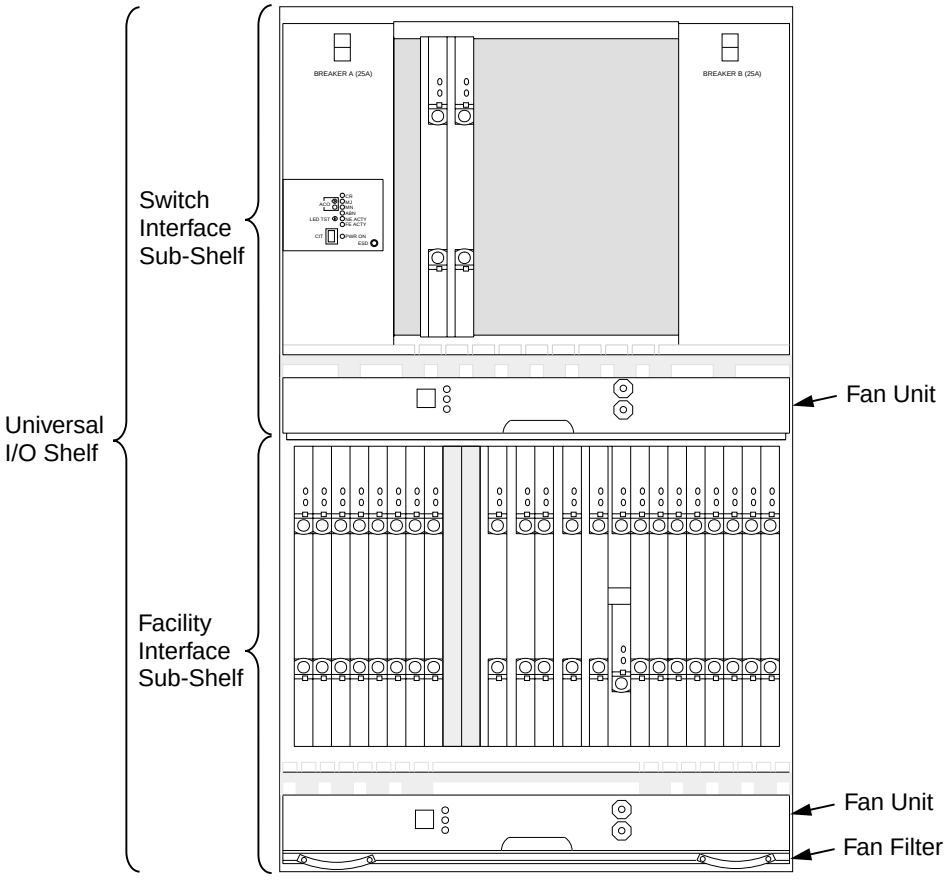
Depending on the type of port units used, a Facility Interface Sub-Shelf may be equipped as one of the following types of modules:

- DS3EC1 Electrical Module (DS3EC1/8 port units)
- OC48/STM16 Optical Module (OC48/STM16 port units)
- OC12/STM4 Optical Module (OC12/STM4 port units)
- OC3/STM1 Optical Module (OC3/STM1 port units)
- Mixed Module (supported combinations of DS3EC1/8, OC48/STM16, OC12/STM4, and/or OC3/STM1 port units)

Universal I/O Shelf figure

Figure 4-26 illustrates a Universal I/O Shelf.

Figure 4-26 Universal I/O Shelf



Switch Interface Sub-Shelf

Overview

A Switch Interface Sub-Shelf, the upper portion of a Universal I/O Shelf, is available to house SWIF switch packs. The term “sub-shelf” simply refers to a designated portion of the Universal I/O Shelf.

Definition of module

Because multiple configurations are possible for the sub-shelves of the Universal I/O Shelf, the term “module” is used to describe an equipped sub-shelf.

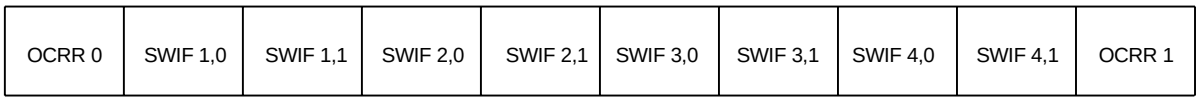
SWIF Module

A SWIF Module is a Switch Interface Sub-Shelf equipped with SWIF packs. Either two or four of the eight available SWIF slots are equipped with one or two SWIF pairs (for a maximum of four SWIF packs).

Designation label strip

The Switch Interface Sub-Shelf is equipped from left to right, according to the designation label strip illustrated in Figure 4-27.

Figure 4-27 Switch Interface Sub-Shelf Designation Label Strip



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Equipped slots SWIF packs should be inserted in the slots indicated in the following table.

Table 4-4 Equipped Slots – Switch Interface Sub-Shelf

Slot	Circuit Pack
OCRR 0[a]	Blank
SWIF 1,0[b]	1 pair of SWIF packs
SWIF 1,1[c]	
SWIF 2,0	1 pair of SWIF packs
SWIF 2,1	
SWIF 3,0	Blank
SWIF 3,1	Blank
SWIF 4,0	Blank
SWIF 4,1	Blank
OCRR 1a	Blank

a) The 0 indicates the service pack of a pair goes in that slot. The 1 indicates the protection pack of a pair goes in that slot.

b) SWIF 1,0 and 1,1 are equipped first (96 STS-1/32 STM-1 equivalents). SWIF 2,0 and 2,1 are added if an additional 96 STS-1/32 STM-1 equivalents of switch interface capacity are needed by any of the modules, for a total of 192 STS-1/64 STM-1 equivalents.SWIF 1,0 and 1,1 are equipped first (96 STS-1/32 STM-1 equivalents). SWIF 2,0 and 2,1 are added if an additional 96 STS-1/32 STM-1 equivalents of switch interface capacity are needed by any of the modules, for a total of 192 STS-1/64 STM-1 equivalents.

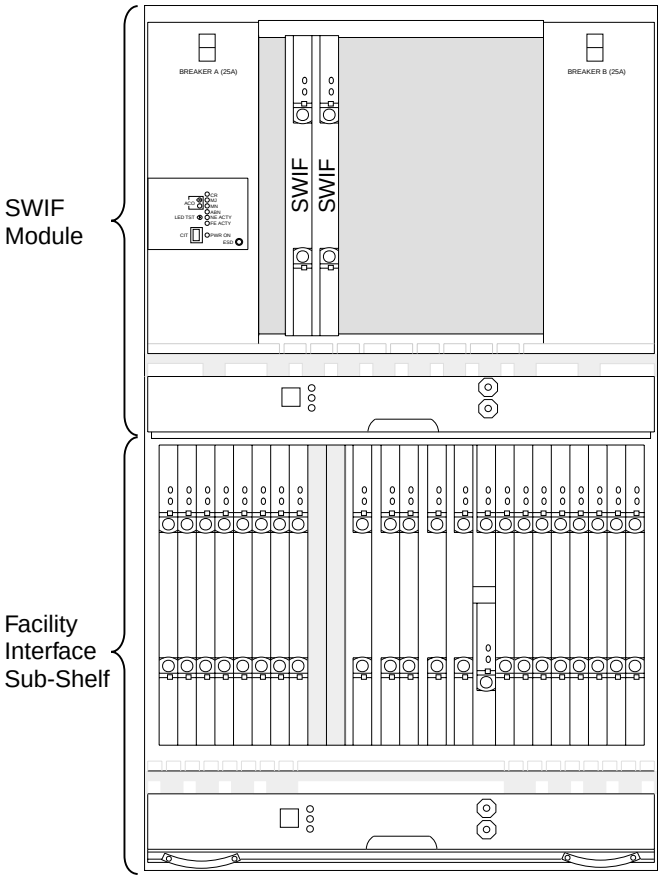
c) The first number represents the SWIF pair (1-4). The second number, 0 or 1, indicates the service or protection pack, respectively.

SWIF Module

Overview A SWIF Module is a Switch Interface Sub-Shelf that is equipped with SWIF packs.

Figure Figure 4-28 illustrates the SWIF Module of a Universal I/O Shelf. This example assumes that the Facility Interface Sub-Shelf is equipped as an OC3/STM1 Optical Module. Therefore, the SWIF Module is equipped with one SWIF pair (96 STS-1/32 STM-1 equivalents). If the Facility Interface Sub-Shelf was equipped as any of the other Optical Modules, the SWIF Module could be equipped with two SWIF pairs (192 STS-1/64 STM-1 equivalents).

Figure 4-28 SWIF Module of a Universal I/O Shelf



Facility Interface Sub-Shelf

Overview

A Facility Interface Sub-Shelf, the lower portion of a Universal I/O Shelf, is available to house common circuit packs and port units. Additional types of interface port units will be available in future releases.

Definition of module

Because multiple configurations are possible for the sub-shelves of the Universal I/O Shelf, the term “module” is used to describe an equipped sub-shelf. The term “sub-shelf” simply refers to a designated portion of the Universal I/O Shelf.

Modules

The port units used in the sub-shelf determine the type of module. The Facility Interface Sub-Shelf may be equipped as one of the following modules:

- DS3EC1 Electrical Module
- OC48/STM16 Optical Module
- OC12/STM4 Optical Module
- OC3/STM1 Optical Module
- Mixed Module

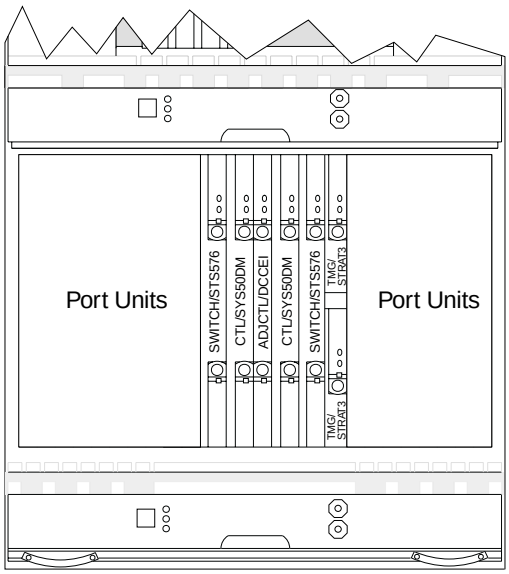
Common packs

Regardless of the port units used, all modules include the following common circuit packs:

- Two SWITCH/STS576
- Two CTL/SYS50DM
- One ADJCTL/DCCEI
- Two TMG/STRAT3

Figure Figure 4-29 illustrates the common packs used in all Universal I/O Shelves.

Figure 4-29 Common Packs in the Facility Interface Sub-Shelf



Important! When ordering the Common Circuit Pack Kit for a Universal I/O Shelf, you receive one pair of SWIF packs in addition to the packs illustrated in Figure 4-29.

Universal interface slot

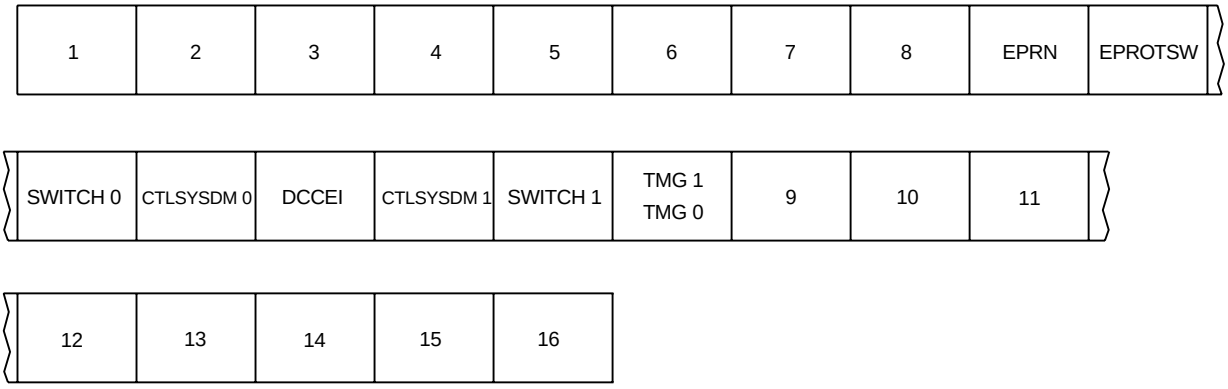
Each Facility Interface Sub-Shelf contains 16 universal interface slots. The unique characteristic of a universal slot is its ability to accept any of the port units that are available in the current and planned future releases of WaveStar BandWidth Manager.

Important! In Figure 4-30, the universal interface slots are designated as slots 1 through 8 and slots 9 through 16.

Designation label strip

The Facility Interface Sub-Shelf designation label strip illustrated in Figure 4-30 is used for all modules of the sub-shelf.

Figure 4-30 Facility Interface Sub-Shelf Designation Label Strip



Important! If a Mixed Module is equipped with DS3EC1/8 port units and 1xN protection is used, then slot 16 must either be equipped with a DS3EC1/8 port unit or left blank.

Important! Slots 7, 8, 9 and 10 cannot be equipped with DS3EC1/8 port units.

Equipped slots Circuit packs should be inserted in the slots indicated in the following table.

Table 4-5 Equipped Slots – Facility Interface Sub-Shelf

Slot	Circuit Pack
1-6[a]	DS3EC1/8
1-8	OC48/STM16, OC12/STM4, and/or OC3/STM1
EPRN	DS3EC1/8 (for 1x12 protection of the DS3EC1/8 port units) or Blank for Optical Modules
EPROTSW	SWITCH/DS3EC1 or Blank for Optical Modules
SWITCH 0[b]	SWITCH/STS576
CTLSYSDM 0	CTL/SYS50DM
DCCEI	ADJCTL/DCCEI
CTLSYSDM 1	CTL/SYS50DM
SWITCH 1[b]	SWITCH/STS576
TMG 1[c] TMG 0	TMG/STRAT3 TMG/STRAT3
9-16	OC48/STM16, OC12/STM4, and/or OC3/STM1
11-16[a]	DS3EC1/8

a) Slots 7, 8, 9 and 10 are blank when the Facility Interface Sub-Shelf is fully-equipped as a DS3EC1/8 Electrical Module; slots 7 through 10 cannot be equipped with DS3EC1/8 port units.

b) The 0 indicates the service pack of a pair goes in that slot. The 1 indicates the protection pack of a pair goes in that slot.

c) The TMG/STRAT3 packs are half the height of a normal full-sized pack. Therefore, when one pack is placed on top of the other these two packs can fit in one normal slot.

DS3EC1 Electrical Module

Overview

A DS3EC1 Electrical Module is a Facility Interface Sub-Shelf that is equipped with the common circuit packs and DS3EC1/8 port units.

Common packs

A fully-equipped DS3EC1 Electrical Module includes the following common circuit packs:

- Two SWITCH/STST576
- Two CTL/SYS50DM
- One ADJCTL/DCCEI
- Two TMG/STRAT3

Important! When ordering the Common Circuit Pack Kit for a Universal I/O Shelf, you receive one pair of SWIF packs in addition to the packs listed above.

Port units and circuit pack

A DS3EC1 electrical module includes

- Twelve DS3EC1/8 port units (located in slots 1-6 and 11-16)
- One DS3EC1/8 port unit (needed for 1x12 protection)
- One SWITCH/DS3EC1 pack

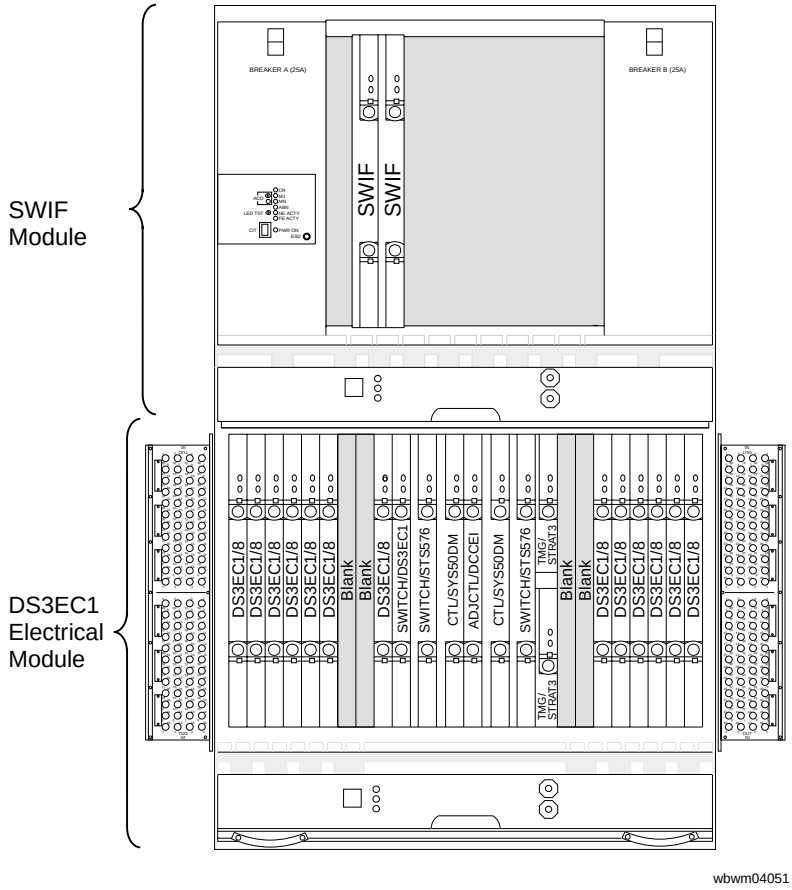
Important! Although four of the universal slots (slots 7-10) remain empty, the module is fully-equipped.

SWIF capacity

A DS3EC1 Electrical Module requires one SWIF pair (96 STS-1 equivalents = 8 ports X 12 port units) to drop all the capacity available from the DS3EC1/8 port units to the main switch fabric.

Figure Figure 4-31 illustrates a fully-equipped DS3EC1 Electrical Module of a Universal I/O Shelf.

Figure 4-31 DS3EC1 Electrical Module of a Universal I/O Shelf



OC48/STM16 Optical Module

Overview

An OC48/STM16 Optical Module is a Facility Interface Sub-Shelf that is equipped with the common circuit packs and OC48/STM16 port units.

Common packs

A fully-equipped OC48/STM16 Optical Module includes the following common circuit packs

- Two SWITCH/STST576
- Two CTL/SYS50DM
- One ADJCTL/DCCEI
- Two TMG/STRAT3

Important! When ordering the Common Circuit Pack Kit for a Universal I/O Shelf, you receive one pair of SWIF packs in addition to the packs listed above.

Port units

An OC48/STM16 Optical Module includes either

- Two OC48/STM16 port units for one 2-fiber OC-48 BLSR/STM-16 MS-SPRings
- Two OC48/STM16 port units for one 4-fiber OC-48 BLSR (open) or a 4-fiber STM-16 MS-SPRing (open), assuming that the module is in an end terminal that is terminating an open ring
- Four OC48/STM16 port units for one 4-fiber OC-48 BLSR/STM-16 MS-SPRing (with or without transoceanic protocol)
- Two, four, six, or eight OC48/STM16 port units (1+1 protected)
- One, two, three, or four OC48/STM16 port units (0x1 protected)

Important! Since an OC48/STM16 port unit is a double-width circuit pack, two OC48/STM16 port units occupy four universal slots and four OC48/STM16 port units occupy eight universal slots.

SWIF capacity

An OC48/STM16 Optical Module generally uses one SWIF pair (96 STS-1/32 STM-1 equivalents) to drop 96 STS-1/32 STM-1 equivalents of service capacity from the BLSR/MS-SPRing to the main switch fabric. In addition, any combination of the service and protection capacity from the BLSR/MS-SPRing that totals 192 STS-1/64 STM-1 equivalents can be dropped. If desired, two SWIF pairs are required to drop 192 STS-1/64 STM-1 equivalents of capacity to the main switch.

Table 4-6 SWIF Capacity – OC48/STM16 Optical Module

2-Fiber OC-48 BLSR/ STM-16 MS-SPRing	4-Fiber OC-48 BLSR/ STM-16 MS-SPRing (open)[a]	4-Fiber OC-48 BLSR/ STM-16 MS-SPRing (closed)	Capacity Dropped	STS-1/ STM-1	SWIF Pairs
1	1	NA	all service	48/16	1
			all protection	48/16	1
			all service and protection capacity	96/32	1
2	2	1	all service	96/32	1
			all protection	96/32	1
			combination of service and protection totaling 96 STS-1/32 STM-1 equivalents	96/32	1
			all service and protection capacity	192/64	2
3	3	NA	all service	144/48	2
			all protection	144/48	2
			combination of service and protection totaling 96 STS-1/32 STM-1 equivalents	96/32	1
			combination of service and protection totaling 192 STS-1/64 STM-1 equivalents	192/64	2
4	4	2	all service	192/64	2
			all protection	192/64	2
			combination of service and protection totaling 96 STS-1/32 STM-1 equivalents	96/32	1
			combination of service and protection totaling 192 STS-1/64 STM-1 equivalents	192/64	2

a) This column assumes that the OC48/STM16 Optical Module is an end node of an open ring. The capacity issues for an intermediate node in an open ring are the same as the nodes in a closed ring.

An OC48/STM16 Optical Module equipped with 1+1 and 0x1 protected OC48/STM16 port units can use two SWIF pairs to drop 192 STS-1/64 STM-1 equivalents of service capacity from four working port units to the main switch fabric. If desired, one SWIF pair can be used to drop 96 STS-1/32 STM-1 equivalents of service capacity from two working port units to the main switch fabric.

Table 4-7 SWIF Capacity – OC48/STM16 Optical Module (1+1 and 0x1 Protection)

OC48/STM16	Capacity Dropped	STS-1/ STM-1	SWIF Pairs
1+1 protection: 4 working, 4 protection port units	all service capacity	192/64	2
1+1 protection: 3 working, 3 protection port units	all service capacity	144/48	2
1+1 protection: 2 working, 2 protection port units	all service capacity	96/32	1
1+1 protection: 1 working, 1 protection port unit	all service capacity	48/16	1
0x1 protection: 4 working but unprotected port units	all service capacity	192/64	2
0x1 protection: 3 working but unprotected port units	all service capacity	144/48	2
0x1 protection: 2 working but unprotected port units	all service capacity	96/32	1
0x1 protection: 1 working but unprotected port units	all service capacity	48/16	1

Placement of OC48/STM16 port units

The OC48/STM16 port units must follow specific placement rules when they are provisioned as BLSRs/MS-SPRings.

The protection packs must be either adjacent or symmetrical.

In a Universal I/O Shelf, only the following double-slot pairs are considered *adjacent*:

- 1/2 and 3/4
- 5/6 and 7/8
- 9/10 and 11/12
- 13/14 and 15/16

In a Universal I/O Shelf, only the following double-slot pairs are considered *symmetrical*:

- 1/2 and 15/16
- 3/4 and 13/14
- 5/6 and 11/12
- 7/8 and 9/10

4-fiber BLSR/MS-SPRings

The following table illustrates two examples of the placement and provisioning of OC48/STM16 port units for 4-fiber OC-48 BLSRs/STM-16 MS-SPRings in an OC48/STM16 Optical Module. The protection packs (regardless of the East or West assignment) must be either adjacent or symmetrical.

Table 4-8 OC48/STM16 Port Unit Placement for 4-Fiber BLSRs/MS-SPRings

Slot	Port Unit	Ring	Provisioning Option 1: Adjacent	Ring	Provisioning Option 2: Symmetrical
1	OC48/STM16	1	Service - East	1	Protection -East
2					
3	OC48/STM16		Service - West		Service - East
4					
5	OC48/STM16		Protection -East	2	Protection -East
6					
7	OC48/STM16		Protection - West		Service - East
8					
9	OC48/STM16	2	Protection -East	2	Service - West
10					
11	OC48/STM16		Protection - West		Protection -West
12					
13	OC48/STM16		Service - East	1	Service - West
14					
15	OC48/STM16		Service - West		Protection - West
16					

2-fiber BLSR/MS-SPRings

The following table illustrates two examples of the placement and provisioning of OC48/STM16 port units for 2-fiber OC-48 BLSRs/STM-16 MS-SPRings in an OC48/STM16 Optical Module. Because both port units in a 2-fiber BLSR/MS-SPRing carry service and protection traffic, both port units in a 2-fiber ring are considered to be protection packs. Therefore, it is the East and West packs that must be either adjacent or symmetrical.

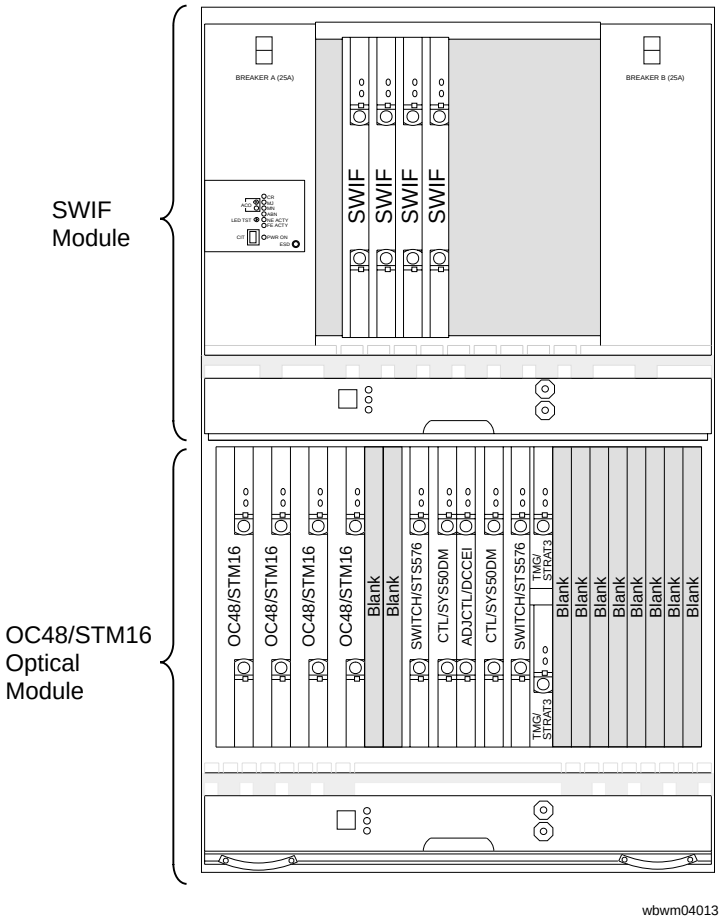
Table 4-9 OC48/STM16 Port Unit Placement for 2-Fiber BLSRs/MS-SPRings

Slot	Port Unit	Ring	Provisioning Option 1: Adjacent	Ring	Provisioning Option 2: Symmetrical
1	OC48/STM16	1	West	1	West
2					
3	OC48/STM16		East	2	West
4					
5	OC48/STM16	2	West	3	East
6					
7	OC48/STM16		East	4	West
8					
9	OC48/STM16	3	West	4	East
10					
11	OC48/STM16		East	3	West
12					
13	OC48/STM16	4	West	2	East
14					
15	OC48/STM16		East	1	East
16					

4-fiber OC-48 BLSR/STM-16 MS-SPRing

Figure 4-32 illustrates an OC48/STM16 Optical Module of a Universal I/O Shelf with one 4-fiber OC-48 BLSR/STM-16 MS-SPRing. In this example, two SWIF pairs are used, indicating that all service and protection capacity from one 4-fiber OC-48 BLSR/STM-16 MS-SPRing, totaling 192 STS-1/64 STM-1 equivalents, is dropped to the main switch fabric, or all service capacity from four unprotected OC48/STM16 port units is dropped to the main switch fabric.

Figure 4-32 OC48/STM16 Optical Module A of a Universal I/O Shelf

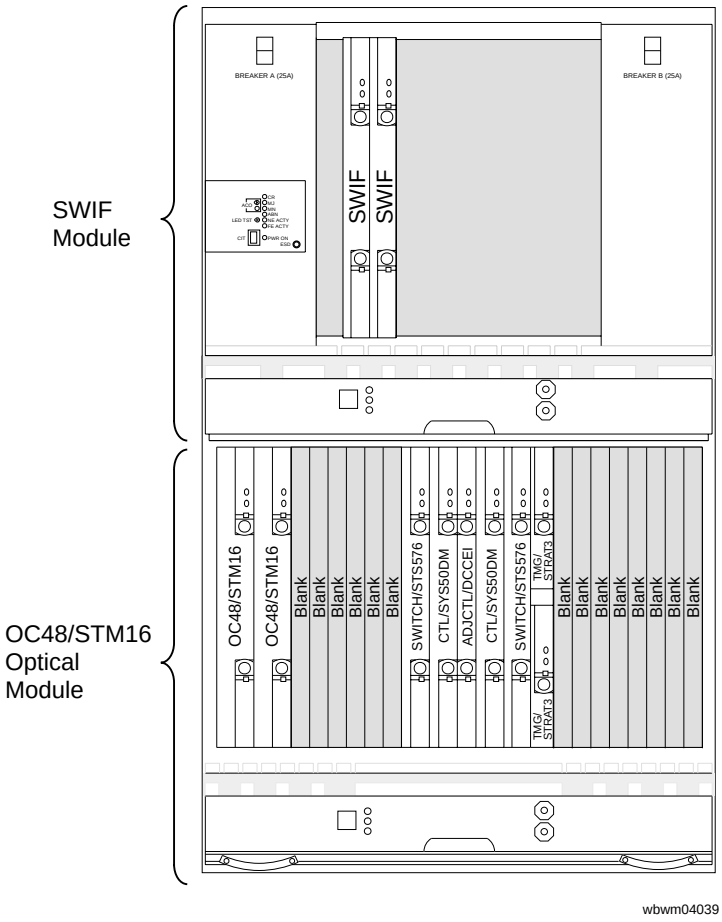


4-fiber OC-48 BLSR/STM-16 MS-SPRing (open)

Figure 4-33 illustrates a second configuration of an OC48/STM16 Optical Module of a Universal I/O Shelf. In this example, one SWIF pair is used, indicating that all service and protection capacity one 4-fiber OC-48 BLSR (open) or one 4-fiber STM-16 MS-SPRing (open), totaling 96 STS-1/32 STM-1 equivalents, is dropped to the main switch fabric, or all service capacity from two unprotected OC48/STM16 port units is dropped to the main switch fabric.

Figure 4-33 assumes that the OC48/STM16 Optical Module is an end node of an open ring. The capacity issues for an intermediate node in an open ring are the same as the nodes in a closed ring.

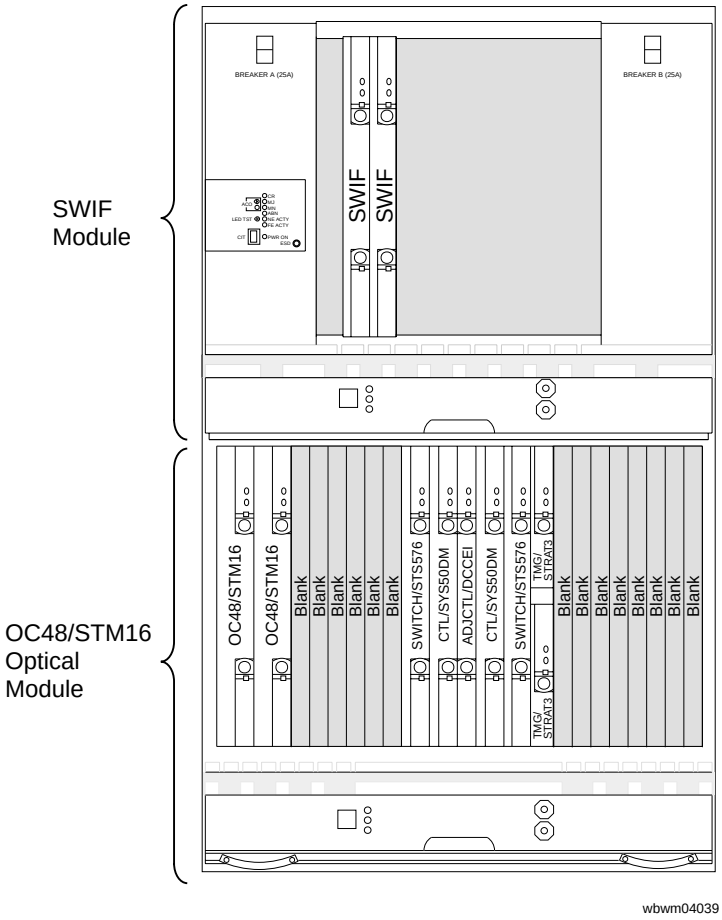
Figure 4-33 OC48/STM16 Optical Module B of a Universal I/O Shelf



2-fiber OC-48 BLSR/STM-16 MS-SPRing

Figure 4-34 illustrates a third configuration of an OC48/STM16 Optical Module of a Universal I/O Shelf. In this example, one SWIF pair is used, indicating that all service and protection capacity from one 2-fiber OC-48 BLSR/STM-16 MS-SPRing, totaling 96 STS-1/32 STM-1 equivalents, is dropped to the main switch fabric, or all service capacity from two unprotected OC48/STM16 port units is dropped to the main switch fabric.

Figure 4-34 OC48/STM16 Optical Module C of a Universal I/O Shelf



OC12/STM4 Optical Module

Overview

An OC12/STM4 Optical Module is a Facility Interface Sub-Shelf that is equipped with the common circuit packs and OC12/STM4 port units.

Common packs

An OC12/STM4 Optical Module includes the following common circuit packs:

- Two SWITCH/STS576
- Two CTL/SYS50DM
- One ADJCTL/DCCEI
- Two TMG/STRAT3

Important! When ordering the Common Circuit Pack Kit for a Universal I/O Shelf, you receive one pair of SWIF packs in addition to the packs listed above.

Port units

An OC12/STM4 Optical Module includes OC12/STM4 port units provisioned in one of the following manners:

- 1+1 protection: 8 working, 8 protection port units
- 0x1 protection: 8 working but unprotected port units

SWIF capacity

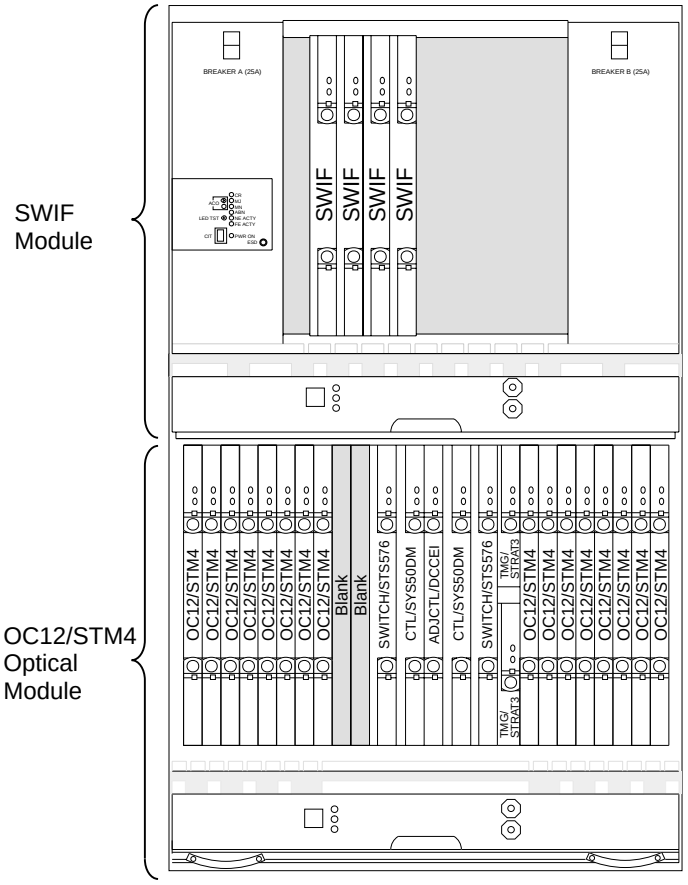
An OC12/STM4 Optical Module can use two SWIF pairs (192 STS-1/64 STM-1 equivalents) to drop 192 STS-1/64 STM-1 equivalents of capacity to the main switch fabric. If desired, one SWIF pair can be used to drop only 96 STS-1/32 STM-1 equivalents from four working port units to the main switch fabric.

Table 4-10 SWIF Capacity – OC12/STM4 Optical Module

OC12/STM4	Capacity Dropped	STS-1/ STM-1	SWIF Pairs
1+1 protection: 8 working, 8 protection port units	all service capacity	192/64	2
1+1 protection: 4 working, 4 protection port units	all service capacity	96/32	1
0x1 protection: 8 working but unprotected port units	all service capacity	192/64	2
0x1 protection: 4 working but unprotected port units	all service capacity	96/32	1

Figure Figure 4-35 illustrates the OC12/STM4 Optical Module (1+1 protected) of a Universal I/O Shelf. In this example, two SWIF pairs are used, indicating that all the service capacity from the eight working protected OC12/STM4 port units (192 STS-1/64 STM-1 equivalents) is dropped to the main switch fabric.

Figure 4-35 OC12/STM4 Optical Module of a Universal I/O Shelf



OC3/STM1 Optical Module

Overview

An OC3/STM1 Optical Module is a Facility Interface Sub-Shelf that is equipped with the common circuit packs and OC3/STM1 port units.

Common packs

An OC3/STM1 Optical Module includes the following common circuit packs:

- Two SWITCH/STST576
- Two CTL/SYS50DM
- One ADJCTL/DCCEI
- Two TMG/STRAT3

Important! When ordering the Common Circuit Pack Kit for a Universal I/O Shelf, you receive one pair of SWIF packs in addition to the packs listed above.

Port units

An OC3/STM1 Optical Module includes 16 OC3/STM1 port units provisioned in one of the following manners:

- 1+1 protection: 8 working, 8 protection port units
- 0x1 protection: 16 working but unprotected port units

SWIF Capacity

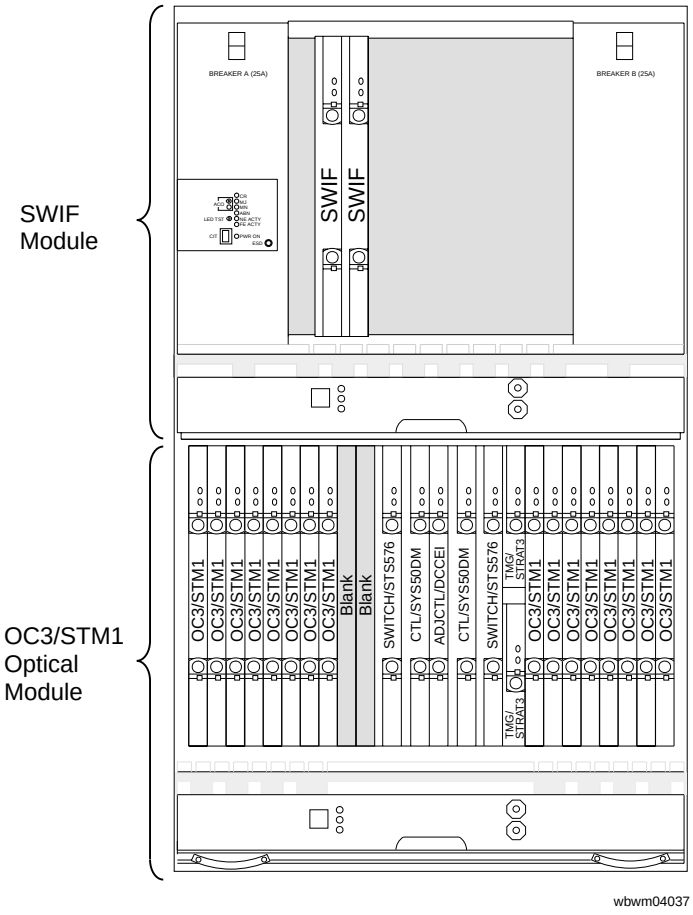
An OC3/STM1 Optical Module can use one SWIF pair to drop 96 STS-1/32 STM-1 equivalents of capacity from eight working port units to the main switch fabric. If desired, two SWIF pairs can be used to drop all service capacity from 16 unprotected OC3/STM1 port units, (192 STS-1/64 STM-1 equivalents) to the main switch fabric.

Table 4-11 SWIF Capacity – OC3/STM1 Optical Module

OC3/STM1	Capacity Dropped	STS-1/ STM-1	SWIF Pairs
1+1 protection: 8 working, 8 protection port units	all service capacity	96/32	1
1+1 protection: 4 working, 4 protection port units	all service capacity	48/16	1
0x1 protection: 16 working but unprotected port units	all service capacity	192/64	2
0x1 protection: 8 working but unprotected port units	all service capacity	96/32	1

Figure Figure 4-36 illustrates the OC3/STM1 Optical Module of a Universal I/O Shelf. In this example, one SWIF pair is used, indicating that all service capacity from 16 1+1 protected OC3/STM1 port units (96 STS-1/32 STM-1 equivalents) is dropped to the main switch fabric.

Figure 4-36 OC3/STM1 Optical Module of a Universal I/O Shelf



Mixed Module

Overview

A Mixed Module is a Facility Interface Sub-Shelf that is equipped with the common circuit packs and a combination of any of the following port units:

- DS3EC1/8
- OC48/STM16
- OC12/STM4
- OC3/STM1

Common packs

A fully-equipped Mixed Module includes the following common circuit packs:

- Two SWITCH/STS576
- Two CTL/SYS50DM
- One ADJCTL/DCCEI
- Two TMG/STRAT3

Important! When ordering the Common Circuit Pack Kit for a Universal I/O Shelf, you receive one pair of SWIF packs in addition to the packs listed above.

Port units and circuit packs

A Mixed Module includes a combination of the following port units and circuit packs:

- ≤12 working DS3EC1/8 port units
  - One SWITCH/DS3EC1 pack
  - One protection DS3EC1/8 port unit (needed for 1xN [N ≤ 12] protection of the DS3EC1/8 port units)
- 4 OC48/STM16 port units (one 4-fiber OC-48 BLSR/STM-16 MS-SPRing)
- ≤6 OC48/STM16 port units (1+1 protected: 3 working, 3protection port units)
- ≤6 OC48/STM16 port units (one, two, or three 2-fiber OC-48 BLSRs/STM-16 MS-SPRings)
- ≤16 OC12/STM4 port units (1+1 protected: 8 working, 8 protection port units)
- ≤16 OC3/STM1 port units (1+1 protected: 8 working, 8 protection port units)

Important! If a Mixed Module is equipped with DS3EC1/8 port units and 1xN protection is used, then slot 16 must either be equipped with a DS3EC1/8 port unit or left blank.

SWIF capacity

A Mixed Module generally uses two SWIF pairs to drop 192 STS-1/64 STM-1 equivalents from the port units to the main switch fabric. The amount of traffic cross-connected directly on the shelf using the SWITCH/STS576 packs can not exceed 384 STS-1/128 STM-1 equivalents.

Table 4-12 SWIF Capacity – Mixed Module

Port Units	Capacity Dropped	STS-1/ STM-1	SWIF Pairs
≤12 DS3EC1/8	all service capacity	≤96/32	2
4 OC48/STM16	combination of service and protection from one 4-fiber OC-48 BLSR/STM-16 MS-SPRing	≤192/64	
	all service capacity from one 4-fiber OC-48 BLSR/STM-16 MS-SPRing	≤96/32	
2 OC48/STM16	combination of service and protection from one 2-fiber OC-48 BLSR or one 4-fiber OC-48 BLSR/STM-16 MS-SPRing (open)[b]	≤96/32	
	all service capacity from one 2-fiber OC-48 BLSR or one 4-fiber OC-48 BLSR/STM-16 MS-SPRing (open)[b]	≤48/16	
≤4 OC48/STM16a	all service capacity	≤96/32	
≤16 OC12/STM4a	all service capacity	≤192/64	
≤16 OC3/STM1a	all service capacity	≤96/32	

a) In these examples, the OC48/STM16, OC12/STM4, and OC3/STM1 port units are all 1+1 protected.

b) These rows assume that the Mixed Module is an end node of an open ring. The capacity issues for an intermediate node in an open ring are the same as the nodes in a closed ring.

Important! The port unit quantities listed in the preceding table represent the total number of port units in that shelf. When the port units are 1+1 protected, one half of the port units are working and one half of the port units are protection.

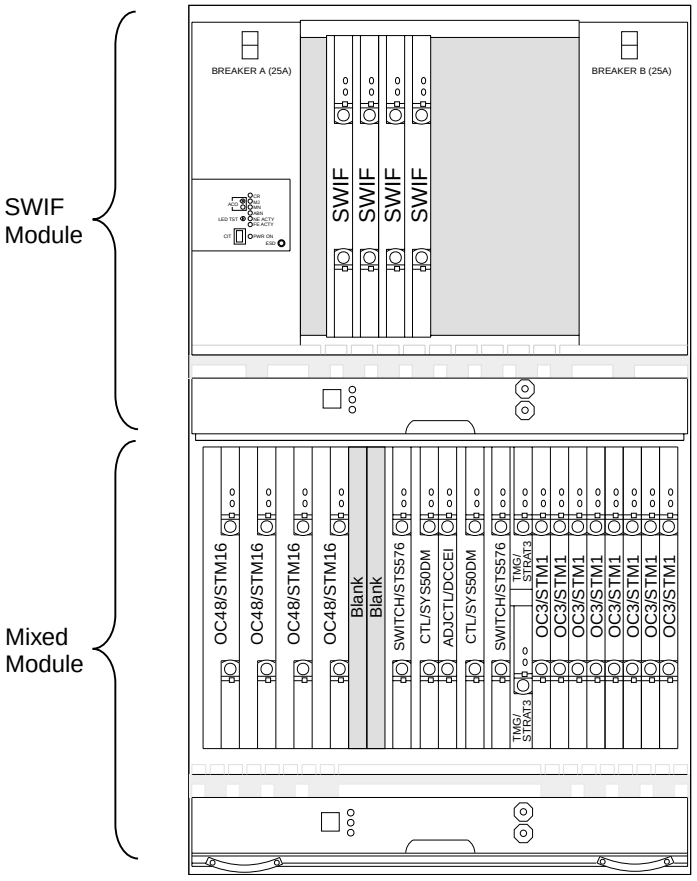
Although a Mixed Module supports multiple combinations of port units, the different types of port units must be placed in the appropriate slots and not exceed the physical capacity of the shelf.

The amount of traffic dropped to the main switch fabric can not exceed 192 STS-1/64 STM-1 equivalents.

Mixed Module configuration A

Figure 4-37 illustrates a possible configuration of a Mixed Module of a Universal I/O Shelf that contains four OC48/STM16 port units (one 4-fiber OC-48 BLSR/STM-16 MS-SPRing) and eight OC3/STM1 port units (1+1 protected). The four working OC3/STM1 port units use 48 STS-1/16 STM-1 equivalents of the available 192 STS-1/64 STM-1 equivalents provided by the two SWIF pairs. Therefore, up to 144 STS-1/48 STM-1 equivalents of capacity can be used by a combination of service and protection capacity from the BLSR/MS-SPRing.

Figure 4-37 Mixed Module A of a Universal I/O Shelf

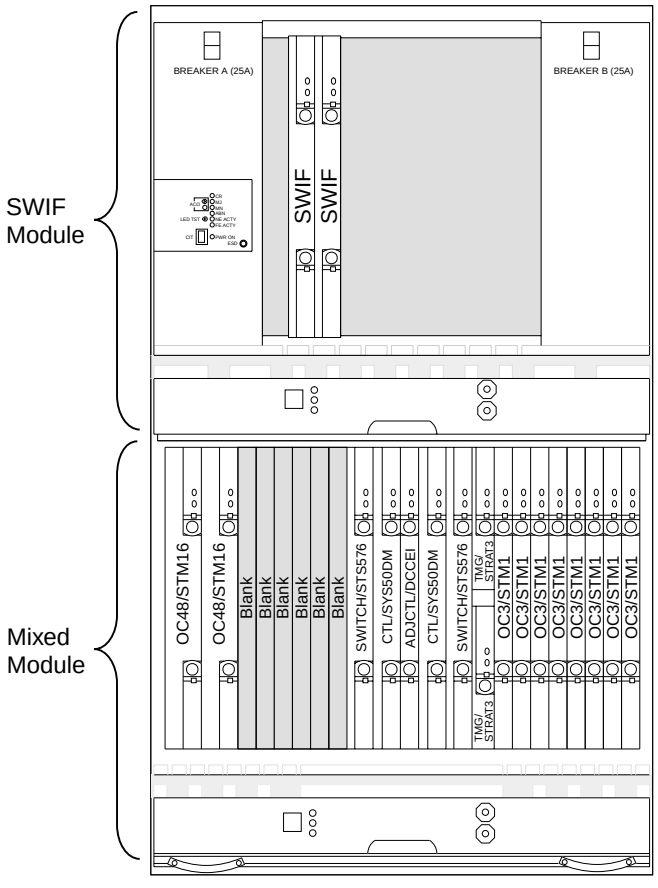


Mixed Module configuration B

Figure 4-38 illustrates a possible configuration of the Mixed Module of a Universal I/O Shelf that contains two OC48/STM16 port units (one 4-fiber OC-48 BLSR [open] or 4-fiber STM-16 MS-SPRing [open]) and eight OC3/STM1 port units (1+1 protected). The service capacity of the open BLSR/MS-SPRing uses 48 STS-1/16 STM-1 equivalents and the four working OC3/STM4 port units use 48 STS-1/16 STM-1 equivalents. When combined, these capacities total 96 STS-1/32 STM-1 equivalents. Therefore, only one SWIF pair is necessary to drop all service capacity to the main switch fabric.

Figure 4-38 assumes that the Mixed Module is an end node of an open ring. The capacity issues for an intermediate node in an open ring are the same as the nodes in a closed ring.

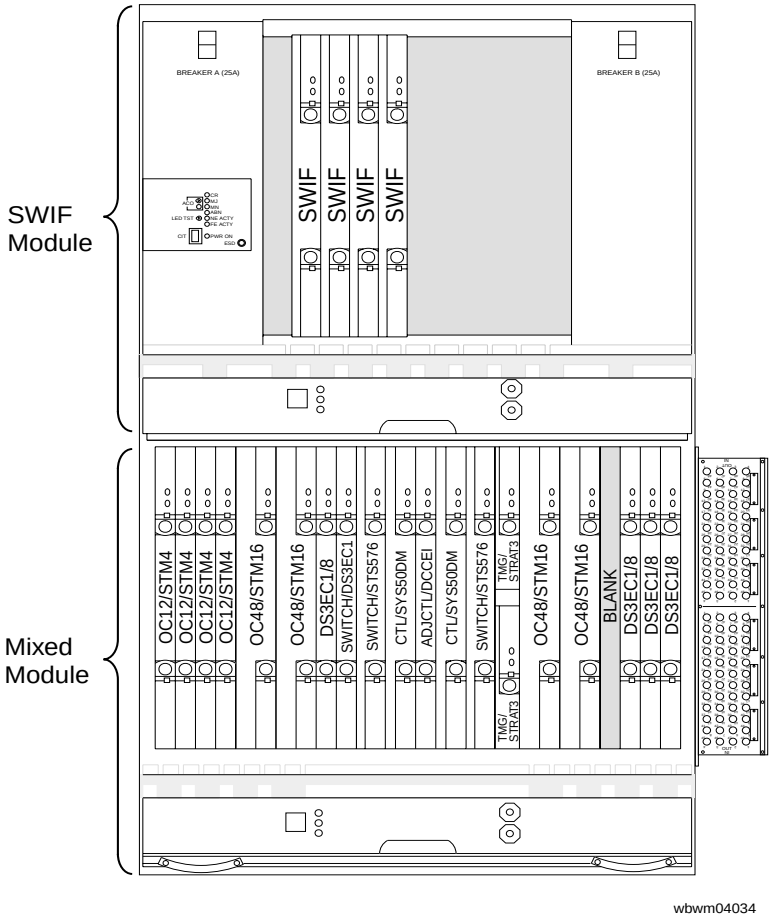
Figure 4-38 Mixed Module B of a Universal I/O Shelf



Mixed Module configuration C

Figure 4-39 illustrates a possible configuration of a Mixed Module of a Universal I/O Shelf that contains four OC48/STM16 port units (one 4-fiber OC-48 BLSR/STM-16 MS-SPRing), three DS3EC1/8 port units (1xN protected), and four OC12/STM4 port units (1+1 protected). When combined, the three working DS3EC1/8 port units (24 STS-1/8 STM-1 equivalents) and the two working OC12/STM4 port units (48 STS-1/16 STM-1 equivalents) use 72 STS-1/24 STM-1 equivalents of the available 192 STS-1/64 STM-1 equivalents provided by the two SWIF pairs. Therefore, up to 120 STS-1/40 STM-1 equivalents of capacity can be used by a combination of service and protection capacity from the BLSR/MS-SPRing.

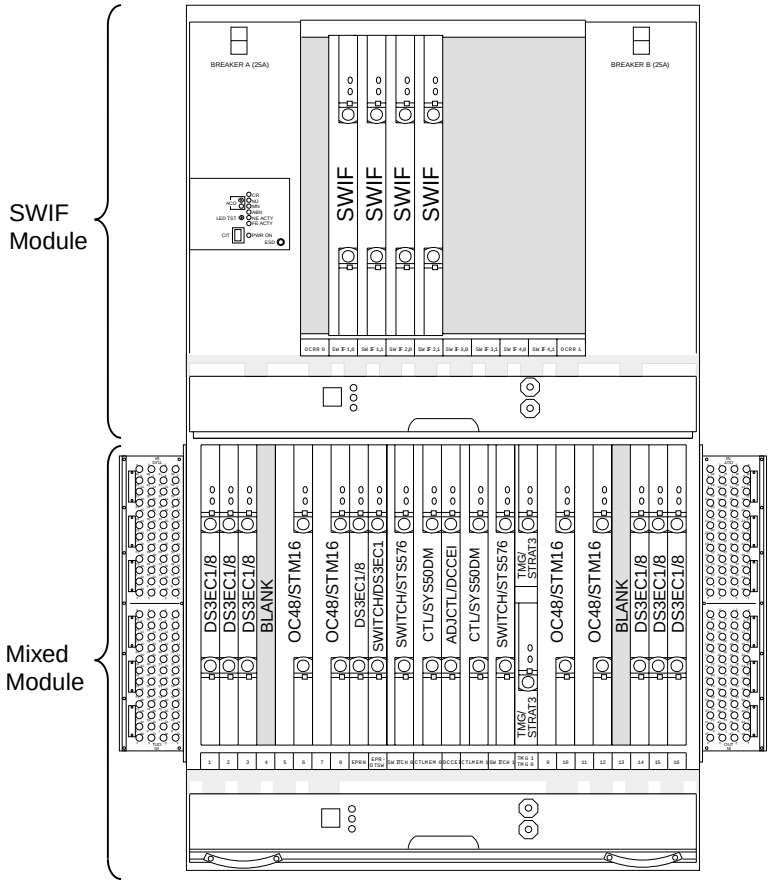
Figure 4-39 Mixed Module C of a Universal I/O Shelf



Mixed Module configuration D

Figure 4-40 illustrates a possible configuration of the Mixed Module of a Universal I/O Shelf that contains four OC48/STM16 port units and six DS3EC1/8 port units. The six working DS3EC1/8 port units use 48 STS-1/16 STM-1 equivalents of the available 192 STS-1/64 STM-1 equivalents provided by the two SWIF pairs. Therefore, 144 STS-1/48 STM-1 equivalents of capacity are available for a combination of service and protection capacity from the BLSR/MS-SPRing.

Figure 4-40 Mixed Module D of a Universal I/O Shelf

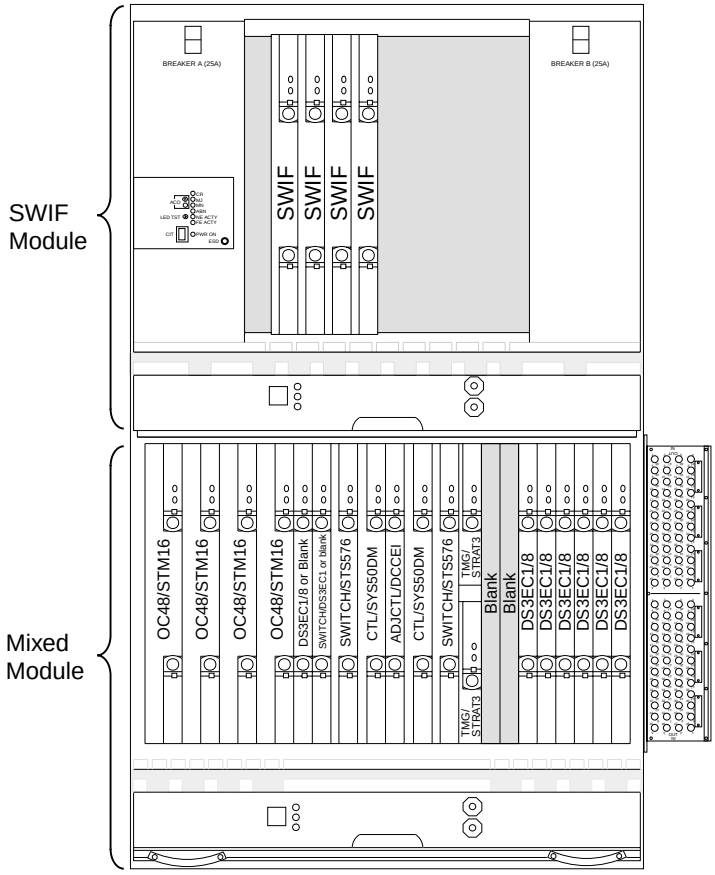


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Mixed Module configuration E

Figure 4-41 illustrates a possible configuration of the Mixed Module of a Universal I/O Shelf that contains four OC48/STM16 port units and six DS3EC1/8 port units. The benefit of this configuration is the division of the optical and electrical port units on separate sides of the shelf. Because the electrical port units are all on the right side of the module, only one DS3EC1 Connector Panel is required. The DS3EC1/8 port units use 48 STS-1/16 STM-1 equivalents of the available 192 STS-1/64 STM-1 equivalents provided by the two SWIF pairs, thus allowing 144 STS-1/48 STM-1 equivalents of capacity to be used by a combination of service and protection capacity from the BLSR/MS-SPRing.

Figure 4-41 Mixed Module E of a Universal I/O Shelf



wbwm04014

DS3EC1 Connector Panel

Overview

This section describes the DS3EC1 Connector Panel that is needed for the Facility Interface Sub-Shelf when the sub-shelf is equipped as either a DS3EC1 Electrical Module or a Mixed Module with DS3EC1/8 port units.

Description

Each DS3EC1 Connector Panel is equipped with 48 pairs of BNC connectors. Each pair includes one transmit and one receive connector. Therefore, six DS3EC1/8 port units (eight ports each) can be cabled to each panel. Ribbon-cable connects the BNC connectors to the backplane. Each panel is silk-screened with labels that allow the panels to be placed on either side of the shelf (see Figure 4-42).

Determining number of panels

Use the following table to determine the number of DS3EC1 Connector Panels needed for each Facility Interface Sub-Shelf. You must know the number and location of the DS3EC1 port units in the sub-shelf.

Table 4-13 Determining the Number of DS3EC1 Connector Panels

IF you have...	AND they are located...	THEN you need...
0 DS3EC1/8 port units	NA	0 DS3EC1 Connector Panels.
<6 DS3EC1/8 port units	in slots 1 through 6 OR in slots 11 through 16	1 DS3EC1 Connector Panel.
>6 DS3EC1/8 port units	in slots 1 through 6 AND in slots 11 through 16	2 DS3EC1 Connector Panels.

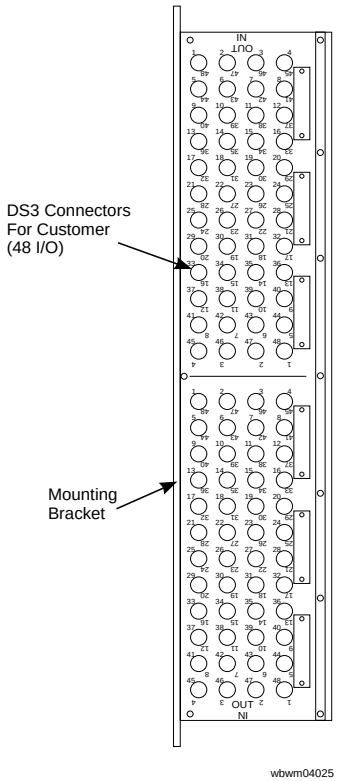
Quantity and location

A Facility Interface Sub-Shelf may include one, two, or no DS3EC1 Connector Panels. The number of panels needed is dependent upon the type, location, and number of port units used in the sub-shelf. The panels are placed on either the left or right side of the shelf, or on both sides of the shelf, depending on the locations of the DS3EC1/8 port units.

Individual panel

Figure 4-42 illustrates a DS3EC1 Connector Panel. Each panel may be mounted on either side of the Facility Interface Sub-Shelf. Simply rotate the panel illustrated in Figure 4-42 180 degrees to mount on the left-hand side of a shelf.

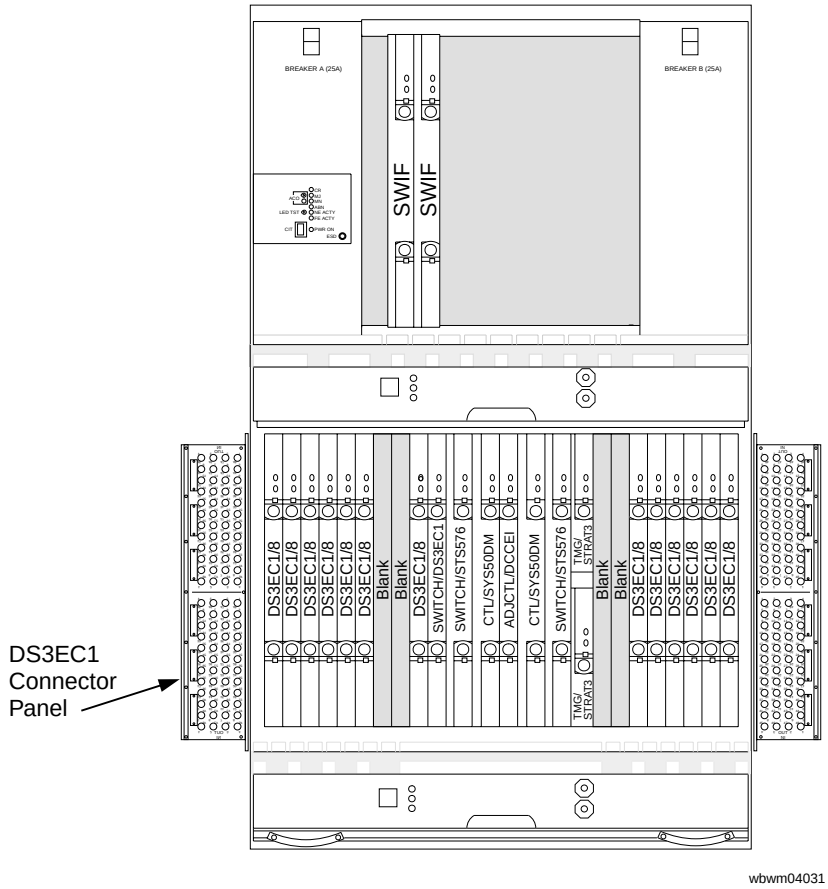
Figure 4-42 DS3EC1 Connector Panel



Mounted panels

Figure 4-43 illustrates a DS3EC1 Electrical Module with two DS3EC1 Connector Panels.

Figure 4-43 DS3EC1 Connector Panels on a DS3EC1 Electrical Module



10G I/O Shelf

Overview

The 10G I/O Shelves house the OC192/STM64 transmission interface port units and switch interface circuit packs. Each shelf is divided into the two following sub-shelves:

- CTL/Switch Interface Sub-Shelf (control packs and SWITCH/STS768 switch packs)
- Facility/SWIF Interface Sub-Shelf (transmission port units and SWIF packs)

CTL/Switch Interface Sub-Shelf

The upper portion of a 10G I/O Shelf, referred to as a CTL/Switch Interface Sub-Shelf, houses the following common packs:

- Ten SWITCH/STS768 circuit packs
- Two TMG/STRAT3 circuit packs
- Two CTL/SR50DC circuit packs
- Four PPROC/FO circuit packs

Important! When ordering the Common Circuit Pack Kit for a 10G I/O Shelf, you receive one pair of SWIF packs in addition to the packs listed above.

Facility/SWIF Interface Sub-Shelf

The lower portion of a 10G I/O Shelf, referred to as a Facility/SWIF Interface Sub-Shelf, houses

- ≤Four OC192/STM64 port units
- One to four SWIF pairs
- One ADJCTL/DCCEI circuit pack

Modules

When equipped with circuit packs and/or port units, sub-shelves are referred to as modules.

CTL/Switch Interface

In WaveStar BandWidth Manager, an equipped CTL/Switch Interface Sub-Shelf is referred to as a CTL/Switch Module. A CTL/Switch Module is equipped with ten SWITCH/STS768 circuit packs (shelf-based switch fabric and through-connections), four pointer processor packs, two timing packs, and two control packs.

Facility/SWIF Interface

In WaveStar BandWidth Manager, an equipped Facility/SWIF Interface Sub-Shelf is referred to as an OC192/STM64 Optical Module. An OC192/STM64 Optical Module may be equipped with one to four OC192/STM64 port units and one to four SWIF pairs. The SWIF packs provide the interface between the transmission port units and the main switch fabric provided by the Switch Shelves.

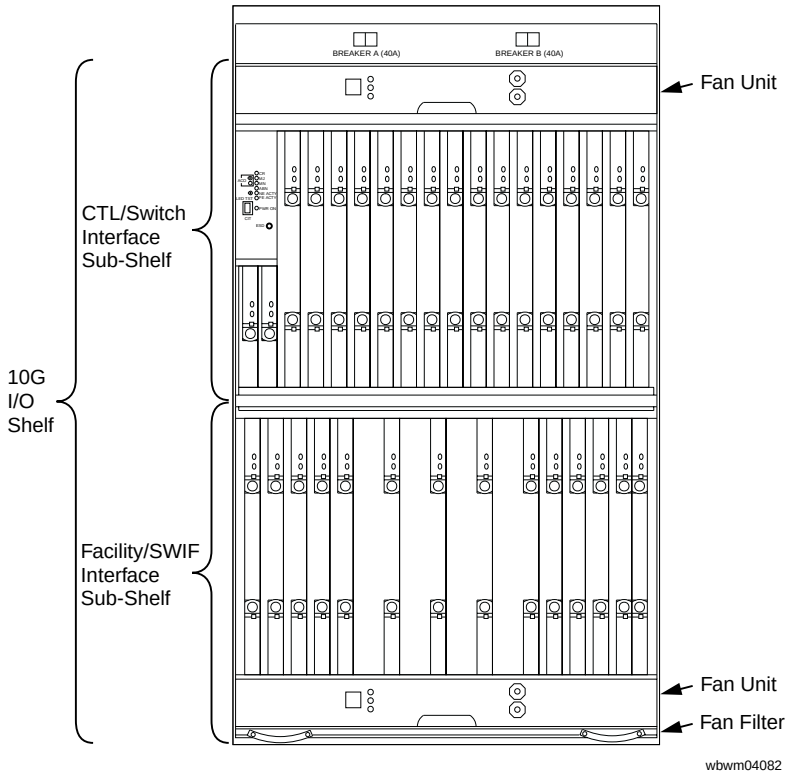
All transmission port units (hardware) are capable of transmitting and receiving SDH-rate and SONET-rate signals. The WaveStar BandWidth Manager software allows you to provision the port unit to accept the appropriate type of signal.

When equipped with the following SWIF pairs, the 10G I/O Shelf consumes the corresponding number of STS-1/STM-1 equivalents on the main switch fabric:

- One pair: 96 STS-1/32 STM-1 equivalents
- Two pairs: 192 STS-1/64 STM-1 equivalents
- Three pairs: 288 STS-1/96 STM-1 equivalents
- Four pairs: 384 STS-1/128 STM-1 equivalents

Figure Figure 4-44 illustrates a 10G I/O Shelf.

Figure 4-44 10G I/O Shelf



CTL/Switch Interface Sub-Shelf

Overview

A CTL/Switch Interface Sub-Shelf, the upper portion of a 10G I/O Shelf, is available to house the control and timing packs, the shelf-based switch fabric packs (SWITCH/STS768) packs, and the pointer processor packs.

Definition of module

Because multiple configurations are possible for the shelves of an I/O Shelf, the term “module” is used to describe an equipped sub-shelf. The term “sub-shelf” simply refers to a designated portion of an I/O Shelf.

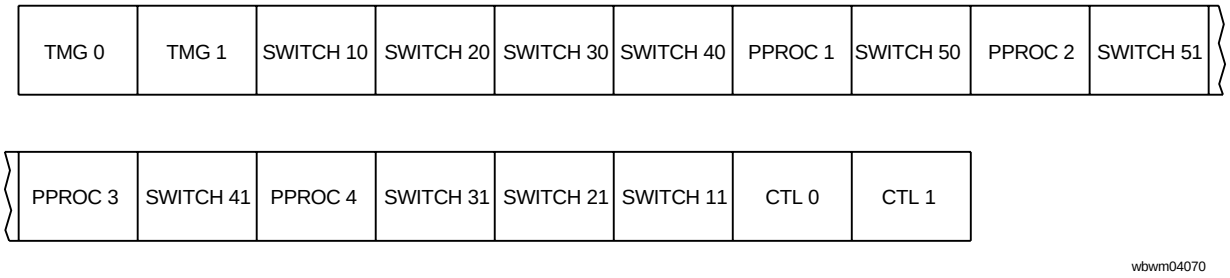
CTL/Switch Module

A CTL/Switch Module is a CTL/Switch Interface Sub-Shelf equipped with circuit packs.

Designation label strip

The CTL/Switch Interface Sub-Shelf is equipped from left to right, according to the designation label strip illustrated in Figure 4-45.

Figure 4-45 CTL/Switch Interface Sub-Shelf Designation Label Strip



Equipped slots The appropriate packs should be inserted in the slots indicated in the following table.

Table 4-14 Equipped Slots – CTL/Switch Interface Sub-Shelf

Slot	Circuit Pack
TMG 1a	TMG/STRAT3
TMG 0[a]	TMG/STRAT3
SWITCH 1,0[b]	SWITCH/STS768[c]
SWITCH 2,0	SWITCH/STS768
SWITCH 3,0	SWITCH/STS768
SWITCH 4,0	SWITCH/STS768
PPROC 1[d]	PPROC/FO
SWITCH 5,0	SWITCH/STS768
PPROC 2[d]	PPROC/FO
SWITCH 5,1	SWITCH/STS768
PPROC 3[d]	PPROC/FO
SWITCH 4,1	SWITCH/STS768
PPROC 4[d]	PPROC/FO
SWITCH 3,1	SWITCH/STS768
SWITCH 2,1	SWITCH/STS768
SWITCH 1,1	SWITCH/STS768
CTL 0	CTL/SR50DC
CTL 1	CTL/SR50DC

a) The TMG/STRAT3 packs are half the height of a normal full-sized pack. The 0 indicates the service pack of a pair goes in that slot. The 1 indicates the protection pack of a pair goes in that slot.

b) The first number represents the SWITCH/STS768 pair (1-4). The second number, 0 or 1, indicates the service or protection pack, respectively.

c) SWITCH/STS768 equates to SWITCH/STM256 in SDH terminology.

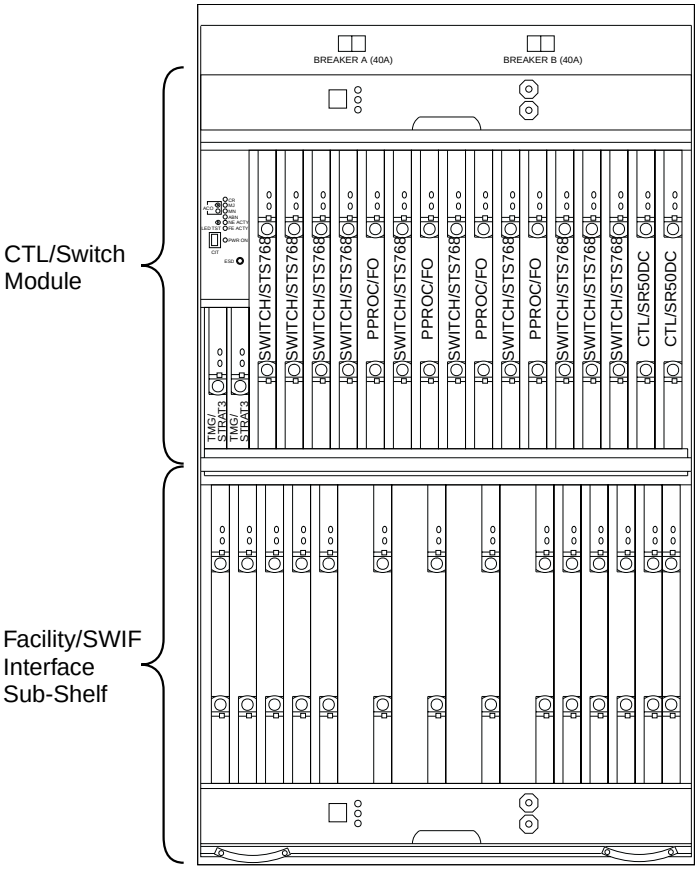
d) The numbers following PPROC do not represent a protection scheme, but rather quantity.

CTL/Switch Module

Overview A CTL/Switch Module is a CTL/Switch Interface Sub-Shelf that is equipped with circuit packs.

Figure Figure 4-46 illustrates the CTL/Switch Module of a 10G I/O Shelf.

Figure 4-46 CTL/Switch Module of a 10G I/O Shelf



Facility/SWIF Interface Sub-Shelf

Overview

A Facility/SWIF Interface Sub-Shelf, the lower portion of a 10G I/O Shelf, is available to house OC192/STM64 port units and their associated SWIF packs.

Definition of module

Because multiple configurations are possible for the shelves of an I/O Shelf, the term “module” is used to describe an equipped shelf. The term “sub-shelf” simply refers to a designated portion of an I/O Shelf.

Modules

The port units used in the sub-shelf determine the type of module. The Facility/SWIF Interface Sub-Shelf may be equipped as an OC192/STM64 Optical Module.

Facility interface slot

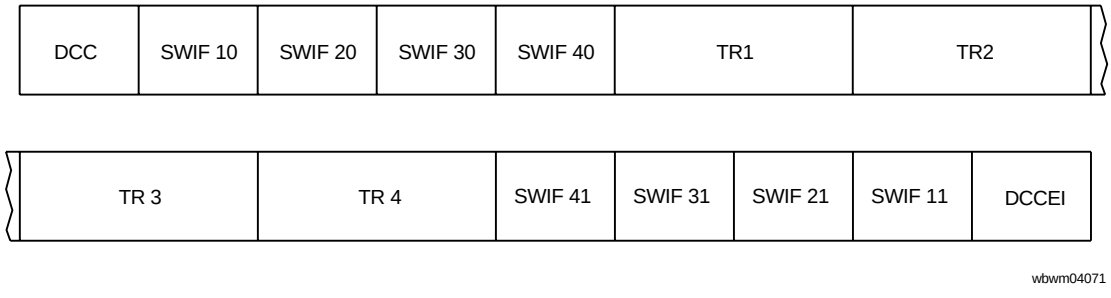
Each Facility/SWIF Interface Sub-Shelf contains four 60 mm wide facility interface slots designed for the OC192/STM64 port units.

> **Important!** In Figure 4-47, the facility interface slots are designated as TR1-TR4 (TR represents transmit/receive).

Designation label strip

The Facility/SWIF Interface Sub-Shelf designation label strip is illustrated in Figure 4-47.

Figure 4-47 Facility/SWIF Interface Sub-Shelf Designation Label Strip



Equipped slots Circuit packs should be inserted in the slots indicated in the following table.

Table 4-15 Equipped Slots – Facility/SWIF Interface Sub-Shelf

Slot	Circuit Pack
DCC	Blank
SWIF 1,0[a]	SWIF (Service of pair 1)
SWIF 2,0[b]	SWIF (Service of pair 2)
SWIF 3,0	SWIF (Service of pair 3)
SWIF 4,0	SWIF (Service of pair 4)
TR 1	OC192/STM64
TR 2	OC192/STM64
TR 3	OC192/STM64
TR 4	OC192/STM64
SWIF 4,1	SWIF (Protection of pair 4)
SWIF 3,1	SWIF (Protection of pair 3)
SWIF 2,1	SWIF (Protection of pair 2)
SWIF 1,1	SWIF (Protection of pair 1)
DCCEI	ADJCTL/DCCEI

a) SWIF 1,0 and 1,1 are equipped first (96 STS-1/32 STM-1 equivalents). SWIF 2,0 and 2,1 are added if an additional 96 STS-1/32 STM-1 equivalents of switch interface capacity are needed, for a total of 192 STS-1/64 STM-1 equivalents. SWIF 3,0 and 3,1 are added if an additional 96 STS-1/32 STM-1 equivalents of switch interface capacity are needed, for a total of 288 STS-1/96 STM-1 equivalents. SWIF 4,0 and 4,1 are added if an additional 96 STS-1/32 STM-1 equivalents of switch interface capacity are needed, for a total of 384 STS-1/128 STM-1 equivalents

b) The first number represents the SWIF pair (1-4). The second number, 0 or 1, indicates the service or protection pack, respectively.

OC192/STM64 Optical Module

Overview

An OC192/STM64 Optical Module is a Facility/SWIF Interface Sub-Shelf that is equipped with the common circuit packs, OC192/STM64 port units, and one to four SWIF pairs.

Circuit packs

A fully-equipped OC192/STM64 Optical Module includes the following circuit packs:

- One ADJCTL/DCCEI
- One to four SWIF pairs

Port units

An OC192/STM64 Optical Module includes either

- Two OC192/STM64 port units for
  - one 2-fiber OC-192 BLSR/STM-64 MS-SPRing
  - one 4-fiber OC-192 BLSR/STM-64 MS-SPRing (open)
  - one 4-fiber STM-64 MS-SPRing (open) with transoceanic protocol
- Four OC192/STM64 port units for
  - two 2-fiber OC-192 BLSRs/STM-64 MS-SPRings
  - one 4-fiber OC-192 BLSR/STM-64 MS-SPRing (closed)
  - one 4-fiber STM-64 MS-SPRing with transoceanic protocol
- ≤Four OC192/STM64 1+1 protected port units
- ≤Two OC192/STM64 0x1 protected port units

SWIF capacity

An OC192/STM64 Optical Module equipped with a 4-fiber OC-192 BLSR/STM-64 MS-SPRing can use one to four SWIF pairs to drop 96 to 384 STS-1/32 to 128 STM-1 equivalents of capacity from the BLSR/MS-SPRing to the main switch fabric. Refer to the following table for specific examples.

Table 4-16 SWIF Capacity – OC192/STM64 Optical Module (OC-192 BLSRs/STM-64 MS-SPRings)

2-Fiber OC-192 BLSR/STM-64 MS-SPRing	4-Fiber OC-192 BLSR/STM-64 MS-SPRing (open)[a]	4-Fiber OC-192 BLSR/STM-64 MS-SPRing (closed)	Capacity Dropped	STS-1/ STM-1	SWIF Pairs
1	1	NA	all service and protection capacity	384/128	4
			combination of service and/or protection capacity totaling 288 STS-1/96 STM-1 equivalents	288/96	3
			all service capacity or combination of service and/or protection capacity totaling 192 STS-1/64 STM-1 equivalents	192/64	2
			combination of service and/or protection capacity totaling 96 STS-1/32 STM-1 equivalents	96/32	1
2	2	1	all service capacity or combination of service and/or protection capacity totaling 384 STS-1/128 STM-1 equivalents	384/128	4
			combination of service and/or protection capacity totaling 288 STS-1/96 STM-1 equivalents	288/96	3
			combination of service and/or protection capacity totaling 192 STS-1/64 STM-1 equivalents	192/64	2
			combination of service and/or protection capacity totaling 96 STS-1/32 STM-1 equivalents	96/32	1

a) These rows assume that the OC192/STM64 Optical Module is an end node of an open ring. The capacity issues for an intermediate node in an open ring are the same as the nodes in a closed ring.

An OC192/STM64 Optical Module equipped with 1+1 and 0x1 protected OC192/STM64 port units can use two SWIF pairs to drop 192 STS-1/64 STM-1 equivalents of capacity from one working port units to the main switch fabric, or four SWIF pairs to drop 384 STS-1/128 STM-1 equivalents of capacity from two working port units to the main switch fabric.

Table 4-17 SWIF Capacity – OC192/STM64 Optical Module (1+1 and 0x1 Protection)

OC192/STM64	Capacity Dropped	STS-1/ STM-1	SWIF Pairs
1+1 protection: 2 working, 2 protection port units	all service capacity	384/128	4
1+1 protection: 1 working, 1 protection port units	all service capacity	192/64	2
0x1 protection: 2 working but unprotected port units	all service capacity	384/128	4
0x1 protection: 1 working but unprotected port unit	all service capacity	192/64	2

Important! The amount of traffic cross-connected directly on the shelf using the SWITCH/STS768 packs can not exceed 768 STS-1/256 STM-1 equivalents.

Placement of protected OC192/STM64 port units

The OC192/STM64 port units must following specific placement rules when they are provisioned as BLSRs/MS-SPRings.

The protection packs must be either adjacent or symmetrical.

In a 10G I/O Shelf, only the following slot pairs are considered *adjacent*:

- 1 and 2
- 3 and 4

In a 10G I/O Shelf, only the following slot pairs are considered *symmetrical*:

- 1 and 4
- 2 and 3

4-fiber BLSR/MS-SPRings

The following table illustrates two examples of the placement and provisioning of OC48/STM16 port units for 4-fiber OC-192 BLSRs/STM-64 MS-SPRings in an OC192/STM64 Optical Module. The protection packs (regardless of the East or West assignment) must be either adjacent or symmetrical.

Table 4-18 OC192/STM64 Port Unit Placement for 4-Fiber BLSRs/MS-SPRings

Slot	Port Unit	Ring	Provisioning Option 1: Adjacent	Provisioning Option 2: Symmetrical
TR 1	OC192/STM64	1	Service -West	Service -West
TR 2	OC192/STM64		Service - East	Protection - West
TR 3	OC192/STM64		Protection - West	Protection - East
TR 4	OC192/STM64		Protection - East	Service - East

2-fiber BLSR/MS-SPRings

The following table illustrates two examples of the placement and provisioning of OC192/STM64 port units for 2-fiber OC-192 BLSRs/STM-64 MS-SPRings in an OC192/STM64 Optical Module. Because both port units in a 2-fiber BLSR/MS-SPRing carry service and protection traffic, both port units in a 2-fiber ring are considered to be protection packs. Therefore, it is the East and West packs that must be either adjacent or symmetrical.

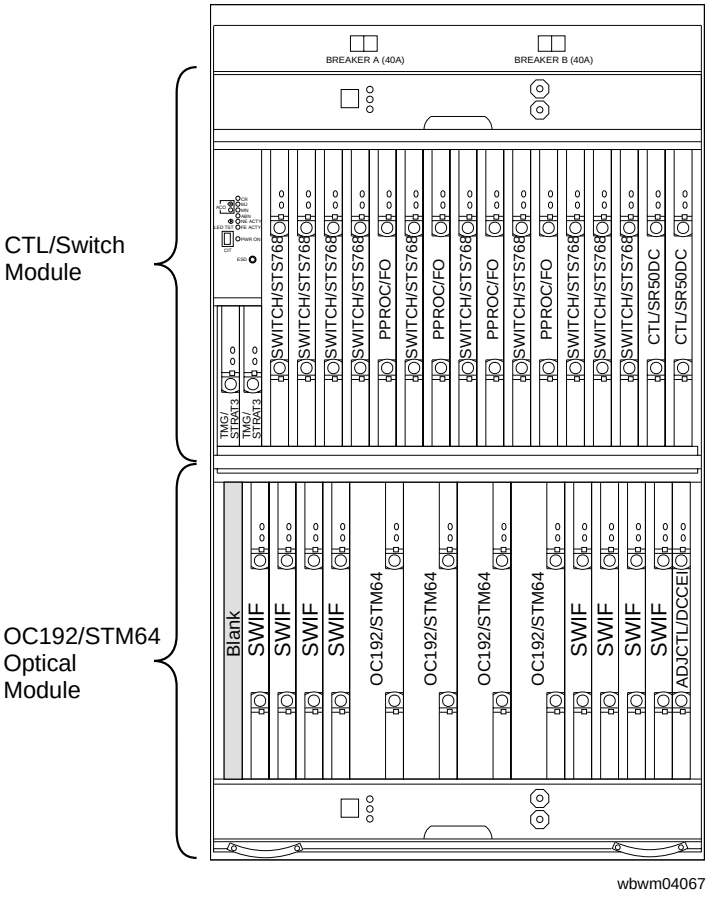
Table 4-19 OC192/STM64 Port Unit Placement for 2-Fiber BLSRs/MS-SPRings

Slot	Port Unit	Ring	Provisioning Option 1: Adjacent	Ring	Provisioning Option 2: Symmetrical
TR 1	OC192/STM64	1	West	1	West
TR 2	OC192/STM64		East	2	West
TR 3	OC192/STM64	2	West		East
TR 4	OC192/STM64		East	1	East

4-fiber OC-192 BLSR/STM-64 MS-SPRing

Figure 4-48 illustrates an OC192/STM64 Optical Module of a 10G I/O Shelf equipped with four OC192/STM64 port units. In this example, four SWIF pairs are used which indicates that either all service capacity, or a combination of service and protection capacity from one 4-fiber OC-192 BLSR/STM-64 MS-SPRing, totaling 384 STS-1/128 STM-1 equivalents, is dropped to the main switch fabric. Figure 4-48 could also represent four 1+1 protected port units with all service capacity from the two working OC192/STM64 port units being dropped to the main switch fabric.

Figure 4-48 OC192/STM64 Optical Module A of a 10G I/O Shelf



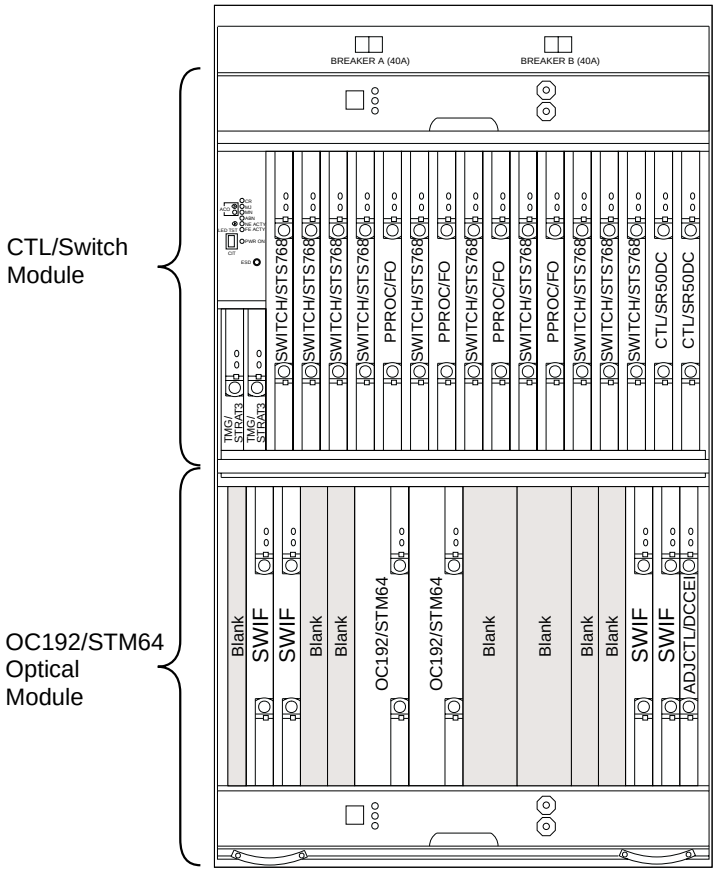
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4-fiber OC-192 BLSR/ STM-64 MS-SPRing (open)

Figure 4-49 illustrates an OC192/STM64 Optical Module of a 10G I/O Shelf equipped with two OC192/STM64 port units. In this example, two SWIF pairs are used which indicates that either all service capacity, or a combination of service and protection capacity from one 4-fiber OC-192 BLSR (open) or 4-fiber STM-64 MS-SPRing (open), totaling 192 STS-1/64 STM-1 equivalents, is dropped to the main switch fabric. Figure 4-49 could also represent two 1+1 protected port units with all service capacity from the working OC192/STM64 port unit being dropped to the main switch fabric.

Figure 4-49 assumes that the OC192/STM64 Optical Module is an end node of an open ring. The capacity issues for an intermediate node in an open ring are the same as the nodes in a closed ring.

Figure 4-49 OC192/STM64 Optical Module B of a 10G I/O Shelf



2-fiber OC-192 BLSR/ STM-64 MS-SPRing

Figure 4-50 illustrates an OC192/STM64 Optical Module of a 10G I/O Shelf equipped with two OC192/STM64 port units. In this example, two SWIF pairs are used which indicates that either all service capacity, or a combination of service and protection capacity from one 2-fiber OC-192 BLSR/STM-64 MS-SPRing, totaling 192 STS-1/64 STM-1 equivalents, is dropped to the main switch fabric. Figure 4-50 could also represent two 1+1 protected port units with all service capacity from the working OC192/STM64 port unit being dropped to the main switch fabric.

Figure 4-50 OC192/STM64 Optical Module C of a 10G I/O Shelf

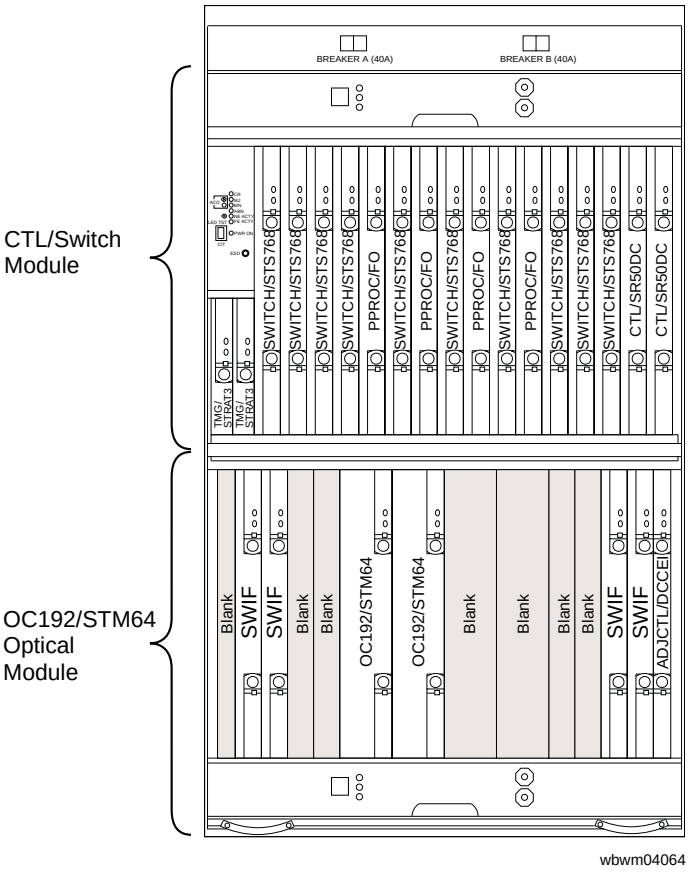
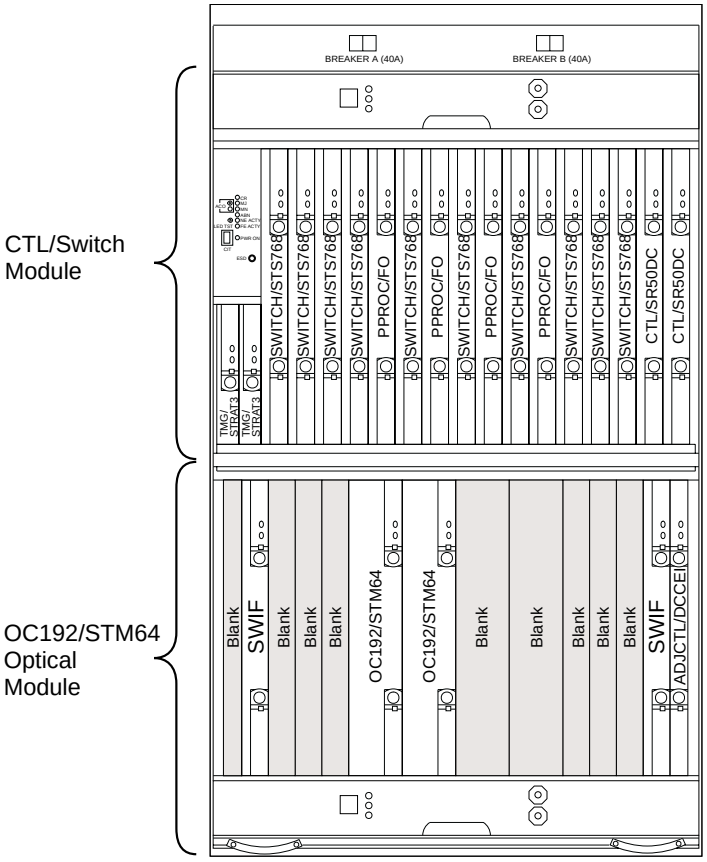


Figure 4-51 illustrates an OC192/STM64 Optical Module of a 10G I/O Shelf equipped with two OC192/STM64 port units. In this example, one SWIF pair is used which indicates that either a portion of the service capacity, or a combination of service and protection capacity from one 2-fiber OC-192 BLSR/STM-64 MS-SPRing, totaling 96 STS-1/32 STM-1 equivalents, is dropped to the main switch fabric.

Figure 4-51 OC192/STM64 Optical Module D of a 10G I/O Shelf



SDH Universal I/O Shelf

Overview

The WaveStar BandWidth Manager SDH Universal I/O Shelves house transmission interface port units and switch interface circuit packs. Each shelf is divided into the two following sub-shelves:

- Switch Interface Sub-Shelf (SWIF packs)
- Facility Interface Sub-Shelf (transmission port units)

Switch Interface Sub-Shelf

The upper portion of a SDH Universal I/O Shelf, referred to as a Switch Interface Sub-Shelf, provides eight slots for SWIF packs and two slots for future releases.

Facility Interface Sub-Shelf

The lower portion of an SDH Universal I/O Shelf, referred to as a Facility Interface Sub-Shelf, provides 16 slots for port units and 9 slots for the common circuit packs. The Facility Interface Sub-Shelves house OC-48/STM-16, OC-12/STM-4, and OC-3/STM-1 optical transmission interfaces and the STM-1e electrical transmission interfaces.

SDH gateway

When used in a SONET system, the SDH Universal I/O Shelf acts as a gateway for SDH STM-1e signals. However, if the optical interfaces are also used in this shelf, they must be provisioned as SDH interfaces as well.

Modules

When equipped with circuit packs and/or port units the sub-shelves are referred to as modules.

Switch Interface

In WaveStar BandWidth Manager, an equipped Switch Interface Sub-Shelf is referred to as a SWIF Module. Depending on the capacity needed by the associated Facility Interface Shelf, a SWIF Module may be equipped with either one SWIF pair (96 STS-1/32 STM-1 equivalents) or two SWIF pairs (192 STS-1/64 STM-1 equivalents). The Switch Interface Sub-Shelves house the packs that provide interfaces between the transmission port units (housed in the Facility Interface Sub-Shelves) and the main switch fabric provided by the Switch Shelves.

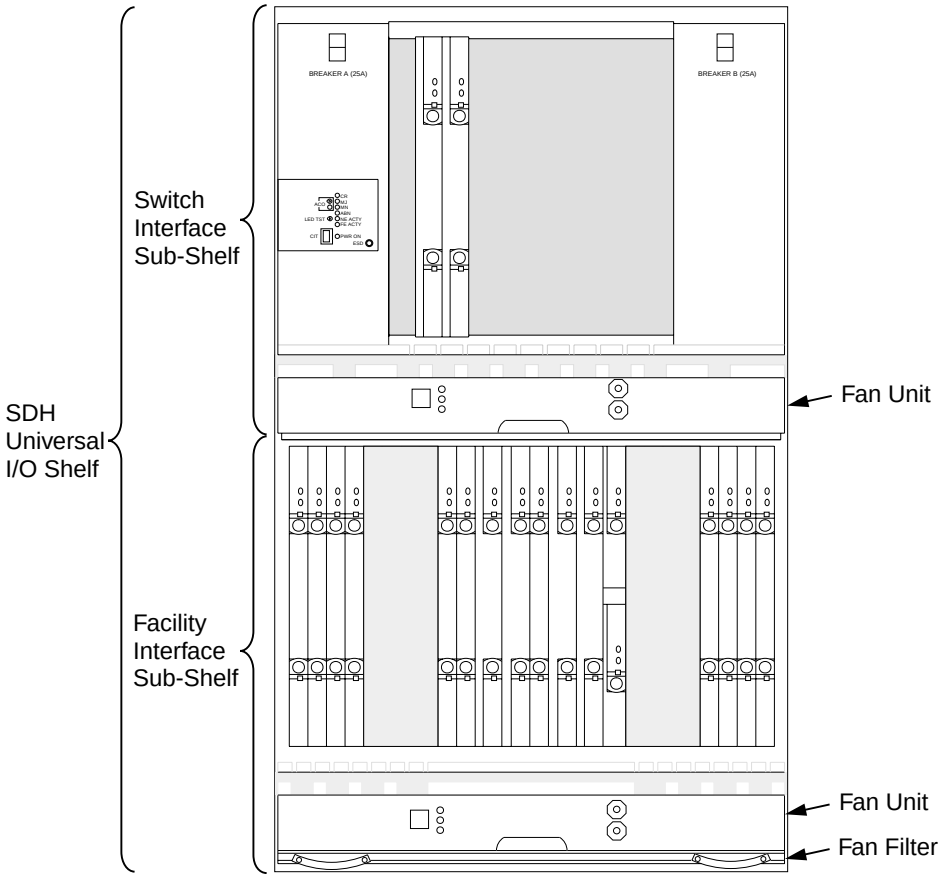
Facility Interface

Depending on the type of port units used, a Facility Interface Sub-Shelf may be equipped as one of the following types of modules:

- STM1e Electrical Module (only STM1E/4 port units)
- Mixed Module (supported combinations of STM1E/4, OC48/STM16, OC12/STM4, and/or OC3/STM1 port units)

Figure Figure 4-52 illustrates a SDH Universal I/O Shelf.

Figure 4-52 SDH Universal I/O Shelf



Switch Interface Sub-Shelf

Overview

A Switch Interface Sub-Shelf, the upper portion of an SDH Universal I/O Shelf, is available to house SWIF switch packs. The term “sub-shelf” simply refers to a designated portion of the shelf.

Definition of module

Because multiple configurations are possible for the sub-shelves of the SDH Universal I/O Shelf, the term “module” is used to describe an equipped sub-shelf.

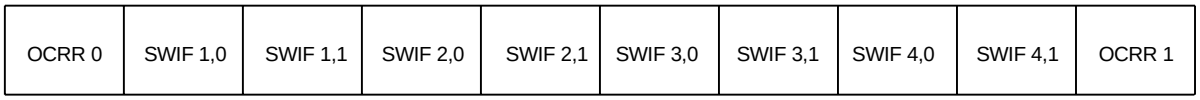
SWIF Module

A SWIF Module is a Switch Interface Sub-Shelf equipped with SWIF packs. Either two or four of the eight available SWIF slots are equipped with one or two SWIF pairs (for a maximum of four SWIF packs).

Designation label strip

The Switch Interface Sub-Shelf is equipped from left to right, according to the designation label strip illustrated in Figure 4-53.

Figure 4-53 Switch Interface Sub-Shelf Designation Label Strip



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Equipped slots SWIF packs should be inserted in the slots indicated in the following table.

Table 4-20 Equipped Slots – Switch Interface Sub-Shelf

Slot	Circuit Pack
OCRR 0[a]	Blank
SWIF 1,0[b]	1 pair of SWIF packs
SWIF 1,1[c]	
SWIF 2,0	1 pair of SWIF packs
SWIF 2,1	
SWIF 3,0	Blank
SWIF 3,1	Blank
SWIF 4,0	Blank
SWIF 4,1	Blank
OCRR 1[a]	Blank

a) The 0 indicates the service pack of a pair goes in that slot. The 1 indicates the protection pack of a pair goes in that slot.

b) SWIF 1,0 and 1,1 are equipped first (96 STS-1/32 STM-1 equivalents). SWIF 2,0 and 2,1 are added if an additional 96 STS-1/32 STM-1 equivalents of switch interface capacity are needed by any of the modules, for a total of 192 STS-1/64 STM-1 equivalents.

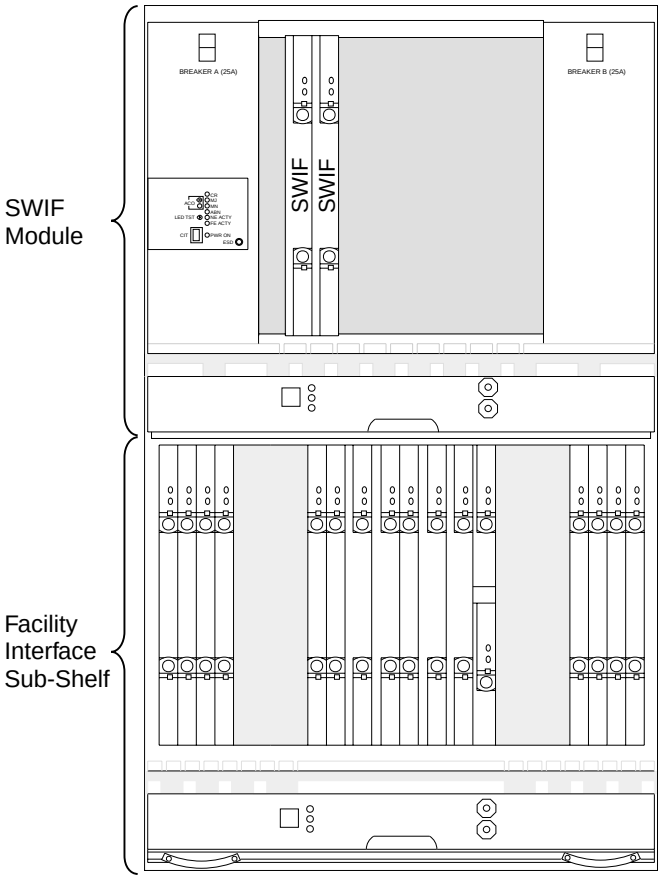
c) The first number represents the SWIF pair (1-4). The second number, 0 or 1, indicates the service or protection pack, respectively.

SWIF Module

Overview A SWIF Module is a Switch Interface Sub-Shelf that is equipped with SWIF packs.

Figure Figure 4-54 illustrates the SWIF Module of an SDH Universal I/O Shelf. This example assumes that the Facility Interface Sub-Shelf is equipped as an STM1e Electrical Module. Therefore, the SWIF Module is equipped with one pair of SWIF packs (96 STS-1/32 STM-1 equivalents). If the Facility Interface Sub-Shelf was equipped as a Mixed Module, the SWIF Module could be equipped with two SWIF pairs (192 STS-1/64 STM-1 equivalents).

Figure 4-54 SWIF Module of an SDH Universal I/O Shelf



Facility Interface Sub-Shelf

Overview

A Facility Interface Sub-Shelf, the lower portion of an SDH Universal I/O Shelf, is available to house common circuit packs and port units. Additional types of interface port units will be available in future releases.

Definition of module

Because multiple configurations are possible for the sub-shelves of the Universal I/O Shelf, the term “module” is used to describe an equipped sub-shelf. The term “sub-shelf” simply refers to a designated portion of the shelf.

Modules

The port units used in the sub-shelf determine the type of module. The Facility Interface Sub-Shelf may be equipped as one of the following modules:

- STM1e Electrical Module
- Mixed Module

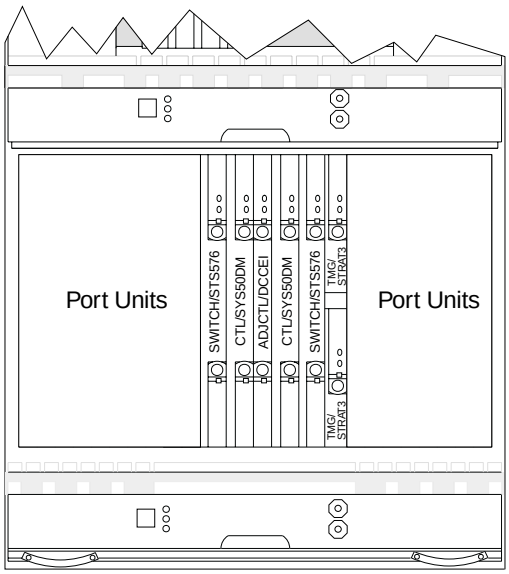
Common packs

Regardless of the port units used, all SDH Universal I/O Shelves include the following common circuit packs:

- Two SWITCH/STS576
- Two CTL/SYS50DM
- One ADJCTL/DCCEI
- Two TMG/STRAT3

Figure 4-55 illustrates the common packs used in all Facility Interface Sub-Shelf modules.

Figure 4-55 Common Packs in the Facility Interface Sub-Shelf



Important! When ordering the Common Circuit Pack Kit for an SDH Universal I/O Shelf, you receive one pair of SWIF packs in addition to the packs illustrated in Figure 4-55.

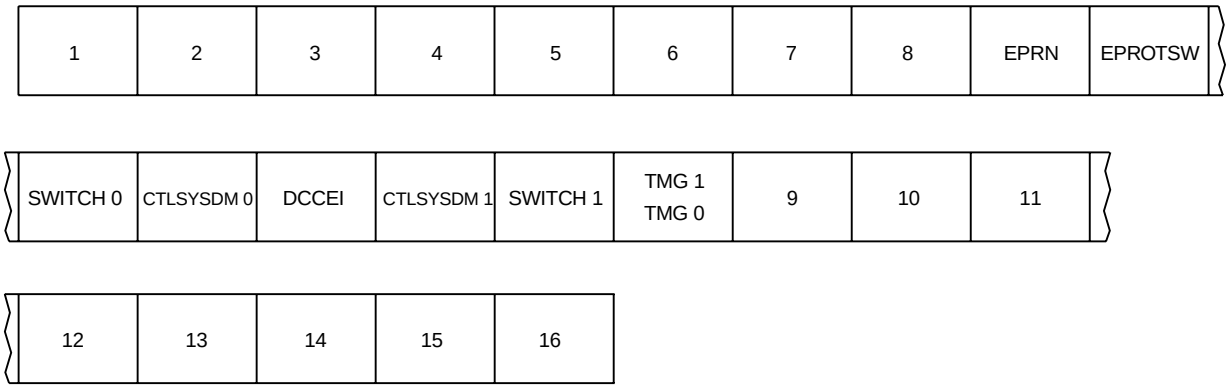
Universal interface slot

Each Facility Interface Sub-Shelf contains sixteen universal interface slots. The unique characteristic of a universal slot is its ability to accept any of the port units that are available in the current and planned future releases of WaveStar BandWidth Manager.

Designation label strip

The Facility Interface Sub-Shelf designation label strip illustrated in Figure 4-56 is used for all modules of the sub-shelf.

Figure 4-56 Facility Interface Sub-Shelf Designation Label Strip



Important! If a Mixed Module is equipped with STM1E/4 port units and 1xN protection is used, then slot 16 must either be equipped with a STM1E/4 port unit or left blank.

Slots 5 through 8 and 9 through 12 cannot be equipped with STM1E/4 port units.

Equipped slots Circuit packs should be inserted in the slots indicated in the following table.

Table 4-21 Equipped Slots – Facility Interface Sub-Shelf

Slot	Circuit Pack
1-4[a]	STM1E/4
1-8	OC48/STM16, OC12/STM4, and/or OC3/STM1 (Mixed Module) or Blank (STM1e Electrical Module)
EPRN	STM1E/4 (for 1xN protection of the STM1E/4 port units)
EPROTSW	SWITCH/STM1E4
SWITCH 0[b]	SWITCH/STS576
CTLSYSDM 0	CTL/SYS50DM
DCCEI	ADJCTL/DCCEI
CTLSYSDM 1	CTL/SYS50DM
SWITCH 1[b]	SWITCH/STS576
TMG 1[c] TMG 0	TMG/STRAT3 TMG/STRAT3
9-16	OC48/STM16, OC12/STM4, and/or OC3/STM1 (Mixed Module) or Blank (STM1e Electrical Module)
13-16[a]	STM1E/4

a) Slots 5 through 12 are blank when the Facility Interface Sub-Shelf is fully-equipped as an STM1e Electrical Module; slots 5 through 12 cannot be equipped with STM1E/4 port units.

b) The 0 indicates the service pack of a pair goes in that slot. The 1 indicates the protection pack of a pair goes in that slot.

c) The TMG/STRAT3 packs are half the height of a normal full-sized pack. Therefore, when one pack is placed on top of the other these two packs can fit in one normal slot.

STM1e Electrical Module

Overview

An STM1e Electrical Module is a Facility Interface Sub-Shelf that is equipped with the common circuit packs and STM1E/4 port units.

Common packs

A fully-equipped STM1e Electrical Module includes the following common circuit packs:

- Two SWITCH/STST576
- Two CTL/SYS50DM
- One ADJCTL/DCCEI
- Two TMG/STRAT3

Important! When ordering the Common Circuit Pack Kit for an SDH Universal I/O Shelf, you receive one pair of SWIF packs in addition to the packs listed above.

Port units and circuit pack

A fully-equipped STM1e Electrical Module includes

- Eight STM1E/4 port units (located in slots 1-4 and 13-16)
- One STM1E/4 port unit (needed for 1x8 protection)
- One SWITCH/STM1E4 pack

Important! Although the eight universal slots (slots 5-12) remain empty, the module is fully-equipped.

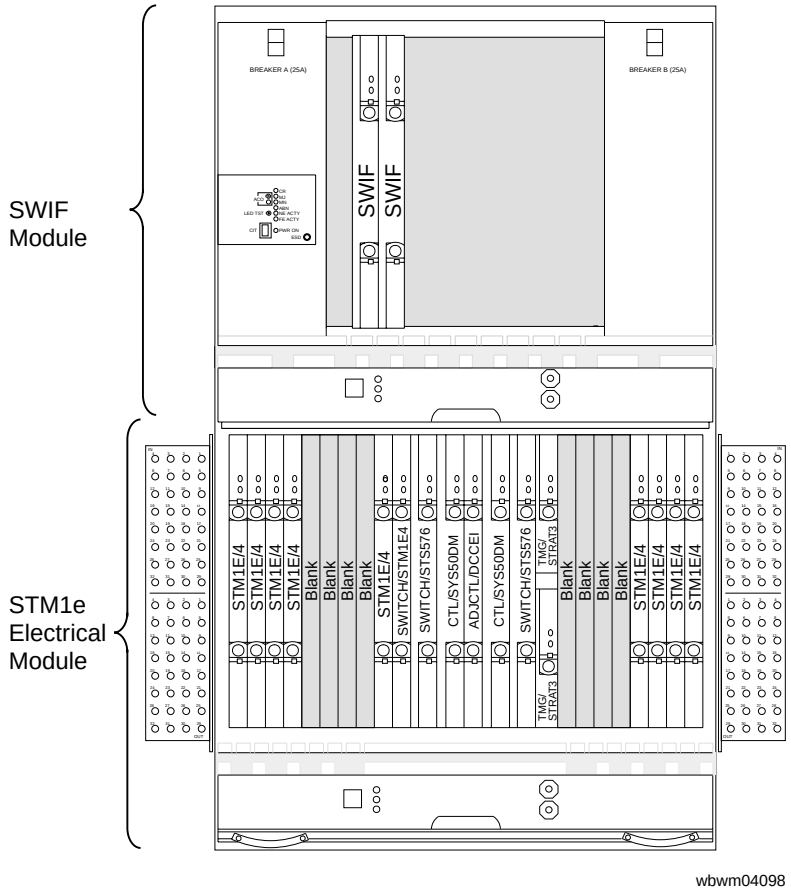
SWIF capacity

An STM1e Electrical Module requires SWIF pair (32 STM-1 equivalents = 4 ports X 8 port units) to drop all the capacity available from the STM1E/4 port units to the main switch fabric.

Important! 32 STM-1 equivalents (SDH) equates to 96 STS-1 equivalents (SONET).

Figure Figure 4-57 illustrates a fully-equipped STM1e Electrical Module of an SDH Universal I/O Shelf.

Figure 4-57 STM1e Electrical Module of an SDH Universal I/O Shelf



Mixed Module

Overview

A Mixed Module is a Facility Interface Sub-Shelf that is equipped with the common circuit packs and a combination of any of the following port units:

- STM1E/4
- OC48/STM16
- OC12/STM4
- OC3/STM1

Common packs

A fully-equipped Mixed Module includes the following common circuit packs:

- Two SWITCH/STS576
- Two CTL/SYS50DM
- One ADJCTL/DCCEI
- Two TMG/STRAT3

Important! When ordering the Common Circuit Pack Kit for an SDH Universal I/O Shelf, you receive one pair of SWIF packs in addition to the packs listed above.

Port units and circuit packs

A Mixed Module includes a combination of the following port units and circuit packs:

- ≤8 working STM1E/4 port units
  - One SWITCH/STM1E4 pack
  - One protection STM1E/4 port unit (needed for 1xN [N ≤ 8] protection of the STM1E/4 port units)
- 4 OC48/STM16 port units (one 4-fiber OC-48 BLSR/STM-16 MS-SPRing)
- ≤4 OC48/STM16 port units (1+1 protected: 2 working, 2 protection port units)
- 2 OC48/STM16 port units (one 2-fiber OC-48 BLSR/STM-16 MS-SPRing)
- ≤8 OC12/STM4 port units (1+1 protected: 4 working, 4 protection port units)
- ≤8 OC3/STM1 port units (1+1 protected: 4 working, 4 protection port units)

Important! STM1E/4 port units may only be placed in slots 1-4 and 13-16. OC48/STM16, OC12/STM4, or OC3/STM1 port units may be placed in any universal interface slot (1-16).

SWIF capacity

A Mixed Module generally uses two SWIF pairs to drop 192 STS-1/64 STM-1 equivalents from the port units to the main switch fabric.

Table 4-22 SWIF Capacity – Mixed Module

Port Units	Capacity Dropped	STS-1/ STM-1	SWIF Pairs
≤8 STM1E/4	all service capacity	≤96/32	2
4 OC48/STM16	combination of service and protection from one 4-fiber OC-48 BLSR/STM-16 MS-SPRing	≤192/64	
	all service capacity from one 4-fiber OC-48 BLSR/STM-16 MS-SPRing	≤96/32	
2 OC48/STM16	combination of service and protection from one 2-fiber OC-48 BLSR or one 4-fiber OC-48 BLSR/STM-16 MS-SPRing (open)[b]	≤96/32	
	all service capacity from one 2-fiber OC-48 BLSR or one 4-fiber OC-48 BLSR/STM-16 MS-SPRing (open)[b]	≤48/16	
≤4 OC48/STM16[a]	all service capacity	≤96/32	
≤8 OC12/STM4[a]	all service capacity	≤96/32	
≤8 OC3/STM1[a]	all service capacity	≤48/16	

a) In these examples, the OC48/STM16, OC12/STM4, and OC3/STM1 port units are all 1+1 protected.

b) These rows assume that the Mixed Module is an end node of an open ring. The capacity issues for an intermediate node in an open ring are the same as the nodes in a closed ring.

Important! The port unit quantities listed in the preceding table represent the total number of port units in that shelf. When the port units are 1+1 protected, one half of the port units are working and one half of the port units are protection.

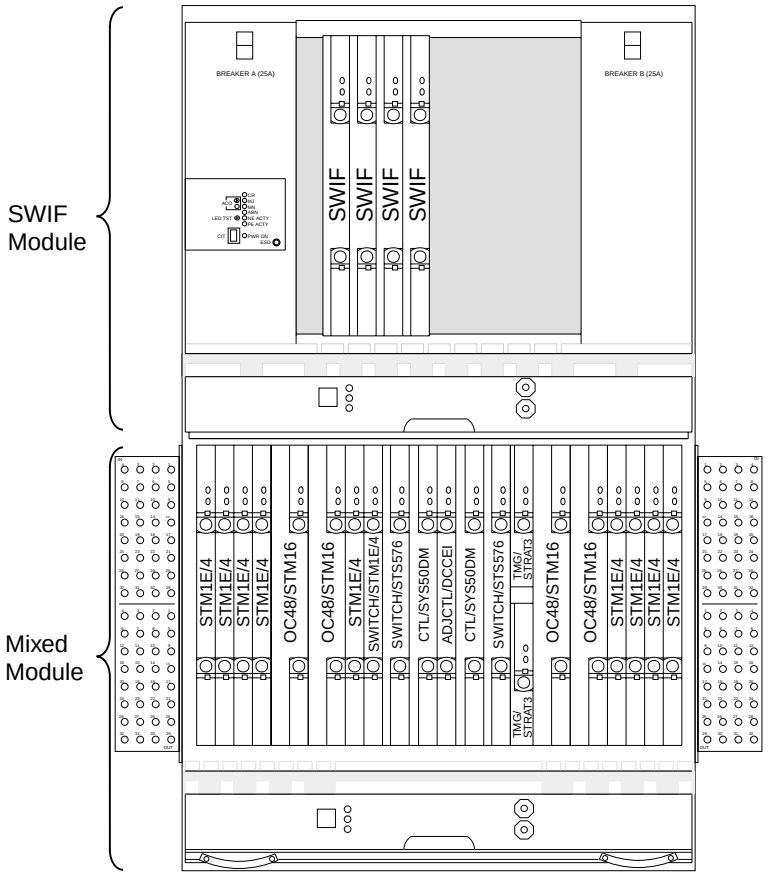
Although a Mixed Module supports multiple combinations of port units, the different types of port units must be placed in the appropriate slots and not exceed the physical capacity of the shelf. The amount of traffic dropped to the main switch fabric can not exceed 192 STS-1/64 STM-1 equivalents.

The amount of traffic cross-connected directly on the shelf using the SWITCH/STS576 packs can not exceed 384 STS-1/128 STM-1 equivalents.

Mixed Module configuration A

Figure 4-58 illustrates a possible configuration of a Mixed Module of a Universal I/O Shelf that contains eight STM1E/4 port units (1xN protected) and four OC48/STM16 port units (one 4-fiber OC-48 BLSR/STM-16 MS-SPRing).The eight working STM1E/4 port units use 96 STS-1/32 STM-1 equivalents of the available 192 STS-1/64 STM-1 equivalents provided by the two SWIF pairs. Therefore, up to 96 STS-1/32 STM-1 equivalents of capacity can be used by a combination of service and protection capacity from the BLSR/MS-SPRing.

Figure 4-58 Mixed Module A of an SDH Universal I/O Shelf

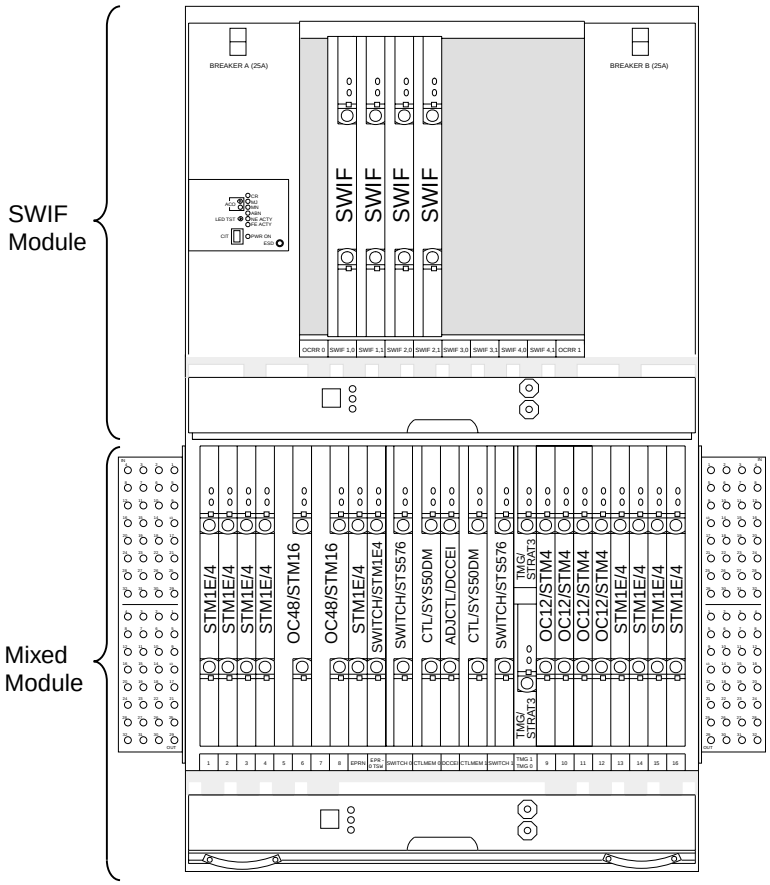


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Mixed Module configuration B

Figure 4-59 illustrates a possible configuration of the Mixed Module of an SDH Universal I/O Shelf that contains eight STM1E/4 port units (1xN protected), two OC48/STM16 port units (one 2-fiber OC-48 BLSR/STM-16 MS-SPRing), and four OC12/STM4 port units (1+1). When combined, the eight working STM1E/4 port units (96 STS-1/32 STM-1 equivalents) and the two working OC12/STM4 port units (48 STS-1/16 STM-1 equivalents) use 144 STS-1/48 STM-1 equivalents of the available 192 STS-1/64 STM-1 equivalents provided by the two SWIF pairs. Therefore, up to 48 STS-1/16 STM-1 equivalents of capacity can be used by a combination of service and protection capacity from the BLSR/MS-SPRing.

Figure 4-59 Mixed Module B of an SDH Universal I/O Shelf



STM1e Connector Panel

Overview

This section describes the STM1e Connector Panel that is needed for the Facility Interface Sub-Shelf when the sub-shelf is equipped as either a STM1e Electrical Module or a Mixed Module with STM1E/4 port units.

Description

Each STM1e Connector Panel is equipped with 32 pairs of connectors. Each pair includes one transmit and one receive connector. The STM1e Connector Panels are available with either 43-type (also known as SMB) connectors (75-ohm) or 1.6/5.6 connectors (75-ohm). Four STM1E/4 port units can be cabled to each panel. The bundled cable connects the 43-type or 1.6/5.6 connectors to the backplane.

The STM1e Connector Panels are designed to support future releases of the STM1E port units that will contain eight ports. Therefore, only half of the available connectors on each panel are used by the STM1E/4 port units.

Determining number of panels

Use the following table to determine the number of STM1e Connector Panels needed for each Facility Interface Sub-Shelf. You must know the number and location of the STM1E/4 port units in the sub-shelf.

Table 4-23 Determining the Number of STM1e Connector Panels

IF you have...	AND they are located...	THEN you need...
0 STM1E/4 port units	NA	0 STM1e Connector Panels.
< 4 STM1E/4 port units	in slots 1 through 4	1 STM1e Connector Panel (left-mount).
<4 STM1E/4 port units	in slots 13 through 16	1 STM1e Connector Panel (right-mount).
<8 STM1E/4 port units	in slots 1 through 4 AND in slots 13 through 16	2 STM1e Connector Panels (one left-mount, and one right-mount).

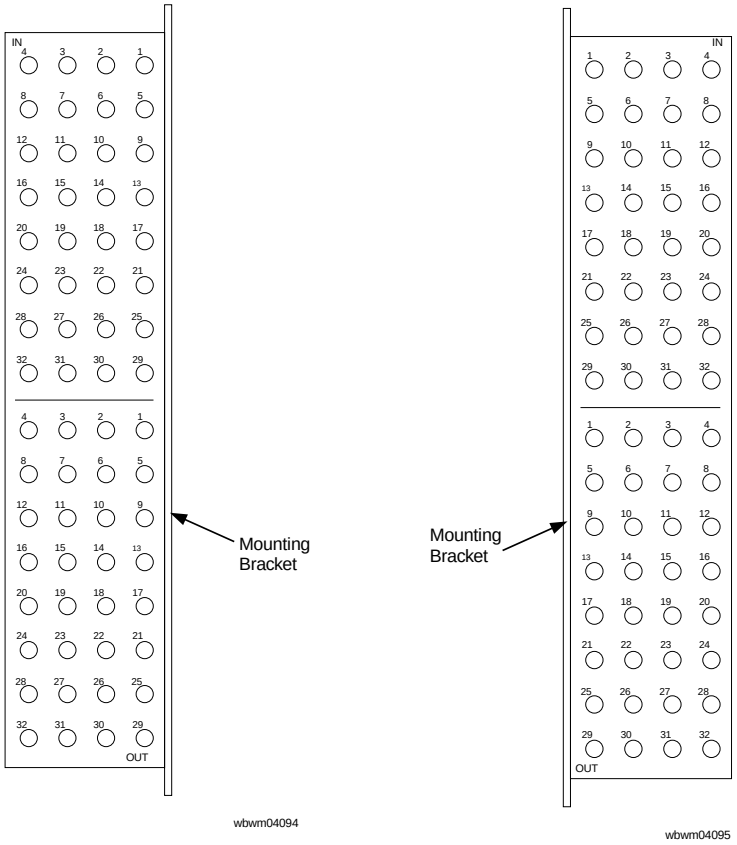
Quantity and location

A Facility Interface Sub-Shelf may include one, two, or no STM1e Connector Panels. The number of panels needed is dependent upon the type, location, and number of port units used in the sub-shelf. The panels are placed on either the left or right side of the shelf, or on both sides of the shelf, depending on the locations of the STM1E/4 port units.

Individual panels

Figure 4-60 illustrates left-mount and a right-mount STM1e Connector Panels.

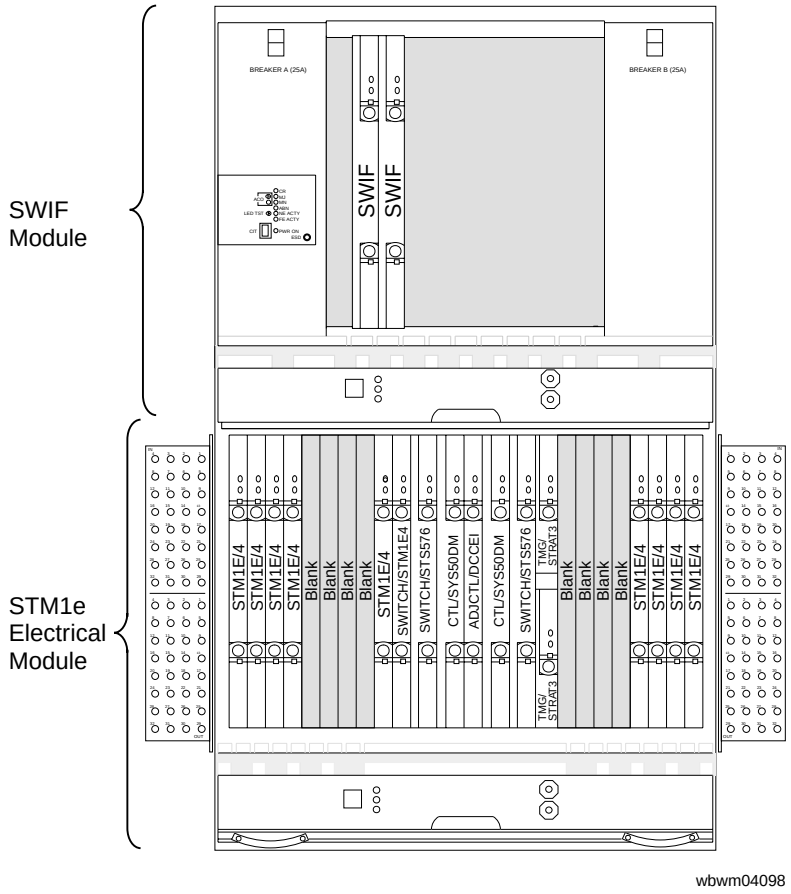
Figure 4-60 STM1e Connector Panels



Mounted panels

Figure 4-61 illustrates an STM1e Electrical Module with two STM1e Connector Panels.

Figure 4-61 STM1e Connector Panels on an STM1e Electrical Module



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Fan Unit

Overview

Each fan unit provides forced-air cooling for its associated shelf. This section describes the physical design, purpose, and features of the fan unit that is included with each shelf in WaveStar BandWidth Manager.

Description

The fan unit is a plug-in module that fits into position at the bottom of each shelf, just beneath the designation label strip. Each fan unit includes

- Six individual fans
- A filter alarm reset button
- Three LEDs
  - Power on (PWR ON)
  - Filter alarm (FILTER ALM)
  - FAIL
- Two circuit breakers
  - Power feed A (BREAKER A)
  - Power feed B (BREAKER B)

Important! When replacing a fan unit, ensure that the spare fan unit is in hand.

All fan units must be installed and operating in a shelf before any port units/circuit packs are installed.

Quantity and location

The following table provides the number and location of the fan unit(s) included with each type of shelf.

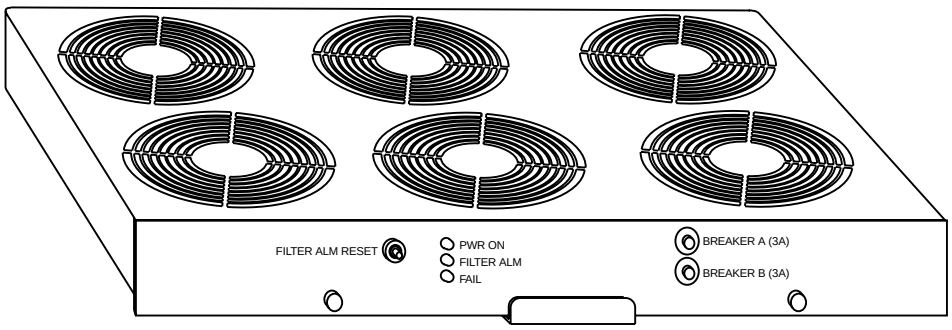
Table 4-24 Location of Fan Units

Type of Shelf	Number of Fan Units	Location
System Controller Shelf	1	bottom of shelf
Switch Shelf	1	bottom of shelf
Universal I/O Shelf	2	one on bottom of Switch Interface Sub-Shelf
		one on bottom of Facility Interface Sub-Shelf
10G I/O Shelf	2	one on top of CTL/Switch Interface Sub-Shelf
		one on bottom of Facility/SWIF Interface Sub-Shelf
SDH Universal I/O Shelf	2	one on bottom of Switch Interface Sub-Shelf
		one on bottom of Facility Interface Sub-Shelf

Figure

Figure 4-62 illustrates the fan unit that is included with each shelf in WaveStar BandWidth Manager.

Figure 4-62 Fan Unit



Fan Filter

Overview A fan filter, located beneath each fan unit, is also included with each shelf.

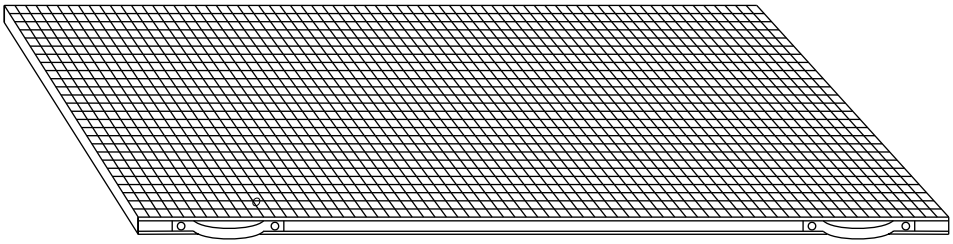
Description Each fan unit is accompanied by a fan filter that keeps dust and debris from entering the fan unit.

> **Important!** Although the I/O Shelves include two fan units, only the bottom fan unit is equipped with a fan filter.

Maintenance The fan filter must be replaced once every 6 months to ensure the proper working condition of the fan unit.

Figure Figure 4-63 illustrates the fan filter.

Figure 4-63 Fan Filter



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Heat Baffle

Overview This section describes the physical design, purpose, and placement of heat baffles in certain bays in WaveStar BandWidth Manager.

Function The heat baffle facilitates air circulation between the two working shelves, thus aiding in the cooling process.

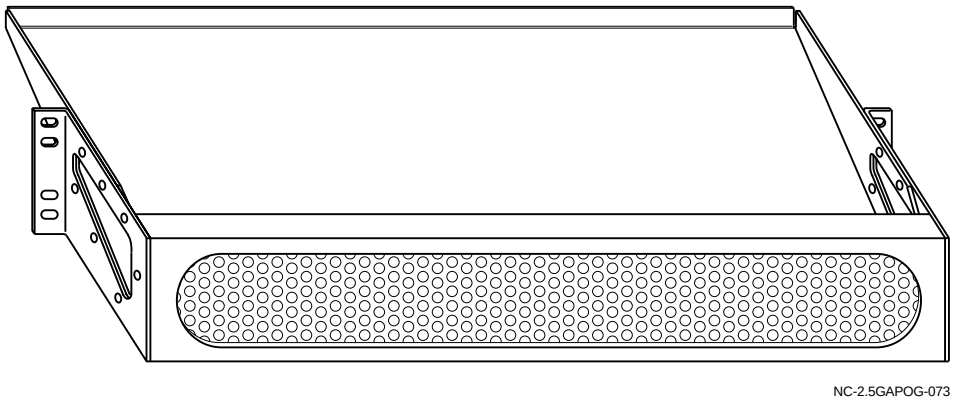
Quantity and location The following table provides the number and location of the heat baffle(s) included with each type of bay.

Table 4-25 Location of Heat Baffles

Bay	Number of Heat Baffles	Location
System Controller Bay	1	one below the System Controller Shelf
Control/Switch Bay	2	one between the System Controller Shelf and the Switch Shelf
Switch Bay	1	one below the Switch Shelf
Universal I/O Bay	1	one between the two Universal I/O Shelves
10G I/O Bay	1	one above the single 10G I/O Shelf
		one between the two 10G I/O Shelves
10G/Universal I/O Bay	1	one between the Universal I/O Shelf and the 10G I/O Shelf
SDH I/O Bay	1	one between the two SDH Universal I/O Shelves
10G/SDH I/O Bay	1	one between the SDH Universal I/O Shelf and the 10G I/O Shelf

Figure Figure 4-64 illustrates the heat baffle in WaveStar BandWidth Manager.

Figure 4-64 Heat Baffle



User Panel and Circuit Breakers

Overview

All shelves used in WaveStar BandWidth Manager are equipped with similar a user panel and circuit breakers.

User panel

Each user panel provides system-level information, such as alarm status, for its associated shelf. Each user panel also provides an ESD wrist strap ground connector and a CIT port to connect a WaveStar CIT to the system.

Circuit breakers

Each shelf is equipped with two -48/-60 VDC power circuit breakers, one for each power feed (A and B). The circuit breakers operate if their power feed exceeds normal current ranges. Circuit breakers provide a visual indication of their status via their rocker switches. The normally hidden portion of each rocker switch is red. Should a circuit breaker respond to an overcurrent by cutting off power to the shelf, the hidden red portion of the rocker switch rotates forward and is visible. The circuit breakers can be tripped manually by inserting a small screwdriver blade (or equivalent) into a slot in the rocker.

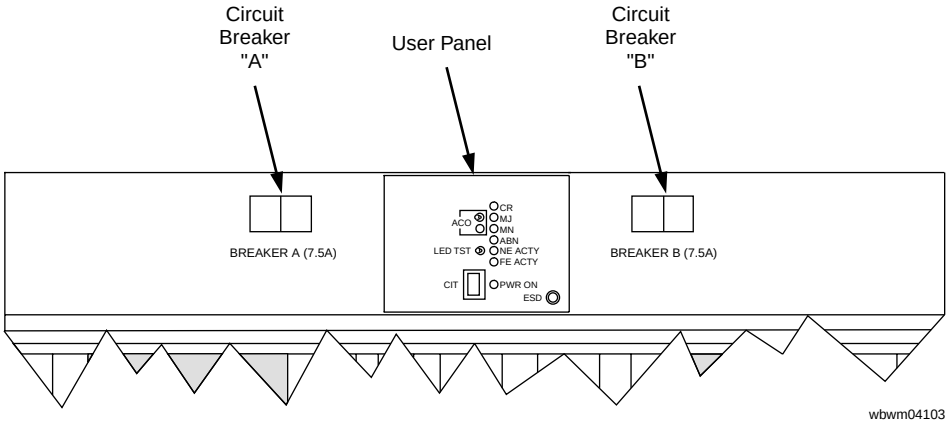
The following table lists the amperage of the circuit breakers for shelves and fan units in WaveStar BandWidth Manager.

Table 4-26 Amps of Circuit Breakers

Equipment	Circuit Breakers
System Controller Shelf	7.5A
Switch Shelf	30A
Universal I/O Shelf	25A
10G I/O Shelf	40A
SDH Universal I/O Shelf	25A
Fan Units	3A

Figure Figure 4-65 illustrates the user panel and circuit breakers that are present on all shelves. The exact placement of these pieces of equipment varies depending on the type of shelf. (Figure 4-65 is the top portion of a System Controller Shelf.)

Figure 4-65 User Panel and Circuit Breakers



In previous releases, all shelves (except the 10G I/O Shelves) had two power filters with voltage protection visible from the front of the shelf. Beginning in Release 4.1, the shelves have been redesigned and the power filters with voltage protection are now incorporated into the power filters (now referred to as power filters with voltage protection) on the back of the shelves. The Switch Shelf is the only shelf in which the power filters with voltage protection are still visible form the front of the shelf.

References

For information about the placement of the equipment illustrated in Figure 4-65 on the different shelves, refer to the illustrations of the individual shelves.

□

Passive Optic Equipment

Overview

WaveStar BandWidth Manager offers OC192/STM64/POU and OC48/STM16/POU passive optic port units that are compatible with the SONET and SDH standards.

Description

The Lucent Passive Optics Boxes do not require power, software, or operations support. However, they must be used with the OC48/STM16/POU or OC192/STM64/POU port units. By using the passive optic port units and the Passive Optic Boxes, you are able to increase fiber capacity by a factor of 16.

Port units

The OC192/STM64/POU and OC48/STM16/POU port units are both available in 16 different wavelengths (for a total of 32 passive optic port units). Each set of port units is designated by a 16 different 4-digit numeric suffixes that correspond to the frequency of each optical signal.

Passive Optic Boxes

The Passive Optics Boxes provide a low-cost solution for transmitting large amount of traffic over one fiber. The Passive Optics Boxes are capable of multiplexing and demultiplexing up to 16 colors together for transmission over a single fiber. The boxes are not dependent upon the rate of the signal; OC-192/STM-64 and OC-48/STM-16 wavelengths may be multiplexed by a single box.The boxes do not require any electricity.

Lucent offers the following options for the Passive Optics Boxes:

- 8-Mux/8-Demux Passive Optics Box: A single box is capable of multiplexing 8 colors and demultiplexing eight colors within the same box. Two boxes are required; one on each side of transmission. The two boxes are capable of multiplexing and demultiplexing 8 colors for transmission over a single fiber.
- 16-Mux + 16-Demux Passive Optics Boxes: The 16-Mux box is capable of multiplexing 16 colors and the 16-Demux box is capable of demultiplexing 16 colors. Two boxes are required in each direction, one for multiplexing and one for demultiplexing. Each box is capable of either multiplexing or demultiplexing 16 colors in a for transmission over a single fiber.

Dimensions

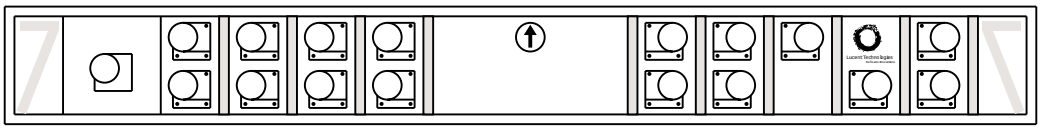
The dimensions of the Passive Optics Boxes are

- 76.2 mm/3 in. high
- 533.4 mm/21 in. wide
- 482.6 mm/19 in. deep

Figure

Figure 4-66 illustrates a Passive Optics Box.

Figure 4-66 Passive Optics Box



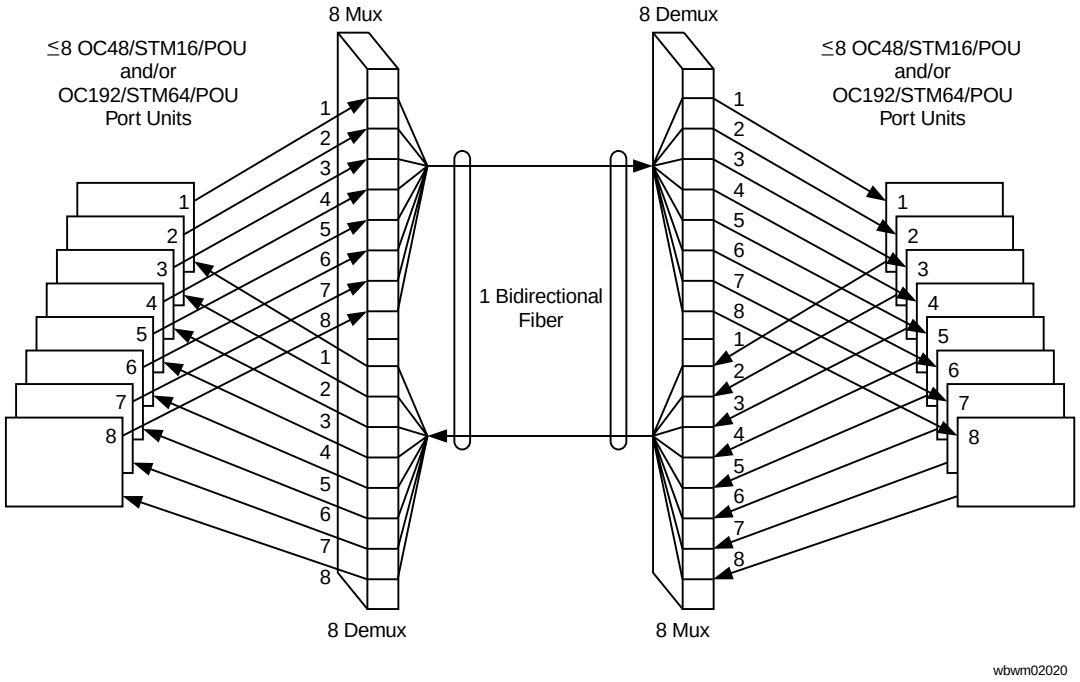
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Protection The passive optic port units support the same protection modes as the standard port units. For example, both sets of passive port units support BLSR/MS-SPRing, 1+1, and 0x1 protection.

8-Mux/8-Demux

Figure 4-67 illustrates two 8-Mux/8-Demux Passive Optics Boxes. The eight port units on each side of transmission may be a combination of OC192/STM64/POU and/or OC48/STM16/POU port units. Each passive port unit is equipped with a bidirectional port (both transmit and receive). The fiber between the two Passive Optics Boxes is bidirectional (transmit and receive).

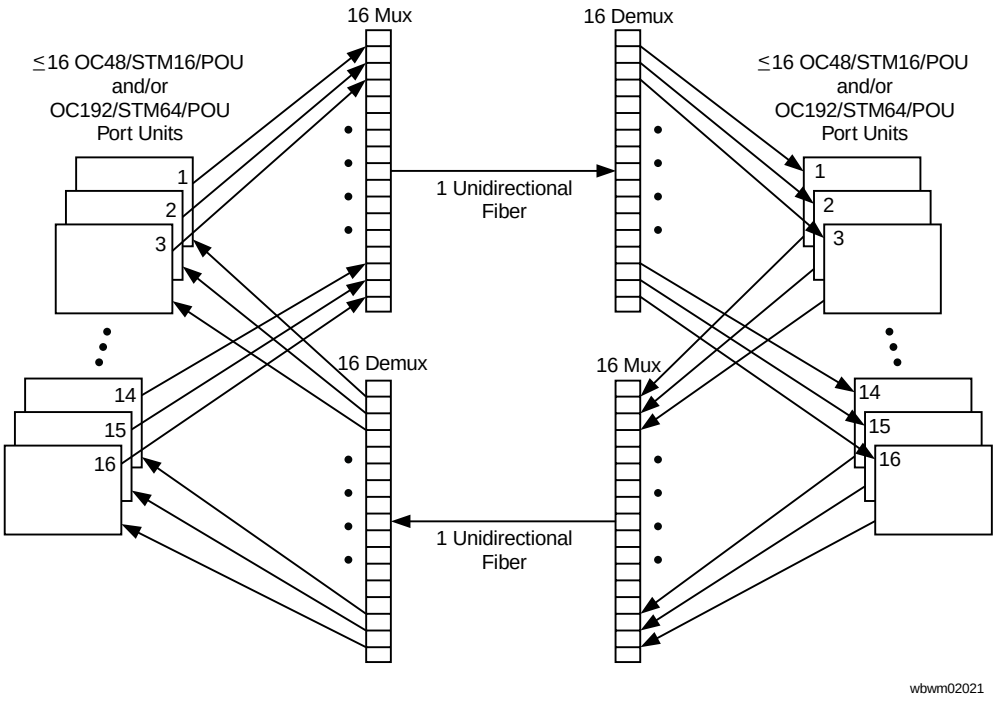
Figure 4-67 8-Mux/8-Demux Passive Optics Box (Functional Diagram)



16-Mux + 16-Demux

Figure 4-68 illustrates four 16-Mux + 16-Demux Passive Optics Boxes; two boxes in each direction. The sixteen port units on each side of transmission may be a combination of OC192/STM64/POU and/or OC48/STM16/POU port units. Each passive port unit is equipped with a bidirectional port (both transmit and receive). The fiber between the two Passive Optics Boxes on the upper portion of the figure is unidirectional in the east direction. The fiber between the two Passive Optics Boxes on the lower portion of the figure is unidirectional in the west direction.

Figure 4-68 16-Mux + 16-Demux Passive Optics Box (Functional Diagram)



Types of Circuit Packs

Overview

The WaveStar BandWidth Manager circuit packs are divided into the following three categories, based mainly on their functions:

- Control packs
- Switch packs
- Port units

Control packs

The control packs available in WaveStar BandWidth Manager are

- CTL/SR50DC
- PPROC/FO
- CTL/SYS50D
- CTL/SYS50DM
- CTL/EI
- ADJCTL/DCC
- ADJCTL/DCCEI
- CSIEX
- SWIEX
- CTL/MEM
- TMG/STRAT3

Switch packs

The switch circuit packs available for use in WaveStar BandWidth Manager are

- SWITCH/STS576
- SWITCH/STS768
- SWITCH/DS3EC1
- SWITCH/STM1E4
- BSW
- SWIF

Port units The port units available for use in WaveStar BandWidth Manager are

- DS3EC1/8 (electrical interface)
- STM1E/4 (electrical interface)
- OC192/STM64 (optical interface)
- OC48/STM16 (optical interface)
- OC12/STM4 (optical interface)
- OC3/STM1 (optical interface)

□

Control Circuit Packs

Overview This section describes the function and location of each WaveStar BandWidth Manager control pack.

CTL/SR50DC The CTL/SR50DC circuit pack, located in the 10G I/O Shelf, provides a secondary level of the control hierarchy. The CTL/SR50DC provides control and memory functions for the 10G I/O Shelf.

PPROC/FO The PPROC/FO circuit pack, located in the CTL/Switch Interface Sub-Shelf of the 10G I/O Shelf, provides an interface between the OC192/STM64 port units and the SWITCH/STS768 packs. The PPROC/FO packs processes the header information to the SWITCH/STS768 packs.

CTL/SYS50D The CTL/SYS50D circuit pack, located in the System Controller Shelf, provides the main system control functions for the system. The CTL/SYS50D circuit pack, the CLT/MEM, and CTL/EI circuit packs provide all user interfaces to the system.

CTL/SYS50DM The CTL/SYS50DM pack, located in the Facility Interface Sub-Shelf of the Universal I/O Shelf, is the second level of the control hierarchy. The CTL/SYS50DM provides control and memory functions for the I/O Shelves.

CTL/EI The CTL/EI (Control/External Interface) circuit pack, located in the System Controller Shelf, selects the 10Base-T LAN from the ADJCTL/DCC and CTL/SYS50D circuit packs and routes the signal to the backplane.

ADJCTL/DCC The ADJCTL/DCC (Adjunct Control/32 Data Communications Channels) pack, located in the System Controller Shelf, terminates 32 DCC channels. This circuit pack also provides interfaces to the 10Base-T LAN.

ADJCTL/DCCEI The ADJCTL/DCCEI (Adjunct Control/32 Data Communications Channels with External Interface) pack, located in the Facility Interface Sub-Shelf of the Universal I/O Shelf and SDH Universal I/O Shelf (all modules), combines the functionalities of the ADJCTL/DCC circuit pack and the CTL/EI circuit pack.

CSIEX The CSIEX (Control System Interface Expander) circuit pack, located in the System Controller Shelf, interfaces to the CTL/SYS50D circuit pack, the SWIEX circuit packs, and the secondary CTL/MEM circuit pack. The CSIEX circuit pack also provides an OS interface to the all I/O Shelves.

SWIEX The SWIEX (Switch Interface Expander) circuit pack, located in the Switch Shelf, distributes the internal system control to the BSW packs. The SWIEX circuit pack also monitors and controls the power supplied to the Switch Shelf.

CTL/MEM The CTL/MEM (Control/Memory) circuit pack, located in the System Controller Shelf, provides both redundant primary (PRI) and non-volatile secondary (SEC) memory. When combined with the CTL/SYS50D and CTL/EI circuit packs, the CTL/MEM circuit pack completes the main system controller complex.

TMG/STRAT3 The TMG/STRAT3 (Stratum 3 Timing) pack, located in the System Controller Shelf, the Switch Shelf, and all I/O Shelves, provides redundant timing distribution to all the shelves. The timing source is traceable to the office BITS clock (SONET) or SEC (SDH).

□

Switch Circuit Packs

Overview This section describes each WaveStar BandWidth Manager switch circuit pack's function and location.

SWITCH/STS576 The SWITCH/STS576 (576x576 STS-1/192x192 STM-1 Switch) circuit pack, located in all modules of the Facility Interface Sub-Shelf of the Universal I/O Shelves and the SDH Universal I/O Shelves, provides a 576x576/192x192 cross-connect function at the STS-1/STM-1 level, respectively. This pack also provides through connections, on-shelf cross-connections, port unit protection switching, and connection to the main switch fabric for protected signals.

SWITCH/STS768 The SWITCH/STS768 (768x768 STS-1/256x256 STM-1 Switch) circuit pack, located in the CTL/Switch Interface Sub-Shelf of the 10G I/O Shelf, provides an 1152x1152 STS-1/384x384 STM-1 cross-connect function. These packs provide through connections, on-shelf cross-connections, port unit protection switching, and connection to the main switch fabric for protected signals.

SWITCH/DS3EC1 The SWITCH/DS3EC1 (Electrical Protection Switch for up to 96 DS3 signals) pack, located in the Facility Interface Sub-Shelf of the Universal I/O Shelf (DS3EC1 Electrical or Mixed Module), is responsible for implementing the DS3EC1/8 1xN protection switching.

SWITCH/STM1E4 The SWITCH/STM1E4 (Electrical Protection Switch for up to 32 STM-e signals) pack, located in the Facility Interface Sub-Shelf of the SDH Universal I/O Shelf (STM1e Electrical or Mixed Module), is responsible for implementing the STM1E/4 1xN protection switching.

BSW The BSW (Byte Switch) pack, located in the Switch Shelf, cross-connects the byte-sliced signals coming from the SWIF pairs to the 4608 STS-1/1536 STM-1 main switch fabric.

SWIF The SWIF (Switch Interface) pack, located in all I/O Shelves, converts the data format output from the port units into 4608/1536 byte-sliced format utilized by the BSW switch packs (located in the Switch Shelves). The SWIF packs (always used in pairs) also perform cross-coupling best-byte selection.

□

Port Units

Overview

This section describes each WaveStar BandWidth Manager port units' function and location.

DS3EC1/8

The DS3EC1/8 (8 port DS3 interface) port unit, located in the Facility Interface Sub-Shelf of the Universal I/O Shelf (DS3EC1 Electrical Module or Mixed Module), provides WaveStar BandWidth Manager's electrical interface at the DS3-rate. The DS3EC1/8 port unit provides eight bidirectional DS3 line interfaces and a SWITCH/STS576 interface function, as well as supporting electrical protection switching. The protection switching feature provides a selection and fan-out capability for switching between one of the working DS3EC1/8 port units and the protection DS3EC1/8 port unit.

STM1E/4

The STM1E/4 (4 port STM-1e interface) port unit, located in the Facility Interface Sub-Shelf of the SDH Universal I/O Shelf (STM1e Electrical Module or Mixed Module), provides an electrical interface at the SDH STM-1e-rate. The STM1E/4 port unit provides four bidirectional STM-1e line interfaces and a SWITCH/STS576 interface function, as well as supporting electrical protection switching. The protection switching feature provides a selection and fan-out capability for switching between one of the working STM1E/4 port units and the protection STM1E/4 port unit.

OC192/STM64

Two OC192/STM64 port units are necessary to terminate each 2-fiber OC-192 BLSR/STM-64 MS-SPRing. Four OC192/STM64 port units are necessary to terminate each 4-fiber OC-192 BLSR/STM-64 MS-SPRing.

OC192/STM64/1.5IR1

The OC192/STM64/1.5IR1 (Optical Carrier 192/Synchronous Transport Module 64/1.5 µm Intermediate Reach, 1 Port) port unit, located in the Facility/SWIF Interface Sub-Shelf of the 10G I/O Shelf (OC192/STM64 Optical Module), provides a bidirectional OC-192/STM-16 interface (user-provisionable) in the 1.5 µm range with multibit forward error correction (FEC) and strong forward error correction (SFEC) (up to 60 km).

OC192/STM64/1.5IRS1

The OC192/STM64/1.5IRS1 (Optical Carrier 192/Synchronous Transport Module 64/1.5 μm Intermediate Reach, SFEC 1 Port) port unit, located in the Facility/SWIF Interface Sub-Shelf of the 10G I/O Shelf (OC192/STM64 Optical Module), provides a bidirectional OC-192/STM-16 interface (user-provisionable) in the 1.5 μm range with multibit forward error correction (FEC) and strong forward error correction (SFEC) (up to 30 km).

OC192/STM64/POU

The OC192/STM64/POU (Optical Carrier 192/Synchronous Transport Module 64/Passive Optics Unit) port unit, located in the Facility/SWIF Interface Shelf of the 10G I/O Shelf (OC192/STM64 Optical Module), provides a bidirectional OC-192/STM-16 interface (user-provisionable) in the 1.5 μm range to WaveStar BandWidth Manager. The OC192/STM64/POU port units support 16 wavelengths for passive optical applications with dense wavelength division multiplexing systems. The 16 different codes of OC192/STM64/POU port units are each designated by a 4-digit numeric suffix that corresponds to the frequency of the optical signal. The OC192/STM64/POU port units are designed to be used in conjunction with the Lucent Technologies' Passive Optics Boxes, either the 8-Mux/8-Demux box or the 16-Mux + 16-Demux Passive Optics Boxes (up to 40 km with the Passive Optics Boxes).

OC192/STM64/WDM

The OC192/STM64/WDM (Optical Carrier 192/Synchronous Transport Module 64/Wavelength Division Multiplexing) port unit, located in the Facility/SWIF Interface Sub-Shelf of the 10G I/O Shelf (OC192/STM64 Optical Module), provides a bidirectional OC-192/STM-64 interface (user-provisionable) in the 1.5 μm range to WaveStar BandWidth Manager. The 40 different codes of OC192/STM64/WDM port units are each designated by a 4-digit numeric suffix that corresponds to the frequency of the optical signal. The OC192/STM64/WDM port units support 40 wavelengths for applications with WaveStar OLS 400G dense wavelength division multiplexing systems (without OTUs) (up to 25 km with Lucent's WaveStar OLS 400G).

OC48/STM16

Two OC48/STM16 port units are necessary to terminate each 2-fiber OC-48 BLSR/STM-16 MS-SPRing. Four OC48/STM16 port units are necessary to terminate each 4-fiber OC-48 BLSR/STM-16 MS-SPRing.

OC48/STM16/1.3LR1

The OC48/STM16/1.3LR1 (Optical Carrier 48/Synchronous Transport Module 16/1.3 μm Long Reach, 1 Port) port unit, located in the Facility Interface Sub-Shelf of the Universal I/O Shelf (OC48/STM16 Optical Module or Mixed Module) or the SDH Universal I/O Shelf (Mixed Module), provides a bidirectional OC-48/STM-16 interface (user-provisionable) in the 1.3 μm range (up to 51 km).

OC48/STM16/1.5LR1

The OC48/STM16/1.5LR1 (Optical Carrier 48/Synchronous Transport Module 16/1.5 μm Long Reach, 1 Port) port unit, located in the Facility Interface Sub-Shelf of the Universal I/O Shelf (OC48/STM16 Optical Module or Mixed Module) or the SDH Universal I/O Shelf (Mixed Module), provides a bidirectional OC-48/STM-16 interface (user-provisionable) in the 1.5 μm range (up to 80 km).

OC48/STM16/DWDM01-16

The OC48/STM16/DWDM01-16 (Dense Wavelength Division Multiplexing/Optical Carrier 48/Synchronous Transport Module 16/Wavelengths 1, 2, 3...16) port unit, located in the Facility Interface Sub-Shelf of the Universal I/O Shelf (OC48/STM16 Optical Module or Mixed Module) or the SDH Universal I/O Shelf (Mixed Module), provides a bidirectional OC-48/STM-16 interface (user-provisionable) in the 1.5 μm range, compatible with ITU signals (up to 25 km with Lucent's WaveStar OLS 40G/80G).

OC48/STM16/POU

The OC48/STM16/POU (Optical Carrier 48/Synchronous Transport Module 16/Passive Optics Unit) port unit, located in the Facility Interface Sub-Shelf of the Universal I/O Shelf (OC48/STM16 Optical Module and Mixed Modules) or the SDH Universal I/O Shelf (Mixed Module), provides a bidirectional OC-48/STM-16 interface (user-provisionable) in the 1.5 μm range to WaveStar BandWidth Manager. The OC48/STM16/POU port units support 16 wavelengths for passive optical applications with dense wavelength division multiplexing systems. The 16 different codes of OC48/STM16/POU port units are each designated by a 4-digit numeric suffix that corresponds to the frequency of the optical signal. The OC48/STM16/POU port units are designed to be used in conjunction with the Lucent Technologies' Passive Optics Boxes, either the 8-Mux/8-Demux box or the 16-Mux + 16-Demux Passive Optics Boxes (up to 55km with the Passive Optics Boxes).

OC48/STM16/WDM

The OC48/STM16/WDM (Optical Carrier 48/Synchronous Transport Module 16/Wavelength Division Multiplexing) port unit, located in the Facility Interface Sub-Shelf of the Universal I/O Shelf (OC48/STM16 Optical Module and Mixed Modules) or the SDH Universal I/O Shelf (Mixed Module), provides a bidirectional OC-48/STM-16 interface (user-provisionable) in the 1.5 μm range to WaveStar BandWidth Manager. The 80 different codes of OC48/STM16/WDM port units are each designated by a 4-digit numeric suffix that corresponds to the frequency of the optical signal. The OC48/STM16/WDM port units support 80 wavelengths for applications with WaveStar OLS 400G dense wavelength division multiplexing systems (without OTUs).

OC12/STM4 WaveStar BandWidth Manager provides two OC12/STM4 port units.

OC12/STM4/1.3SR2

The OC12/STM4/1.3SR2 (Optical Carrier 12/Synchronous Transport Module 4/1.3 µm Short Reach, 2 Ports) port unit, located in the Facility Interface Sub-Shelf of the Universal I/O Shelf (OC12/STM4 Optical Module or Mixed Module) or the SDH Universal I/O Shelf (Mixed Module), provides two bidirectional (one receive and one transmit) short reach OC-12/STM-4 interface (user-provisionable). The OC12/STM4/1.3SR2 port units may also be used in intermediate reach applications (up to 15 km).

OC12/STM4/1.3LR2

The OC12/STM4/1.3LR2 (Optical Carrier 12/Synchronous Transport Module 4/1.3 µm Long Reach, 2 Ports) port unit, located in the Facility Interface Sub-Shelf of the Universal I/O Shelf (OC12/STM4 Optical Module or Mixed Module) or the SDH Universal I/O Shelf (Mixed Module), provides two bidirectional (one receive and one transmit) long reach OC-12/STM-4 interface (user-provisionable) (up to 51 km).

OC3/STM1 WaveStar BandWidth Manager provides two OC3/STM1 port units.

OC3/STM1/1.3SR4

The OC3/STM1/1.3SR4 (Optical Carrier 3/Synchronous Transport Module 1/1.3 µm Short Reach, 4 Ports) port unit, located in the Facility Interface Sub-Shelf of the Universal I/O Shelf (OC3/STM1 Optical Module or Mixed Module) or the SDH Universal I/O Shelf (Mixed Module), provides four bidirectional (one receive and one transmit) short reach OC-3/STM-1 interfaces (user-provisionable). The OC3/STM1/1.3SR4 port units may also be used in intermediate reach applications (up to 15 km).

OC3/STM1/1.3LR4

The OC3/STM1/1.3LR4 (Optical Carrier 3/Synchronous Transport Module 1/1.3 µm Long Reach, 4 Ports) port unit, located in the Facility Interface Sub-Shelf of the Universal I/O Shelf (OC3/STM1 Optical Module or Mixed Module) or the SDH Universal I/O Shelf (Mixed Module), provides four bidirectional (one receive and one transmit) long reach OC-3/STM-1 interfaces (user-provisionable) (up to 51 km).

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Faceplates

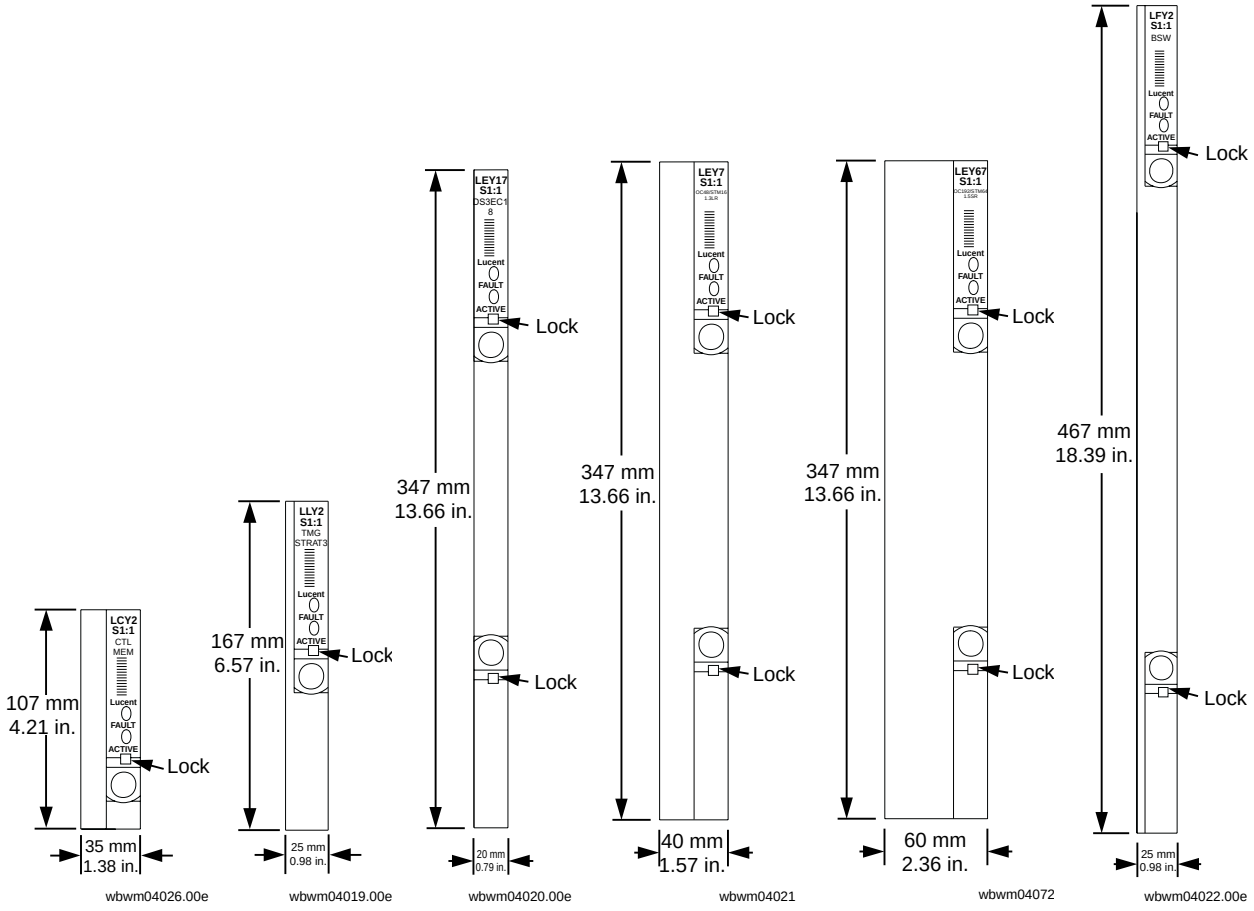
Overview

This section illustrates the faceplates and dimensions of the different sizes of circuit packs and port units available in WaveStar BandWidth Manager.

Circuit pack faceplates

Figure 4-69 illustrates the some of the different circuit pack and port unit heights and widths available in WaveStar BandWidth Manager. Additional sizes are available.

Figure 4-69 Circuit Pack Faceplates



Important! The OC48/STM16 port units are double-width packs. The OC192/STM64 port units are triple-width packs. Additional packs are available at the heights shown, but the widths may range from 20 mm to 60 mm.

References For a complete list of the WaveStar BandWidth Manager circuit packs and their dimensions, refer to the section entitled “Equipment Dimensions” in Chapter 10 “Technical Specifications.”

□

Power

Overview

This section describes the power for the WaveStar BandWidth Manager 4608/1536 platform.

Power distribution

This section describes the power distribution in WaveStar BandWidth Manager.

System distribution

WaveStar BandWidth Manager uses a distributed power architecture. The “raw” central office battery voltage(s) are distributed to each shelf of the platform via office cabling.

Shelf distribution

Within each shelf the incoming power is “conditioned” and distributed to all circuit packs and port units in the shelf via internal backplane power layers.

Circuit pack distribution

The board mounted power (BMP) modules present in each circuit pack or port unit convert the incoming battery voltage into the specific voltage(s) required by the various devices in the pack.

Redundant power

Two redundant power feeds (“A” power feed and a “B” power feed) are provided to each shelf in the platform. All functional circuitry, including cooling, is powered from both battery feeds. Duplication of the feeders provides maximum power robustness. A shelf can be powered from only one source if two independent sources of DC power are not available. Also, two connections to the same DC power source may be supported.

Power supply voltages

WaveStar BandWidth Manager operates from a nominal supply voltage power source of -48 VDC (SONET/SDH) or -60 VDC (SDH).

Normal service range

The normal service range is the range of steady-state voltages over which the equipment maintains specified service characteristics. The normal service range for -48V power is -40.0V to -57.0V. The normal service range for -60.0V power is -50.0V to -72.0V.

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Power Filters with Voltage Protection (PFVP)

Overview

Each shelf is equipped with two power filters with voltage protection (one for each power feed [A and B]) that are designed to protect the shelf from unusually low voltage.

Description

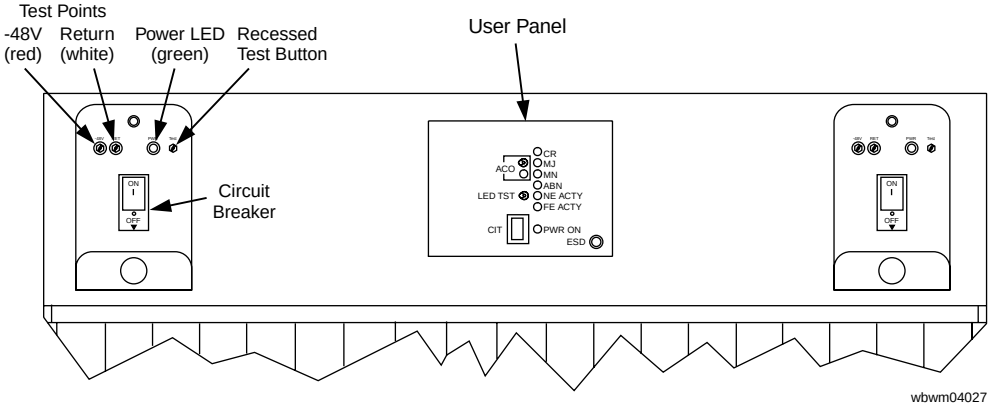
The power filters with voltage protection are incorporated into the power filters. All power filters with voltage protection are equipped with green Power LED and the recessed push-button for maintenance testing.

The power filters with voltage protection on the Switch Shelves, System Controller Shelves, Universal I/O Shelves, and SDH Universal I/O Shelves also include test points to verify incoming voltage levels. The -48V test point is red and the Return test point is black (except on the Switch Shelf the Return test point in white). In R4.1, the 10G I/O Shelves do not have test points.

PFVP on the Switch Shelves

Figure 4-70 illustrates the power filters with voltage protection that are visible and accessible from the front of the Switch Shelves.

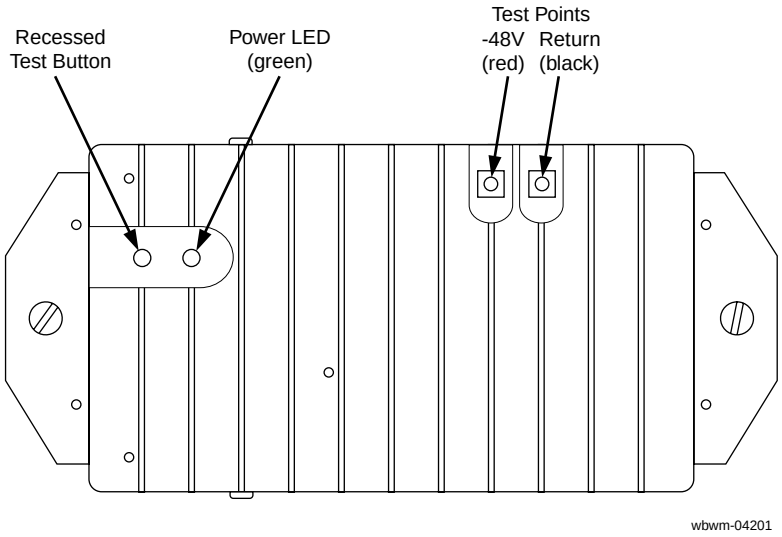
Figure 4-70 Power Filter with Voltage Protection on a Switch Shelf



PFVPs on the System Controller Shelf, and the SDH and Universal I/O Shelves

Figure 4-71 illustrates the power filters with voltage protection that are visible and accessible from the rear of the System Controller Shelves, Universal I/O Shelves, and the SDH Universal I/O Shelves.

Figure 4-71 Power Filters with Voltage Protection on a System Controller Shelf, Universal I/O Shelf, or an SDH Universal I/O Shelf

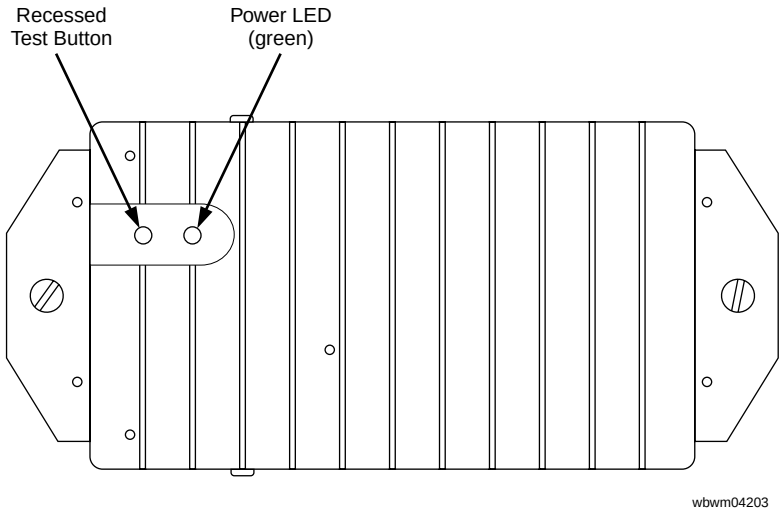


Important! The exact placement and orientation of the PFVPs varies on the different types of shelves.

PFVPs on the 10G I/O Shelves

Figure 4-72 illustrates the power filters with voltage protection that are visible and accessible for the rear of the 10G I/O Shelves.

Figure 4-72 Power Filters With Voltage Protection on a 10G I/O Shelf



Operation

If the incoming voltage on a power feed drops to -38.5 VDC (±1.0V), the power filter with voltage protection associated with that power feed interrupts power to the shelf. (The second power feed responds accordingly to the voltage on its feed. Therefore, if the voltage is in an acceptable range, the second power feed powers the shelf.) The power filters with voltage protection automatically restore power to the shelf when the incoming voltage reaches -43 VDC (±0.5V).

> **Important!** The low voltage protection feature only responds to voltages that persist for ≥100 ms.

Maintenance testing

Each power filter with voltage protection is equipped with recessed push-button for maintenance testing. Depressing and holding the button simulates a low voltage battery condition that tests the operation of the low voltage cut-off feature. The green Power LED goes out when the button is depressed. When the button is released, the system returns to normal operation, and the green Power LED is illuminated again.

The input voltage can be verified at the test points on the power filters with voltage protection using a digital voltage meter.

> **Important!** The 10G I/O Shelves do not include test points.

□



5 Operations, Administration, Maintenance, and Provisioning

Overview of Operations

Purpose This section describes operations features, including hardware and software user interfaces that control administration, maintenance, and provisioning activities.

Contents The following topics are discussed in this chapter:

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Visible Alarm Indicators

Overview

This section describes and illustrates the visible indicators in WaveStar BandWidth Manager that are located on the

- User panel
- Circuit pack faceplate
- Fan unit faceplate
- Circuit breakers

Two-tier craft interface

Maintenance procedures are built on two tiers of system information and control: the visible/audible alarm indicators and the craft interface terminal (CIT).

Visible/audible alarm indicators

Visible alarm indicators provide the first maintenance tier by notifying you of maintenance tasks (for example, circuit pack replacement).

WaveStar CIT

The second maintenance tier uses the graphical user interface (GUI) on the WaveStar CIT to retrieve detailed information about alarms and status, system configuration for local and remote terminals and performance monitoring. The WaveStar CIT is used to provision circuit packs and the cross-connect switch.

User panel

The user panel on each shelf is the primary source of shelf-level visible alarm indicators. The user panel provides system-level information, such as alarm status, through light-emitting diodes (LEDs), buttons, and connectors.

> **Important!** The NE ACTY LED is present on the user panels, but the Release 4.1 software does not support near-end activity alarms.

LEDs

The user panel on each shelf provides the following LEDs:

- A red LED that indicates Critical (CR) alarms
- A red LED that indicates Major (MJ) alarms
- A yellow LED that indicates Minor (MN) alarms
- A yellow LED that indicates Abnormal (ABN) conditions – temporary conditions that may potentially affect transmission, such as a CIT-initiated protection switch or a loopback.
- A yellow LED that indicates Near-End Activity (NE ACTY) – status condition at the local terminal, such as a software download
- A yellow LED that indicates Far-End Activity (FE ACTY) – status condition indicating k-byte activity on a ring
- A green Power On (PWR ON) LED that indicates that power is applied to the shelf
- A green Alarm Cut-Off (ACO) LED that indicates that the ACO button was pressed to silence audible office alarms

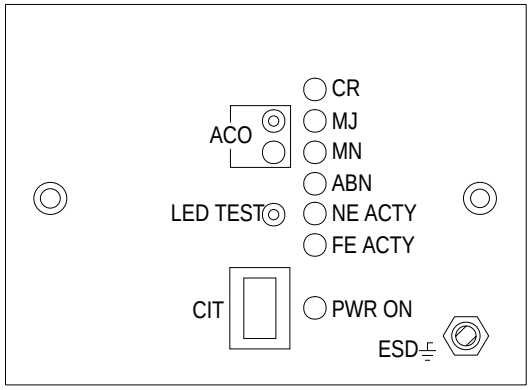
Buttons and connectors

In addition to LEDs, each user panel is equipped with

- A LED test (LED TEST) button for testing all shelf LEDs (except PWR ON on the user panel and the fan unit LEDs)
- An ACO button to silence audible office alarms
- An electrostatic discharge (ESD) wrist strap ground
- A CIT port to connect a WaveStar CIT to the system LAN

Figure 5-1 illustrates the user panel that is included with every shelf in WaveStar BandWidth Manager.

Figure 5-1 User Panel



Circuit pack faceplate

All circuit pack faceplates are equipped with a Fault LED and a Power (PWR) LED.

Fault LED

A continuously lighted red Fault LED means that WaveStar BandWidth Manager has isolated a failure to, or involving that circuit pack.

The following table provides a list of the failures that trigger a flashing Fault LED.

Table 5-1 Failures Indicated by a Flashing Fault LED

A flashing Fault LED on...	INDICATES that...
a port unit	an incoming signal to that port unit has failed.
a synchronization circuit pack	an externally timed reference signal has failed.

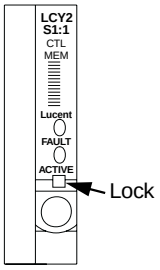
Power LED

All circuit packs have a green PWR LED to indicate that the circuit pack is either in the active (ON) or standby (OFF) mode. When a circuit pack is inserted in a shelf, the green PWR LED flashes as software is downloaded and self-tests are performed. The LED stops flashing and remains lighted after the circuit pack (or at least one port on a multi-port pack) becomes active.

Figure

Figure 5-2 illustrates the placement of the LEDs on a circuit pack faceplate.

Figure 5-2 Circuit Pack Faceplate LEDs



wbwm05016.00e

Fan unit faceplate

The fan unit provides forced-air cooling for its associated shelf or sub-shelf. All fan faceplates are equipped with LEDs and buttons.

Important! When replacing a fan unit, ensure that the spare fan unit is in hand.

LEDs

Each fan unit faceplate is equipped with the following LEDs:

- A green power on (PWR ON) LED is activated when the fan is receiving –48/-60 VDC power
- A red fail (FAIL) LED is activated when there is an alarm of any type associated with the fan unit (for example, a fan in the unit fails).
- A red filter alarm (FILTER ALM) LED is activated when the fan filter needs attention (for example, the filter is dirty and must be replaced).

Important! The FAIL LED indicates both Severity 1 and Severity 2 alarms. The FILTER ALM LED only indicates Severity 2 alarms.

Severity 1 alarms are either service affecting or potentially service affecting. For example, total loss of the fan unit.
Severity 2 alarms are non-service affecting. For example, a dirty filter or the loss of one of the six fans in the fan unit.

Buttons

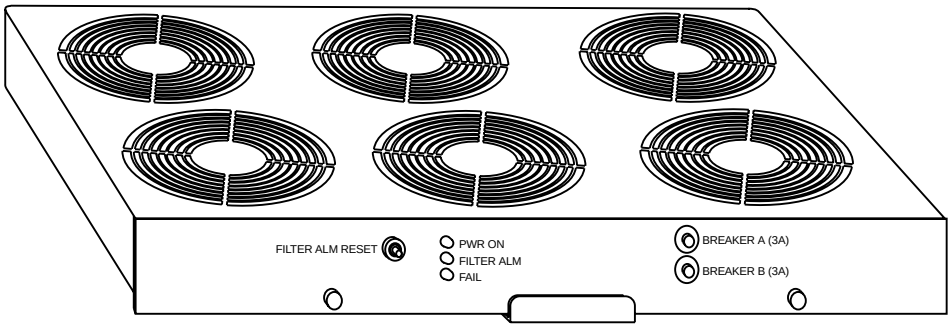
The fan unit faceplate is also equipped with the following buttons:

- A filter alarm reset button to reset the FILTER ALM LED after the condition is resolved
- Two flush-mounted -48/-60 VDC circuit breakers (BREAKER A and BREAKER B) to protect against current overload

Figure

Figure 5-3 illustrates the fan unit faceplate included with each shelf in WaveStar BandWidth Manager.

Figure 5-3 Fan Unit and Faceplate



wbwm04018

Circuit breakers

Each shelf is equipped with two -48/-60 VDC power circuit breakers (BREAKER A and BREAKER B) for both power feeds. Each circuit breaker provides a visual indication of an abnormality involving its associated power feed via the rocker switch.

Important! The normally hidden portion of each rocker switch is red. Should a circuit breaker operate, the hidden red portion of the rocker switch rotates out and becomes visible, indicating that -48/-60 VDC power has either been lost or normal currents have been exceeded.

□

WaveStar CIT

Overview

The WaveStar craft interface terminal (CIT) provides

- A Microsoft Windows® NT-based graphical user interface (GUI)
- A Transaction Language 1 (TL1) interface
- Convenient CIT access connections
- Security features to prevent unauthorized access
- Information and control of maintenance and administrative activities

Definition

The WaveStar CIT is a desktop or laptop computer that is loaded with WaveStar BandWidth Manager software. The WaveStar CIT provides a fully-functional graphical user interface (GUI) with pull-down menus and extensive, context-sensitive, on-line help. The WaveStar CIT gives craftspeople a unified set of features for provisioning, testing, and reporting. The WaveStar CIT is necessary to install and accept the system.

Minimum requirements

The customer-furnished personal computer required for the WaveStar CIT must meet the following minimum requirements:

- Microsoft Windows® NT 4.0 operating system with Service Pack 5

  The customer is responsible for ensuring that the operating system remains virus-free.
- Pentium II® 266 MHz processor with 128 MB of RAM
- SVGA monitor with 800x600 resolution
- 6 GB hard drive

  The WaveStar CIT application requires 50 MB and the installation requires 30 MB. In addition, each copy of each NE generic requires 60 MB.
- CD-ROM drive
- 10BaseT LAN interface capable of parallel tasking
- Personal Computer Memory Card International Association (PCMCIA) Type II slot with driver software that supports read/write of PCMCIA flash disk cards
- Adobe Acrobat® Reader™ for Windows (version 3.01)
- Standard floppy drive for 1.44 MB 3.5-inch floppy disks

Recommended requirements

The customer-furnished personal computer required for the WaveStar CIT should meet the following recommended requirements:

- Microsoft Windows® NT 4.0 operating system with Service Pack 5

  The customer is responsible for ensuring that the operating system remains virus-free.
- Pentium III® 500 MHz processor with 128 MB of RAM
- SVGA monitor with 1024x768 resolution
- 6 GB hard drive

  The WaveStar CIT application requires 50 MB and the installation requires 30 MB. In addition, each copy of each NE generic requires 60 MB.
- Primary hard disk drive partition (logical drive "C") should be 4 GB
- CD-ROM drive
- 10BaseT LAN interface: a 3Com® or Intel® network card that is capable of parallel tasking and is equipped with the latest drivers for Windows® NT
- Personal Computer Memory Card International Association (PCMCIA) Type II slot with driver software that supports read/write of PCMCIA flash disk cards
- Adobe Acrobat® Reader™ for Windows (version 4.0)
- Standard floppy drive for 1.44 MB 3.5-inch floppy disks

PCMCIA flash disk

This section describes the Personal Computer Memory Card International Association (PCMIA) flash disk requirements for laptop and desktop computers.

Laptop computers

Laptop computers contain two PCMCIA Type II card slots:

- One PCMCIA slot must be equipped with a 10BaseT interface network card to support WaveStar CIT communications with the NE over the OSI LAN.
- One PCMCIA slot is used to copy the NE installation generic from the laptop to the PCMCIA flash disk. The PCMCIA flash disk is then installed in the NE.

Desktop computers

If a desktop computer is used for the NE installation process, the desktop computer must have one PCMCIA Type II card slot to copy the NE installation generic from the desktop to the PCMCIA flash disk. The PCMCIA flash disk is then installed in the NE.

CIT access

WaveStar BandWidth Manager permits local and remote access via the WaveStar CIT. Remote access uses the data communications channel (DCC) or an external WAN connected to a WaveStar BandWidth Manager LAN port. You can connect the WaveStar CIT to any shelf that is equipped with an ADJCTL/DCC or ADJCTL/DCCEI pack. Therefore, the 10BaseT port on the user panel on the System Controller Shelf, the Universal I/O Shelf, and the 10G I/O Shelf supports a WaveStar CIT connection to the LAN.

You can have multiple WaveStar CITs connected to the LAN simultaneously, providing that the total number of logins, including Superuser logins, does not exceed 14.

> **Important!** Because the Switch Shelves do not have either an ADJCTL/DCC or an ADJCTL/DCCEI pack, you cannot connect to the LAN via the Switch Shelves.

TL1 interface

Many customers develop standardized scripts for use in the field for standard operations. The WaveStar CIT supports the capability to write, save, and execute standardized TL1 scripts and allows the users to enter individual TL1 commands.

The WaveStar CIT provides a fully-functional graphical user interface (GUI). Via this user interface, all provisioning, testing, and report generation can be done easily and intuitively. When the WaveStar CIT is used as a GUI, TL1 is not visible to the user.

Security function

WaveStar BandWidth Manager provides a security function to protect against unauthorized access to the CIT system functions (such as provisioning). Security is controlled through logins, passwords, CIT port disabling/enabling, and authorization levels for the system capabilities.

Maintenance and administrative activities

The WaveStar CIT provides detailed information and system control of the following specialized local/remote maintenance and administrative activities:

- Provisioning
- Loopback operation and testing
- Reporting
- Cross-connect (or time slot) assignments
- Protection switching
- Initialization of performance-monitoring storage registers
- Limited alarm filtering for growth scenarios

□

Operations Interfaces

Overview

WaveStar BandWidth Manager supports the following operations interfaces:

- Office alarms
- A message-based operations system interface
- Data communications channel
- Network Communications Controller (NCC)

Defonition of operations interfaces

Operations interfaces include the DCC interfaces on the OC-N/STM-M port units and the IOA LAN (intraoffice LAN) interface. Both the DCC interface and the IAO LAN interface can receive commands from operations systems (network element management systems) or from a remote WaveStar CIT.

Office alarms interface

The office alarms interface is a set of discrete relays that control audible and visible office alarms. Separate relays handle critical, major, and minor alarms. If desired, critical and major alarm outputs can be wired so that either, neither, or both of the outputs control the major office alarm.

Message-based interface: TL1

WaveStar BandWidth Manager supports a message-based operations system (OS) interface that uses the LAN to communicate with a message-based OS. This interface supports Transaction Language 1 (TL1) and standard SONET/SDH operations messages. This interface is compatible with Telcordia Technologies' Network Monitoring and Analysis (NMA), Lucent Technologies' Transvu II, and Lucent Technologies' WaveStar® Subnetwork Management System. A message-based operations system can access the local WaveStar BandWidth Manager (local access capability) and any remote terminals in a maintenance subnetwork using the DCC (gateway network element [GNE] capability).

> **Important!** WaveStar Subnetwork Management System (SNMS) is a type of OS element manager. An element manager forwards messages (commands) from an OS to the Network Elements in the network and performs fault correlation. It then collects and forwards the responses and autonomous messages from the Network Elements to itself. The information it receives is used to perform fault correlation and diagnose problems in the network. WaveStar SNMS concentrates the data links to/from NEs onto a single link back to a network management OS, thus reducing costs.

RS-232 interfaces

WaveStar BandWidth Manager, R4.1 provides duplicated RS-232 interfaces. These RS-232 interfaces allow the user an additional method of logging onto the system and entering raw ASCII TL1 commands from an ASCII terminal or a PC that is running an application like HyperTerminal. The Y-cable plugs into the J189 Debug Port on the backplane of the System Controller Shelf. The Y-cable provides access to two independent, redundant RS-232 serial ports on the System Controller Shelf.

FTAM

WaveStar BandWidth Manager provides a File Transfer and Access Management (FTAM) interface for file transfers of software and data. Specifically, there is an FTAM initiator on the NE, and an FTAM responder on the WaveStar CIT, or element management system).(EMS)/network management system (NM).

> **Important!** FTAM is the Open Systems Interconnection (OSI) standard for file transfer, file access, and file management.

Interface security function

WaveStar BandWidth Manager also provides a security function to protect against unauthorized access to OS functions, such as provisioning. Security is controlled through logins, passwords, and authorization levels for the system capabilities.

Software download/backup and restore using OSI

WaveStar BandWidth Manager provides the capability, via the OSI network, to download software from the WaveStar CIT to the NE or from the element/network management system to the NE and support backup and restore of the NE database. WaveStar BandWidth Manager also provides the capability to install a full-featured software release from a management system (for example, WaveStar SNMS).

Operations via TCP/IP and OSI

The NE can be managed directly over a TCP/IP WAN. The NE can also function as the TL1 gateway, translating TL1 messages between pure TCP/IP and OSI. This capability permits the management of remote NEs from a TCP/IP access DCN.

The TCP/IP connection allows the NE to support FTP file transfers between itself (FTP client) and a FTP Server in the TCP/IP access DCN. The NE also acts as a FTAM/FTP gateway, allowing file transfers between remote NEs (using FTAM over the embedded DCC) and a FTP file server on the access DCN. Simultaneous file transfers to/from multiple remote NEs is also supported.

Data communications channel (DCC)

WaveStar BandWidth Manager supports operations interworking (communication) via the standard 7-layer OSI protocol over DCC. The ADJCTL/DCC and ADJCTL/DCCEI circuit packs provide access to the DCCs that are contained within the section and line overhead for SONET signals and the regenerator section and multiplex section overhead for SDH signals. The DCCs are used as embedded operations channels to communicate between network elements. WaveStar BandWidth Manager supports simultaneous access to 32 DCCs per shelf.

The craft and operations interface features extend beyond the local WaveStar BandWidth Manager to cover remote sites. Craft interface dialogues and operations interface messages travel in the DCC bytes.

> **Important!** DCC channel protection switching is supported in conjunction with protection switching of the respective optical interface.

SONET

SONET section DCC bytes are available in the D1-D3 overhead bytes for the OC-192, OC-48, OC-12, and OC-3 signals. The SONET line DCC bytes are available in the D4-D12 overhead bytes for the OC-192, OC-48, OC-12, and OC-3 signals.

SDH

SDH regenerator section DCC (DCC_R) bytes are available in the D1-D3 overhead bytes for STM-64, STM-16, STM-4, and STM-1 optical signals. Multiplex section DCC (DCC_M) bytes are available in the D4-D12 overhead bytes for STM-64, STM-16, STM-4, and STM-1 optical signals.

DCC 1+1 protection

The DCC 1+1 bidirectional, non-revertive protection mode can be applied to DCC_R or DCC_M, for all supported optical interface rates. DCC protection switching uses the underlying transmission protection switching mechanism. Therefore, if DCC protection switching is enabled, the DCC protection mode must match the protection that is used for the corresponding optical ports.

> **Important!** The DCC protection switch mode is automatically applied to DCC_R for the optical port protection group. However, the user may provision the protection mode to DDC_M.

Network Communications Controller

The Network Communications Controller (NCC) is compatible with WaveStar BandWidth Manager and can be mounted in the bottom shelf-space of the System Controller Bay (3-bay Control/Switch Complex) or in the top shelf-space of the Switch Bay (2-bay Control/Switch Complex). The NCC improves the way that SONET management systems find and establish connections to SONET network elements (NEs). The NCC decreases costs and increases standardization in SONET/SDH operations by providing directory service and protocol conversion functions to WaveStar BandWidth Manager NEs and their operations systems.

> **Important!** WaveStar BandWidth Manager does not require the NCC. The NCC is optional if you require an X.25 interface to WaveStar BandWidth Manager.

X.25 interface

WaveStar BandWidth Manager, R4.1 incorporates all of the functionality realized with the NCC in earlier release of WaveStar BandWidth Manager except the X.25 interface.

If you require an X.25 interface to WaveStar BandWidth Manager, you will still require the NCC or a protocol converter box.

Directory services

WaveStar BandWidth Manager provides a registration manager and a T5 gateway for directory services.

Registration manager

WaveStar BandWidth Manager supports a directory registration manager (compliant with ANSI T1.245, X.500 based, Phase 2). The registration manager identifies the directory to a new NE, allowing the new NE to automatically register itself in the directory when it is initially added to the network. The registration manager functionality can be accessed through the ADJCTL/DCC circuit pack in the WaveStar BandWidth Manager System Controller Shelf.

T5 gateway

The T5 Gateway, located on WaveStar BandWidth Manager shelves, provides the ability to interwork between TARP and T1.245 directory services (for example, registering TARP-only NEs in a T1.245 directory information base).



Overview of Administration

Overview

The system management function for the administration of WaveStar BandWidth Manager is security.

NVM/DB consistency checks during startup

WaveStar BandWidth Manager checks for empty, corrupted, or incorrect database (DB) information in the non-volatile memory (NVM) during startup. Therefore, safe-guarding the system against loss of transmission due to inadvertent procedural errors.

Maximum sub-network size

The sub-network size shall not exceed 1000 network service access points (NSAPs). For example, in WaveStar BandWidth Manager every I/O Shelf and the WaveStar CIT are each single-NSAP equivalents.

> **Important!** Therefore, for NEs, the number of NSAPs equal the number of shelves, plus one, if simplex DCC controllers are used.

Equipment inventory

Each network element provides an inventory of all circuit packs including equipment type, version, and serial number. Inventory information is available via user request.

Equipage check

WaveStar BandWidth Manager provides an equipage check to prevent the user from inserting wrong circuit packs/port units in the shelves. The equipage check is triggers an alarm if an invalid configuration is detected.

Shelf location

WaveStar BandWidth Manager allows the user to associate each shelf with a location (for example, a building or a particular floor).

Security

WaveStar BandWidth Manager provides for secure system access by means of a three-tier mechanism.

□

Security

Overview

This section describes the various security features WaveStar BandWidth Manager provides to monitor and control access to the system.

Three-tier security

The three tiers of security that protect against unauthorized access to the WaveStar CIT and network element functions are

- Port security
- Network element login security
- User login security

Port security

Port security controls access to the system through a per-port enable/disable mechanism and inactivity time-outs.

Network element login security

NE login security controls access to the system through a lockout mechanism to disable all but administrative logins.

User login security

User login security controls access to the system on an individual user basis via

- Login ID and password assignment
- Inactivity logout
- Login aging
- Password aging
- Autonomous indications and history records
- User privilege codes

Login and password assignment

To access the system, the user must enter a valid login ID and password. WaveStar BandWidth Manager allows up to 500 login IDs and passwords. Two of these login IDs are for the Superuser authorization level and the balance are for Privileged User, Maintenance, Reports Only, and General User authorization levels.

Inactivity logout

WaveStar BandWidth Manager supports the capability to automatically logout users on an operations interface after a provisionable period of inactivity.

Login aging

WaveStar BandWidth Manager supports login aging on each user login. Login aging deletes individual logins if unused for a provisionable number of days or on a particular date (for example, for a visitor or for temporary access during installation).

Password aging

WaveStar BandWidth Manager supports password aging on each user login. Password aging requires that each user change his or her password periodically; a user with an expired password must select a new password before logging into the system. The password aging interval is provisionable.

Autonomous indications and history records

WaveStar BandWidth Manager provides autonomous indications and history log records of successful and unsuccessful logins, as well as intrusion attempts for security audits.

User privilege codes

When a user is added to the NE, a separate user privilege code, which may include an authorization level, is assigned to that user for each of the functional categories, based on the type of work the user is doing. The user privilege codes may be accompanied by an authorization level represented by a number between 1 and 5, with 5 being the highest level of access. It is permissible to grant access to any combination of commands using a privilege code, except for full privileges which are reserved for the two pre-installed superusers.

Functional categories

The functional categories for the user privilege codes may include

- Security (S)
- Maintenance (M)
- Performance monitoring (PM)
- Testing (T)
- Provisioning (P)

Authorization levels

Users may execute any commands at their functional categories' authorization level, as well as all commands at lower levels than theirs. For example, a user with authorization level 4 in the maintenance category, can also execute commands listed in levels 3, 2, and 1 in the maintenance category.

□

Overview of Maintenance

Overview

This section introduces the maintenance features available in WaveStar BandWidth Manager.

Definition

Maintenance is the system's capability to continuously monitor its equipment and the signals that it carries in order to notify the user of any current or potential problems. This enables the user to take appropriate proactive (preventive) or reactive (corrective) action.

Types of maintenance

Maintenance information and control are provided by

- Maintenance signals
- Fault detection, isolation, and reporting
- Provisioning consistency audits
- Loopbacks and tests
- Limited test access
- Protection switching
- Performance monitoring
- Reports

□

Maintenance Signals

Overview

This section describes the maintenance signals available in WaveStar BandWidth Manager.

Definition

WaveStar BandWidth Manager maintenance signals notify

- Downstream equipment that a failure has been detected and alarmed by either WaveStar BandWidth Manager or upstream equipment (alternate insertion signal [AIS])
- Upstream equipment that a downstream failure has been detected

Standards

WaveStar BandWidth Manager complies with SONET and SDH standards.

SONET

The fault monitoring and maintenance signals supported in WaveStar BandWidth Manager are compliant with the SONET, ANSI, and Telcordia standards.

SDH

The fault monitoring and maintenance signals supported in WaveStar BandWidth Manager are compliant with the SDH, ETSI, and ITU standards.

Signal maintenance

When defects are detected, WaveStar BandWidth Manager inserts an appropriate maintenance signal to downstream and/or upstream equipment.

SONET

The SONET maintenance signals include

- line remote defect indications (RDI-L)
- path remote defect indication (RDI-P)
- STS Path alternate insertion signal (AIS-P)
- STS path trace
- STS path unequipped
- payload defect indications (PDI)

The DS3 maintenance signals include

- DS3 AIS
- DS3 idle signal

SDH

The SDH maintenance signals include

- Regenerator Section Trace
- Multiplex Section Alternate Insertion Signal (MS-AIS)
- Administrative Unit Alternate Insertion Signal (AU-AIS)
- Multiplex Section Remote Defect Indications (MS-RDI)
- Multiplex Section Remote Error Indications (MS-REI)
- High Order Path Remote Defect Indication (VC-RDI)
- High Order Path Remote Error Indication (VC-REI)
- High Order Path Trace
- VC Path Unequipped

Path unequipped

WaveStar BandWidth Manager inserts the path unequipped identifier to downstream and/or upstream equipment if paths are intentionally not carrying traffic.

Fault detection and reporting

When a fault is detected, WaveStar BandWidth Manager employs automatic diagnostics to isolate the failed circuit pack or signal. Failures are reported to local craft and OS so that repair decisions can be made. If desired, OS personnel and local craft can use the WaveStar CIT to gain more detailed information about a specific fault condition.

Monitoring failures

WaveStar BandWidth Manager continuously monitors its internal conditions and its incoming signals as listed in the following two tables. Read access to the path trace information is provided for all signals.

Table 5-2 SONET Signal Monitoring

IF you have...	THEN the signals are monitored for...
incoming SONET signals	loss of signal (LOS)
	loss of frame (LOF)
	STS Path alternate insertion signal (AIS)
	loss of pointer (LOP)
	signal rate mismatch (SRM)
	high bit error rate (BER)
	path unequipped
incoming DS3 signals	loss of signal (LOS)
	loss of frame (LOF)
	DS3 alternate insertion signal (AIS)
	high bit error rate (BER)
	DS3 idle signal
SONET STS-1 signals that terminate in DS3 interfaces	path unequipped
	payload mismatches

Table 5-3 SDH Signal Monitoring

IF you have...	THEN the signals are monitored for...
incoming SDH signals	STM Loss Of Signal (STM_LOS)
	Regenerator Section Loss Of Frame (RS_LOF)
	Multiplex Section Alarm Indication Signal (MS_AIS)
	High Order Path Alarm Indication Signal (VC_AIS)
	Multiplex Section Remote Defect Indicator (MS_RDI)
	High Order Path Remote Defect Indicator (VC_RDI)
	Administrative Unit Loss Of Pointer (AU_LOP)
	Multiplex Section High Bit Error Rate (MS_BER)
	High Order Path High Bit Error Rate (VC_BER)
	Path Unequipped
	Payload Mismatches

Fault history

All alarmed fault conditions detected and isolated by WaveStar BandWidth Manager are stored and made available to be reported, on demand, through the WaveStar CIT. In addition, a history of the past 500 alarm and status conditions and WaveStar CIT or OS-initiated events is maintained and available for on-demand reporting. Each event is date and time stamped.

Reports

WaveStar BandWidth Manager automatically and autonomously reports all detected alarm and status conditions through the

- Office alarm relays
- User panel
- Equipment LEDs
- Message-based OS

□

Provisioning Consistency Audits

Overview

This section describes the provisioning consistency audits available in WaveStar BandWidth Manager.

Definition

WaveStar BandWidth Manager provides a function that monitors (audits) the consistency of the provisioning information related to ring administration and cross-connections. This function alerts you to situations that may result in lost traffic or protection switching malfunctions.

Audit types

WaveStar BandWidth Manager audits the target identifier (TID) information to insure consistent operation of the ring subnetwork as a whole.

Target identifier (TID)

The TID must be unique within a given ring subnetwork for proper operation of the OS interface. WaveStar BandWidth Manager uses a protocol called Directory Services to ensure the uniqueness of TIDs for all network elements in a subnetwork. You can make changes to a TID at anytime. However, if a change would result in a duplication, WaveStar BandWidth Manager sends an alarm and does not put the changes into effect until you make another change that removes the duplication.

> **Important!** Directory Services are based on the International Telecommunication Union, Telecommunication Standardization Sector [(ITU-T) formerly called CCITT] recommendation X.500 and proposed as a standard to the ANSI T1X1.5 working group.

□

Loopbacks

Overview

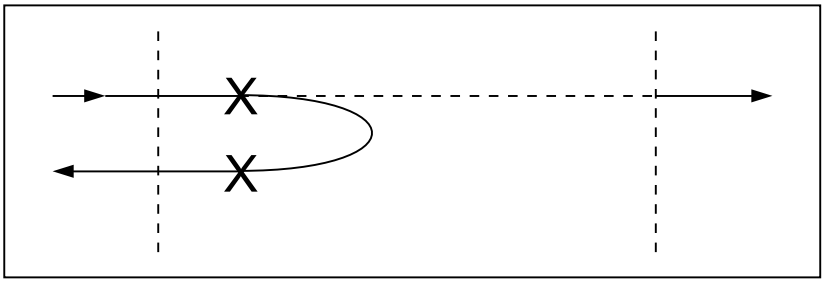
This section describes the automatic and manual loopbacks that WaveStar BandWidth Manager performs.

Loopback definition

A loopback is a troubleshooting test in which a signal is transmitted through a port unit to a set destination and then returned to the originating port unit. The transmitted and received signals are measured and evaluated by the user to insure that the received signal is accurate and complete when compared to the originating signal.

Figure 5-4 illustrates a loopback.

Figure 5-4 Loopback



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Software-initiated loopbacks

WaveStar BandWidth Manager can perform software-initiated loopbacks within the port units. Active loopbacks are indicated by the abnormal (ABN) LED on the user panel.

Facility Loopbacks

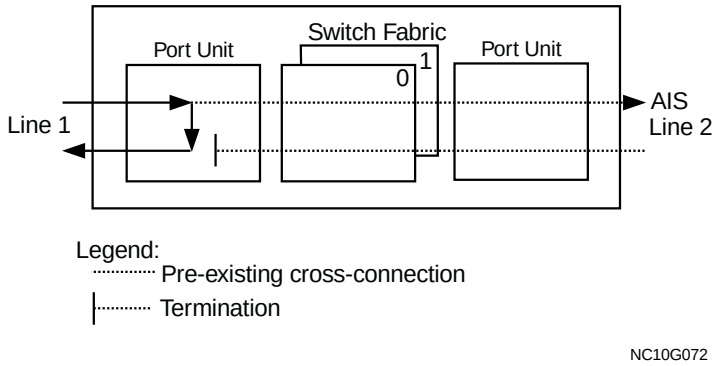
Near-side facility loopbacks allow an incoming DS3, EC-1, OC-3/STM-1, OC-12/STM-4, or OC-48/STM-16 line to be looped back in the port unit to the output of the same line. WaveStar BandWidth Manager supports near-side (input) facility loopbacks on a port or a set of ports for the following electrical and optical signals.

- OC-48/STM-16
- OC-12/STM-4
- OC-3/STM-1
- DS3
- STM-1e

Loopbacks allow for testing of cabling and system operation as well as trouble-shooting during factory system tests and channel growth. Near-side facility loopbacks are used during system installation and channel growth activities to test the integrity of cabling and connections to the new NE.

Figure 5-5 illustrates a near-side facility loopback.

Figure 5-5 Near-Side Facility Loopback



Near-side facility loopbacks are allowed on any incoming DS3, EC-1, OC-3/STM-1, OC-12/STM-4, or OC-48/STM-16 line regardless of whether there is an existing cross-connection(s) established to tributaries associated with the port. If a cross-connection exists on a tributary associated with the port, an alarm indication signal (AIS) is inserted downstream during the loopback. If a cross-connection exists in the opposite direction, the signal is terminated during the loopback. When the nearside facility loopback is released, any pre-existing cross-connections are automatically reestablished.

Active nearside facility loopbacks are reported by the abnormal (ABN) LED on the user panel and the WaveStar CIT.

Cross-connect loopbacks

WaveStar BandWidth Manager can perform cross-connect loopbacks on either idle or cross-connected tributaries for each supported cross-connection rate.

SONET

The synchronous payload envelope (SPE) is looped unchanged from the input port to the corresponding output port via the switch fabric. Any cross-connection that is affected by a cross-connect loopback is automatically restored when the loopback is taken down.

SDH

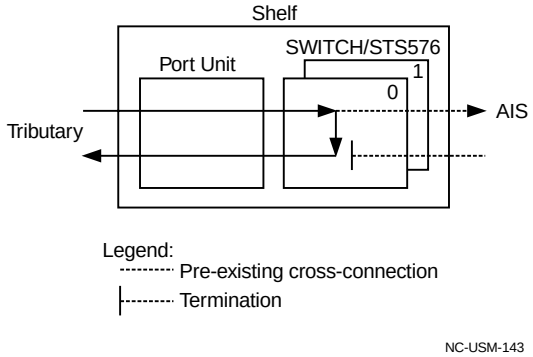
The virtual container (VC) is looped unchanged from the input port to the corresponding output port via the switch fabric. Any cross-connection that is affected by a cross-connect loopback is automatically restored when the loopback is taken down.

Example

Cross-connect loopbacks allow an input tributary to be looped back within an I/O Shelf through either the SWITCH/STS576 or SWITCH/STS768 circuit packs to the output of the same tributary.

Figure 5-6 illustrates an example of a cross-connect loopback on either a Universal I/O Shelf, an SDH Universal I/O Shelf, or a 10G I/O Shelf.

Figure 5-6 Cross-Connect Loopback on an I/O Shelf



Cross-connect loopbacks are allowed on any tributary regardless of whether there is an existing cross-connection to that selected tributary. If a cross-connection exists on the selected tributary, an alarm indication signal (AIS) is inserted downstream during the loopback. If a cross-connection exists in the opposite direction, the signal is terminated during the loopback. When the cross-connect loopback is released, any pre-existing cross-connections are automatically reestablished.

Active cross-connect loopbacks are noted by the abnormal (ABN) LED on the user panel and the WaveStar CIT.

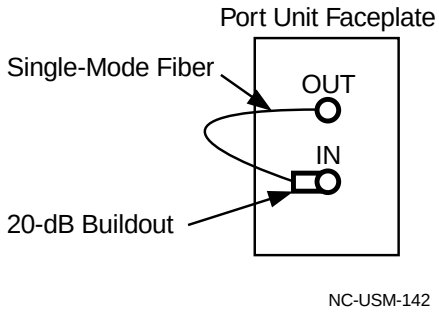
> **Important!** Cross-connect loopbacks are not allowed on tributaries used for test access.

Optical loopbacks

WaveStar BandWidth Manager allows manual loopbacks to be performed on all optical interfaces. Manual optical loopbacks require front access to the optical connectors on the port unit faceplates. This loopback is performed by connecting the OUT optical connector on the faceplate of a port unit to the IN optical connector on the same port unit with a single-mode fiber jumper and lightguide build-outs/optical attenuators.

Figure 5-7 illustrates an optical loopback connections.

Figure 5-7 Optical Loopback



Test Access

Overview

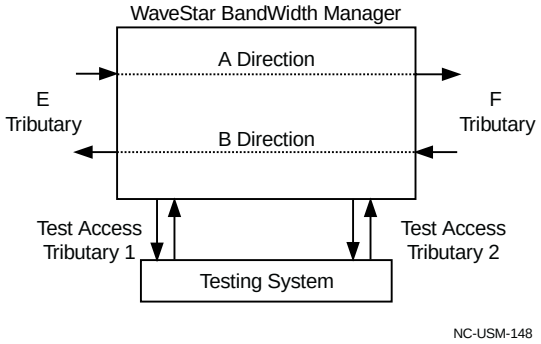
WaveStar BandWidth Manager supports test access cross-connections that allow circuits to be monitored and split by external testing systems. This aids in turning up facilities and in sectionalizing faults in existing service circuits. Test access allows circuit quality to be tested at a single network element or over all of an end-to-end circuit that is routed through multiple network elements.

Test access cross-connections can be established at the STS-1/VC-3, STS-3/VC-4, STS-12/VC-4-4c, and STS-48/VC-4-16c rates. DS3, EC-1, OC-3/STM-1, OC-12/STM-4, OC-48/STM-16, or OC-192/STM-64 ports support test access tributaries for connection to an external testing system.

Tributaries

The tributaries to which test access are applied are designated as either the “E” tributary or the “F” tributary. In WaveStar BandWidth Manager, “E” and “F” correspond to logical tributaries. The E-tributary and F-tributary represent the near-end (E) and far-end (F) of a one-way or two-way cross-connection. If an idle tributary (one without a cross-connection) is the focus of test access, the idle tributary is always designated as the E-tributary.

Figure 5-8 Test Access Tributaries



The test access tributaries are defined as follows:

- E Tributary: The first tributary to be monitored or split. There is always an E Tributary. If a tributary without a cross-connection is to be tested, it is always an E Tributary.
- F Tributary: The second tributary to be monitored or split. The F Tributary is not required for all test access modes.
- A Direction: The signal path from the E Tributary to the F Tributary. If there is only a one-way cross-connection, the signal travels in the A direction.
- B Direction: The signal path from the F Tributary to the E Tributary.
- Test Access Tributary 1: The first tributary that is connected to the external testing system.
- Test Access Tributary 2: The second tributary that is connected to the external testing system. This tributary is only used in dual-test modes.

Test modes

This section describes the single and dual tributary test modes.

Single tributary test modes

The single tributary test modes are

- Monitor near-end (MONE) mode monitors the E input of an idle tributary, or a leg of a cross-connection
- Monitor near-end (MONF) mode monitors the F leg of a two-way cross-connection
- Split A direction (SPLTA) mode splits the A-B directions of a two-way cross-connection to allow testing in the A direction
- Split B direction (SPLTB) mode splits the A-B directions of a two-way cross-connection to allow testing in the B direction
- Split near-end (SPLTE) mode splits the E-F connection of a leg of a one-way or two-way cross-connection to allow testing of the E tributary
- Split near-end (SPLTF) mode splits the E-F connection of a leg of a one-way or two-way cross-connection to allow testing of the F tributary

Dual tributary test modes

The dual tributary test modes are

- Monitor near-end and far-end (MONEF) mode monitors both directions of a two-way cross-connection
- Split A and B directions (SPLTAB) mode splits both directions of a two-way cross-connection to allow testing at A and B
- Split near-end and far-end (SPLTEF) mode splits both directions of a two-way cross-connection to allow testing of both the E and F tributaries

Test access with cross-connections

WaveStar BandWidth Manager allows the test access modes listed in the following table, depending on the *cross-connect leg status* of the cross-connection established on the E-end tributary

Table 5-4 Test modes for Cross-Connection Types

Status of Cross-Connection Leg	Cross-Connection Type	
	Not Through-Connected	BLSR/MS-SPRing
Idle (no cross-connection)	MONE SPLTE	MONE SPLTE
One-way cross-connection	MONE SPLTA SPLTE	 MONE
Two-way cross-connection	MONE MONF MONEF SPLTA SPLTB SPLTAB SPLTE SPLTF SPLTEF	 MONE MONF MONEF

Restrictions The following restrictions apply to test access:

- Test Access Tributary 1 and E Tributary are always required.
- Test Access Tributary 1, E Tributary, Test Access Tributary 2 (if entered), and F Tributary (if entered) must not be already in use as a test tributary.
- Test Access Tributary 1, E Tributary, Test Access Tributary 2 (if entered), and F Tributary (if entered) must not be looped back.
- Test Access Tributary 1 and Test Access Tributary 2 must not be part of a cross-connection.
- Test Access Tributary 1 must be different from E Tributary.
- Test Access Tributary 1 must be different from Test Access Tributary 2.
- Tributaries must be on physically-present circuit packs (pre-provisioned circuit packs can not be used)
- Test access is not supported on the protection DS3EC1/8 or STM1E/4 port units.
- Test access is not supported on protection ports of 1+1 optical protection groups.
- Test access must be established initially in the MONE, MONF, or MONEF mode. This restriction is referred to as “monitor before split” and is a safety precaution that prevents possible service interruptions.
- Test access cross-connections must be made in the main switch fabric. Therefore, test access for BLSR/MS-SPRing and UPSR/SNCP tributaries is not supported.
- Test access is not supported on tributaries that are part of UPSR/SNCP path-protected cross-connections.

□

Protection Switching

Overview

This section describes the following protection switching modes available in WaveStar BandWidth Manager:

- 2-fiber BLSRs/MS-SPRings
- 4-fiber BLSRs/MS-SPRings (open or closed)
- UPSR
- SNCP
- 1+1 protected
- 0x1 protected (unprotected)

BLSR/MS-SPRing protection switching

Two- and four-fiber BLSR/MS-SPRing protection switching occurs in response to automatically detected faults in the optical line, as well as external commands from craft at a local/remote WaveStar CIT or operations system. SONET protection switching in WaveStar BandWidth Manager complies with GR-253-CORE.

Revertive protection switching

BLSRs/MS-SPRings use bidirectional revertive ring protection switching. Bidirectional refers to protection switching performed in the transmit and receive directions. In revertive switching, the traffic switches from the working line to the protection line when a fault occurs. When the fault clears, the traffic switches back (reverts) to the working line.

1+1 Protection

In WaveStar BandWidth Manager, 1+1 protection (two port units providing full 1+1 protection), may be provisioned as

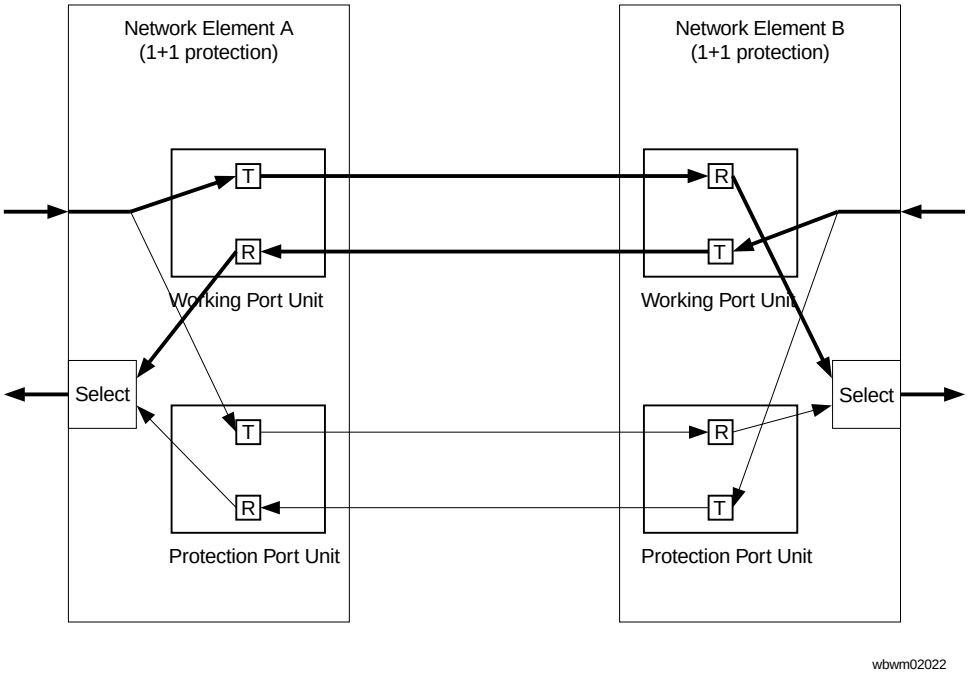
- unidirectional, non-revertive (OC-192/STM-64, OC-48/STM-16, OC-12/STM-4, OC-3/STM-1)
- bidirectional, non-revertive (OC-48/STM-16, STM-4, STM-1)
- bidirectional, revertive (STM-4, STM-1)

Important! T and R in Figure 5-9, Figure 5-10, and Figure 5-11 represent the transmitters and receivers on the port units.

1+1 Protection

Figure 5-9 illustrates normal transmission between 1+1 protected port units. The two port units in each Network Element (A and B) are 1+1 protected. The bold lines of transmission represent the active transmission paths (East and West).

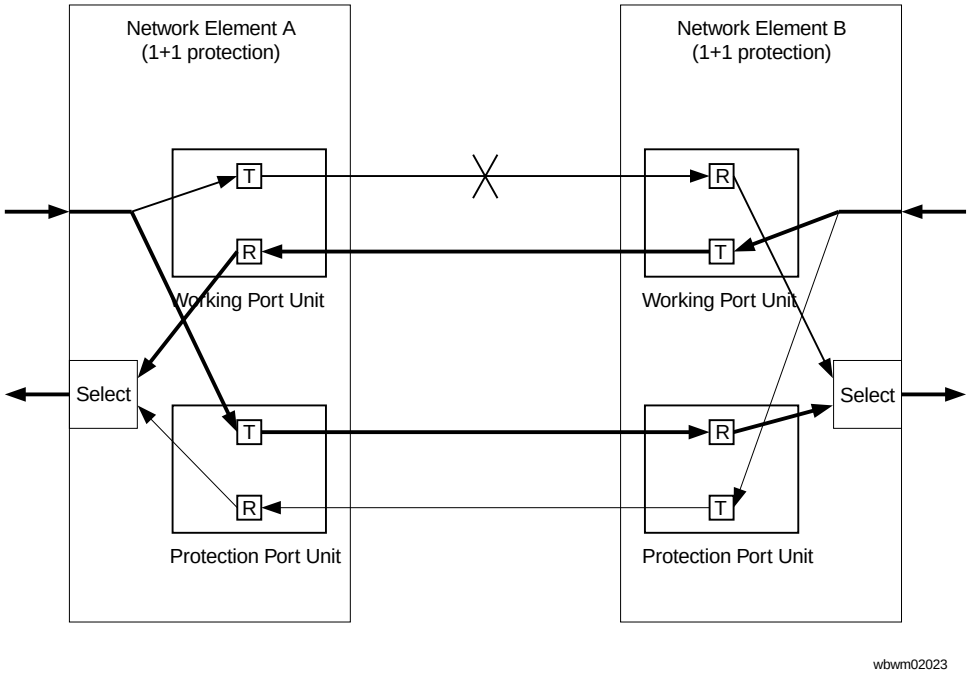
Figure 5-9 1+1 Protection (Normal Transmission)



Unidirectional 1+1 protection switch

Figure 5-10 illustrates a unidirectional 1+1 protection switch. The two port units in each Network Element (A and B) are 1+1 protected. In this scenario, only the East transmission direction (unidirectional) switches to the protection port units. The bold lines of transmission represent the active transmission paths (East and West).

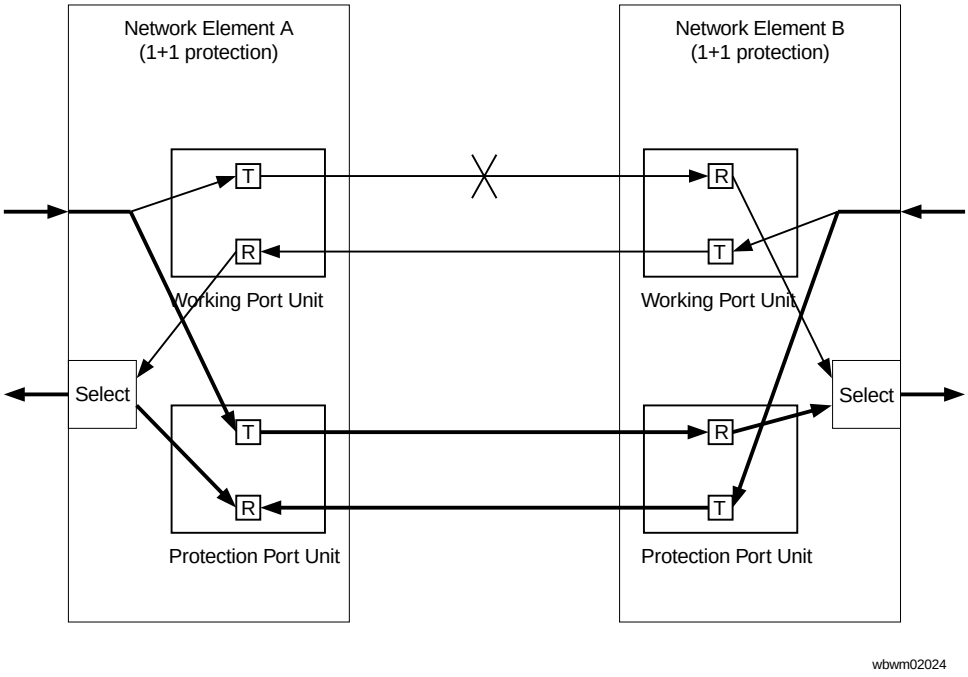
Figure 5-10 1+1 Protection (Unidirectional)



Bidirectional 1+1 protection switch

Figure 5-11 illustrates a bidirectional 1+1 protection switch. The two port units in each Network Element (A and B) are 1+1 protected. In this scenario, both directions of transmission (bidirectional) switch to the protection port units. The bold lines of transmission represent the active transmission paths (East and West).

Figure 5-11 1+1 Protection (Bidirectional)



OC-192/STM-64 protection

The OC192/STM64 port units in WaveStar BandWidth Manager may be provisioned as

- 2-fiber OC-192 BLSR/STM-64 MS-SPRing
- 4-fiber OC-192 BLSR (open or closed)
- 4-fiber STM-64 MS-SPRing with transoceanic protocol
- STM-64 SNCP
- 1+1 protected (two port units providing OC-192/STM-64 1+1 protection, unidirectional, non-revertive)
- 0x1 protected (unprotected)

OC-48/STM-16 protection

The OC48/STM16 port units in WaveStar BandWidth Manager may be provisioned as

- 2-fiber OC-48 BLSR/STM-16 MS-SPRing
- 4-fiber OC-48 BLSR/STM-16 MS-SPRing (open or closed)
- 4-fiber STM-16 MS-SPRing with transoceanic protocol
- OC-48 UPSR
- STM-16 SNCP
- 1+1 protected (two port units providing OC-48/STM-16 1+1 protection, which may be
  - unidirectional, non-revertive
  - bidirectional, non-revertive
- 0x1 protected (unprotected)

OC-12/STM-4 protection

The protection mode for the OC12/STM4 port units in WaveStar BandWidth Manager may be provisioned as

- OC-12 UPSR
- STM-4 SNCP
- 1+1 protected (two port units providing OC-12 1+1 protection, unidirectional, non-revertive)
- 1+1 protected (two port units providing STM-4 1+1 protection, which may be
  - unidirectional, non-revertive
  - bidirectional, non-revertive
  - bidirectional, revertive
- 0x1 protected (unprotected)

OC-3/STM-1 protection

The protection mode for the OC3/STM1 port units in WaveStar BandWidth Manager may be provisioned as

- STM-1 SNCP
- 1+1 protected (two port units providing OC-3 1+1 protection, unidirectional, non-revertive)
- 1+1 protected (two port units providing STM-1 1+1 protection, which may be
  - unidirectional, non-revertive
  - bidirectional, non-revertive
  - bidirectional, revertive
- 0x1 protected (unprotected)

DS3EC1/8 protection

WaveStar BandWidth Manager provides protection for all DS3EC1/8 port units. Electrical port units are 1xN (N≤12) protected and use bidirectional revertive switching. Only one protection DS3EC1/8 port unit is needed in each Facility Interface Sub-Shelf (DS3EC1 Electrical Module or Mixed Module). One dedicated protection DS3EC1/8 circuit pack provides protection for N (N≤12) service DS3EC1/8 port units. One SWITCH/DS3EC1 circuit pack is required for electrical protection switching.

STM1E/4 protection

WaveStar BandWidth Manager provides protection for all STM1E/4 port units. Electrical port units are 1xN (N≤8) protected and use bidirectional revertive switching. Only one protection STM1E/4 port unit is needed in each Facility Interface Sub-Shelf (STM1e Electrical Module or Mixed Module). One dedicated protection STM1E/4 circuit pack provides protection for N (N≤8) service STM1E/4 port units. One SWITCH/STM1E4 circuit pack is required for electrical protection switching.

Synchronization protection

WaveStar BandWidth Manager provides protection for the Stratum 3 Timing Generator (TMG/STRAT3) circuit packs and the timing reference signals. Two Stratum 3 circuit packs provide 1+1 non-revertive protection switching. In addition, two DS1 timing inputs are provided to each TMG/STRAT3 pack for external timing reference signal protection.

Reference

For additional information on synchronization, refer to Chapter 6, “System Planning and Engineering.”

□

Performance Monitoring

Overview

This section contains information about

- Performance-monitoring data storage
- Performance monitoring during failed conditions
- Performance parameter thresholds
- Threshold-crossing alert transmission to an operations system

Performance-monitoring data storage

WaveStar BandWidth Manager provides one current, one previous, and 31 recent 15-minute registers, as well as one current and one previous 24-hour register for all accumulated performance parameters. The performance monitoring parameters begin daily at a preset time.

> **Important!** WaveStar BandWidth Manager can retrieve and report the contents of any parameter storage register. WaveStar BandWidth Manager can also initialize the current 15-minute and/or current 24-hour registers through the WaveStar CIT locally or remotely. This capability enables the user to verify that a repair to a failed facility was successful.

Performance monitoring during failed conditions

When a trouble condition is detected, WaveStar BandWidth Manager stops accumulating performance monitoring parameters that were inhibited during unavailable time per GR-253-CORE (SONET) and ITU G.784 and G.826 (SDH). All unaffected performance parameters continue to be accumulated during a trouble condition.

Performance parameter thresholds

The current 15-minute and current 24-hour thresholds for each performance- monitoring parameter are provisionable according to a profile using the WaveStar CIT. Whenever the current 15-minute or the current 24-hour threshold for a performance-monitoring parameter is either reached or exceeded, WaveStar BandWidth Manager generates a threshold-crossing alert (TCA) in the form of a quality of service alarm. The alarm condition is then entered into the appropriate performance-monitoring report.

Threshold-crossing alert (TCA) reporting

WaveStar BandWidth Manager supports the TL1 REPORT EVENT autonomous messages for TCA reporting. All TCAs are retrievable either locally or remotely via the WaveStar CIT. If provisioned for autonomous TCA reporting, the message-based operations system interface can communicate TCA reports to the operations centers.

SONET

The TL1 messages provide information on the crossing of a raw count, ES-S, ES-L, ES-LFE, ES-P, ES-PFE, SES-S, SES-L, SES-LFE, SES-P, SES-PFE, or UAS-S, UAS-L, UAS-LFE, UAS-P, UAS-PFE thresholds for the current 15-minute register.

SDH

The TL1 messages provide information on the crossing of a raw count RS_N_ES, MS_N_ES, MS_F_ES, RS_N_SES, MS_N_SES, MS_F_SES, or RS_N_UAS, MS_N_UAS, MS_F_UAS threshold for the current 15-minute register.

Limited alarm filtering

WaveStar BandWidth Manager supports the capability to filter alarms that are trigger during equipment/capacity growth (for example, adding an I/O Shelf) using alarm severity assignment profiles (ASAPs). During growth, the ASAPs define that all alarms are set to “Not Reported”.

> **Important!** WaveStar BandWidth Manager allows the user to reset the ASAPs back to the Lucent recommend values.

□

OC-N Performance Parameters

Overview

This section describes the performance monitoring parameters that are applicable to OC-N (OC-3, OC-12, OC-48, OC-192) and EC-1 signals.

Description

WaveStar BandWidth Manager provides performance monitoring to support proactive maintenance of a network. WaveStar BandWidth Manager also provides fault-locating parameters, such as the optic power receive (OPR) parameters.

Performance thresholds

OC-N performance parameters are assigned thresholds that are used to measure degraded performance. When a performance-monitoring threshold is crossed, a report is sent to the OS. All threshold crossings that are associated with a particular path are correlated by the OS and then the source of the degradation is identified.

Table

The following table lists the OC-N section and line performance parameters that WaveStar BandWidth Manager monitors.

Table 5-5 OC-N Performance Parameters

Facility	Measured Provisionable Parameter
OC-N	Laser Bias Current (LBC)a
	Optic Power Transmit (OPT)a
	Optic Power Receive (OPR)a
OC-N Section	Coding Violations (CV-S)a
	Errored Seconds (ES-S)a
	Severely Errored Seconds (SES-S)a
	Severely Errored Frame Seconds (SEFS-S)
OC-N Line	Coding Violations (CV-L)
	Coding Violations Far End (CV-LFE)
	Errored Seconds (ES-L)
	Errored Seconds Far End (ES-LFE)
	Severely Errored Seconds (SES-L)
	Severely Error Seconds Far End (SES-LFE)
	Forward Error Correction Corrected (FECC-L)b
	Forward Error Correction Uncorrected (FECU-L)b
	Unavailable Seconds (UAS-L)
	Unavailable Seconds Far End (UAS-LFE)
	Failure Counts (FC-L)
	Failure Counts Far End (FC-LFE)
	AIS Seconds (AISS-L)
	Protection Switch Count (PSC)a
	Protection Switch Duration (PSD)a

a) This parameter is not supported for EC-1 signals.

b) This parameter is only supported for OC-192 signals.

OC-N optical parameters

WaveStar BandWidth Manager processes the raw performance monitoring parameters into derived parameters. The derived parameters are based on the condition of the incoming OC-N signal during a given second. The following derived parameters are calculated for the parameters listed in the preceding table.

WaveStar BandWidth Manager monitors three OC-N optical parameters to detect degrading performance of the laser.

Laser bias current (LBC)

The LBC parameter indicates whether or not the system is operating within normal margins. The LBC parameter does not vary among the optical circuit packs and is stored in system non-volatile memory (NVM). The upper limit is 150% of the initial factory value. There is no lower limit.

Optic power transmit (OPT)

The OPT parameter monitors the average optical output power generated by each active laser transmitter. Because the OPT varies among the optical port units packs, the OPT values are not stored in the system NVM. The OPT values are stored in the inventory NVM of each circuit pack. The upper limit for OPT is +1 dB above the initial measured value. The lower limit for OPT is -1 dB below the initial measured value.

Optic power receive (OPR)

The OPR parameter indicates whether or not the received optical power is currently within the nominal sensitivity limits of the receiver. Because the OPR varies among the optical port units, the OPR values are not stored in the system NVM. The OPR values are stored in the inventory NVM of each port unit. The factory-set thresholds for the low and high OPR are -29 dBm and -10 dBm, respectively. The OPR is a fault-locating tool used in conjunction with the proactive-maintenance performance monitoring parameters. The OPR parameter indicates whether or not the transmitter, receiver, or fiber is the source of an impending failure.

OC-N section parameters

WaveStar BandWidth Manager monitors several OC-N section parameters.

> **Important!** WaveStar BandWidth Manager monitors one section parameter for EC-1 signals, SEFS-S.

B1 coding violations (CV-S)

Section layer byte interleaved parity (BIP) errors are reflected in the B1 byte of the line overhead. WaveStar BandWidth Manager calculates the errors in the received frame and compares that value to the errors received in the following frames. WaveStar BandWidth Manager can detect up to 8 BIP errors per STS-N frame. Each error is then reflected in the CV-S count. In the outgoing direction, WaveStar BandWidth Manager calculates a BIP value and writes it into the outgoing SONET line overhead of the OC-N line.

Errored seconds (ES-S)

The ES-S parameter increments once for each second during which WaveStar BandWidth Manager detects either one or more section layer bit interleaved parity (BIP) errors, a severely errored frame (SEF), or a loss of signal (LOS) defect.

Severely errored seconds (SES-S)

The SES-S parameter increments once for each second during which WaveStar BandWidth Manager detects either one or more SEF defects or LOS defects, or K section layer BIP errors where K equals:

- 155 BIP errors for OC-3 signals
- 616 BIP errors for OC-12 signals
- 2392 BIP errors for OC-48 signals
- 8554 BIP errors for OC-192 signals

Severely errored frame seconds (SEFS-S)

The SEFS-S parameter increments once for each second during which WaveStar BandWidth Manager detects one or more near-end SEF defects.

Loss of signal seconds (LOSS-S)

The LOSS-S parameter increments once for each second during which WaveStar BandWidth Manager detects one or more LOS defects.

OC-N line parameters

WaveStar BandWidth Manager monitors several OC-N and EC-1 line parameters.

> **Important!** The FECC-L and the FECU-L parameters only apply to OC-192 signals.

B2 coding violations (CV-L)

Line layer byte interleaved parity (BIP) errors are reflected in the B2 byte of the line overhead. WaveStar BandWidth Manager calculates the errors in the received frame and compares that value to the errors received in the following frames. WaveStar BandWidth Manager can detect up to 8 times N (8xN) BIP errors per STS-N frame. Each error is then reflected in the CV-L count. In the outgoing direction, WaveStar BandWidth Manager calculates a BIP value and writes it into the outgoing SONET line overhead of the OC-N line.

Coding violations far end (CV-LFE)

The CV-LFE parameter counts the number of BIP errors detected by the far end and reported by the REI-L indication of the Line overhead. For SONET signals rates below OC-48 (OC-3 and OC-12), WaveStar BandWidth Manager can detect up to 8 times N (8xN) BIP errors per STS-N frame. For OC-48 signals, WaveStar BandWidth Manager can detect up to 255 BIP errors per STS-N frame. The CV-LFE current second register increments for each BIP error indicated by the incoming REI-L.

Errored seconds (ES-L)

The ES-L parameter increments once for every second during which WaveStar BandWidth Manager detects either one or more B2 parity violations or an OC-N line AIS.

Errored seconds far end (ES-LFE)

The ES-LFE parameter increments once for every second during which WaveStar BandWidth Manager detects either one or more far-end Line layer BIP errors as reported by the REI-L indication of the Line overhead or an RDI-L defect.

Severely errored seconds (SES-L)

The SES-L parameter increments once for every second during which WaveStar BandWidth Manager detects either an OC-N line AIS defect, or K Line layer BIP errors where K equals:

- 51 BIP errors for EC-1 signals
- 154 BIP errors for OC-3 signals
- 615 BIP errors for OC-12 signals
- 2459 BIP errors for OC-48 signals
- 9835 BIP errors for OC-192 signals

Severely errored seconds far end (SES-LFE)

The SES-LFE parameter increments once for each second during which WaveStar BandWidth Manager detects either an RDI-L defect, or K Line layer BIP errors where K equals:

- 51 BIP errors for EC-1 signals
- 154 BIP errors for OC-3 signals
- 615 BIP errors for OC-12 signals
- 2459 BIP errors for OC-48 signals
- 9835 BIP errors for OC-192 signals

Forward error correction corrected (FECC-L)

The FECC-L parameter is monitored for each OC-192 line. The FECC-L parameter is a count of corrected transmission errors at the line layer. Up to 72 FECC-L counts can be detected per STS-192 frame, with each event incrementing the FECC-L current second register. A single FECC-L count relates to the correction of one bit error. Two bit errors (multi-bit) can be corrected per block (36 blocks per frame) for a total of 72 bits correctable per frame.

Forward error correction uncorrected (FECU-L

The FECU-L parameter is monitored for each OC-192 line. The FECU-L parameter is a count of uncorrected transmission errors at the line layer. Up to 36 FECU-L events can be detected per STS-192 frame, with each event incrementing the FECU-L current second register. A single FECU-L count relates to the detection of transmission errors in a block that were too severe to be corrected using the multi-bit error correction algorithm. One uncorrectable event per block is possible (36 blocks per frame) for a total of 36 per frame.

Unavailable seconds (UAS-L)

The UAS-L parameter increments once each second during which a line is unavailable. A line is considered unavailable from the beginning of 10 consecutive SES until the beginning of 10 consecutive seconds, none of which are severely errored.

Unavailable seconds far end (UAS-LFE)

The UAS-LFE parameter increments once each second during which a line is unavailable. A line is considered unavailable from the beginning of 10 consecutive SES-LFE until the beginning of 10 consecutive seconds, none of which are severely errored.

AIS Seconds (AISS-L)

The AISS-L parameter increments once for each second during which WaveStar BandWidth Manager detects one or more AIS defects.

Failure counts (FC-L)

The FC-L parameter counts the number of NE line failure events. A failure event begins when the AIS-L failure is declared, and ends when the AIS-L failure is cleared. A failure that begins in one period and ends in another period, is only counted in the period during which it began.

Failure counts far end (FC-LFE)

The FC-LFE parameter counts the number of RFI-L failure events. A failure event begins when the RFI-L failure is declared, and ends when the RFI-L failure is cleared. A failure that begins in one period and ends in another period, is only counted in the period during which it began.

Protection switch count (PSC)

The PSC parameter records the number of times that service traffic switched to or from another line either automatically, by a WaveStar CIT command, or operations system command.

Protection switch duration (PSD)

The PSD parameter for each SONET line counts the number of seconds during which service was carried on the protection line of that protection group.



STM-N Performance Parameters

Overview

This section describes the performance monitoring parameters that are applicable to STM-16 and STM-64 signals.

Description

WaveStar BandWidth Manager provides performance monitoring to support proactive maintenance of a network.

Performance thresholds

STM-N performance parameters are assigned thresholds that are used to measure degraded performance. When a performance-monitoring threshold is crossed, a report is sent to the OS. All threshold crossings that are associated with a particular path are correlated by the OS and then the source of the degradation is identified.

Table

The following table lists the STM-N regenerator section and multiplex section performance parameters that WaveStar BandWidth Manager monitors.

Table 5-6 STM-N Performance Parameters

Facility	Measured Provisionable Parameter
STM-N Regenerator Section	Background Block Errors (RS_N_BBE)
	Errored Seconds (RS_N_ES)
	Severely Errored Seconds (RS_N_SES)
	Unavailable Seconds (RS_N_UAS)
STM-N Multiplex Section	Background Block Errors (MS_N_BBE)
	Background Block Errors Far End (MS_F_BBE)
	Errored Seconds (MS_N_ES)
	Errored Seconds Far End (MS_F_ES)
	Severely Errored Seconds (MS_N_SES)
	Severely Errored Seconds Far End (MS_F_SES)
	Unavailable Seconds (MS_N_UAS)
	Unavailable Seconds Far End (MS_F_UAS)

STM-N regenerator section parameters

WaveStar BandWidth Manager processes the raw performance monitoring parameters into derived parameters. The derived parameters are based on the condition of the incoming STM-N signal during a given second. The following derived parameters are calculated for the parameters listed in the preceding table.

WaveStar BandWidth Manager monitors several STM-N section parameters.

B1 background block errors (RS_N_BBE)

Regenerator section BBEs are reflected in the B1 byte of the regenerator section overhead. WaveStar BandWidth Manager calculates the errors in the received frame and compares that value to the errors received in the following frames. Each error is then reflected in the RS_N_BBE count. In the outgoing direction, WaveStar BandWidth Manager calculates a B1 value and writes it into the outgoing SDH regenerator overhead of the STM-N line.

Errored seconds (RS_N_ES)

An RS_N_ES is a second during which WaveStar BandWidth Manager detects either one or more B1 block errors, an RS_SEF defect, or an STM_LOS defect.

Severely errored seconds (RS_N_SES)

An RS_N_SES is a second during which WaveStar BandWidth Manager detects either an RS_SEF defect, an STM_LOS defect, or 2400 or more STM-N regenerator section block errors

Unavailable seconds (RS_N_UAS)

An RS_N_UAS is a second during which the STM-N regenerator section is “unavailable.” The regenerator section is considered unavailable from the beginning of 10 consecutive RS_N_SES until the beginning of 10 consecutive seconds, none of which are severely errored.

STM-N multiplex section parameters

WaveStar BandWidth Manager monitors several STM-N multiplex section parameters.

B2 background block errors (MS_N_BBE)

Multiplex section byte BBEs are reflected in the B2 byte of the multiplex section overhead. WaveStar BandWidth Manager calculates the errors in the received frame and compares that value to the errors received in the following frames. Each error is reflected in the MS_N_BBE count. In the outgoing direction, WaveStar BandWidth Manager calculates a B2 value and writes it into the outgoing SDH multiplex section overhead of the STM-N line.

Background block errors far end (MS_F_BBE)

The MS_F_BBE parameter counts the number of block errors detected by the far end and reported by the MS_REI indication of the multiplex section overhead. The MS_F_BBE current second register increments for each block error indicated by the incoming MS_REI.

Errored seconds (MS_N_ES)

An MS_N_ES is a second during which WaveStar BandWidth Manager detects either one or more B2 block error or an STM-N MS_AIS.

Errored seconds far end (MS_F_ES)

An MS_F_ES is a second during which WaveStar BandWidth Manager detects either one or more far-end multiplex section block errors as reported by the MS_REI indication of the multiplex section overhead or an MS_RDI defect.

Severely errored seconds (MS_N_SES)

An MS_N_SES is a second during which WaveStar BandWidth Manager detects either an MS_AIS defect or

- 28,800 or more STM-1 B2 block errors
- 115,200 or more STM-4 B2 block errors
- 460,800 or more STM-16 B2 block errors
- 1,843,200 or more STM-64 B2 block errors

Severely errored seconds far end (MS_F_SES)

An MS_F_SES is a second during which WaveStar BandWidth Manager detects either an MS_RDI defect or the following multiplex section block errors as reported by the MS_REI indication of the multiplex section overhead

- 306,000 or more STM-16 block errors via MS_REI
- 306,000 or more STM-64 block errors via MS_REI
- 115,200 or more STM-4 block errors via MS_REI
- 28,800 or more STM-1 block errors via MS_REI

Unavailable seconds (MS_N_UAS)

An MS_N_UAS is a second during which the STM-N line is "unavailable." A line is considered unavailable from the beginning of 10 consecutive MS_N_SES until the beginning of 10 consecutive seconds, none of which are severely errored.

Unavailable seconds far end (UAS-MSFE)

An MS_F_SES is a second during which the STM-N line is "unavailable." A line is considered unavailable from the beginning of 10 consecutive MS_F_SES until the beginning of 10 consecutive seconds, none of which are severely errored.

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STS-N Performance Parameters

Overview This section describes the performance monitoring parameters that apply to the STS-N (STS-1, STS-3c, STS-12c, STS-48c) path layers within OC-N signals.

Table The following two tables list the STS-N path performance parameters that WaveStar BandWidth Manager monitors.

Table 5-7 STS-N Terminated Path Performance Parameters

Facility	Measured Provisionable Parameter
STS Terminated Path	Coding Violations (CV-P)
	Coding Violations Far End (CV-PFE)
	Errored Seconds (ES-P)
	Errored Seconds Far End (ES-PFE)
	Severely Errored Seconds (SES-P)
	Severely Error Seconds Far End (SES-PFE)
	Unavailable Seconds (UAS-P)
	Unavailable Seconds Far End (UAS-PFE)
	Failure Counts (FC-P)
	Failure Counts Far End (FC-PFE)
	Pointer Justifications

Table 5-8 STS-N Intermediate Path Performance Parameters

Facility	Measured Provisionable Parameter
STS Intermediate Path	Coding Violations (CV-P)
	Coding Violations Far End (CV-PFE)
	Errored Seconds (ES-P)
	Errored Seconds Far End (ES-PFE)
	Severely Errored Seconds (SES-P)
	Severely Error Seconds Far End (SES-PFE)
	Unavailable Seconds (UAS-P)
	Unavailable Seconds Far End (UAS-PFE)
	Failure Counts (FC-P)
	Failure Counts Far End (FC-PFE)
	Pointer Justifications

STS-N path parameters

WaveStar BandWidth Manager monitors several STS path parameters.

B3 coding violations (CV-P)

Path layer byte interleaved parity (BIP) errors are reflected in the B3 byte of the incoming STS-N (STS-1, STS-3c) path overhead. WaveStar BandWidth Manager calculates the errors in the received frame and compares that value to the errors received in the following frames. WaveStar BandWidth Manager can detect up to 8 BIP errors per frame. Each error is then reflected in the CV-P count. In the outgoing direction, WaveStar BandWidth Manager calculates a BIP value and writes it into the outgoing SONET line overhead of the OC-N line.

Coding violations far end (CV-PFE)

The CV-PFE parameter counts the number of BIP errors detected by the far end and reported by the REI-P indication of the Path overhead. For STS-12c, WaveStar BandWidth Manager can detect up to 8 times N (8xN) BIP errors per STS-N frame. For STS-48c signals, WaveStar BandWidth Manager can detect up to 255 BIP errors per STS-N frame. The CV-PFE current second register increments for each BIP error indicated by the incoming REI-P.

Errored seconds (ES-P)

The ES-P parameter increments once for each second during which WaveStar BandWidth Manager detects either one or more STS Path layer BIP errors, an AIS-P defect, or an LOP-P defect.

Errored seconds far end (ES-PFE)

The ES-PFE parameter increments once for each second during which WaveStar BandWidth Manager detects either one or more far-end STS Path layer BIP errors as reported by the REI-P indication of the Path overhead, or an RDI-P defect.

Severely errored seconds (SES-P)

The SES-P parameter increments once for each second during which WaveStar BandWidth Manager detects either an AIS-P defect, or an LOP-P defect, or 2400 or more STS Path layer BIP errors

Severely errored seconds far end (SES-PFE)

The SES-PFE parameter increments once for each second during which WaveStar BandWidth Manager detects an RDI-P defect, or the REI-P indication of the line overhead reports 2400 or more STS Path layer BIP errors.

Unavailable seconds (UAS-P)

A UAS-P is a second during which the path is unavailable. A path is considered unavailable from the beginning of 10 consecutive SES-P until the beginning of 10 consecutive seconds, none of which are severely errored.

Unavailable seconds far end (UAS-PFE)

The UAS-PFE is a second during which the path is unavailable. A path is considered unavailable from the beginning of 10 consecutive SES-PFE until the beginning of 10 consecutive seconds, none of which are severely errored.

Failure counts (FC-P)

The FC-P parameter counts the number of NE line failure events. A failure event begins when an AIS-P or LOP-P failure is declared, and ends when the AIS-P or LOP-P failure is cleared, respectively. A failure that begins in one period and ends in another period, is only counted in the period during which it began.

Failure counts far end (FC-PFE)

The FC-PFE parameter counts the number of RFI-P failure events. A failure event begins when the RFI-P failure is declared, and ends when the RFI-P failure is cleared. A failure that begins in one period and ends in another period, is only counted in the period during which it began. (RFI-P is reported in the G1 byte of the Path Overhead.)

Pointer justifications

WaveStar BandWidth Manager monitors STS Pointer Justifications that are detected and generated on at least one SONET non-terminated path. These STS Pointer Justifications are

- PPJC-PGen – This parameter summarizes all Positive Pointer Justifications generated by WaveStar BandWidth Manager.
- NPJC-PGen – This parameter summarizes all Negative Pointer Justifications generated by WaveStar BandWidth Manager.
- PPJC-PDet – This parameter summarizes all Positive Pointer Justifications detected by WaveStar BandWidth Manager.
- NPJC-PDet – This parameter summarizes all Negative Pointer Justifications detected by WaveStar BandWidth Manager.



VC-N Performance Parameters

Overview This section describes the performance monitoring parameters that apply to the high order intermediate path layer within VC-N (VC-3, VC-4, VC-4-4c, VC-4-16c) signals.

Table lists the VC-N High Order Intermediate Path performance parameters that WaveStar BandWidth Manager monitors.

Table 5-9 VC-N High Order Intermediate Path Performance Parameters

Facility	Measured Provisionable Parameter
VC-N High Order Intermediate Path	Background Block Errors (VC_N_BBE)
	Background Block Errors Far End (VC_F_BBE)
	Errored Seconds (VC_N_ES)
	Errored Seconds Far End (VC_F_ES)
	Severely Errored Seconds (VC_N_SES)
	Severely Error Seconds Far End (VC_F_SES)
	Unavailable Seconds (VC_N_UAS)
	Unavailable Seconds Far End (VC_F_UAS)

VC-N parameters WaveStar BandWidth Manager monitors several VC-N path parameters.

B3 background block errors (VC_N_BBE)

Path layer background block errors are reflected in the B3 byte of the path overhead. WaveStar BandWidth Manager calculates the errors in the received frame and compares that value to the errors received in the following frames. Each error is reflected in the VC_BBE count. In the outgoing direction, WaveStar BandWidth Manager calculates a B3 value and writes it into the outgoing path overhead of the VC-N.

Background block errors far end (VC_N_BBE)

The VC_F_BBE parameter counts the number of block errors detected by the far end and reported by the VC_REI indication of the path overhead.

Errored seconds (VC_N_ES)

A VC_N_ES is a second during which WaveStar BandWidth Manager detects either one or more VC-N path layer block errors, a VC_AIS defect, or a VC_LOP defect.

Errored seconds far end (VC_F_ES)

A VC_F_ES is a second during which WaveStar BandWidth Manager detects either one or more far-end path layer block errors as reported by the VC_REI indication of the path overhead or a VC_RDI defect.

Severely errored seconds (VC_N_SES)

A VC_N_SES is a second during which WaveStar BandWidth Manager detects either a VC_AIS defect, or a VC_LOP defect, or a preset number of path layer block errors.

Severely errored seconds far end (VC_F_SES)

A VC_F_SES is a second in which the system detects a VC_RDI defect, or the VC_REI indication of the path overhead reports a preset number of path layer block errors.

Unavailable seconds (VC_N_UAS)

A VC_N_UAS is a second during which the STM-N line is “unavailable.” A path is considered unavailable from the beginning of 10 consecutive VC_N_SES until the beginning of 10 consecutive seconds, none of which are severely errored.

Unavailable seconds far end (VC_F_UAS)

A VC_F_UAS is a second during which the STM-N line is “unavailable.” A path is considered unavailable from the beginning of 10 consecutive VC_F_SES until the beginning of 10 consecutive seconds, none of which are severely errored.



DS3 Performance Parameters

Overview

This section describes the performance monitoring parameters that apply to DS3 signals.

Definition

DS3 performance parameters are assigned thresholds to measure degraded performance. When a performance-monitoring threshold is crossed, it is reported to the operations system where all threshold crossings can be correlated, and the likely source of the degradation can be identified.

Table The following table lists the DS3 performance parameters monitored.

Table 5-10 DS3 Performance Parameters

Facility	Measured Provisionable Parameter
DS3 Line	Coding Violations (CV-L)
	Errored Seconds (ES-L)
	Severely Errored Seconds (SES-L)
	LOS Seconds (LOSS-L)
DS3 Path	Coding Violations (CV-P)
	Coding Violations Far End (CV-PFE)
	Errored Seconds (ES-P)
	Errored Seconds Far End (ES-PFE)
	Errored Seconds “A” (ESA-P)
	Errored Seconds “A” Far End (ESA-PFE)
	Errored Seconds “B” (ESB-P)
	Errored Seconds “B” Far End (ESB-PFE)
	Severely Errored Seconds (SES-P)
	Severely Error Seconds Far End (SES-PFE)
	Severely Errored Frame/AIS Seconds (SAS-P)
	Severely Error Frame/AIS Seconds Far End (SAS-PFE)
	Unavailable Seconds (UAS-P)
	Unavailable Seconds Far End (UAS-PFE)
	Failure Counts (FC-P)
	Failure Counts Far End (FC-PFE)

DS3 line parameters

WaveStar BandWidth Manager processes the raw performance monitoring parameters into derived parameters. The derived parameters are based on the condition of the incoming DS3 signal during a second. The following derived parameters are calculated for the parameters listed in the preceding table.

WaveStar BandWidth Manager monitors several DS3 line parameters.

Coding violations (CV-L)

The CV-L parameter increments once for each BPV and EXZ error detected at the line layer. For lines that are B3ZS coded, BPVs that are part of the zero substitution code are excluded. Only one count is added for each EXZ regardless of the length of the zero string.

Errored seconds (ES-L)

The ES-L parameter increments once for each second during which WaveStar BandWidth Manager detects either one or more BPV errors or a DS3 LOS defect.

Severely errored seconds (SES-L)

The SES-L parameter increments once for each second during which WaveStar BandWidth Manager detects either 2444 or more BPVs (at a minimum BER of 7.5×10^{-5}) or 44 or more BPVs (at a minimum BER of 1×10^{-6}) plus EXZ errors, or one or more LOS defects. For lines that are B3ZS coded, BPVs that are part of the zero substitution code are excluded.

Loss of signal seconds (LOSS-L)

The LOSS-L parameter increments once for each second during which WaveStar BandWidth Manager detects one or more LOS defects.

DS3 path parameters

WaveStar BandWidth Manager monitors several DS3 path parameters in P-bit and CP-bit monitoring modes. Each mode supports P-bit correction (violation monitoring and removal [VMR]) on the outgoing DS3 signal toward the DS3 facility. The following table defines P-bit and CP-bit monitoring and correction in each of the VMR and DS3 PM framed and unframed modes. Bit parity errors used to derive the counts depend on the PM mode as follows:

- pbit — DS3 P-bit parity check coding violations determine PM counts.
- cbit — DS3 CP-bit parity check coding violations determine PM counts.

Monitoring and correction of the P-bits are based on the VMR and PM mode provisioning of the DS3 interface. CP-bits are never corrected. CP-bits are copies of the P-bits inserted by the path originator and are not changed by any non-path terminating equipment.

Table 5-11 DS3 Interface and PM Provisioning Parameters

Framing	DS3 SF	PM Mode	VMR Mode	Monitor P-Bits	Correct P-Bits	Monitor C-Bits
Framed	Framed or M23	pbit	VMR	x	x	
			VM	x		
			No VMa			
	C-Bit Parity	cbit	VMR		x	x
			VM			x
			No VMa			x
Unframed	Clear Channel	B3ZS	No VM			

a) Default.

Coding violations (CV-P)

The sum of the signal parity violations on a given line is an indicator of the performance of that line. The CV-P parameter increments once for each parity error detected at the path level. The CV-P parameter applies to all framed DS3 PM modes. Unidentical P-bits corresponding to the same DS-3 M-frame also increment the CV-P parameter in P-bit mode. For C-bit mode, the three C-bits in sub-frame 3 of a C-bit formatted DS3 frame carry the DS3 path-parity information. At the DS3 transmitter, the CP bits in the DS3 C-bit frame are set equal to the two P-bits in frame “n”. These CP bits are then inserted into frame “n+1”. Since the CP bits are not modified in any way while passing through the network, the DS3 high-speed receiver can determine if errors occurred in the DS3 path. The DS3 receiver computes the parity of frame “n” and compares that parity with the value received in the CP bits in frame “n+1”. If the values do not match, DS3 path parity violations are counted.

Coding violations far end (CV-PFE)

The CV-PFE parameter increments once for each received FEBE message indicating a DS3 C-bit, F-bit, or M-bit path error at the far-end. The CV-PFE applies to the DS3 C-bit PM mode.

Errored seconds (ES-P)

The ES-P parameter increments once for each second during which WaveStar BandWidth Manager detects either one or more DS3 coding violations, one or more DS3 path AIS defects, one or more SEF defects, or one or more DS3 path LOF defects in the signal. The ES-P parameter applies to all framed DS3 PM modes.

Errored seconds far end (ES-PFE)

The ES-PFE parameter increments once for each second during which WaveStar BandWidth Manager detects either one M-frame with the three FEBE bits not all set to ONE, one or more far-end SEF defects, or one or more AIS defects. The ES-PFE applies to the DS3 C-bit PM mode.

Errored seconds “A” (ESA-P)

The ESA-P parameter increments once for each second during which WaveStar BandWidth Manager detects one parity error and no SEF or AIS defects. The ESA-P parameter applies to all framed DS3 PM modes.

Errored seconds “A” far end (ESA-PFE)

The ESA-PFE parameter increments once for each second during which WaveStar BandWidth Manager detects either one M-frame with the three FEBE bits not all set to ONE, and does not detect any far-end SEFs or AIS defects. The ESA-PFE applies to the DS3 C-bit PM mode.

Errored seconds “B” (ESB-P)

The ESB-P parameter increments once for each second during which WaveStar BandWidth Manager detects either less than 2444 parity errors (at a minimum BER of 7.5×10^{-5}) or less than 44 parity errors (at a minimum BER of 1×10^{-6}) and does not detect any far-end SEF or AIS defects. The ESB-P applies to the DS3 C-bit PM mode.

Errored seconds “B” far end (ESB-PFE)

The ESB-PFE is a second during which WaveStar BandWidth Manager detects either less than 2444 parity errors (at a minimum BER of 7.5×10^{-5}) or less than 44 parity errors (at a minimum BER of 1×10^{-6}) and no far-end SEF or AIS defects. The ESB-PFE applies to the DS3 C-bit PM mode.

Severely errored seconds (SES-P)

The SES-P parameter increments once for each second during which WaveStar BandWidth Manager detects either more than 2444 parity errors (at a minimum BER of 7.5×10^{-5}) or more than 44 parity errors (at a minimum BER of 1×10^{-6}), or detects one or more DS3 path AIS or SEF defects. The SES-P parameter applies to all framed DS3 PM modes.

Severely errored seconds far end (SES-PFE)

The SES-PFE parameter increments once for each second during which WaveStar BandWidth Manager detects either more than 2444 far-end FEBE errors (at a minimum BER of 7.5×10^{-5}) or more than 44 far-end FEBE errors (at a minimum BER of 1×10^{-6}), or one or more far-end SEF, or one or more AIS defects. The SES-PFE applies to the DS3 C-bit PM mode.

Severely errored frame/AIS seconds (SEFS-P)/(SAS-P)

The SEFS-P/SAS-P parameter increments once for each second during which WaveStar BandWidth Manager detects either one or more AIS defects or SED defects. The SAS-P parameter applies to all framed DS3 PM modes.

Severely errored frame/AIS seconds far end (SEFS-PFE)/(SAS-PFE)

The SEFS-PFE/SAS-PFE parameter increments once for each second during which WaveStar BandWidth Manager detects either one or more far-end SEF or one or more AIS defects. The SEFS-PFE/SAS-PFE applies to the DS3 C-bit PM mode.

AIS Seconds (AISS-P)

The AISS-P parameter increments once for each second during which WaveStar BandWidth Manager detects one or more AIS defects. The AISS-P parameter applies to all framed DS3 PM modes.

Unavailable seconds (UAS-P)

The UAS-P parameter is a count of one second intervals during which the DS3 path is unavailable. A path is considered unavailable during LOS, LOF, and path AIS conditions. A path is also considered unavailable from the beginning of 10 consecutive severely errored seconds until the beginning of 10 consecutive seconds, none of which are severely errored. The UAS-P parameter applies to DS3 p-bit and F&M bit PM modes.

Unavailable seconds far end (UAS-PFE)

The UAS-PFE parameter is a count of one second intervals during which the DS3 path is unavailable. A path is considered unavailable from the beginning of 10 consecutive SES-PFE until the beginning of 10 consecutive seconds, none of which are severely errored. The UAS-PFE applies to the DS3 C-bit PM mode.

Failure counts (FC-P)

The FC-P parameter counts the number of failure events. A failure event begins when the DS3 AIS or DS3 LOF failure is declared, and ends when the DS3 AIS or DS3 LOF failure is cleared. A failure that begins in one period and ends in another period, is only counted in the period during which it began. The FC-P parameter applies to all framed DS3 PM modes.

Failure counts far end (FC-PFE)

The FC-PFE parameter counts the number of DS3 RAI failure events. A failure event begins when the RAI failure is declared, and ends when the RAI failure is cleared. A failure that begins in one period and ends in another period, is only counted in the period during which it began. The FC-PFE applies to the DS3 C-bit PM mode.

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Monitoring Modes

Overview

The port monitoring mode monitors physical, section, and line parameters. The tributary mode monitors path parameters. You can enable or disable either monitoring mode independently. You set the port or tributary monitoring mode values when you provision a port or tributary on a port unit.

Port monitoring mode

Port monitoring mode may be set to AUTO, MON (monitored), or NMON (not monitored). A port monitoring mode set to NMON disables line level fault management and performance monitoring functions for the port. A port monitoring mode set to MON enables line level fault management and performance monitoring functions. A port monitoring mode set to AUTO allows the fault management function to continue monitoring the port and disables the performance monitoring function. When a valid incoming signal is detected on a port set to AUTO, the port monitoring mode is automatically set to MON and the performance monitoring function is enabled.

Tributary monitoring mode

Tributary (path) monitoring modes may be set to MON or NMON. A tributary monitoring mode set to NMON disables the path level fault management and performance monitoring functions. A tributary monitoring mode set to MON enables the path level fault management and performance monitoring functions.

PM mode — enable/disable

You can also enable or disable performance monitoring on a parameter group level in addition to setting the port and tributary performance monitoring mode. Performance monitoring mode is enabled or disabled when you use the WaveStar CIT System View Performance menu to provision a port or tributary with performance monitoring TCA profile information. When the performance monitoring mode is disabled, the port and tributary monitoring modes are disabled, performance monitoring data collection stops, and no TCAs are reported.

SONET

The following are the default performance monitoring (PM) modes for each SONET parameter group:

- Physical PM — enabled
- Section and line (near-end) PM — enabled
- Line (far-end) PM — disabled
- Path PM — disabled
- DS3 PM — disabled

PM parameter accumulation

This section describes the PM parameter accumulation for SONET, SDH, and DS3 parameters.

SONET parameters

SONET physical, section, and line parameter accumulation for optical ports is active when that port is in service, the port monitoring mode is set to MON, and the PM mode is enabled.

SDH parameters

SDH regenerator section, and multiplex section, and high order path parameter accumulation for optical ports is active when that port is in service, the port monitoring mode is set to MON, and the PM mode is enabled.

DS3 parameters

DS3 line parameters (CV-L, ES-L, SES-L, LOSS-L) accumulation is activate when that DS3 port is in service, the port monitoring mode is set to MON, and the PM mode is enabled.

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SONET Threshold Profiles

Overview

Threshold profiles store the threshold values of PM parameters that require thresholding. One threshold profile of each parameter group type may be associated with each port or tributary. PM values stored in threshold profiles determine the threshold crossing alerts of a monitored value for a port or tributary. The Performance menu in the System View window of the WaveStar CIT allows you to create, modify, or delete profiles, view profile information, and assign profiles to port and tributaries.

Maximum number

The maximum number of threshold profiles is limited to NVM space. The system supports the following maximum number of default and user created profiles:

- 10 physical profiles
- 30 section/line port level profiles
- 250 path level profiles (future)

TCA reporting

The system supports enabling or disabling TCA reporting on a parameter basis using threshold profiles. When the threshold value of a parameter is set to zero, no QOS alarm message is generated. Enabling/disabling the TCA reporting of an individual parameter is independent of any other parameter. The system does not provide disabling TCA reporting on a parameter grouping such as line or path. You can disable reporting on a parameter group by setting zeros to a parameter group in the threshold profile. For example, you can set zero to the threshold values of all path PM parameters to disable the TCA reporting on the path level.

> **Important!** WaveStar BandWidth Manager allows the user to reset the TCA profiles back to the Lucent recommended values.

Physical profile default values and ranges

The following table lists the default profile values and ranges for physical parameters.

Table 5-12 Physical Profile Default Values and Ranges

Parameter	Default	Range
LBC	150%	1 is enabled 0 is disabled
OPT	OPT low - OPT high	
OPR	OPR low - OPR high	

Section/Line profile default values and ranges

The following table lists the section/line default profile values and ranges.

Table 5-13 Section/Line Default Values and Ranges

Parameter	15 minutes		1 day	
	Default	Range	Default	Range
CV-S for OC-3	140	1-16777215	1344	1-2147483647
CV-S for OC-12	560	1-16777215	5376	1-2147483647
CV-S for OC-48	2240	1-16777215	21504	1-2147483647
CV-S for OC-192	8960	1-16777215	86016	1-2147483647
ES-S	25	1-900	250	1-86400
SES-S	10	1-810	40	1-77760
SEFS-S	5	1-900	10	1-86400
CV-L and CV-LFE for EC-1	47	1-16777215	448	1-2147483647
CV-L and CV-LFE for OC-3	140	1-16777215	1344	1-2147483647
CV-L and CV-LFE for OC-12	560	1-16777215	5376	1-2147483647
CV-L and CV-LFE for OC-48	2240	1-16777215	21504	1-2147483647
CV-L and CV-LFE for OC-192	8960	1-16777215	86016	1-2147483647
ES-L and ES-LFE	25	1-900	250	1-86400
SES-L and SES-LFE	10	1-810	40	1-77760
FECC-L (OC-192 only)	5184	1-5184000	497664	1-497664000
FECU-L (OC-192 only)	2592	1-2592000	248832	1-248832000
UAS-L and UAS-LFE	10	1-900	10	1-86400

Path profile default values and ranges

The following table lists the default profile values and ranges for the path profiles.

Table 5-14 Path Profile Default Values and Ranges

Parameter	15 Minutes		1 Day	
	Default	Range	Default	Range
CV-P and CV-PFE for STS-1	15	1-65535	125	1-8388607
CV-P and CV-PFE for STS-3c	25	1-65535	250	1-8388607
ES-P and ES-PFE for STS-1	12	1-900	100	1-86400
ES-P and ES-PFE for STS-3c	20	1-900	200	1-86400
SES-P and SES-PFE	3	1-810	7	1-77760
UAS-P and UAS-PFE	10	1-900	10	1-86400

DS3 profile default values and ranges

The following table lists the default values and ranges for the default DS3 profile.

Table 5-15 DS3 Profile Default Values and Ranges

Parameter	15-minutes		1-day	
	Default	Range	Default	Range
CV-L	387	1-16383	3865	1-1048575
ES-L	25	1-900	250	1-86400
SES-L	4	1-900	40	1-86400
CV-P and CV-PFE	382	1-16383	3820	1-1048575
ES-P and ES-PFE	25	1-900	250	1-86400
ESA-P and ESA-PFE	25	1-900	250	1-86400
ESB-P and ESB-PFE	25	1-900	250	1-86400
SES-P and SES-PFE	4	1-810	40	1-77760
SAS-P and SAS-PFE	2	1-900	8	1-86400
UAS-P and UAS-PFE	10	1-900	10	1-86400

Reports

Overview

This topic contains information about the

- Active alarms and status report
- Performance monitoring report
- History report
- Report on circuit pack, slot, and port states
- Version/equipment list
- Synchronization report

Active alarms and status reports

WaveStar BandWidth Manager provides an on-demand report that shows all the active alarm and status conditions. WaveStar BandWidth Manager automatically displays the local alarm and status report on the local and remote WaveStar CIT. The report shows the following alarm levels and alarm conditions:

- Critical (CR)
- Major (MJ)
- Minor (MN)
- Not-alarmed (status) (NA)

The source address and description of each alarm condition (for example, controller failure and incoming signal failure) are included in the report along with the date and time detected. The report also indicates whether or not the alarm is service-affecting. Multiple options are available to sort alarm data (for example, in order of severity).

Performance monitoring report

WaveStar BandWidth Manager provides reports that contain the values of all performance monitoring registers requested at the time the report. The start time of each register's recording period is also included. The reports provide all parameters and performance monitoring data that was recorded in a series of 15-minute and 24-hour storage registers.

Performance parameters report

WaveStar BandWidth Manager provides another report that contains a summary of all performance parameters that have crossed their provisioned 15-minute or 24-hour thresholds within the history of the 15-minute and 24-hour registers.

Important! A series of 31 recent, one current, and one previous 15-minute registers is provided for each parameter, allowing for up to 8 hours and 15 minutes (495 minutes) of history in 15-minute registers. Also, one current and one previous 24-hour register is provided, allowing for up to 2 days (48 hours) of history in 24-hour registers.

History report

A history report displays the past 500 events. An event is any change in WaveStar BandWidth Manager that may affect its performance (for example, a failure) or change its operation status (for example, loopback setup). This summary contains time stamps showing when each condition was detected and when it cleared. The WaveStar CIT events contain a time stamp showing when the command was entered.

Time stamp

The day bin time stamp at the top of the reports reflects the last time the 24-hour performance monitoring counts were initialized, even if the resulting "day" is longer or shorter than 24 hours. The report shows corrupted data as a question mark (?) for all non-24-hour day bin collection intervals, including those exceeding 24 hours.

Report on pack, slot, and switch states

This on-demand report displays

- Circuit pack, transmission port, and timing port state information
- Protection group switch states

Version/ equipment list

The version/equipment list report is an on-demand report that lists all

- Provisioned or pre-provisioned circuit packs
- Circuit packs that are present

Synchronization report

The synchronization report is an on-demand report that lists

- System synchronization status
- Clock parameters that can be interrogated from a WaveStar CIT or from remote telemetry

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Overview of Provisioning

Overview

This section contains information about the following features:

- Local or remote provisioning
- Preprovisioning circuit packs
- Circuit pack replacement provisioning
- Original value provisioning

Definition

Provisioning refers to assigning values to parameters used for specific functions by network elements. The values of the provisioned parameters determine many operating characteristics of a network element.

Local or remote provisioning

WaveStar BandWidth Manager software allows local and remote provisioning of all user-provisionable parameters using the graphical user interface (GUI). The provisionable parameters and values (current and original) are maintained in the nonvolatile memory of the CTL/MEM circuit pack.

Preprovisioning circuit packs

To simplify circuit pack installation, parameters can be provisioned before inserting the corresponding circuit pack. All system parameters and values (current and original) are preserved by WaveStar BandWidth Manager in the nonvolatile memory of the CTL/MEM circuit pack. The parameters and values are protected by the nonvolatile memory if a power failure occurs and are retrievable on demand regardless of the means used for provisioning. The appropriate parameters are automatically downloaded when the corresponding circuit pack is installed.

Circuit pack replacement provisioning

Replacement of a failed circuit pack is simplified by WaveStar BandWidth Manager's automatic provisioning of the original circuit pack values. The System Controller (CTL/SYS50D and CTL/SYS50DM) and Control Memory (CTL/MEM) circuit packs maintain a provisioning map of the current provisioning values. When a transmission and/or a timing circuit pack is replaced, the CTL/SYS50D, CTL/SYS50DM, and CTL/MEM circuit packs automatically download the previous provisioning parameters and values that are stored in the non-volatile memory (NVM) to the new circuit pack.

Original value provisioning

Installation provisioning is minimized with original values. Each provisionable parameter is assigned an original value at the factory. A parameter is a characteristic of the system that affects its operation. A value is a number, text string, or other menu selection. The provisionable parameters and original values are set during installation.

There are three complete sets of data (parameters and their values) in the system under normal conditions:

- The first set contains the system parameters and their original values (values assigned to a parameter at the factory). This set is located in the nonvolatile memory of the CTL/MEM circuit pack.
- The second set contains the system parameters and their current values (values currently being used by the system). This set is also located in the nonvolatile memory of the CTL/MEM circuit pack.
- The third set contains the system parameters and their current values. This set is located in the volatile memory of the CTL/SYS50D circuit pack.

Important! The original values assigned at the factory cannot be changed. However, the current values can be overridden through local or remote provisioning.

References

For more information about provisioning parameters and original values using the WaveStar CIT, refer to *WaveStar BandWidth Manager User Operations Guide*, *365-370-109.*

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Port Monitoring Modes

Overview

This section describes the different port monitoring modes in WaveStar BandWidth Manager.

Definition

Port monitoring modes represent the monitoring state for each port in the system at any given time. Each port monitoring mode has its own characteristics for signal failure alarms and performance monitoring (PM) data collection. Transitions between modes occur due to events such as applying a good signal and WaveStar CIT commands. The detection of a fault does not affect the state of the port monitoring mode.

Port modes

The port modes in WaveStar BandWidth Manager are

- Auto (AUTO): AUTO refers to a port that is available for automatic provisioning. A port transitions from the AUTO mode to the MON mode if a good signal is detected. The original port monitoring mode value is AUTO. When the port monitoring mode is AUTO, the port is not alarmed.
- Monitored (MON): MON refers to a port that is fully monitored and alarmed.
- Not monitored (NMON): NMON refers to a port that is not monitored and does not transition to the MON state even if a good signal is detected. Any port modes may be user-provisioned independently to the NMON state at anytime, regardless of the auto-provisioned mode of the terminating interface slot. This port mode is used to suppress alarms.

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6 System Planning and Engineering

Overview

Purpose This chapter provides information about planning capacity, power, synchronization, floor plan layout, and equipment interconnection.

Contents The following topics are discussed in this chapter:

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Important Notices

Overview

This section provides important information about changes in the availability of equipment and floorplans.

3-bay Control/Switch Complexes

As of April 1, 2002, the 3-bay Control/Switch Complexes will be Discontinued Availability (DA). The business reasons behind the decision to DA the 3-bay Control/Switch Complex include

- The 3-bay Control/Switch Complex was originally developed to allow upgrades to the 9216/3072 platform and support the optical remoting of I/O Shelves. Due to a change in our customers' needs, the 4608/1536 platform is now evolving to a 55,296/18,432 platform in Release 5.0. Therefore, the 9216/3072 platform and the optical remoting of I/O Shelves have been removed from the development program.
- The elimination of the 3-bay Control/Switch Complex, further adds to the reduction in the footprint. Customers gain two bay-widths of floor space (one bay and one cable management bay) without losing any features or functionality.

Reduce footprint platforms

The reduced footprint floor plans with the reduced cabling for 2-bay Control/Switch Complexes are available as of July 1, 2001.

Important! Because the 3-bay Control/Switch Complexes will be DA effective April 1, 2002, the reduced footprint floor plans will only be available with 2-bay Control/Switch Complexes. Please contact you account executive for more information.

Standard footprint equipment

Effective June 1, 2002, all standard footprint equipment (bays and floorplans) will be Discontinued Availability (DA).

Because floor space is very critical to our customers, Lucent is taking advantage of leading edge technologies in cabling to reduce the footprint of WaveStar BandWidth Manager. Therefore, the original standard footprints are no longer necessary and they will be DA effective June 1, 2002. Customers will save significant floor space by purchasing the new reduced footprints. When compared to the floor space occupied by the standard footprints:

- The new reduced footprint NEBS 2-bay Control/Switch Complex (without I/O bays) reduces the amount of floor space by approximately 13.5%.
- The new reduced footprint ETSI 2-bay Control/Switch Complex (without I/O bays) reduces the amount of floor space by approximately 30%.
- The new reduced footprint ETSI I/O Bays reduces the amount of floor space by approximately 16.7%.

Important! The floor space savings stated above does not apply to the ETSI Universal I/O Bays and the 10G/Universal I/O Bays if those bays are equipped with DS3EC1/8 port units and therefore DS3EC1 Connect Panels.

Available floor plans The following table lists the available floor plans.

Table 6-1 Release 4.1 Floor Plans

Drawing Number	NEBS/ETSI	Description	Note
Using ED9C280-28 with original cables			DA: Effective 6/01/02 Replaced by: ED9C280-12
801-802-001-2	NEBS	NEBS Original Footprint 3-Aisle Floor Plan Data Sheet (3-Bay Control/Switch Complex)	DA: Effective 4/01/02
801-802-001-3	NEBS	NEBS Original Footprint 4-Aisle Floor Plan Data Sheet (3-Bay Control/Switch Complex)	DA: Effective 4/01/02
801-802-001-4	ETSI	ETSI Original Footprint 3-Aisle Floor Plan Data Sheet (3-Bay Control/Switch Complex)	DA: Effective 4/01/02
801-802-001-5	ETSI	ETSI Original Footprint 4-Aisle Floor Plan Data Sheet (3-Bay Control/Switch Complex)	DA: Effective 4/01/02
801-802-001-10	NEBS	NEBS Original Footprint 3-Aisle Floor Plan Data Sheet (2-Bay Control/Switch Complex)	DA: Effective 6/01/02 Replaced by: 801-802-001-30
801-802-001-11	NEBS	NEBS Original Footprint 4-Aisle Floor Plan Data Sheet (2-Bay Control/Switch Complex)	DA: Effective 6/01/02 Replaced by: 801-802-001-31
801-802-001-12	ETSI	ETSI Original Footprint 3-Aisle Floor Plan Data Sheet (2-Bay Control/Switch Complex)	DA: Effective 6/01/02 Replaced by: 801-802-001-32
801-802-001-13	ETSI	ETSI Original Footprint 4-Aisle Floor Plan Data Sheet (2-Bay Control/Switch Complex)	DA: Effective 6/01/02 Replaced by: 801-802-001-33
Using ED9C280-11 for reduced footprints with reduced cables or ED9C280-13 for reduced footprints with reduced cables with the cable racking greater than 11.5 ft/3.5 m above the floor or for raised-floor platforms with cable-rack depths of greater than 1 ft/305 mm			Available 7/01/01
801-802-001-15	NEBS	NEBS Reduced Footprint 4-Aisle Floor Plan Data Sheet (2-Bay Control/Switch Complex)	Available 7/01/01

Drawing Number	NEBS/ETSI	Description	Note
801-802-001-17	NEBS	NEBS Reduced Footprint 3-Aisle Floor Plan Data Sheet (2-Bay Control/Switch Complex)	Available 7/01/01
801-802-001-19	ETSI	ETSI Reduced Footprint 4-Aisle Floor Plan Data Sheet (2-Bay Control/Switch Complex)	Available 7/01/01
801-802-001-21	ETSI	ETSI Reduced Footprint 3-Aisle Floor Plan Data Sheet (2-Bay Control/Switch Complex)	Available 7/01/01
Using ED9C280-12 for standard footprints with reduced cables			Available 7/01/01
801-802-001-22	NEBS	NEBS Standard Footprint 3-Aisle Floor Plan Data Sheet (3-Bay Control/Switch Complex)	DA: Effective 4/01/02
801-802-001-23	NEBS	NEBS Standard Footprint 4-Aisle Floor Plan Data Sheet (3-Bay Control/Switch Complex)	DA: Effective 4/01/02
801-802-001-24	ETSI	ETSI Standard Footprint 3-Aisle Floor Plan Data Sheet (3-Bay Control/Switch Complex)	DA: Effective 4/01/02
801-802-001-25	ETSI	ETSI Standard Footprint 4-Aisle Floor Plan Data Sheet (3-Bay Control/Switch Complex)	DA: Effective 4/01/02
801-802-001-30	NEBS	NEBS Standard Footprint 3-Aisle Floor Plan Data Sheet (2-Bay Control/Switch Complex)	Available 7/01/01
801-802-001-31	NEBS	NEBS Standard Footprint 4-Aisle Floor Plan Data Sheet (2-Bay Control/Switch Complex)	Available 7/01/01
801-802-001-32	ETSI	ETSI Standard Footprint 3-Aisle Floor Plan Data Sheet (2-Bay Control/Switch Complex)	Available 7/01/01
801-802-001-33	ETSI	ETSI Standard Footprint 4-Aisle Floor Plan Data Sheet (2-Bay Control/Switch Complex)	Available 7/01/01

□

General Planning Information

Overview

This section provides general planning information for WaveStar BandWidth Manager.

Planning considerations

When planning your network, you should consider the eventual system size, including

- Synchronization
- Floor plan layouts
- SWIF capacity
- Modular I/O growth
- Equipment interconnection

Engineering and Installation Services Group

Lucent Technologies offers the Engineering and Installation Services group to assist the customer in planning and engineering a new system. The Engineering and Installation Services group is a highly skilled force of support personnel dedicated to providing customers with quality engineering and installation services. These specialists use state-of-the-art technology, equipment, and procedures to provide customers with highly competent, rapid response services.

References

For more information about the Engineering and Installation Services group, contact your Account Executive or refer to Chapter 8, “Product Support.”

4608/1536 platform capacity

WaveStar BandWidth Manager 4608/1536 platform has the capability to transport and cross-connect 4608 STS-1/1536 STM-1 equivalents through transmission port units and the 4608x4608/1536x1536 switch fabric.

Operations systems

The Network Communications Controller (NCC) is compatible with WaveStar BandWidth Manager and can be mounted above the System Controller Shelf in the System Controller Bay (3-bay Control/Switch Complex) or above the System Controller Shelf in the Control/Switch Bay (2-bay Control/Switch Complex). The NCC improves the establishment of cross-connections between network elements (NEs). The NCC decreases costs and standardizes operations by providing directory service and protocol conversion functions to WaveStar BandWidth Manager NEs and the operations systems.

Power planning

Two -48.0/ -60.0 VDC power feeders (A and B) power each shelf in WaveStar BandWidth Manager. Redundant power feeders are used to ensure maximum system reliability. All power feeders should be sized to carry the maximum shelf power consumption. Each feeder is equipped with a power filter with voltage protection to reduce any switching noise that may be present on the input current and to provide low voltage protection.

References

For more information about power, refer to Chapter 4, “Product Description” and Chapter 10, “Technical Specifications.”



SONET Synchronization

Overview

This section describes the SONET synchronization and timing features available in WaveStar BandWidth Manager.

Platform synchronization

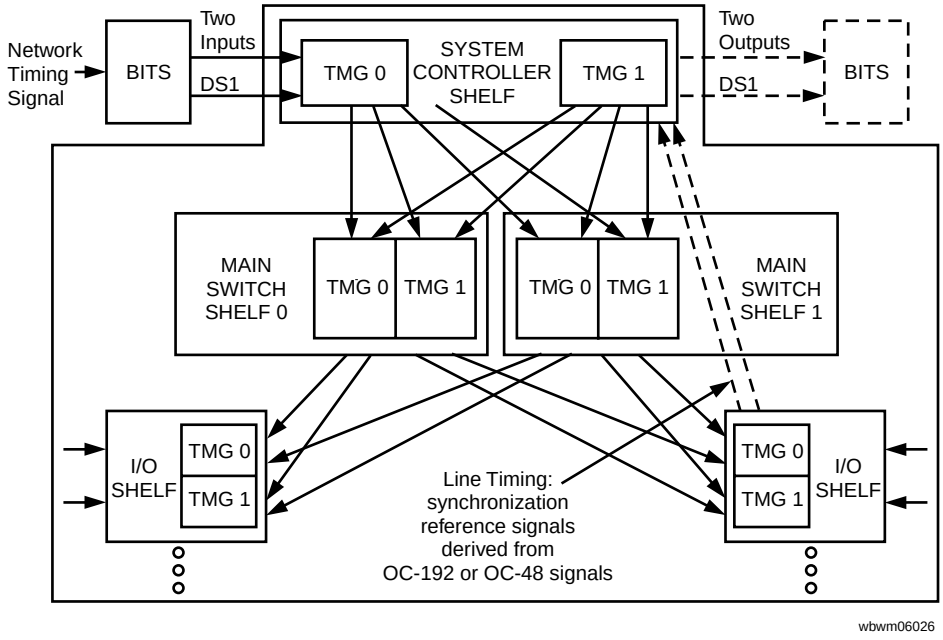
WaveStar BandWidth Manager is primarily timed from duplex TMG/STRAT3 packs located in the System Controller Shelf, which are tied to the office Building Integrated Timing Source (BITS) clock via duplicated DS1 inputs. The TMG/STRAT3 packs distribute timing to all shelves in the platform. Because all the shelves in the system (platform) derive their timing from the same initial source, the platform is synchronized.

> **Important!** A BITS clock is simply a clock within a central office that distributes timing to all the equipment in that central office. The BITS clock is tied to an external, stable timing source, such as a GPS (global positioning satellite).

SONET synchronization architecture

Figure 6-1 illustrates the synchronization architecture in a SONET platform.

Figure 6-1 SONET Synchronization Architecture



System synchronization characteristics

WaveStar BandWidth Manager synchronization characteristics must be provisioned as either SONET or SDH mode (generally, provisioned during installation). The system synchronization behavior (SONET or SDH) defines the

- Clock characteristics
  - Stratum 3: SONET
  - SDH Equipment Clock (SEC): SDH
- Synchronization status messages (SSMs)

If the synchronization characteristics are provisioned as SONET mode and WaveStar BandWidth Manager receives an SDH SSM, WaveStar BandWidth Manager will ignore the reference associated with that SDH SSM.

> **Important!** The synchronization characteristics are independent of the port characteristics (OC-N or STM-N).

Timing modes

WaveStar BandWidth Manager supports the following timing modes:

- Free running
- Locked (external) timing mode
- Line timing

Duplicated timing

Every shelf in WaveStar BandWidth Manager is equipped with duplicated TMG/STRAT3 packs for superior reliability. The System Controller Shelf, the Switch Shelves, and the I/O Shelves each contain two TMG/STRAT3 packs that use 1+1, non-revertive protection. TMG 0 (working) is the default-state master timing source and TMG 1 is the protection pack.

> **Important!** The external timing references are protected independently of the TMG/STRAT3 packs. The reference protection is provisionable as non-revertive (default) or revertive (depending on the timing reference priorities).

Timing distribution

Timing is distributed from the TMG/STRAT3 packs in the System Controller Shelf to the TMG/STRAT3 packs in the Switch Shelves and then to TMG/STRAT3 packs in all the I/O Shelves in the platform for synchronization of the transport interfaces.

Outgoing synchronization messaging

WaveStar BandWidth Manager supports outgoing OC-192, OC-48, OC-12, and OC-3 S1 byte synchronization messaging. Synchronization messaging allows WaveStar BandWidth Manager to communicate its synchronization status to other nodes in the network. The synchronization messages are transported via bits 5, 6, 7, and 8 of the S1 byte of the OC-N signals for system synchronization and interworking. WaveStar BandWidth Manager complies with all ANSI and Telcordia synchronization messaging standards.

Incoming synchronization messaging

WaveStar BandWidth Manager supports incoming OC-192 and OC-48, S1 byte synchronization messaging. Synchronization messaging allows WaveStar BandWidth Manager to receive synchronization status from other nodes in the network. The synchronization messages are transported via bits 5, 6, 7, and 8 of the S1 byte of the OC-192 and OC-48 signals for system synchronization and interworking. WaveStar BandWidth Manager complies with all ANSI and Telcordia synchronization messaging standards.

Free running mode

During installation and turn-up, WaveStar BandWidth Manager is designed to operate without an external timing reference (from a BITS clock) in the free running mode. In the free running mode, the system derives its timing from the highly stable internal stratum 3 oscillator located in the TMG/STRAT3 packs in the System Controller Shelf. After the system is operational, the external timing source (the BITS clock) is applied to the system and the system enters the locked (external) timing mode.

> **Important!** The internal oscillator has a long-term accuracy of better than ±4.6 ppm.

Locked (external) timing mode

In a typical configuration, WaveStar BandWidth Manager is locked to an external Building Integrated Timing Source (BITS) reference that is traceable to a Stratum 1 timing source. The two TMG/STRAT3 packs in the System Controller Shelf accept two DS1 synchronization reference input signals (B8ZS-format) from an external Stratum 3 or better office BITS clock. The DS1 inputs may be provisioned to be superframe format (SF) or extended superframe format (ESF) (default). The external timing references may also be derived from an OC-48 or OC-192 signal.

Holdover mode

The TMG/STRAT3 circuit packs monitor both DS1 timing references for error-free operation. If both DS1 references are corrupted, the system enters holdover mode. In holdover mode, the system clock holds the internal stratum 3 oscillator at the last good timing reference while the DS1 references are repaired.

Line timing with SSM

The two TMG/STRAT3 packs in the System Controller Shelf can be provisioned to accept synchronization reference signals from two incoming OC-N (OC-192 or OC-48) lines. The two incoming lines must originate from the same I/O Shelf.

WaveStar BandWidth Manager continuously monitors the Synchronization Status Messages (SSMs) that notify the system if a reference signal is acceptable or unacceptable. If a reference signal is unacceptable, the system reconfigures itself to use the next assigned reference source. If no other sources are available, the system enters holdover mode. WaveStar BandWidth Manager supports reference reconfiguration for two DS1 inputs and two line timing references, depending on the incoming SSMs.

Holdover mode

If the reference signal becomes either corrupted or unavailable, the TMG/STRAT3 packs revert back to DS1 synchronization reference signals. If both DS1 references are corrupted, the system enters holdover mode. In holdover mode, the system clock holds the internal Stratum 3 oscillator at the last good timing reference while the DS1 references are repaired.

Incoming/Outgoing SSMs

Standard synchronization status messages (SSMs) are transported on the S1 Byte. The transmission of SSMs on the S1 Byte is required on all OC-192 on OC-48 lines. Incoming SSMs are used to monitor the acceptability of timing references. SSMs are determined according to SONET (ANSI, Telcordia) standards.

Automatic reconfiguration of synchronization mode

WaveStar BandWidth Manager supports the automatic reconfiguration of the synchronization mode based on incoming SSMs. When an incoming SSM is deemed to be unacceptable, the system reconfigures itself to use the next assigned reference signal source. If no other sources are available, or those signals are not an acceptable quality, the system goes enters holdover mode. WaveStar BandWidth Manager supports the automatic reconfiguration of up to two DS1 inputs and two line references.

Holdover mode

The TMG/STRAT3 circuit packs monitor the timing references for error-free operation. If the derived reference signal becomes either corrupted or unavailable, the system clock reverts back to DS1 synchronization reference signals. If both derive timing references and both DS1 references are corrupted, the system enters holdover mode. In holdover mode, the system clock holds the internal stratum 3 oscillator at the last good timing reference while the DS1 references are repaired. While the system is in holdover mode, the internal system clock controls the timing for all transmitted OC-N and DS3/EC1 signals.

> **Important!** A “Force to Holdover” command issued via the WaveStar CIT is available to put the system into holdover mode during maintenance and repair activities.

DS1 timing outputs

WaveStar BandWidth Manager can supply two derived DS1 timing reference outputs to the office BITS clock. The two DS1 outputs may be derived from a single OC-N line, or each DS1 output may be derived by a separate OC-N line.

> **Important!** Auto-switching for DS1 outputs is not supported.

Timing Reference Frequency Monitoring

All provisioned references are monitored with frequency measurements. A reference signal that measures above 17 ppm is declared failed. A reference signal that measures below 13.8 ppm is cleared.

Provisioning timing references

Before provisioning the timing references, the user must provision the system timing as locked. In R4.1, up to four timing references may be provisioned. The references may included the following:

- One or two external (DS1)
- One or two timing references derived from OC-192 or OC-48 lines

Priority levels

The timing references may be prioritized as 1, 2, 3, or 4 (depending on the number of references provisioned). Priority 1 is the highest level and priority 4 is the lowest. If two external references are provisioned and they are both assigned equal priority levels, and one reference fails, the protection switch is non-revertive. If two external references are provisioned and one is priority level 1 and the other is assigned priority level 2, and the priority 1 reference fails, the protection switch is revertive. (The system will revert back to the priority 1 line when it is restored.) The system will always revert back to the reference with the higher priority whenever possible.

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SDH Synchronization

Overview

This section describes the SDH synchronization and timing features available in WaveStar BandWidth Manager.

Platform synchronization

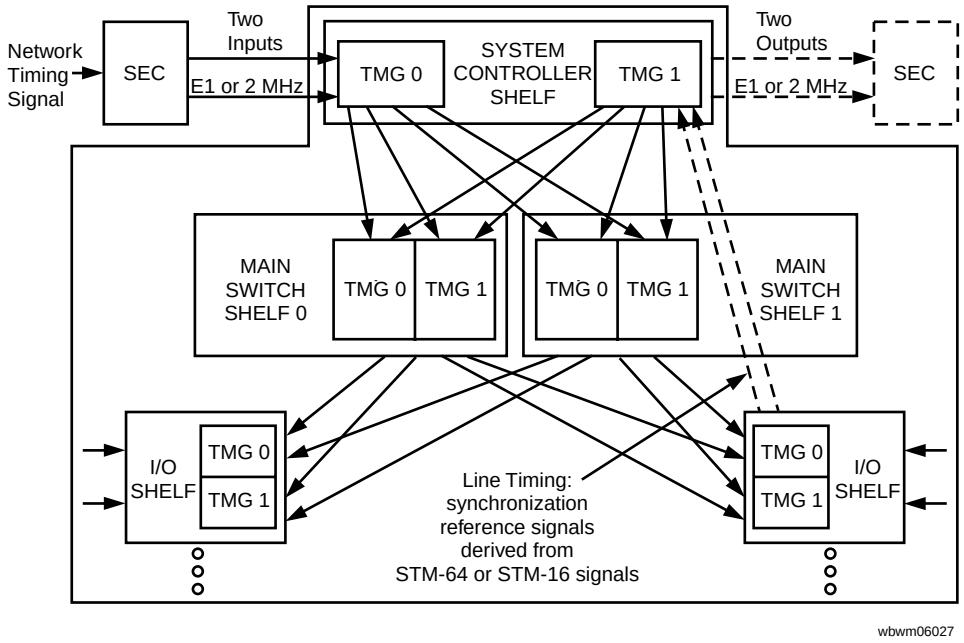
WaveStar BandWidth Manager is primarily timed from duplex TMG/STRAT3 packs located in the System Controller Shelf, which are tied to the SDH Equipment Clock (SEC) via duplicated E1 inputs. The E1 timing ports support 2048 KHz (2MHz), 2048 Kb/s (2 Mb/s) framed, and 2048 Kb/s (2Mb/s) unframed formats, per ITUT G.703, G812, and ETSI DE/TM-3017-4, Vol. 5.

The TMG/STRAT3 packs distribute timing to all shelves in the platform. Because all the shelves in the system (platform) derive their timing from the same initial source, the platform is synchronized.

SDH synchronization architecture

Figure 6-2 illustrates the synchronization architecture in an SDH platform.

Figure 6-2 SDH Synchronization Architecture



System synchronization characteristics

WaveStar BandWidth Manager synchronization characteristics must be provisioned as SONET or SDH (generally, provisioned during installation). The system synchronization behavior (SONET or SDH) defines the

- Clock characteristics
  - Stratum 3: SONET
  - SDH Equipment Clock (SEC): SDH
- Synchronization status messages (SSMs)

If the synchronization characteristics are provisioned as SDH and WaveStar BandWidth Manager receives a SONET SSM, WaveStar BandWidth Manager will ignore the reference associated with that SONET SSM.

> **Important!** The synchronization characteristics are independent of the port characteristics (OC-N or STM-N).

Timing modes

WaveStar BandWidth Manager supports the following timing modes:

- Free running
- Locked (external) timing mode
- Line timing

> **Important!** SSM may be enabled/disabled for each STM-N

Duplicated timing

Every shelf in WaveStar BandWidth Manager is equipped with duplicated TMG/STRAT3 packs for superior reliability. The System Controller Shelf, the Switch Shelves, and the I/O Shelves each contain two TMG/STRAT3 packs that use 1+1, non-revertive protection. TMG 0 (working) is the default-state master timing source and TMG 1 is the protection pack.

> **Important!** The external timing references are protected independently of the TMG/STRAT3 packs. The reference protection is provisionable as non-revertive (default) or revertive (depending on the timing reference priorities).

Timing distribution

Timing is distributed from the TMG/STRAT3 packs in the System Controller Shelf to the TMG/STRAT3 packs in the Switch Shelves and then to TMG/STRAT3 packs in all the I/O Shelves in the platform for synchronization of the transport interfaces.

Outgoing synchronization messaging

WaveStar BandWidth Manager supports outgoing STM-64, STM-16, STM-4, and STM-1 S1 byte synchronization messaging. Synchronization messaging allows WaveStar BandWidth Manager to communicate its synchronization status to other nodes in the network. The synchronization messages are transported via bits 5, 6, 7, and 8 of the S1 byte of the STM-1 signals for system synchronization and interworking. WaveStar BandWidth Manager complies with all ITU-T and ETSI synchronization messaging standards.

Incoming synchronization messaging

WaveStar BandWidth Manager supports incoming STM-64 and STM-16, S1 byte synchronization messaging. Synchronization messaging allows WaveStar BandWidth Manager to receive synchronization status from other nodes in the network. The synchronization messages are transported via bits 5, 6, 7, and 8 of the S1 byte of the STM-N signal for system synchronization and interworking. WaveStar BandWidth Manager complies with all ITU-T and ETSI synchronization messaging standards.

Free running mode

During installation and turn-up, WaveStar BandWidth Manager is designed to operate without an external timing reference (from the SEC) in the free running mode. In the free running mode, the system derives its timing from the highly stable internal oscillator (SEC) located in the TMG/STRAT3 packs in the System Controller Shelf. After the system is operational, the external timing source (the Primary Reference Clock [PRC] or Synchronization Supply Unit [SSU]) is applied to the system and the system enters the locked (external) timing mode.

Important! The internal oscillator complies with ITU-T G.813, Option 1 for SECs with improved stability.

Locked (external) timing mode

In a typical configuration, WaveStar BandWidth Manager is locked to an external reference (E1 or 2 MHz) that is traceable to a PPRC or SSU timing source. The two TMG/STRAT3 packs in the System Controller Shelf accept two synchronization reference input signals from an external source (PRC or SSU). The inputs may be one of the following:

- 2048 KHz (2 MHz)
- E1
  - 2048 Kb/s (2 Mb/s) unframed
  - 2048 Kb/s (2 Mb/s) framed

Important! The external timing references may also be derived from an STM-N signal. The locked mode complies with ITU-T G.703, Section 9 and 13.

Holdover mode

The TMG/STRAT3 circuit packs monitor external timing references for error-free operation. If all provisioned external references are corrupted, the system enters holdover mode. In holdover mode, the system clock holds the internal oscillator at the last good timing reference while the external references are repaired.

Line timing with SSM

The two TMG/STRAT3 packs in the System Controller Shelf can be provisioned to accept synchronization reference signals from two incoming STM-N (STM-16 or STM-64) lines. The two incoming lines must originate from the same I/O Shelf.

WaveStar BandWidth Manager continuously monitors the Synchronization Status Messages (SSMs) that notify the system if a reference signal is acceptable or unacceptable. If a reference signal is unacceptable, the system reconfigures itself to use the next assigned reference source. If no other sources are available, the system enters holdover mode. WaveStar BandWidth Manager supports reference reconfiguration for two E1 inputs and two line timing references, depending on the incoming SSMs.

Holdover mode

If the reference signal becomes either corrupted or unavailable, the TMG/STRAT3 packs revert back to E1 synchronization reference signals. If both E1 references are corrupted, the system enters holdover mode. In holdover mode, the system clock holds the internal oscillator (SEC) at the last good timing reference while the E1 references are repaired.

Incoming/Outgoing SSMs

Standard synchronization status messages (SSMs) are transported on the S1 Byte. The transmission of SSMs on the S1 Byte is required on all STM-64 and STM-16 lines. Incoming SSMs are used to monitor the acceptability of timing references. SSMs are determined according to SDH (ITU-T, ETSI) standards.

Automatic reconfiguration of synchronization mode

WaveStar BandWidth Manager supports the automatic reconfiguration of the synchronization mode based on incoming SSMs. When an incoming SSM is deemed to be unacceptable, the system reconfigures itself to use the next assigned reference signal source. If no other sources are available, or those signals are not an acceptable quality, the system goes enters holdover mode. WaveStar BandWidth Manager supports the automatic reconfiguration of up to two E1 inputs and two line references.

Holdover mode

The TMG/STRAT3 circuit packs monitor the timing references for error-free operation. If the derived reference signal becomes either corrupted or unavailable, the system clock reverts back to E1 synchronization reference signals. If both derive timing references and both E1 references are corrupted, the system enters holdover mode. In holdover mode, the system clock holds the internal oscillator at the last good timing reference while the E1 references are repaired. While the system is in holdover mode, the internal system clock controls the timing for all transmitted STM-N and plesiochronous signals.

Important! A “Force to Holdover” command issued via the WaveStar CIT is available to put the system into holdover mode during maintenance and repair activities.

E1 timing outputs

WaveStar BandWidth Manager can supply two derived E1 timing reference outputs to the SEC. The two outputs may be derived from a single STM-N line, or each output may be derived by a separate STM-N line.

The following outputs can be generated:

- 2048 KHz (2 MHz)
- E1
  - 2048 Kb/s (2 Mb/s) unframed
  - 2048 Kb/s (2 Mb/s) framed

Important! Auto-switching for E1 outputs is not supported.

Timing Reference Frequency Monitoring

All provisioned references are monitored with frequency measurements. A reference signal that measures above 17 ppm is declared failed. A reference signal that measures below 13.8 ppm is cleared.

Provisioning timing references

Before provisioning the timing references, the user must provision the system timing as locked. In R4.1, up to four timing references may be provisioned. The references may included the following:

- One or two external (E1 or 2 MHz)
- One or two timing references derived from STM-16 or STM-64 lines

Priority levels

The timing references may be prioritized as 1, 2, 3, or 4 (depending on the number of references provisioned). Priority 1 is the highest level and priority 4 is the lowest. If two external references are provisioned and they are both assigned equal priority levels, and one reference fails, the protection switch is non-revertive. If two external references are provisioned and one is priority level 1 and the other is assigned priority level 2, and the priority 1 reference fails, the protection switch is revertive. (The system will revert back to the priority 1 line when it is restored.) The system will always revert back to the reference with the higher priority whenever possible.

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Floor Plan Layouts

Overview

This section illustrates the space needed to assemble the WaveStar BandWidth Manager 4608/1536 platform.

> **Important!** In Release 4.1, the WaveStar BandWidth Manager 4608/1536 platform supports a maximum of 48 SWIF pairs, which may be located in a combination of Universal I/O Shelves, SDH Universal I/O Shelves, and/or 10G I/O Shelves.
> The WaveStar BandWidth Manager 4608/1536 platform supports a maximum of 36 I/O Shelves with a maximum of 48 SWIF pairs.

Reduced cabling

The standard and reduced floor plan layouts illustrated in this chapter assume the availability of the reduced cabling. The reduced cabling kits are documented in the following drawings:

- ED9C280-11 Cable Assembly Kit for Reduced Footprints
- ED9C280-12 Cable Assembly Kit for Standard Footprints
- ED9C280-13 Cable Assembly Kit for Reduced Footprints with the cable racking greater than 11.5 ft/3.5 m above the floor or for raised-floor platforms with cable-rack depths of greater than 1 ft/305 mm

> **Important!** All cabling kits listed above are available as of July 1, 2001.

Raised-floor platforms

If you wish to engineer your floor plan as a raised-floor platform, you must select one of the following ETSI floor plans, even for a NEBS system:

- 2-bay Control/Switch Complex
  - 3-aisle Standard Footprint FPD 801-802-001-32 (Figure 6-12)
  - 4-aisle Standard Footprint FPD 801-802-001-33 (Figure 6-13)
  - 3-aisle Reduced Footprint FPD 801-802-001-21 (Figure 6-8)
  - 4-aisle Reduced Footprint FPD 801-802-001-19 (Figure 6-9)
- 3-bay Control/Switch Complex
  - 3-aisle Standard Footprint FPD 801-802-001-24 (Figure 6-16)
  - 4-aisle Standard Footprint FPD 801-802-001-25 (Figure 6-17)

Contact your Account Executive for more information about these ETSI floor plans.

> **Important!** All raised-floor platforms must be carefully engineered by the customer to account for the floor tiles in the central office. Cabinet spacers are available.

System footprint

WaveStar BandWidth Manager complies with the following requirements for standard foot bay areas, floor loading, and support requirements:

- SONET
  - Telcordia Technologies' Network Equipment Building System (NEBS)
  - AT&T's Network Equipment Design System (NEDS)
- SDH: ETSI 300 119-2, January 1994

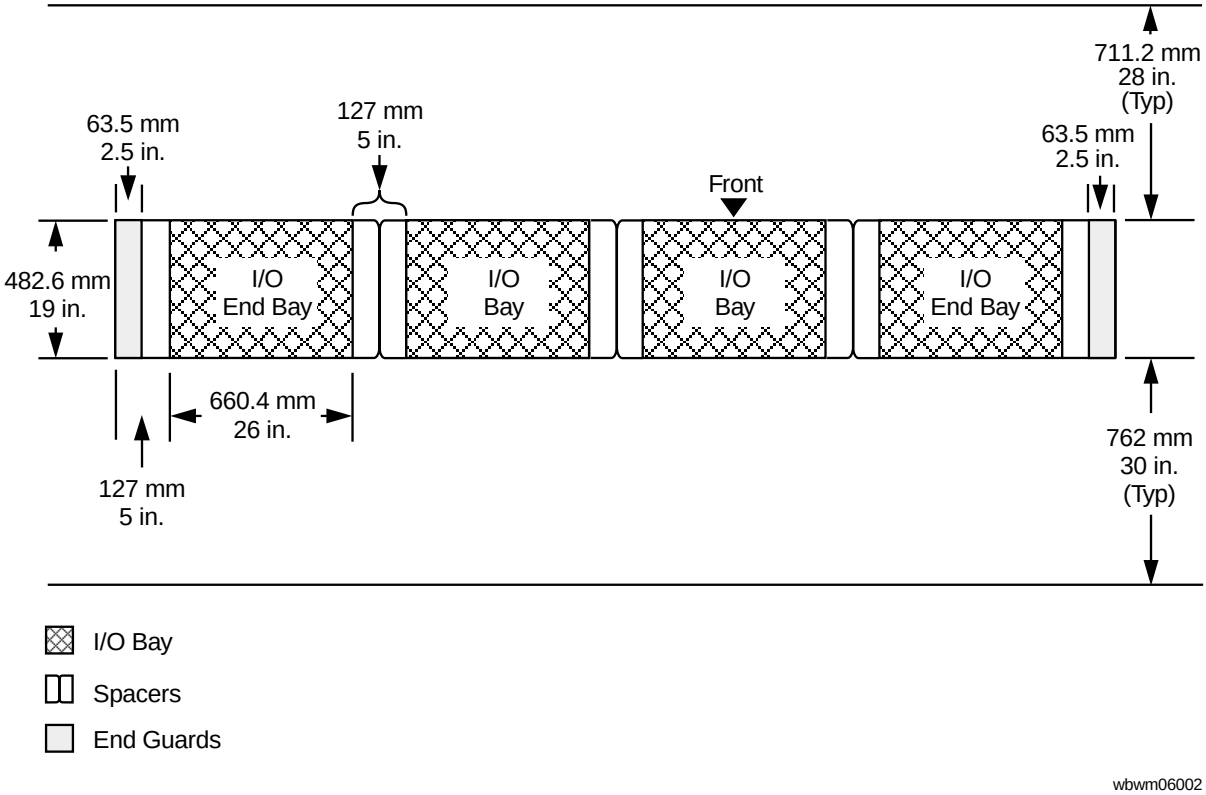
Front and rear access

Front access is required for maintenance and operations activities. Rear access is required for shelf additions and for upgrades that require rearranging cables.

NEBS

Figure 6-3 illustrates the space typically required for front and rear access to the NEBS bays.

Figure 6-3 Front and Rear Access to NEBS Bays (Standard and Reduced Footprints)

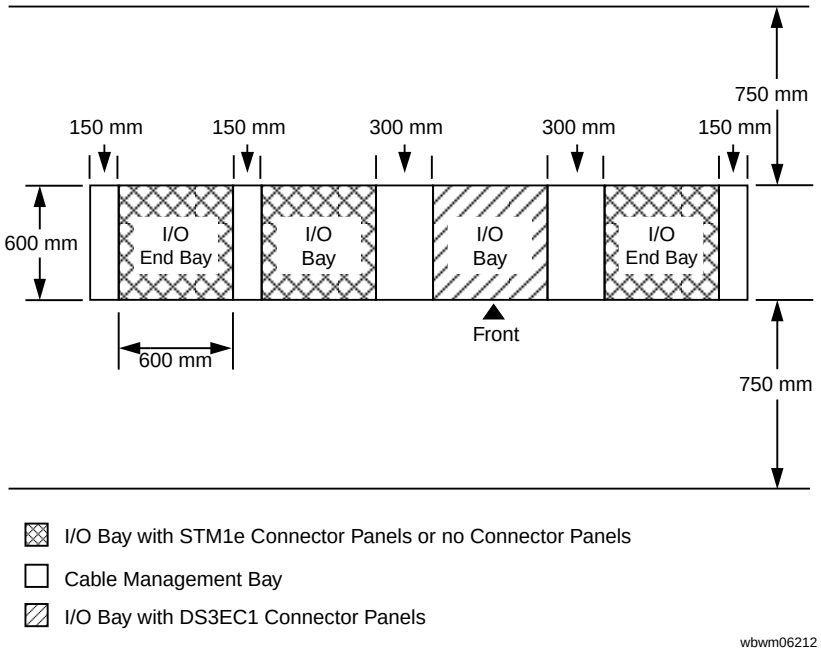


ETSI

Figure 6-4 (reduced footprints) illustrate the space typically required for front and rear access to the ETSI bays.

Important! The cable management bays in ETSI I/O Complexes (reduced footprints) vary in size depending on the type of connector panels on the I/O Shelves in the adjacent I/O Bays.

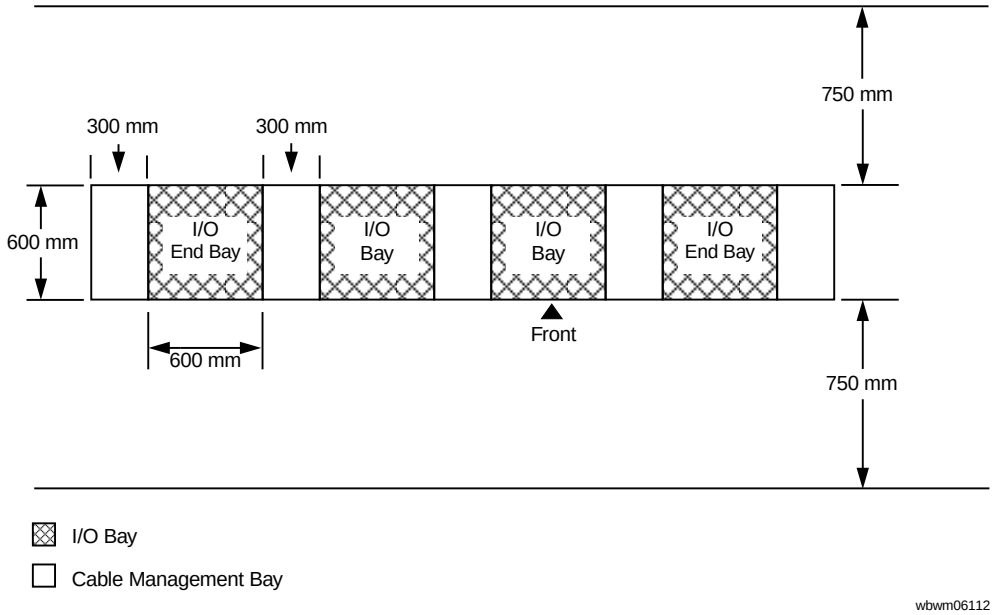
Figure 6-4 Front and Rear Access to ETSI Bays (Reduced Footprints)



Important! The cable management bays between or adjacent to I/O Bays with STM1e Connector Panels or no connector panels are 150 mm wide. The cable management bays between or adjacent to I/O Bays with DS3EC1 Connector Panels are 300 mm wide. For example, a single 300 mm cable management bay between an I/O bay with DS3EC1 Connector Panels and an I/O Bay with no connector panels is sufficient.
For example, an I/O Bay with a single DS3EC1 Connector Panel on the right side of the bay only requires one 300 mm wide cable management bay on the right side of the bay. The cable management on the left side of the bay should be 150 mm wide.

Figure 6-5 (standard footprints) illustrate the space typically required for front and rear access to the ETSI bays.

Figure 6-5 Front and Rear Access to ETSI Bays (Standard Footprints)



2-Bay Control/Switch Complex Reduced-Footprint Floor Plan Layouts

Overview

This section illustrates the reduced footprint floor plan layouts for the 2-bay Control/Switch Complexes. These floor plans and the required ED9C280-11 Cable Assembly Kit are available as of July 1, 2001.

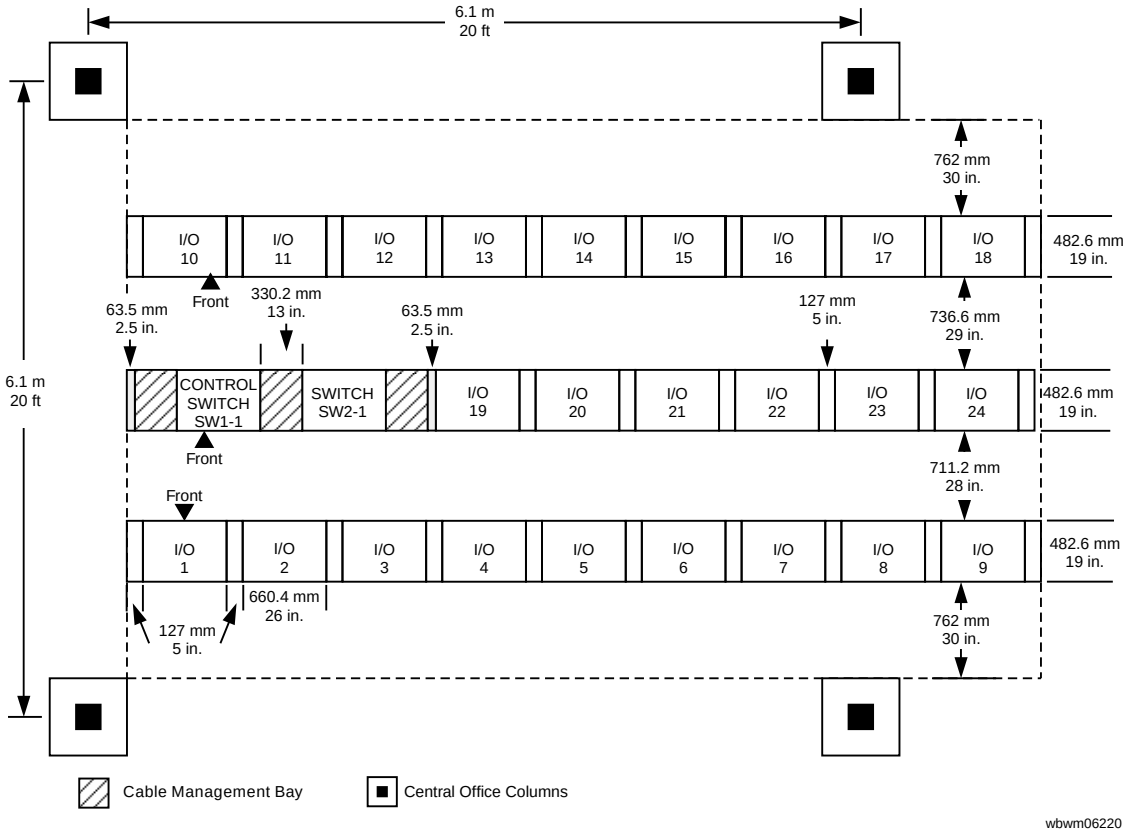
Contact for Account Executive for more information.

NEBS This section illustrates the 3-aisle and 4-aisle reduced-footprint floor plan layouts for NEBS 2-bay Control/Switch Complexes.

3-aisle

Figure 6-6 illustrates the typical 3-aisle arrangement with 24 I/O Bays for a 4608/1536 platform with a NEBS reduced-footprint 2-Bay Control/Switch Complex. Cabling information is available in ED9C280-11 Cable Assembly Kit for reduced footprints.

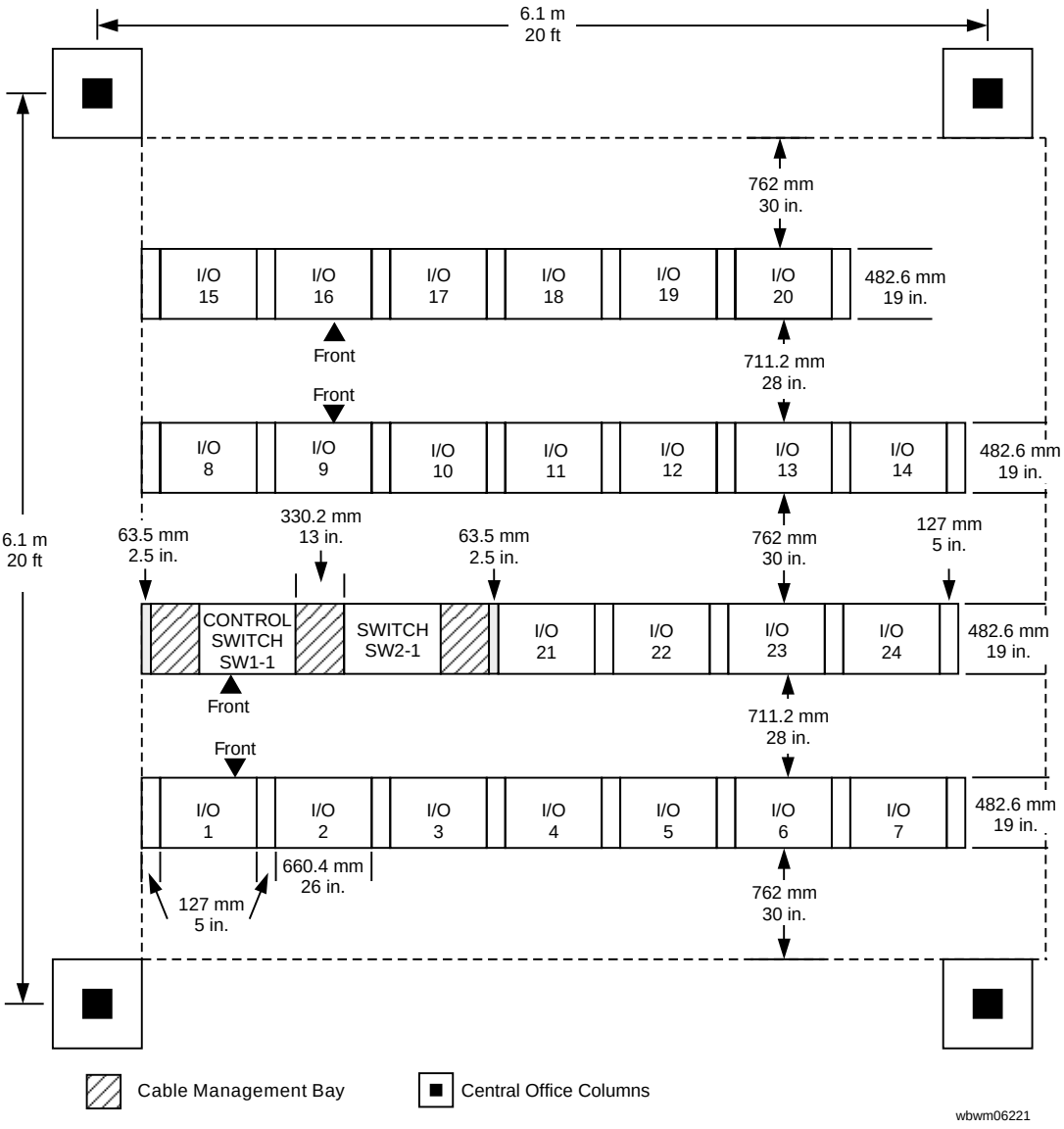
Figure 6-6 3-Aisle Reduced-Footprint Floor Plan Layout for a NEBS 2-Bay Control/Switch Complex (FPD 801-802-001-17)



4-aisle

Figure 6-7 illustrates the typical 4-aisle arrangement with 24 I/O Bays for a 4608/1536 platform with a NEBS reduced-footprint 2-Bay Control/Switch Complex. Cabling information is available in ED9C280-11 Cable Assembly Kit for reduced footprints.

Figure 6-7 4-Aisle Reduced-Footprint Floor Plan Layout for a NEBS 2-Bay Control/Switch Complex (FPD 801-802-001-15)

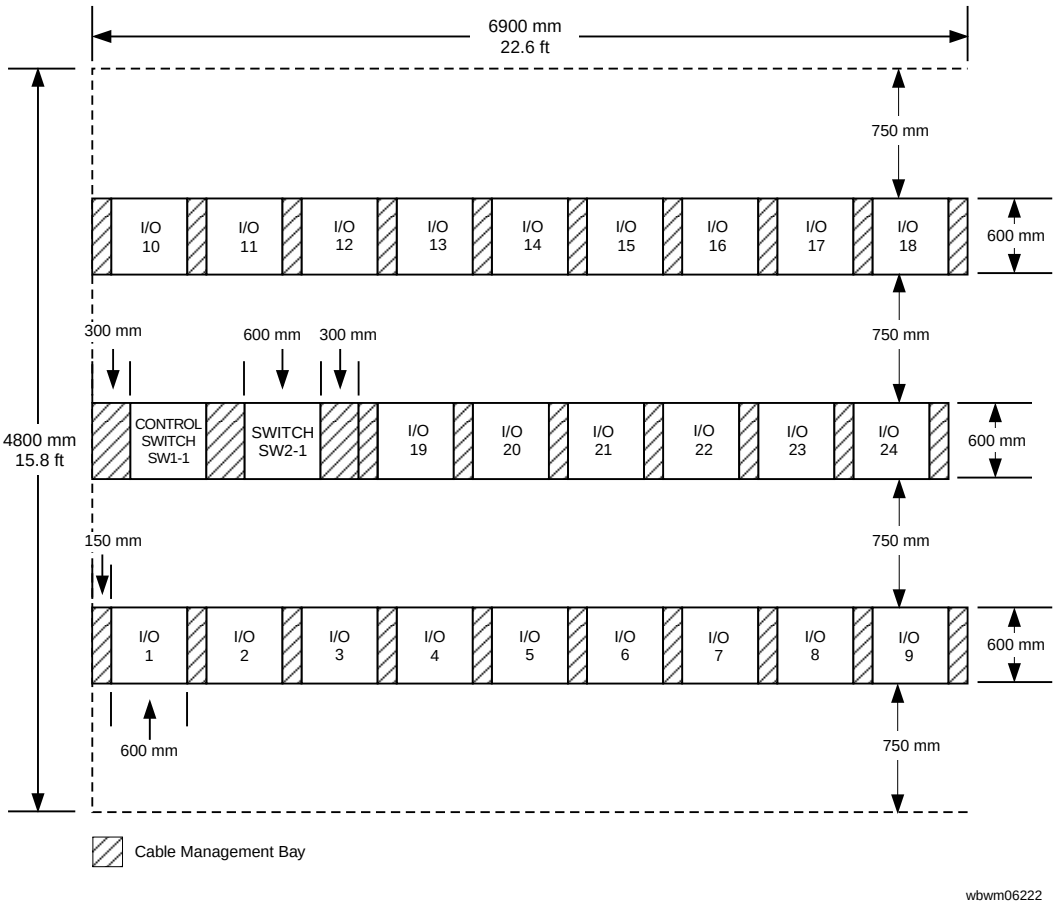


ETSI This section illustrates the 3-aisle and 4-aisle reduced-footprint floor plan layouts for ETSI 2-bay Control/Switch Complexes.

3-aisle

Figure 6-8 illustrates the typical 3-aisle arrangement with 24 I/O Bays for a 4608/1536 platform with an ETSI reduced-footprint 2-bay Control/Switch Complex. Cabling information is available in ED9C280-11 Cable Assembly Kit for reduced footprints.

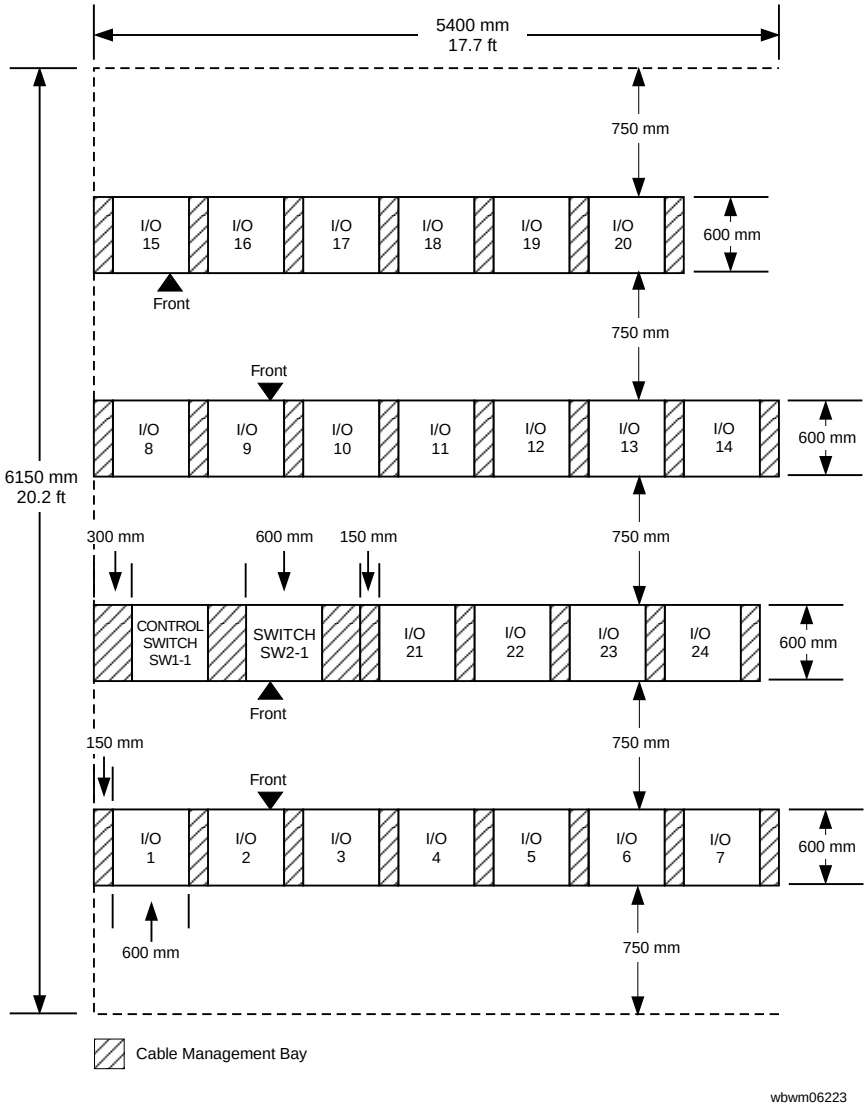
Figure 6-8 3-Aisle Reduced-Footprint Floor Plan Layout for an ETSI 2-Bay Control/Switch Complex (FPD 801-802-001-21)



4-aisle

Figure 6-9 illustrates the typical 4-aisle arrangement with 24 I/O Bays for a 4608/1536 platform with an ETSI reduced-footprint 2-Bay Control/Switch Complex. Cabling information is available in ED9C280-11 Cable Assembly Kit for reduced footprints.

Figure 6-9 4-Aisle Reduced-Footprint Floor Plan Layout for an ETSI 2-Bay Control/Switch Complex (FPD 801-802-001-19)



2-Bay Control/Switch Complex Standard-Footprint Floor Plan Layouts

Overview This section illustrates the standard footprint floor plan layouts for the 2-bay Control/Switch Complexes. These floor plans require the ED9C280-12 Cable Assembly Kit.

Important! As of June 1, 2002, the standard footprint and these floor plans will be Discontinued Availability (DA).

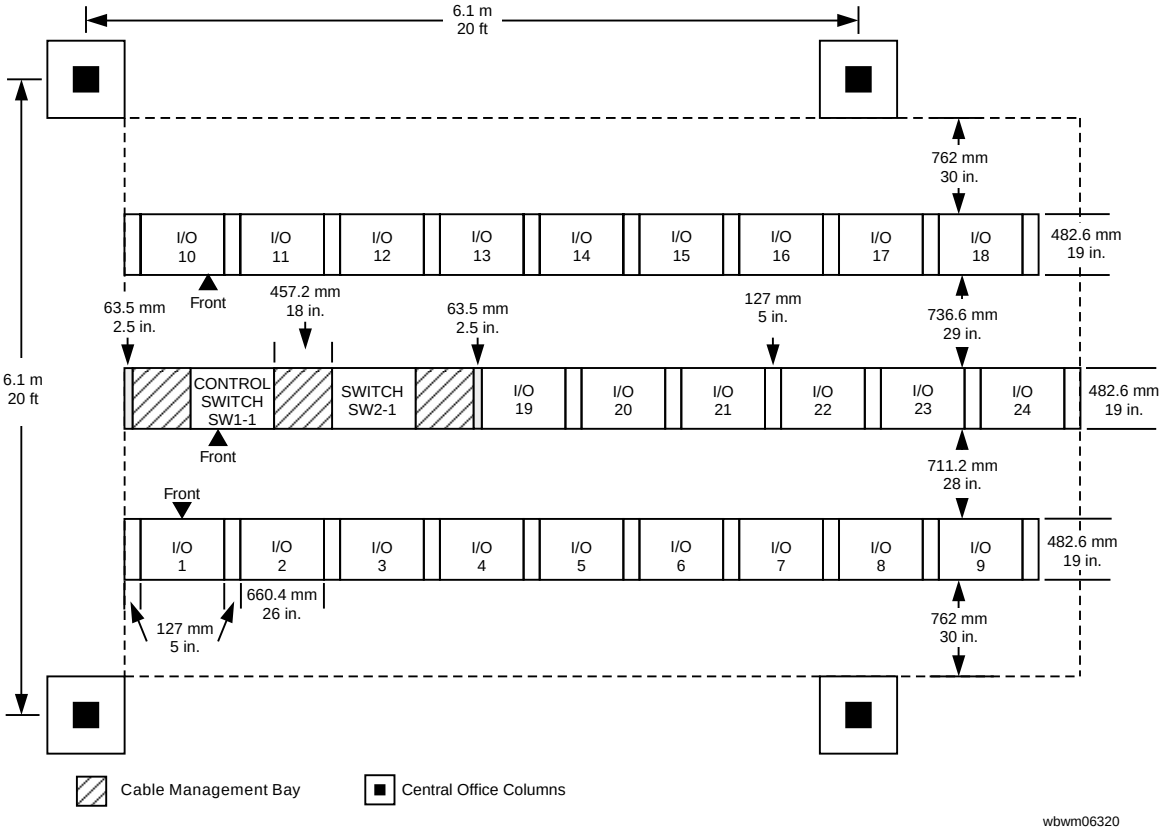
Contact for Account Executive for more information.

NEBS This section illustrates the 3-aisle and 4-aisle standard-footprint floor plan layouts for NEBS 2-bay Control/Switch Complexes.

3-aisle

Figure 6-10 illustrates the typical 3-aisle arrangement with 24 I/O Bays for a 4608/1536 platform with a NEBS 2-Bay Control/Switch Complex. Cabling information is available in ED9C280-12 Cable Assembly Kit for standard footprints.

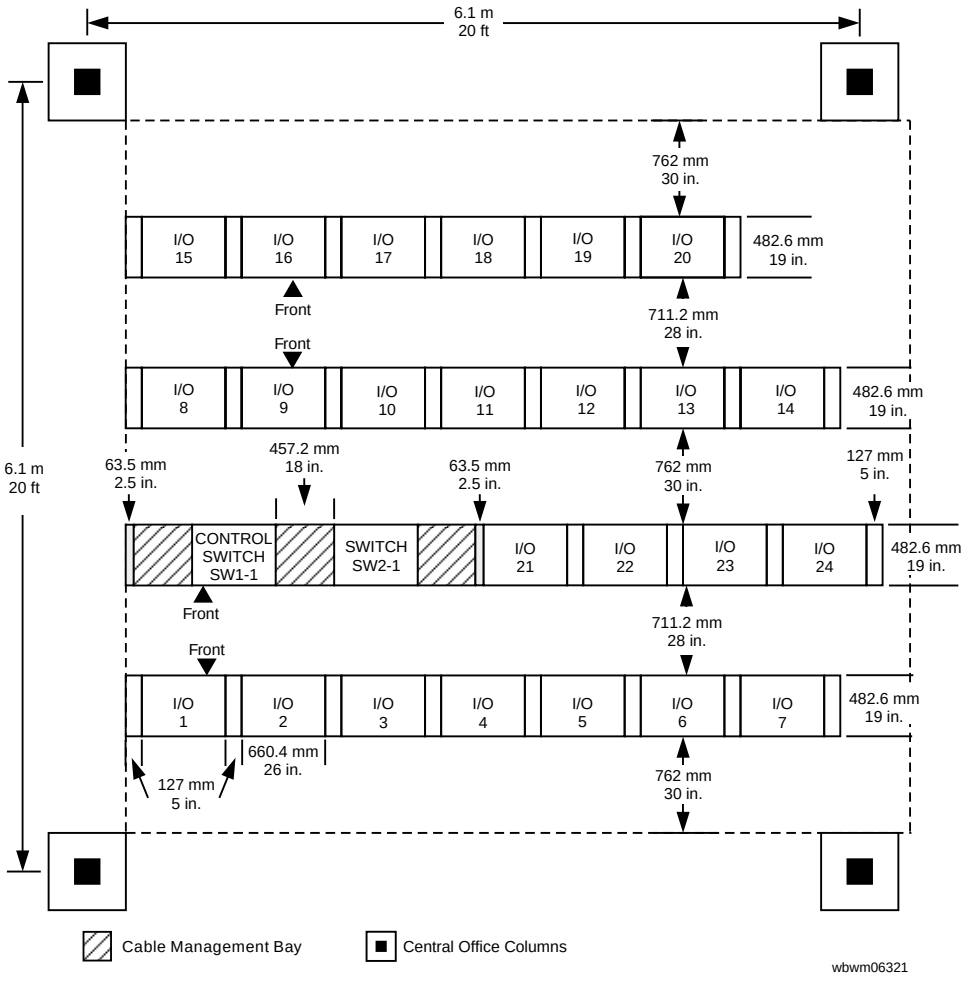
Figure 6-10 3-Aisle Standard Floor Plan Layout for a NEBS 2-Bay Control/Switch Complex (FPD 801-802-001-30)



4-aisle

Figure 6-11 illustrates the typical 4-aisle arrangement with 24 I/O Bays for a 4608/1536 platform with a NEBS 2-Bay Control/Switch Complex. Cabling information is available in ED9C280-12 Cable Assembly Kit for standard footprints.

Figure 6-11 4-Aisle Standard Floor Plan Layout for a NEBS 2-Bay Control/Switch Complex (FPD 801-802-001-31)

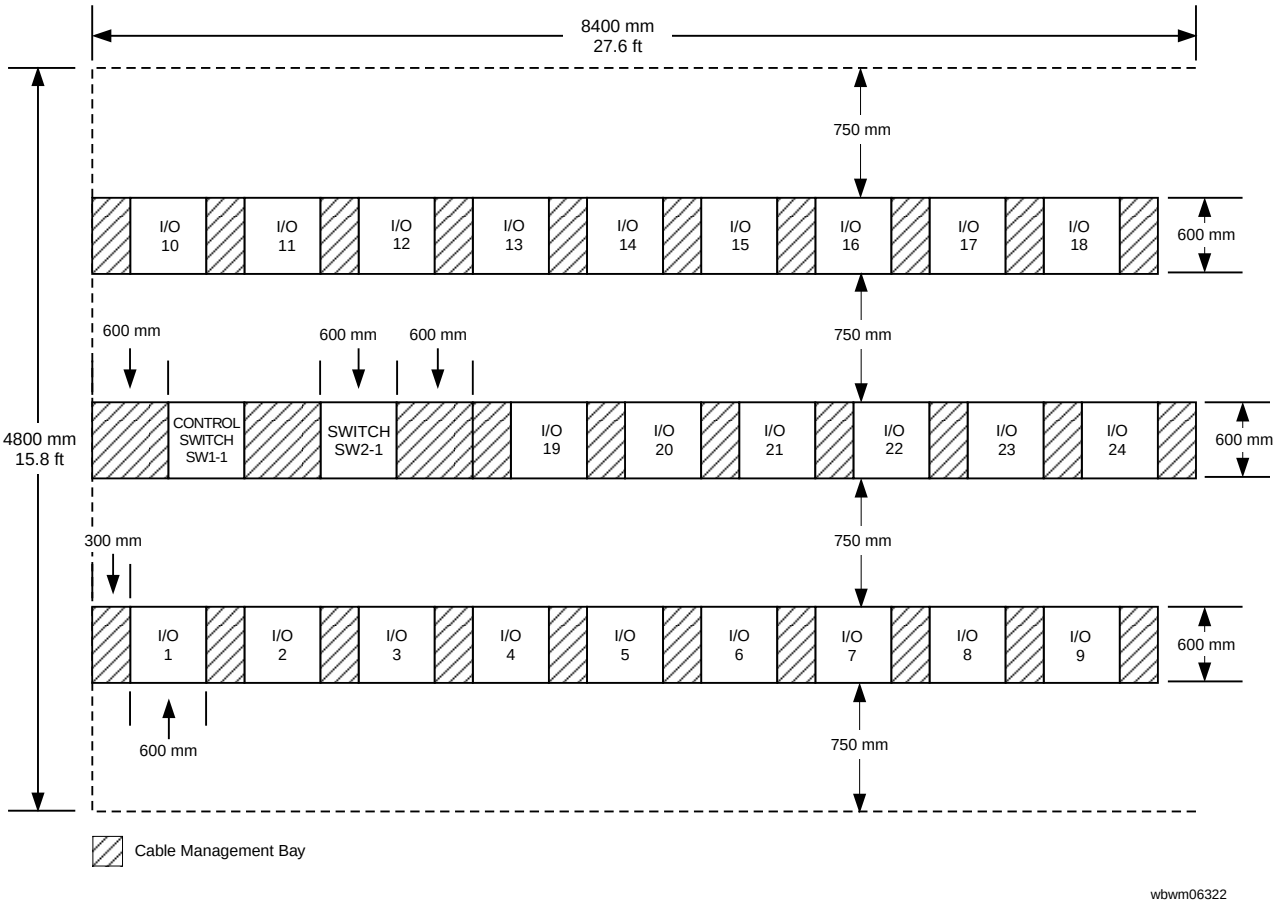


ETSI This section illustrates the 3-aisle and 4-aisle standard-footprint floor plan layouts for ETSI 2-bay Control/Switch Complexes.

3-aisle

Figure 6-12 illustrates the typical 3-aisle arrangement with 24 I/O Bays for a 4608/1536 platform with an ETSI 2-Bay Control/Switch Complex. Cabling information is available in ED9C280-12 Cable Assembly Kit for standard footprints.

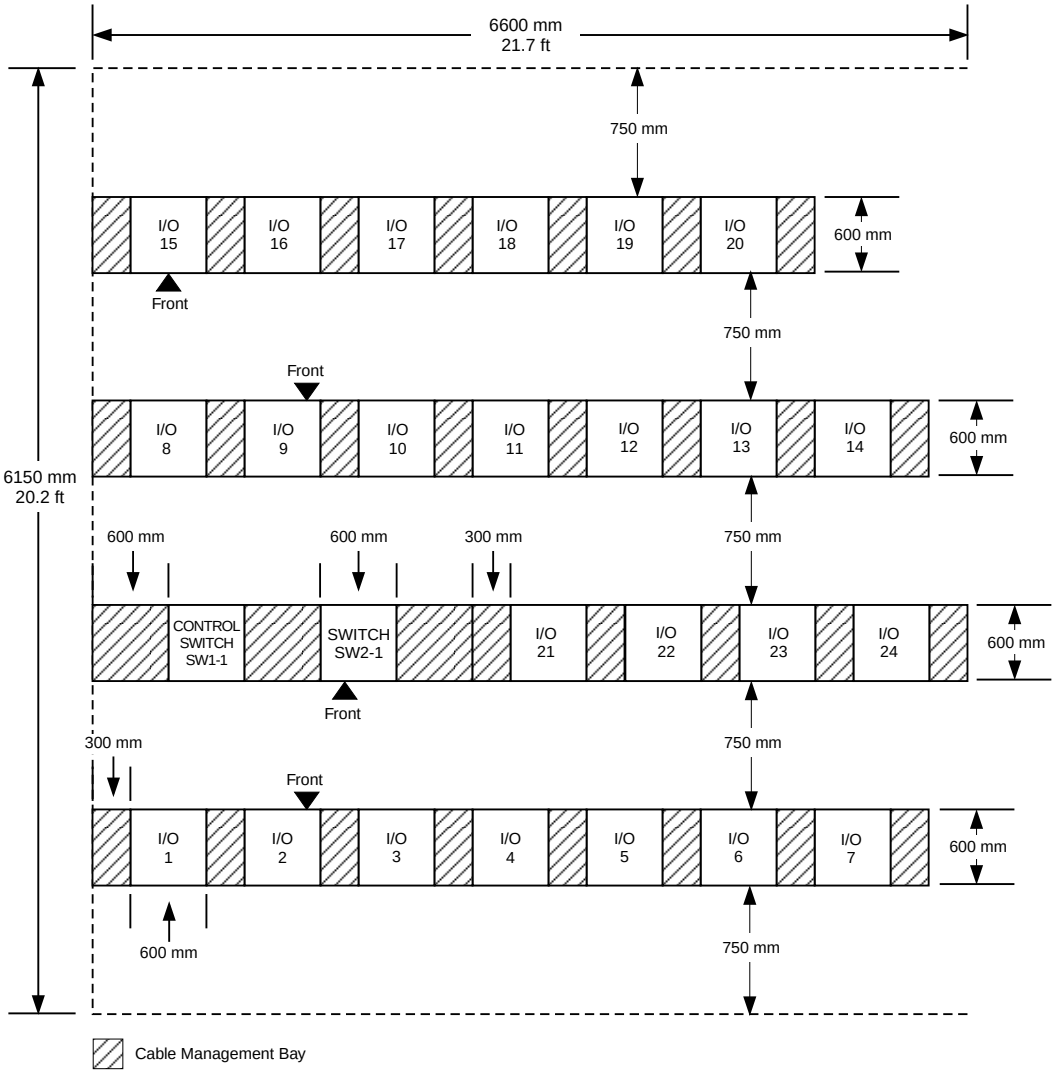
Figure 6-12 3-Aisle Floor Plan Layout for an ETSI 2-Bay Control/Switch Complex (FPD 801-802-001-32)



4-aisle

Figure 6-13 illustrates the typical 4-aisle arrangement with 24 I/O Bays for a 4608/1536 platform with an ETSI 2-Bay Control/Switch Complex. Cabling information is available in ED9C280-12 Cable Assembly Kit for standard footprints.

Figure 6-13 4-Aisle Standard Floor Plan Layout for an ETSI 2-Bay Control/Switch Complex (FPD 801-802-001-33)



3-Bay Control/Switch Complex Standard-Footprint Floor Plan Layouts

Overview This section illustrates the standard footprint floor plan layouts for the 3-bay Control/Switch Complexes. These floor plans require the ED9C280-12 Cable Assembly Kit.

Important! As of April 1, 2002, the 3-bay Control/Switch Complexes and these floor plans will be Discontinued Availability (DA).

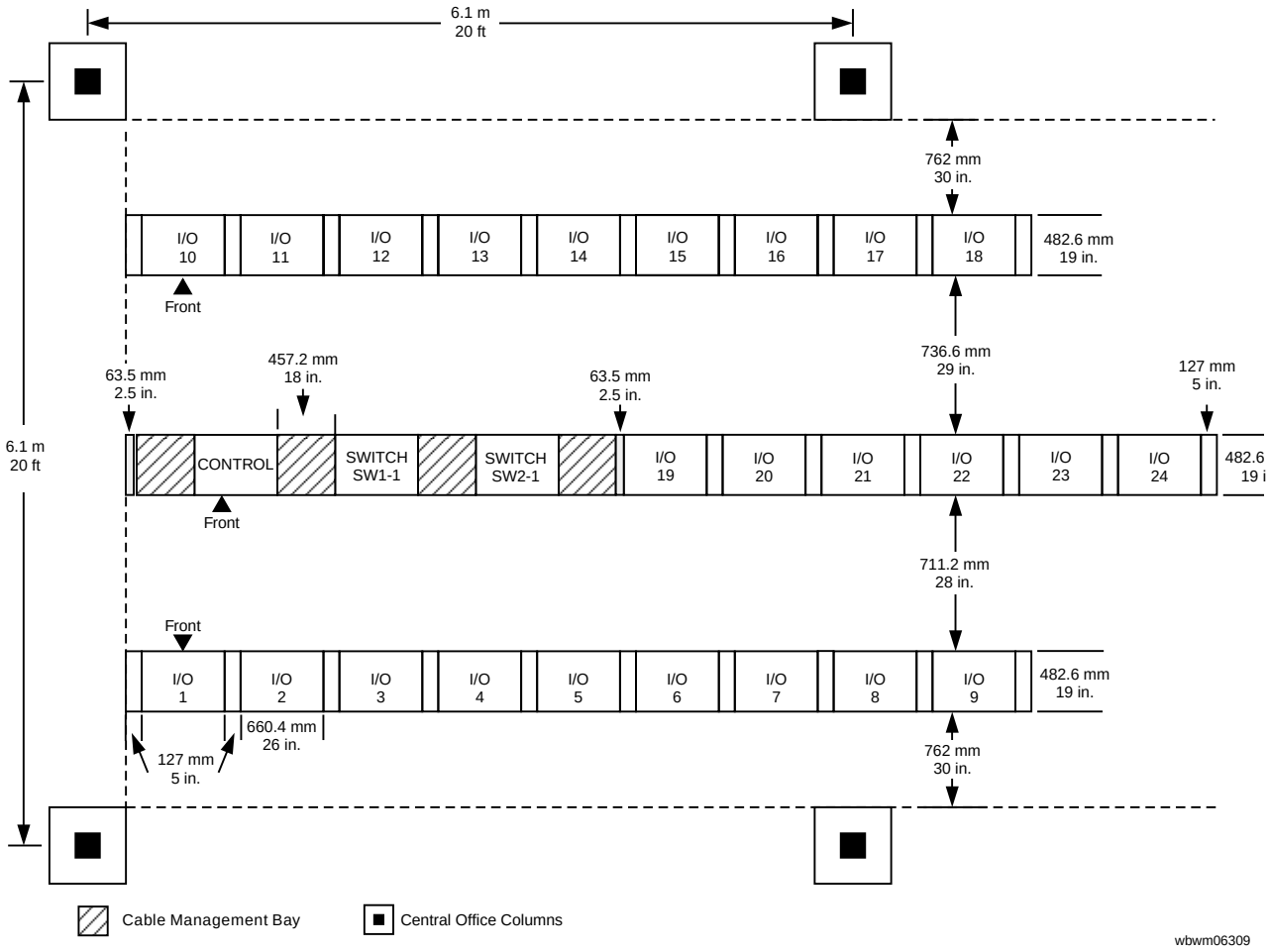
Contact for Account Executive for more information.

NEBS This section illustrates the 3-aisle and 4-aisle standard-footprint floor plan layouts for NEBS 3-bay Control/Switch Complexes.

3-aisle

Figure 6-14 illustrates the typical 3-aisle arrangement with 24 I/O Bays for a 4608/1536 platform with a NEBS 3-Bay Control/Switch Complex. Cabling information is available in ED9C280-12 Cable Assembly Kit for standard footprints.

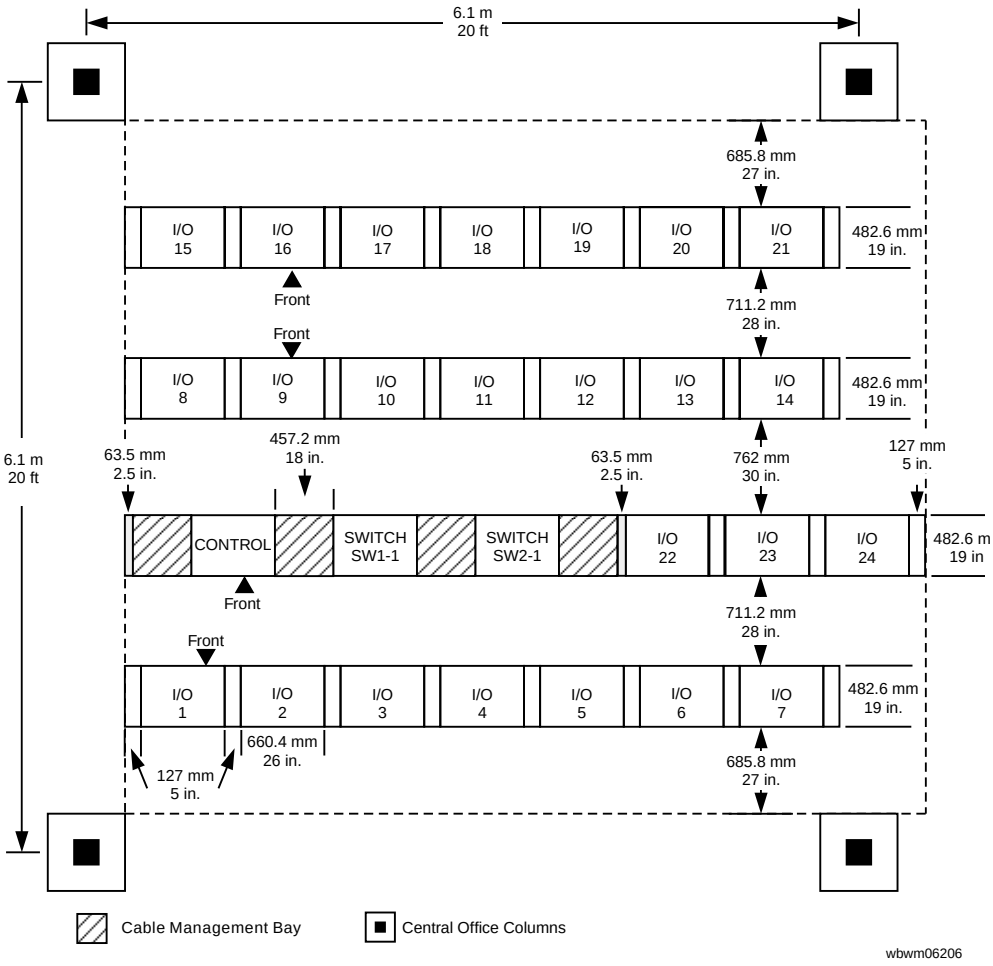
Figure 6-14 3-Aisle Standard Floor Plan Layout for a NEBS 3-Bay Control/Switch Complex (FPD 801-802-001-22)



4-aisle

Figure 6-15 illustrates the typical 4-aisle arrangement with 24 I/O Bays for a 4608/1536 platform with a NEBS 3-Bay Control/Switch Complex. Cabling information is available in ED9C280-12 Cable Assembly Kit for standard footprints.

Figure 6-15 4-Aisle Standard Floor Plan Layout for a NEBS 3-Bay Control/Switch Complex (FPD 801-802-001-23)

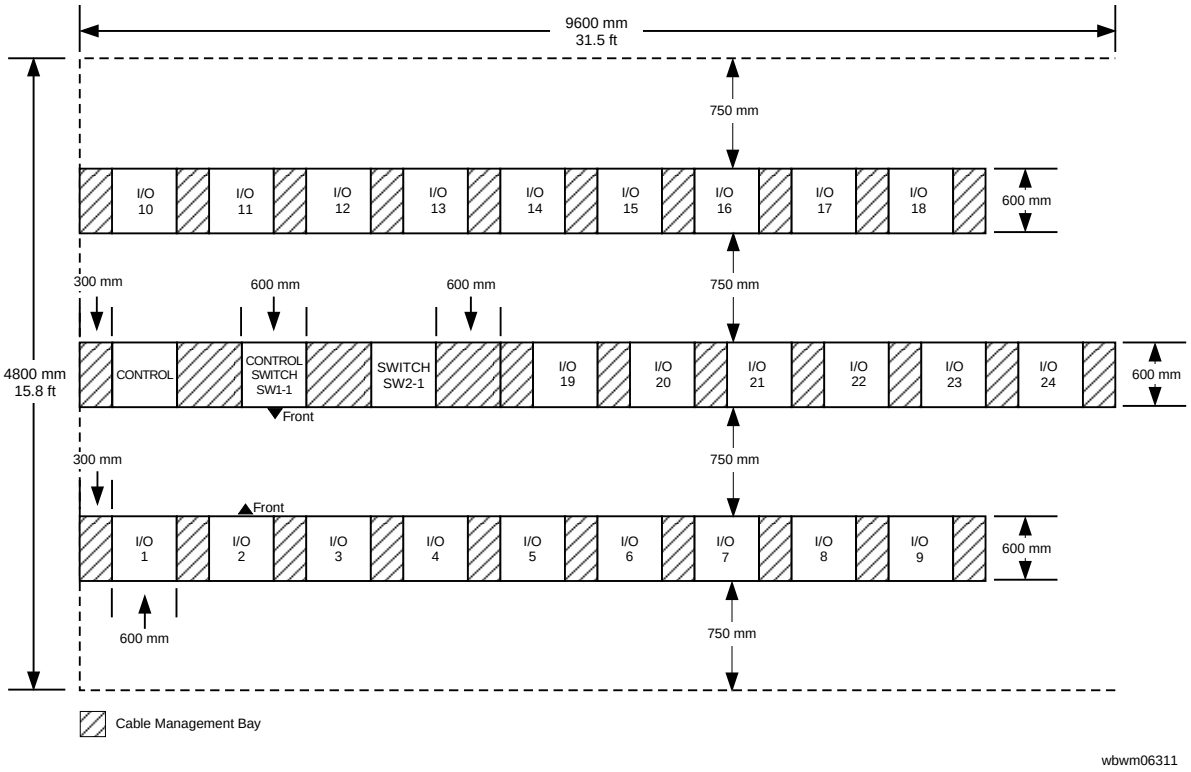


ETSI This section illustrates the 3-aisle and 4-aisle standard-footprint floor plan layouts for ETSI 3-bay Control/Switch Complexes.

3-aisle

Figure 6-16 illustrates the typical 3-aisle arrangement with 24 I/O Bays for a 4608/1536 platform with an ETSI 3-Bay Control/Switch Complex. Cabling information is available in ED9C280-12 Cable Assembly Kit for standard footprints.

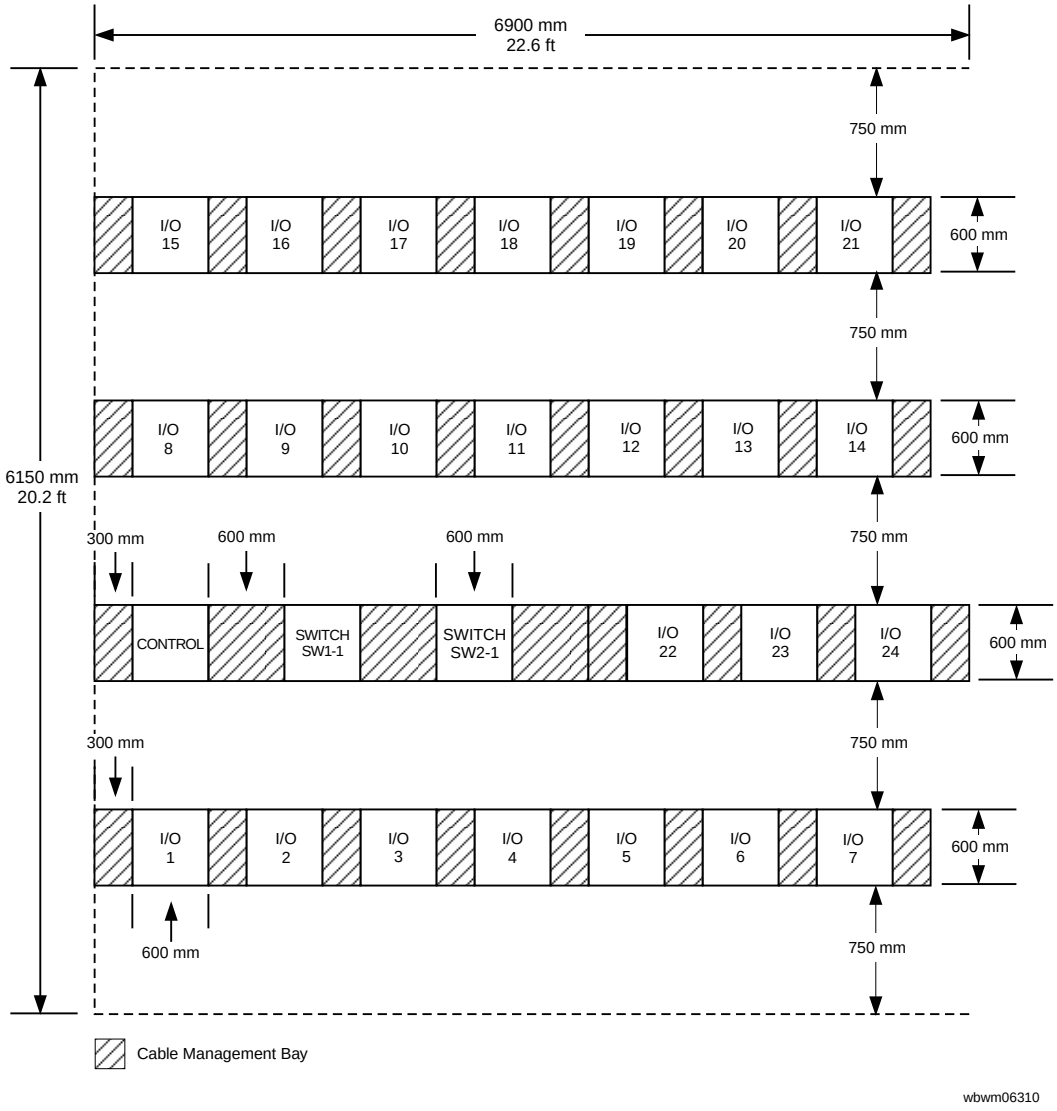
Figure 6-16 3-Aisle Standard Floor Plan Layout for an ETSI 3-Bay Control/Switch Complex (FPD 801-802-001-24)



4-aisle

Figure 6-17 illustrates the typical 4-aisle arrangement with 24 I/O Bays for a 4608/1536 platform with an ETSI 3-bay Control/Switch Complex. Cabling information is available in ED9C280-12 Cable Assembly Kit for standard footprints.

Figure 6-17 4-Aisle Standard Floor Plan Layout for an ETSI 3-Bay Control/Switch Complex (FPD 801-802-001-25)



SWIF Capacity

Overview

Use the information in this section to determine the number of SWIF pairs needed to support the capacity of the associated modules. Each SWIF pair can drop 96 STS-1/32 STM-1 equivalents to the switch fabric.

OC192/STM64 Optical Module SWIFs

Because the OC192/STM64 Optical Modules can terminate 2-fiber or 4-fiber OC-192 BLSRs/STM-64 MS-SPRings with protection access, both the service and protection capacities may be considered in the number of associated SWIF pairs.

One 4-fiber OC-192 BLSR carries 384 STS-1 equivalents of service capacity and 384 STS-1 equivalents of protection capacity.
One 2-fiber OC-192 BLSR carries 192 STS-1 equivalents of service capacity and 192 STS-1 equivalents of protection capacity.

One 4-fiber STM-64 MS-SPRing carries 128 STM-1 equivalents of service capacity and 128 STM-1 equivalents of protection capacity.
One 2-fiber STM-64 MS-SPRing carries 64 STM-1 equivalents of service capacity and 64 STM-1 equivalents of protection capacity.

> **Important!** Capacity on a BLSR/MS-SPRing that is not dropped to the main switch fabric can be through-connected or cross-connected directly on the shelf via the SWITCH/STS768 circuit packs.

Four SWIF pairs

An OC192/STM64 Optical Module equipped with four OC192/STM64 port units can terminate one 4-fiber or two 2-fiber OC-192 BLSRs/STM-64 MS-SPRings. Since four SWIF pairs can drop 384 STS-1/128 STM-1 equivalents to the switch, either all service capacity, all protection capacity, or a combination of service and protection capacity totaling 384 STS-1/128 STM-1 equivalents can be dropped to the main switch fabric.

An OC192/STM64 Optical Module equipped with two OC192/STM64 port units can terminate one 2-fiber OC-192 BLSR/STM-64 MS-SPRing. As an end terminal on an open ring, an OC192/STM64 Optical Module equipped with two OC192/STM64 port units can terminate one 4-fiber OC-192 BLSR/STM-64 MS-SPRing (open). Since four SWIF pairs can drop 384 STS-1/128 STM-1 equivalents to the switch, all service and protection capacity totaling 384 STS-1/128 STM-1 equivalents can be dropped to the main switch fabric.

An OC192/STM64 Optical Module equipped with four SWIF pairs may be dropping 384 STS-1/128 STM-1 equivalents of service capacity from either two unprotected port units or four 1+1 protected port units (two working, two protection).

Three SWIF pairs

An OC192/STM64 Optical Module equipped with four OC192/STM64 port units can terminate one 4-fiber or two 2-fiber OC-192 BLSRs/128 STM-1. Since three SWIF pairs can drop 288 STS-1/96 STM-1 equivalents to the switch, a combination of service and protection capacity totaling 288 STS-1/96 STM-1 equivalents can be dropped to the main switch fabric.

An OC192/STM64 Optical Module equipped with two OC192/STM64 port units can terminate one 2-fiber OC-192 BLSR/STM-64 MS-SPRing. As an end terminal on an open ring, an OC192/STM64 Optical Module equipped with two OC192/STM64 port units can terminate one 4-fiber OC-192 BLSR/STM-64 MS-SPRing (open). Since three SWIF pairs can drop 288 STS-1/96 STM-1 equivalents to the switch, a combination of service and protection capacity totaling 288 STS-1/96 STM-1 equivalents can be dropped to the main switch fabric.

Two SWIF pairs

An OC192/STM64 Optical Module equipped with four OC192/STM64 port units can terminate one 4-fiber or two 2-fiber OC-192 BLSRs. Since two SWIF pairs can drop 192 STS-1/64 STM-1 equivalents to the switch, a combination of service and protection capacity totaling 192 STS-1/64 STM-1 equivalents can be dropped to the main switch fabric.

An OC192/STM64 Optical Module equipped with two OC192/STM64 port units can terminate one 2-fiber OC-192 BLSR/STM-64 MS-SPRing As an end terminal on an open ring, an OC192/STM64 Optical Module equipped with two OC192/STM64 port units can terminate one 4-fiber OC-192 BLSR/STM-64 MS-SPRing (open).

Since two SWIF pairs can drop 192 STS-1/64 STM-1 equivalents to the switch, either all service capacity, all protection capacity, or a combination of service and protection capacity totaling 192 STS-1/64 STM-1 equivalents can be dropped to the main switch fabric.

An OC192/STM64 Optical Module equipped with two SWIF pairs may be dropping 192 STS-1/64 STM-1 equivalents of service capacity from either one unprotected port unit or two 1+1 protected port units (one working, one protection)

One SWIF pair

An OC192/STM64 Optical Module equipped with four OC192/STM64 port units can terminate one 4-fiber or two 2-fiber OC-192 BLSRs. Since one SWIF pair can drop 96 STS-1/32 STM-1 equivalents to the switch, a combination of service and protection capacity totaling 96 STS-1/32 STM-1 equivalents can be dropped to the main switch fabric.

An OC192/STM64 Optical Module equipped with two OC192/STM64 port units can terminate one 2-fiber OC-192 BLSR/STM-64 MS-SPRing As an end terminal on an open ring, an OC192/STM64 Optical Module equipped with two OC192/STM64 port units can terminate one 4-fiber OC-192 BLSR/STM-64 MS-SPRing (open). Since one SWIF pair can drop 96 STS-1/32 STM-1 equivalents to the switch, a combination of service and protection capacity totaling 96 STS-1/32 STM-1 equivalents can be dropped to the main switch fabric.

OC48/STM16 Optical Module SWIFs

Because the OC48/STM16 Optical Modules can terminate 2-fiber and 4-fiber OC-48 BLSRs/STM-16 MS-SPRings with protection access, both the service and protection capacities may be considered in the number of associated SWIF packs.

One 4-fiber OC-48 BLSR carries 96 STS-1 equivalents of service capacity and 96 STS-1 equivalents of protection capacity.
One 2-fiber OC-48 BLSR carries 48 STS-1 equivalents of service capacity and 48 STS-1 equivalents of protection capacity.
One 4-fiber STM-16 MS-SPRing carries 32 STM-1 equivalents of service capacity and 32 STM-1 equivalents of protection capacity.
One 2-fiber STM-16 MS-SPRing carries 16 STM-1 equivalents of service capacity and 16 STM-1 equivalents of protection capacity.

> **Important!** Capacity on a BLSR/MS-SPRing that is not dropped to the main switch fabric can be through-connected or cross-connected directly on the shelf via the SWITCH/STS576 circuit packs.

Two SWIF pairs

An OC48/STM16 Optical Module equipped with eight OC48/STM16 port units can physically terminate either four 2-fiber OC-48 BLSRs/STM-16 MS-SPRings or two 4-fiber OC-48 BLSRs/STM-16 MS-SPRings (service and protection capacities equal 384 STS-1/128 STM-1 equivalents).

However, the maximum capacity that two SWIF pairs can drop to the switch is 192 STS-1/64 STM-1 equivalents. Therefore, any combination of service and protection capacity that totals ≤192 STS-1/64 STM-1 equivalents can be dropped to the main switch fabric.

An OC48/STM16 Optical Module equipped with four OC48/STM16 port units can terminate one 4-fiber or two 2-fiber OC-48 BLSRs. Since two SWIF pairs can drop 192 STS-1/64 STM-1 equivalents to the switch, all service and protection capacity can be dropped to the main switch fabric.

An OC48/STM16 Optical Module equipped with two SWIF pairs may be dropping 192 STS-1/64 STM-1 equivalents of service capacity to the main switch fabric from either four unprotected OC48/STM16 port units or eight 1+1 protected port units (four working, four protection).

One SWIF pair

An OC48/STM16 Optical Module equipped with four OC48/STM16 port units can terminate one 4-fiber or two 2-fiber OC-48 BLSRs. Since one SWIF pair can drop 96 STS-1/32 STM-1 equivalents to the switch, either all service capacity, or a combination of service and protection capacity that totals ≤96 STS-1/32 STM-1 equivalents can be dropped to the main switch fabric.

An OC48/STM16 Optical Module equipped with two OC48/STM16 port units can terminate a 2-fiber OC-48 BLSR/STM-16 MS-SPRing. Since one SWIF pair can drop 96 STS-1/32 STM-1 equivalents to the switch, all service and protection capacity can be dropped to the main switch fabric.

An OC48/STM16 Optical Module equipped with one SWIF pair may be dropping 96 STS-1/32 STM-1 equivalents of service capacity to the main switch fabric from either two unprotected OC48/STM16 port units or four 1+1 protected port units (two working, two protection).

OC12/STM4 Optical Module SWIFs

An OC12/STM4 Optical Module may be equipped with one or two SWIF pairs.

Two SWIF pairs

An OC12/STM4 Optical Module equipped with two SWIF pairs is capable of dropping the service capacity from sixteen 1+1 protected OC12/STM4 port units (eight working, eight protection) or eight unprotected OC12/STM4 port units.

One SWIF pair

An OC12/STM4 Optical Module equipped with one SWIF pair is capable of dropping the service capacity from eight 1+1 protected OC12/STM4 port units (four working, four protection) or four unprotected OC12/STM4 port units.

OC3/STM1 Optical Module SWIFs

An OC3/STM1 Optical Module may be equipped with one or two SWIF pairs.

Two SWIF pairs

An OC3/STM1 Optical Module equipped with two SWIF pairs is capable of dropping the service capacity from sixteen unprotected OC3/STM1 port units.

One SWIF pair

An OC3/STM1 Optical Module equipped with one SWIF pair is capable of dropping the service capacity from sixteen 1+1 OC3/STM1 port units (eight working, eight protection) or eight unprotected OC3/STM1 port units.

DS3EC1 Electrical Module SWIFs

A DS3EC1 Electrical Module is capable of housing ≤12 service DS3EC1/8 port units. The service capacity carried by those 12 DS3EC1/8 port units totals 96 STS-1/32 STM-1 equivalents. Therefore, only one SWIF pair is necessary to drop the all service capacity to the main switch fabric.

STM1e Electrical Module SWIFs

An STM1e Electrical Module is capable of housing ≤8 service STM1E/4 port units. The service capacity carried by those 8 STM1E/4 port units totals 32 STM-1 equivalents (96 STS-1/32 STM-1 equivalents). Therefore, only one SWIF pair is necessary to drop the all service capacity to the main switch fabric.

Mixed Module (Universal I/O Shelf) SWIFs

A Mixed Module (Universal I/O Shelf) can be equipped with any combination of the following port units:

- ≤Twelve DS3EC1/8 port units
- ≤Four OC48/STM16 port units
- ≤Eight OC12/STM4 port units
- ≤Eight OC3/STM1 port units

Constraints

The following constraints must be observed when equipping a Mixed Module:

- The mix of port units must physically fit in 16 port unit slots in the Facility Interface Sub-Shelf.
- The capacity dropped to the switch using
  - One SWIF pair cannot exceed 96 STS-1/32 STM-1 equivalents
  - Two SWIF pairs cannot exceed 192 STS-1/64 STM-1 equivalents

Important! If a Mixed Module is equipped with DS3EC1/8 port units and 1xN protection is used, then slot 16 must either be equipped with a DS3EC1/8 port unit or left blank.

Mixed Module (SDH Universal I/O Shelf) SWIFs

A Mixed Module (SDH Universal I/O Shelf) can be equipped with any combination of the following port units:

- ≤Eight STM1E/4 port units
- ≤Four OC48/STM16 port units
- ≤Eight OC12/STM4 port units
- ≤Eight OC3/STM1 port units

Constraints

The following constraints must be observed when equipping a Mixed Module:

- The mix of port units must physically fit in 16 port unit slots in the Facility Interface Sub-Shelf.
- The capacity dropped to the switch using
  - One SWIF pair cannot exceed 96 STS-1/32 STM-1 equivalents
  - Two SWIF pairs cannot exceed 192 STS-1/64 STM-1 equivalents

Important! If a Mixed Module is equipped with STM1E/4 port units and 1xN protection is used, then slot 16 must either be equipped with a STM1E/4 port unit or left blank.

□

Modular I/O Growth

Configurations of 10G I/O Shelves

The following table lists the maximum number of 10G I/O Bays and 10G I/O Shelves that the WaveStar BandWidth Manager 4608/1536 platform can support, assuming that full utilization of the associated switch fabric is a controlling factor. This table assumes that all the I/O Shelves in the platform are 10G I/O Shelves and they are all equipped with the same number of SWIF pairs.

Table 6-2 Possible Configurations of 10G I/O Shelves in a 4608/1536 Platform

IF each 10G I/O Shelf contains...		WHICH consume...	THEN the platform can support...		
OC192/STM64	**SWIF Pair(s)**	**STS-1/STM-1 equivalents**	**Equipped 10G I/O Shelves**	**10G I/O Bays (one shelf)**	**10G I/O Bays (two shelves)**
2	1	96 STS-1/32 STM-1	≤48[a]	≤48[b]	≤24[c]
2	2	192 STS-1/64 STM-1	≤24	≤24	≤12
2	3	288 STS-1/96 STM-1	≤16	≤16	≤8
2	4	384 STS-1/128 STM-1	≤12	≤12	≤6
4	1	96 STS-1/32 STM-1	≤48[a]	≤48[b]	≤24[c]
4	2	192 STS-1/64 STM-1	≤24	≤24	≤12
4	3	288 STS-1/96 STM-1	≤16	≤16	≤8
4	4	384 STS-1/128 STM-1	≤12	≤12	≤6
1	2	192 STS-1/64 STM-1	≤24	≤24	≤12

a) In Release 4.1, WaveStar BandWidth Manager supports a maximum of 36 I/O Shelves. Therefore, in R4.1 this number would be 36.

b) In Release 4.1, the floor plan layouts support a maximum of 24 I/O Bays. Therefore, in R4.1 the maximum number of 10G I/O Bays with one 10G I/O Shelf would be 24.

c) In Release 4.1, the floor plan layouts support a maximum of 36 I/O Shelves. Therefore, in R4.1 the maximum number of 10G I/O Bays with two 10G I/O Shelves would be 18.

Configuration of Universal I/O Shelves

The following table lists the maximum number of Universal I/O Bays and Universal I/O Shelves that the WaveStar BandWidth Manager 4608/1536 platform supports with the stated configurations of the Universal I/O Shelves. The figures presented assume that full utilization of the associated switch fabric is a controlling factor. This table assumes that all Facility Interface Sub-Shelves in the platform are equipped with the same type and number of port units.

Table 6-3 Possible Configurations of Universal I/O Shelves in a 4608/1536 Platform

IF each Universal I/O Shelf contains...					WHICH consume...	THEN the platform can support...	
OC48/STM16	OC12/STM4	OC3/STM1	DS3EC1/8	SWIF Pair(s)	STS-1/STM-1 equivalents	Equipped I/O Shelves	Universal I/O Bays
0	0	0	12	1	96 STS-1/32 STM-1	≤48[a]	≤24[b]
2	0	0	0	1	96 STS-1/32 STM-1	≤48[a]	≤24[b]
4	0	0	0	1	96 STS-1/32 STM-1	≤48[a]	≤24[b]
4	0	0	0	2	192 STS-1/64 STM-1	≤24	≤12
0	16	0	0	2	192 STS-1/64 STM-1	≤24	≤12
0	8	0	0	2	192 STS-1/64 STM-1	≤24	≤12
0	0	16	0	1	96 STS-1/32 STM-1	≤48[a]	≤24[b]
0	0	16	0	2	192 STS-1/64 STM-1	≤24	≤12
≤4	≤8	≤8	≤12	2	192 STS-1/64 STM-1	≤24	≤12

a) In Release 4.1, WaveStar BandWidth Manager supports a maximum of 36 I/O Shelves. Therefore, in R4.1 this number would be 36.

b) In Release 4.1, the floor plan layouts support a maximum of 36 I/O Shelves. Therefore, in R4.1 the maximum number of Universal I/O Bays with two Universal I/O Shelves would be 18.

Configuration of SDH Universal I/O Shelves

The following table lists the maximum number of SDH I/O Bays and SDH Universal I/O Shelves that the WaveStar BandWidth Manager 4608/1536 platform supports with the stated configurations of the I/O Shelves. The figures presented assume that full utilization of the associated switch fabric is a controlling factor. This table assumes that all Facility Interface Sub-Shelves in the platform are equipped with the same type and number of port units.

Table 6-4 Possible Configurations of SDH Universal I/O Shelves in a 4608/1536 Platform

IF each SDH Universal I/O Shelf contains...					WHICH consume...	THEN the platform can support...	
OC48/STM16	OC12/STM4	OC3/STM1	STM1E/4	SWIF Pair(s)	STS-1/STM-1 equivalents	Equipped I/O Shelves	SDH I/O Bays
0	0	0	8	1	96 STS-1/32 STM-1	≤48[a]	≤24[b]
≤4	≤8	≤8	≤8	2	192 STS-1/64 STM-1[c]	≤24	≤12

a) In Release 4.1, WaveStar BandWidth Manager can support a maximum of 36 I/O Shelves. Therefore, in R4.1 this number would be 36.

b) In Release 4.1, the floor plan layouts support a maximum of 36 I/O Shelves. Therefore, in R4.1 the maximum number of SDH I/O Bays with two SDH Universal I/O Shelves would be 18.

c) This configuration can be handled in numerous ways. The SDH Universal I/O Shelf can include any mixture of port units as long as the physical and capacity restrictions of the shelf are observed.

Total number of shelves for a 4608/1536 platform

To calculate the total number of shelves that a 4608/1536 platform can support, use the following information and formulas.

Known (SONET)

The size of platform/switch fabric is 4608. Switch capacity consumed by one SWIF pair is 96 STS-1 equivalents. Therefore, if one SWIF pair is represented by x, then
x= 96, 2x = 192, 3x = 288, 4x = 384

The total SWIF pairs must be less than or equal to 48.
Therefore, the number of SWIF pairs per shelf:
a = 1 pair, b = 2 pairs, c = 3 pairs, d = 4 pairs

1. One SWIF pair consumes 96 STS-1 equivalents on the main switch fabric (all I/O Shelves)
   - 4608 = 48x
     (4608 = 48 x 96)
   - 48 = 48a + 0b + 0c +0d
2. Two SWIF pairs consume 192 STS-1 equivalents on the main switch fabric (all I/O Shelves)
   - 4608 = 24(2x)
     (4608 = 24 x 192)
   - 48 = 0a + 24b + 0c + 0d
3. Three SWIF pairs consume 288 STS-1 equivalents on the main switch fabric (10G I/O Shelves)
   - 4608 = 16(3x)
     (4608 = 16 x 288)
   - 48 = 0a + 0b + 16c + 0d
4. Four SWIF pairs consume 384 STS-1 equivalents on the main switch fabric (10G I/O Shelves)
   - 4608 = 12(4x)
     (4608 = 12 x 384)
   - 48 = 0a + 0b + 0c + 12d

Known (SDH)

The size of platform/switch fabric is 1536. Switch capacity consumed by one SWIF pair is 32 STM-1 equivalents. Therefore, if one SWIF pair is represented by y, then
y= 32, 2y = 64, 3y = 96, 4y = 128

The total SWIF pairs must be less than or equal to 48. Therefore, the number of SWIF pairs per shelf:
a = 1 pair, b = 2 pairs, c = 3 pairs, d = 4 pairs

1. One SWIF pair consumes 32 STM-1 equivalents on the main switch fabric (all I/O Shelves)
   - 1536 = 48y
     (1536 = 48 x 32)
   - 48 = 48a + 0b + 0c +0d
2. Two SWIF pairs consume 64 STM-1 equivalents on the main switch fabric (all I/O Shelves)
   - 1536 = 24(2y)
     (1536 = 24 x 64)
   - 48 = 0a + 24b + 0c + 0d
3. Three SWIF pairs consume 96 STM-1 equivalents on the main switch fabric (10G I/O Shelves)
   - 1536 = 16(3y)
     (1536 = 16 x 96)
   - 48 = 0a + 0b + 16c + 0d
4. Four SWIF pairs consume 128 STM-1 equivalents on the main switch fabric (10G I/O Shelves)
   - 1536 = 12(4y)
     (1536 = 12 x 128)
   - 48 = 0a + 0b + 0c + 12d

Unknown

The total number of shelves assuming that the shelves do not contain the same number of SWIF pairs.

- Number of shelves with one SWIF pair (less than 48) and/or
- Number of shelves with two pairs (less than 24) and/or
- Number of shelves with three SWIF pairs (less than 16) and/or
- Number of shelves with four SWIF pairs (less than 12)

Equipment Interconnection

Overview

This section describes equipment interconnection in WaveStar BandWidth Manager.

Inter-bay cabling

The cabling between bays in WaveStar BandWidth Manager is through a raised floor or overhead racking.

Optical connectors

The OC192/STM64, OC48/STM16, OC12/STM4, and OC3/STM1 port units provide optical connections through faceplate-mounted connectors.

LBO/optical attenuators

If required, WaveStar BandWidth Manager provides optical attenuation using lightguide build-outs (LBOs)/optical attenuators on the optical port units. The OLS-compatible port units (OC48/STM16/DWDM, OC48/STM16/WDM, and OC192/STM64/WDM) are factory-equipped with LC-type 0 dB optical attenuators. All other optical port units are factory-equipped with SC-type 0 db optical attenuators Each kit includes a 0 dB, 5 dB, 10 dB, 15 dB, and a 20 dB attenuator. The optical attenuation and connector type can be changed by replacing the LBO/optical attenuator.

All OC192/STM64, OC48/STM16, OC12/STM4, and OC3/STM1 port units are capable of operating with the following three connector types:

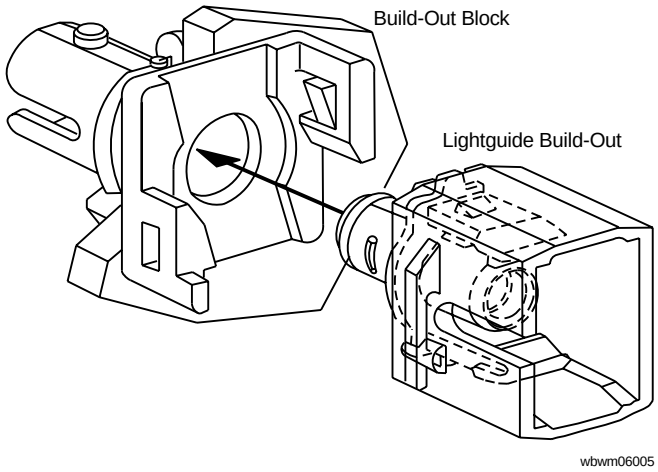
- SC-type (0 dB, 5 dB, 10 dB, 15 dB, 20 dB)
- ST-type (0 dB, 5 dB, 10 dB, 15 dB, 20 dB)
- FC-type (0 dB, 5 dB, 10 dB, 15 dB, 20 dB)

Important! The receiver ports on the OC12/STM4 and OC3/STM1 port units require single-mode to multi-mode (SM-MM) LBO/optical attenuators. The transmit ports on the OC12/STM4 and OC3/STM1 port units, and the OC192/STM64 and OC48/STM16 port units require SM-SM LBO/optical attenuators.

SC-Type LBO/optical attenuator

Figure 6-18 illustrates the universal optical access point with an SC-type LBO/optical attenuator.

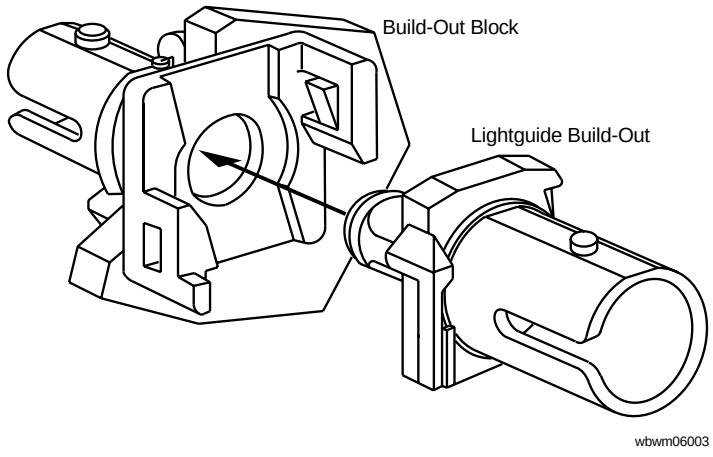
Figure 6-18 SC-Type LBO/Optical Attenuator



ST-Type LBO/optical attenuator

Figure 6-19 illustrates the universal optical access point with an ST-type LBO/optical attenuator.

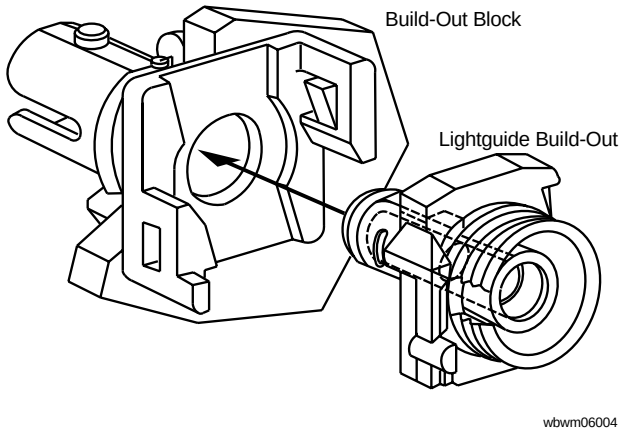
Figure 6-19 ST-Type LBO/optical Attenuator



FC-Type LBO/optical attenuator

Figure 6-20 illustrates the universal optical access point with an FC-type LBO/optical attenuator.

Figure 6-20 FC-Type LBO/Optical Attenuator



Reference For LBO/optical attenuator ordering codes, refer to Chapter 7, "Ordering." The colors of the different LBO/optical attenuators (SM-SM and SM-MM) are also listed in Chapter 7.

Line build-out Because the electrical port units are designed to accept the entire signal range, external line build-outs are not required in WaveStar BandWidth Manager.

Electrical connectors This section describes the electrical connectors.

DS3EC1/8 port units

The DS3EC1/8 port units are cabled to the DS3EC1/8 Connector Panels via backplane-mounted ribbon cables. Cable connections to the DS3EC1/8 Connector Panels use BNC-type connectors. All cables must be terminated in 75-ohm terminations.

STM1E/4 port units

The STM1E/4 port units are cabled to the STM1e Connector Panels via backplane-mounted coaxial cables. Each STM1e Connector Panel is equipped with 32 pairs of connectors. Each pair includes one transmit and one receive connector. The STM1e Connector Panels are available with either 43-type (SMB) 75-ohm connectors or 1.6/5.6 75-ohm connectors. Four STM1E/4 port units can be cabled to each panel. The bundled cable connects the 43-type or 1.6/5.6 connectors to the backplane.

> **Important!** The STM1e Connector Panels are designed to support future releases of the STM1E/4 port units that will contain eight ports. Therefore, only half of the available connectors on each panel are used by the STM1E/4 port units that are available in R4.1.

□



7 Ordering

Overview

Purpose This chapter provides information necessary to order a WaveStar BandWidth Manager platform.

Contents The following topics are discussed in this chapter:

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Important Notices

Overview

This section provides important information about the availability of equipment

Standard footprint equipment

Effective June 1, 2002, all standard footprint equipment (bays and floorplans) will be Discontinued Availability (DA).

Because floor space is very critical to our customers, Lucent is taking advantage of leading edge technologies in cabling to reduce the footprint of WaveStar BandWidth Manager. Therefore, the original standard footprints are no longer necessary and they will be DA effective June 1, 2002. Customers will save significant floor space by purchasing the new reduced footprints. When compared to the floor space occupied by the standard footprints:

- The new reduced footprint NEBS 2-bay Control/Switch Complex (without I/O bays) reduces the amount of floor space by approximately 13.5%.
- The new reduced footprint ETSI 2-bay Control/Switch Complex (without I/O bays) reduces the amount of floor space by approximately 30%.
- The new reduced footprint ETSI I/O Bays reduces the amount of floor space by approximately 16.7%.

Important! The floor space savings stated above does not apply to the ETSI Universal I/O Bays and the 10G/Universal I/O Bays if those bays are equipped with DS3EC1/8 port units and therefore DS3EC1 Connect Panels.

NEBS Level 3

If you are engineering a NEBS Level 3 compliant platform, be sure to refer to the tables for NEBS Level 3 equipment for wired-equipment, circuit pack kits, and all individual port units. You must also order NEBS Level 3 spares for NEBS Level 3 circuit packs and port units.

Important! You cannot install NEBS Level 2 circuit packs or port units in NEBS Level 3 wired-equipment.

NEBS Level 2

NEBS Level 2 compliant equipment will be Discontinued Availability (DA) during 2001. The business reasons behind the decision to DA the NEBS Level 2 equipment include

- NEBS Level 2 equipment and NEBS Level 3 equipment are functionally identical.
- NEBS Level 2 compliance requirements are the subset of NEBS Level 3 requirements. Therefore, NEBS Level 3 compliant products are automatically NEBS Level 2 compliant.
- NEBS Level 3 equipment is backward compatible.

Wired-equipment and circuit pack kits

Effective July 1, 2001, the NEBS Level 2 wired-equipment (for example, all bays) and circuit packs kits are Discontinued Availability (DA).

Please order the NEBS Level 3 equipment and contact your Account Executive for more information.

Individual circuit pack and port units

As of December 1, 2001, the NEBS Level 2 circuit packs and port units that are available individually and for spares will be Discontinued Availability (DA). The period between 4/01 and 12/01 will give our customers enough time to migrate to NEBS Level 3 equipment and spares.

> **Important!** You cannot install NEBS Level 3 circuit packs or port units in NEBS Level 2 wired-equipment unless a mechanical modification has been performed.
>
> Contact your Account Executive for more information.

3-bay Control/Switch Complexes

As of April 1, 2002, the NEBS Level 3 3-bay Control/Switch Complexes will be Discontinued Availability (DA). The business reasons behind the decision to DA the 3-bay Control/Switch Complex include

- The 3-bay Control/Switch Complex was originally developed to allow upgrades to the 9216/3072 platform and support the optical remoting of I/O Shelves. Due to a change in our customer needs, 4608/1536 platform is now evolving to a 55,296/18,432 platform in Release 5.0. Therefore, the 9216/3072 platform and the optical remoting of I/O Shelves have been removed from the development program.
- The elimination of the 3-bay Control/Switch Complex, further adds to the reduction in the footprint. Customers gain two bay-widths of floor space (one bay and one cable management bay) without losing any features or functionality.

  Important! The NEBS Level 2 3-bay Control/Switch Complexes DA is in conjunction with the NEBS Level 2 wired-equipment DA, effective July 1, 2001. Please refer to the information above regarding NEBS Level 2 wired-equipment.

Reduced cabling

The standard and reduced footprints detailed in this chapter included the reduced cabling. The reduced cabling kits are documented in the following drawings:

- ED9C280-11 Cable Assembly Kit for Reduced Footprints
- ED9C280-12 Cable Assembly Kit for Standard Footprints
- ED9C280-13 Cable Assembly Kit for Raised-Floor Footprints ED9C280-13 is used for reduced footprints with the cable racking greater than 11.5 ft/3.5 m above the floor or for raised-floor platforms with cable-rack depths of greater than 1 ft/305 mm.

  Important! All cabling kits listed in this chapter are available beginning July 1, 2001. Contact your Account Executive for more information.

□

Ordering Control/Switch Complexes

Overview

The WaveStar BandWidth Manager 4608/1536 platform has been carefully engineered and all equipment kitted to simplify the ordering process.

2-bay Control/Switch Complex

This section lists the ordering information for the 4608/1536 2-bay Control/Switch Complexes.

A 2-bay Control/Switch Complex includes one Control/Switch Bay, one Switch Bay, and the three required cable management bays.

NEBS Level 3

The following table lists the items required for the NEBS Level 3 compliant 4608/1536 2-bay Control/Switch Complex. You must order either a NEBS (G1E or G3E) or an ETSI (G2E or G4E) Control/Switch Complex.

Table 7-1 NEBS Level 3 2-Bay Control/Switch Complex

Drawing	Group	Description	Notes
ED9C280-60	G1E	One Control/Switch Bay and One Switch Bay (NEBS) Standard Footprint *Cable management bays are 18 in. wide.*	DA: Effective 6/01/02 Replaced by: ED9C280-60, G3E
ED9C280-60	G2E	One Control/Switch Bay and One Switch Bay (ETSI) Standard Footprint *Cable management bays are 600 mm wide.*	DA: Effective 6/01/02 Replaced by: ED9C280-60, G4E
ED9C280-60	G3E	One Control/Switch Bay and One Switch Bay (NEBS) Reduced Footprint *Cable management bays are 13 in. wide.*	Available 7/01/01
ED9C280-60	G4E	One Control/Switch Bay and One Switch Bay (ETSI) Reduced Footprint *Cable management bays are 300 mm wide.*	Available 7/01/01
ED9C280-30	G101E	Circuit Pack Kit for One System Controller Shelf for Release 3.1 and above	
ED9C280-30	G141E	Circuit Pack Kit for Two 4608/1536 Switch Shelves for Release 3.1 and above	Replaced G140E beginning with R3.1.

NEBS Level 2

Important! Effective July 1, 2001, the NEBS Level 2 wired-equipment (for example, the 2-bay Control/Complex and all bays) and circuit packs kits and will be Discontinued Availability (DA).

Please order the NEBS Level 3 2-bay Control/Switch Complex and contact your Account Executive for more information.

3-bay Control/Switch Complex

This section lists the ordering information for 3-bay Control/Switch Complexes.

A 3-bay Control/Switch Complex includes one System Controller Bay, two Switch Bays, and the four required cable management bays.

Important! As of April 1, 2002, the 3-bay Control/Switch Complexes will be Discontinued Availability (DA). Please order the 2-bay Control/Switch Complex and contact your Account Executive for more information.
Because this equipment will soon be DA, Lucent is not offering a reduced footprint for the 3-bay Control/Switch Complex.

NEBS Level 3

The following table lists the items required for the NEBS Level 3 compliant 4608/1536 3-bay Control/Switch Complex.You must order either a NEBS (G1E) or an ETSI (G2E) Control/Switch Complex.

Table 7-2 NEBS Level 3 3-Bay Control/Switch Complex

Drawing	Group	Description	Notes
ED9C280-30	G1E	One System Controller Bay and Two Switch Bays (NEBS) Standard Footprint	DA: Effective 4/01/02 Replaced by: ED9C280-60, G3E
ED9C280-30	G2E	One System Controller Bay and Two Switch Bays (ETSI) Standard Footprint	DA: Effective 4/01/02 Replaced by: ED9C280-60, G4E
ED9C280-30	G101E	Circuit Pack Kit for One System Controller Shelf for Release 3.1 and above	
ED9C280-30	G141E	Circuit Pack Kit for Two 4608/1536 Switch Shelves for Release 3.1 and above	Replaced G140E beginning with R3.1.

NEBS Level 2

Important! Effective July 1, 2001, the NEBS Level 2 wired-equipment (for example, bays) and circuit packs kits and will be Discontinued Availability (DA).

Please order the NEBS Level 3 3-bay Control/Switch Complex and contact your Account Executive for more information.

□

Ordering I/O Equipment

10G I/O Bay

This section lists the ordering information for ordering 10G I/O Bays. The 10G I/O Bays are available with either one or two 10G I/O Shelves.

NEBS Level 3

The following two tables list the orderable items for the NEBS Level 3 10G I/O Bays.
You must order either a NEBS (G3E) or an ETSI (G4E or G14E) 10G I/O Bay with one shelf.

Table 7-3 NEBS Level 3 10G I/O Bay with One 10G I/O Shelf

Drawing	Group	Description	Notes
ED9C280-39	G3E	One 10G I/O Bay with One 10G I/O Shelf (NEBS) Standard or Reduced Footprint	
ED9C280-39	G4E	One 10G I/O Bay with One 10G I/O Shelf (ETSI) Standard Footprint *Cable management bay is 300 mm wide.*	DA: Effective 6/01/02 Replaced by: ED9C280-39, G14E
ED9C280-39	G14E	One 10G I/O Bay with One 10G I/O Shelf (ETSI) Reduced Footprint *Cable management bay is 150 mm wide.*	Available 7/01/01
ED9C280-39	G101E	Common Circuit Pack Kit for One 10G I/O Shelf (includes two SWIF packs)	
ED9C280-31	G110E	Circuit Pack Kit for an additional 96 STS-1s/32 STM-1s (two additional SWIF packs)	
ED9C280-42	G2	One 300 mm wide Cable Management Bay (ETSI) *One required for the first I/O Bay in each bay line-up for standard footprints.*	DA: Effective 6/01/02
ED9C280-42	G3	One 150 mm wide Cable Management Bay (ETSI) *One required for the first I/O Bay in each bay line-up for reduced footprints.*	Available 7/01/01

You must order either a NEBS (G5E) or an ETSI (G6E or GE16) 10G I/O Bay with two shelves.

Table 7-4 NEBS Level 3 10G I/O Bay with Two 10G I/O Shelves

Drawing	Group	Description	Notes
ED9C280-39	G5E	One 10G I/O Bay with Two 10G I/O Shelves (NEBS) Standard or Reduced Footprint	
ED9C280-39	G6E	One 10G I/O Bay with Two 10G I/O Shelves (ETSI) Standard Footprint *Cable management bay is 300 mm wide.*	DA: Effective 6/01/02 Replaced by: ED9C280-39, G16E
ED9C280-39	G16E	One 10G I/O Bay with Two 10G I/O Shelves (ETSI) Reduced Footprint *Cable management bay is 150 mm wide.*	Available 7/01/01
ED9C280-39	G101E	Common Circuit Pack Kit for One 10G I/O Shelf (includes two SWIF packs)	
ED9C280-31	G110E	Circuit Pack Kit for an additional 96 STS-1s/32 STM-1s (two additional SWIF packs)	
ED9C280-42	G2	One 300 mm wide Cable Management Bay (ETSI) *One required for the first I/O Bay in each bay line-up for standard footprints.*	DA: Effective 6/01/02
ED9C280-42	G3	One 150 mm wide Cable Management Bay (ETSI) *One required for the first I/O Bay in each bay line-up for reduced footprints.*	Available 7/01/01

NEBS Level 2

Important! Effective July 1, 2001, the NEBS Level 2 wired-equipment (for example, all I/O Bays) and circuit pack kits are Discontinued Availability (DA). Please order the NEBS Level 3 equipment and contact your Account Executive for more information.

Universal I/O Bay

This section lists the ordering information for ordering Universal I/O Bays. The Universal I/O Bays are only available with two Universal I/O Shelves.

NEBS Level 3

The following table lists the orderable items for a single NEBS Level 3 compliant Universal I/O Bay. You must order either a NEBS (G1E) or an ETSI (G2E or GE12) Universal I/O Bay.

Table 7-5 NEBS Level 3 Universal I/O Bay

Drawing	Group	Description	Notes
ED9C280-31	G1E	One Universal I/O Bay (NEBS) Standard or Reduced Footprint	
ED9C280-31	G2E	One Universal I/O Bay (ETSI) Standard Footprint *Cable management bay is 300 mm wide.*	DA: Effective 6/01/02 Replaced by: ED9C280-31, G12E
ED9C280-31	G12E	One Universal I/O Bay (ETSI) Reduced Footprint *Cable management bay is 150 mm wide.*	Available 7/01/01
ED9C280-31	G101E	Common Circuit Pack Kit for One Universal I/O Shelf includes two SWIF packs)	
ED9C280-31	G110E	Circuit Pack Kit for an additional 96 STS-1s/32 STM-1s (two additional SWIF packs)	
ED9C280-31	G130E	Circuit Pack Kit for 1xN DS3/EC1 Protection	
ED9C280-31	G160	One DS3EC1 Connector Panel	
ED9C280-42	G2	One 300 mm wide Cable Management Bay (ETSI) *One required for the first I/O Bay in each bay line-up for standard footprints.*	DA: Effective 6/01/02
		One 300 mm wide Cable Management Bay (ETSI) *One required adjacent to any I/O Bay that includes DS3EC1 connector panel on that side of the bay for reduced footprint*	
ED9C280-42	G3	One 150 mm wide Cable Management Bay (ETSI) *One required for the first I/O Bay in each bay line-up for reduced footprints.*	Available 7/01/01

NEBS Level 2

Important! Effective July 1, 2001, the NEBS Level 2 wired-equipment (for example, all I/O Bays) and circuit pack kits are Discontinued Availability (DA). Please order the NEBS Level 3 equipment and contact your Account Executive for more information.

10G/Universal I/O Bay

This section lists the ordering information for ordering 10G/Universal I/O Bays.

The 10G/Universal I/O Bays are available with one 10G I/O Shelf and one Universal I/O Shelf.

NEBS Level 3

The following table lists the orderable items for a NEBS Level 3 compliant 10G/Universal I/O Bay. You must order either a NEBS (G1E) or an ETSI (G2E or GE12) 10G/Universal I/O Bay.

Table 7-6 NEBS Level 3 10G/Universal I/O Bay

Drawing	Group	Description	Notes
ED9C280-39	G1E	One 10G/Universal I/O Bay (NEBS) Standard or Reduced Footprint	
ED9C280-39	G2E	One 10G/Universal I/O Bay (ETSI) Standard Footprint *Cable management bay is 300 mm wide.*	DA: Effective 6/01/02 Replaced by: ED9C280-39, G12E
ED9C280-39	G12E	One 10G/Universal I/O Bay (ETSI) Reduced Footprint *Cable management bay is 150 mm wide.*	Available 7/01/01
ED9C280-39	G101E	Common Circuit Pack Kit for One 10G I/O Shelf (includes two SWIF packs)	
ED9C280-31	G101E	Common Circuit Pack Kit for One Universal I/O Shelf (includes two SWIF packs)	
ED9C280-31	G110E	Circuit Pack Kit for an additional 96 STS-1s/32 STM-1s (two additional SWIF packs)	
ED9C280-31	G130E	Circuit Pack Kit for 1xN DS3/EC1 Protection	
ED9C280-31	G160	One DS3EC1 Connector Panel	
ED9C280-42	G2	One 300 mm wide Cable Management Bay (ETSI) *One required for the first I/O Bay in each bay line-up for standard footprints.*	DA: Effective 6/01/02
		One 300 mm wide Cable Management Bay (ETSI) *One required adjacent to any I/O Bay that includes DS3EC1 connector panel on that side of the bay for reduced footprint*	
ED9C280-42	G3	One 150 mm wide Cable Management Bay (ETSI) *One required for the first I/O Bay in each bay line-up for reduced footprints.*	Available 7/01/01

NEBS Level 2

Important! Effective July 1, 2001, the NEBS Level 2 wired-equipment (for example, all I/O Bays) and circuit pack kits are Discontinued Availability (DA). Please order the NEBS Level 3 equipment and contact your Account Executive for more information.

10G/SDH I/O Bay

This section lists the ordering information for 10G/Universal I/O Bays. The 10G/SDH I/O Bays are available with one 10G I/O Shelf and one SDH Universal I/O Shelf.

NEBS Level 3

The following table lists the orderable items for a NEBS Level 3 compliant 10G/SDH I/O Bay. You must order either a NEBS (G1E) or an ESTI (G2E or G12E) 10G/SDH I/O Bay.

Table 7-7 NEBS Level 3 10G/SDH I/O Bay

Drawing/ Comcode	Group	Description	Notes
ED9C280-65	G1E	One 10G/SDH I/O Bay (NEBS) Standard or Reduced Footprint	
ED9C280-65	G2E	One 10G/SDH I/O Bay (ETSI) Standard Footprint *Cable management bay is 300 mm wide.*	DA: Effective 6/01/02 Replaced by: ED9C280-65, G12E
ED9C280-65	G12E	One 10G/SDH I/O Bay (ETSI) Reduced Footprint *Cable management bay is 150 mm wide.*	Available 7/01/01
ED9C280-39	G101E	Common Circuit Pack Kit for One 10G I/O Shelf (includes two SWIF packs)	
ED9C280-31	G101E	Common Circuit Pack Kit for One SDH Universal I/O Shelf (includes two SWIF packs)	
ED9C280-31	G110E	Circuit Pack Kit for an additional 96 STS-1s/32 STM-1s (two additional SWIF packs)	
ED9C280-65	G130E	Circuit Pack Kit for 1xN STM1e Protection	
408 528 024	NA	One 1.6/5.6 STM1e Connector Panel (Left Mount)	
408 528 032	NA	One 1.6/5.6 STM1e Connector Panel (Right Mount)	
408 528 008	NA	One 43-type STM1e Connector Panel (Left Mount)	
408 528 016	NA	One 43-type STM1e Connector Panel (Right Mount)	
ED9C280-42	G2	One 300 mm wide Cable Management Bay (ETSI) *One required for the first I/O Bay in each bay line-up for standard footprints.*	DA: Effective 6/01/02
ED9C280-42	G3	One 150 mm wide Cable Management Bay (ETSI) *One required for the first I/O Bay in each bay line-up for reduced footprints.*	Available 7/01/01

NEBS Level 2

Important! Effective July 1, 2001, the NEBS Level 2 wired-equipment (for example, all I/O Bays) are Discontinued Availability (DA). Please order the NEBS Level 3 equipment and contact your Account Executive for more information.

SDH I/O Bay

This section lists the ordering information for SDH I/O Bays. The SDH I/O Bays are only available with two SDH Universal I/O Shelves.

NEBS Level 3

The following table lists the orderable items for a NEBS Level 3 compliant SDH I/O Bay. You must order either a NEBS (G5E) or an ESTI (G6E or G16E) SDH I/O Bay.

Table 7-8 NEBS Level 3 SDH I/O Bay

Drawing/ Comcode	Group	Description	Notes
ED9C280-65	G5E	One SDH I/O Bay (NEBS) Standard or Reduced Footprint	
ED9C280-65	G6E	One SDH I/O Bay (ETSI) Standard Footprint *Cable management bay is 300 mm wide.*	DA: Effective 6/01/02 Replaced by: ED9C280-65, G16E
ED9C280-65	G16E	One SDH I/O Bay (ETSI) Reduced Footprint *Cable management bay is 150 mm wide.*	Available 7/01/01
ED9C280-31	G101E	Common Circuit Pack Kit for One SDH Universal I/O Shelf (includes two SWIF packs)	
ED9C280-31	G110E	Circuit Pack Kit for an additional 96 STS-1s/32 STM-1s (two additional SWIF packs)	
ED9C280-65	G130E	Circuit Pack Kit for 1xN STM1e Protection	
408 528 024	NA	One 1.6/5.6 STM1e Connector Panel (Left Mount)	
408 528 032	NA	One 1.6/5.6 STM1e Connector Panel (Right Mount)	
408 528 008	NA	One 43-type STM1e Connector Panel (Left Mount)	
408 528 016	NA	One 43-type STM1e Connector Panel (Right Mount)	
ED9C280-42	G2	One 300 mm wide Cable Management Bay (ETSI) *One required for the first I/O Bay in each bay line-up for standard footprints.*	DA: Effective 6/01/02
ED9C280-42	G3	One 150 mm wide Cable Management Bay (ETSI) *One required for the first I/O Bay in each bay line-up for reduced footprints.*	Available 7/01/01

NEBS Level 2

Important! Effective July 1, 2001, the NEBS Level 2 wired-equipment (for example, all I/O Bays) and circuit pack kits are Discontinued Availability (DA). Please order the NEBS Level 3 equipment and contact your Account Executive for more information.

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Circuit Pack Kits

Overview This section lists the contents of the different circuit pack kits.

System Controller Shelf The following table lists the circuit packs and equipment that are included in ED9C280-30, G101E and G101.

Table 7-9 Circuit Pack Kit for a System Controller Shelf

Kit	Circuit Packs and Equipment			
	Quantity	Name	Apparatus Code	Comcode
ED9C280-30, G101E NEBS Level 3	2	CTL/SYS50D	LEY20BE	108 735 200
	2	CTL/EI	LCZ1AE	108 730 094
	3	CTL/MEM	LCY2AE	108 730 086
	2	ADJCTL/DCC	LEY2AE	108 733 189
	2	TMG/STRAT3	LLY2BE	108 865 882
	2	CSIEX	LEZ1AE	108 735 127
	3	220 MB Memory Cards	NA	109 426 409
	1	Jumper Cable Assembly	NA	848 494 639
ED9C280-30, G101 NEBS Level 2	2	CTL/SYS50D	LEY20B	108 716 333
	2	CTL/EI	LCZ1	107 993 917
	3	CTL/MEM	LCY2	107 993 925
	2	ADJCTL/DCC	LEY2	107 855 090
	2	TMG/STRAT3	LLY2B	108 865 866
	2	CSIEX	LEZ1	108 056 029
	3	220 MB Memory Cards	NA	109 426 409
	1	Jumper Cable Assembly	NA	848 494 639

Switch Shelves

The following table lists the circuit packs and equipment that are included in ED9C280-30, G141E and G141.

Table 7-10 Circuit Pack Kit for Two Switch Shelves

Kit	Circuit Packs and Equipment			
	Quantity	Name	Apparatus Code	Comcode
ED9C280-30, G141E NEBS Level 3	4	SWIEX	LFY1AE	108 735 135
	32	BSW	LFY2AE	108 735 143
	4	TMG/STRAT3	LLY2BE	108 865 882
ED9C280-30, G141 NEBS Level 2	4	SWIEX	LFY1	108 015 686
	32	BSW	LFY2	108 015 694
	4	TMG/STRAT3	LLY2B	108 865 866

Universal I/O Shelf/ SDH Universal I/O Shelf

The following table lists the circuit packs and equipment that are included in ED9C280-31, G101E and G101.

Table 7-11 Common Circuit Pack Kit for One Universal I/O Shelf/SDH Universal I/O Shelf

Kit	Circuit Packs and Equipment			
	Quantity	Name	Apparatus Code	Comcode
ED9C280-31, G101E NEBS Level 3	2	CTL/SYS50DM	LEY10BE	108 730 227
	2	TMG/STRAT3	LLY2BE	108 865 882
	2	SWITCH/STS576	LEY4AE	108 734 617
	1	ADJCTL/DCCEI	LEY1AE	108 730 102
	2	SWIF	LEY21AE	108 733 809
ED9C280-31, G101 NEBS Level 2	2	CTL/SYS50DM	LEY10B	108 387 440
	2	TMG/STRAT3	LLY2B	108 865 866
	2	SWITCH/STS576	LEY4	107 855 116
	1	ADJCTL/DCCEI	LEY1	107 914 822
	2	SWIF	LEY21	108 686 064

10G I/O Shelf The following table lists the circuit packs and equipment that are included in ED9C280-39, G101E and G101.

Table 7-12 Common Circuit Pack Kit for One 10G I/O Shelf

Kit	Circuit Packs and Equipment			
	Quantity	Name	Apparatus Code	Comcode
ED9C280-39, G101E NEBS Level 3	2	CTL/SR50DC	LEY68AE	108 734 831
	2	TMG/STRAT3	LLY2BE	108 865 882
	10	SWITCH/STS768	LEY73AE	108 734 898
	4	PPROC/FO	LEY72AE	108 734 872
	1	ADJCTL/DCCEI	LEY1AE	108 730 102
	2	SWIF	LEY21AE	108 733 809
ED9C280-39, G101 NEBS Level 2	2	CTL/SR50DC	LEY68	108 774 605
	2	TMG/STRAT3	LLY2B	108 865 866
	10	SWITCH/STS768	LEY73	108 408 824
	4	PPROC/FO	LEY72	108 468 141
	1	ADJCTL/DCCEI	LEY1	107 914 822
	2	SWIF	LEY21	108 686 064

STM1E/4 1xN protection The following table lists the circuit packs and equipment that are included in ED9C280-65, G130E and G130.

Table 7-13 Common Circuit Pack Kit for STM1e 1xN Protection

Kit	Circuit Packs and Equipment			
	Quantity	Name	Apparatus Code	Comcode
ED9C280-65, G130E NEBS Level 3	1	SWITCH/STM1E4	LEY41AE	108 734 633
	1	STM1E/4	LEY43AE	108 775 404
ED9C280-65, G130 NEBS Level 2	1	SWITCH/STM1E4	LEY41	108 396 318
	1	STM1E/4	LEY43	108 775 396

DS3EC1/8 1xN protection

The following table lists the circuit packs and equipment that are included in ED9C280-31, G130E and G130.

Table 7-14 Common Circuit Pack Kit for DS3EC1/8 1xN Protection

Kit	Circuit Packs and Equipment			
	Quantity	Name	Apparatus Code	Comcode
ED9C280-31, G130E NEBS Level 3	1	SWITCH/DS3EC1	LEY18AE	108 733 452
	1	DS3EC1/8	LEY17AE	108 733 445
ED9C280-31, G130 NEBS Level 2	1	SWITCH/DS3EC1	LEY18	107 978 090
	1	DS3EC1/8	LEY17	107 978 082

Additional 96 STS-1/ 32 STM-1 of SWIF capacity

The following table lists the circuit packs that are included in ED9C280-31, G110E and G110.

Table 7-15 Circuit Pack Kit for an Additional 96 STS-1/32 STM-1 of SWIF Capacity

Kit	Circuit Packs and Equipment			
	Quantity	Name	Apparatus Code	Comcode
ED9C280-31, G110E NEBS Level 3	2	SWIF	LEY21AE	108 733 809
ED9C280-31, G110 NEBS Level 2	2	SWIF	LEY21	108 686 064



Ordering Software

Overview

This section provides the information necessary to order software upgrades and initial installation of Release 4.1 software.

R4.1 initial installation

The following table lists the orderable items for the WaveStar BandWidth Manager Release 4.1 software.

Table 7-16 Release 4.1 Software

Comcode	Group	Description	Notes
109 155 960 (required)	NA	Release 4.1 Software CD-ROM and the Software Release Description (SRD)	
109 153 866 (optional)	NA	*WaveStar BandWidth Manager Release 4.1 Documents CD-ROM*	
109 156 000 (optional)	NA	Spare Release 4.1 Software CD-ROM	

R4.1 from R4.0.x upgrade

The following table lists the orderable items for the WaveStar BandWidth Manager Release 4.1 software upgrade from Release 4.0.x (4.0.1, 4.0.2) software.

Table 7-17 R4.1 from R4.0.x Software Upgrade

Comcode	Group	Description	Notes
109 155 978 (required)	NA	Release 4.1 Upgrade Software CD-ROM and the Software Release Description (SRD)	Upgrade from 4.0.1 Upgrade from 4.0.2
109 153 866 (optional)	NA	*WaveStar BandWidth Manager Release 4.1 Documents CD-ROM*	
109 156 000 (optional)	NA	Spare Release 4.1 Software CD-ROM	

R4.1 upgrade from R3.1.x

The following table lists the orderable items for WaveStar BandWidth Manager, Release 4.1 software upgrade from Release 3.1.x (3.1.0, 3.1.1, 3.1.2, 3.1.3) software.

Table 7-18 R4.1 from R3.1.x Software Upgrade

Comcode	Group	Description	Notes
109 155 986 (required)	NA	Release 4.1 Upgrade Software CD-ROM and the Software Release Description (SRD)	Upgrade from 3.1.0 Upgrade from 3.1.1 Upgrade from 3.1.2 Upgrade from 3.1.3
109 153 866 (optional)	NA	*WaveStar BandWidth Manager* *Release 4.1 Documents CD-ROM*	
109 156 000 (optional)	NA	Spare Release 4.1 Software CD-ROM	

R4.1 upgrade from R3.0.x

Important! Be sure to order the correct comcode for either NEBS Level 3 equipment or NEBS Level 2 equipment.

The following table lists the orderable items for WaveStar BandWidth Manager Release 4.1 software upgrade from Release 3.0.x (3.0.15, 3.0.16) software.

Table 7-19 R4.1 from R3.0.x Software Upgrade

Comcode	Group	Description	Notes
848 821 302 (required)	NA	• Release 4.1 Upgrade Software CD-ROM and the Software Release Description (SRD) • three CTL/SYS50D (LEY20BE) circuit packs • one ADJCTL/DCC (LEY2AE) circuit pack • two LAN jumper cables	**NEBS Level 3** Upgrade from 3.0.15 Upgrade from 3.0.16
848 821 294 (required)	NA	• Release 4.1 Upgrade Software CD-ROM and the Software Release Description (SRD) • three CTL/SYS50D (LEY20B) circuit packs • one ADJCTL/DCC (LEY2) circuit pack • two LAN jumper cables	**NEBS Level 2** Upgrade from 3.0.15 Upgrade from 3.0.16
109 153 866 (optional)	NA	*WaveStar BandWidth Manager* *Release 4.1 Documents CD-ROM*	
109 156 000 (optional)	NA	Spare Release 4.1 Software CD-ROM	

R4.1 upgrade from R2

Important! WaveStar BandWidth Manager does not support a direct upgrade from Release 2 to Release 4.1. You must upgrade from R2 to R3.0 (the following table), then from R3.0.16 to R4.1 (the preceding table).

The following table lists the orderable items for WaveStar BandWidth Manager, R3.0 software upgrade from R2.

Table 7-20 R3.0 from R2 Software Upgrade

Comcode	Group	Description	Notes
109 136 622 (required)	NA	Release 3.0 Upgrade Software CD-ROM and the Software Release Description (SRD)	
108 847 104 (optional)	NA	*WaveStar BandWidth Manager User Operations Guide, Release 3.0* (365-370-109 R3.0)	
		WaveStar BandWidth Manager Alarm Messages and Troubleclearing Guide, Release 3.0 (365-370-110 R3.0)	
109 136 465 (optional)	NA	Spare Release 3.0 Software Upgrade CD-ROM	

R4.1 upgrade from R1.3

Important! WaveStar BandWidth Manager does not support a direct upgrade from Release 1.3 to Release 4.1.You must upgrade from R1.3 to R2 (the following table), then from R2 to R3.0 (the preceding table), and then from R3.0.16 to R4.1.

The following table lists the orderable items for WaveStar BandWidth Manager, R2 software upgrade from R1.3.

Table 7-21 R2 from R1.3 Software Upgrade

Drawing/ Comcode	Group	Description	Notes
108 831 025 (required)	NA	Release 2 Upgrade Software CD-ROM and the Software Release Description (SRD)	
ED9C280-40 (optional)	GC	*WaveStar BandWidth Manager User Operations Guide, Release 2* (365-370-109 R2)	
		WaveStar BandWidth Manager Alarm Messages and Troubleclearing Guide, Release 2 (365-370-110 R2)	
108 831 058 (optional)	NA	Spare Release 2 Software Upgrade CD-ROM	



Ordering Cables and Connectors

Overview

Refer to the correct ED9C280-xx (-11, -12, or -13), WaveStar BandWidth Manager Cable Assembly Kits, to engineer the cabling for your specific platform.

Cable drawings

The following table lists the appropriate cable drawings for the different types of platforms.

Table 7-22 Cable Drawings

Drawing	Description	Notes
ED9C280-28	Cable Assembly Kit for Release 3.1 and below	DA: Effective 6/01/02 Replaced by: ED9C280-12
ED9C280-11	Cable Assembly Kit for Reduced Footprints: R4.0 and above	Available 7/01/01
ED9C280-12	Cable Assembly Kit for Standard Footprints: R4.0 and above	Available 7/01/01
ED9C280-13	Cable Assembly Kit for Standard and Reduced Footprints with the cable racking greater than 11.5 ft/3.5 m above the floor or for raised-floor platforms with cable-rack depths of greater than 1 ft/305 mm: R4.0 above	Available 7/01/01

Control/Switch Complex cables

This section lists cable kits required for each Control/Switch Complex. Each kit includes 22 cables.

Each WaveStar BandWidth Manager platform requires one kit from the following table.

Table 7-23 External Timing Cables

Drawing	Comcode	Description	Notes
ED9C280-11 ED9C280-12 ED9C280-13	848 772 133	2-Bay Control/Switch Complex	
ED9C280-12	848 772 125	3-Bay Control/Switch Complex	DA: Effective 6/01/02

Important! Refer to the individual ED9C280-xx (-11, -12, and -13) Cable Assembly Kits for the details of these kits.

External timing cables

This section lists cables required between the timing cables for external timing (primary and secondary timing cables are included and connectors where applicable).

Each WaveStar BandWidth Manager platform requires one kit from the following table.

Table 7-24 External Timing Cables

Drawing	Comcode	Description	Notes
ED9C280-11 ED9C280-12 ED9C280-13	848 772 513	System Controller Shelf to Customer Timing Source Cable Kit for Office Timing Applications DS1 Timing 50 ft/15,240 mm	
	848 772 521	System Controller Shelf to Customer Timing Source Cable Kit for Office Timing Applications DS1 Timing: 150 ft/45,720 mm	
	848 772 539	System Controller Shelf to Customer Timing Source Cable Kit for Office Timing Applications DS1 Timing: 300 ft/91,440 mm	
ED9C280-11 ED9C280-12 ED9C280-13	848 772 505	System Controller Shelf to Customer Timing Source Cable Kit for Office Timing Applications E1 Timing (75 ohm, 43-type connectors): 50 ft/15,240 mm	
	848 772 497	System Controller Shelf to Customer Timing Source Cable Kit for Office Timing Applications E1 Timing (75 ohm, 43-type connectors): 150 ft/45,720 mm	
	848 772 489	System Controller Shelf to Customer Timing Source Cable Kit for Office Timing Applications E1 Timing (75 ohm, 43-type connectors): 250 ft/76,200 mm	

Drawing	Comcode	Description	Notes
ED9C280-11 ED9C280-12 ED9C280-13	848 772 448	System Controller Shelf to Customer Timing Source Cable Kit for Office Timing Applications E1 Timing (75 ohm, 1.6/5.6-type connectors): 50 ft/15,240 mm	
	848 772 430	System Controller Shelf to Customer Timing Source Cable Kit for Office Timing Applications E1 Timing (75 ohm, 1.6/5.6-type connectors): 150 ft/45,720 mm	
	848 772 455	System Controller Shelf to Customer Timing Source Cable Kit for Office Timing Applications E1 Timing (75 ohm, 1.6/5.6-type connectors): 250 ft/76,200 mm	
ED9C280-11 ED9C280-12 ED9C280-13	848 772 422	System Controller Shelf to Customer Timing Source Cable Kit for Office Timing Applications E1 Timing (120 ohm): 50 ft/15,240 mm	
	848 772 463	System Controller Shelf to Customer Timing Source Cable Kit for Office Timing Applications E1 Timing (120 ohm): 150 ft/45,720 mm	
	848 772 471	System Controller Shelf to Customer Timing Source Cable Kit for Office Timing Applications E1 Timing (120 ohm): 300 ft/91,440 mm	

I/O to switch cables

Every pair of SWIF packs (ED9C280-31, G100/G100E and ED9C280-31, G110/G110E) in your I/O Shelves (Universal I/O Shelves, SDH Universal I/O Shelves, and 10G I/O Shelves) requires one kit from the appropriate table in this section. If an I/O Shelf is equipped with two pairs of SWIF packs, it requires two cable kits. If a 10G I/O Shelf is equipped with three pairs of SWIF packs, it requires three cable kits. If a 10G I/O Shelf is equipped with four pairs of SWIF packs, it requires four cable kits.

Important! The 4608/1536 platform supports a maximum of 48 SWIF pairs (48 x 96 STS-1s = 4068/48 x 32 STM-1s = 1536). Therefore, maximum number of I/O to switch cable kits that a platform could require is 48 kits.

Reduced footprints: ED9C280-11

The following table lists the cables between the I/O Shelves (one for each SWIF pair) and the Switch Shelves for a reduced-footprint platform.

Table 7-25 I/O to Switch Cables: ED9C280-11

Drawing	Comcode	Description	Notes
ED9C280-11	848 749 834	I/O Shelf to Switch Shelves Cable Kit: 25 ft/7,620 mm	
	848 749 792	I/O Shelf to Switch Shelves Cable Kit: 30 ft/7,742 mm	
	848 749 842	I/O Shelf to Switch Shelves Cable Kit: 35 ft/10,668 mm	
	848 749 859	I/O Shelf to Switch Shelves Cable Kit: 40 ft/12,192 mm	
	848 773 859	I/O Shelf to Switch Shelves Cable Kit: 45 ft/13,716 mm	
	848 785 457	I/O Shelf to Switch Shelves Cable Kit: 50 ft/15,240	

Important! Refer to ED9C280-11 for the bay layout positions.

Standard footprints: ED9C280-12

The following table lists the cables between the I/O Shelves (one for each SWIF pair) and the Switch Shelves for a standard platform.

Table 7-26 I/O to Switch Cables: ED9C280-12

Drawing	Comcode	Description	Notes
ED9C280-12	848 749 792	I/O Shelf to Switch Shelves Cable Kit	
	848 749 842	I/O Shelf to Switch Shelves Cable Kit	
	848 783 734	I/O Shelf to Switch Shelves Cable Kit	
	848 749 859	I/O Shelf to Switch Shelves Cable Kit	
	848 783 791	I/O Shelf to Switch Shelves Cable Kit	
	848 784 096	I/O Shelf to Switch Shelves Cable Kit	
	848 784 070	I/O Shelf to Switch Shelves Cable Kit	
	848 784 088	I/O Shelf to Switch Shelves Cable Kit	
	848 773 859	I/O Shelf to Switch Shelves Cable Kit	

Important! Refer to ED9C280-12 for the cable lengths and bay layout positions.

Raised-floor footprints: ED9C280-13

The following table lists the cables between the I/O Shelves (one for each SWIF pair) and the Switch Shelves for a raised-floor platform.

Table 7-27 I/O to Switch Cables: ED9C280-13

Drawing	Comcode	Description	Notes
ED9C280-13	848 749 792	I/O Shelf to Switch Shelves Cable Kit: 30 ft/7,742 mm	
	848 749 842	I/O Shelf to Switch Shelves Cable Kit: 35 ft/10,668 mm	
	848 749 859	I/O Shelf to Switch Shelves Cable Kit: 40 ft/12,192 mm	
	848 773 859	I/O Shelf to Switch Shelves Cable Kit: 45 ft/13,716 mm	
	848 785 457	I/O Shelf to Switch Shelves Cable Kit: 50 ft/15,240	
	848 785 473	I/O Shelf to Switch Shelves Cable Kit: 55 ft/16,764	Limited Availability

Important! Refer to ED9C280-13 for the bay layout positions.

I/O to control cables

Every I/O Shelf (Universal I/O Shelves, SDH Universal I/O Shelves, and 10G I/O Shelves) in your platform requires one kit the appropriate table in this section).

Each kit includes two I/O Shelf to System Controller Shelf (Unit Interface [UI]) cables and one visual alarm mult cable (I/O to I/O).

Reduced footprint: ED9C280-11

The following table lists the cables between the I/O Shelves and the System Controller Shelf for a reduced-footprint platform.

Table 7-28 I/O to Control Cables: ED9C280-11

Drawing	Comcode	Description	Notes
ED9C280-11	848 749 891	I/O Shelf to System Controller Shelf Cable Kit: 25 ft/7,620 mm	
	848 749 875	I/O Shelf to System Controller Shelf Cable Kit: 30 ft/7,742 mm	
	848 749 925	I/O Shelf to System Controller Shelf Cable Kit: 35 ft/10,668 mm	
	848 749 933	I/O Shelf to System Controller Shelf Cable Kit: 40 ft/12,192 mm	
	848 749 941	I/O Shelf to System Controller Shelf Cable Kit: 45 ft/13,716 mm	
	848 749 958	I/O Shelf to System Controller Shelf Cable Kit: 50 ft/15,240	

Standard footprint: ED9C280-12

The following table lists the cables between the I/O Shelves and the System Controller Shelf for a standard-footprint platform.

Table 7-29 I/O to Control Cables: ED9C280-12

Drawing	Comcode	Description	Notes
ED9C280-12	848 749 891	I/O Shelf to System Controller Shelf Cable Kit: 25 ft/7,620 mm	
	848 749 875	I/O Shelf to System Controller Shelf Cable Kit: 30 ft/7,742 mm	
	848 749 925	I/O Shelf to System Controller Shelf Cable Kit: 35 ft/10,668 mm	
	848 749 933	I/O Shelf to System Controller Shelf Cable Kit: 40 ft/12,192 mm	
	848 749 941	I/O Shelf to System Controller Shelf Cable Kit: 45 ft/13,716 mm	

Raised-floor footprint: ED9C280-13

The following table lists the cables between the I/O Shelves and the System Controller Shelf for a raised-floor platform.

Table 7-30 I/O to Control Cables: ED9C280-13

Drawing	Comcode	Description	Notes
ED9C280-13	848 749 875	I/O Shelf to System Controller Shelf Cable Kit: 30 ft/7,742 mm	
	848 749 925	I/O Shelf to System Controller Shelf Cable Kit: 35 ft/10,668 mm	
	848 749 933	I/O Shelf to System Controller Shelf Cable Kit: 40 ft/12,192 mm	
	848 749 941	I/O Shelf to System Controller Shelf Cable Kit: 45 ft/13,716 mm	
	848 749 958	I/O Shelf to System Controller Shelf Cable Kit: 50 ft/15,240	
	848 756 615	I/O Shelf to System Controller Shelf Cable Kit: 55 ft/16,764 mm	

Bay line-up cables

The first I/O Bay (Universal I/O Bay, 10G I/O Bay, 10G/Universal I/O Bay, SDH I/O Bay, or 10G/SDH I/O Bay) in every bay line-up requires one kit from the following table. Each kit includes one office alarm cable and one 10Base-T LAN cable.

Table 7-31 Bay Line-Up Cables

Drawing	Comcode	Description	Notes
ED9C280-11 ED9C280-12 ED9C280-13	109 068 361	First I/O Bay in a Bay Line-Up Cable Kit: 50 ft/15,240 mm	
	109 068 379	First I/O Bay in a Bay Line-Up Cable Kit: 100 ft/30,480 mm	
	109 068 387	First I/O Bay in a Bay Line-Up Cable Kit: 150 ft/45,720 mm	

Important! If you are engineering an ETSI platform, you must also order a cable management bay for the first I/O Bay in each I/O bay line-up: ED9C280-42, G2 for standard footprints or ED9C280-42, G3 for reduced footprints.

Power cables

This section lists the power cables for all the shelves in your platform. These power cables provide very low loop voltage drop between the secondary power distribution point and the shelves.

If you engineer a specific voltage drop in order to use smaller gauge wire, these cables may also be used for other shelves.

Information to support engineered cable applications is provided in the cable drawings ED9C280-11, -12, and -13.

Important! Every shelf in your platform requires one kit from this section. Use the table appropriate for each type of shelf. If you choose to supply your own cables, you must order the 45-amp connectors (System Controller Shelf, Switch Shelves, Universal I/O Shelves, and SDH Universal I/O Shelves) or 65-amp connectors (10G I/O Shelves).

System Controller Shelf

Every System Controller Shelf in your platform requires cable kit from the following table. Each kit includes two 6-gauge (16 mm) power cables for the A and B power feeders.

Table 7-32 Power Cables for a System Controller Shelf

Drawing	Comcode	Description	Notes
ED9C280-11 ED9C280-12 ED9C280-13	848 773 073	Power Cables for each System Controller Shelf: 12 ft/3,658 mm	
	848 773 107	Power Cables for each System Controller Shelf: 50 ft/15,240 mm	
	848 773 115	Power Cables for each System Controller Shelf: 75 ft/22,860 mm	

Switch Shelf

Every Switch Shelf in your platform requires one kit from the following table.

Table 7-33 Power Cables for a Switch Shelf

Drawing	Comcode	Description	Notes
ED9C280-11 ED9C280-12 ED9C280-13	848 773 073	6-gauge (16 mm) Power Cables for each Switch Shelf: 12 ft/3,658 mm	
	848 773 081	4-gauge (25 mm) Power Cables for each Switch Shelf: 50 ft/15,240 mm	
	848 773 099	2-gauge (35 mm) Power Cables for each Switch Shelf: 70 ft/21,336 mm	

Universal I/O Shelf

Every Universal I/O Shelf in your platform requires one kit from the following table.

Table 7-34 Power Cables for a Universal I/O Shelf

Drawing	Comcode	Description	Notes
ED9C280-11 ED9C280-12 ED9C280-13	848 773 073	6-gauge (16 mm) Power Cables for each Universal I/O Shelf: 12 ft/3,658 mm	
	848 773 081	4-gauge (25 mm) Power Cables for each Universal I/O Shelf: 50 ft/15,240 mm	
	848 773 099	2-gauge (35 mm) Power Cables for each Universal I/O Shelf: 70 ft/21,336 mm	

SDH Universal I/O Shelf

Every SDH Universal I/O Shelf in your platform requires one kit from the following table.

Table 7-35 Power Cables for an SDH Universal I/O Shelf

Drawing	Comcode	Description	Notes
ED9C280-11 ED9C280-12 ED9C280-13	848 773 073	6-gauge (16 mm) Power Cables for each SDH Universal I/O Shelf: 12 ft/3,658 mm	
	848 773 081	4-gauge (25 mm) Power Cables for each SDH Universal I/O Shelf: 50 ft/15,240 mm	
	848 773 099	2-gauge (35 mm) Power Cables for each SDH Universal I/O Shelf: 70 ft/21,336 mm	

10G I/O Shelf

Every 10G I/O Shelf in your platform requires one kit from the following table.

Table 7-36 Power Cables for a 10G I/O Shelf

Drawing	Comcode	Description	Notes
ED9C280-11 ED9C280-12 ED9C280-13	848 773 123	6-gauge (16 mm) Power Cables for each 10G I/O Shelf: 12 ft/3,658 mm	
	848 773 131	4-gauge (25 mm) Power Cables for each 10G I/O Shelf: 30 ft/ 9.144 mm	
	848 773 149	2-gauge (35 mm) Power Cables for each 10G I/O Shelf: 50 ft/15,240 mm	

Important! All kits must be carefully engineered using ED9C280-11, -12, or -13.

RS-232 interface adapter

The System Controller Shelf can accept an optional RS-232 interface adapter to provide duplicated RS-232 interfaces. If you wish to use the RS-232 interface, you must order the interface adapter kit from the following table.

Table 7-37 Timing Adapter for Wire-Wrap

Comcode	Description	Notes
848 815 718	RS-232 Interface Adaptor Kit	

Timing adapter

The System Controller Shelf is equipped with two timing connectors on the rear of the shelf. If you wish to wire-wrap, you must order the timing adapter kit from the following table.

Table 7-38 Timing Adapter for Wire-Wrap

Comcode	Description	Notes
848 821 096	Timing Adapter Kit (Two Adapters for One System Controller Shelf and a 50 ft/1,524 mm DS1 22-Gauge Timing Cable)	
848 821 104	Timing Adapter Kit (Two Adapters for One System Controller Shelf and a 100 ft/1,524 mm DS1 22-Gauge Timing Cable)	
848 821 112	Timing Adapter Kit (Two Adapters for One System Controller Shelf and a 150 ft/4,572 mm DS1 22-Gauge Timing Cable)	
848 821 120	Timing Adapter Kit (Two Adapters for One System Controller Shelf and a 250 ft/7,620 mm DS1 22-Gauge Timing Cable)	
848 821 138	Timing Adapter Kit (Two Adapters for One System Controller Shelf and a 450 ft/13,716 mm DS1 22-Gauge Timing Cable)	

Visual alarm mult cable

I/O Shelves that were installed in R3.1 or earlier, may require a visual alarm mult cable for I/O Shelves. If you are using the ED9C280-12 Cable Assembly Kit, you may order a alarm mult cable from the following table.

Table 7-39 Visual Alarm Mult Cable

Comcode	Description	Notes
848 752 549	Visual Alarm Mult Cable (4 ft/1219 mm)	

45- and 65-amp connectors

Each System Controller Shelf, Switch Shelf, Universal I/O Shelf, or SDH Universal I/O Shelf in the platform with customer-supplied wiring requires one kit from the following table.

Table 7-40 45-Amp Connectors for System Controller Shelf, Switch Shelf, Universal I/O Shelf, and SDH Universal I/O Shelf

Drawing	Group	Description	Notes
ED9C280-11	848 771 861	Two 45-Amp Connectors: 2-gauge (35 mm) wire	
ED9C280-12	848 771 853	Two 45-Amp Connectors: 4-gauge (25 mm) wire	
ED9C280-13	848 771 846	Two 45-Amp Connectors: 6-gauge (16 mm) wire	

Every 10G I/O Shelf in the platform with customer-supplied wiring requires one kit from the following table.

Table 7-41 65-Amp Connectors for 10G I/IO Shelf

Drawing	Group	Description	Notes
ED9C280-11	848 771 887	Two 65-Amp Connectors: 2-gauge (35 mm) wire	
ED9C280-12	848 771 879	Two 65-Amp Connectors: 4-gauge (25 mm) wire	
ED9C280-13	848 771 895	Two 65-Amp Connectors: 6-gauge (16 mm) wire	

Null modem adapter

The System Controller Shelf supports a null modem adapter for RJ-45-male to RJ-45-female connectors. If you require a null modem adapter, order one null modem adapter kit from the following table.

Table 7-42 Null Modem Adapter for RJ-45 to RJ-45 Adapter

Comcode	Description	Notes
408 357 903	Null Modem Adapter Kit	

Optical attenuators

The OLS-compatible port units (OC48/STM16/DWDM, OC48/STM16/WDM, and OC192/STM64/WDM) are factory-equipped with LC-type 0 dB optical attenuators. All other optical port units are factory-equipped with SC-type 0 db optical attenuators. Each kit includes a 0 dB, 5 dB, 10 dB, 15 dB, and a 20 dB attenuator. If you wish to change the attenuation or the type of connector, you must order a optical attenuator kit from either of the following two tables.

Single-Mode to Single-Mode (SM-SM)

The following table lists the optical attenuator kits as well as the individual LBOS/optical attenuators for the transmit connectors and receive connectors for the OC192/STM64 and OC48/STM16 port units. These SM-SM optical attenuator kits are also for the transmit connectors on the OC12/STM4 and OC3/STM1 port units.

Table 7-43 Single-Mode to Single-Mode Optical Attenuators

Product Code	Comcode	Description		Notes
		Power Level	Color	
ST-Type Optical Attenuators (SM-SM)				
NA	108 812 231	ST-Type SM-SM Optical Attenuator Kit		
A3070	106 795 354	0 dB	White or Blue	
ASTS5	108 053 091	5 dB	Yellow or Green	
ASTS10	108 053 190	10 dB		
ASTS15	108 053 240	15 dB		
ASTS20	108 053 273	20 dB		
FC-Type Optical Attenuators (SM-SM)				
NA	108 812 249	FC-Type SM-SM Optical Attenuator Kit		
A3080	106 795 404	0 dB	White or Blue	
AFCS5	108 107 095	5 dB	Yellow or Green	
AFCS10	108 107 194	10 dB		
AFCS15	108 107 244	15 dB		
AFCS20	108 107 277	20 dB		
SC-Type Optical Attenuators (SM-SM)				
NA	108 812 256	SC-Type SM-SM Optical Attenuator Kit		
A3060	106 708 951	0 dB	White or Blue	
ASCS5	108 314 501	5 dB	Yellow or Green	
ASCS10	108 314 600	10 dB		
ASCS15	108 440 538	15 dB		
ASCS20	108 440 561	20 dB		

Important! All 0 dB (SM-SM or SM-MM) LBOs/optical attenuators are either white or blue. All other SM-SM LBOs/optical attenuators are either yellow or green. All other SM-MM LBOs/optical attenuators are either beige or gray.

Single-Mode to Multi-Mode (SM-MM)

The following table lists the SM-MM optical attenuator kits as well as the individual SM-MM LBOs/optical attenuators for the receive connectors on the OC12/STM4 and OC3/STM1 port units.

Table 7-44 Single-Mode to Multi-Mode Optical Attenuators

Product Code	Comcode	Description		Notes
		Power Level	Color	
ST-Type Optical Attenuators (SM-MM)				
NA	108 812 207	ST-Type SM-MM Optical Attenuator Kit		
A3070	106 795 354	0 dB	White or Blue	
ASTM5	108 052 960	5 dB	Beige or Gray	
ASTM10	108 052 994	10 dB		
ASTM15	108 053 018	15 dB		
ASTM20	108 053 042	20 dB		
FC-Type Optical Attenuators (SM-MM)				
NA	108 812 215	FC-Type SM-MM Optical Attenuator Kit		
A3080	106 795 404	0 dB	White or Blue	
AFCM5	108 107 285	5 dB	Beige or Gray	
AFCM10	108 107 301	10 dB		
AFCM15	108 107 327	15 dB		
AFCM20	108 107 343	20 dB		
SC-Type Optical Attenuators (SM-MM)				
NA	108 812 223	SC-Type SM-MM Optical Attenuator Kit		
A3060	106 708 951	0 dB	White or Blue	
ASCM5	108 440 579	5 dB	Beige or Gray	
ASCM10	108 440 595	10 dB		
ASCM15	108 440 611	15 dB		
ASCM20	108 440 637	20 dB		

Important! All 0 dB (SM-SM or SM-MM) LBOs/optical attenuators are either white or blue. All other SM-SM LBOs/optical attenuators are either yellow or green. All other SM-MM LBOs/optical attenuators are either beige or gray.

Ordering NEBS Level 3 Port Units

Overview

If you are engineering a NEBS Level 3 compliant platform, be sure to refer to the tables for NEBS Level 3 equipment for wired-equipment, circuit pack kits, and all individual port units. You must also order NEBS Level 3 spares for NEBS Level 3 circuit packs and port units.

> **Important!** You cannot install NEBS Level 2 circuit packs or port units in NEBS Level 3 wired-equipment.

Port units

The following table lists the NEBS Level 3 compliant OC192/STM64, OC48/STM16, OC12/STM4, and OC3/STM1 port units.

Table 7-45 NEBS Level 3 Port Units

Comcodes	Apparatus Codes	Description	Notes
108 735 184	LEY7AE	OC48/STM16/1.3LR1	
108 735 192	LEY8AE	OC48/STM16/1.5LR1	
108 730 441	LEY13AE	OC12/STM4/1.3LR2	
108 730 557	LEY14AE	OC12/STM4/1.3SR2	
108 730 813	LEY15AE	OC3/STM1/1.3LR4	
108 730 821	LEY16AE	OC3/STM1/1.3SR4	
108 733 445	LEY17AE	DS3EC1/8	
108 775 404	LEY43AE	STM1E/4	
NA	LEY67AE	OC192/STM64/1.5SR1	DA: Effective 12/00
109 174 052	LEY69AE	OC192/STM64/1.5IR1	
109 174 078	LEY97AE	OC192/STM64/1.5IRS1	

OC48/STM16 DWDM port units

The following table lists the NEBS Level 3 compliant OC48/STM16/DWDM port units (16 wavelengths).

Table 7-46 NEBS Level 3 Compliant OC48/STM16/DWDM Port Units (16 Wavelengths)

Comcodes	Apparatus Codes	Description	Notes
108 734 666	LEY50AE	OC48/STM16/DWDM01	
108 734 674	LEY51AE	OC48/STM16/DWDM02	
108 734 682	LEY52AE	OC48/STM16/DWDM03	
108 734 690	LEY53AE	OC48/STM16/DWDM04	
108 734 708	LEY54AE	OC48/STM16/DWDM05	
108 734 716	LEY55AE	OC48/STM16/DWDM06	
108 734 724	LEY56AE	OC48/STM16/DWDM07	
108 734 732	LEY57AE	OC48/STM16/DWDM08	
108 734 740	LEY58AE	OC48/STM16/DWDM09	
108 734 757	LEY59AE	OC48/STM16/DWDM10	
108 734 765	LEY60AE	OC48/STM16/DWDM11	
108 734 773	LEY61AE	OC48/STM16/DWDM12	
108 734 781	LEY62AE	OC48/STM16/DWDM13	
108 734 799	LEY63AE	OC48/STM16/DWDM14	
108 734 807	LEY64AE	OC48/STM16/DWDM15	
108 734 815	LEY65AE	OC48/STM16/DWDM16	

OC48/STM16 passive port units

The following table lists the NEBS Level 3 compliant OC48/STM16/POU passive port units (16 wavelengths).

Table 7-47 NEBS Level 3 Compliant OC48/STM16/POU Passive Port Units (16 Wavelengths)

Comcodes	Apparatus Codes	Description	Notes
108 734 955	LEY80AE	OC48/STM16/POU9590	
108 734 963	LEY81AE	OC48/STM16/POU9570	
108 734 971	LEY82AE	OC48/STM16/POU9550	
108 734 989	LEY83AE	OC48/STM16/POU9530	
108 735 002	LEY84AE	OC48/STM16/POU9490	
108 735 010	LEY85AE	OC48/STM16/POU9470	
108 735 028	LEY86AE	OC48/STM16/POU9450	
108 735 036	LEY87AE	OC48/STM16/POU9430	
108 735 044	LEY88AE	OC48/STM16/POU9370	
108 735 051	LEY89AE	OC48/STM16/POU9350	
108 735 069	LEY90AE	OC48/STM16/POU9330	
108 735 077	LEY91AE	OC48/STM16/POU9310	
108 735 085	LEY92AE	OC48/STM16/POU9270	
108 735 093	LEY93AE	OC48/STM16/POU9250	
108 735 101	LEY94AE	OC48/STM16/POU9230	
108 735 119	LEY95AE	OC48/STM16/POU9210	

Important! Contact your Account Executive to order the 8-Mux/8-Demux and/or 16-Mux + 16-Demux Passive Optics Boxes.

OC48/STM16 WDM port units

The following table lists the NEBS Level 3 compliant OC48/STM16/WDM port units (80 wavelengths).

Table 7-48 NEBS Level 3 Compliant OC48/STM16/WDM Port Units (80 Wavelengths)

Comcodes	Apparatus Codes	Description	Notes
108 730 110	LEY101AE	OC48/STM16/WDM9585	
108 730 128	LEY102AE	OC48/STM16/WDM9580	
108 730 136	LEY103AE	OC48/STM16/WDM9575	
108 730 144	LEY104AE	OC48/STM16/WDM9570	
108 730 151	LEY105AE	OC48/STM16/WDM9565	
108 730 169	LEY106AE	OC48/STM16/WDM9560	
108 730 185	LEY107AE	OC48/STM16/WDM9555	
108 730 193	LEY108AE	OC48/STM16/WDM9550	
108 730 219	LEY109AE	OC48/STM16/WDM9545	
108 730 235	LEY110AE	OC48/STM16/WDM9540	
108 730 243	LEY111AE	OC48/STM16/WDM9535	
108 730 250	LEY112AE	OC48/STM16/WDM9530	
108 730 268	LEY113AE	OC48/STM16/WDM9535	
108 730 284	LEY114AE	OC48/STM16/WDM9520	
108 730 292	LEY115AE	OC48/STM16/WDM9515	
108 730 300	LEY116AE	OC48/STM16/WDM9510	
108 730 318	LEY117AE	OC48/STM16/WDM9505	
108 730 326	LEY118AE	OC48/STM16/WDM9500	
108 730 334	LEY119AE	OC48/STM16/WDM9495	
108 730 342	LEY120AE	OC48/STM16/WDM9490	
108 730 359	LEY121AE	OC48/STM16/WDM9485	
108 730 367	LEY122AE	OC48/STM16/WDM9480	
108 730 375	LEY123AE	OC48/STM16/WDM9475	
108 730 383	LEY124AE	OC48/STM16/WDM9470	
108 730 391	LEY125AE	OC48/STM16/WDM9465	
108 730 409	LEY126AE	OC48/STM16/WDM9460	
108 730 417	LEY127AE	OC48/STM16/WDM9455	

Comcodes	Apparatus Codes	Description	Notes
108 730 425	LEY128AE	OC48/STM16/WDM9450	
108 730 433	LEY129AE	OC48/STM16/WDM9445	
108 730 458	LEY130AE	OC48/STM16/WDM9440	
108 730 466	LEY131AE	OC48/STM16/WDM9435	
108 730 474	LEY132AE	OC48/STM16/WDM9430	
108 730 482	LEY133AE	OC48/STM16/WDM9425	
108 730 490	LEY134AE	OC48/STM16/WDM9420	
108 730 508	LEY135AE	OC48/STM16/WDM9415	
108 730 516	LEY136AE	OC48/STM16/WDM9410	
108 730 524	LEY137AE	OC48/STM16/WDM9405	
108 730 532	LEY138AE	OC48/STM16/WDM9400	
108 730 540	LEY139AE	OC48/STM16/WDM9395	
108 730 565	LEY140AE	OC48/STM16/WDM9390	
108 730 573	LEY141AE	OC48/STM16/WDM9385	
108 730 581	LEY142AE	OC48/STM16/WDM9380	
108 730 599	LEY143AE	OC48/STM16/WDM9375	
108 730 607	LEY144AE	OC48/STM16/WDM9370	
108 730 615	LEY145AE	OC48/STM16/WDM9365	
108 730 623	LEY146AE	OC48/STM16/WDM9360	
108 730 631	LEY147AE	OC48/STM16/WDM9355	
108 730 649	LEY148AE	OC48/STM16/WDM9350	
108 730 656	LEY149AE	OC48/STM16/WDM9345	
108 730 664	LEY150AE	OC48/STM16/WDM9340	
108 730 672	LEY151AE	OC48/STM16/WDM9335	
108 730 680	LEY152AE	OC48/STM16/WDM9330	
108 730 698	LEY153AE	OC48/STM16/WDM9325	
108 730 706	LEY154AE	OC48/STM16/WDM9320	
108 730 714	LEY155AE	OC48/STM16/WDM9315	
108 730 722	LEY156AE	OC48/STM16/WDM9310	
108 730 730	LEY157AE	OC48/STM16/WDM9305	
108 730 748	LEY158AE	OC48/STM16/WDM9300	

Comcodes	Apparatus Codes	Description	Notes
108 730 755	LEY159AE	OC48/STM16/WDM9295	
108 730 763	LEY160AE	OC48/STM16/WDM9290	
108 730 771	LEY161AE	OC48/STM16/WDM9285	
108 730 789	LEY162AE	OC48/STM16/WDM9280	
108 730 797	LEY163AE	OC48/STM16/WDM9275	
108 730 805	LEY164AE	OC48/STM16/WDM9270	
108 732 991	LEY165AE	OC48/STM16/WDM9265	
108 733 007	LEY166AE	OC48/STM16/WDM9260	
108 733 015	LEY167AE	OC48/STM16/WDM9255	
108 733 023	LEY168AE	OC48/STM16/WDM9250	
108 733 031	LEY169AE	OC48/STM16/WDM9245	
108 733 049	LEY170AE	OC48/STM16/WDM9240	
108 733 056	LEY171AE	OC48/STM16/WDM9235	
108 733 064	LEY172AE	OC48/STM16/WDM9230	
108 733 072	LEY173AE	OC48/STM16/WDM9225	
108 733 080	LEY174AE	OC48/STM16/WDM9220	
108 733 098	LEY175AE	OC48/STM16/WDM9215	
108 733 106	LEY176AE	OC48/STM16/WDM9210	
108 733 122	LEY177AE	OC48/STM16/WDM9205	
108 733 130	LEY178AE	OC48/STM16/WDM9200	
108 733 148	LEY179AE	OC48/STM16/WDM9195	
108 733 155	LEY180AE	OC48/STM16/WDM9190	

OC192/STM64 WDM port units

The following table lists the NEBS Level 3 compliant OC192/STM64/WDM port units (40 wavelengths).

Table 7-49 NEBS Level 3 Compliant OC192/STM64/WDM Port Units (40 Wavelengths)

Comcodes	Apparatus Codes	Description	Notes
109 178 996	LEY201AE	OC192/STM64/WDM9580	
109 179 028	LEY202AE	OC192/STM64/WDM9570	
109 179 036	LEY203AE	OC192/STM64/WDM9560	
109 179 051	LEY204AE	OC192/STM64/WDM9550	
109 179 523	LEY205AE	OC192/STM64/WDM9540	
109 179 572	LEY206AE	OC192/STM64/WDM9530	
109 179 580	LEY207AE	OC192/STM64/WDM9520	
109 179 648	LEY208AE	OC192/STM64/WDM9510	
109 179 655	LEY209AE	OC192/STM64/WDM9500	
109 179 697	LEY210AE	OC192/STM64/WDM9490	
109 179 739	LEY211AE	OC192/STM64/WDM9480	
109 179 762	LEY212AE	OC192/STM64/WDM9470	
109 179 879	LEY213AE	OC192/STM64/WDM9460	
109 179 903	LEY214AE	OC192/STM64/WDM9450	
109 179 945	LEY215AE	OC192/STM64/WDM9440	
109 179 978	LEY216AE	OC192/STM64/WDM9430	
109 179 994	LEY217AE	OC192/STM64/WDM9420	
109 180 042	LEY218AE	OC192/STM64/WDM9410	
109 180 067	LEY219AE	OC192/STM64/WDM9400	
109 181 602	LEY220AE	OC192/STM64/WDM9390	
109 181 610	LEY221AE	OC192/STM64/WDM9380	
109 181 628	LEY222AE	OC192/STM64/WDM9370	
109 181 636	LEY223AE	OC192/STM64/WDM9360	
109 181 651	LEY224AE	OC192/STM64/WDM9350	
109 176 800	LEY225AE	OC192/STM64/WDM9340	
109 181 719	LEY226AE	OC192/STM64/WDM9330	
109 176 834	LEY227AE	OC192/STM64/WDM9320	

Comcodes	Apparatus Codes	Description	Notes
109 181 743	LEY228AE	OC192/STM64/WDM9310	
109 181 750	LEY229AE	OC192/STM64/WDM9300	
109 181 768	LEY230AE	OC192/STM64/WDM9290	
109 181 792	LEY231AE	OC192/STM64/WDM9280	
109 181 800	LEY232AE	OC192/STM64/WDM9270	
109 181 818	LEY233AE	OC192/STM64/WDM9260	
109 181 826	LEY234AE	OC192/STM64/WDM9250	
109 181 834	LEY235AE	OC192/STM64/WDM9240	
109 181 859	LEY236AE	OC192/STM64/WDM9230	
109 181 867	LEY237AE	OC192/STM64/WDM9220	
109 181 875	LEY238AE	OC192/STM64/WDM9210	
109 181 883	LEY239AE	OC192/STM64/WDM9200	
109 176 917	LEY240AE	OC192/STM64/WDM9190	

OC192/STM64 passive port units

The following table lists the NEBS Level 3 compliant OC192/STM64/POU passive port units (16 wavelengths).

Table 7-50 NEBS Level 3 Compliant OC192/STM64/POU Passive Port Units (16 Wavelengths)

Comcodes	Apparatus Codes	Description	Notes
109 180 091	LEY284AE	OC192/STM64/POU9590	
109 180 117	LEY285AE	OC192/STM64/POU9570	
109 180 133	LEY286AE	OC192/STM64/POU9550	
109 180 158	LEY287AE	OC192/STM64/POU9530	
109 180 174	LEY288AE	OC192/STM64/POU9490	
109 180 190	LEY289AE	OC192/STM64/POU9470	
109 179 598	LEY290AE	OC192/STM64/POU9450	
109 179 663	LEY291AE	OC192/STM64/POU9430	
109 179 721	LEY292AE	OC192/STM64/POU9370	
109 179 788	LEY293AE	OC192/STM64/POU9350	
109 179 812	LEY294AE	OC192/STM64/POU9330	
109 179 838	LEY295AE	OC192/STM64/POU9310	
109 179 853	LEY296AE	OC192/STM64/POU9270	
109 179 895	LEY297AE	OC192/STM64/POU9250	
109 179 937	LEY298AE	OC192/STM64/POU9230	
109 180 000	LEY299AE	OC192/STM64/POU9210	

Important! Contact your Account Executive to order the 8-Mux/8-Demux and/or 16-Mux + 16-Demux Passive Optics Boxes.

□

Ordering NEBS Level 2 Port Units

Overview

This section lists the NEBS Level 2 port units.

As of December 1, 2001, the NEBS Level 2 circuit packs and port units that are available individually and for spares will be Discontinued Availability (DA). The period between 4/01 and 12/01 will give our customers enough time to migrate to NEBS Level 3 equipment and spares.

> **Important!** You cannot install NEBS Level 3 circuit packs or port units in NEBS Level 2 wired-equipment unless a mechanical modification has been performed.
> Contact your Account Executive for more information.

Port units

The following table lists the NEBS Level 2 OC192/STM64, OC48/STM16, OC12/STM4, and OC3/STM1 port units.

Table 7-51 NEBS Level 2 Port Units

Comcodes	Apparatus Codes	Description	Notes
108 679 796	LEY7	OC48/STM16/1.3LR1	DA: Effective 12/01/01
107 855 157	LEY8	OC48/STM16/1.5LR1	
107 978 041	LEY13	OC12/STM4/1.3LR2	
107 978 058	LEY14	OC12/STM4/1.3SR2	
107 978 066	LEY15	OC3/STM1/1.3LR4	
107 978 074	LEY16	OC3/STM1/1.3SR4	
107 978 082	LEY17	DS3EC1/8	
108 775 396	LEY43	STM1E/4	
NA	LEY67	OC192/STM64/1.5SR1	DA: Effective 12/00
109 174 045	LEY69	OC192/STM64/1.5IR1	DA: Effective 12/01/01
109 174 060	LEY97	OC192/STM64/1.5IRS1	

OC48/STM16 DWDM port units

The following table lists the NEBS Level 2 OC48/STM16/DWDM port units (16 wavelengths).

Table 7-52 NEBS Level 2 DWDM Port Units

Comcodes	Apparatus Codes	Description	Notes
108 206 707	LEY50	OC48/STM16/DWDM01	DA: Effective 12/01/01
108 206 715	LEY51	OC48/STM16/DWDM02	
108 206 723	LEY52	OC48/STM16/DWDM03	
108 206 731	LEY53	OC48/STM16/DWDM04	
108 206 749	LEY54	OC48/STM16/DWDM05	
108 206 756	LEY55	OC48/STM16/DWDM06	
108 206 764	LEY56	OC48/STM16/DWDM07	
108 206 772	LEY57	OC48/STM16/DWDM08	
108 206 780	LEY58	OC48/STM16/DWDM09	
108 206 798	LEY59	OC48/STM16/DWDM10	
108 216 045	LEY60	OC48/STM16/DWDM11	
108 216 052	LEY61	OC48/STM16/DWDM12	
108 216 060	LEY62	OC48/STM16/DWDM13	
108 216 078	LEY63	OC48/STM16/DWDM14	
108 216 086	LEY64	OC48/STM16/DWDM15	
108 216 094	LEY65	OC48/STM16/DWDM16	

OC48/STM16 passive port units

The following table lists the NEBS Level 2 OC48/STM16/POU passive port units (16 wavelengths).

Table 7-53 NEBS Level 2 OC48/STM16/POU Passive Port Units (16 Wavelengths)

Comcodes	Apparatus Codes	Description	Notes
108 667 171	LEY80	OC48/STM16/POU9590	DA: Effective 12/01/01
108 667 189	LEY81	OC48/STM16/POU9570	
108 667 197	LEY82	OC48/STM16/POU9550	
108 667 205	LEY83	OC48/STM16/POU9530	
108 667 213	LEY84	OC48/STM16/POU9490	
108 667 221	LEY85	OC48/STM16/POU9470	
108 667 239	LEY86	OC48/STM16/POU9450	
108 667 247	LEY87	OC48/STM16/POU9430	
108 667 254	LEY88	OC48/STM16/POU9370	
108 667 262	LEY89	OC48/STM16/POU9350	
108 667 270	LEY90	OC48/STM16/POU9330	
108 667 288	LEY91	OC48/STM16/POU9310	
108 667 296	LEY92	OC48/STM16/POU9270	
108 667 304	LEY93	OC48/STM16/POU9250	
108 667 312	LEY94	OC48/STM16/POU9230	
108 667 320	LEY95	OC48/STM16/POU9210	

Important! Contact your Account Executive to order the 8-Mux/8-Demux and/or 16-Mux + 16-Demux Passive Optics Boxes.

OC48/STM16 WDM port units

The following table lists the NEBS Level 2 OC48/STM16/WDM port units (80 wavelengths).

Table 7-54 NEBS Level 2 OC48/STM16/WDM Port Units (80 Wavelengths)

Comcodes	Apparatus Codes	Description	Notes
108 513 383	LEY101	OC48/STM16/WDM9585	
108 513 391	LEY102	OC48/STM16/WDM9580	
108 513 409	LEY103	OC48/STM16/WDM9575	
108 513 417	LEY104	OC48/STM16/WDM9570	
108 513 425	LEY105	OC48/STM16/WDM9565	
108 513 433	LEY106	OC48/STM16/WDM9560	
108 513 441	LEY107	OC48/STM16/WDM9555	
108 513 458	LEY108	OC48/STM16/WDM9550	
108 514 688	LEY109	OC48/STM16/WDM9545	
108 514 696	LEY110	OC48/STM16/WDM9540	
108 514 704	LEY111	OC48/STM16/WDM9535	
108 514 712	LEY112	OC48/STM16/WDM9530	
108 514 720	LEY113	OC48/STM16/WDM9535	
108 514 738	LEY114	OC48/STM16/WDM9520	
108 514 746	LEY115	OC48/STM16/WDM9515	
108 514 753	LEY116	OC48/STM16/WDM9510	
108 514 761	LEY117	OC48/STM16/WDM9505	
108 514 779	LEY118	OC48/STM16/WDM9500	
108 514 787	LEY119	OC48/STM16/WDM9495	
108 514 795	LEY120	OC48/STM16/WDM9490	
108 514 803	LEY121	OC48/STM16/WDM9485	
108 514 811	LEY122	OC48/STM16/WDM9480	
108 514 829	LEY123	OC48/STM16/WDM9475	
108 514 837	LEY124	OC48/STM16/WDM9470	
108 514 845	LEY125	OC48/STM16/WDM9465	
108 514 852	LEY126	OC48/STM16/WDM9460	
108 514 860	LEY127	OC48/STM16/WDM9455	

Comcodes	Apparatus Codes	Description	Notes
108 514 878	LEY128	OC48/STM16/WDM9450	
108 514 886	LEY129	OC48/STM16/WDM9445	
108 514 894	LEY130	OC48/STM16/WDM9440	
108 514 902	LEY131	OC48/STM16/WDM9435	
108 514 910	LEY132	OC48/STM16/WDM9430	
108 514 928	LEY133	OC48/STM16/WDM9425	
108 514 936	LEY134	OC48/STM16/WDM9420	
108 514 944	LEY135	OC48/STM16/WDM9415	
108 514 951	LEY136	OC48/STM16/WDM9410	
108 514 969	LEY137	OC48/STM16/WDM9405	
108 514 977	LEY138	OC48/STM16/WDM9400	
108 514 985	LEY139	OC48/STM16/WDM9395	
108 514 993	LEY140	OC48/STM16/WDM9390	
108 515 008	LEY141	OC48/STM16/WDM9385	
108 515 180	LEY142	OC48/STM16/WDM9380	
108 515 198	LEY143	OC48/STM16/WDM9375	
108 515 206	LEY144	OC48/STM16/WDM9370	
108 515 214	LEY145	OC48/STM16/WDM9365	
108 515 222	LEY146	OC48/STM16/WDM9360	
108 515 230	LEY147	OC48/STM16/WDM9355	
108 515 255	LEY148	OC48/STM16/WDM9350	
108 515 271	LEY149	OC48/STM16/WDM9345	
108 515 297	LEY150	OC48/STM16/WDM9340	
108 515 305	LEY151	OC48/STM16/WDM9335	
108 515 172	LEY152	OC48/STM16/WDM9330	
108 515 313	LEY153	OC48/STM16/WDM9325	
108 515 339	LEY154	OC48/STM16/WDM9320	
108 515 347	LEY155	OC48/STM16/WDM9315	
108 515 412	LEY156	OC48/STM16/WDM9310	
108 515 420	LEY157	OC48/STM16/WDM9305	
108 515 438	LEY158	OC48/STM16/WDM9300	

Comcodes	Apparatus Codes	Description	Notes
108 515 446	LEY159	OC48/STM16/WDM9295	
108 515 495	LEY160	OC48/STM16/WDM9290	
108 515 503	LEY161	OC48/STM16/WDM9285	
108 515 511	LEY162	OC48/STM16/WDM9280	
108 515 529	LEY163	OC48/STM16/WDM9275	
108 515 537	LEY164	OC48/STM16/WDM9270	
108 515 545	LEY165	OC48/STM16/WDM9265	
108 515 552	LEY166	OC48/STM16/WDM9260	
108 515 560	LEY167	OC48/STM16/WDM9255	
108 515 578	LEY168	OC48/STM16/WDM9250	
108 515 586	LEY169	OC48/STM16/WDM9245	
108 515 594	LEY170	OC48/STM16/WDM9240	
108 515 602	LEY171	OC48/STM16/WDM9235	
108 515 610	LEY172	OC48/STM16/WDM9230	
108 515 628	LEY173	OC48/STM16/WDM9225	
108 515 644	LEY174	OC48/STM16/WDM9220	
108 515 651	LEY175	OC48/STM16/WDM9215	
108 515 669	LEY176	OC48/STM16/WDM9210	
108 515 677	LEY177	OC48/STM16/WDM9205	
108 515 685	LEY178	OC48/STM16/WDM9200	
108 515 693	LEY179	OC48/STM16/WDM9195	
108 515 701	LEY180	OC48/STM16/WDM9190	

OC192/STM64 WDM port units

The following table lists the NEBS Level 2 OC192/STM64/WDM port units (40 wavelengths).

Table 7-55 NEBS Level 2 OC192/STM64/WDM Port Units (40 Wavelengths)

Comcodes	Apparatus Codes	Description	Notes
109 178 731	LEY201	OC192/STM64/WDM9580	
109 179 010	LEY202	OC192/STM64/WDM9570	
109 178 764	LEY203	OC192/STM64/WDM9560	
109 179 044	LEY204	OC192/STM64/WDM9550	
109 179 069	LEY205	OC192/STM64/WDM9540	
109 179 556	LEY206	OC192/STM64/WDM9530	
109 176 743	LEY207	OC192/STM64/WDM9520	
109 179 606	LEY208	OC192/STM64/WDM9510	
109 178 780	LEY209	OC192/STM64/WDM9500	
109 179 671	LEY210	OC192/STM64/WDM9490	
109 179 705	LEY211	OC192/STM64/WDM9480	
109 179 747	LEY212	OC192/STM64/WDM9470	
109 179 796	LEY213	OC192/STM64/WDM9460	
109 179 887	LEY214	OC192/STM64/WDM9450	
109 179 929	LEY215	OC192/STM64/WDM9440	
109 179 952	LEY216	OC192/STM64/WDM9430	
109 179 986	LEY217	OC192/STM64/WDM9420	
109 180 018	LEY218	OC192/STM64/WDM9410	
109 180 059	LEY219	OC192/STM64/WDM9400	
109 180 075	LEY220	OC192/STM64/WDM9390	
109 178 822	LEY221	OC192/STM64/WDM9380	
109 178 905	LEY222	OC192/STM64/WDM9370	
109 178 913	LEY223	OC192/STM64/WDM9360	
109 178 962	LEY224	OC192/STM64/WDM9350	
109 176 750	LEY225	OC192/STM64/WDM9340	
109 181 685	LEY226	OC192/STM64/WDM9330	
109 176 826	LEY227	OC192/STM64/WDM9320	

Comcodes	Apparatus Codes	Description	Notes
109 176 842	LEY228	OC192/STM64/WDM9310	
109 176 768	LEY229	OC192/STM64/WDM9300	
109 176 859	LEY230	OC192/STM64/WDM9290	
109 181 784	LEY231	OC192/STM64/WDM9280	
109 176 867	LEY232	OC192/STM64/WDM9270	
109 176 875	LEY233	OC192/STM64/WDM9260	
109 178 970	LEY234	OC192/STM64/WDM9250	
109 176 883	LEY235	OC192/STM64/WDM9240	
109 181 842	LEY236	OC192/STM64/WDM9230	
109 176 776	LEY237	OC192/STM64/WDM9220	
109 176 891	LEY238	OC192/STM64/WDM9210	
109 178 988	LEY239	OC192/STM64/WDM9200	
109 176 909	LEY240	OC192/STM64/WDM9190	

OC192/STM64 passive port units

The following table lists the NEBS Level 2 OC192/STM64/POU passive port units (16 wavelengths).

Table 7-56 NEBS Level 2 OC192/STM64/POU Passive Port Units (16 Wavelengths)

Comcodes	Apparatus Codes	Description	Notes
109 180 083	LEY284	OC192/STM64/POU9590	DA: Effective 12/01/01
109 180 109	LEY285	OC192/STM64/POU9570	
109 180 125	LEY286	OC192/STM64/POU9550	
109 180 141	LEY287	OC192/STM64/POU9530	
109 180 166	LEY288	OC192/STM64/POU9490	
109 180 182	LEY289	OC192/STM64/POU9470	
109 179 564	LEY290	OC192/STM64/POU9450	
109 179 622	LEY291	OC192/STM64/POU9430	
109 179 689	LEY292	OC192/STM64/POU9370	
109 179 754	LEY293	OC192/STM64/POU9350	
109 179 804	LEY294	OC192/STM64/POU9330	
109 179 820	LEY295	OC192/STM64/POU9310	
109 179 846	LEY296	OC192/STM64/POU9270	
109 179 861	LEY297	OC192/STM64/POU9250	
109 179 911	LEY298	OC192/STM64/POU9230	
109 179 960	LEY299	OC192/STM64/POU9210	

Important! Contact your Account Executive to order the 8-Mux/8-Demux and/or 16-Mux + 16-Demux Passive Optics Boxes.

□

Ordering Spares

NEBS Level 3 circuit packs for spares

The following table lists the NEBS Level 3 compliant circuit packs that are available in WaveStar BandWidth Manager. All the NEBS Level 3 compliant circuit packs needed for your platform are kitted and orderable in previous tables.

Table 7-57 NEBS Level 3 Circuit Packs for Spares

Comcodes	Apparatus Codes	Description	Notes
108 730 102	LEY1AE	ADJCTL/DCCEI	
108 733 189	LEY2AE	ADJCTL/DCC	
108 734 617	LEY4AE	SWITCH/STS576	
108 730 227	LEY10BE	CTL/SYS50DM	
108 733 452	LEY18AE	SWITCH/DS3EC1	
108 735 200	LEY20BE	CTL/SYS50D	
108 733 809	LEY21AE	SWIF	
108 734 633	LEY41AE	SWITCH/STM1E4	
108 734 831	LEY68AE	CTL/SR50DC	
108 734 872	LEY72AE	PPROC/FO	
108 734 898	LEY73AE	SWITCH/STS768	
108 730 094	LCZ1AE	CTL/EI	
108 730 086	LCY2AE	CTL/MEM	
108 735 127	LEZ1AE	CSIEX	
108 735 135	LFY1AE	SWIEX	
108 735 143	LFY2AE	BSW	
108 865 882	LLY2BE	TMG/STRAT3[a]	
108 735 168	LLY2AE	TMG/STRAT3	DA: Effective 4/01/01

a) LLY2BE is backward compatible.

Important! The preceding table should only be used to order spares for NEBS Level 3 circuit packs.

NEBS Level 2 circuit packs for spares

The following table lists the NEBS Level 2 circuit packs that are available in WaveStar BandWidth Manager. All the NEBS Level 2 circuit packs needed for your platform are kitted and orderable in previous tables.

Table 7-58 NEBS Level 2 Circuit Packs for Spares

Comcodes	Apparatus Codes	Description	Notes
107 914 822	LEY1	ADJCTL/DCCEI	
107 855 090	LEY2	ADJCTL/DCC	
107 855 116	LEY4	SWITCH/STS576	
108 387 440	LEY10B	CTL/SYS50DM	
107 978 090	LEY18	SWITCH/DS3EC1	
108 716 333	LEY20B	CTL/SYS50D	
108 686 064	LEY21	SWIF	
108 396 318	LEY41	SWITCH/STM1E4	
108 774 605	LEY68	CTL/SR50DC	DA: Effective 12/01/01
108 468 141	LEY72	PPROC/FO	
108 408 824	LEY73	SWITCH/STS768	
107 993 917	LCZ1	CTL/EI	
107 993 925	LCY2	CTL/MEM	
108 056 029	LEZ1	CSIEX	
108 015 686	LFY1	SWIEX	
108 015 694	LFY2	BSW	
108 865 866	LLY2B	TMG/STRAT3[a]	
107 855 181	LLY2	TMG/STRAT3	DA: Effective 4/01/01

a) LLY2B is backward compatible.

Important! The preceding table should only be used to order spares for NEBS Level 2 circuit packs.

Equipment for spares The following table lists the comcodes for equipment spares.

Table 7-59 Equipment for Spares

Comcodes	Apparatus Codes	Description	Notes
408 482 412	NA	Fan Assembly	
408 280 287	NA	Replacement Fan Filter Kit (25 Filters)	

Important! The preceding table should only be used to order spare pieces of equipment.

Sparing Information

Introduction

This section provides equipment

sparing information for WaveStar BandWidth Manager.

> **Important!** The number of spares for each code must be determined and maintained separately, based on that code's in-service population at each given location.

Lead time

Lead time, also known as turnaround time, is defined as the elapsed time between a known equipment (circuit pack, port unit, fan unit, etc.) failure at a given service location and the arrival of repaired (or new) equipment at the location where spare equipment is stocked to maintain a level of spares consistent with the population of that type of equipment in service.

> **Important!** Lead time should not be confused with mean time to repair (≤2 hours), which is the elapsed time between identifying and in-service equipment failure and placing a spare into service.

□

Failure Rates

Circuit pack failure rates

The following table provides the steady-state circuit pack failure rates for WaveStar BandWidth Manager NEBS Level 2 and NEBS Level 3 compliant circuit packs.

Table 7-60 Circuit Pack Failure Rates

Circuit Pack	NEBS Level 2 Apparatus Codes	NEBS Level 3 Apparatus Codes	Failure Rate (FIT)
ADJCTL/DCCEI	LEY1	LEY1AE	7100
ADJCTL/DCC	LEY2	LEY2AE	2700
SWITCH/STS576	LEY4	LEY4AE	4200
CTL/SYS50DM	LEY10B	LEY10BE	5100
SWITCH/DS3EC1	LEY18	LEY18AE	2000
CTL/SYS50D	LEY20B	LEY20BE	6200
SWIF	LEY21	LEY21AE	2800
SWITCH/STM1E4	LEY41	LEY41AE	8250
CTL/SR50DC	LEY68	LEY68AE	5200
PPROC/FO	LEY72	LEY72AE	4800
SWITCH/STS768	LEY73	LEY73AE	3500
CTL/EI	LCZ1	LCZ1AE	4100
CTL/MEM	LCY2	LCY2AE	1600
CSIEX	LEZ1	LEZ1AE	5600
SWIEX	LFY1	LFY1AE	4200
BSW	LFY2	LFY2AE	3500
TMG/STRAT3	LLY2B	LLY2BE	3800

Port unit failure rates

The following table provides the steady-state port unit failure rates for WaveStar BandWidth Manager NEBS Level 2 and NEBS Level 3 compliant port units.

Table 7-61 Port Unit Failure Rates

Port Unit	NEBS Level 2 Apparatus Codes	NEBS Level 3 Apparatus Codes	Failure Rate (FIT)
OC48/STM16/1.3LR1	LEY7	LEY7AE	7500
OC48/STM16/1.5LR1	LEY8	LEY8AE	7500
OC12/STM4/1.3LR2	LEY13	LEY13AE	3900
OC12/STM4/1.3SR2	LEY14	LEY14AE	4600
OC3/STM1/1.3LR4	LEY15	LEY15AE	3900
OC3/STM1/1.3SR4	LEY16	LEY16AE	4600
DS3EC1/8	LEY17	LEY17AE	5200
STM1E/4	LEY43	LEY43AE	6700
OC48/STM16/DWDM01-16	LEY50-65	LEY50AE-65AE	7500
OC192.STM64/1.5SR1	LEY67	LEY67AE	8500
OC192/STM64/1.5IR1	LEY69	LEY69AE	8500
OC48/STM16/POU	LEY80-95	LEY80AE-95AE	7500
OC192/STM64/1.5IRS1	LEY97	LEY97AE	8500
OC48/STM16/WDM (all)	LEY101-180	LEY101AE-180AE	7500
OC192/STM64/WDM (all)	LEY201-240	LEY201AE-240AE	8500
OC192/STM64/POU (all)	LEY284-299	LEY284AE-299AE	8500

Important! OC192/STM64/1.5SR1 (LEY67 and LEY67AE) port unit were DA in 12/00. Choose between LEY97 and LEY69 based on loss budget and the optical parameters requirements of the application to be served. Refer to Chapter 10, *Technical Specification*s for a comparison of LEY97 and LEY69 specifications. The LEY67 Port Unit Data Sheet is included in Appendix C.

Equipment failure rates

The following table provides the steady-state equipment failure rates for WaveStar BandWidth Manager.

Table 7-62 Equipment Failure Rates

Equipment	Failure Rate (FIT)
Circuit Breaker	10
Power Filter	40
User Panel	110
DS3EC1 Connector Panel	110
STM1e Connector Panel	110
PCMCIA Flashdisk	660
Fan Unit	1600

Important! Figure 7-1 and Figure 7-2 apply to the equipment listed in the preceding table, as well as to the circuit packs and port units.

□

Sparing Graphs

Introduction

This section provides guidelines and a procedure to determine the number of spare circuit packs/port units needed at each location. The number of spares for each circuit pack/port unit code must be determined and maintained separately, based on that code's in-service population at each given location.

> **Important!** You must order NEBS Level 3 spares for NEBS Level 3 equipment.
>
> You must order NEBS Level 2 spares for NEBS Level 2 equipment.

Using the sparing graph

Use the following procedure to determine how many spare circuit packs/port units/pieces of equipment are required for each code at each location to maintain 99.9 percent service continuity, given a 10-day lead time (Figure 7-1) or a 64-day lead time (Figure 7-2).

1. Locate the
1. FIT rate for the circuit pack/port unit/type of equipment in question using the appropriate table in this chapter.
2. Refer to the appropriate figure for either a 10-day lead time (Figure 7-1) or a 64-day lead time (Figure 7-2) and select the curve that represents the nearest FIT rate.
3. Follow the curve until it intersects the vertical line that represents the number of circuit packs/port units/pieces of equipment in service at that given location.
4. Refer to the horizontal line immediately above the intersection. The number associated with this line is the minimum number of spares recommended for that location.
5. Repeat steps 1-4 for each circuit pack, port unit, and type of equipment in your system.

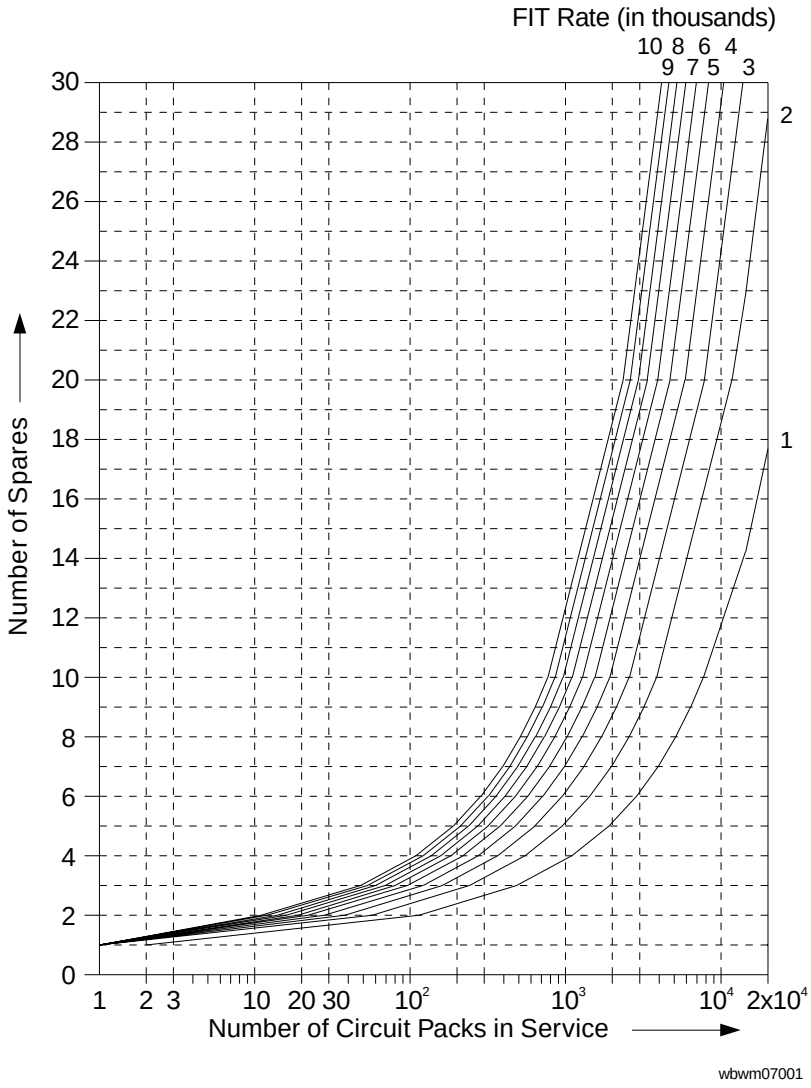
Example using the graph

If there are 192 OC3/STM1/1.3LR4 port units (FIT rate of 3900) in service at a given location and your lead time is 10 days, then you need to order and stock 4 spare OC3/STM1/1.3LR4 port units for that location.

10-day lead time graph

For a 10-day lead time, use Figure 7-1 to determine the number of spares necessary for all the circuit packs, port units and pieces of common equipment used in WaveStar BandWidth Manager.

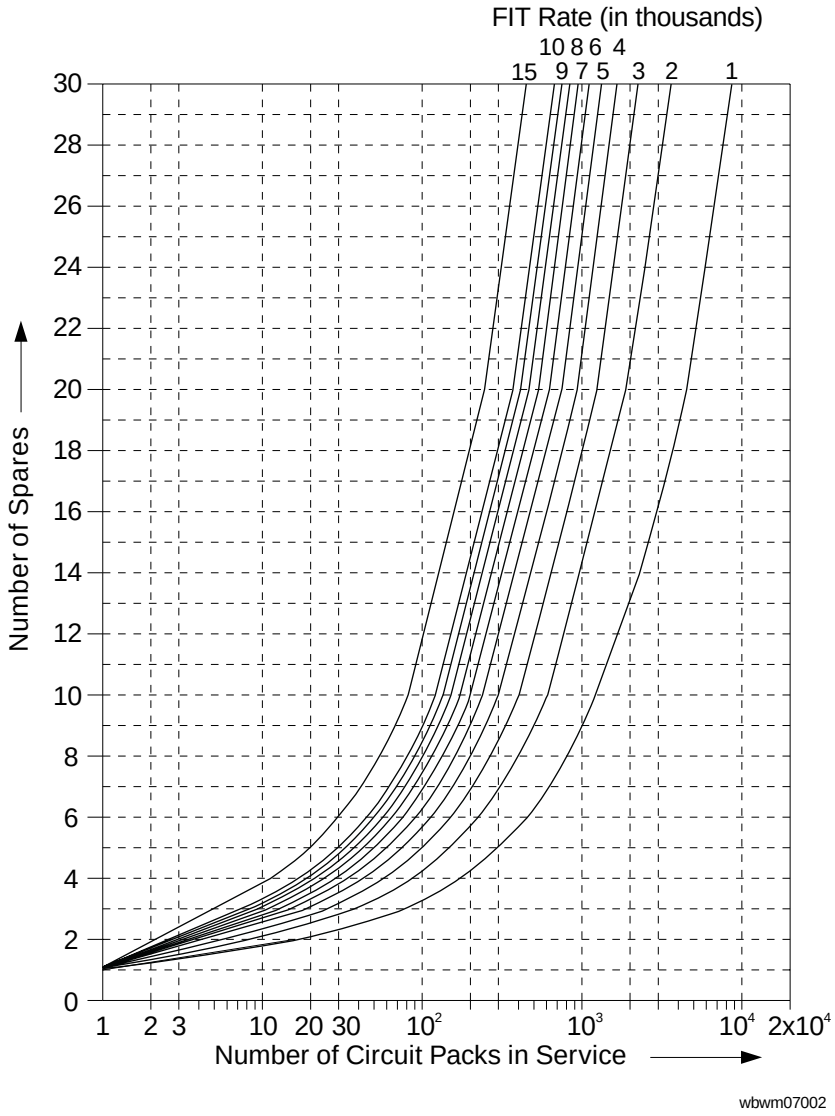
Figure 7-1 Sparing Graph for a 10-Day Lead Time



64-day lead time graph

For a 64-day lead time, Figure 7-2 use to determine the number of spares necessary for all the circuit packs, port units, and pieces of common equipment used in WaveStar BandWidth Manager.

Figure 7-2 Sparing Graph for a 64-Day Lead Time



8 Product Support

Overview

Purpose

This chapter describes the support services available to Lucent Technologies' customers.

Lucent Technologies offers a number of services to assist customers with Engineering, Installation and Technical Support of their networks. Additionally, Lucent Technologies offers product-specific training courses.

Contents

The following topics are discussed in this chapter:

Worldwide Services	8 - 2
Training	8 - 4
Available Training Courses	8 - 5

Worldwide Services

Overview

Lucent Worldwide Services provides a full life-cycle of services and solutions to help you plan, design, implement, and operate your network in today's rapidly changing and complex environment.

Engineering Services

Engineering Services provide information and technical support to customers during the planning, implementation, and placement of equipment into new or existing networks. We determine the best, most economical equipment solution for a customer and help ensure equipment is configured correctly for the customer’s network needs, works as specified, and is ready for installation on delivery. These services consist of the following:

- Equipment engineering
- Software engineering
- Site records
- Engineering consulting
- Additional engineering services (for example, Network Realignment, System Capacity Planning, System Health Assessment

Installation Services

Lucent Technologies offers Installation Services focused on providing the technical support and resources customers need to efficiently and cost-effectively install their network equipment. We offer a variety of options that provide extensive support and deliver superior execution to help ensure the system hardware is installed, tested, and functioning as engineered and specified. Installation Services provides a complete flexible solution tailored to meet customers' specific needs. These services consist of the following:

- Equipment installation
- Specialized equipment installation
- Network connectivity services
- Installation support services

Technical Support

Lucent Technologies provides the following Technical Support Services:

- Remote Technical Support (RTS) - remote technical support to troubleshoot and resolve system problems.
- On-site Technical Support (OTS) - on-site assistance with operational issues and remedial maintenance.
- Repair and Replacement (R&R) - technical support services for device repair/return or parts replacement.
- Lucent OnLine Customer Support - online access to information and services that can help resolve technical support requests.

Important! Technical Support Services are available 24 hours a day, 7 days a week.

Customers inside the United States and Canada

Technical Support Services can be reached at **1-866-LUCENT8** (866-582-3688): *Prompt 1*.

Customers outside the United States

Technical Support Services can be reached at **+1-630-224-4672**: *Prompt 2*.

Web-Site

For additional information regarding Worldwide Services, refer to the Lucent Technologies' web-site at **http://www.lucent.com/products**

1. Click on **Browse the catalog**
2. Click on **Worldwide Services Solutions**
3. Select the desired service to display:
   - Engineering and Installation
   - Technical Support Services

□

Training

Overview

Lucent Technologies offers a formal training curriculum to complement your product needs.

Registering for a course

To review the available courses or to enroll in a training course at one of Lucent's corporate training centers,

- Within the United States,
  - Visit **https://www.lucent-product-training.com**
  - Call **1-888-LUCENT8** (888-582-3688): *Prompt 2*.
- Outside the continental United States,
  - Visit **https://www.lucent-product-training.com**
  - Contact your in-country training representative
  - Call: **+1-407-767-2798**
  - Fax: **+1-407-767-2677**

Suitcasing

To arrange for a suitcase session at your facility,

- Within the United States, call **1-888-LUCENT8** (888-582-3688): *Prompt 2*.
- Outside the continental United States,
  - Contact your in-country training representative
  - Call: **+1-407-767-2798**
  - Fax: **+1-407-767-2677**

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Available Training Courses

Overview

This section describes the training courses available for the WaveStar BandWidth Manager.

WaveStar BandWidth Manager Overview

This section describes TR3800 and TR3802.

Content

The WaveStar BandWidth Manager Overview Courses (TR3800, SONET edition and TR3802, SDH edition) provide a detailed introduction to WaveStar BandWidth Manager, covering the features and benefits of the network solutions, equipment functions and requirements, and network planning.

Audience

Lucent marketing/sales personnel, customer network planners and engineers, product managers, technical consultants, and account representatives.

Course length

3 days

WaveStar BandWidth Manager Operations and Maintenance

This section describes TR3801 and TR3803.

Content

The WaveStar BandWidth Manager Operations and Maintenance Course (TR3801, SONET edition and TR3803, SDH edition) includes detailed descriptions of initial turnup and day-to-day operations and maintenance tasks, as well as emphasis on developing skills using 365-370-109, WaveStar BandWidth Manager User Operations Guide and 365-370-110, WaveStar BandWidth Manager Alarm Messages and Troubleclearing Guide. The course covers the physical equipment and using the new GUI-based WaveStar CIT to provision equipment, make cross-connects, perform administrative functions, run diagnostic tests, and do manual protection switching.

Audience

Technicians, installers, maintenance engineers, technical support personnel, product evaluators, and anyone desiring operations and maintenance information for WaveStar BandWidth Manager.

Course length

5 days

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9 Quality and Reliability

Overview

Purpose

Lucent Technologies is extremely committed to providing our customers with products of the highest level of quality and reliability in the industry. WaveStar BandWidth Manager is a prime example of this commitment.

Contents

The following topics are discussed in this chapter:

Ensuring Quality	9 - 2
Failure Rates	9 - 4
Unavailability Specifications	9 - 8
General Specifications	9 - 10

Ensuring Quality

Overview

This section describes the critical elements that ensure product quality and reliability within

- Product development
- Manufacturing

Quality policy

Lucent Technologies is committed to achieving sustained business excellence by integrating quality principles and methods into all we do at every level of our company to

- Anticipate and meet customer needs and exceed their expectations, every time
- Relentlessly improve how we work – to deliver the world's best and most innovative communications solutions – faster and more cost-effectively than our competitors

Critical elements of product development

Product development's strict adherence to the following critical elements ensures the product's reliability:

- Design standards
- Design and test practices
- Comprehensive qualification programs
- System-level reliability integration
- Reliability audits and predictions
- Development of quality assurance standards for manufactured products

Reliability in the product's life-cycle

Each stage of the life cycle of WaveStar BandWidth Manager relies on people and processes that contribute to the highest product quality and reliability possible. The reliability of a product begins at the earliest planning stage and continues into

- Product architecture
- Design and simulation
- Documentation
- Prototyping testing during development
- Design change control
- Manufacturing and product testing (including 100% screening)
- Product quality assurance
- Product field performance
- Product field return management

Critical elements of manufacturing

Manufacturing and field deployment's strict adherence to the following critical elements ensures the product's reliability:

- Pre-manufacturing
- Qualification
- Accelerated product testing
- Product screening
- Production quality tracking
- Failure mode analysis
- Feedback and corrective actions

Important! Independent Quality Representatives are also present at manufacturing locations to ensure Shipped Product Quality.



Failure Rates

Overview

This section provides failure rates for WaveStar BandWidth Manager equipment.

Standards

All failure rates are calculated according to the SONET and SDH standards listed in this section.

SONET

All data for SONET and NEBS equipment is based on Telcordia Technologies' (Bellcore) Method I, *Reliability Prediction Procedure for Electronic Equipment*, Issue 6, December 1997.

SDH

All data for SDH and ETSI equipment is based on ITU-T Recommendation G.911, *Parameters and Calculation Methodologies for Reliability and Availability of Fibre Optic Systems*, April 1997.

Circuit pack failure rates

The following table provides the steady-state circuit pack failure rates for WaveStar BandWidth Manager NEBS Level 2 and NEBS Level 3 compliant circuit packs.

Table 9-1 Circuit Pack Failure Rates

Circuit Pack	NEBS Level 2 Apparatus Codes	NEBS Level 3 Apparatus Codes	Failure Rate (FIT)
ADJCTL/DCCEI	LEY1	LEY1AE	7100
ADJCTL/DCC	LEY2	LEY2AE	2700
SWITCH/STS576	LEY4	LEY4AE	4200
CTL/SYS50DM	LEY10B	LEY10BE	5100
SWITCH/DS3EC1	LEY18	LEY18AE	2000
CTL/SYS50D	LEY20B	LEY20BE	6200
SWIF	LEY21	LEY21AE	2800
SWITCH/STM1E4	LEY41	LEY41AE	8250
CTL/SR50DC	LEY68	LEY68AE	5200
PPROC/FO	LEY72	LEY72AE	4800
SWITCH/STS768	LEY73	LEY73AE	3500
CTL/EI	LCZ1	LCZ1AE	4100
CTL/MEM	LCY2	LCY2AE	1600
CSIEX	LEZ1	LEZ1AE	5600
SWIEX	LFY1	LFY1AE	4200
BSW	LFY2	LFY2AE	3500
TMG/STRAT3	LLY2B	LLY2BE	3800

Port unit failure rates

The following table provides the steady-state port unit failure rates for WaveStar BandWidth Manager NEBS Level 2 and NEBS Level 3 compliant port units.

Table 9-2 Port Unit Failure Rates

Port Unit	NEBS Level 2 Apparatus Codes	NEBS Level 3 Apparatus Codes	Failure Rate (FIT)
OC48/STM16/1.3LR1	LEY7	LEY7AE	9450
OC48/STM16/1.5LR1	LEY8	LEY8AE	9450
OC12/STM4/1.3LR2	LEY13	LEY13AE	3900
OC12/STM4/1.3SR2	LEY14	LEY14AE	3900
OC3/STM1/1.3LR4	LEY15	LEY15AE	4900
OC3/STM1/1.3SR4	LEY16	LEY16AE	4900
DS3EC1/8	LEY17	LEY17AE	5200
STM1E/4	LEY43	LEY43AE	6700
OC48/STM16/DWDM01-16	LEY50-65	LEY50AE-65AE	9450
OC192.STM64/1.5SR1	LEY67	LEY67AE	8500
OC192/STM64/1.5IR1	LEY69	LEY69AE	8500
OC48/STM16/POU	LEY80-95	LEY80AE-95AE	7500
OC192/STM64/1.5IRS1	LEY97	LEY97AE	8500
OC48/STM16/WDM (all)	LEY101-180	LEY101AE-180AE	7500
OC192/STM64/WDM (all)	LEY201-240	LEY201AE-240AE	8500
OC192/STM64/POU (all)	LEY284-299	LEY284AE-299AE	8500

Important! OC192/STM64/1.5SR1 (LEY67 and LEY67AE) port unit were DA in 12/00. Choose between LEY97 and LEY69 based on loss budget and the optical parameters requirements of the application to be served. Refer to Chapter 10, *Technical Specification*s for a comparison of LEY97 and LEY69 specifications. The LEY67 Port Unit Data Sheet is included in Appendix C.

Equipment failure rates

The following table provides the steady-state equipment failure rates for WaveStar BandWidth Manager.

Table 9-3 Equipment Failure Rates

Equipment	Failure Rate (FIT)
Circuit Breaker	10
Power Filter	40
User Panel	110
Fan Unit	1600
DS3EC1 Connector Panel	110
STM1e Connector Panel	110
PCMCIA Flashdisk	660
DS3EC1 Connector Panel	110

Unavailability Specifications

Overview

This section provides hardware unavailability specifications for WaveStar BandWidth Manager.

Standards

All unavailability specifications are based on the FIT rates that are calculated according to the SONET and SDH standards listed in this section.

SONET

All data for SONET and NEBS equipment is based on Telcordia Technologies' (Bellcore) Method I, *Reliability Prediction Procedure for Electronic Equipment*, Issue 6, December 1997.

SDH

All data for SDH and ETSI equipment is based on ITU-T Recommendation G.911, *Parameters and Calculation Methodologies for Reliability and Availability of Fibre Optic Systems*, April 1997.

System unavailability

The following table provides steady-state system unavailability estimates for WaveStar BandWidth Manager due to system failures.

Table 9-4 System Unavailability

System	Unavailability
Downtime for Control and Reconfiguration	1.4 min/year
Total Switch Downtime	0.0006 min/year
Downtime for Alarm Visibility	1.4 min/year

Important! The metrics used for the data in the preceding table are based on Telcordia Technologies' (Bellcore) GR1339-CORE, *Generic Reliability Requirements for Digital Cross-Connect Systems*.

Silent failure unavailability

Since WaveStar BandWidth Manager is designed to minimize system unavailability due to silent failures. Equipment failures in the system that may result in a loss of service or protection trigger office alarms or generate an autonomous message.

Downtime per port

The following table provides hardware downtime estimates for the individual ports on the optical port units in WaveStar BandWidth Manager.

Table 9-5 Downtime per Port (Hardware Only)

Port Unit	NEBS Level 2Apparatus Codes	NEBS Level 3 Apparatus Codes	Downtime per Porta
OC48/STM16/1.3LR1	LEY7	LEY7AE	0.0009 min/year
OC48/STM16/1.5LR1	LEY8	LEY8AE	0.0009 min/year
OC12/STM4/1.3LR2	LEY13	LEY13AE	0.0008 min/year
OC12/STM4/1.3SR2	LEY14	LEY14AE	0.0008 min/year
OC3/STM1/1.3LR4	LEY15	LEY15AE	0.0008 min/year
OC3/STM1/1.3SR4	LEY16	LEY16AE	0.0008 min/year
DS3EC1/8	LEY17	LEY17AE	0.0068 min/year
STM1E/4	LEY43	LEY43AE	0.0070 min/year
OC48/STM16/DWDM01-16	LEY50-65	LEY50AE-65AE	0.0009 min/year
OC192/STM64/1.5IR1	LEY69	LEY69AE	0.0009 min/year
OC48/STM16/POU	LEY80-95	LEY80AE-95AE	0.0009 min/year
OC192/STM64/1.5IRS1	LEY97	LEY97AE	0.0009 min/year
OC48/STM16/WDM (all)	LEY101-180	LEY101AE-180AE	0.0009 min/year
OC192/STM64/WDM (all)	LEY201-240	LEY201AE-240AE	0.0009 min/year
OC192/STM64/POU (all)	LEY284-299	LEY284AE-299AE	0.0009 min/year

a) The downtime for the optical port units assumes 1+1 protection and the downtime for the electrical port units (DS3EC1/8 and STM1E/4) assumes 1xN protection.

Important! The metrics used for the data in the preceding table are based on Telcordia Technologies' (Bellcore) GR1339-CORE, *Generic Reliability Requirements for Digital Cross-Connect Systems*.

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General Specifications

Overview

This section provides general reliability specifications for WaveStar BandWidth Manager.

Mean time between maintenance activities

The following table provides the mean time between maintenance activities (MTBMA) for the equipment in WaveStar BandWidth Manager.

Table 9-6 Mean Time Between Maintenance Activities

Bay	MTBMA (months)
System Controller Bay	25.9
Control/Switch Bay	10.8
Switch Bay	18.6
Universal I/O Bay (with two equipped Universal I/O Shelves)	5.4
10G I/O Bay (with one equipped 10G I/O Shelf)	9.7
10G I/O Bay (with two equipped 10G I/O Shelves)	6.7
10G/Universal I/O Bay (with one equipped Universal I/O Shelf and one equipped 10G I/O Shelf)	5.1
STM1e I/O Bay (with two equipped STM1e Universal I/O Shelves)	5.5
10G/STM1e I/O Bay (with one equipped STM1e Universal I/O Shelf and one equipped 10G I/O Shelf)	5.2

Mean time to repair

The mean time to repair (MTTR) assumption for WaveStar BandWidth Manager is ≤2 hours. This figure includes dispatch, diagnostic, and repair time.

Infant mortality factor

The number of failures that a product experiences during the first year of service after turn-up may be greater than the number of subsequent annual steady state failures.

The infant mortality factor (IMF) for WaveStar BandWidth Manager is ≤1.3. Therefore, the first year failure rate (or infant mortality rate [IMR]) is 1.3 times the steady state failure rate.

Important! The steady state failure rate is equal to the FIT rate of the system.

Product design life

The product design life for WaveStar BandWidth Manager is 25 years.

> **Important!** The product design life for the fan unit is 12 years.

Maintainability specifications

WaveStar BandWidth Manager does not require periodic electronic equipment maintenance activities. Continuous performance monitoring enables the system to detect conditions before they become service-affecting.

> **Important!** The fan filters, located below the fan unit in the individual shelves, must be replaced once every 6 months to ensure the proper operation of the fan units.

Warranty

The terms and conditions of sale include a 1-year warranty on WaveStar BandWidth Manager hardware and software.

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10 Technical Specifications

Overview

Purpose

The information included in this appendix is necessary to plan the implementation of WaveStar BandWidth Manager into an existing or new network. The data presented is applicable to a fully-equipped 4608/1536 platform.

Contents

The following topics are discussed in this chapter:

General System Specifications	10 - 2
Optical Port Unit Specifications	10 - 3
Electrical Port Unit Specifications	10 - 21
Power Specifications	10 - 24
Equipment Dimensions	10 - 28
Operations Interface Specifications	10 - 31
External Synchronization Specifications	10 - 32
Environmental Specifications	10 - 35



General System Specifications

Overview

This section provides some general system specifications.

Transmission fibers

WaveStar BandWidth Manager uses the following transmission fibers:

- Standard single-mode non-dispersion shifted fiber
- TrueWave™ non-zero dispersion shifted fiber

Connectorized cabling

Because all connections to transmission interfaces, WaveStar CIT, overhead byte access, and miscellaneous discretes are via connectorized cabling, the need to “wire-wrap” connections is eliminated.

Front access

Front access is provided for all circuit pack insertions/removals, all external connections/cabling to transmission interfaces, and a CIT port on each user panel for a WaveStar CIT.

Rear access

Because inter-bay cabling occurs at the rear of the bays, rear access is required for system installation and future upgrades.

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Optical Port Unit Specifications

Overview

The optical specifications provided in this section apply to the optical port units in WaveStar BandWidth Manager, (OC192/STM64 OC48/STM16, OC12/STM4, and OC3/STM1).

Line rate

This section provides the line rates for the optical port units.

OC192/STM64

The optical line rate for the OC192/STM64 port units is 9.953 Gb/s.

OC48/STM16

The optical line rate for the OC48/STM16 port units is 2.488 Gb/s.

OC12/STM4

The optical line rate for the OC12/STM4 port units is 622.08 Mb/s.

OC3/STM1

The optical line rate for the OC3/STM1 port units is 155.52 Mb/s.

Line code

The optical line code for the optical port units is scrambled nonreturn to zero (NRZ).

Connector interfaces

The optical port units may be equipped with either ST-type, FC-type, or SC-type lightguide build-out (LBOs)/optical attenuators for optical attenuation. The LBOs/optical attenuators are order in kits; each kit includes a 0 dB, 5 dB, 10 dB, 15 dB, and a 20 dB attenuator.

> **Important!** The OLS-compatible port units (OC48/STM16/DWDM, OC48/STM16/WDM, and OC192/STM64/WDM) are factory-equipped with LC-type 0 dB optical attenuators. All other optical port units are factory-equipped with SC-type 0 db optical attenuators.

Lightguide jumpers

Single-mode optical jumpers are used on all optical interfaces in WaveStar BandWidth Manager. Single-mode to multi-mode LBOs/optical attenuators are used on the receive connectors on the OC12/STM4 and OC3/STM1 port units.

Optical source

This sections provides the optical source information for the optical port units.

OC192/STM64

The optical source for the OC192/STM64/1.5IRS1 port units is an electro-absorptive Modulated Laser (EML).

The optical source for the OC192/STM64/1.5IR1, OC192/STM64/WDM, and OC192/STM64/POU port units is a Continuous Wave (CW) laser with a Mach-Zender modulator.

OC48/STM16

The optical source for the OC48/STM16/1.3LR1 and OC48/STM16/1.5LR1 port units is a distributed feedback (DFB) laser.

The optical source for the and OC48/STM16/DWDM01-16, OC48/STM16/WDM, OC48/STM16/POU port units is an electro-absorptive Modulated Laser (EML).

OC12/STM4

The optical source for the OC12/STM4/1.3SR2 and OC12/STM4/1.3LR2 port units is a DFB laser.

OC3/STM1

The optical source for the OC3/STM1/1.3SR4 port units can be either a DFB laser or a Fabre-Perot laser.

The optical source for the OC3/STM1/1.3LR4 port units is a DFB laser.

Capacity

This sections provides the capacity information for the optical port units.

OC192/STM64

Each OC192/STM64 port unit supports either one OC-192 or one STM-64 (user-provisionable) bidirectional (one receive and one transmit) line. The port unit capacity may be translated to 192 STS-1/64 STM-1 equivalents or 129,024 two-way voice circuits.

OC48/STM16

Each OC48/STM16 port unit supports either one OC-48 or one STM-16 (user-provisionable) bidirectional (one receive and one transmit) line. The port unit capacity may be translated to 48 STS-1/16 STM-1 equivalents or 32,256 two-way voice circuits.

OC12/STM4

Each OC12/STM4 port unit supports either two OC-12 or two STM-4 (user-provisionable) bidirectional (one receive and one transmit) lines. The port unit capacity may be translated to 24 STS-1/8 STM-1 equivalents or 16,128 two-way voice circuits.

OC3/STM1

Each OC3/STM1 port unit supports either four OC-3 or four STM-1 (user-provisionable) bidirectional (one receive and one transmit) lines. The port unit capacity may be translated to 12 STS-1/4 STM-1 equivalents or 8,064 two-way voice circuits.

Optical detector

The optical detector for the optical port units is an avalanche photodiode (APD).

Optical safety

This sections provides the optical safety information for the optical port units.

SONET

The following table lists the optical safety data for the laser-containing port units.

Table 10-1 Optical Safety for Optical Port Units

Port Unit	Standard Apparatus Codes	NEBS Level 3 Apparatus Codes	FDA/CDRH Classification System
OC48/STM16/1.3LR1	LEY7	LEY7AE	Class IIIB
OC48/STM16/1.5LR1	LEY8	LEY8AE	Class I
OC12/STM4/1.3LR2	LEY13	LEY13AE	Class IIIB
OC12/STM4/1.3SR2	LEY14	LEY14AE	Class IIIB
OC3/STM1/1.3LR4	LEY15	LEY15AE	Class IIIB
OC3/STM1/1.3SR4	LEY16	LEY16AE	Class IIIB
OC48/STM16/DWDM01-16	LEY50-65	LEY50AE-65AE	Class I
OC192/STM64/1.5IR1	LEY69	LEY69AE	Class I
OC48/STM16/POU (all)	LEY80-95	LEY80AE-95AE	Class I
OC192/STM64/1.5IRS1	LEY97	LEY97AE	Class I
OC48/STM16/WDM (all)	LEY101-180	LEY101AE-180AE	Class I
OC192/STM64/WDM (all)	LEY201-240	LEY201AE-240AE	Class I
OC192/STM64/POU (all)	LEY284-299	LEY284AE-299AE	Class I

SDH

Optical safety data for laser-containing port units is Level 1 in the IEC classification system.

Protection

This section provides the provisionable protection modes for the port units.

OC192/STM64

The protection mode for the OC192/STM64 port units in WaveStar BandWidth Manager may be provisioned as

- 2-fiber OC-192 BLSR/STM-64 MS-SPRing
- 4-fiber OC-192 BLSR (open or closed)
- 4-fiber STM-64 MS-SPRing with transoceanic protocol
- STM-64 SNCP
- 1+1 protected (two port units providing OC-192/STM-64 1+1 protection, unidirectional, non-revertive)
- 0x1 protected (unprotected)

OC48/STM16

The protection mode for the OC48/STM16 port units in WaveStar BandWidth Manager may be provisioned as

- 2-fiber OC-48 BLSR/STM-16 MS-SPRing
- 4-fiber OC-48 BLSR/STM-16 MS-SPRing (open or closed)
- 4-fiber STM-16 MS-SPRing with transoceanic protocol
- OC-48 UPSR
- STM-16 SNCP
- 1+1 protected (two port units providing OC-48/STM-16 1+1 protection, which may be
  - unidirectional, non-revertive
  - bidirectional, non-revertive
- 0x1 protected (unprotected)

OC12/STM4

The protection mode for the OC12/STM4 port units in WaveStar BandWidth Manager may be provisioned as

- OC-12 UPSR
- STM-4 SNCP
- 1+1 protected (two port units providing OC-12 1+1 protection, unidirectional, non-revertive)
- 1+1 protected (two port units providing STM-4 1+1 protection, which may be
  - unidirectional, non-revertive
  - bidirectional, non-revertive
  - bidirectional, revertive
- 0x1 protected (unprotected)

OC3/STM1

The protection mode for the OC3/STM1 port units in WaveStar BandWidth Manager may be provisioned as

- STM-1 SNCP
- 1+1 protected (two port units providing OC-3 1+1 protection, unidirectional, non-revertive)
- 1+1 protected (two port units providing STM-1 1+1 protection, which may be
  - unidirectional, non-revertive
  - bidirectional, non-revertive
  - bidirectional, revertive
- 0x1 protected (unprotected)

Dispersion

WaveStar BandWidth Manager can accommodate the following types of dispersion:

Chromatic dispersion

The receiver can accommodate 6500 ps/nm of total chromatic dispersion with an optical path penalty of no more than 2 dB when measured at $1x10^{-12}$ BER.

Group delay dispersion for PMD

The receiver can accommodate up to 75 ps/nm of group delay dispersion due to polarization mode dispersion (PMD) with an optical path penalty of no more than 2 dB when measured at $1x10^{-12}$ BER.

Optical port unit dispersion

The following table provides the dispersion information for the optical port units.

Table 10-2 Optical Port Unit Dispersion

Port Unit	Standard Apparatus Codes	NEBS Level 3 Apparatus Codes	Dispersion
OC48/STM16/1.3LR1	LEY7	LEY7AE	300 ps/nm
OC48/STM16/1.5LR1	LEY8	LEY8AE	1800 ps/nm
OC12/STM4/1.3LR2	LEY13	LEY13AE	300 ps/nm
OC12/STM4/1.3SR2	LEY14	LEY14AE	300 ps/nm
OC3/STM1/1.3LR4	LEY15	LEY15AE	300 ps/nm
OC3/STM1/1.3SR4	LEY16	LEY16AE	300 ps/nm
OC48/STM16/DWDM01-16	LEY50-65	LEY50AE-65AE	Compatible with WaveStar OLS 40G/80G
OC192/STM64/1.5IR1	LEY69	LEY69AE	1200 ps/nm
OC192/STM64/1.5IRS1	LEY97	LEY97AE	800 ps/nm
OC48/STM16/POU	LEY80-95	LEY80AE-95AE	1200 ps/nm
OC48/STM16/WDM (all)	LEY101-180	LEY101AE-180AE	Compatible with WaveStar OLS 400G
OC192/STM64/WDM (all)	LEY201-240	LEY201AE-240AE	Compatible with WaveStar OLS 400G
OC192/STM64/POU (all)	LEY284-299	LEY284AE-299AE	1200 ps/nm

Operating wavelengths

The following two tables provide the operating wavelength ranges for the optical port units.

The following table provides the operating wavelength ranges for the OC48/STM16, OC12/STM4, and OC3/STM1 port units.

Table 10-3 OC48/STM16, OC12/STM4, and OC3/STM1 Port Unit Operating Wavelengths

Port Unit	Wavelength
OC48/STM16/1.3LR1	1280-1335 nm
OC48/STM16/1.5LR1	1530-1565 nm
OC12/STM4/1.3LR2	1298-1325 nm
OC12/STM4/1.3SR2	1274-1356 nm
OC3/STM1/1.3LR4	1298-1325 nm
OC3/STM1/1.3SR4	1261-1360 nm
OC48/STM16/DWDM01	1549.32 nm
OC48/STM16/DWDM02	1550.92 nm
OC48/STM16/DWDM03	1552.52 nm
OC48/STM16/DWDM04	1554.13 nm
OC48/STM16/DWDM05	1555.75 nm
OC48/STM16/DWDM06	1557.36 nm
OC48/STM16/DWDM07	1558.98 nm
OC48/STM16/DWDM08	1560.61 nm
OC48/STM16/DWDM09	1548.52 nm
OC48/STM16/DWDM10	1550.12 nm
OC48/STM16/DWDM11	1551.72 nm
OC48/STM16/DWDM12	1553.33 nm
OC48/STM16/DWDM13	1554.94 nm
OC48/STM16/DWDM14	1556.56 nm
OC48/STM16/DWDM15	1558.17 nm
OC48/STM16/DWDM16	1559.79 nm
OC48/STM16/POU9590	1530.33 nm
OC48/STM16/POU9570	1531.90 nm
OC48/STM16/POU9550	1533.47 nm
OC48/STM16/POU9530	1535.04 nm

Port Unit	Wavelength
OC48/STM16/POU9490	1538.19 nm
OC48/STM16/POU9470	1539.77 nm
OC48/STM16/POU9450	1541.35 nm
OC48/STM16/POU9430	1542.94 nm
OC48/STM16/POU9370	1547.72 nm
OC48/STM16/POU9350	1549.32 nm
OC48/STM16/POU9330	1550.92 nm
OC48/STM16/POU9310	1552.52 nm
OC48/STM16/POU9270	1555.75 nm
OC48/STM16/POU9250	1557.36 nm
OC48/STM16/POU9230	1558.98 nm
OC48/STM16/POU9210	1560.61 nm
OC48/STM16/WDM9585	1530.72 nm
OC48/STM16/WDM9580	1531.11 nm
OC48/STM16/WDM9575	1531.50 nm
OC48/STM16/WDM9570	1531.89 nm
OC48/STM16/WDM9565	1532.28 nm
OC48/STM16/WDM9560	1532.68 nm
OC48/STM16/WDM9555	1533.07 nm
OC48/STM16/WDM9550	1533.46 nm
OC48/STM16/WDM9545	1533.85 nm
OC48/STM16/WDM9540	1534.25 nm
OC48/STM16/WDM9535	1534.64 nm
OC48/STM16/WDM9530	1535.03 nm
OC48/STM16/WDM9525	1535.42 nm
OC48/STM16/WDM9520	1535.82 nm
OC48/STM16/WDM9515	1536.21 nm
OC48/STM16/WDM9510	1536.60 nm
OC48/STM16/WDM9505	1537.00 nm
OC48/STM16/WDM9500	1537.39 nm
OC48/STM16/WDM9495	1537.39 nm
OC48/STM16/WDM9490	1538.18 nm

Port Unit	Wavelength
OC48/STM16/WDM9485	1538.58 nm
OC48/STM16/WDM9480	1538.97 nm
OC48/STM16/WDM9475	1539.37 nm
OC48/STM16/WDM9470	1539.76 nm
OC48/STM16/WDM9465	1540.16 nm
OC48/STM16/WDM9460	1540.55 nm
OC48/STM16/WDM9455	1540.95 nm
OC48/STM16/WDM9450	1541.34 nm
OC48/STM16/WDM9445	1541.74 nm
OC48/STM16/WDM9440	1542.14 nm
OC48/STM16/WDM9435	1542.53 nm
OC48/STM16/WDM9430	1542.93 nm
OC48/STM16/WDM9425	1543.33 nm
OC48/STM16/WDM9420	1543.73 nm
OC48/STM16/WDM9415	1544.12 nm
OC48/STM16/WDM9410	1544.52 nm
OC48/STM16/WDM9405	1544.92 nm
OC48/STM16/WDM9400	1545.32 nm
OC48/STM16/WDM9395	1545.72 nm
OC48/STM16/WDM9390	1546.11 nm
OC48/STM16/WDM9385	1546.51 nm
OC48/STM16/WDM9380	1546.91 nm
OC48/STM16/WDM9375	1547.31 nm
OC48/STM16/WDM9370	1547.71 nm
OC48/STM16/WDM9365	1548.11 nm
OC48/STM16/WDM9360	1548.51 nm
OC48/STM16/WDM9355	1548.91 nm
OC48/STM16/WDM9350	1549.31 nm
OC48/STM16/WDM9345	1549.71 nm
OC48/STM16/WDM9340	1550.11 nm
OC48/STM16/WDM9335	1550.51 nm
OC48/STM16/WDM9330	1550.91 nm

Port Unit	Wavelength
OC48/STM16/WDM9325	1551.31 nm
OC48/STM16/WDM9320	1551.72 nm
OC48/STM16/WDM9315	1552.12 nm
OC48/STM16/WDM9310	1552.52 nm
OC48/STM16/WDM9305	1552.92 nm
OC48/STM16/WDM9300	1553.32 nm
OC48/STM16/WDM9295	1553.73 nm
OC48/STM16/WDM9290	1554.13 nm
OC48/STM16/WDM9285	1554.53 nm
OC48/STM16/WDM9280	1554.94 nm
OC48/STM16/WDM9275	1555.34 nm
OC48/STM16/WDM9270	1555.74 nm
OC48/STM16/WDM9265	1556.15 nm
OC48/STM16/WDM9260	1556.55 nm
OC48/STM16/WDM9255	1556.95 nm
OC48/STM16/WDM9250	1557.36 nm
OC48/STM16/WDM9245	1557.76 nm
OC48/STM16/WDM9240	1558.17 nm
OC48/STM16/WDM9235	1558.57 nm
OC48/STM16/WDM9230	1558.98 nm
OC48/STM16/WDM9225	1559.38 nm
OC48/STM16/WDM9220	1559.59 nm
OC48/STM16/WDM9215	1560.20 nm
OC48/STM16/WDM9210	1560.60 nm
OC48/STM16/WDM9205	1561.01 nm
OC48/STM16/WDM9200	1561.41 nm
OC48/STM16/WDM9195	1561.82 nm
OC48/STM16/WDM9190	1562.23 nm

The following table provides the operating wavelength ranges for the OC192/STM64 port units.

Table 10-4 OC4192/STM64 Port Unit Operating Wavelengths

Port Unit	Wavelength
OC192/STM64/1.5IR1	1530-1565 nm
OC192/STM64/I.5IRS1	1530-1565 nm
OC192/STM64/POU9590	1530.33 nm
OC192/STM64/POU9570	1531.90 nm
OC192/STM64/POU9550	1533.47 nm
OC192/STM64/POU9530	1535.04 nm
OC192/STM64/POU9490	1538.19 nm
OC192/STM64/POU9470	1539.77 nm
OC192/STM64/POU9450	1541.35 nm
OC192/STM64/POU9430	1542.94 nm
OC192/STM64/POU9370	1547.72 nm
OC192/STM64/POU9350	1549.32 nm
OC192/STM64/POU9330	1550.92 nm
OC192/STM64/POU9310	1552.53 nm
OC192/STM64/POU9270	1555.75 nm
OC192/STM64/POU9250	1557.36 nm
OC192/STM64/POU9230	1558.98 nm
OC192/STM64/POU9210	1560.61 nm
OC192/STM64/WDM9580	1531.12 nm
OC192/STM64/WDM9570	1531.90 nm
OC192/STM64/WDM9560	1532.68 nm
OC192/STM64/WDM9550	1533.47 nm
OC192/STM64/WDM9540	1534.25 nm
OC192/STM64/WDM9530	1535.04 nm
OC192/STM64/WDM9520	1535.82 nm
OC192/STM64/WDM9510	1536.61 nm
OC192/STM64/WDM9500	1537.40 nm
OC192/STM64/WDM9490	1538.19 nm

Port Unit	Wavelength
OC192/STM64/WDM9480	1538.98 nm
OC192/STM64/WDM9470	1539.77 nm
OC192/STM64/WDM9460	1540.56 nm
OC192/STM64/WDM9450	1541.35 nm
OC192/STM64/WDM9440	1542.14 nm
OC192/STM64/WDM9430	1542.94 nm
OC192/STM64/WDM9420	1543.73 nm
OC192/STM64/WDM9410	1544.53 nm
OC192/STM64/WDM9400	1545.32 nm
OC192/STM64/WDM9390	1546.12 nm
OC192/STM64/WDM9380	1546.92 nm
OC192/STM64/WDM9370	1547.72 nm
OC192/STM64/WDM9360	1548.52 nm
OC192/STM64/WDM9350	1549.32 nm
OC192/STM64/WDM9340	1550.12 nm
OC192/STM64/WDM9330	1550.92 nm
OC192/STM64/WDM9320	1551.72 nm
OC192/STM64/WDM9310	1552.52 nm
OC192/STM64/WDM9300	1553.33 nm
OC192/STM64/WDM9290	1554.13 nm
OC192/STM64/WDM9280	1554.94 nm
OC192/STM64/WDM9270	1555.75 nm
OC192/STM64/WDM9260	1556.56 nm
OC192/STM64/WDM9250	1557.36 nm
OC192/STM64/WDM9240	1558.17 nm
OC192/STM64/WDM9230	1558.98 nm
OC192/STM64/WDM9220	1559.79 nm
OC192/STM64/WDM9370	1547.72 nm
OC192/STM64/WDM9360	1548.52 nm
OC192/STM64/WDM9350	1549.32 nm
OC192/STM64/WDM9340	1550.12 nm
OC192/STM64/WDM9330	1550.92 nm

Port Unit	Wavelength
OC192/STM64/WDM9320	1551.72 nm
OC192/STM64/WDM9310	1552.52 nm
OC192/STM64/WDM9300	1553.33 nm
OC192/STM64/WDM9290	1554.13 nm
OC192/STM64/WDM9280	1554.94 nm
OC192/STM64/WDM9270	1555.75 nm
OC192/STM64/WDM9260	1556.56 nm
OC192/STM64/WDM9250	1557.36 nm
OC192/STM64/WDM9240	1558.17 nm
OC192/STM64/WDM9230	1558.98 nm
OC192/STM64/WDM9220	1559.79 nm
OC192/STM64/WDM9210	1560.61 nm
OC192/STM64/WDM9200	1562.42 nm
OC192/STM64/WDM9190	1562.23 nm

Optical requirements and loss budgets

The following three tables list the optical requirements and loss budgets for optical port units in WaveStar BandWidth Manager.

The following table lists the optical requirements and loss budgets for the OC192/STM64 port units in WaveStar BandWidth Manager.

Table 10-5 Loss Budgets for OC192/STM64 Port Units

Parameter	OC192/STM64/[a]			
			POU (all) with	
	1.5IR1	1.5IRS1	8-Mux/ 8-Demux Box	16-Mux + 16-Demux Boxes
Maximum Transmitter Output Power (P_{Tmax})	2.0 dBm	2.0 dBm	2.0 dBm	2.0 dBm
Minimum Transmitter Output Power (P_{Tmin})	-1.0 dBm	-1.0 dBm	-1.0 dBm	-1.0 dBm
Maximum Received Power (P_{Rmax})[b]	-8.0 dBm	-3.0 dBm	-8.0 dBm	-8.0 dBm
Receiver Sensitivity (P_{Rmin})	-21.0 dBm	-14.0 dBm	-21.0 dBm	-21.0 dBm
Minimum System Gain (S-R)	20.0 dB	13.0 dB	20.0 dB	20.0 dB
Optical Path Penalty (P_O)	2.0 dB	2.0 dB	2.0 dB	2.0 dB
Minimum Loss Budget	10.0 dB	5.0 dB	10.0 dB	10.0 dB
Maximum Loss Budget	18.0 dB	11.0 dB	10.3 dB[c]	11.2 dB[d]

a) The OC192/STM64/WDM port units (40 wavelengths) are compatible with WaveStar OLS 400G. Refer to the WaveStar OLS 400G Applications and Planning Guide (365-575-736) to calculate loss budgets.

b) These values are measured at a BER of $1x10^{-12}$ with a modulated transmitter.

c) When using the 8-Mux/8-Demux Passive Optics Box with the OC192/STM64/POU port units, you must subtract 7.8 dB from the maximum loss budget to compensate for the mux/demux functions. This loss budget adjustment results in a span of 38 km with standard single-mode fiber. Without the passive optics boxes, the maximum span length of these port units is 60 km.

d) When using the 16-Mux + 16-Demux Passive Optics Boxes with the OC192/STM64/POU port units, you must subtract 6.8 dB from the maximum loss budget to compensate for the mux/demux functions. This loss budget adjustment results in a span of 40 km with standard single-mode fiber. Without the passive optics boxes, the maximum span length of these port units is 60 km.

The following table lists the optical requirements and loss budgets for the OC48/STM16 port units in WaveStar BandWidth Manager.

Table 10-6 Loss Budgets for OC48/STM16 Port Units

Parameter	OC48/STM16/[a]			
	1.3LR1	1.5LR1	POU	
			8-Mux/8-Demux Box	16-Mux + 16-Demux Boxes
Maximum Transmitter Output Power (P_{Tmax})	3.0 dBm	3.0 dBm	2.0 dBm	2.0 dBm
Minimum Transmitter Output Power (P_{Tmin})	-2.0 dBm	-2.0 dBm	-2.8 dBm	-2.8 dBm
Maximum Received Power (P_{Rmax})[b]	-9.0 dBm	-9.0 dBm	-9.0 dBm	-9.0 dBm
Receiver Sensitivity (P_{Rmin})	-27.0 dBm	-28.0 dBm	-28.0 dBm	-28.0 dBm
Minimum System Gain (S-R)	25.0 dB	26.0 dB	25.2 dB	25.2 dB
Optical Path Penalty (P_O)	1.0 dB	2.0 dB	2.0 dB	2.0 dB
Minimum Loss Budget	10.0 dB	10.0 dB	10.0 dB	10.0 dB
Maximum Loss Budget	24.0 dB	24.0 dB	15.4 dB[c]	16.4 dB[d]

a) The OC48/STM16/DWDM/01-16 port units are compatible with WaveStar OLS 40G/80G. Refer to the WaveStar OLS 40G Applications, Planning, and Ordering Guide (365-575-380) or the WaveStar OLS 80G Applications, Planning, and Ordering Guide (365-575-370) to calculate loss budgets.
The OC48/STM16/WDM port units (80 wavelengths) are compatible with WaveStar OLS 400G. Refer to the WaveStar OLS 400G Applications, Planning, and Ordering Guide (365-575-736) to calculate loss budgets.

b) These values are measured at a BER of $1x10^{-12}$ with a modulated transmitter.

c) When using the 8-Mux/8-Demux Passive Optics Box with the OC48/STM16/POU port units, you must subtract 7.8 dB from the maximum loss budget to compensate for the mux/demux functions. This loss budget adjustment results in a span of 57 km with standard single-mode fiber. Without the passive optics boxes, the maximum span length of these port units is 60 km.

d) When using the 16-Mux + 16-Demux Passive Optics Boxes with the OC48/STM16/POU port units, you must subtract 6.8 dB from the maximum loss budget to compensate for the mux/demux functions. This loss budget adjustment results in a span of 60 km with standard single-mode fiber. Without the passive optics boxes, the maximum span length of these port units is 60 km.

The following table lists the optical requirements and loss budgets for the OC12/STM4 and OC3/STM1 port units in WaveStar BandWidth Manager.

Table 10-7 Loss Budgets for OC12/STM4 and OC3/STM1 Port Units

Parameter	OC12/STM4/		OC3/STM1/	
	1.3LR2	1.3SR2	1.3LR4	1.3SR4
Maximum Transmitter Output Power (P_{Tmax})	2.0 dBm	-8.0 dBm	0.0 dBm	-8.0 dBm
Minimum Transmitter Output Power (P_{Tmin})	-2.5 dBm	-15.0 dBm	-5.0 dBm	-15.0 dBm
Maximum Received Power (P_{Rmax}) [a]	-8.0 dBm	-8.0 dBm	-10.0 dBm	-8.0 dBm
Receiver Sensitivity (P_{Rmin})	-30.5 dBm	-28.0 dBm	-34.0 dBm	-28.0 dBm
Minimum System Gain (S-R)	28.0 dB	13.0 dB	29.0 dB	13.0 dB
Optical Path Penalty (P_O)	1.0 dB	1.0 dB	1.0 dB	1.0 dB
Minimum Loss Budget	10.0 dB	0.0 dB	10.0 dB	0.0 dB
Maximum Loss Budget	27.0 dB	12.0 dB	28.0 dB	12.0 dB

a) These values are measured at a BER of $1x10^{-12}$ with a modulated transmitter.

Electrical Port Unit Specifications

Overview

The specifications provided in this section apply to the electrical port units in WaveStar BandWidth Manager, DS3EC1/8 and STM1E/4.

Transmission medium

This section provides the transmission medium information for the electrical port units.

DS3EC1/8

One unbalanced coaxial line is used for each direction of transmission. Therefore, two coaxial lines are used for each of the eight bidirectional ports on a DS3EC1/8 port unit.

STM1E/4

One unbalanced coaxial line is used for each direction of transmission. Therefore, two coaxial lines are used for each of the four bidirectional ports on a STM1E/4 port unit.

Capacity

This section provides the capacity information for the electrical port units.

DS3EC1/8

Each DS3EC1/8 port unit supports eight DS3- or EC-1-rate bidirectional lines (eight receive and eight transmit).

STM1E/4

Each STM1E/4 port unit supports four STM-1e-rate bidirectional lines (four receive and four transmit).

Line rate

This section provides the line rate information for the electrical port units.

DS3EC1/8

Each bidirectional port on the DS3EC1/8 port unit may be provisioned to transmit and receive one of the following:

- One DS3 signal with a nominal rate of 44.736 Mb/s ±895 b/s (±20 ppm)
- One EC-1 signal with a nominal rate of 51.840 Mb/s ±1037 b/s (±20 ppm)

STM1E/4

Each of the four bidirectional ports on the STM1E/4 port unit may be provisioned to transmit and receive an STM-1e signal with a nominal rate of 155.520 Mb/s (±20 ppm).

Connectors

This section provides the connector information for the electrical port units.

DS3EC1/8

The physical interface for each port, both the transmit and receive directions, of the DS3EC1/8 port unit is a 75-ohm BNC connector. The BNC connectors are located on the DS3EC1/8 Connector Panels on the left, right, or both sides of a Facility Interface Sub-Shelf when the sub-shelf is equipped as either a Electrical or Mixed Module.

STM1E/4

The physical interface for each port, both the transmit and receive directions, of the STM1E/4 port unit is a 75-ohm connector. WaveStar BandWidth Manager provides two versions of the STM1e Connector Panels:

- STM1e Connector Panel with 43-type (SMB) 75-ohm connectors
- STM1e Connector Panel with 1.6/5.6-type 75-ohm connectors

The STM1e Connector Panels may be located on the left, right, or both sides of a Facility Interface Sub-Shelf when the sub-shelf is equipped as either an STM1e Module or a Mixed Module.

Line code

This section provides the line code information for the electrical port units.

DS3EC1/8

The line code for the DS3EC1/8 port units is bipolar with 3-zero substitution (B3ZS).

STM1E/4

The line code for the STM1E/4 port units is coded mark inversion (CMI).

Bipolar violation monitoring

This section provides the BVM information for the electrical port units.

DS3EC1/8

Bipolar violation monitoring (BVM) is provided for the incoming B3ZS signal of each bidirectional port in a DS3EC1/8 port unit. The BVM feature can be enabled or disabled on a per port basis.

STM1E/4

Bipolar violation monitoring (BVM) is provided for the incoming B3ZS signal of each bidirectional port in a STM1E/4 port unit. The BVM feature can be enabled or disabled on a per port basis.

Protection

This section provides the provisionable protection modes for the electrical port units.

DS3EC1/8

The protection mode for the DS3EC1/8 port units in WaveStar BandWidth Manager may be provisioned as

- 1xN (N≤12) protected (one protection port unit providing protection for up to 12 service port units)
- 0x1 protected (unprotected)

Important! A SWITCH/DS3EC1 port unit and an additional DS3EC1/8 port unit are required for 1xN protection.

STM1E/4

The protection mode for the STM1E/4 port units in WaveStar BandWidth Manager may be provisioned as

- 1xN (N≤8) protected (one protection port unit providing protection for up to eight service port units)
- 0x1 protected (unprotected)

Important! A SWITCH/STM1E4 port unit and an additional STM1E/4 port unit are required for 1xN protection.

Line build-out

Because the electrical port units are designed to accept the entire signal range, external line build-outs are not required.

□

Power Specifications

Overview

This section provides specifications about the power supply, low voltage cut-off feature, heat dissipation, and current drain in WaveStar BandWidth Manager.

Power supply

The following table provides requirements for the power supply in WaveStar BandWidth Manager.

Table 10-8 Power Supply Requirements

Item	Description
Voltage Range, All Components[a]	-40.0 VDC to -72.0 VDC
Nominal Operation for -48V Power	-40.0 VDC to -57.0 VDC
Nominal Operation for -60V Power	-50.0 VDC to -72.0 VDC
Power Feeders	two -48.0/-60.0 VDC power feeders (A and B)
Circuit Breakers (two per System Controller Shelf)	7.5 amps
Circuit Breakers (two per Switch Shelf)	30.0 amps
Circuit Breakers (two per Universal I/O Shelf)	25.0 amps
Circuit Breakers (two per SDH Universal I/O Shelf)	25.0 amps
Circuit Breakers (two per 10G I/O Shelf)	40.0 amps
Circuit Breakers (two per Fan Unit)	3.0 amps

a) All components in WaveStar BandWidth Manager are designed to operate with -48V (SONET) and -48V/-60V (SDH) power.

Power planning

The following table provides the heat dissipation requirements for WaveStar BandWidth Manager.

Table 10-9 Heat Dissipation

Bays	Maximum Heat Dissipated
Control/Switch Bay	1224 watts
System Controller Bay	204 watts
Switch Bay	1020 watts
Universal I/O Bay (with two equipped Universal I/O Shelves)	1740 watts
10G I/O Bay (with one equipped 10G I/O Shelf)	1450 watts
10G I/O Bay (with two equipped 10G I/O Shelves)	2900 watts
10G/Universal I/O Bay (with one equipped Universal I/O Shelf and one equipped 10G I/O Shelf)	2320 watts
10G/SDH I/O Bay (with one equipped SDH Universal I/O Shelf and one equipped 10G I/O Shelf)	2370 watts
SDH I/O Bay (with two equipped SDH Universal I/O Shelves)	1840 watts

Current drains

The following two tables provide the current drain requirements for WaveStar BandWidth Manager.

SONET/SDH

The following table provides the -48V current drain requirements for WaveStar BandWidth Manager.

Table 10-10 Current Drains for -48V Platforms (SONET/SDH)

Shelves	Current Drains per Shelf in Amps		
	List 1 @ -48V	List 2	
		@ -42.75V	@ -39.5V
System Controller Shelf	4.3	4.8	5.2
Switch Shelf	21.3	23.9	25.8
Universal I/O Shelf	18.1	20.4	22.0
10G I/O Shelf	30.2	33.9	36.7
SDH Universal I/O Shelf	19.2	21.5	23.3

Important! The current drains presented in and are per shelf. Each current drain listed is the sum of both power feeds (A and B).

SDH

The following table provides the -60V current drain requirements for WaveStar BandWidth Manager.

Table 10-11 Current Drains for -60V Platforms (SDH)

Shelves	Current Drains per Shelf in Amps		
	List 1 @ -60V	List 2	
		@ -40.0V	@ -39.5V
System Controller Shelf	3.4	5.1	5.2
Switch Shelf	17.0	25.5	25.8
Universal I/O Shelf	14.5	21.8	22.0
10G I/O Shelf	24.2	36.3	36.7
SDH Universal I/O Shelf	15.3	23.0	23.3

Important! The current drains presented in and are per shelf. Each current drain listed is the sum of both power feeds (A and B).

Power filters with voltage protection

The power filters with voltage protection, located on all shelves in WaveStar BandWidth Manager, respond to DC voltage threshold levels. The power filters with voltage protection interrupt and restore power to their associated shelves according to the preset thresholds listed in the following table.

Table 10-12 Voltage Protection Thresholds

Status	Voltage
Nominal Operation for -48V Power	-40.0 VDC to -57.0 VDC
Nominal Operation for -48V/-60V Power	-50.0 VDC to -72.0 VDC
Cut-Off[a]	-38.5 VDC ±1.0V
Restart	-43.0 VDC ±0.5V

a) The stated threshold must persist for ≤100 ms in order to activate either the cut-off or restoration response.

Equipment Dimensions

Overview

This section provides the height, width, and depth for all major pieces of equipment in WaveStar BandWidth Manager.

Circuit pack dimensions

The following table provides the dimensions for all the circuit packs (including faceplates) in WaveStar BandWidth Manager.

Table 10-13 Circuit Pack Dimensions

Circuit Pack	Dimensions (mm/inches)		
	Height	Width	Depth
ADJCTL/DCCEI	347/13.66	20/0.79	270/10.63
ADJCTL/DCC	347/13.66	20/0.79	270/10.63
SWITCH/DS3EC1	347/13.66	20/0.79	270/10.63
SWITCH/STM1E4	347/13.66	20/0.79	270/10.63
SWITCH/STS576	347/13.66	30/1.18	270/10.63
SWIF	347/13.66	30/1.18	270/10.63
CTL/SR50DC	347/13.66	30/1.18	27010.63
PPROC/FO	347/13.66	30/1.18	270/10.63
SWITCH/STS768	347/13.66	30/1.18	270/10.63
CTL/SYS50DM	347/13.66	30/1.18	270/10.63
CTL/SYS50D	347/13.66	35/1.38	270/10.63
CSIEX	347/13.66	40/1.57	270/10.63
CTL/EI	107/4.21	35/1.38	270/10.63
CTL/MEM	107/4.21	35/1.38	270/10.63
TMG/STRAT3	107/4.21	25/0.98	270/10.63
SWIEX	467/18.39	25/0.98	270/10.63
BSW	467/18.39	25/0.98	270/10.63

Port unit dimensions

The following table provides the dimensions for the port units (including faceplates) in WaveStar BandWidth Manager.

Table 10-14 Port Unit Dimensions

Circuit Pack	Dimensions (mm/inches)		
	Height	Width	Depth
OC192/STM64 (all)	347/13.66	60/2.36	270/10.63
OC48/STM16 (all)	347/13.66	40/1.57	270/10.63
OC12/STM4 (all)	347/13.66	20/0.79	270/10.63
OC3/STM1 (all)	347/13.66	20/0.79	270/10.63
DS3EC1/8	347/13.66	20/0.79	270/10.63
STM1E/4	347/13.66	20/0.79	270/10.63

Bay dimensions

The following two tables provide the dimensions for all the bays (NEBS and ETSI) in WaveStar BandWidth Manager.

NEBS Bays

The following table provides the dimensions for NEBS bays in WaveStar BandWidth Manager.

Table 10-15 NEBS Bay Dimensions

Bay	Dimensions (mm/inches)		
	Height	Width	Depth
System Controller Bay	2133.6/84	660.4/26	482.6/19
Control/Switch Bay	2133.6/84	660.4/26	482.6/19
Switch Bay	2133.6/84	660.4/26	482.6/19
Universal I/O Bay	2133.6/84	660.4/26	482.6/19
10G I/O Bay	2133.6/84	660.4/26	482.6/19
10G/Universal I/O Bay	2133.6/84	660.4/26	482.6/19
10G/SDH I/O Bay	2133.6/84	660.4/26	482.6/19
SDH I/O Bay	2133.6/84	660.4/26	482.6/19
Cable Management Bay (Standard Footprint)	2133.6/84	457.2 /18	482.6/19
Cable Management Bay (Reduced Footprint)	2133.6/84	330.2/13	482.6/19

ETSI Bays

The following table provides the dimensions for NEBS bays in WaveStar BandWidth Manager.

Table 10-16 ETSI Bay Dimensions

Bay	Dimensions (mm)		
	Height	Width	Depth
System Controller Bay	2200	600	600
Control/Switch Bay	2200	600	600
Switch Bay	2200	600	600
Universal I/O Bay	2200	600	600
10G I/O Bay	2200	600	600
10G/Universal I/O Bay	2200	600	600
10G/SDH I/O Bay	2200	600	600
SDH I/O Bay	2200	600	600
Cable Management Bays (Original Footprint)	2200	300 and 600	600
Cable Management Bays (Reduced Footprint)	2200	150 and 300	600

Additional equipment

The following table provides the dimensions for all additional equipment in WaveStar BandWidth Manager.

Table 10-17 Additional Equipment Dimensions

Equipment	Dimensions (mm/inches)		
	Height	Width	Depth
Fan Unit	48.0/1.89	543.1/21.38	380.0/14.96
Fan Filter	13.5/0.53	543.1/21.38	380.0/14.96
DS3EC1 Connector Panels	546.1/21.5	101.6/4.0	57.2/2.25
STM1e Connector Panels	544.8/21.45	104.4/4.11	52.6/2.07
Heat Baffle	70.1/2.76	543.1/21.38	380.0/14.96

Operations Interface Specifications

Overview

This section provides the detailed specifications for the operations interfaces in WaveStar BandWidth Manager.

Office alarms

This section provides information about office alarms.

Steady state current

The steady state current for office alarm connections should not exceed 0.9A at -48V/-60V or 1.8A at 30V.

Maximum transient current

The maximum transient currents (20ms duration) for office alarm connections should not exceed 9A at -48V/-60V or 18A at 30V.

TL1

The TL1 interface operates at 1200 to 19,200 baud through an EIA-232-D port.



External Synchronization Specifications

Overview

This section provides specifications for the DS1 and E1 timing inputs and outputs and the external synchronization cables.

DS1 timing inputs/outputs

WaveStar BandWidth Manager is primarily timed from duplicated TMG/STRAT3 circuit packs located in the System Controller Shelf. The TMG/STRAT3 packs tied to an office BITS clock via duplicated DS1 timing inputs.

The following table provides detailed specifications for the DS1 timing inputs/outputs.

Table 10-18 DS1 Timing Inputs/Outputs

Characteristic	Description
Source	Two references: must be derived from Stratum 3 or better timing sources (for example, an office BITS clock)
Line Coding	AMI (default) B8ZS
Frame Format	SF ESF (default)
Connectors	DB9
Protection Switching between References	Revertive automatically on LOS, AIS-L, LOF, or BER

E1 timing inputs/outputs

WaveStar BandWidth Manager is primarily timed from duplicated TMG/STRAT3 circuit packs located in the System Controller Shelf. The TMG/STRAT3 packs tied to a SEC via duplicated E1 timing inputs.

The following table provides detailed specifications for the E1 timing inputs/outputs.

Table 10-19 E1 Timing Inputs/Outputs

Characteristic	Description
Source	Two references: must be derived from either a Primary Reference Clock (PRC) or Synchronization Supply Unit (SSU) or better timing sources (for example, a SEC)
Line Coding	Time wave signal
Frame Format	2 MHz E1 • 2 Mb/s unframed • 2 Mb/s framed
Connectors	DB9
Cabling Interface	Coax 75 ohm (unbalanced) Twisted-pair 120 ohm (balanced)
Protection Switching between References	Complies with ITU synchronization requirements

Synchronization cables

The following table lists the maximum allowable lengths for the external synchronization timing cables.

Table 10-20 External Synchronization Timing Cable

Cable	Maximum Length (mm/ft)
DS1 Cross-Connect	199,644/655
Other Sources	399,288/1310

Environmental Specifications

Overview

This section provides the specific environmental conditions that WaveStar BandWidth Manager is designed to endure without detrimentally effecting the system's operation.

Floor loading specifications

WaveStar BandWidth Manager complies with the floor loading specifications listed in the following table.

Table 10-21 Floor Loading Specifications

Equipment (excluding cables)	Weight lbs/kg	
	NEBS	ETSI
System Controller Bay	304 lbs/138 kg	401 lbs/182 kg
Control/Switch Bay	493 lbs/224 kg	590 lbs/268 kg
Switch Bay	375 lbs/170 kg	472 lbs/215 kg
Universal I/O Bay with two equipped Universal I/O Shelves	625 lbs/284 kg	722 lbs/328 kg
10G I/O Bay with one equipped 10G I/O Shelf	406 lbs/185 kg	503 lbs/229 kg
10G I/O Bay with two equipped 10G I/O Shelves	635 lbs/289 kg	732 lbs/333 kg
10G/Universal I/O Bay with one equipped 10G I/O Shelf and one equipped Universal I/O Shelf	630 lbs/286 kg	727 lbs/330 kg
10G/SDH I/O Bay with one equipped SDH Universal I/O Shelf and one equipped 10G I/O Shelf	610 lbs/277 kg	707 lbs/321 kg
SDH I/O Bay with two equipped SDH Universal I/O Shelves	585 lbs/266 kg	682 lbs/310 kg

Operating conditions

WaveStar BandWidth Manager is designed to be operate in a controlled environment that complies with the environmental requirements listed in the following table.

Table 10-22 Temperature and Humidity Requirements

Operating Condition	Normal		Short-terma	
	Celsius (C)	Fahrenheit (F)	Celsius (C)	Fahrenheit (F)
Ambientb temperature	5° to 40°	41° to 104°	-5° to 50°	23° to 122°
Maximum temperature rate of change	30°/hour	54°/hour	30°/hour	54°/hour
Ambientb relative humidity	5% to 85%		5% to 90%c	
Pressure	70 to 106 kPa		NA	
Altitude	-61m to 1,928m/ -200 ft to 6500 ft		NA	

a) Short-term refers to a period of time ≤90 consecutive hours and a total of ≤15 days in one year. The time may total 360 hours in any given year, but may not exceed 15 individual occurrences during that one year.

b) Ambient refers to conditions at the specific location of 1500 mm/59 in. above the floor and 400mm/15.8 in. in front of the equipment.

c) Not to exceed 0.024 kg of water per kg of dry air.

Storage and transportation conditions

WaveStar BandWidth Manager is designed to be fully operational after being subjected to the environmental conditions listed in the following table during storage and transportation.

Table 10-23 Storage and Transportation Requirements

Condition	Range	
	Celsius (C)	Fahrenheit (F)
Temperature	-40°C to 70°C	-40°F to 158°F
Maximum temperature rate of change	30°C/hour	54°F/hour
Relative humidity	5% to 95%	
Maximum absolute humidity	0.024 kg of water/kg of dry air	
Altitude	-61m to 12,195m	-200 ft to 40,000 ft



Appendix A: A SONET Overview

Overview

Purpose This chapter briefly describes the Synchronous Optical Network (SONET).

Contents The following topics are discussed in this chapter:

History of SONET	A - 2
SONET Signal Hierarchy	A - 4
SONET Layers	A - 6
SONET Frame Structure	A - 9
SONET Digital Multiplexing	A - 13
SONET Interface	A - 16
SONET Multiplexing Process	A - 17
SONET Demultiplexing Process	A - 19
SONET Transport Rates	A - 22



History of SONET

Overview

This section highlights the historical milestones in the development of SONET.

History of the SONET name

The American National Standards Institute (ANSI) recognized the need for an optical signal standard for future broadband transmission, and a committee began working on optical signal and interface standards in 1984.

In 1985, Bellcore proposed a network approach to fiber system standardization to T1X1. In the proposal, Bellcore suggested the following:

- Hierarchical family of signals whose rates would be integer multiples of a basic modular signal
- Synchronous multiplexing technique, leading to the coining of the term *Synchronous Optical Network* (SONET)

CCITT interest in SONET

The International Telegraph and Telephone Consultative Committee (CCITT) was interested in SONET and held conferences in 1987 and 1988 which resulted in coordinated specifications and approval of both the American National Standard (SONET) and the CCITT-International Standard, Synchronous Digital Hierarchy (SDH) in 1988.

> **Important!** The CCITT is now named International Telecommunication Union, Telecommunication Standardization Sector (ITU-T). For more information refer to the “Standards: Their Global Impact” in the *IEEE Communications Magazine*, Vol. 32, No. 1, January 1994.

Purpose

The basic purpose of SONET is to provide a standard synchronous optical hierarchy with sufficient flexibility to accommodate digital signals that currently exist in the networks of today, as well as those planned for the future.

SONET currently defines standard rates and formats and optical interfaces. Today, mid-span meet is possible at the optical transmission level. These and other related issues continue to evolve through the ANSI committees.

ANSI addressed issues

The set of American National Standards defines:

- Optical parameters
- Multiplexing schemes to map existing digital signals (that is, DS1 and DS3) into SONET payload signals
- Overhead channels to support standard operation, administration, maintenance, and provisioning (OAM&P) functions
- Criteria for optical line automatic protection switch (APS)

References

For more detailed information on SONET, refer to:

- ANSI T1.105 – 1995 American National Standard for Telecommunications, Synchronous Optical Network (SONET)
- ANSI T1.106-1988 American National Standard for Telecommunications – Digital Hierarchy Optical Interface Specifications, Single Mode
- ITU Recommendations G.707, G.708, G.709
- R. Ballart and Y. C. Ching, SONET: Now It's the Standard Optical Network, *IEEE Communications Magazine*, Vol. 27, No. 3 (March 1989): 8-15

□

SONET Signal Hierarchy

Overview

This section describes the basics of the SONET hierarchy.

STS-1 frame

The SONET signal hierarchy is based on a basic "building block" frame called the synchronous transport signal-level 1 (STS-1), as shown in Figure A-1.

- The STS-1 frame has:
  - A recurring rate of 8000 frames a second
  - The frame rate of 125 microseconds
- The STS-1 frame consists of:
  - 90 columns
  - 9 rows

Important! Each cell in the matrix represents an 8-bit byte.

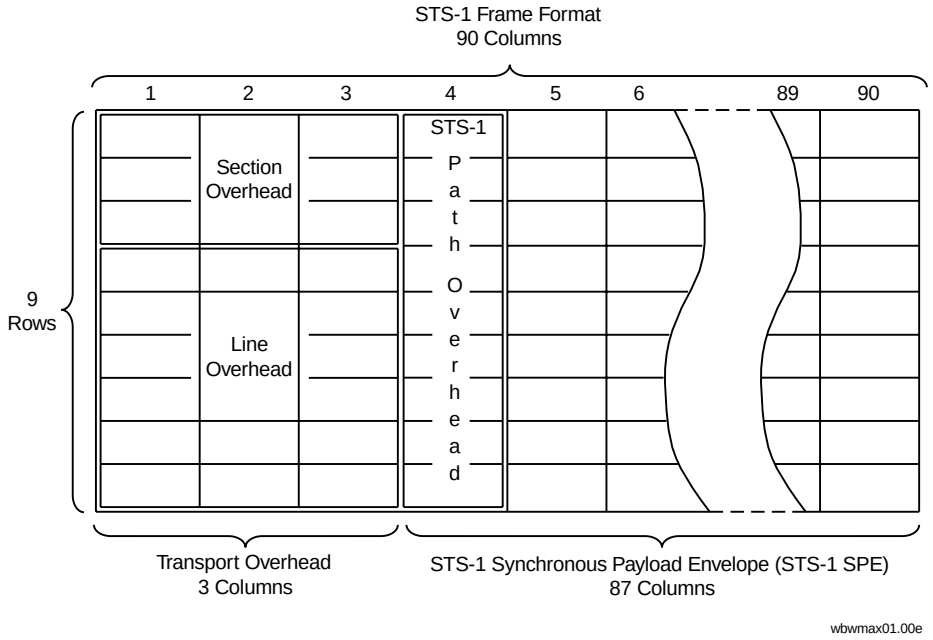
Transmitting signals

The STS-1 frame is transmitted serially starting from the left with row 1 column 1 through column 90, then row 2 column 1 through 90, continuing on, row-by-row, until all 810 bytes (9x90) of the STS-1 frame have been transmitted. Because each STS-1 frame consists of 810 bytes and each byte has 8 bits, the frame contains 6480 bits a frame. There are 8000 STS-1 frames a second, at the STS-1 signal rate of 51,840,000 (6480x8000) bits a second.

Figure of SONET STS-1 Frame

Figure A-1 illustrates the SONET STS-1 frame.

Figure A-1 SONET STS-1 Frame Simplified Version



Transport overhead

The first three columns in each of the nine rows carry the section and line overhead bytes. Collectively, these 27 bytes are referred to as transport overhead.

Synchronous payload envelope

Columns 4 through 90 (the remainder of the frame), are reserved for payload signals (for example, DS1 and DS3) and is referred to as the STS-1 synchronous payload envelope (STS-1 SPE). The optical counterpart of the STS-1 is the optical carrier level 1 signal (OC-1), which is the result of a direct optical conversion after scrambling.

□

SONET Layers

Overview

SONET divides its processing functions into the following three layers:

- Section
- Line
- Path

These three layers are associated with:

- Equipment that reflects the natural divisions in network spans
- Bytes that carry information used by various network elements

Equipment layers

The following table lists and defines each SONET equipment layer.

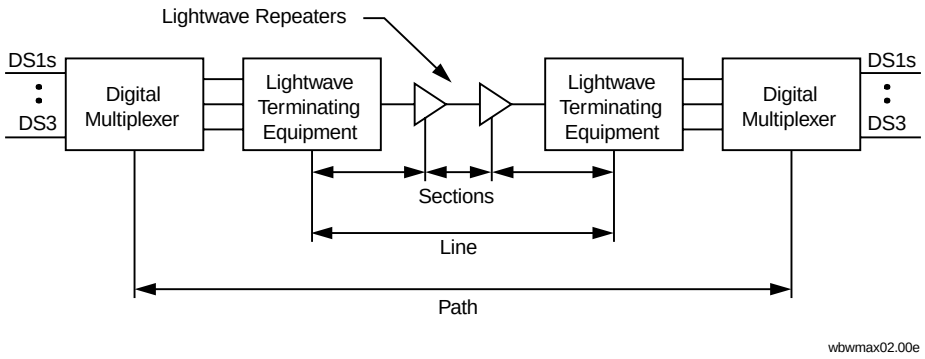
Table A-1 SONET Equipment Layers

Layer	Definition
Section and Section Terminating Equipment	The transmission spans (Spans between regenerators are also referred to as sections.) between lightwave terminating equipment and the regenerators. This equipment provides regenerator functions which terminate the section overhead to provide single-ended operations and section performance monitoring.
Line and Line Terminating Equipment	The transmission span between terminating equipment (STS-1 cross-connects) that provides line performance monitoring.
STS-1 and Virtual Tributary (VT) Path Terminating Equipment	The SONET portion of the transmission span for an end-to-end tributary (DS1 or DS3) signal that provides signal labeling and path performance monitoring for signals as they are transported through a SONET network. STS-1 path terminating equipment also provides cross-connections for lower-rate, (that is, DS1) signals. A VT is a sub-DS3 payload and is described later in more detail.

Figure

Figure A-2 illustrates the equipment layers (section, line, and path) in a signal path.

Figure A-2 Section, Line, and Path Definitions



Overhead byte layers

The following table lists and defines the overhead associated with each SONET layer.

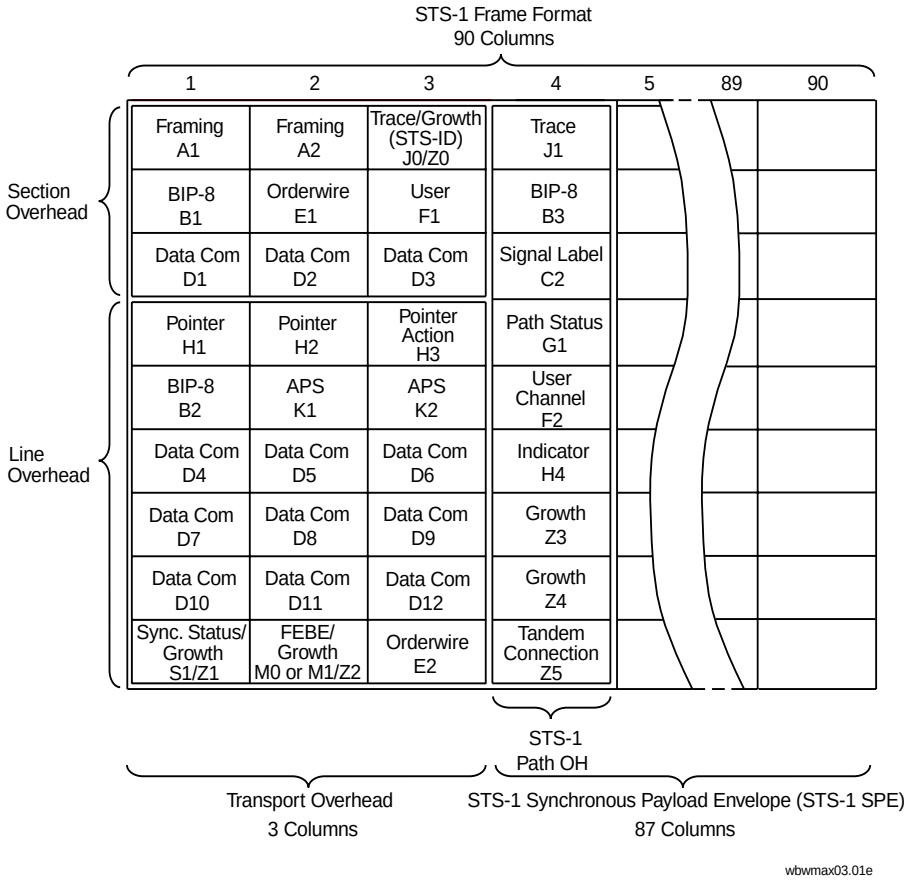
Table A-2 Overhead Byte Layers

Overhead Byte Layer	Definition
Section	Contains information that is used by all SONET equipment including repeaters.
Line	Used by all SONET equipment except repeaters.
Path	Carried within the payload envelope across the end-to-end path with: • STS-1 remaining with the STS-1 SPE until its payload is demultiplexed • VTN (N= 1.5, 2, 3, or 6) remaining with the VTN until it is demultiplexed to its asynchronous signal

Figure of SONET frame format

Figure A-3 illustrates each SONET layer and its set of overhead bytes.

Figure A-3 SONET Frame Format



SONET Frame Structure

Overview

This section provides detailed information on the locations and functions of various overhead bytes for each of the following SONET layers:

- Section
- Line
- Path (STS-1 and VT)

Section overhead

The following table identifies the location and function of each section overhead byte.

Table A-3 Section Overhead Bytes

Byte	Location and Function
Framing (A1 & A2)	Provides framing for each STS-1.
Trace/Growth (J0/Z0)	The Section Trace and Section Growth bytes replace STS-1 ID (C1). J0/Z0 are for future use and the locations are as follows: • J0 byte is in the first STS-1 of an STS-N. • Z0 byte is in the second through N^{th} STS-1 of the STS-N.
Section Bit Interleaved Parity (BIP-8) (B1)[a]	Provides section performance monitoring and is calculated over all bits of the previous STS-N frame.
Section Orderwire (E1)[a]	Provides a local orderwire for voice communication channel between regenerators.
Section User Channel (F1)[a]	Set aside for the purpose of the user.
Section Data Communications Channel (D1-D3)[a]	A 192 kb/s message-based channel that is used for alarms, maintenance, control, monitoring, and other communication needs between section terminating equipment.

a) Defined only for STS-1 #1 of an STS-N signal.

Line overhead

The following table identifies the location and function of each line overhead byte.

Table A-4 Line Overhead Bytes

Byte	Location and Function
Pointer (H1, H2)	Two bytes indicating the offset in bytes between the pointer action byte (H3) and the first byte (J1) of the STS-1 synchronous payload envelope (SPE).
Pointer Action (H3)	Allocated for frequency justification.
Line Bit Interleaved Parity (BIP-8) (B2)	Provided for line performance monitoring in all STS-1 signals within an STS-N signal.
Automatic Protection Switching (APS) (K1, K2)[a]	Two bytes used for APS signaling between line level entities. In addition, bits 6, 7, and 8 of K2 are used for line alarm indication signal (AIS) and line far-end receive failure (FERF).
Line Data Communications Channel (D4 - D12)	A 576 kb/s message-based channel that is used for alarms, maintenance, control, monitoring, and other communication needs between section terminating equipment.
Synchronization Status (S1)	• Located in the first STS-1 of an STS-N. • Conveys the synchronization status of the Network Element.
Growth (Z1)	• Located in the second through N^{th} STS-1 of an STS-N. • Reserved for future growth.
Line Orderwire (E2)[a]	Allocated to be used as an express orderwire between line entities.

a) Defined only for STS-1 #1 of an STS-N signal.

STS-1 path overhead

The STS-1 path overhead is assigned to and remains with the STS-1 SPE until the payload is demultiplexed and is used for functions that are necessary to transport all synchronous payload envelopes.

Use the following table to determine the location and function of each STS-1 path overhead byte.

Table A-5 STS-1 Path Overhead Bytes

Byte	Location and Function
STS-1 Path Trace (J1)	Repetitively transmits a 64 byte, fixed length string so that an STS-1 path receiving terminal can verify its continued connection to the intended transmitter.
STS-1 Path Bit Interleaved Parity (BIP-8) (B3)	Provides each STS-1 path performance monitoring. This byte is calculated over all bits of the previous STS-1 SPE before scrambling.
STS-1 Path Signal Label (C2)	Indicates the construction of the STS-1 synchronous payload envelope (SPE).
Path Status (G1)	Conveys the STS-1 path terminating status, performance, and remote defect indication (RDI) signal conditions back to an originating STS-1 path terminating equipment.
Path User Channel (F2)	Reserved for user communication.
Indicator (H4)	Provides a general multiframe indicator for VT-structured payloads.
Path Growth (Z3 - Z4)	Reserved for future growth.
Tandem Connection (Z5)	Allocated for Tandem Connection Maintenance and the Path Data Channel, as specified by ANSI T1.105.05.

SPE values

The following table lists the types of STS-1 synchronous payload envelope values and their meanings. The system can generate 00, 01, or 04 and can carry any of the other values within the path layer overhead.

Table A-6 Synchronous Payload Envelopes

Hexidecimal Code	STS-1 SPE
00	Unequipped
01	Equipped nonspecific payload
02	VT-Structured STS-1 SPE
04	Asynchronous mapping for DS3
12	DS4NA Asynchronous mapping
13	Mapping for ATM
14	Mapping for DQDB
15	Asynchronous mapping FDDI

VT path overhead

Virtual tributary (VT) path overhead provides important functions for managing sub-STS-1 payloads; such as, error checking, path status, and signal label. These functions are similar to those provided for STS-1 paths.



SONET Digital Multiplexing

Overview

SONET provides the following two multiplexing schemes:

- Asynchronous
- Synchronous

Asynchronous multiplexing

When fiber optic facilities are used to carry DS3 signals, the signal consists of a combination of the following payload signals:

- 28 DS1s
- 14 DS1s
- 7 DS2s

M23 format

Typically, 28 DS1 signals are multiplexed into a DS3 signal, using the M23 format. The M23 format involves bit interleaving of four DS1 signals into a DS2 signal and then bit interleaving of seven DS2 signals into a DS3. In addition, the DS3 rate is not a direct multiple of the DS1 or the DS2 rates due to the bit-stuffing synchronization technique used in asynchronous multiplexing.

Disadvantages of M23 format

When using an M23 format, identification of DS0s contained in any DS-N signal is complex, and DS0s cannot be directly extracted. An asynchronous DS3 signal must be demultiplexed down to the DS1 level to access and cross-connect DS0 and DS1 signals. In addition, the M23 format does not provide an end-to-end overhead channel for use by OAM&P groups.

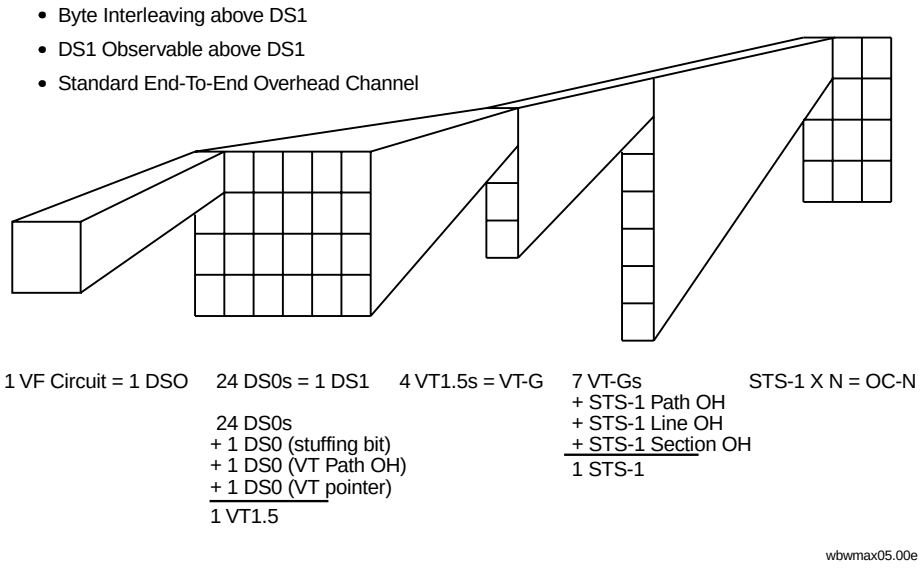
Synchronous multiplexing

Synchronous multiplexing is the SONET method of byte interleaving DS1s to a higher signal rate, which permits economical extraction of a single DS1 without the need to demultiplex the entire STS-1 SPE. In addition, SONET provides overhead channels for use by OAM&P groups.

Figure of synchronous multiplexing

Figure A-4 illustrates the SONET technique of mapping a single asynchronous DS1 signal into an STS-1 SPE.

Figure A-4 Synchronous Multiplexing



Transporting SONET payloads

Sub-DS3 asynchronous signals (DS1, DS1C, DS2, and E1) are *byte interleaved* into a digital signal called a virtual tributary (VT). The VT is a structure designed for the transport and switching of sub-DS3 payloads. There are four sizes of VTs: 1.5, 2, 3, and 6.

Table Digital signals DS1 and DS3 are the most important asynchronous signals in the current network. Broadband payloads, such as ATM, are also of great importance.

The following table provides the digital signals that can be transported as SONET payloads.

Table A-7 SPE Payloads

Input Tributary	Voice Channels (DS0s)	Rate	SONET Signal	Rate
DS1	24 DS0s	1.544 Mb/s	VT1.5	1.728 Mb/s
E1 (CEPT)	32 DS0s	2.048 Mb/s	VT2	2.304 Mb/s
DS1C	48 DS0s	3.152 Mb/s	VT3	3.456 Mb/s
DS2	96 DS0s	6.312 Mb/s	VT6	6.912 Mb/s
DS3	672 DS0s	44.736 Mb/s	STS-1	51.840 Mb/s
DS4NA	2016 DS0s	139.264 Mb/s	STS-3c	155.520 Mb/s
ATM	2016 DS0s	149.760 Mb/s	STS-3c	155.520 Mb/s
FDDI	2016 DS0s	125.000 Mb/s	STS-3c	155.520 Mb/s

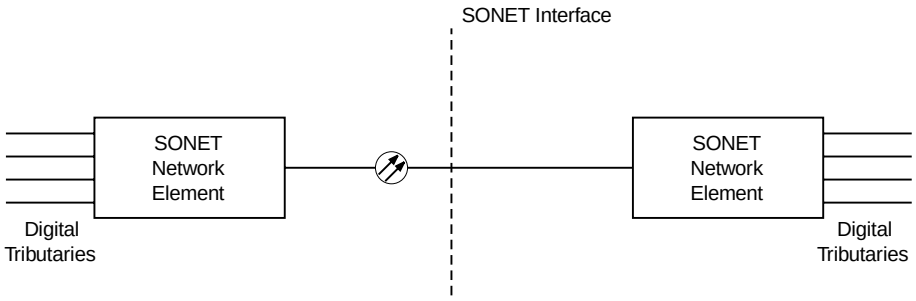
SONET Interface

Overview This section describes the SONET interface.

Description The SONET interface provides the optical mid-span meet between SONET network elements. A SONET network element is the hardware and software that affects the termination or repeating of a SONET standard signal.

Figure of SONET interface Figure A-5 illustrates the SONET interface.

Figure A-5 SONET Interface



Standard optical interconnect at SONET interface

Family of standard rates at N X 51.84 Mb/s [Synchronous Transport Signal (STS-1)]

Overhead channels defined for interoffice operations and maintenance functions

wbwmax06.00e

SONET Multiplexing Process

Overview

SONET provides for multiplexing of asynchronous DS1s, synchronous DS1s, and asynchronous DS3s.

Multiplexing Process

The following describes the process for multiplexing a signal.

1 Input DS1 or DS3 tributary is mapped.

In the case of DS1 inputs, three time slots (DS0s) are added to the incoming signal, becoming a VT1.5.

An asynchronous DS1 that fully meets the specified rate is mapped into the VT1.5 SPE as clear channel input since no framing is needed.

- Each VT1.5 carries a single DS1 payload.
- Four VT1.5s are bundled into a VT group (VT-G).
- Seven VT-Gs are byte interleaved into an STS-1 frame.

Important! The VT-G to-STS-1 multiplex is a simple byte interleaving process, so individual VT signals are easily observable within the STS-1. Thus, cross-connections and add/drop can be accomplished without the back-to-back mux/demux steps required by asynchronous signal formats.

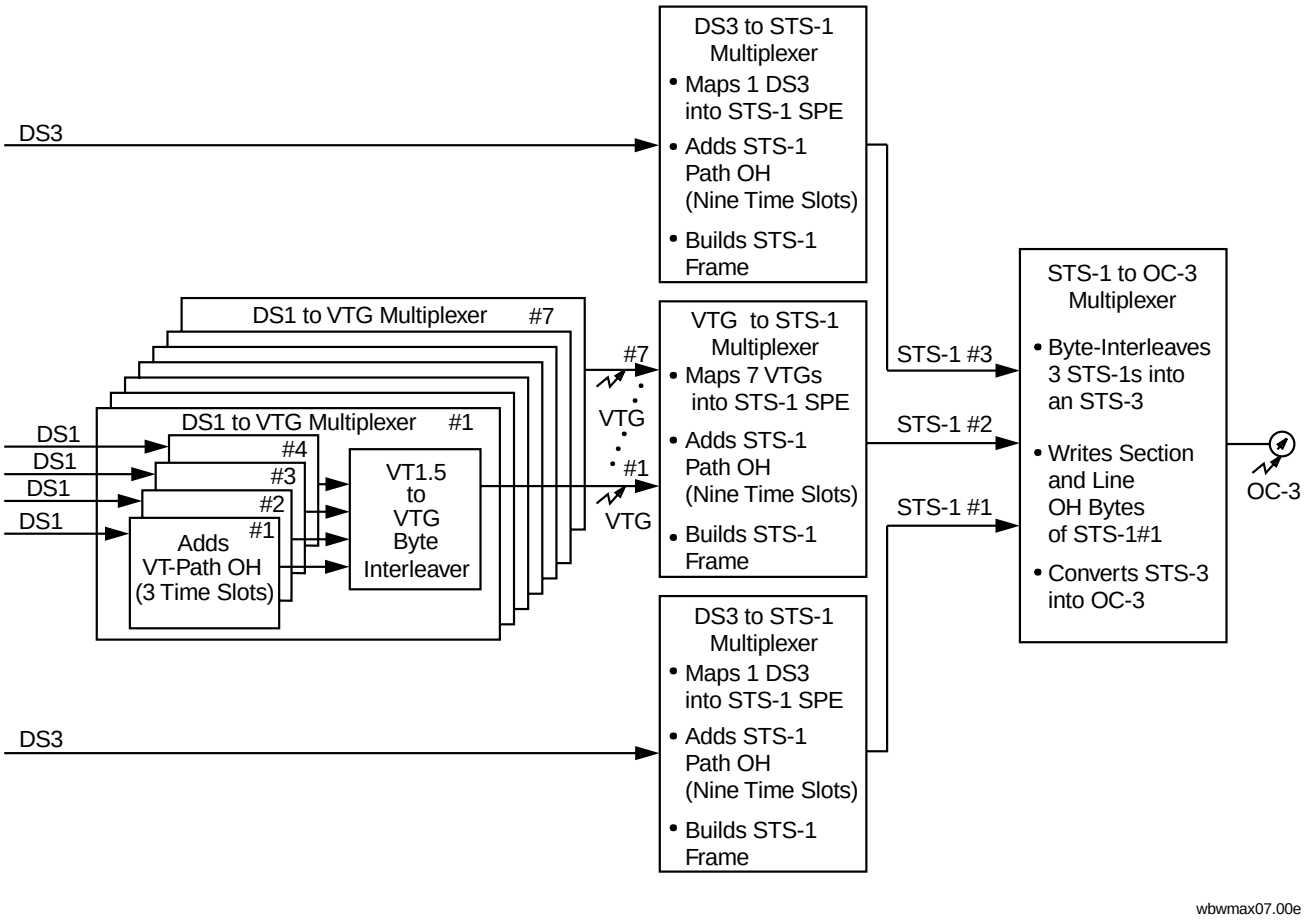
2 After VTs are multiplexed into the STS-1 SPE, the path, line, and section overhead is added.

3 Scrambled STS-N signal is transported to the optical stage.

Figure

Figure A-6 illustrates the SONET multiplexing process.

Figure A-6 SONET Multiplexing Process



SONET Demultiplexing Process

Overview

Demultiplexing is the inverse of multiplexing. This topic describes how to demultiplex a signal.

Demultiplexing Process

The following describes the process for demultiplexing an STS-1 signal to a DS1 signal.

1 The unscrambled STS-1 signal from the optical conversion stages is processed to extract the section and line overhead and accurately locate the SPE.

2 The STS-1 path overhead is processed to locate the VTs. The individual VTs are then processed to extract VT overhead and, via the VT pointer, accurately locate the DS1.

3 The DS1 is desynchronized, providing a standard DS1 signal to the asynchronous network.

Key points

Remember the following key points when demultiplexing a signal:

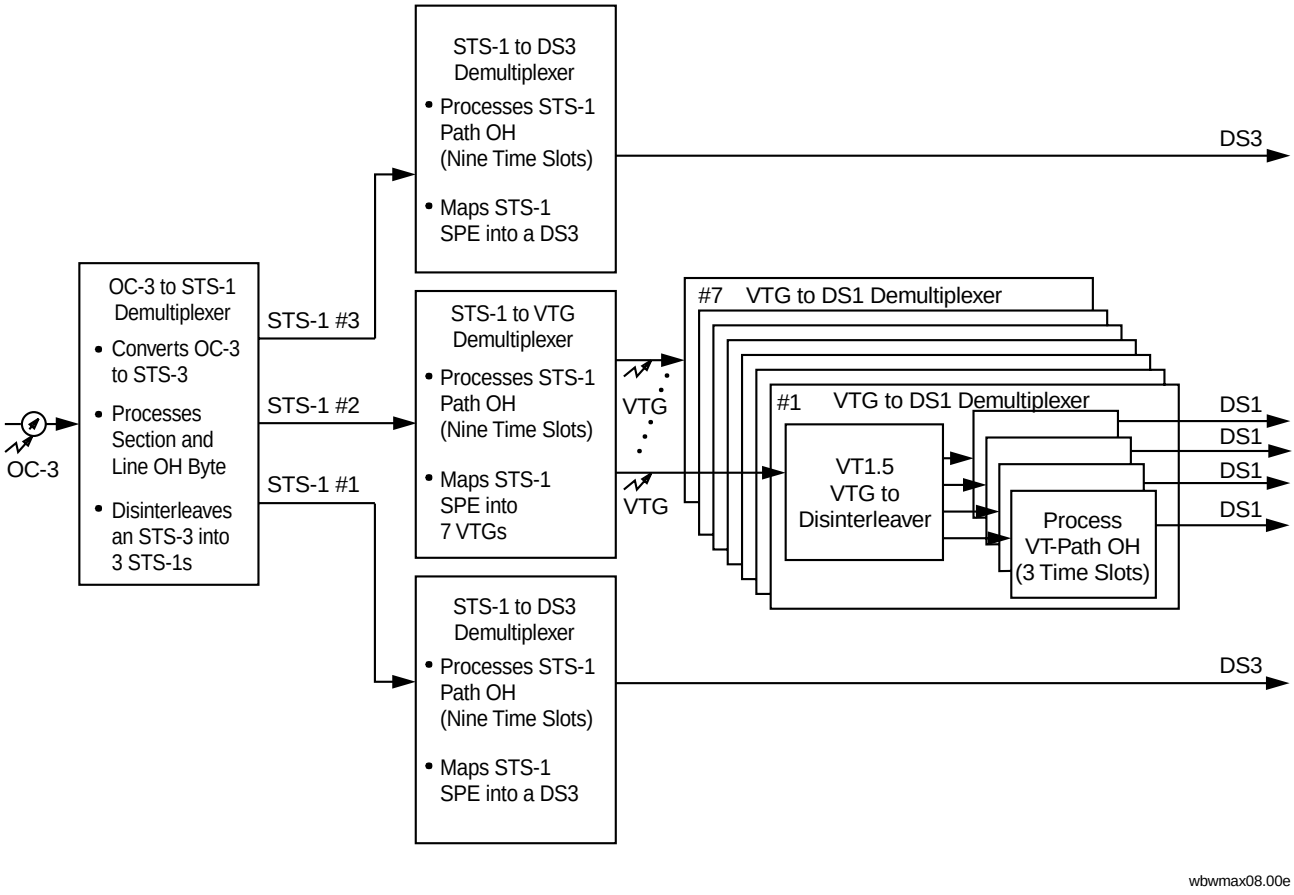
- The SONET frame is a fixed time (125 ms) and no bit-stuffing is used.
- The synchronous payload envelope (SPE) can *float* within the frame. This is to permit compensation for small variations in frequency between the clocks of the two systems that may occur if the systems are independently timed (plesiochronous timing). The SPE can also *drift* across the 125-ms frame boundary.

  Important! SONET STS pointers are used to locate the SPE relative to the transport overhead.

Figure

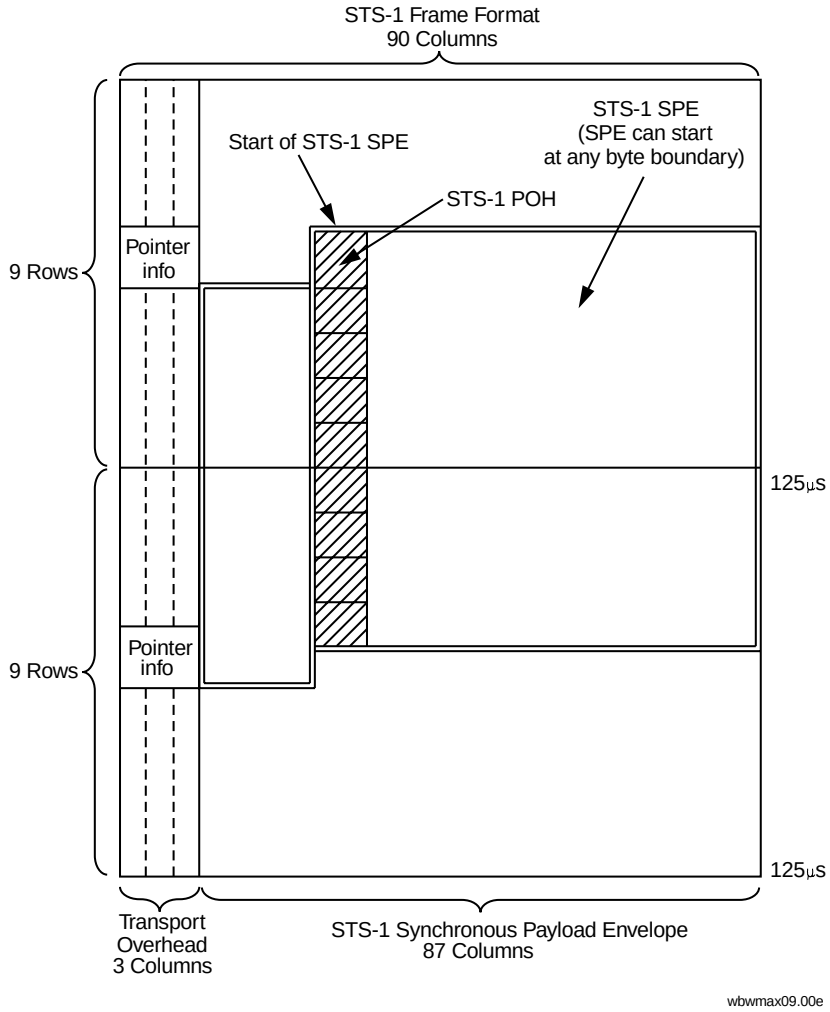
Figure A-7 illustrates the SONET demultiplexing process.

Figure A-7 SONET Demultiplexing Process



SPE figure Figure A-8 illustrates the SPE floating within an STS-1 frame.

Figure A-8 STS-1 SPE in Interior of STS-1 Frame



SONET Transport Rates

Overview

Higher rate SONET signals are created by byte-interleaving N STS-1s to form an N STS-1 signal.

Creating higher rate signals

The desired N STS-1s are created by:

- Adjusting all payload pointers and regenerating the section and line overhead bytes to be in phase with each other and the outgoing multiplexed signal
- Scrambling and converting the N STS-1 to an optical carrier – level N (OC-*N*) signal

SONET transport rates

The following table lists the SONET transport rates.

Table A-8 SONET Transport Rates

OC Level	Line Rate (Mb/s)	Capacity
OC-1	51.84	28 DS1s or 1 DS3
OC-3	155.52	84 DS1s or 3 DS3s
OC-12	622.08	336 DS1s or 12 DS3s
OC-48	2488.32	1344 DS1s or 48 DS3s
OC-192	9953.28	5376 DS1s or 192 DS3s





Appendix B: An SDH Overview

Overview

Purpose This chapter briefly describes the Synchronous Digital Hierarchy (SDH).

Contents This chapter provides the following descriptions:

SDH Signal Hierarchy	B - 5
SDH Path and Line Sections	B - 7
SDH Frame Structure	B - 11
SDH Digital Multiplexing	B - 13
SDH Interface	B - 15
SDH Multiplexing Process	B - 16
SDH Demultiplexing Process	B - 17
SDH Transport Rates	B - 18

History of SDH

Overview

This section highlights the historical milestones in the development of SDH.

Synchronous Digital Hierarchy

In 1988, the ITU-T *(formerly CCITT)* came to an agreement on the Synchronous Digital Hierarchy (SDH). The corresponding ITU-T Recommendation G.707 forms the basis of a global, uniform optical transmission network. SDH can operate with plesiochronous networks and therefore allows the continuous evolution of existing digital transmission networks.

The major features and advantages of SDH are:

- Compatibility of transmission equipment and networks on a worldwide basis
- Uniform physical interfaces
- Easy cross connection of signals in the network nodes
- Possibility of transmitting PDH (Plesiochronous Digital Hierarchy) tributary signals at bit rates commonly used at present
- Simple adding and dropping of individual channels without special multiplexers (add/drop facility)
- Easy transition to higher transmission rates
- Due to the standardization of the network element functions SDH supports a superordinate network management and new monitoring functions and provides transport capacity and protocols (Telecommunication Management Network, TMN) for this purpose in the overheads of the multiplex signals.
- High flexibility and user-friendly monitoring possibilities, e.g. end-to-end monitoring of the bit error ratio.

Purpose of SDH

The basic purpose of SDH is to provide a standard synchronous optical hierarchy with sufficient flexibility to accommodate digital signals that currently exist in today's network, as well as those planned for the future.

SDH currently defines standard rates and formats and optical interfaces. Today, mid-span meet is possible at the optical transmission level. These and other related issues continue to evolve through the ITU-T committees.

ITU-T addressed issues

The set of ITU-T Recommendations defines

- Optical parameters
- Multiplexing schemes to map existing digital signals (PDH) into SDH payload signals
- Overhead channels to support standard operation, administration, maintenance, and provisioning (OAM&P) functions
- Criteria for optical line Automatic Protection Switch (APS)

References

For more detailed information on SDH, refer to

- ITU-T Recommendation G.703, Physical/electrical characteristics of hierarchical digital interfaces, October 1996
- ITU-T Recommendation G.707, Network Node Interface For The Synchronous Digital Hierarchy (SDH), March 1996
- ITU-T Recommendation G.780, Vocabulary of terms for synchronous digital hierarchy (SDH) networks and equipment, November 1993
- ITU-T Recommendation G.783, Characteristics of Synchronous Digital Hierarchy (SDH) Multiplexing Equipment Functional Blocks, April 1997
- ITU-T Recommendation G.784, Synchronous Digital Hierarchy (SDH) Management, January 1994
- ITU-T Recommendation G.785, Characteristics of a flexible multiplexer in a synchronous digital hierarchy environment, November 1996
- ITU-T Recommendation G.813, Timing characteristics of SDH equipment slave clocks (SEC), August 1996
- ITU-T Recommendation G.823, The control of jitter and wander within digital networks which are based on the 2048-bit/s hierarchy, March 1993
- ITU-T Recommendation G.825, The control of jitter and wander within digital networks which are based on the synchronous digital hierarchy (SDH), March 1993

- ITU-T Recommendation G.826, Error performance Parameters and Objectives for International, Constant Bit Rate Digital Paths at or Above the Primary Rate, February 1999
- ITU-T Recommendation G.957, Optical interfaces foR Equipment and Systems Relating to the Synchronous Digital Hierarchy, July 1995

□

SDH Signal Hierarchy

Overview

This section describes the basics of the SDH hierarchy.

STM-1 frame

The SDH signal hierarchy is based on a basic “building block” frame called the Synchronous Transport Module 1 (STM-1), as shown in Figure B-1.

The STM-1 frame has a rate of 8000 frames per second and a duration of 125 microseconds

The STM-1 frame consists of 270 columns and 9 rows.

Each cell in the matrix represents an 8-bit byte.

Transmitting signals

The STM-1 frame (STM = Synchronous Transport Module) is transmitted serially starting from the left with row 1 column 1 through column 270, then row 2 column 1 through 270, continuing on, row-by-row, until all 2430 bytes (9x270) of the STM-1 frame have been transmitted. Because each STM-1 frame consists of 2430 bytes and each byte has 8 bits, the frame contains 19440 bits a frame. There are 8000 STM-1 frames a second, at the STM-1 signal rate of 155.520.000 (19440 x 8000) kbit/s.

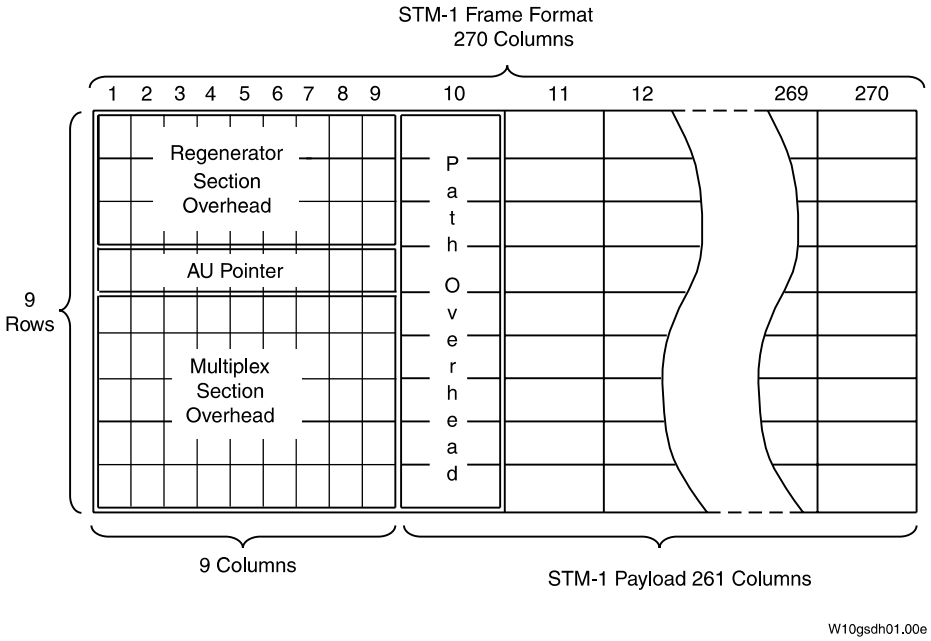
Three higher bit rates are also defined:

- 622.080 Mbit/s (STM-4)
- 2488.320 Mbit/s (STM-16)
- 9953.280 Mbit/s (STM-64)

The bit rates of the higher order hierarchy levels are integer multiples of the STM-1 transmission rate.

Figure Figure B-1 illustrates the SDH STM-1 frame.

Figure B-1 SDH STM-1 Frame Simplified Version



Section Overhead (SOH) The first nine bytes of each row with exception of the fourth row are part of the SOH (Section OverHead). The first nine byte of the fourth row contain the AU pointer (AU = Administrative Unit).

STM-1 payload Columns 10 through 270 (the remainder of the frame), are reserved for payload signals.

□

SDH Path and Line Sections

Overview

This section describes and illustrates the SDH path and line sections.

SDH layers

SDH divides its processing functions into the following three path and line sections:

- Regenerator section
- Multiplex section
- Path

These three path and line sections are associated with

- Equipment that reflects the natural divisions in network spans
- Overhead bytes that carry information used by various network elements

Equipment layers

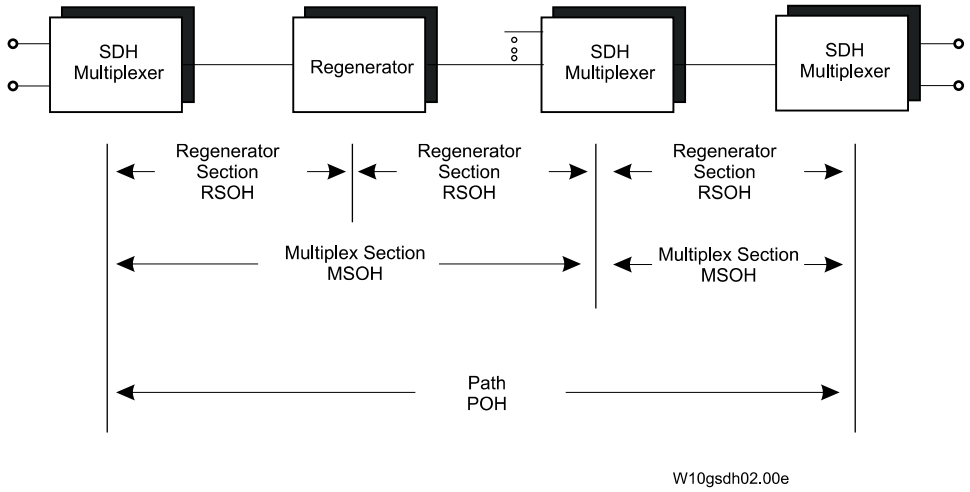
The following table lists and defines each SDH equipment path and line section.

Table B-1 SDH Equipment Sections

Path and Line Sections	Definition
Regenerator Section	A regenerator section describes the section between two network elements. The network elements, however, do not necessarily have to be regenerators.
Multiplex Section	A multiplex section is the section between two multiplexers. A multiplex section is defined as that part of a path where no multiplexing or demultiplexing of the STM-N frame takes place.
Path	A path is the logical signal connection between two termination points. A path can be composed of a number of multiplex sections which themselves can consist of several regenerator sections.

Figure Figure B-2 illustrates the equipment path and line sections in a signal path.

Figure B-2 Section, Line, and Path Definitions



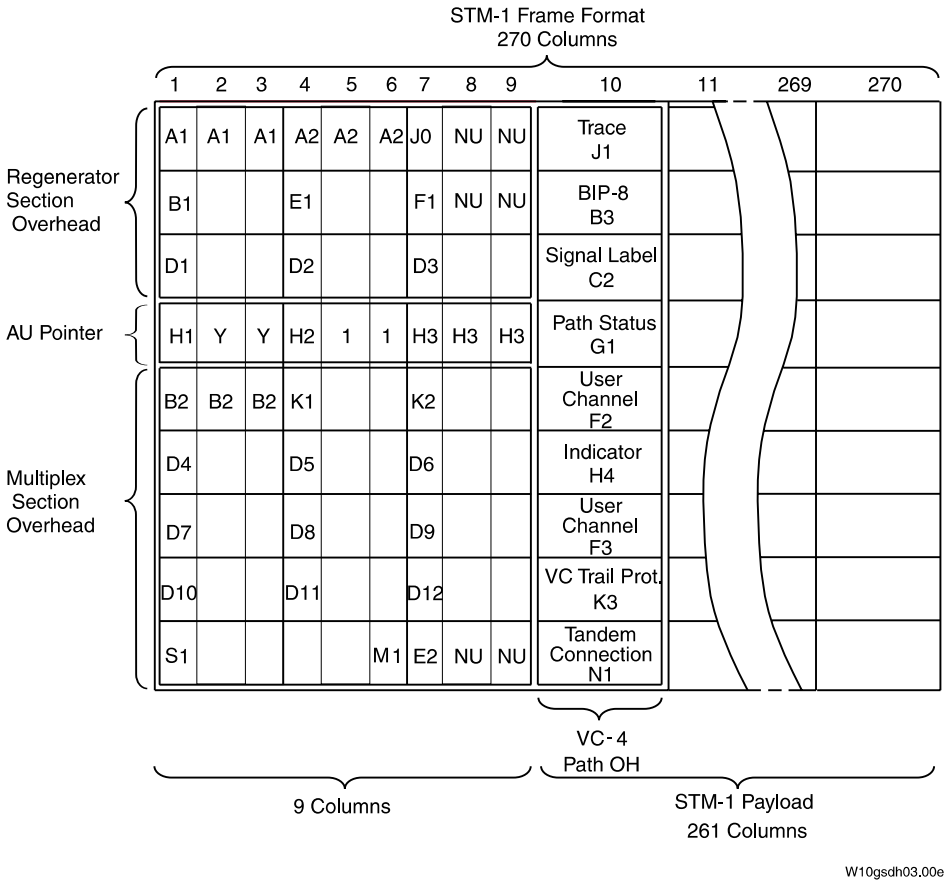
Overhead bytes The following table lists and defines the overhead associated with each SDH path and line section.

Table B-2 Overhead Byte Sections

Overhead Byte Section	Definition
Regenerator Section	Contains information that is used by all SDH equipment including repeaters.
Multiplex Section	Used by all SDH equipment except repeaters.
Path	The POH contains all the additional signals of the respective hierarchy level so that a VC can be transmitted and switched through independently of its contents.

Figure Figure B-3 illustrates each SDH frame section and its set of overhead bytes.

Figure B-3 SDH Frame Format



SDH Frame Structure

Overview

This section provides detailed information on the locations and functions of various overhead bytes for each of the following SDH path and line sections:

- Regenerator Section
- Multiplex Section
- Path

Section Overhead (SOH)

The following table identifies the location and function of each regenerator SOH byte.

Table B-3 Regenerator Section Overhead Byte

Bytes	Function
A1, A2	Frame alignment A1 = 1111 0110; A2 = 0010 1000; These fixed-value bytes are used for synchronization.
B1	BIP-8 parity test/Regenerator section error monitoring; BIP-8: Computed over all bits of the previous frame after scrambling; B1 is placed into the SOH before scrambling; BIP-X: (Bit Interleaved Parity X bits) Even parity, X-bit code; first bit of code = even parity over first bit of all X-bit sequences;
B2	Multiplex section error monitoring; BIP-24: B2 is computed over all bits of the previous STM-1 frame except for row 1 to 3 of the SOH (RSOH); B2 is computed after and placed before scrambling;
Z0	Spare bytes
D1 - D3 (= DCC_R) D4 - D12 (= DCC_M)	Data Communication Channel (network management information exchange)
E1	Orderwire channel
E2	Orderwire channel
F1	User channel
K1, K2	Automatic protection switch
K2	MS-AIS/RDI indicator
S1	Synchronization Status Message
M1	REI (Remote Error Indication) byte
NU	National Usage

Path Overhead (POH)

The Path Overhead (POH) is generated for all plesiochronous tributary signals in accordance with ITU-T Rec. G.709. The POH provides for integrity of communication between the point of assembly of a Virtual Container VC and its point of disassembly. The following table lists the POH bytes and their functions.

Table B-4 Path Overhead Bytes

Byte	Location and Function
J1	Path Trace Identifier byte
B3	Path Bit Interleaved Parity (BIP-8) Provides each path performance monitoring. This byte is calculated over all bits of the previous payload before scrambling.
C2	Signal Label All “0” means unequipped; other and “00000001” means equipped
G1	Path Status Conveys the STM-1 path terminating status, performance, and remote defect indication (RDI) signal conditions back to an originating path terminating equipment.
F2, F3	User Data Channel Reserved for user communication.
H4	Multiframe Indicator Provides a general multiframe indicator for VC-structured payloads.
K3	VC Trail protection.
N1	Tandem connection OH

AU pointer

The AU pointer together with the last 261 columns of the STM-1 frame forms an AUG (Administrative Unit Group). An AUG may contain one AU-4 or three byte-multiplexed AU-3s (an AU-3 is exactly one third of the size of an AU-4). AU-3s are also compatible with the SONET standard (Synchronous Optical NETwork) which is the predecessor of SDH (and still the prevailing technology within the USA). Three byte-multiplexed STS frames (SONET frame), each containing one AU-3 can be mapped into one STM-1.

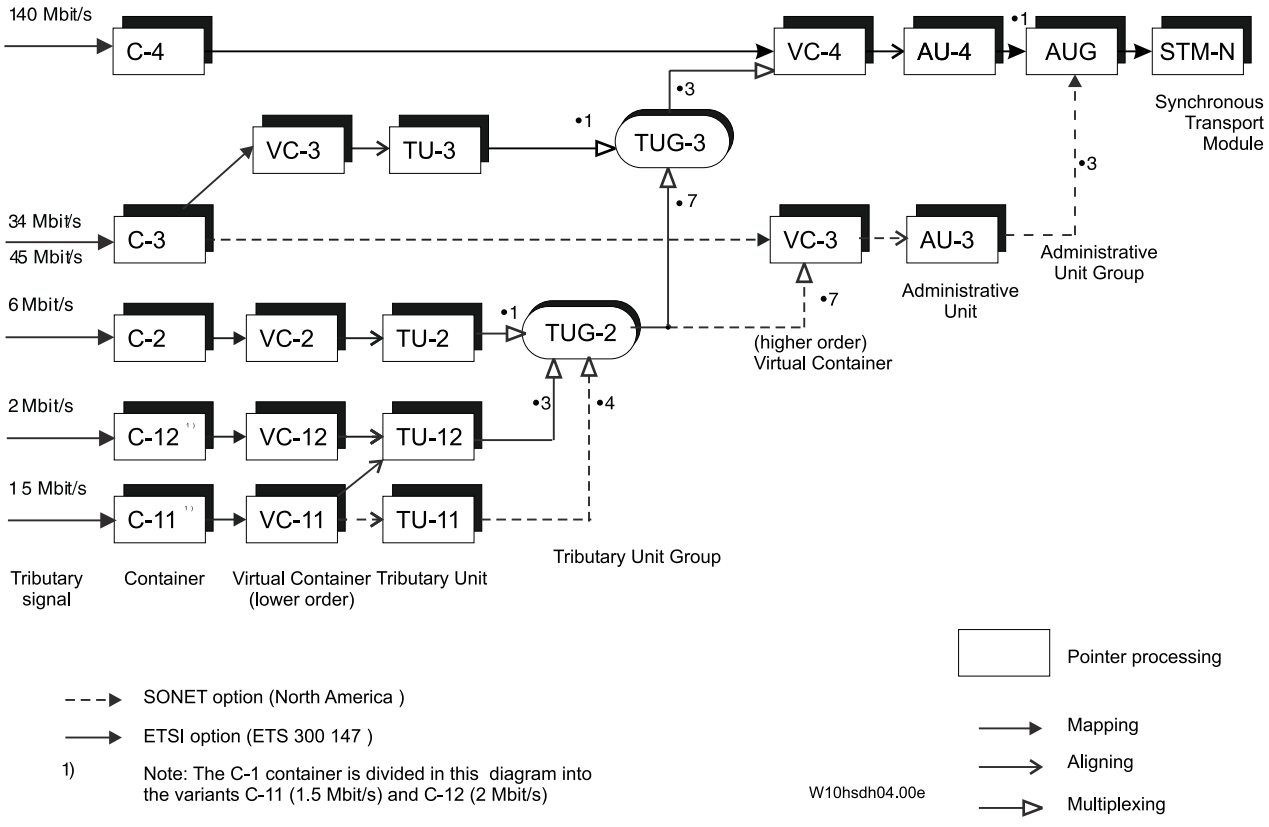
□

SDH Digital Multiplexing

Overview Digital multiplexing is the SDH method of byte mapping tributary signals to a higher signal rate, which permits economical extraction of a single tributary signal without the need to demultiplex the entire STM-1 payload. In addition, SDH provides overhead channels for use by OAM&P groups.

Figure Figure B-4 illustrates the SDH technique of mapping tributary signals into an STM-1 frame.

Figure B-4 SDH Multiplexing Structure



Transporting SDH payloads

Tributary signals are mapped into a digital signal called a virtual container (VC). The VC is a structure designed for the transport and switching of sub-STM-1 payloads. There are five sizes of VCs: VC-11, VC-12, VC-2, VC-3, and VC-4.

Table

The following table provides the digital signals that can be transported as SDH payloads.

Table B-5 SDH Payloads

Input tributary	Voice Channels	Rate	Mapped Into
1.5 Mbit/s	24	1.544 Mbit/s	VC-11
2 Mbit/s	32	2.048 Mbit/s	VC-12
6 Mbit/s	96	6.312 Mbit/s	VC-2
34 Mbit/s	672	34.368 Mbit/s	VC-3
45 Mbit/s	672	44.736 Mbit/s	VC-3
140 Mbit/s	2016	139.264 Mbit/s	VC-4



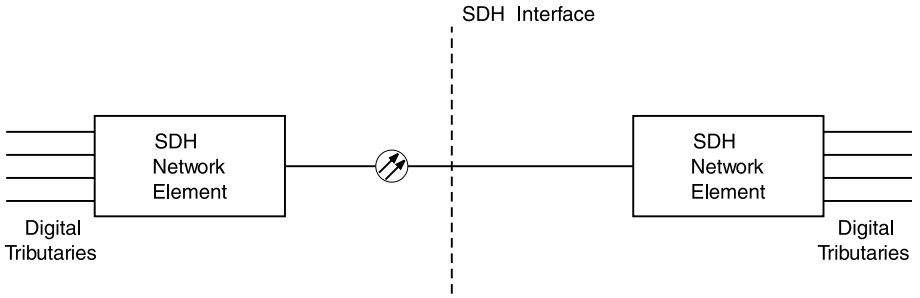
SDH Interface

Overview This section describes the SDH interface.

Description The SDH interface provides the optical mid-span meet between SDH network elements. An SDH network element is the hardware and software that affects the termination or repeating of an SDH standard signal.

Figure Figure B-5 illustrates the SDH interface.

Figure B-5 SDH Interface



Standard optical interconnect at SDH interface

Family of standard rates at N x 155.52 Mbit/s
[Synchronous Transport Module (STM-1)]

Overhead channels defined for interoffice operations
and maintenance functions

W10gsdh06.00e

SDH Multiplexing Process

Overview

SDH provides for multiplexing of 2-Mbit/s (C-12) and 34-Mbit/s (C-3) signals into an STM-1 frame.

Furthermore, multiplexing paths also exist for the SONET specific 1.5-Mbit/s, 6-Mbit/s and 45-Mbit/s signals.

Process

The following describes the process for multiplexing a 2-Mbit/s signal.

1 Input 2-Mbit/s tributary is mapped

- Each VC-12 carries a single 2-Mbit/s payload.
- The VC-12 is aligned into a Tributary Unit TU-2 using a TU pointer.
- Three TU-2 are then multiplexed into a Tributary Unit Group TUG-2.
- Seven TUG-2 are multiplexed into an TUG-3.
- Three TUG-3 are multiplexed into an VC-4.
- The VC-4 is aligned into an Administrative Unit AU-4 using a AU pointer.
- The AU-4 is mapped into an AUG which is then mapped into an STM-1 frame.

2 After VCs are multiplexed into the STM-1 payload, the section overhead is added.

3 Scrambled STM-1 signal is transported to the optical stage.

□

SDH Demultiplexing Process

Overview Demultiplexing is the inverse of multiplexing. This topic describes how to demultiplex a signal.

Process The following describes the process for demultiplexing an STM-1 signal to a 2 Mbit/s signal. The illustrates the demultiplexing process.

1 The unscrambled STM-1 signal from the optical conversion stages is processed to extract the path overhead and accurately locate the payload.

2 The STM-1 path overhead is processed to locate the VCs. The individual VCs are then processed to extract VC overhead and, via the VC pointer, accurately locate the 2-Mbit/s signal.

3 The 2-Mbit/s signal is desynchronized, providing a standard 2-Mbit/s signal to the asynchronous network.

Key points SDH STM pointers are used to locate the payload relative to the transport overhead.

Remember the following key points about signal demultiplexing:

- The SDH frame is a fixed time (125 ms) and no bit-stuffing is used.
- The synchronous payload can float within the frame. This is to permit compensation for small variations in frequency between the clocks of the two systems that may occur if the systems are independently timed (plesiochronous timing).

SDH Transport Rates

Overview

Higher rate STM-N frames are built through byte-multiplexing of N STM-1 signals.

Creating higher rate signals

A STM-N signal can only be multiplexed out of N STM-1 frames with their first A1 byte at the same position (i.e. the first A1 byte arriving at the same time).

STM-N frames are built through byte-multiplexing of N STM-1 signals. Not all bytes of the multiplexed SOH (size = N x SOH of STM-1) are relevant in an STM-4/16.

For example there is only one B1 byte in an STM-4/16 frame which is computed the same way as for an STM-1. Generally the SOH of the first STM-1 inside the STM-N is used for SOH bytes that are needed only once. The valid bytes are given in ITU-T G.707.

SDH transport rates

The following table displays the SDH transport rates.

Table B-6 SDH Transport Rates

Designation	Line Rate (Mbit/s)	Capacity
STM-1	155.520	1 AU-4 or 3 AU-3
STM-4	622.080	4 AU-4 or 12 AU-3
STM-16	2488.320	16 AU-4 or 48 AU-3
STM-64	9953.280	64 AU-4 or 144 AU-3





Appendix C: Port Unit Data Sheets

Overview

Purpose This chapter provides data sheets for the port units in WaveStar BandWidth Manager.

Contents This chapter provides the following descriptions:

Using the Data Sheets	C - 3
OC192/STM64/1.5SR1 (LEY67/LEY67AE) Data Sheet	C - 5
OC192/STM64/1.5IR1 (LEY69/LEY69AE) Data Sheet	C - 11
OC192/STM64/1.5IRS1 (LEY97/LEY97AE) Data Sheet	C - 17
OC192/STM64/POU (LEY284-299/LEY284AE-299AE) Data Sheet	C - 21
OC192/STM64/WDM (LEY201-240/LEY201AE-240AE) Data Sheet	C - 27
OC48/STM16/1.3LR1 (LEY7/LEY7AE) Data Sheet	C - 31
OC48/STM16/1.5LR1 (LEY8/LEY8AE) Data Sheet	C - 35
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OC48/STM16/POU (LEY80-95/LEY80AE-95AE) Data Sheet	C - 43
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OC12/STM4/1.3LR2 (LEY13/LEY13AE) Data Sheet	C - 53
OC12/STM4/1.3SR2 (LEY14/LEY14AE) Data Sheet	C - 57
OC3/STM1/1.3LR4 (LEY15/LEY15AE) Data Sheet	C - 61
OC3/STM1/1.3SR4 (LEY16/LEY16AE) Data Sheet	C - 65
DS3EC1/8 (LEY17/LEY17AE) Data Sheet	C - 69
STM1E/4 (LEY43/LEY43AE) Data Sheet	C - 71

Using the Data Sheets

Overview

The data sheets provide technical specifications about each type of port unit used in WaveStar BandWidth Manager in a singular location. Some information in the data sheets is included in other chapters of the APG, but not necessarily in the same location for each product.

Using the data sheets

The different port units are arranged so that information about each type of port unit may be pulled out from Appendix C intact.

Port unit availability

The following table lists the availability of port units for WaveStar BandWidth Manager.

Table C-1 Availability of Port Units in WaveStar BandWidth Manager

Port Unit	Apparatus Codes	R1.3	R2	R3.0	R3.1	R4.0	R4.1
OC192/STM64/1.5SR1	LEY67 LEY67AE		X	X	X	DA	DA
OC192/STM64/1.5IR1	LEY69 LEY69AE			X	X	X	X
OC192/STM64/1.5IRS1	LEY97 LEY97AE			X	X	X	X
OC192/STM64/POU	LEY284-299 LEY284AE-299AE			X	X	X	X
OC192/STM64/WDM	LEY201-240 LEY201AE-240AE			X	X	X	X
OC48/STM16/1.3LR1	LEY7 LEY7AE	X	X	X	X	X	X
OC48/STM16/1.5LR1	LEY8 LEY8AE	X	X	X	X	X	X
OC48/STM16/DWDM01-16	LEY50-65 LEY50-65AE		X	X	X	X	X
OC48/STM16/POU	LEY80-95 LEY80AE-95AE			X	X	X	X
OC48/STM16/WDM	LEY101-180 LEY 101AE-180AE				X	X	X
OC12/STM4/1.3LR2	LEY13 LEY13AE	X	X	X	X	X	X
OC12/STM4/1.3SR2	LEY14 LEY14AE	X	X	X	X	X	X
OC3/STM1/1.3LR4	LEY15 LEY15AE	X	X	X	X	X	X
OC3/STM1/1.3SR4	LEY16 LEY16AE	X	X	X	X	X	X
DS3EC1/8	LEY17 LEY17AE	X	X	X	X	X	X
STM1E/4	LEY43 LEY43AE				X	X	X

OC192/STM64/1.5SR1 (LEY67/LEY67AE) Data Sheet

Overview This data sheet contains technical specifications for the OC192/STM64/1.5SR1 (intermediate reach) port units that are used in WaveStar BandWidth Manager. DA effective 12/00.

Capacity Each OC192/STM64/1.5SR1 port unit supports one bidirectional (one receive and one transmit) OC192/STM64 formatted optical signal. The capacity may be translated to 192 STS1/64 STM1 equivalents or 129,024 two-way voice circuits per port unit.

OC-192/STM-64 access

The following table describes OC192/STM64 capabilities.

Table C-2 OC192/STM64/1.5SR1 Access

Specification	Description
Interface	Intermediate-reach (40 km) interface[a]
Growth Increment	One OC192/STM64 per port unit
Line Code	Scrambled NRZ

[a] This number is a typical value. 50 km can be achieved with forward error correction (FEC). The actual value must be calculated using measured data (see Figure C-1).

Protection switching

The following table describes protection switching information per high speed line.

Table C-3 Protection Switching for OC192/STM64/1.5SR1 Port Units

Specification	Length of Time
Switching Bit Error Rate (BER)	10^{-3} to 10^{-9} (user provisionable)
Restoral BER	One-tenth of the switching BER
Switching Time	60 msec (BER $\geq 10^{-3}$ line signal failure)

Optical safety

Optical safety data on laser-containing port units, such as the OC192/STM64/1.5SR1 port unit, is

- SONET: Class I in the FDA/CDRH Classification System
- SDH: Level 1 in the IEC Classification System.

Optical dispersion

The optical dispersion for the OC192/STM64/1.5SR1 port units is 800 ps/nm.

Optical return loss

The following table provides the optical return loss for a system using OC192/STM64/1.5SR1 port units.

Table C-4 Optical Return Loss

Specification	Amount
Maximum system optical return loss	24.0 dB
Maximum receiver reflectance	–27.0 dB
Maximum discrete reflectance	–27.0 dB

Transmission specifications

The following table provides transmission specifications for the OC192/STM64/1.5SR1 port units.

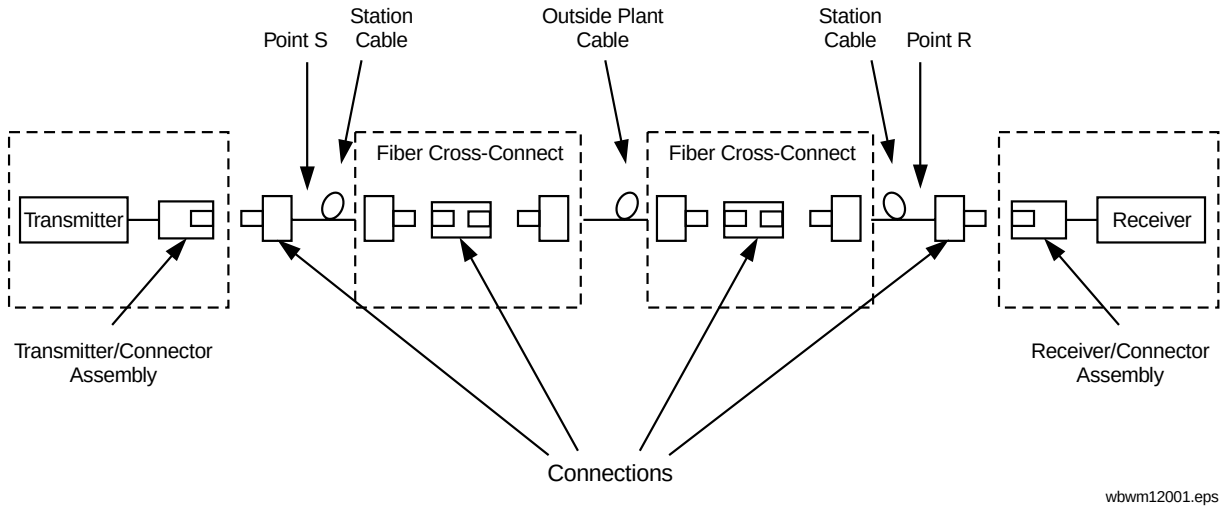
Table C-5 Transmission Specifications for OC192/STM64/1.5SR1 Port Units

Specification	Description
Transmission Medium	Input Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber Output Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber
Operating Connector Interfaces	Universal build-out block and optional ST-type, FC-type, or SC-type lightguide build-out (LBO) connectors for optical attenuation
Optical Line Rate	Input: 9.953 Gb/s Output: 9.953 Gb/s
Transmitter Wavelengths	Minimum: 1530 nm Maximum: 1565 nm
Spectral Width	2.0 nm (RMS)
Optical Source	Electro-absorptive Modulated Laser (EML)

Optical system interfaces

Figure C-1 illustrates the optical path between the transmitter and the receiver.

Figure C-1 Optical System Interfaces



Optical requirements and loss budgets

The following table lists the optical requirements and loss budgets for the OC192/STM64/1.5SR1 port units.

Table C-6 Optical Loss Budgets for the OC192/STM64/1.5SR1 Port Units

Parameter	OC192/STM64/1.5SR1 Port Unit[a]
Maximum Transmitter Output Power (P_{Tmax})[b]	2.0 dBm
Minimum Transmitter Output Power (P_{Tmin})[c]	–4.0 dBm
Maximum Received Power (P_{Rmax})[d]	–13.0 dBm
Receiver Sensitivity (P_{Rmin})[c,d]	–21.0 dBm
Minimum System Gain (S-R)	17.0 dB
Optical Path Penalty (P_O)	2.0 dB
Minimum Loss Budget[e]	10.0 dB
Maximum Loss Budget[f]	15.0 dB

a) All values assume that standard single-mode non-dispersion shifted fiber is used. Dispersion shifted fiber may be used. WaveStar BandWidth Manager complies with Telcordia Technologies and ITU requirements for dispersion shifted fiber.

b) Transmit and receive points are referenced as points S and R in Figure C-1.

c) These values include transmitter/receiver connectors at 0.7 dB each (worst case) and the system margins.

d) These values are measured at a BER of $1x10^{-12}$.

e) This value assumes that the maximum received power limitations are not exceeded.

f) Dispersion is limited to 40 km for intermediate reach optics. (50 km can be achieved with FEC.)

OC192/STM64/1.5IR1 (LEY69/LEY69AE) Data Sheet

Overview

This data sheet contains technical specifications for the OC192/STM64/1.5IR1 (extended intermediate reach) passive port units that are used in WaveStar BandWidth Manager.

OC192/STM64/1.5IR1 port units are capable of transmitting and receiving one extended intermediate reach OC-192/STM-64 signal with strong forward error correction (SFEC) in the 1.5 μm range (up to 60 km).

Capacity

Each OC192/STM64/1.5IR1 port unit supports one bidirectional (one receive and one transmit) OC-192/STM-64 formatted optical signal. The capacity may be translated to 192 STS-1/64 STM-1 equivalents or 129,024 two-way voice circuits per port unit.

OC-192/STM-64 access

The following table describes OC-192/STM-64 capabilities.

Table C-7 OC192/STM64/1.5IR1 Access

Specification	Description
Interface	Extended intermediate-reach (60 km) interface
Growth Increment	One OC-192/STM-64 per port unit
Line Code	Scrambled NRZ

Protection switching

The following table describes protection switching information per high speed line.

Table C-8 Protection Switching for OC192/STM64/1.5IR1 Port Units

Specification	Length of Time
Switching Bit Error Rate (BER)	10^{-3} to 10^{-9} (user provisionable)
Restoral BER	One-tenth of the switching BER
Switching Time	60 msec (BER $\geq 10^{-3}$ line signal failure)

Optical safety

Optical safety data on laser-containing port units, such as the OC192/STM64/1.5IR1 port unit, is

- SONET: Class I in the FDA/CDRH Classification System
- SDH: Level 1 in the IEC Classification System

Optical dispersion

The optical dispersion for the OC192/STM64/1.5IR1 port units is 1200 ps/nm.

Optical return loss

The following table provides the optical return loss for a system using OC192/STM64/1.5IR1 port units.

Table C-9 Optical Return Loss

Specification	Amount
Maximum system optical return loss	24.0 dB
Maximum receiver reflectance	–27.0 dB
Maximum discrete reflectance	–27.0 dB

Transmission specifications

The following table provides transmission specifications for the OC192/STM64/1.5IR1 port units.

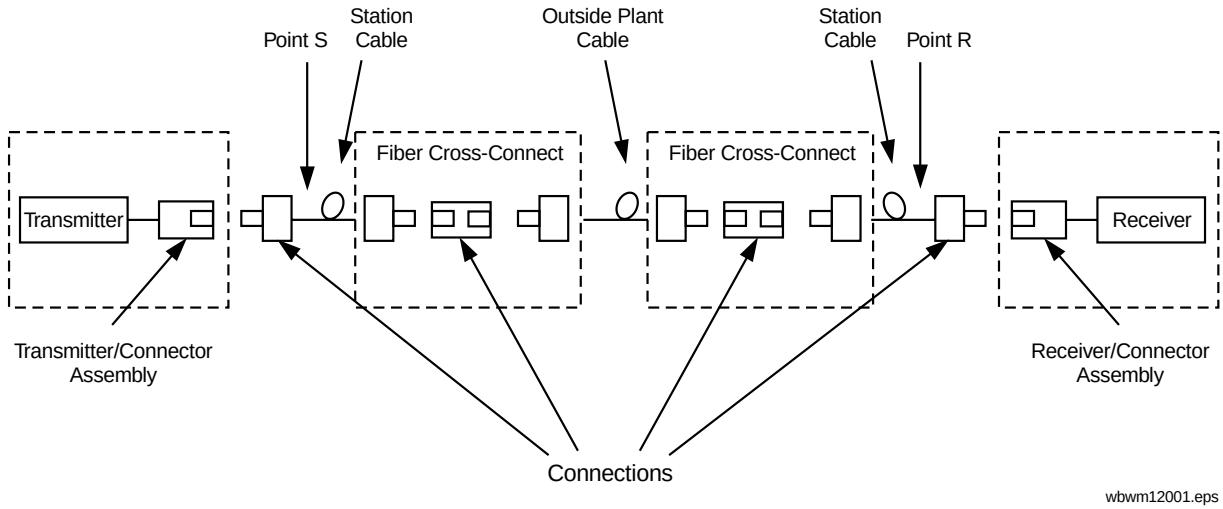
Table C-10 Transmission Specifications for OC192/STM64/1.5IR1 Port Units

Specification	Description
Transmission Medium	Input Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber Output Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber
Operating Connector Interfaces	Universal build-out block and optional ST-type, FC-type, or SC-type lightguide build-out (LBO) connectors for optical attenuation
Optical Line Rate	Input: 9.953 Gb/s Output: 9.953 Gb/s
Transmitter Wavelengths	Minimum: 1530 nm Maximum: 1565 nm
Spectral Width	0.08 nm (RMS)
Optical Source	Continuos Wave (CW) Laser with a Mach-Zender Modulator

Optical system interfaces

Figure C-2 illustrates the optical path between the transmitter and the receiver.

Figure C-2 Optical System Interfaces



Optical requirements and loss budgets

The following table lists the optical requirements and loss budgets for the OC192/STM64/1.5IR1 port units.

Table C-11 Optical Loss Budgets for the OC192/STM64/1.5IR1 Port Units

Parameter	OC192/STM64/1.5IR1 Port Unit[a]
Maximum Transmitter Output Power (P_{Tmax})[b]	2.0 dBm
Minimum Transmitter Output Power (P_{Tmin})[c]	–1.0 dBm
Maximum Received Power (P_{Rmax})[d]	–8.0 dBm
Receiver Sensitivity (P_{Rmin})[c,d]	–21.0 dBm
Minimum System Gain (S-R)	20.0 dB
Optical Path Penalty (P_O)	2.0 dB
Minimum Loss Budget	10.0 dB
Maximum Loss Budget	18.0 dB

a) All values assume that standard single-mode non-dispersion shifted fiber is used. Dispersion shifted fiber may be used. WaveStar BandWidth Manager complies with Telcordia Technologies and ITU requirements for dispersion shifted fiber.

b) Transmit and receive points are referenced as points S and R in Figure C-1.

c) These values include transmitter/receiver connectors at 0.7 dB each (worst case) and the system margins.

d) These values are measured at a BER of $1x10^{-12}$.

OC192/STM64/1.5IRS1 (LEY97/LEY97AE) Data Sheet

Overview

This data sheet contains technical specifications for the OC192/STM64/1.5IRS1 (intermediate reach) port units that are used in WaveStar BandWidth Manager.

OC192/STM64/1.5IRS1 port units are capable of transmitting and receiving one intermediate reach OC-192/STM-64 signal with strong forward error correction (SFEC) and a pin receiver in the 1.5 μm range (up to 40 km).

Capacity

Each OC192/STM64/1.5IRS1 port unit supports one bidirectional (one receive and one transmit) OC-192/STM-64 formatted optical signal. The capacity may be translated to 192 STS-1/64 STM-1 equivalents or 129,024 two-way voice circuits per port unit.

OC-192/STM-64 access

The following table describes OC-192/STM-64 capabilities.

Table C-12 OC192/STM64/1.5IRS1 Access

Specification	Description
Interface	Extended intermediate-reach (40 km) interface
Growth Increment	One OC-192/STM-64 per port unit
Line Code	Scrambled NRZ

Protection switching

The following table describes protection switching information per high speed line.

Table C-13 Protection Switching for OC192/STM64/1.5IRS1 Port Units

Specification	Length of Time
Switching Bit Error Rate (BER)	10^{-3} to 10^{-9} (user provisionable)
Restoral BER	One-tenth of the switching BER
Switching Time	60 msec (BER $\geq 10^{-3}$ line signal failure)

Optical safety

Optical safety data on laser-containing port units, such as the OC192/STM64/1.5IRS1 port unit, is Class I in the FDA/CDRH Classification SystemLevel 1 in the IEC Classification System.

Optical dispersion

The optical dispersion for the OC192/STM64/1.5IRS1 port units is 800 ps/nm.

Optical return loss

The following table provides the optical return loss for a system using OC192/STM64/1.5IRS1 port units.

Table C-14 Optical Return Loss

Specification	Amount
Maximum system optical return loss	24.0 dB
Maximum receiver reflectance	–27.0 dB
Maximum discrete reflectance	–27.0 dB

Transmission specifications

The following table provides transmission specifications for the OC192/STM64/1.5IRS1 port units.

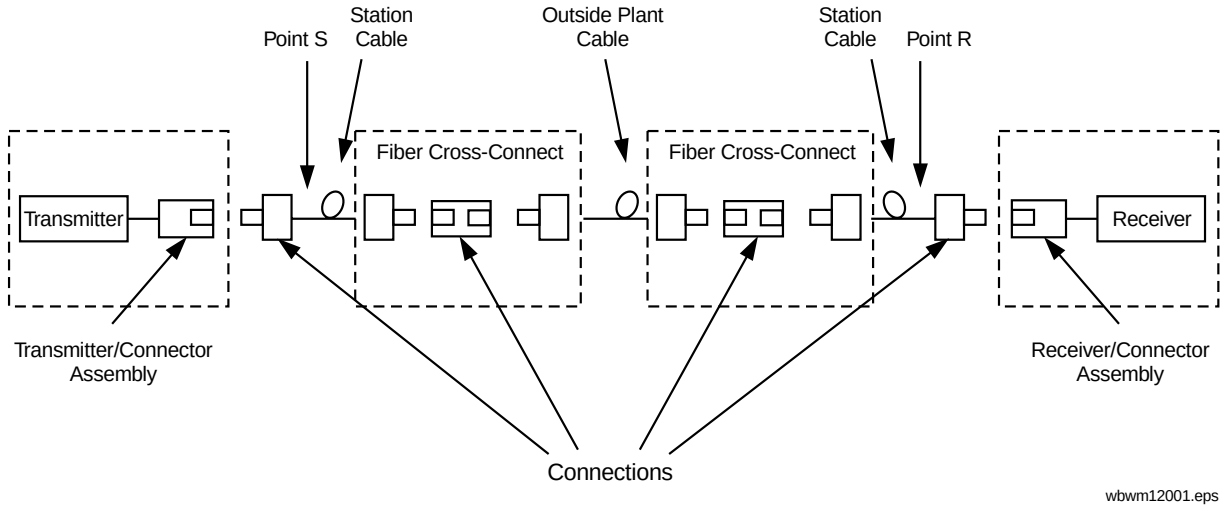
Table C-15 Transmission Specifications for OC192/STM64/1.5IRS1 Port Units

Specification	Description
Transmission Medium	Input Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber Output Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber
Operating Connector Interfaces	Universal build-out block and optional ST-type, FC-type, or SC-type lightguide build-out (LBO) connectors for optical attenuation
Optical Line Rate	Input: 9.953 Gb/s Output: 9.953 Gb/s
Transmitter Wavelengths	Minimum: 1530 nm Maximum: 1565 nm
Spectral Width	1.0 nm (RMS)
Optical Source	Electro-absorptive Modulated Laser (EML)

Optical system interfaces

Figure C-3 illustrates the optical path between the transmitter and the receiver.

Figure C-3 Optical System Interfaces



Optical requirements and loss budgets

The following table lists the optical requirements and loss budgets for the OC192/STM64/1.5IRS1 port units.

Table C-16 Optical Loss Budgets for the OC192/STM64/1.5IRS1 Port Units

Parameter	OC192/STM64/1.5IRS1 Port Unit[a]
Maximum Transmitter Output Power (P_{Tmax})[b]	2.0 dBm
Minimum Transmitter Output Power (P_{Tmin})[c]	–1.0 dBm
Maximum Received Power (P_{Rmax})[d]	–3.0 dBm
Receiver Sensitivity (P_{Rmin})[c,d]	–14.0 dBm
Minimum System Gain (S-R)	13.0 dB
Optical Path Penalty (P_O)	2.0 dB
Minimum Loss Budget	5.0 dB
Maximum Loss Budget	11.0 dB

a) All values assume that standard single-mode non-dispersion shifted fiber is used. Dispersion shifted fiber may be used. WaveStar BandWidth Manager complies with Telcordia Technologies and ITU requirements for dispersion shifted fiber.

b) Transmit and receive points are referenced as points S and R in Figure C-2.

c) These values include transmitter/receiver connectors at 0.7 dB each (worst case) and the system margins.

d) These values are measured at a BER of $1x10^{-12.}$

OC192/STM64/POU (LEY284-299/LEY284AE-299AE) Data Sheet

Overview

This data sheet contains technical specifications for the OC192/STM64/POU passive port units that are used in WaveStar BandWidth Manager.

OC192/STM64/POU passive optic port units, compatible with 16 wavelengths of the ITU standard for dense wavelength division multiplexing (DWDM), are capable of transmitting and receiving one long reach OC-192/STM-64 signal (up to 40 km with the Passive Optics Boxes).

Capacity

Each OC192/STM64/POU port unit supports one bidirectional (one receive and one transmit) OC-192/STM-64 formatted optical signal. The capacity may be translated to 192 STS-1/64 STM-1 equivalents or 129,024 two-way voice circuits per port unit.

OC-192/STM-64 access

The following table describes OC-192/STM-64 capabilities.

Table C-17 OC192/STM64/POU Access

Specification	Description
Interface	Intermediate-reach (40 km) interface[a]
Growth Increment	One OC-192/STM-64 per port unit
Line Code	Scrambled NRZ

a) The 40 km assumes that you are using either the 8-Mux/8-Demux or 16-Mux + 16-Demux Passive Optics Box with FEC enabled. However, without the Passive Optics Boxes, the maximum transmission distance could be 60 km.

Protection switching

The following table describes protection switching information per high speed line.

Table C-18 Protection Switching for OC192/STM64/POU Port Units

Specification	Length of Time
Switching Bit Error Rate (BER)	10^{-3} to 10^{-9} (user provisionable)
Restoral BER	One-tenth of the switching BER
Switching Time	60 msec (BER $\geq 10^{-3}$ line signal failure)

Optical safety

Optical safety data on laser-containing port units, such as the OC192/STM64/POU port unit, is

- SONET: Class I in the FDA/CDRH Classification System
- SDH: Level 1 in the IEC Classification System

Optical dispersion

The optical dispersion for the OC192/STM64/POU port units is 1200 ps/nm.

Optical return loss

The following table provides the optical return loss for a system using OC192/STM64/POU port units.

Table C-19 Optical Return Loss

Specification	Amount
Maximum system optical return loss	24.0 dB
Maximum receiver reflectance	–27.0 dB
Maximum discrete reflectance	–27.0 dB

Transmission specifications

The following table provides transmission specifications for the OC192/STM64/POU port units.

Table C-20 Transmission Specifications for OC192/STM64/POU Port Units

Specification	Description
Transmission Medium	Input Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber Output Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber
Operating Connector Interfaces	Universal build-out block and optional ST-type, FC-type, or SC-type lightguide build-out (LBO) connectors for optical attenuation
Optical Line Rate	Input: 9.953 Gb/s Output: 9.953 Gb/s
Transmitter Wavelengths	Minimum: 1530 nm Maximum: 1565 nm
Spectral Width	0.08 nm (RMS)
Optical Source	Continuous Wave (CW) Laser with a Mach-Zender Modulator

Operating wavelengths

The following table lists the operating wavelengths for the OC192/STM64/POU port units.

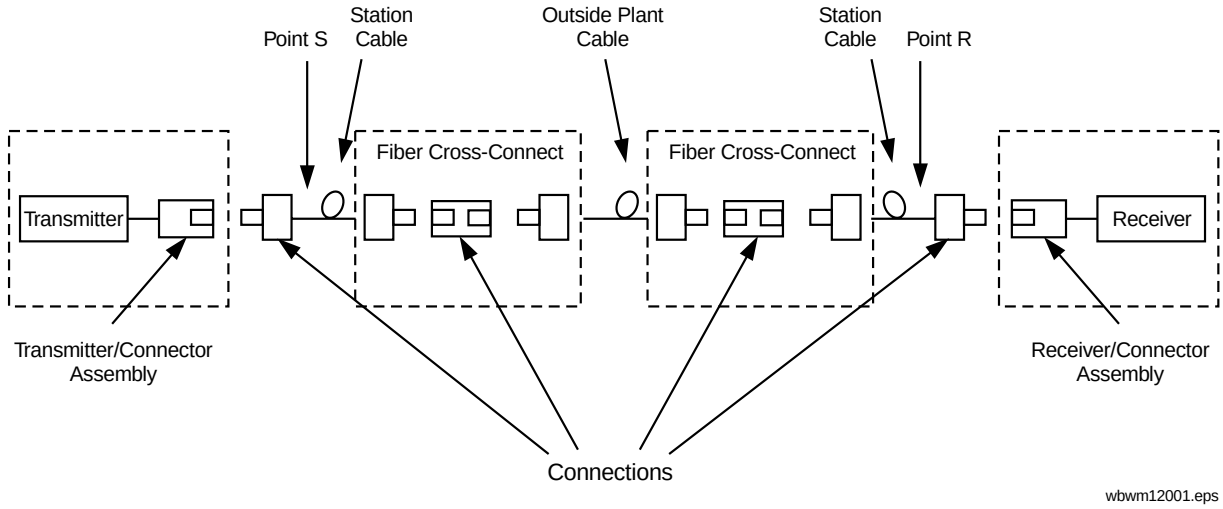
Table C-21 OC192/STM64/POU Port Unit Operating Wavelengths

Port Unit	Wavelength
OC192/STM64/POU9590	1530.33 nm
OC192/STM64/POU9570	1531.90 nm
OC192/STM64/POU9550	1533.47 nm
OC192/STM64/POU9530	1535.04 nm
OC192/STM64/POU9490	1538.19 nm
OC192/STM64/POU9470	1539.77 nm
OC192/STM64/POU9450	1541.35 nm
OC192/STM64/POU9430	1542.94 nm
OC192/STM64/POU9370	1547.72 nm
OC192/STM64/POU9350	1549.32 nm
OC192/STM64/POU9330	1550.92 nm
OC192/STM64/POU9310	1552.53 nm
OC192/STM64/POU9270	1555.75 nm
OC192/STM64/POU9250	1557.36 nm
OC192/STM64/POU9230	1558.98 nm
OC192/STM64/POU9210	1560.61 nm

Optical system interfaces

Figure C-4 illustrates the optical path between the transmitter and the receiver.

Figure C-4 Optical System Interfaces



Optical requirements and loss budgets

The following table lists the optical requirements and loss budgets for the OC192/STM64/POU port units.

Table C-22 Optical Loss Budgets for the OC192/STM64/POU Port Units

Parameter	OC192/STM64/POU Port Unit[a] with	
	8-Mux/8-DemuxBox	16-Mux + 16-Demux Boxes
Maximum Transmitter Output Power (P_{Tmax})[b]	2.0 dBm	2.0 dBm
Minimum Transmitter Output Power (P_{Tmin})[c]	–1.0 dBm	–1.0 dBm
Maximum Received Power (P_{Rmax})[d]	–8.0 dBm	–8.0 dBm
Receiver Sensitivity (P_{Rmin})[c,d]	–21.0 dBm	–21.0 dBm
Minimum System Gain (S-R)	20.0 dB	20.0 dB
Optical Path Penalty (P_O)	2.0 dB	2.0 dB
Minimum Loss Budget	10.0 dB	10.0 dB
Maximum Loss Budget	10.3 dB[e]	11.2 dB[f]

a) All values assume that standard single-mode non-dispersion shifted fiber is used. Dispersion shifted fiber may be used. WaveStar BandWIdth Manager complies with Telcordia Technologies and ITU requirements for dispersion shifted fiber.

b) Transmit and receive points are referenced as points S and R in Figure C-3.

c) These values include transmitter/receiver connectors at 0.7 dB each (worst case) and the system margins.

d) These values are measured at a BER of $1x10^{-12}$.

e) When using the 8-Mux/8-Demux Passive Optics Box with the OC192/STM64/POU port units, you must subtract 7.8 dB from the maximum loss budget to compensate for the mux/demux functions. This loss budget adjustment results in a span of 38 km with standard single-mode fiber. Without the passive optics boxes, the maximum span length of these port units is 60 km.

f) When using the 16-Mux + 16-Demux Passive Optics Boxes with the OC192/STM64/POU port units, you must subtract 6.8 dB from the maximum loss budget to compensate for the mux/demux functions. This loss budget adjustment results in a span of 40 km with standard single-mode fiber. Without the passive optics boxes, the maximum span length of these port units is 60 km.

OC192/STM64/WDM (LEY201-240/LEY201AE-240AE) Data Sheet

Overview

This data sheet contains technical specifications for the OC192/STM64/WDM port units that are used in WaveStar BandWidth Manager.

OC192/STM64/WDM port units, compatible with 40 wavelengths of the ITU standard for dense wavelength division multiplexing (DWDM), are capable of transmitting and receiving one long reach OC-192/STM-64 signal. Because the OC192/STM64/WDM port units are designed to work with the WaveStar OLS 400G systems without OTUs, the maximum transmission distance is dependant upon OLS (up to 25 km with Lucent's WaveStar OLS 400G).

Capacity

Each OC192/STM64/WDM port unit supports one bidirectional (one receive and one transmit) OC-192/STM-64 formatted optical signal. The capacity may be translated to 192 STS-1/64 STM-1 equivalents or 129,024 two-way voice circuits per port unit.

OC-192/STM-64 access

The following table describes OC-192/STM-64 capabilities.

Table C-23 OC192/STM64/WDM Access

Specification	Description
Interface	Compatible with WaveStar OLS 400G
Growth Increment	One OC-192/STM-64 per port unit
Line Code	Scrambled NRZ

Protection switching

The following table describes protection switching information per high speed line.

Table C-24 Protection Switching for OC192/STM64/WDM Port Units

Specification	Length of Time
Switching Bit Error Rate (BER)	10^{-3} to 10^{-9} (user provisionable)
Restoral BER	One-tenth of the switching BER
Switching Time	60 msec (BER $\geq 10^{-3}$ line signal failure)

Optical safety

Optical safety data on laser-containing port units, such as the OC192/STM64/WDM port unit, is

- SONET: Class I in the FDA/CDRH Classification System
- SDH: Level 1 in the IEC Classification System

Optical dispersion

The optical dispersion for the OC192/STM64/WDM port units is compatible with WaveStar OLS 400G. Refer to the WaveStar OLS 400G Applications, Planning, and Ordering Guide (365-575-736) for more information.

Optical return loss

The following table provides the optical return loss for a system using OC192/STM64/WDM port units.

Table C-25 Optical Return Loss

Specification	Amount
Maximum system optical return loss	24.0 dB
Maximum receiver reflectance	–27.0 dB
Maximum discrete reflectance	–27.0 dB

Transmission specifications

The following table provides transmission specifications for the OC192/STM64/WDM port units.

Table C-26 Transmission Specifications for OC192/STM64/WDM Port Units

Specification	Description
Transmission Medium	Input Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber Output Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber
Operating Connector Interfaces	LC Connectors and optional ST-type, FC-type, or SC-type lightguide build-out (LBO) connectors for optical attenuation
Optical Line Rate	Input: 9.953 Gb/s Output: 9.953 Gb/s
Transmitter Wavelengths	Minimum: 1530 nm Maximum: 1565 nm
Spectral Width	0.08 nm (RMS)
Optical Source	Continuos Wave (CW) Laser with a Mach-Zender Modulator

Operating wavelengths

The following table lists the operating wavelengths for the OC192/STM64/WDM port units.

Table C-27 OC192/STM64/WDM Port Unit Operating Wavelengths

Port Unit	Wavelength
OC192/STM64/WDM9580	1531.12 nm
OC192/STM64/WDM9570	1531.90 nm
OC192/STM64/WDM9560	1532.68 nm
OC192/STM64/WDM9550	1533.47 nm
OC192/STM64/WDM9540	1534.25 nm
OC192/STM64/WDM9530	1535.04 nm
OC192/STM64/WDM9520	1535.82 nm
OC192/STM64/WDM9510	1536.61 nm
OC192/STM64/WDM9500	1537.40 nm
OC192/STM64/WDM9490	1538.19 nm
OC192/STM64/WDM9480	1538.98 nm
OC192/STM64/WDM9470	1539.77 nm
OC192/STM64/WDM9460	1540.56 nm
OC192/STM64/WDM9450	1541.35 nm
OC192/STM64/WDM9440	1542.14 nm
OC192/STM64/WDM9430	1542.94 nm
OC192/STM64/WDM9420	1543.73 nm
OC192/STM64/WDM9410	1544.53 nm
OC192/STM64/WDM9400	1545.32 nm
OC192/STM64/WDM9390	1546.12 nm
OC192/STM64/WDM9380	1546.92 nm

Optical requirements and loss budgets

Because OC192/STM64/WDM port units interface with WaveStar Optical Line System (OLS) 400G, refer to the *WaveStar OLS 400G Applications, Planning, and Ordering Guide, 365-575-736* to calculate loss budgets.

□

OC48/STM16/1.3LR1 (LEY7/LEY7AE) Data Sheet

Overview

This data sheet contains technical specifications for the OC48/STM16/1.3LR1 port units (LEY7/LEY7AE) that are used in WaveStar BandWidth Manager.

OC48/STM16/1.3LR1 port units are capable of transmitting and receiving one long reach OC-48/STM-16 signal in the 1.3 µm range (up to 51 km).

Capacity

Each OC48/STM16/1.3LR1 port unit supports one bidirectional (one receive and one transmit) OC-48/STM-16 formatted optical signal. The capacity may be translated to 48 STS-1/16 STM-1 equivalents or 32,256 two-way voice circuits per port unit.

OC-48/STM-16 access

The following table describes OC-48/STM-16 capabilities.

Table C-28 OC48/STM16/1.3LR1 Access

Specification	Description
Interface	Long-reach (51 km) interface[a]
Growth Increment	One OC-48/STM-16 per port unit
Line Code	Scrambled NRZ

a) This number is a typical value. The actual value must be calculated using measured data (see Figure C-4).

Protection switching

The following table describes protection switching information per high speed line.

Table C-29 Protection Switching for OC48/STM16/1.3LR1 Port Units

Specification	Length of Time
Switching Bit Error Rate (BER)	10^{-3} to 10^{-9} (user provisionable)
Restoral BER	One-tenth of the switching BER
Switching Time	60 msec (BER $\geq 10^{-3}$ line signal failure)

Optical safety

Optical safety data on laser-containing port units, such as the OC48/STM16/1.3LR1 port unit, is

- SONET: Class IIIB in the FDA/CDRH Classification System
- SDH: Level 1 in the IEC Classification System

Optical dispersion

The optical dispersion for the OC48/STM16/1.3LR1 port units is 300 ps/nm.

Optical return loss

The following table provides the optical return loss for a system using OC48/STM16/1.3LR1 port units.

Table C-30 Optical Return Loss

Specification	Amount
Maximum system optical return loss	24.0 dB
Maximum receiver reflectance	–27.0 dB
Maximum discrete reflectance	–27.0 dB

Transmission specifications

The following table provides transmission specifications for the OC48/STM16/1.3LR1 port units.

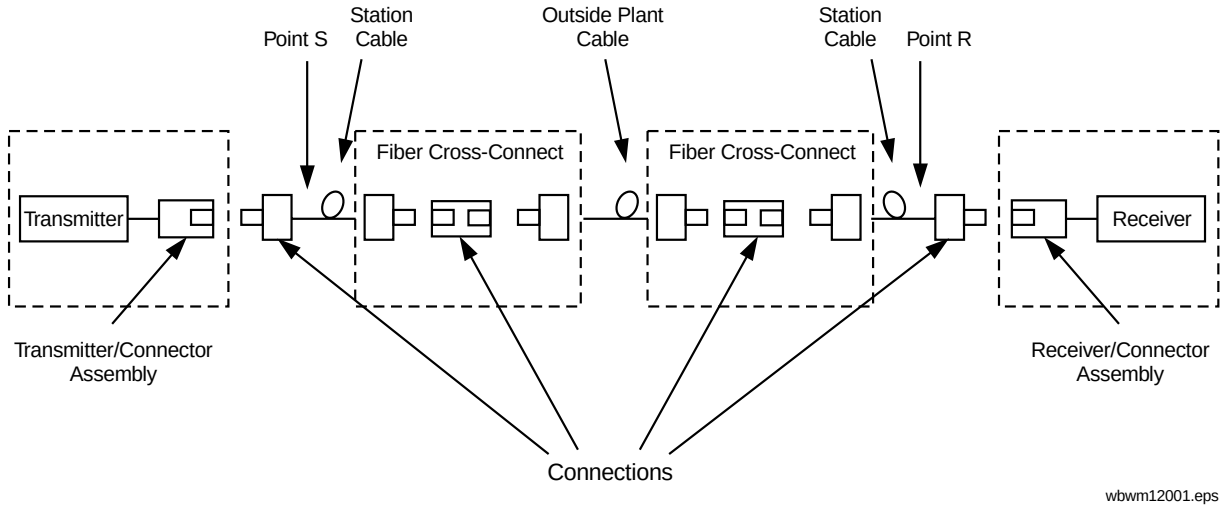
Table C-31 Transmission Specifications for OC48/STM16/1.3LR1 Port Units

Specification	Description
Transmission Medium	Input Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber Output Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber
Operating Connector Interfaces	Universal build-out block and optional ST-type, FC-type, or SC-type lightguide build-out (LBO) connectors for optical attenuation
Optical Line Rate	Input: 2.488 Gb/s Output: 2.488 Gb/s
Transmitter Wavelengths	Minimum: 1280 nm Maximum: 1335 nm
Spectral Width	2.0 nm (RMS)
Optical Source	Distributed Feedback (DFB) laser

Optical system interfaces

Figure C-5 illustrates the optical path between the transmitter and the receiver.

Figure C-5 Optical System Interfaces



Optical requirements and loss budgets

The following table lists the optical requirements and loss budgets for the OC48/STM16/1.3LR1 port units.

Table C-32 Optical Loss Budgets for the OC48/STM16/1.3LR1 Port Units

Parameter	OC48/STM16/1.3LR1 Port Unit[a]
Maximum Transmitter Output Power (P_{Tmax})[b]	3.0 dBm
Minimum Transmitter Output Power (P_{Tmin})[c]	–2.0 dBm
Maximum Received Power (P_{Rmax})[d]	–9.0 dBm
Receiver Sensitivity (P_{Rmin})[c,d]	–27.0 dBm
Minimum System Gain (S-R)	25.0 dB
Optical Path Penalty (P_O)	1.0 dB
Minimum Loss Budget[e]	10.0 dB
Maximum Loss Budget[f]	24.0 dB

a) All values assume that standard single-mode non-dispersion shifted fiber is used. Dispersion shifted fiber may be used. WaveStar BandWidth Manager complies with Telcordia Technologies and ITU requirements for dispersion shifted fiber.

b) Transmit and receive points are referenced as points S and R in Figure C-4.

c) These values include transmitter/receiver connectors at 0.7 dB each (worst case) and the system margins.

d) These values are measured at a BER of $1x10^{-12}$.

e) This value assumes that the maximum received power limitations are not exceeded.

f) Dispersion is limited to 92 km for long reach optics.

OC48/STM16/1.5LR1 (LEY8/LEY8AE) Data Sheet

Overview

This data sheet contains technical specifications for the OC48/STM16/1.5LR1 port units (LEY8/LEY8AE) that are used in WaveStar BandWidth Manager.

OC48/STM16/1.5LR1 port units are capable of transmitting and receiving one long reach OC-48/STM-16 signal in the 1.5 µm range (up to 80 km).

Capacity

Each OC48/STM16/1.5LR1 port unit supports one bidirectional (one receive and one transmit) OC-48/STM-16 formatted optical signal. The capacity may be translated to 48 STS-1/16 STM-1 equivalents or 32,256 two-way voice circuits per port unit.

OC-48/STM-16 access

The following table describes OC-48/STM-16 capabilities.

Table C-33 OC48/STM16/1.5LR1 Access

Specification	Description
Interface	Long-reach (80 km) interface[a]
Growth Increment	One OC-48/STM-16 per port unit
Line Code	Scrambled NRZ

a) This number is a typical value. The actual value must be calculated using measured data (see Figure C-5).

Protection switching

The following table describes protection switching information per high speed line.

Table C-34 Protection Switching for OC48/STM16/1.5LR1 Port Units

Specification	Length of Time
Switching Bit Error Rate (BER)	10^{-3} to 10^{-9} (user provisionable)
Restoral BER	One-tenth of the switching BER
Switching Time	60 msec (BER $\geq 10^{-3}$ line signal failure)

Optical safety

Optical safety data on laser-containing port units, such as the OC48/STM16/1.5LR1 port unit, is

- SONET: Class I in the FDA/CDRH Classification System
- SDH: Level 1 in the IEC Classification System

Optical dispersion

The optical dispersion for the OC48/STM16/1.5LR1 port units is 1800 ps/nm.

Optical return loss

The following table provides the optical return loss for a system using OC48/STM16/1.5LR1 port units.

Table C-35 Optical Return Loss

Specification	Amount
Maximum system optical return loss	24.0 dB
Maximum receiver reflectance	–27.0 dB
Maximum discrete reflectance	–27.0 dB

Transmission specifications

The following table provides transmission specifications for the OC48/STM16/1.5LR1 port units.

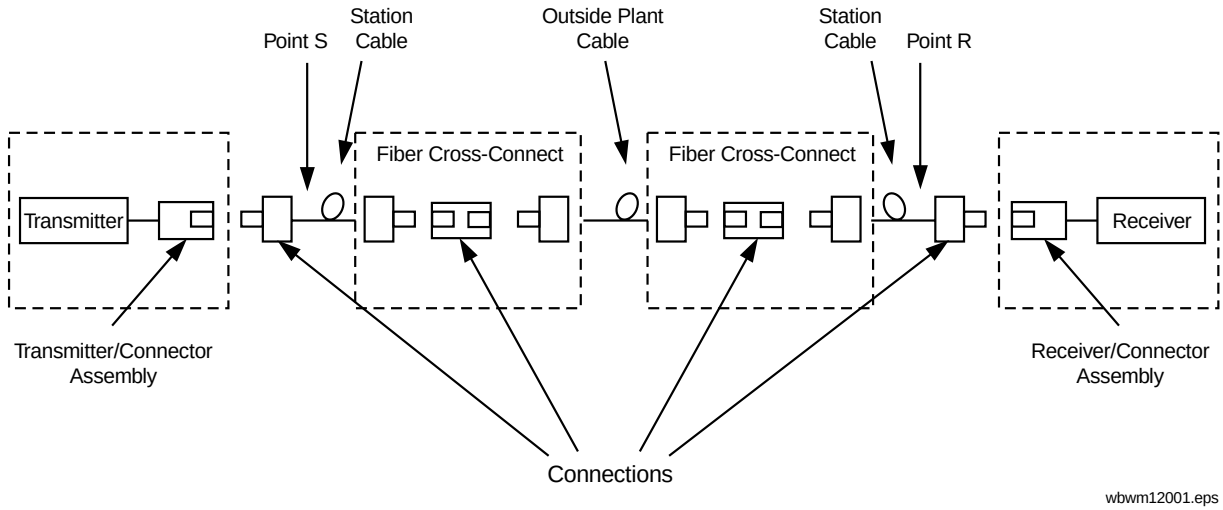
Table C-36 Transmission Specifications for OC48/STM16/1.5LR1 Port Units

Specification	Description
Transmission Medium	Input Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber Output Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber
Operating Connector Interfaces	Universal build-out block and optional ST-type, FC-type, or SC-type lightguide build-out (LBO) connectors for optical attenuation
Optical Line Rate	Input: 2.488 Gb/s Output: 2.488 Gb/s
Transmitter Wavelengths	Minimum: 1530 nm Maximum: 1565 nm
Spectral Width	2.0 nm (RMS)
Optical Source	Distributed Feedback (DFB) laser

Optical system interfaces

Figure C-6 illustrates the optical path between the transmitter and the receiver.

Figure C-6 Optical System Interfaces



Optical requirements and loss budgets

The following table lists the optical requirements and loss budgets for the OC48/STM16/1.5LR1 port units.

Table C-37 Optical Loss Budgets for the OC48/STM16/1.5LR1 Port Units

Parameter	OC48/STM16/1.5LR1 Port Unit[a]
Maximum Transmitter Output Power (P_{Tmax})[b]	3.0 dBm
Minimum Transmitter Output Power (P_{Tmin})[c]	–2.0 dBm
Maximum Received Power (P_{Rmax})[d]	–9.0 dBm
Receiver Sensitivity (P_{Rmin})[c,d]	–28.0 dBm
Minimum System Gain (S-R)	26.0 dB
Optical Path Penalty (P_O)	2.0 dB
Minimum Loss Budget[e]	10.0 dB
Maximum Loss Budget[f]	24.0 dB

a) All values assume that standard single-mode non-dispersion shifted fiber is used. Dispersion shifted fiber may be used. WaveStar BandWidth Manager complies with Telcordia Technologies and ITU requirements for dispersion shifted fiber.

b) Transmit and receive points are referenced as points S and R in Figure C-5.

c) These values include transmitter/receiver connectors at 0.7 dB each (worst case) and the system margins.

d) These values are measured at a BER of $1x10^{-12}$.

e) This value assumes that the maximum received power limitations are not exceeded.

f) Dispersion is limited to 92 km for long reach optics.

OC48/STM16/DWDM01-16 (LEY50-65/LEY50AE-65AE) Data Sheet

Overview

This data sheet contains technical specifications for the OC48/STM16/DWDM01-16 port units that are used in WaveStar BandWidth Manager.

OC48/STM16/DWDM01-16 port units, compatible with 16 wavelengths of the ITU standard for dense wavelength division multiplexing (DWDM), are capable of transmitting and receiving one long reach OC-48/STM-16 signal. Because the OC48/STM16/DWDM01-16 port units are designed to work with the WaveStar OLS 40G/80G systems without OTUs, the maximum transmission distance is dependant upon the OLS system (up to 25 km with Lucent's WaveStar OLS 40G/80G).

Capacity

Each OC48/STM16/DWDM01-16 port unit supports one bidirectional (one receive and one transmit) OC-48/STM-16 formatted, ITU-compatible optical signal. The capacity may be translated to 48 STS-1/16 STM-1 equivalents or 32,256 two-way voice circuits per port unit.

OC-48/STM-16 access

The following table describes OC-48/STM-16 capabilities.

Table C-38 OC48/STM16/DWDM01-16 Access

Specification	Description
Interface	Compatible with WaveStar OLS 40G/80G
Growth Increment	One OC-48/STM-16 per port unit
Line Code	Scrambled NRZ

Protection switching

The following table describes protection switching information per high speed line.

Table C-39 Protection Switching for OC48/STM16/DWDM01-16 Port Units

Specification	Length of Time
Switching Bit Error Rate (BER)	10^{-3} to 10^{-9} (user provisionable)
Restoral BER	One-tenth of the switching BER
Switching Time	60 msec (BER $\geq 10^{-3}$ line signal failure)

Optical safety

Optical safety data on laser-containing port units, such as the OC48/STM16/DWDM01-16 port units, is

- SONET: Class I in the FDA/CDRH Classification System
- SDH: Level 1 in the IEC Classification System

Optical dispersion

The optical dispersion for the OC48/STM16/DWDM01-16 port units is compatible with WaveStar OLS 40G/80G. Refer to the *WaveStar OLS 40G/80G Applications, Planning, and Ordering Guide* for more information.

Optical return loss

The following table provides the optical return loss for a system using OC48/STM16/DWDM01-16 port units.

Table C-40 Optical Return Loss

Specification	Amount
Maximum system optical return loss	24.0 dB
Maximum receiver reflectance	–27.0 dB
Maximum discrete reflectance	–27.0 dB

Transmission specifications

The following table provides transmission specifications for the OC48/STM16/DWDM01-16 port units.

Table C-41 Transmission Specifications for OC48/STM16/DWDM01-16

Specification	Description
Transmission Medium	Input Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber Output Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber
Operating Connector Interfaces	Universal build-out block and optional ST-type, FC-type, or SC-type lightguide build-out (LBO) connectors for optical attenuation
Optical Line Rate	Input: 2.488 Gb/s Output: 2.488 Gb/s
Transmitter Wavelengths[a]	Minimum: 1549 nm Maximum: 1560 nm
Spectral Width	2.0 nm (RMS)
Optical Source	Electro-Absorptive Modulated Laser (EML)

a) Refer to the following table for a complete list of the operating wavelengths.

Operating wavelengths

The following table lists the operating wavelengths for the OC48/STM16/DWDM01-16 port units.

Table C-42 OC48/STM16/DWDM01-16 Port Unit Operating Wavelengths

Port Unit	Wavelength
OC48/STM16/DWDM01	1549.32 nm
OC48/STM16/DWDM02	1550.92 nm
OC48/STM16/DWDM03	1552.52 nm
OC48/STM16/DWDM04	1554.13 nm
OC48/STM16/DWDM05	1555.75 nm
OC48/STM16/DWDM06	1557.36 nm
OC48/STM16/DWDM07	1558.98 nm
OC48/STM16/DWDM08	1560.61 nm
OC48/STM16/DWDM09	1548.52 nm
OC48/STM16/DWDM10	1550.12 nm
OC48/STM16/DWDM11	1551.72 nm
OC48/STM16/DWDM12	1553.33 nm
OC48/STM16/DWDM13	1554.94 nm
OC48/STM16/DWDM14	1556.56 nm
OC48/STM16/DWDM15	1558.17 nm
OC48/STM16/DWDM16	1559.79 nm

Optical requirements and loss budgets

Because OC48/STM16/DWDM01-16 port units interface with WaveStar Optical Line System (OLS) 40G/80G, refer to the *WaveStar OLS 40G/80G Applications, Planning, and Ordering Guide* to calculate loss budgets.

□

OC48/STM16/POU (LEY80-95/LEY80AE-95AE) Data Sheet

Overview

This data sheet contains technical specifications for the OC48/STM16/POU port units that are used in WaveStar BandWidth Manager.

OC48/STM16/POU passive optic port units, compatible with 16 wavelengths of the ITU standard for dense wavelength division multiplexing (DWDM), are capable of transmitting and receiving one long reach OC-48/STM-16 signal (up to 55 km with the Passive Optics Boxes).

Capacity

Each OC48/STM16/POU port unit supports one bidirectional (one receive and one transmit) OC-48/STM-16 formatted, ITU-compatible optical signal. The capacity may be translated to 48 STS-1/16 STM-1 equivalents or 32,256 two-way voice circuits per port unit.

OC-48/STM-16 access

The following table describes OC-48/STM-16 capabilities.

Table C-43 OC48/STM16/POU Access

Specification	Description
Interface	Long-reach (55 km) interface[a]
Growth Increment	One OC-48/STM-16 per port unit
Line Code	Scrambled NRZ

a) The 55 km assumes that you are using either the 8-Mux/8-Demux or 16-Mux + 16-Demux Passive Optics Box with FEC enabled. However, without the Passive Optics Boxes, the maximum transmission distance could be 80 km.

Protection switching

The following table describes protection switching information per high speed line.

Table C-44 Protection Switching for OC48/STM16/POU Port Units

Specification	Length of Time
Switching Bit Error Rate (BER)	10^{-3} to 10^{-9} (user provisionable)
Restoral BER	One-tenth of the switching BER
Switching Time	60 msec (BER $\geq 10^{-3}$ line signal failure)

Optical safety

Optical safety data on laser-containing port units, such as the OC48/STM16/POU port units, is

- SONET: Class I in the FDA/CDRH Classification System
- SDH: Level 1 in the IEC Classification System

Optical dispersion

The optical dispersion for the OC48/STM16/POU port units is 1200 ps/nm.

Optical return loss

The following table provides the optical return loss for a system using OC48/STM16/POU port units.

Table C-45 Optical Return Loss

Specification	Amount
Maximum system optical return loss	24.0 dB
Maximum receiver reflectance	–27.0 dB
Maximum discrete reflectance	–27.0 dB

Transmission specifications

The following table provides transmission specifications for the OC48/STM16/POU port units.

Table C-46 Transmission Specifications for OC48/STM16/POU

Specification	Description
Transmission Medium	Input Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber Output Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber
Operating Connector Interfaces	Universal build-out block and optional ST-type, FC-type, or SC-type lightguide build-out (LBO) connectors for optical attenuation
Optical Line Rate	Input: 2.488 Gb/s Output: 2.488 Gb/s
Transmitter Wavelengths[a]	Minimum: 1530 nm Maximum: 1560 nm
Spectral Width	2.0 nm (RMS)
Optical Source	Electro-absorptive Modulated Laser (EML)

a) Refer to the following table for a complete list of the operating wavelengths.

Operating wavelengths

The following table lists the operating wavelengths for the OC48/STM16/POU port units.

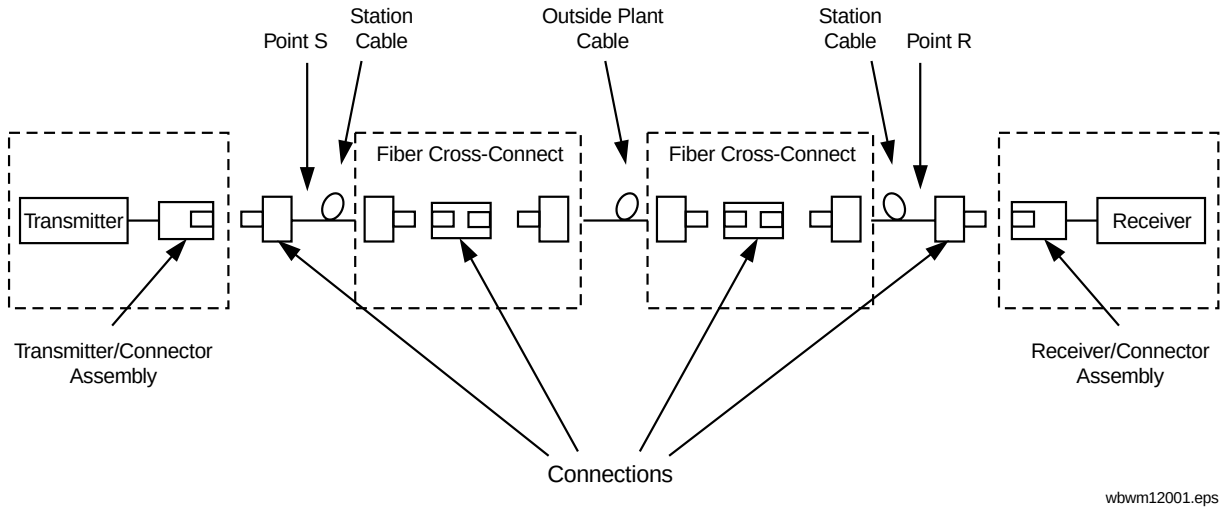
Table C-47 OC48/STM16/POU Port Unit Operating Wavelengths

Port Unit	Wavelength
OC48/STM16/POU9590	1530.33 nm
OC48/STM16/POU9570	1531.90 nm
OC48/STM16/POU9550	1533.47 nm
OC48/STM16/POU9530	1535.04 nm
OC48/STM16/POU9490	1538.19 nm
OC48/STM16/POU9470	1539.77 nm
OC48/STM16/POU9450	1541.35 nm
OC48/STM16/POU9430	1542.94 nm
OC48/STM16/POU9370	1547.72 nm
OC48/STM16/POU9350	1549.32 nm
OC48/STM16/POU9330	1550.92 nm
OC48/STM16/POU9310	1552.52 nm
OC48/STM16/POU9270	1555.75 nm
OC48/STM16/POU9250	1557.36 nm
OC48/STM16/POU9230	1558.98 nm
OC48/STM16/POU9210	1560.61 nm

Optical system interfaces

Figure C-7 illustrates the optical path between the transmitter and the receiver.

Figure C-7 Optical System Interfaces



Optical requirements and loss budgets

The following table lists the optical requirements and loss budgets for the OC48/STM16/POU port units.

Table C-48 Optical Loss Budgets for the OC48/STM16/POU Port Units

Parameter	OC48/STM16/POU Port Unit[a] with	
	8-Mux/8-DemuxBox	16-Mux + 16-Demux Boxes
Maximum Transmitter Output Power (P_{Tmax})[b]	2.0 dBm	2.0 dBm
Minimum Transmitter Output Power (P_{Tmin})[c]	–2.8 dBm	–2.8 dBm
Maximum Received Power (P_{Rmax})[d]	–9.0 dBm	–9.0 dBm
Receiver Sensitivity (P_{Rmin})[c,d]	–28.0 dBm	–28.0 dBm
Minimum System Gain (S-R)	25.2 dB	25.2 dB
Optical Path Penalty (P_O)	2.0 dB	2.0 dB
Minimum Loss Budgete	10.0 dB	10.0 dB
Maximum Loss Budget	15.4 dB[f]	16.4 dB[g]

a) All values assume that standard single-mode non-dispersion shifted fiber is used. Dispersion shifted fiber may be used. WaveStar BandWidth Manager complies with Telcordia Technologies and ITU requirements for dispersion shifted fiber.

b) Transmit and receive points are referenced as points S and R in Figure C-6.

c) These values include transmitter/receiver connectors at 0.7 dB each (worst case) and the system margins.

d) These values are measured at a BER of $1x10^{-12}$.

e) This value assume that the maximum received power limitations are not exceeded.

f) When using the 8-Mux/8-Demux Passive Optics Box with the OC48/STM16/POU port units, you must subtract 7.8 dB from the maximum loss budget to compensate for the mux/demux functions. This loss budget adjustment results in a span of 57 km with standard single-mode fiber. Without the passive optics boxes, the maximum span length of these port units is 60 km.

g) When using the 16-Mux + 16-Demux Passive Optics Boxes with the OC48/STM16/POU port units, you must subtract 6.8 dB from the maximum loss budget to compensate for the mux/demux functions. This loss budget adjustment results in a span of 60 km with standard single-mode fiber. Without the passive optics boxes, the maximum span length of these port units is 60 km.

OC48/STM16/WDM (LEY101-180/LEY101AE-180AE) Data Sheet

Overview

This data sheet contains technical specifications for the OC48/STM16/WDM passive port units that are used in WaveStar BandWidth Manager.

OC48/STM16/WDM port units, compatible with 80 wavelengths of the ITU standard for dense wavelength division multiplexing (DWDM), are capable of transmitting and receiving one long reach OC-48/STM-16 signal. Because the OC48/STM16/WDM port units are designed to work with the WaveStar OLS 400G systems without OTUs, the maximum transmission distance is dependant upon the OLS system (up to 25 km with Lucent's WaveStar OLS 400G)

Capacity

Each OC48/STM16/WDM port unit supports one bidirectional (one receive and one transmit) OC-48/STM-16 formatted optical signal. The capacity may be translated to 48 STS-1/16 STM-1 equivalents or 32,256 two-way voice circuits per port unit.

OC-48/STM-16 access

The following table describes OC-48/STM-16 capabilities.

Table C-49 OC48/STM16/WDM Access

Specification	Description
Interface	Compatible with WaveStar OLS 400G
Growth Increment	One OC-48/STM-16 per port unit
Line Code	Scrambled NRZ

Protection switching

The following table describes protection switching information per high speed line.

Table C-50 Protection Switching for OC48/STM16/WDM Port Units

Specification	Length of Time
Switching Bit Error Rate (BER)	10^{-3} to 10^{-9} (user provisionable)
Restoral BER	One-tenth of the switching BER
Switching Time	60 msec (BER $\geq 10^{-3}$ line signal failure)

Optical safety

Optical safety data on laser-containing port units, such as the OC48/STM16/WDM port unit, is

- SONET: Class I in the FDA/CDRH Classification System
- SDH: Level 1 in the IEC Classification System

Optical dispersion

The optical dispersion for the OC48/STM16/WDM port units is compatible with WaveStar OLS 400G. Refer to the *WaveStar OLS 400G Applications, Planning, and Ordering Guide (365-575-736)* for more information.

Optical return loss

The following table provides the optical return loss for a system using OC48/STM16/WDM port units.

Table C-51 Optical Return Loss

Specification	Amount
Maximum system optical return loss	24.0 dB
Maximum receiver reflectance	–27.0 dB
Maximum discrete reflectance	–27.0 dB

Transmission specifications

The following table provides transmission specifications for the OC48/STM16/WDM port units.

Table C-52 Transmission Specifications for OC48/STM16/WDM Port Units

Specification	Description
Transmission Medium	Input Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber Output Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber
Operating Connector Interfaces	Universal build-out block and optional ST-type, FC-type, or SC-type lightguide build-out (LBO) connectors for optical attenuation
Optical Line Rate	Input: 2.488 Gb/s Output: 2.488 Gb/s
Transmitter Wavelengths[a]	Minimum: 1530 nm Maximum: 1565 nm
Spectral Width	0.11 nm (RMS)
Optical Source	Electro-absorptive Modulated Laser (EML)

a) Refer to the following table for a complete list of the operating wavelengths.

Operating wavelengths

The following table lists the operating wavelengths for the OC48/STM16/WDM port units.

Table C-53 OC48/STM16/WDM Operating Wavelengths

Port Unit	Wavelength
OC48/STM16/WDM9585	1530.72 nm
OC48/STM16/WDM9580	1531.11 nm
OC48/STM16/WDM9575	1531.50 nm
OC48/STM16/WDM9570	1531.89 nm
OC48/STM16/WDM9565	1532.28 nm
OC48/STM16/WDM9560	1532.68 nm
OC48/STM16/WDM9555	1533.07 nm
OC48/STM16/WDM9550	1533.46 nm
OC48/STM16/WDM9545	1533.85 nm
OC48/STM16/WDM9540	1534.25 nm
OC48/STM16/WDM9535	1534.64 nm
OC48/STM16/WDM9530	1535.03 nm
OC48/STM16/WDM9525	1535.42 nm
OC48/STM16/WDM9520	1535.82 nm
OC48/STM16/WDM9515	1536.21 nm
OC48/STM16/WDM9510	1536.60 nm
OC48/STM16/WDM9505	1537.00 nm
OC48/STM16/WDM9500	1537.39 nm
OC48/STM16/WDM9495	1537.39 nm
OC48/STM16/WDM9490	1538.18 nm

Optical requirements and loss budgets

Because OC48/STM16/WDM port units interface with WaveStar Optical Line System (OLS) 400G, refer to the *WaveStar OLS 400G Applications, Planning, and Ordering Guide, 365-375-736* to calculate loss budgets.

OC12/STM4/1.3LR2 (LEY13/LEY13AE) Data Sheet

Overview

This data sheet contains technical specifications for the OC12/STM4/1.3LR2 (long reach) port units that are used in WaveStar BandWidth Manager.

OC12/STM4/1.3LR2 port units are capable of transmitting and receiving two long reach OC-12/STM-4 signals (up to 51 km).

Capacity

Each OC12/STM4/1.3LR2 port unit supports two bidirectional (one receive and one transmit) OC-12/STM-4 formatted optical signals. The capacity may be translated to 24 STS-1/8 STM-1 equivalents or 16,128 two-way voice circuits per port unit.

OC-12/STM-4 access

The following table describes OC-12/STM-4 access capabilities.

Table C-54 OC12/STM4/1.3LR2 Access

Specification	Description
Interface	Long-reach (51 km) interface[a]
Growth Increment	Two OC-12s/STM-4s per port unit
Line Code	Scrambled NRZ

a) This number is a typical value. The actual value must be calculated using measured data (see Figure C-7).

Protection switching

The following table describes protection switching information per high speed line.

Table C-55 Protection Switching for OC12/STM4/1.3LR2 Port Units

Specification	Length of Time
Switching Bit Error Rate (BER)	10^{-3} to 10^{-9} (user provisionable)
Restoral BER	One-tenth of the switching BER
Switching Time	60 msec (BER $\geq 10^{-3}$ line signal failure)

Optical safety

Optical safety data on laser-containing port units, such as the OC12/STM4/1.3LR2 port unit, is

- SONET: Class IIIB in the FDA/CDRH Classification System
- SDH: Level 1 in the IEC Classification System

Optical dispersion

The optical dispersion for the OC12/STM4/1.3LR2 port units is 300 ps/nm.

Optical return loss

The following table provides the optical return loss for a system using OC12/STM4/1.3LR2 port units.

Table C-56 Optical Return Loss

Specification	Amount
Maximum system optical return loss	24.0 dB
Maximum receiver reflectance	–27.0 dB
Maximum discrete reflectance	–27.0 dB

Transmission specifications

The following table provides transmission specifications for the OC12/STM4/1.3LR2 port units.

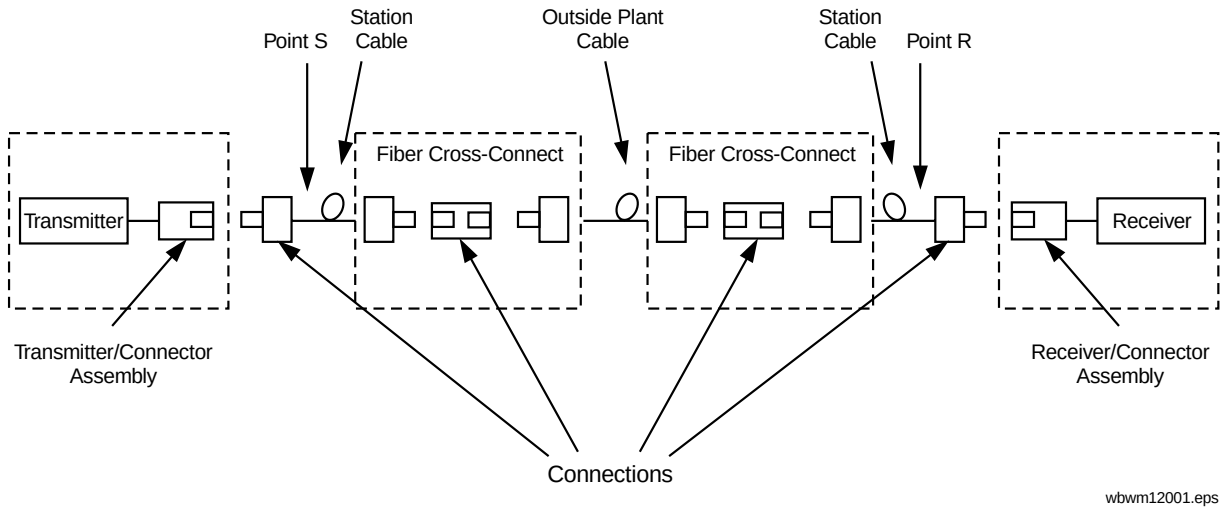
Table C-57 Transmission Specifications for OC12/STM4/1.3LR2 Port Units

Specification	Description
Transmission Medium	Input Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber Output Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber
Operating Connector Interfaces	Universal build-out block and optional ST-type, FC-type, or SC-type lightguide build-out (LBO) connectors for optical attenuation
Optical Line Rate	Input: 622.08 Mb/s Output: 622.08 Mb/s
Transmitter Wavelengths	Minimum: 1298 nm Maximum: 1325 nm
Spectral Width	2.0 nm (RMS)
Optical Source	Distributed Feedback (DFB) laser

Optical system interfaces

Figure C-8 illustrates the optical path between the transmitter and the receiver.

Figure C-8 Optical System Interfaces



Optical requirements and loss budgets

The following table lists the optical requirements and loss budgets for the OC12/STM4/1.3LR2 port units.

Table C-58 Optical Loss Budgets for the OC12/STM4/1.3LR2 Port Units

Parameter	OC12/STM4/1.3LR2 Port Unit[a]
Maximum Transmitter Output Power (P_{Tmax})[b]	2.0 dBm
Minimum Transmitter Output Power (P_{Tmin})[c]	–2.5 dBm
Maximum Received Power (P_{Rmax})[d]	–8.0 dBm
Receiver Sensitivity (P_{Rmin})[c,d]	–30.5 dBm
Minimum System Gain (S-R)	28.0 dB
Optical Path Penalty (P_O)	1.0 dB
Minimum Loss Budget[e]	10.0 dB
Maximum Loss Budget[f]	27.0 dB

a) All values assume that standard single-mode non-dispersion shifted fiber is used. Dispersion shifted fiber may be used. Wave Star BandWidth Manager complies with Telcordia Technologies and ITU requirements for dispersion shifted fiber.

b) Transmit and receive points are referenced as points S and R in Figure C-7.

c) These values include transmitter/receiver connectors at 0.7 dB each (worst case) and the system margins.

d) These values are measured at a BER of $1x10^{-12}$.

e) This value assumes that the maximum received power limitations are not exceeded.

f) Dispersion is limited to 92 km for long reach optics.

OC12/STM4/1.3SR2 (LEY14/LEY14AE) Data Sheet

Overview

This data sheet contains technical specifications for the OC12/STM4/1.3SR2 (short reach) port units that are used in WaveStar BandWidth Manager.

OC12/STM4/1.3SR2 port units are capable of transmitting and receiving two short or intermediate reach OC-12/STM-4 signals (up to 15 km).

Capacity

Each OC12/STM4/1.3SR2 port unit supports two bidirectional (one receive and one transmit) OC-12/STM-4 formatted optical signals. The capacity may be translated to 24 STS-1/8 STM-1 equivalents or 16,128 two-way voice circuits per port unit.

OC-12/STM-4 access

The following table describes OC-12/STM-4 access capabilities.

Table C-59 OC12/STM4/1.3SR2 Access

Specification	Description
Interface	Long-reach (15 km) interface[a]
Growth Increment	Two OC-12s/STM-4s per port unit
Line Code	Scrambled NRZ

a) This number is a typical value. The actual value must be calculated using measured data (see Figure C-8).

Protection switching

The following table describes protection switching information per high speed line.

Table C-60 Protection Switching for OC12/STM4/1.3SR2 Port Units

Specification	Length of Time
Switching Bit Error Rate (BER)	10^{-3} to 10^{-9} (user provisionable)
Restoral BER	One-tenth of the switching BER
Switching Time	60 msec (BER $\geq 10^{-3}$ line signal failure)

Optical safety

Optical safety data on laser-containing port units, such as the OC12/STM4/1.3SR2 port unit, is

- SONET: Class IIIB in the FDA/CDRH Classification System
- SDH: Level 1 in the IEC Classification System

Optical dispersion

The optical dispersion for the OC12/STM4/1.3SR2 port units is 300 ps/nm.

Optical return loss

The following table provides the optical return loss for a system using OC12/STM4/1.3SR2 port units.

Table C-61 Optical Return Loss

Specification	Amount
Maximum system optical return loss	24.0 dB
Maximum receiver reflectance	–27.0 dB
Maximum discrete reflectance	–27.0 dB

Transmission specifications

The following table provides transmission specifications for the OC12/STM4/1.3LR2 port units.

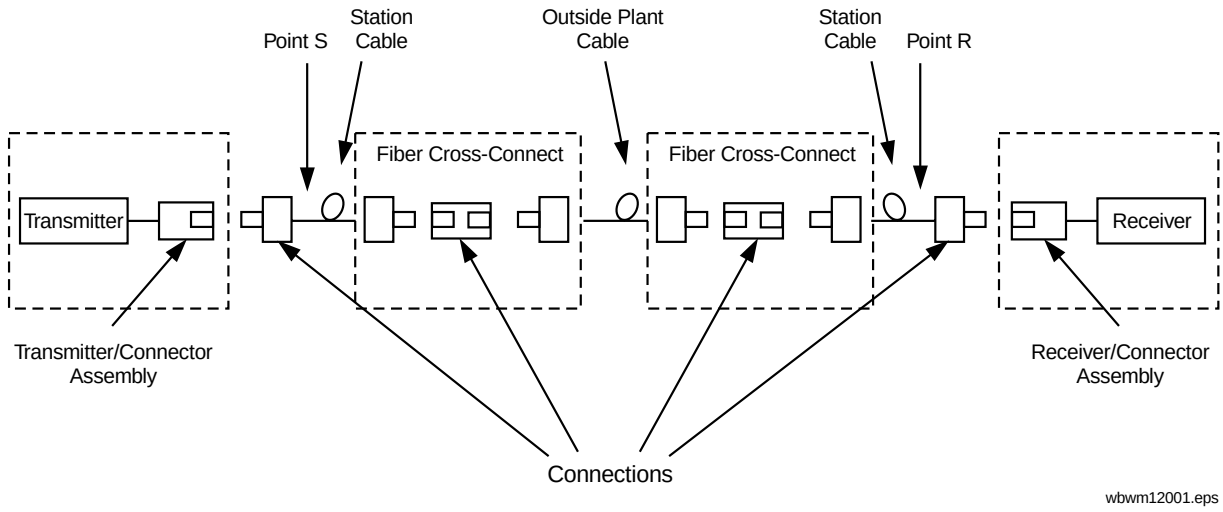
Table C-62 Transmission Specifications for OC12/STM4/1.3SR2 Port Units

Specification	Description
Transmission Medium	Input Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber Output Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber
Operating Connector Interfaces	Universal build-out block and optional ST-type, FC-type, or SC-type lightguide build-out (LBO) connectors for optical attenuation
Optical Line Rate	Input: 622.08 Mb/s Output: 622.08 Mb/s
Transmitter Wavelengths	Minimum: 1274 nm Maximum: 1356 nm
Spectral Width	2.5 nm (RMS)
Optical Source	Distributed Feedback (DFB) laser

Optical system interfaces

Figure C-9 illustrates the optical path between the transmitter and the receiver.

Figure C-9 Optical System Interfaces



Optical requirements and loss budgets

The following table lists the optical requirements and loss budgets for the OC12/STM4/1.3SR2 port units.

Table C-63 Optical Loss Budgets for the OC12/STM4/1.3SR2 Port Units

Parameter	OC12/STM4/1.3SR2 Port Unit[a]
Maximum Transmitter Output Power (P_{Tmax})[b]	–8.0 dBm
Minimum Transmitter Output Power (P_{Tmin}[c])	–15.0 dBm
Maximum Received Power (P_{Rmax})[d]	–8.0 dBm
Receiver Sensitivity (P_{Rmin})[c,d]	–28.0 dBm
Minimum System Gain (S-R)	13.0 dB
Optical Path Penalty (P_O)	1.0 dB
Minimum Loss Budget[e]	0.0 dB
Maximum Loss Budget[f]	12.0 dB

a) All values assume that standard single-mode non-dispersion shifted fiber is used. Dispersion shifted fiber may be used. WaveStar BandWidth Manager complies with Telcordia Technologies and ITU requirements for dispersion shifted fiber.

b) Transmit and receive points are referenced as points S and R in Figure C-8.

c) These values include transmitter/receiver connectors at 0.7 dB each (worst case) and the system margins.

d) These values are measured at a BER of $1x10^{-12}$.

e) This value assumes that the maximum received power limitations are not exceeded.

OC3/STM1/1.3LR4 (LEY15/LEY15AE) Data Sheet

Overview

This data sheet contains technical specifications for the OC3/STM1/1.3LR4 (long reach) port units that are used in WaveStar BandWidth Manager.

OC3/STM1/1.3LR4 port units are capable of transmitting and receiving four long reach OC-3/STM-1 signals (up to 51 km).

Capacity

Each OC3/STM1/1.3LR4 port unit supports four bidirectional (one receive and one transmit) OC-3/STM-1 formatted optical signals. The capacity may be translated to 12 STS-1/4 STM-1 equivalents or 8,064 two-way voice circuits per port unit.

OC-3/STM-1 access

The following table describes OC-3/STM-1 access capabilities.

Table C-64 OC3/STM1/1.3LR4 Access

Specification	Description
Interface	Long-reach (51 km) interface[a]
Growth Increment	Four OC-3s/STM-1s per port unit
Line Code	Scrambled NRZ

a) This number is a typical value. The actual value must be calculated using measured data (see Figure C-9).

Protection switching

The following table describes protection switching information per high speed line.

Table C-65 Protection Switching for OC3/STM1/1.3LR4 Port Units

Specification	Length of Time
Switching Bit Error Rate (BER)	10^{-3} to 10^{-9} (user provisionable)
Restoral BER	One-tenth of the switching BER
Switching Time	60 msec (BER $\geq 10^{-3}$ line signal failure)

Optical safety

Optical safety data on laser-containing port units, such as the OC3/STM1/1.3LR4 port unit, is

- SONET: Class IIIB in the FDA/CDRH Classification System
- SDH: Level 1 in the IEC Classification System

Optical dispersion

The optical dispersion for the OC3/STM1/1.3LR4 port units is 300 ps/nm.

Optical return loss

The following table provides the optical return loss for a system using OC3/STM1/1.3LR4 port units.

Table C-66 Optical Return Loss

Specification	Amount
Maximum system optical return loss	24.0 dB
Maximum receiver reflectance	–27.0 dB
Maximum discrete reflectance	–27.0 dB

Transmission specifications

The following table provides transmission specifications for the OC3/STM1/1.3LR4 port units.

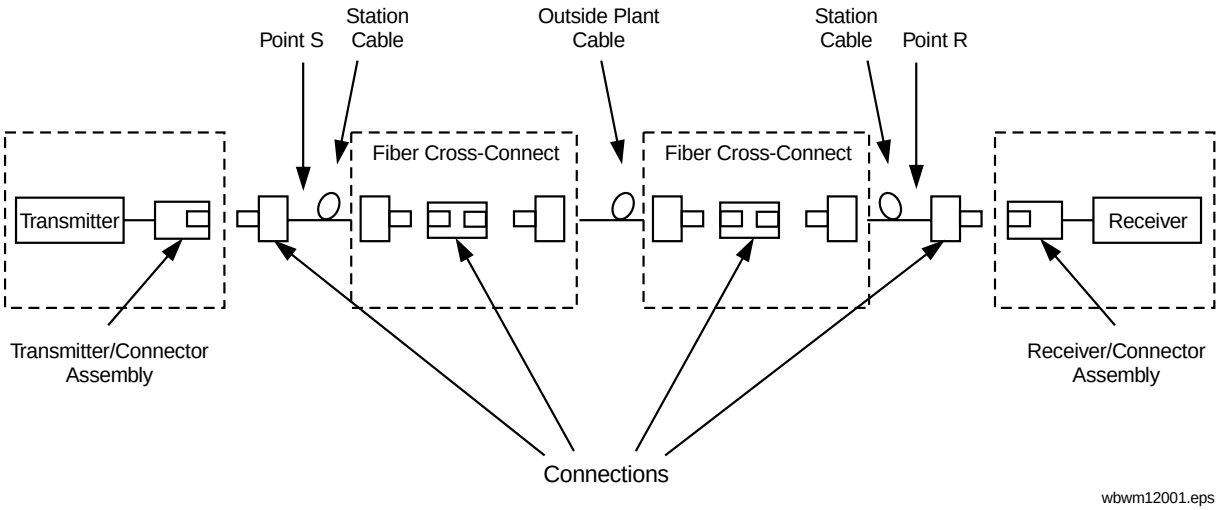
Table C-67 Transmission Specifications for OC3/STM1/1.3LR4 Port Units

Specification	Description
Transmission Medium	Input Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber Output Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber
Operating Connector Interfaces	Universal build-out block and optional ST-type, FC-type, or SC-type lightguide build-out (LBO) connectors for optical attenuation
Optical Line Rate	Input: 155.52 Mb/s Output: 155.52 Mb/s
Transmitter Wavelengths	Minimum: 1298 nm Maximum: 1325 nm
Spectral Width	2.0 nm (RMS)
Optical Source	Distributed Feedback (DFB) laser

Optical system interfaces

Figure C-10 illustrates the optical path between the transmitter and the receiver.

Figure C-10 Optical System Interfaces



Optical requirements and loss budgets

The following table lists the optical requirements and loss budgets for the OC3/STM1/1.3LR4 port units.

Table C-68 Optical Loss Budgets for the OC3/STM1/1.3LR4 Port Units

Parameter	OC3/STM1/1.3LR4 Port Unit[a]
Maximum Transmitter Output Power (P_{Tmax})[b]	0.0 dBm
Minimum Transmitter Output Power (P_{Tmin})[c]	–5.0 dBm
Maximum Received Power (P_{Rmax})[d]	–10.0 dBm
Receiver Sensitivity (P_{Rmin})[c,d]	–34.0 dBm
Minimum System Gain (S-R)	29.0 dB
Optical Path Penalty (P_O)	1.0 dB
Minimum Loss Budget[e]	10.0 dB
Maximum Loss Budget[f]	28.0 dB

a) All values assume that standard single-mode non-dispersion shifted fiber is used. Dispersion shifted fiber may be used. WaveStar BandWidth Manager complies with Telcordia Technologies and ITU requirements for dispersion shifted fiber.

b) Transmit and receive points are referenced as points S and R in Figure C-9.

c) These values include transmitter/receiver connectors at 0.7 dB each (worst case) and the system margins.

d) These values are measured at a BER of $1x10^{-12}$.

e) This value assumes that the maximum received power limitations are not exceeded.

f) Dispersion is limited to 92 km for long reach optics.

OC3/STM1/1.3SR4 (LEY16/LEY16AE) Data Sheet

Overview

This data sheet contains technical specifications for the OC3/STM1/1.3SR4 (short reach) port units that are used in WaveStar BandWidth Manager.

Capacity

Each OC3/STM1/1.3SR4 port unit supports four bidirectional (one receive and one transmit) OC-3/STM-1 formatted optical signals. The capacity may be translated to 12 STS-1/4 STM-1 equivalents or 8,064 two-way voice circuits per port unit.

OC-3/STM-1 access

The following table describes OC-3/STM-1 access capabilities.

Table C-69 OC3/STM1/1.3SR4 Access

Specification	Description
Interface	Long-reach (15 km) interface[a]
Growth Increment	Four OC-3s/STM-1s per port unit
Line Code	Scrambled NRZ

a) This number is a typical value. The actual value must be calculated using measured data (see Figure C-10).

Protection switching

The following table describes protection switching information per high speed line.

Table C-70 Protection Switching for OC3/STM1/1.3SR4 Port Units

Specification	Length of Time
Switching Bit Error Rate (BER)	10^{-3} to 10^{-9} (user provisionable)
Restoral BER	One-tenth of the switching BER
Switching Time	60 msec (BER $\geq 10^{-3}$ line signal failure)

Optical safety

Optical safety data on laser-containing port units, such as the OC3/STM1/1.3SR4 port unit, is

- SONET: Class IIIB in the FDA/CDRH Classification System
- SDH: Level 1 in the IEC Classification System

Optical dispersion

The optical dispersion for the OC3/STM1/1.3SR4 port units is 300 ps/nm.

Optical return loss

The following table provides the optical return loss for a system using OC3/STM1/1.3SR4 port units.

Table C-71 Optical Return Loss

Specification	Amount
Maximum system optical return loss	24.0 dB
Maximum receiver reflectance	–27.0 dB
Maximum discrete reflectance	–27.0 dB

Transmission specifications

The following table provides transmission specifications for the OC3/STM1/1.3SR4 port units.

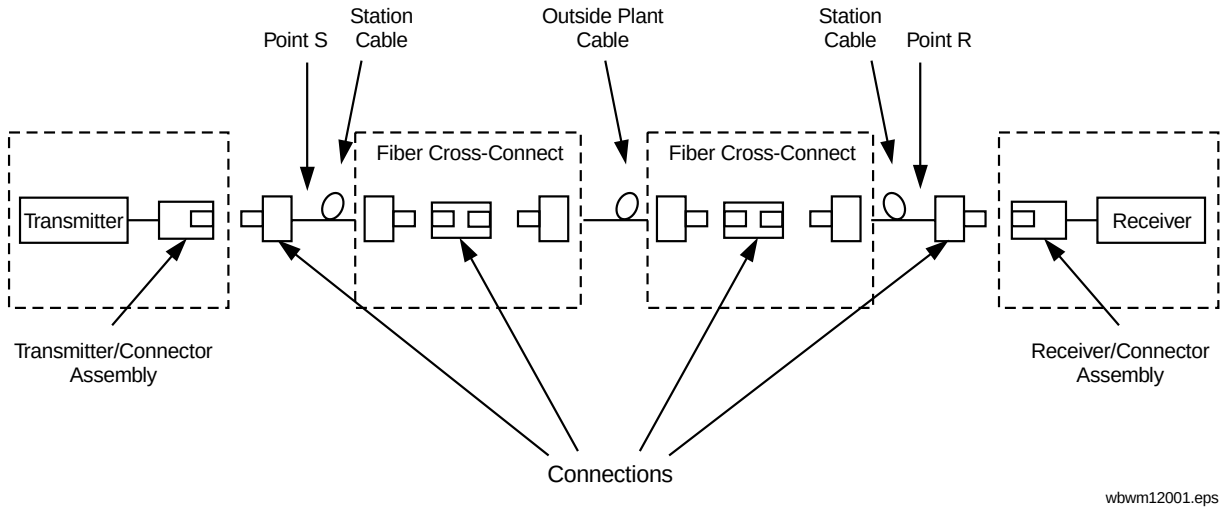
Table C-72 Transmission Specifications for OC3/STM1/1.3SR4 Port Units

Specification	Description
Transmission Medium	Input Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber Output Fiber: Standard Single-Mode Non-Dispersion Shifted Fiber
Operating Connector Interfaces	Universal build-out block and optional ST-type, FC-type, or SC-type lightguide build-out (LBO) connectors for optical attenuation
Optical Line Rate	Input: 155.52 Mb/s Output: 155.52 Mb/s
Transmitter Wavelengths	Minimum: 1261 nm Maximum: 1360 nm
Spectral Width	2.0 nm (RMS)
Optical Source	Distributed Feedback (DFB) laser or Fabre-Perot laser

Optical system interfaces

Figure C-11 illustrates the optical path between the transmitter and the receiver.

Figure C-11 Optical System Interfaces



Optical requirements and loss budgets

The following table lists the optical requirements and loss budgets for the OC3/STM1/1.3SR4 port units.

Table C-73 Optical Loss Budgets for the OC3/STM1/1.3SR4 Port Units

Parameter	OC3/STM1/1.3SR4 Port Unit[a]
Maximum Transmitter Input Power (P_{Tmax})[b]	–8.0 dBm
Minimum Transmitter Output Power (P_{Tmin})[c]	–15.0 dBm
Maximum Received Power (P_{Rmax})[d]	–8.0 dBm
Receiver Sensitivity (P_{Rmin})[c,d]	–28.0 dBm
Minimum System Gain (S-R)	13.0 dB
Optical Path Penalty (P_O)	1.0 dB
Minimum Loss Budget[e]	0.0 dB
Maximum Loss Budget[f]	12.0 dB

a) All values assume that standard single-mode non-dispersion shifted fiber is used. Dispersion shifted fiber may be used. WaveStar BandWidth Manager complies with Telcordia Technologies and ITU requirements for dispersion shifted fiber.

b) Transmit and receive points are referenced as points S and R in Figure C-10.

c) These values include transmitter/receiver connectors at 0.7 dB each (worst case) and the system margins.

d) These values are measured at a BER of $1x10^{-12}$.

e) This value assumes that the maximum received power limitations are not exceeded.

DS3EC1/8 (LEY17/LEY17AE) Data Sheet

Overview

This data sheet contains technical specifications for the DS3EC1/8 port units that are used in WaveStar BandWidth Manager.

The DS3EC1/8 port units are capable of transmitting and receiving signals at either the DS3-rate or EC-1-rate (user-provisionable). Each port unit contains eight independent bidirectional ports (transmit and receive).

Capacity

Each DS3EC1/8 port unit supports eight DS3-rate or EC-1-rate bidirectional lines (eight receive and eight transmit).

Transmission medium

One unbalanced coaxial line is used for each direction of transmission. Therefore, two coaxial lines are used for each of the eight bidirectional ports on a DS3EC1/8 port unit.

Line rate

Each bidirectional port on the DS3EC1/8 port unit may be provisioned to transmit and receive one of the following:

- One DS3 signal with a nominal rate of 44.736 Mb/s ±895 b/s (±20 ppm)
- One EC-1 signal with a nominal rate of 51.840 Mb/s ±1037 b/s (±20 ppm)

Line code

The line code for the DS3EC1/8 port units is bipolar with 3-zero substitution (B3ZS).

Bipolar violation monitoring

Bipolar violation monitoring (BVM) is provided for the incoming B3ZS signal of each bidirectional port in a DS3EC1/8 port unit. The BVM feature can be enabled or disabled on a per port basis.

BNC connectors

The physical interface for each port, both the transmit and receive directions, of the DS3EC1/8 port unit is a 75-ohm BNC connector. The BNC connectors are located on the DS3EC1/8 Connector Panels.

Line build-out

Because the DS3EC1/8 port units are designed to accept the entire signal range, external line build-outs are not required.

□

STM1E/4 (LEY43/LEY43AE) Data Sheet

Overview

This data sheet contains technical specifications for the STM1E/4 port units that are used in WaveStar BandWidth Manager.

The STM1E/4 port units are capable of transmitting and receiving signals at the STM-1e-rate (SDH). Each port unit contains four independent bidirectional ports (transmit and receive).

Capacity

Each STM1E/4 port unit supports four STM-1e-rate bidirectional lines (four receive and four transmit).

Transmission medium

One unbalanced coaxial line is used for each direction of transmission. Therefore, two coaxial lines are used for each of the four bidirectional ports on a STM1E/4 port unit.

Line rate

Each of the four bidirectional ports on the STM1E/4 port unit may be provisioned to transmit and receive an STM-1e signal with a nominal rate of 155.520 Mb/s (±20 ppm).

Line code

The line code for the STM1E/4 port units is coded mark inversion (CMI).

Bipolar violation monitoring

Bipolar violation monitoring (BVM) is provided for the incoming B3ZS signal of each bidirectional port in a STM1E/4 port unit. The BVM feature can be enabled or disabled on a per port basis.

Connectors

The physical interface for each port, both the transmit and receive directions, of the STM1E/4 port unit is a 75-ohm connector. WaveStar BandWidth Manager provides two versions of the STM1e Connector Panels:

- STM1e Connector Panel with 43-type (SMB) 75-ohm connectors
- STM1e Connector Panel with 1.6/5.6-type 75-ohm connectors

Line build-out

Because the STM1E/4 port units are designed to accept the entire signal range, external line build-outs are not required.

□

Glossary

Abbreviations and Acronyms

A

ABN
Abnormal (condition)

ABS
Absent

AC
Alternating Current

ACO
Alarm Cut-Off

ACT
Active

ACU
Alarm Collection Unit (RR)

ADJCTL/DCC
Adjunct Control/32 Data Communication Channels circuit pack

ADJCTL/DCCEI
Adjunct Control/32 Data Communication Channels with External Interface circuit pack

ADM
Add/Drop Multiplexer

ADR
Add/Drop Ring

AGNE
Alarm Gateway Network Element

AID
Access Identifier

AIS
Alarm Indication Signal

AITS
Acknowledged Information Transfer Service: Confirmed mode of operation of the LAPD protocol.

ALS
Automatic Laser Shutdown

AMI
Alternate Mark Inversion

ANSI
American National Standards Institute

APD
Avalanche PhotoDiode

APS
Automatic Protection Switch

APSD
Automatic Power Shutdown

ARM
Adaptive Receiver Module

AS
Alarm Suppression assembly

ASAP
Alarm Severity Assignment Profile

AS&C
Alarm, Status, and Control

ASCII
American Standard Code for Information Interchange

ASN.1
Abstract Syntax Notation 1

ATC
Auxiliary Transmission Channel

ATM
Asynchronous Transfer Mode

ATPC
Automatic Transmit Power Control

AU
Administrative Unit

AU PTR
Administrative Unit Pointer

AU4AD
Administrative Unit 4 Assembler/Disassembler

AUG
Administrative Unit Group

AUTO
Automatic

AVAIL
Available

B

B3ZS
Bipolar 3-Zero Substitution

B8ZS
Bipolar 8-Zero Substitution

BBTR
Backplane Bus Transceiver

BCLAN
Board Controller Local Area Network

BDFB
Battery Distribution and Fuse Bay

BER
Bit Error Rate

BIN
Binary

BIP-N
Bit Interleaved Parity-N

BISDN
Broadband Integrated Services Digital Network

BITS
Building Integrated Timing Source (clock)

BITS
Building Integrated Timing Supply

BLK
Blank

BLSR
Bidirectional Line-Switched Ring

BOC
Bell Operating Company

BSW
Byte Switch circuit pack

BUSTR
BUS Transmitter and Receiver

C

C
Container

CAS
Channel Associated Signalling

CAT
Catastrophic

CC
Cross-Connection

CCITT
Comité Consultatif International Télégrafique & Téléphonique

CCS
Common Channel Signaling

CDRH
Center for Devices and Radiological Health

CEPT
Conférence Européenne des Administrations des Postes et des Télécommunications

CILINK
Communication Interface Link

CIT
Craft Interface Terminal

CL
Clear

CLEI
Common Language Equipment Identifier

CLLI
Common Language Location Identifier

CM
Configuration Management

CMI
Coded Mark Inversion

CMIP
Common Management Information Protocol. OSI standard protocol for OAM&P information exchange.

CMISE
Common Management Information Service Element

CO
Central Office

CP
Circuit Pack

CPE
Customer Premises Equipment

CR
Critical (alarm)

CRC
Cyclical Redundancy Check

CSIEX
Controlled System Interface Expander circuit pack

CSMA/CD
Carrier Sense Multiple Access with Collision Detection

CS&O
Lucent Technologies Customer Support and Operations

CSU
Channel Service Unit

CTIP
Customer Training and Information Products; now known as Lucent Learing Organization (LLO)

CTL
Control (circuit pack prefix)

CTL/EI
Control/External Interface circuit pack

CTL/MEM
Control/Memory circuit pack

CTL/SR50DC
Sub-Rack Duplex (MCA 50D) circuit pack

CTL/SYS50D
System Controller Duplex (MCA 50D) circuit pack

CTL/SYS50DM
System Controller Duplex (MCA 50D) with Non-Volatile Memory circuit pack

CTLI-D
Control Interface to Device

CTS
Customer Technical Support; now known as Technical Support Services (TSS)

CV
Coding Violation

CW
Continuous Wave (laser)

D

DA
Discontinued Availability

DACS
Digital Access Cross-Connect System

dB
Decibels

DC
Direct Current

DCC
Data Communications Channel

DCE
Data Communications Equipment

DCN
Data Communications Network

DCS
Digital Cross-Connect System

DDF
Digital Distribution Frame

DIL
Dual In Line

DPLL
Digital Phase Locked Loop

DP-RING
Dedicated Protection Ring

DR
Digital Radio

DRI
Dual Ring Interworking

DRAM
Dynamic Random Access Memory

DS0, DS1, DS3
Digital Signal Levels 0, 1, 3

DS3EC1/8
8-port DS3 or EC-1 interface port unit

DS-N
Digital Signal, Level N

DS-NE
Directory Service Network Element

DSX
Digital Cross-Connect Frame

DTE
Data Terminating Equipment

DTMF
Dual Tone Multifrequency

DUS
Do not Use for Synchronization

DWDM
Dense Wavelength Division Multiplexing

E

EBER
Equivalent Bit Error Rate

EC
Echo Canceller

EC-1, EC-N
Electrical Carrier, Levels 1 and N

ECC
Embedded Control Channel

ECI
Equipment Catalog Item

EEPROM
Electrically Erasable Programmable Read-Only Memory

EF
Equipment Fail

EIA
Electronic Industries Association

EM
Event Management

EMC
Electromagnetic Compatibility

EMI
Electromagnetic Interference

EMS
Element Management System

EPROM
Erasable Programmable Read-Only Memory

EQ
Equipped

EQPT
Equipment

ES
Errored Seconds

ES
End System

ESD
Electrostatic Discharge

ESF
Extended Superframe Format

ETSI
European Telecommunications Standards Institute

EVT
Event

F

FCC
Federal Communications Commission

FDA
Food and Drug Administration

FDDI
Fiber Distributed Data Interface

FE
Far End

FEBE
Far End Block Error

FEC
Forward Error Correction

FEPROM
Flash EPROM

FIT
Failure in Time

FTAM
File Transfer and Access Management

G

GB
Gigabytes

Gb/s
Gigabits per second

GHz
Gigahertz

GNE
Gateway Network Element

GR
Geographic Redundancy

GR-XXX
Telcordia (Bellcore) General Requirement-XXX

H

HDB3
High Density Bipolar 3

HDLC
High-Level Data Link Control

HE
Host Exchange

HMI
Human Machine Interface

HO
High Order

HPA
Higher Order Path Adaptation

HPC
Higher Order Path Connection

HPT
Higher Order Path Termination

HP-UX
Unix Operating System for Hewlett Packard platform

HS
High Speed

HW
Hardware

Hz
Hertz

I

IAO LAN
Intraoffice Local Area Network

ID
Identifier

IEC
International Electrotechnical Commission

IEEE
Institute of Electrical and Electronics Engineers

I/O
Input/Output

IMF
Infant Mortality Factor

INTFC
Interface

IR
Intermediate Reach

IS
In Service

ISDN
Integrated Services Digital Network

ISM
Intelligent Synchronous Multiplexer

ITCO
Independent Telephone Company

ITM
Integrated Transport Management

ITM-NM
Integrated Transport Management Network Module

ITM-SC
Integrated Transport Management Subnetwork Controller

ITU
International Telecommunications Union

ITU-R
International Telecommunications Union — Radio standardization sector. Formerly known as CCIR: Comité Consultatif International Radio; International Radio Consultative Committee.

ITU-T
International Telecommunications Union — Telecommunication standardization sector. Formerly known as CCITT: Comité Consultatif International Télégrafique & Téléphonique; International Telegraph and Telephone Consultative Committee.

IXC
Interexchange Carrier

K

Kb/s
Kilobits per second

L

LA
Limited Availability

LAN
Local Area Network

LATA
Local Access and Transport Area

LBC
Laser Bias Current

LBFC
Laser Backface Currents

LBO
Lightguide Build-Out

LCN
Local Communications Network

LCT
Large Capacity Terminal

LEC
Local Exchange Carrier

LED
Light-Emitting Diode

LEN
Local Exchange Node

LGX
Lightguide Cross-Connect

LH
Long Haul

LLO
Lucent Learning Organization, formerly Customer Training and Information Products (CTIP)

LO
Low Order

LOF
Loss of Frame

LOM
Loss Of Multiframe

LOP
Loss of Pointer

LOS
Loss of Signal

LPA
Lower order Path Adaptation

LPBK
Loopback

LPC
Lower Order Path Connection

LPT
Lower Order Path Termination

LR
Long Reach

LS
Low Speed

LTE
Line Terminating Equipment

M

m
Microns

mm
Micrometer

MB
Megabytes

Mb/s
Megabits per second

MCOND
Maintenance Condition

MEM
Memory

MIPS
Millions of Instructions Per Second

MJ
Major (alarm)

MMI
Man-Machine Interface

MML
Human-Machine Language

MN
Minor (alarm)

MS
Multiplex Section

ms
Millisecond

MS-SPRing
Multiplex Section Shared Protection Ring

MSOH
Multiplex Section OverHead

MTBF
Mean Time Between Failures

MTBMA
Mean Time Between Maintenance Activities

MTIE
Maximum Time Interval Error

MTPI
Multiplexer Timing Physical Interface

MTS
Multiplex Timing Source

MTTR
Mean Time To Repair

N

NA
Not Applicable

NARTAC
North American Regional Technical Assistance Center

NCC
Network Communication Controller

NE
Network Element

NEBS
Network Equipment-Building System

NEE
Network Element Equivalent

NEF
Network Element Function

NEM
Network Element Manager

nm
Nanometer (10-9 meters)

NMA
Network Monitoring and Analysis System

NMON
Not Monitored

NMS
Network Management System

NNE
Non-SDH Network Element

NORM
Normal

NPI
Null Pointer Indication

NPPA
Non-Preemptible Protection Access

NRZ
Nonreturn to Zero

NSA
Non-Service Affecting

NSAP Address
Network Service Access Point Address (used in the OSI network layer 3)

NTF
No Trouble Found

NVM
Non-Volatile Memory

O

O&M
Operation and Maintenance

OA
Optical Amplifier

OALAN
Overhead Access Local Area Network

OAM&P
Operations, Administration, Maintenance, and Provisioning

OC, OC-N
Optical Carrier

OC-1
Optical Carrier, Level 1 Signal (51.84 Mb/s)

OC-3
Optical Carrier, Level 3 Signal (155.52 Mb/s)

OC-3c
Optical Carrier, Level 3 Concatenated Signal (155.52 Mb/s)

OC-12
Optical Carrier, Level 12 Signal (622.08 Mb/s)

OC-48
Optical Carrier, Level 48 (2488.32 Mb/s) (2.5 Gb/s)

OC-192
Optical Carrier, Level 192 (9953.28 Mb/s) (10 Gb/s)

OC3/STM1/1.3LR4
Optical Carrier 3/Synchronous Transport Module 1 port unit in the 1.3 mm range with four bidirectional long reach ports.

OC3/STM1/1.3SR4
Optical Carrier 3/Synchronous Transport Module 1 port unit in the 1.3 mm range with four bidirectional short reach ports.

OC12/STM4/1.3LR2
Optical Carrier 12/Synchronous Transport Module 4 port unit in the 1.3 mm range with two bidirectional long reach ports.

OC12/STM4/1.3SR2
Optical Carrier 12/Synchronous Transport Module 4 port unit in the 1.3 mm range with two bidirectional short reach ports.

OC48/STM16
Optical Carrier 48/Synchronous Transport Module 16 port unit (generic reference to all OC48/STM16 port units).

OC48/STM16/1.3LR1
Optical Carrier 48/Synchronous Transport Module 16 port unit in the 1.3 mm range with one bidirectional long reach port.

OC48/STM16/1.5LR1
Optical Carrier 48/Synchronous Transport Module 16 port unit in the 1.5 mm range with one bidirectional long reach port.

OC48/STM16/DWDM01-16
Optical Carrier 48/Synchronous Transport Module 16 port unit in 16 different wavelengths that are compatible with ITU wavelengths and WaveStar OLS 40G/80G without OTUs.

OC48/STM16/POU
Optical Carrier 48/Synchronous Transport Module 16 Passive Optic Unit port unit in 16 different wavelengths that are compatible with passive optical applications with dense wavelength division multiplexing systems. The 16 different codes of OC48/STM16/POU port units are each designated by a 4-digit numeric suffix that corresponds to the frequency of the optical signal.

OC48/STM16/WDM
Optical Carrier 48/Synchronous Transport Module 16 Wavelength Division Multiplexing port unit in the 1.5 mm range with one bidirectional short/intermediate reach port. The 80 different codes of OC48/STM16/WDM port units are each designated by a 4-digit numeric suffix that corresponds to the frequency of the optical signal. The OC48/STM16/WDM port units support 80 wavelengths for applications with WaveStar OLS 400G dense wavelength division multiplexing systems without OTUs.

OC192/STM64/1.5IR1
Optical Carrier 192/Synchronous Transport Module 64 port unit in the 1.5 mm range with one bidirectional extended intermediate reach port.

OC192/STM64/1.5SR1
Optical Carrier 192/Synchronous Transport Module 64 port unit in the 1.5 mm range with one bidirectional short/intermediate reach port.

OC192/STM64/POU
Optical Carrier 192/Synchronous Transport Module 64 Passive Optic Unit port unit in 16 different wavelengths that are compatible with passive optical applications with dense wavelength division multiplexing systems. The 16 different codes of OC192/STM64/POU port units are each designated by a 4-digit numeric suffix that corresponds to the frequency of the optical signal.

OC192/STM64/1.5IRS1
Optical Carrier 192/Synchronous Transport Module 64 port unit in the 1.5 mm range with one bidirectional intermediate reach port with Strong Forward Error Correction.

OC192/STM64/WDM
Optical Carrier 192/Synchronous Transport Module 64 Wavelength Division Multiplexing port unit in the 1.5 mm range with one bidirectional short/intermediate reach port. The 40 different codes of OC192/STM64/WDM port units are each designated by a 4-digit numeric suffix that corresponds to the frequency of the optical signal. The OC192/STM64/WDM port units support 40 wavelengths for applications with WaveStar OLS 400G dense wavelength division multiplexing systems without OTUs.

ODF
Optical Distribution Frame

OI
Operations Interworking

OLS
Optical Line System

OOF
Out-of-Frame

OOS
Out-of-Service

OPS/INE
Operations System for Intelligent Network Elements

OS
Operations System

OSI
Open Systems Interconnection

OSMINE
Operations Systems Modifications for the Integration of Network Elements

OTU
Optical Translator Unit (WaveStar OLS)

P

PCB
Printed Circuit Board

PCM
Pulse Code Modulation

PCMCIA
Personal Computer Memory Card International Association

PDH
Plesiochronous Digital Hierarchy

PFVP
Power Filter with Voltage Protection

PI
Physical Interface

PM
Performance Monitoring

PMA
Performance Monitoring Application

PMD
Polarization Mode Dispersion

POH
Path Overhead

POP
Point of Presence

POTS
Plain Old Telephone Service

PP
Pointer Processing

PPROC/FO
Pointer Processor circuit pack for 192 STS-1/64 STM-1 equivalents with fan out

PRC
Primary Reference Clock

PRI
Primary

PROTN
Protection

PROV
Provisioned

PSA
Partially Service Affecting

PSDN
Public Switched Data Network

PSF
Power Supply Filter

PSTN
Public Switched Telephone Network

PTE
Path Terminating Equipment

PTY
Parity

PVC
Permanent Virtual Circuit

PWR
Power

PWR ON
Power On

Q

QAF
Q Adapter Function (in NE)

QL
Quality Level

QOS
Quality of Service

QRSS
Quasi-Random Signal Source

R

RAM
Random Access Memory

RCV
Receive

RCVR
Receiver

RDI
Remote Defect Indication

REI
Remote Error Indicator

RF
Radio Frequency

RFI
Remote Failure Indication

RPP
Reliability Prediction Procedure

RSOH
Regenerator Section OverHead; part of SOH

RST
Regenerator Section Termination

RT
Remote Terminal

RTRV
Retrieve

RZ
Return to Zero

S

SA
Service Affecting

SAI
Station Alarm Interface

SASE
Stand Alone Synchronization Equipment

SCI
Station Clock Input

SCO
Station Clock Output

SD
Signal Degrade

SDH
Synchronous Digital Hierarchy

SDS
Standard Directory Service based on ANSI recommendation T1.245

SEC
SDH Equipment Slave Clock

SES
Severely Errored Seconds

SF
Superframe format

SFEC
Strong Forward Error Correction

SLC
Subscriber Loop Carrier

SH
Short Haul

SNCP
Sub-Network Connection Protection

SNR
Signal-to-Noise Ratio

SOH
Section Overhead

SONET
Synchronous Optical Network

SPE
Synchronous Payload Envelope

SR
Short Reach

SSM
Synchronization Status Marker

SSU_L
Synchronization Supply Unit — Local

SSU_T
Synchronization Supply Unit — Transit

STBY
Standby

STM-1, STM-N
Synchronous Transport Module, Levels 1 and N (155.52 Mb/s)

STM-4
Synchronous Transport Module Level 4 (622.08 Mb/s)

STM-4c
Synchronous Transport Module Level 4 Concatenated Signal (622.08 Mb/s)

STM-16
Synchronous Transport Module Level 16 (2488.32 Mb/s) (2.5 Gb/s)

STM-64
Synchronous Transport Module Level 64 (9953.28 Mb/s) (10 Gb/s)

STS
Synchronous Transport Signal

STS-1, STS-N
Synchronous Transport Signal, Levels 1 and N

STS-3
Synchronous Transport, Level 3

STS-3c
Synchronous Transport, Level 3 Concatenated Signal

STS-12
Synchronous Transport, Level 12

STS-12c
Synchronous Transport, Level 12Concatenated Signal

SVC
Switched Virtual Circuit

SWC
Switch Center

SWIEX
Switch Interface Expander circuit pack

SWIF
Switch Interface circuit pack

SWITCH/DS3EC1
Switch circuit pack for 1xN DS3EC1/8 port unit protection switching

SWITCH/STM1E4
Switch circuit pack for 1xN STM1E/4 port unit protection switching

SWITCH/DS3EC1
Electrical Protection Switch for up to 96 DS3 or EC-1 signals port unit

SWITCH/STS576
576X576 STS-1/192x192 STM-1 Switch circuit pack

SWITCH/STS768
768X768 STS-1/256x256 STM-1 Switch circuit pack

SYNC
Synchronizer

T

TA
Technical Advisory

TABS
Telemetry Asynchronous Byte Serial (Protocol)

TARP
Target Identifiers Address Resolution Protocol

TBD
To Be Determined

TBOS
Telemetry Byte-Oriented Serial (Protocol)

TCA
Threshold-Crossing Alert

TDM
Time Division Multiplexing

THz
Terrahertz (1012 Hz)

TID
Target Identifier

TIRKS
Trunks Integrated Records Keeping System

TL1
Transaction Language 1

TMG/STRAT3
Stratum 3 Timing circuit pack

TR
Technical Requirement

TSA
Time Slot Assignment

TSI
Time Slot Interchange

TSS
Technical Support Services, formerly Customer Tenical Support (CTS)

TU
Tributary Unit

TUG
Tributary Unit Group

U

UAS
Unavailable Seconds

UITS
Unacknowledged Information Transfer Service. Unconfirmed mode of LAPD operation.

UNEQ
Path Unequipped

UPSR
Unidirectional Path-Switched Ring

V

V
Volts

VAC
Volts Alternating Current

VC
Virtual Container

VDC
Volts Direct Current

VF
Voice frequency

VM
Violation Monitor

VMR
Violation, Monitor, and Removal

VT
Virtual Tributary

VT1.5
Virtual Tributary, Level 1.5

VT-G
Virtual Tributary Group

W

WAD
Wavelength Add/Drop

WAN
Wide Area Network

WaveStar OLS 40G/80G/400G
WaveStar Optical Line System 40G/80G/400G

WaveStar SNMS
WaveStar SubNetwork Management System (formerly known as ITM SNC [Integrated Transport Management SubNetwork Controller])

WDCS
Wideband Digital Cross-Connect System

WDM
Wavelength Division Multiplexing

WRT
Wait to Restore Time

X

X.25
An ITU standard defining the connection between a terminal and a public packet-switched network

Numerics

0x1 Line Operation
0x1 means unprotected operation. The connection between network elements has one bidirectional line (no protection line).

1+1 Active Unit State
Indicates which unit (working or protection) is active.

1+1 Line Protection
A protection architecture in which the transmitting equipment transmits a valid signal on both the working and protection lines. The receiving equipment monitors both lines. Based on performance criteria and OS control, the receiving equipment chooses one line as the active line and designates the other as the standby line.

10G I/O Bay
A 10G I/O Bay is capable of housing one or two 10G I/O Shelves. Each 10G I/O Shelf is divided into a CTL/Switch Interface Sub-Shelf and a Facility/SWIF Interface Sub-Shelf.

10G I/O Shelf
A 10G I/O Shelf may be of housed in a 10G I/O Bay or a 10G/Universal I/O Bay. The 10G I/O Shelf is divided into a CTL/Switch Interface Sub-Shelf and a Facility/SWIF Interface Sub-Shelf.

10G/SDH I/O Bay
A 10G/SDH I/O Bay is capable of housing two shelves. The 10G I/O Shelf (bottom) is divided into a CTL/Switch Interface Sub-Shelf and a Facility/SWIF Interface Sub-Shelf. The SDH Universal I/O Shelf (top) is divided into a Switch Interface Sub-Shelf and a Facility Interface Sub-Shelf.

10G/Universal I/O Bay
A 10G/Universal I/O Bay is capable of housing two shelves. The 10G I/O Shelf (bottom) is divided into a CTL/Switch Interface Sub-Shelf and a Facility/SWIF Interface Sub-Shelf. The Universal I/O Shelf (top) is divided into a Switch Interface Sub-Shelf and a Facility Interface Sub-Shelf.

576x576 STS-1 Switch (SWITCH/STS576)
The SWITCH/STS576 circuit pack provides a 576x576 STS-1 equivalent (192x192 STM-1 equivalent) cross-connect function.

768x768 STS-1 Switch (SWITCH/STS768)
The SWITCH/STS768 circuit pack provides a 768x768 STS-1 equivalent (256x256 STM-1 equivalent) cross-connect function.

4608/1536 Platform
The equipment configuration that supports a 4608 STS-1/1536 STM-1 equivalent non-blocking service cross-connection capacity.

4608/1536 Switch Center
A 4608/1536 Switch Center is one fully-equipped Switch Shelf.

4608/1536 Switch Complex
A 4608/1536 Switch Complex is two Switch Bays or one Control/Switch Bay and one Switch Bay. Each bay is equipped with one fully-equipped Switch Shelf.

A

Absent (ABS)
Used to indicate that a given circuit pack is not installed.

Access Identifier (AID)
A technical specification for explicitly naming entities (both physical and logical) of an NE using a grammar comprised of ASCII text, keywords, and grammar rules.

Active (ACT)
Used to indicate that a circuit pack or module is in-service and currently providing service functions.

Active Path
One of two signals entering a constituent path selector, the active path is the path currently being selected.

Add Connection
For the input side, it is any tributary from which the user can provision a cross-connection, in any port or port protection group which is NOT a BLSR/MS-SPRing. For the output side, it is any tributary to which the user can provision a cross-connection, in any port protection group which is a BLSR/MS-SPRing.

Add/Drop Multiplexer (ADM)
The term for a synchronous network element capable of combining signals of different rates and having those signals added to or dropped from the stream.

ADJCTL/DCC
Circuit pack that terminates 32 DCC channels. Two ADJCTL/DCC circuit pack are used in the System Controller Shelf.

ADJCTL/DCCEI
Circuit pack that combines the functionality of the ADJCTL/DCC and CTL/EI circuit packs. The ADJCTL/DCCEI circuit pack is used in the 10G I/O Shelf, the SDH Universal I/O Shelf, and the Universal I/O Shelf.

Alarm
Visible or audible signal indicating that an equipment failure or significant event/condition has occurred.

Alarm Correlation
The search for a directly-reported alarm that can account for a given symptomatic condition.

Alarm Cut-Off (ACO)
A button on the user panel used to silence audible alarms.

Alarm Cut-Off and Test (ACO/TST)
The name of a pushbutton on the user panel used to silence audible alarms.

Alarm Gateway Network Element (AGNE)
A defined Network Element in an alarm group through which members of the alarm group exchange information.

Alarm Indication Signal (AIS)
A code transmitted downstream in a digital network that indicates that an upstream failure has been detected and alarmed, if the upstream alarm has not been suppressed.

Alarm Severity
An attribute defining the priority of the alarm message. The way alarms are processed depends on the severity.

Alarm Severity Assignment Profile (ASAP)
A user provisioned mechanism to control an alarm level.

Alarm Suppression
Selective removal of alarm messages from being forwarded to the GUI or to network management layer OSs.

Alarm Throttling
A feature that automatically or manually suppresses autonomous messages that are not priority alarms.

Alternate Mark Inversion (AMI)
A line code that employs a ternary signal to convert binary digits, in which successive binary ones are represented by signal elements that are normally of alternative positive and negative polarity but equal in amplitude, and in which binary zeros are represented by signal elements that have zero amplitude.

American Standard Code for Information Interchange (ASCII)
A standard 7-bit code that represents letters, numbers, punctuation marks, and special characters in the interchange of data among computing and communications equipment.

APS Channel
The signalling channel carried in the K1 and K2 bytes of the SONET overhead on the protection line. It is used to exchange requests and acknowledgments for protection switch actions.

Association
A logical connection between manager and agent through which management information can be exchanged.

Asynchronous
The essential characteristic of time-scales or signals such that their corresponding significant instants do not necessarily occur at the same average rate.

Asynchronous Transfer Mode (ATM)
A high-speed transmission technology characterized by high bandwidth and low delay. It utilizes a packet switching and multiplexing technique which allocates bandwidth on demand.

Attribute
Alarm indication level: critical, major, minor, or no alarm.

Autolock
Action taken by the system in the event of circuit pack failure/trouble. System switches to protection and prevents a return to the working circuit pack even if the trouble clears. Multiple protection switches on a circuit pack during a short period of time cause the system to autolock the pack.

Autolock State

A state of the 1xN protection switch group with priority above “Automatic Protection Switching”, and below the commands Clear, Lockout, and Forced Switch. The Autolock State supports the following two states: Locked – indicating the existence of an autolock condition, in which traffic from a particular service circuit pack is locked to protection, Unlocked – indicating no autolock condition is present and normal 1xN protection switching is occurring.

Automatic (AUTO)

One possible state of a port or slot. When a port is in the AUTO state and a good signal is detected, the port automatically enters the IS (in-service) state. When a slot is in the AUTO state and a circuit pack is detected, the slot automatically enters the EQ (equipped) state.

Automatic Protection Switch

A protection switch that occurs automatically in response to an automatically detected fault condition.

Autonomous Message

A message transmitted from the controlled Network Element to the ITM-SC which was not a response to an ITM-SC originated command.

Auto-Provisioning

The ability to detect the presence of equipment, validate it, and then assign the original values to the newly created entity’s programmable parameters. These parameters are maintained in NVM and/or hardware registers. If a user has predefined some (or all) of the parameters associated with the entity, the auto-provisioning function validates the request, perhaps using some of the pre-provisioned data, and then assigns the programmable parameter values accordingly.

Avalanche Photodiode (APD)

A diode that increases its electrical conductivity by a multiplication effect when hit by light. APDs are used in lightwave receivers because the APDs have a greater sensitivity to weakened light signals (for example, those which have traveled long distances over fiber).

B

Backout to a Previous Generic

The user initiated procedure whereby the system reverts from the current/most recent generic and back-to the previous generic.

Backup

The backup and restoration features provide the capability to recover from loss of NE data because of such factors as human error, power failure, NE design flaws, and software bugs.

Bandwidth

The difference in Hz between the highest and lowest frequencies in a transmission channel. The data rate that can be carried by a given communications circuit.

Baud Rate
Transmission rate of data (bits per second) on a network link.

Bidirectional Line
A transmission path consisting of two fibers that handle traffic in both the transmit and receive directions.

Bidirectional Line-Switched Ring (BLSR)
A bidirectional ring in which protection switching is accomplished by switching working traffic into protection time slots in the line going in the opposite direction around the ring. BLSRs are functionally equivalent to SDH Multiplexer Section Shared Protection Rings (MS-SPRings).

Bidirectional Ring
A ring in which both directions of traffic between any two nodes travel through the same network elements (although in opposite directions).

Bidirectional Switch
Protection switching performed in both the transmit and receive directions.

Bipolar 3-Zero Substitution (B3ZS)
A line coding technique that replaces three consecutive zeros with a bit sequence having special characteristics accomplishing two objectives: first, this bit sequence accommodates the density requirements of the ones for digital T3 carrier, second, the sequence is recognizable at the destination (due to deliberate bipolar violations) and is removed to produce the original signal.

Bipolar 8-Zero Substitution (B8ZS)
A line coding technique that replaces eight consecutive zeros with a bit sequence having special characteristics accomplishing two objectives: First, this bit sequence accommodates the density requirements of the ones for digital T1 carrier; Second, the sequence is recognizable at the destination (due to deliberate bipolar violations) and is removed to produce the original signal.

Bit
The smallest unit of information in a computer, with a value of either 0 or 1.

Bit Error Rate (BER)
The ratio of error bits received to the total number of bits transmitted.

Bit Error Rate Threshold
The point at which an alarm is issued for bit errors.

Bit Interleaved Parity-N(BIP-N)
A method of error monitoring over a specified number of bits (BIP-3 or BIP-8).

BITS clock
A BITS (Building Integrated Timing Source) clock is simply a clock within a central office that distributes

timing to all the equipment in that central office. The BITS clock is tied to an external, stable timing source, such as a GPS (global positioning satellite).

Blank (BLK)
The status of a circuit pack slot that contains a bus extender (blank) circuit pack.

Board Controller Local Area Network (BCLAN)
The internal local area network that provides communications between the line and board controllers on the circuit packs associated with a high-speed line.

Bridge Cross-Connection
The setting up of a cross-connection leg with the same input tributary as that of an existing cross-connection leg. Thus, forming a 1:2 bridge from an input tributary to two output tributaries.

Broadband Communications
Voice, data, and/or video communications at greater than 2 Mb/s rates.

Building Integrated Timing Supply (BITS)
A single clock that provides all the DS1 and/or composite clock timing reference to all other clocks in that building.

Byte
Refers to a group of eight consecutive binary digits.

Byte Switch (BSW)
A BSW (slice) circuit pack serves as a cross-connect at the byte level between STS-1/STM-1 signals for 4608x4608/1536x1536 switching.

C

C-Bit
A framing format used for DS3 signals produced by multiplexing 28 DS1s into a DS3. This format provides for enhanced performance monitoring of both near-end and far-end entities.

Cell Relay
Fixed length cells. For example, ATM with 53 octets.

Central Office (CO)
A building where common carriers terminate customer circuits.

Channel
A sub-unit of transmission capacity within a defined higher level of transmission capacity.

Channel State Provisioning
A feature that allows a user to suppress reporting of alarms and events during provisioning by supporting

multiple states (automatic, in-service, and not monitored) for VT1.5 and STS-1 channels.

Circuit
A set of transmission channels through one or more network elements that provides transmission of signals between two points, to support a single communications path.

Clear Channel (CC)
A digital circuit where no framing or control bits are required, thus making the full bandwidth available for communications.

Clear Command
Clears any active WaveStar CIT switch request. Clear can be directed to a single electrical interface (working or protection) or to all electrical interfaces. The clear command is used to clear a Lockout, Forced Switch, or Manual Switch conditions, as well as release a Wait-to-Restore.

Closed 4-Fiber BLSR
When all four ports of the BLSR are selected, then the user can provision one of the four ports as the “East Working Port”, one port as the “East Protection Port”, one port as the “West Working Port” and one port as the “West Protection Port.” This arrangement is sometimes referred to as a two-sided node.

Closed Ring Network
A network formed of a ring-shaped configuration of network elements. Each network element connects to two others, one on each side.

Coding Violation (CV)
A performance monitoring parameter indicating that bipolar violations of the signal have occurred.

Collocated
System elements that are located in the same location.

Command Group
An administrator-defined group that defines commands to which a user has access.

Concatenation
A procedure whereby multiple virtual containers are associated one with each other resulting in a combined capacity that can be used as a single container across which bit sequence integrity is maintained.

Constituent Path Selector
A path-level protection switching function that selects the better of two constituent signals in the two logical input tributaries and operates at the constituent signal rate. A path protection group in a cross-connection with an STS-3 or STS-12/STM-1 or STM-4 “pipe” cross-connection rate provides path-level protection switching for all the constituent signals carried by the cross-connection. There may be one or more constituent path selectors operating independently within each path protection group, one for each constituent signal in the logical output tributary. The path protection group adapts to the current constituent

signal rates.

Constituent Signal
A signal at a constituent signal rate that is carried by a cross-connection leg.

Consultative Committee for the International Telephone and Telegraph (CCITT)
International Telephone and Telegraph Consultative Committee — An international advisory committee under United Nations' sponsorship that has composed and recommended for adoption worldwide standards for international communications. Recently changed to the International Telecommunications Union Telecommunications Standards Sector (ITU-TSS).

Control Complex
A Control Complex includes one equipped System Controller Bay or one Control/Switch Bay, which provides the main control functions for WaveStar BandWidth Manager.

Control/Switch Bay
The Control/Switch Bay is capable of housing a System Controller Shelf and a Switch Shelf.

Control/Switch Complex
A Control/Switch Complex comprises either one equipped System Controller Bay and two Switch Bays or one Control/Switch Bay and one Switch Bay. A Control/Switch Complex provides the main control and switching functions for WaveStar BandWidth Manager.

Control System Interface Expander (CSIEX)
The CSIEX circuit pack expands CTLI-D interfaces that connect to the SWIEX circuit packs and the SEC memory circuit packs. The CSIEX circuit pack also expands ON (Operations Network) interfaces that connect to the Facility Interface Sub-Shelf

Co-Resident
A hardware configuration where two applications can be active at the same time independently on the same hardware and software platform without interfering with each others functioning.

Correlation
A process where related hard failure alarms are identified.

Craft Interface Terminal (CIT)
The user interface terminal used by craft personnel to communicate with a network element.

Critical (CR)
Alarm that indicates a severe, service-affecting condition.

Cross-Connect Capacity
The total bandwidth of cross-connections as measured by the bandwidth of input and output tributaries. A

system with N STS-1/STM-1 equivalent input tributaries and N STS-1/STM-1 equivalent output tributaries (referred to as “NxN”) provides a cross-connection capacity of N STS-1/STM-1 equivalents. This system could provide N one-way point-to-point cross-connections or N^2 two-way point-to-point cross-connections at the equivalent rate of STS-1/STM-1.

Cross-Connect Loopback

A cross-connection from an input tributary to the output of that same tributary via the cross-connect fabric.

Cross-Connect Rate

The attribute of a cross-connection that defines the constituent signal rate(s) it can carry. For a cross-connection with an STS-3/STM-1 “pipe” cross-connection rate, the constituent signals carried by the cross-connection can be either an STS-3c/STM-1c signal or three STS-3/STM-1 signals. Similarly, for a cross-connection with an STS-12/STM-4 “pipe” cross-connection rate, the constituent signals carried by the cross-connection can be either an STS-12c/STM-4c signal or an allowed mix of STS-12c/STM-1c signals and STS-3/STM-1 signals.

Cross-Connect Topologies

The different types of cross-connections, or configurations, that may be provisioned. These include: bridging, path-protected, and point-to-point. The topology of a cross-connection defines the number of legs in the cross-connection, whether the inputs and/or outputs of some legs are the same logical tributary, and whether any path protection groups are included.

Cross-Connection

Path-level connections between input and output tributaries or specific ports within a single NE. Cross-connections are made in a consistent way even though there are various types of ports and various types of port protection. Cross-Connections are reconfigurable interconnections between tributaries of transmission interfaces.

Cross-Connection Leg

A one-way connection provisioned from one logical input tributary to one logical output tributary. Each leg is identified as an entity by its logical input and output tributaries, its cross-connection rate, and the type of cross-connection topology. The operation of retrieving cross-connections can be done in terms of cross-connection legs between specific logical tributaries.

Cross-Connection Type

A provisionable parameter whereby the user selects the type as 1 Way Point to Point, or 2 Way Point to Point.

Crosstalk

An unwanted signal introduced into one transmission line from another.

CTL/EI

Circuit pack that selects the 10Base-T from an ADJCTL/DCC circuit pack and routes it to the backplane.

CTL/MEM
The CTL/MEM circuit pack stores information for WaveStar BandWidth Manager. A CTL/MEM circuit pack may be designated as either PRI (Primary) or SEC (Secondary).

CTL/SR50DC
The CTL/SR50DC circuit pack is a main controller (without memory) for WaveStar BandWidth Manager. The CTL/SR50DC is part of the 10G I/O Shelf.

CTL/Switch Interface Sub-Shelf
The top portion of a 10G I/O Shelf which is equipped with ten SWITCH/STS768 packs, two TMG/STRAT3 packs, two CTL/SR50DC packs, and four PPROC/FO packs.

CTL/SYS50D
The SYS50D circuit pack is a main controller (without memory) for WaveStar BandWidth Manager. The SYS50D is part of the System Controller Shelf.

CTL/SYS50DM
The SYS50DM circuit pack is a main controller for WaveStar BandWidth Manager. Two SYS50DM circuit packs are included in all modules of the Facility Interface Sub-.

Current Value
The value currently assigned to a provisionable parameter.

Cut-Through
Refers to a simple ASCII interface to an NE. It enables the user to send TL1 messages directly to the NE with no interpretation or assistance provided by the WaveStar CIT.

D Data

A collection of system parameters and their associated values.

Database Administrator
A user who administers the database of the application.

Data Communications Channel (DCC)
The embedded overhead communications channel in the synchronous line, used for end-to-end communications and maintenance. The DCC carries alarm, control, and status information between network elements in a synchronous network.

Data Communications Equipment (DCE)
The equipment that provides signal conversion and coding between the data terminating equipment (DTE) and the line. The DCE may be separate equipment or an integral part of the DTE or of intermediate equipment. A DCE may perform other functions usually performed at the network end of the line.

Data Terminating Equipment (DTE)
The equipment that originates data for transmission and accepts transmitted data.

DDM-1000
Lucent Technologies' Dual DS3 Multiplexer – A digital multiplexer that multiplexes DS1, DS1C, or DS2 signals into a DS3 signal or a 90 Mb/s or 180 Mb/s optical signal.

DDM-2000
Lucent Technologies SONET-ready network multiplexer that can function as a lightwave terminal. It is designed primarily for loop feeder and interoffice applications that work in existing asynchronous as well as the emerging SONET networks. Multiplexers that multiplex DS1, DS3, or EC-1 inputs into EC-1, OC-1, OC-3, or OC-12 outputs.

Default
An operation or value that the system or application assumes, unless a user makes an explicit choice.

Default Provisioning
The parameter values that are preprogrammed as shipped from the factory.

Defect
A limited interruption of the ability of an item to perform a required function. It may or may not lead to maintenance action depending on the results of additional analysis.

Demultiplexer
A device that splits a combined signal into individual signals at the receiver end of transmission.

Demultiplexing
A process applied to a multiplexed signal for recovering signals combined within it and for restoring the distinct individual channels of these signals.

Dense Wavelength Division Multiplexing (DWDM)
Transmitting two or more signals of different wavelengths simultaneously over a single fiber.

Deprovisioning
The inverse order of provisioning. To manually remove/delete a parameter that has (or parameters that have) previously been provisioned.

Digital Cross-Connect Panel (DSX)
A panel designed to interconnect equipment that operates at a designated rate. For example, a DSX-3 interconnects equipment operating at the DS3-rate.

Digital Multiplexer
Equipment that combines several digital signals into a single composite digital signal by time-division multiplexing.

Digital Signal Levels 0, 1, 3 (DS0, DS1, DS3)
An ANSI-defined signal or service level corresponding to the following: DS0 is 64 Kb/s, DS1 is 1.544 Mb/s (equivalent to T1), and DS3 is 44.736 Mb/s (equivalent to 28 T1 channels or T3).

Dimmed
The state of a control whose normal functionality is not currently available to a user (also referred to as grayed or disabled).

Directory Name
An ASCII string that fully specifies the path and the name of the target directory where the generic to be downloaded, the database to be restored, or the database to be backed up is to be found.

Directory Service Network Element (DSNE)
A designated network element that is responsible for administering a database that maps network element names (TIDs) to addresses [NSAPs (network service access points)] in an OSI subnetwork. There can be one DSNE per ring. A DSNE can also be a GNE.

Dispersion
Time-broadening of a transmitted light pulse.

Dispersion Shifted Optical Fiber
1330/1550 nm minimum dispersion wavelength.

Divergence
When there is unequal amplification of incoming wavelengths, the result is a power divergence between wavelengths.

Doping
The addition of impurities to a substance in order to attain desired properties.

Double Click
To click twice rapidly with the left mouse button. This executes the default command in the Right Click Pop-up Menu. If there is no default command, then double-clicking will have no effect.

Downstream
At or towards the destination of the considered transmission stream, for example, looking in the same direction of transmission.

Downstream Pack
Given a pack-to-pack interface, the downstream pack is the receiving pack.

Drop and Continue
A circuit configuration that provides redundant signal appearances at the outputs of two network elements in a ring. Can be used for Dual Ring Interworking (DRI) and for video distribution applications.

Drop-Down Menu
A menu that is displayed from a menu bar.

DS1 Signal
Signal with a data rate of 1.544 Mb/s.

DS3EC1/8
Port unit that provides 8 bidirectional ports at the DS3-rate or EC-1-rate.

DS3EC1 Connector Panel
The two panels on one or both sides of a Facility Interface Sub-Shelf (Universal I/O Shelf) containing DS3EC1/8 port units. The DS3EC1/8 Connector Panels provide an interface between the DS3EC1/8 port units and the backplane via BNC connectors.

DS3 Format
Specifies the line format of a DS3 interface port, such as M23 or C-bit parity.

DS3 Idle Signal
A signal that can be applied to any output port that is not cross-connected to an input port. This signal lets downstream network elements know that the facility is operating normally even though it is not sending a normal DS3 signal.

DS3 Signal
A logical or electrical B3ZS signal with a data rate of 44.736 Mb/s.

DSX-1, 2, 3
Digital cross-connect used to interconnect equipment, provide patch capability, and provide test access at the DS1, DS2, or DS3 level.

Dual Ring Interworking (DRI)
A topology in which two rings are interconnected at two nodes on each ring and operate so that inter-ring traffic is not lost in the event of a node or link failure at an interconnecting point.

E

Electrical Carrier, Level 1 (EC-1)
An electrical interface signal at the SONET rate of STS-1.

Electrical Module
One of the ways the bottom portion of a Universal I/O Shelf, the Facility Interface Sub-Shelf, may be populated. DS3EC1/8 port units are used to populate an Electrical Module.

Electromagnetic Compatibility (EMC)
A measure of equipment tolerance to external electromagnetic fields.

Electromagnetic Interference (EMI)
High-energy, electrically induced magnetic fields that cause data corruption in cables passing through the fields.

Electronic Industries Association (EIA)
A trade association of the electronic industry that establishes electrical and functional standards.

Electrostatic Discharge (ESD)
Static electrical energy potentially harmful to circuit packs and humans.

Entire System Start-Up Stage A
The amount of time from power-on reset (including system controller downloads to the individual controllers) until transmission is up. This should normally be less than 5 minutes.

Entire System Start-Up Stage B
The amount of time from power-on reset until the system is completely available for any external commands. This should normally be less than 5 minutes.

Entity
A specific piece of hardware (usually a circuit pack, slot, or module) that has been assigned a name recognized by the system.

Entity Identifier
The name used by the system to refer to a circuit pack, memory device, or communications link.

Equipment Fail (EF) State
The protection group shall enter the EF state when any of its circuit packs are in the EF state, and no higher priority request (for example, Clear, Forced Switch) is present. The protection group leaves the EF state when all EF indications are cleared, or a higher priority request is received.

Equipment Protection
Relates to the DS3 and EC-1 electrical interfaces, which are protected by 1xN equipment protection. This means that protection switching for electrical interfaces is supported at the level of the port unit (circuit pack).

Equipped (EQ)
Status of a circuit pack or interface module that is in the system database and physically in the frame, but not yet provisioned.

Erbium
A soft rare earth element used in metallurgy and nuclear research.

Erbium Doped Fiber Amplifier (EDFA)
An amplifier that performs by having a light signal pass through a section of erbium-doped fiber and using

the laser pump diode to amplify the signal.

Errored Seconds (ES)
A performance monitoring parameter. ES “type A” is a second with exactly one error; ES “type B” is a second with more than one and less than the number of errors in a severely errored second for the given signal. ES by itself means the sum of the type A and type B ESs.

Establish
A user initiated command, at the WaveStar CIT, to create an entity and its associated attributes in the absence of certain hardware.

Event
A significant change. Events in controlled Network Elements include signal failures, equipment failures, signals exceeding thresholds, and protection switch activity. When an event occurs in a controlled Network Element, the controlled Network Element will generate an alarm or status message and send it to the management system.

Event Driven
A required characteristic of a network element or software system: NEs are reactive systems, primarily viewed as systems that wait for and then handle events. Events are provided by the external interface packages, the hardware resource packages, and also by the software itself.

Exclude
A user initiated command, at the WaveStar CIT, to remove an entity from service.

Extended Superframe Format (ESF)
A T-1 format that uses the framing bit for non-intrusive signaling and control. A T-1 frame is sent 8,000 times a second, with each frame consisting of a payload of 192 bits, and with each frame preceeded by a framing bit. Because ESF only requires 2,000 framing bits for synchonization, the remaining 6,000 framing bits can be used for error detection.

Externally Timed
An operating condition of a clock in which it is locked to an external reference and is using time constants that are altered to quickly bring the local oscillator’s frequency into approximate agreement with the synchronization reference frequency.

Extract
To physically remove a circuit pack from a slot, thus causing a system initiated removal of an entity from service.

Extra traffic
Unprotected traffic that is carried over protection channels when their capacity is not used for the protection of working traffic.

F Facility

A one- or two-way circuit that carries a transmission signal.

Facility Interface Sub-Shelf

The bottom portion of a Universal I/O Shelf or an SDH Universal I/O Shelf which may be equipped, depending on the port units and circuit packs used, as a DS3EC1 Electrical, Optical, or a Mixed Module (Universal I/O Shelf) or an STM1e Electrical or Mixed Module (SDH Universal I/O Shelf).

Facility Loopback

A facility loopback is where an entire line is looped back.

Facility Roll

The disconnection of the circuit cross-connecting input tributary to an output tributary followed, within the required completion time (≤2.5 ms), by a cross-connection of an input tributary to an output tributary.

Facility/SWIF Interface Sub-Shelf

The bottom portion of a 10G I/O Shelf which may be equipped with OC192/STM64 port units and one to four pairs of SWIF packs.

Failures in Time (FIT)

Circuit pack failure rates per 109 hours as calculated using the method described in Reliability Prediction Procedure for Electronic Equipment, Telcordia Method I, Issue 5, September 1995.

Far End (FE)

Any other network element in a maintenance subnetwork other than the one the user is at or working on. Also called remote.

Far-End Block Error (FEBE)

An indication returned to the transmitting node that an errored block has been detected at the receiving node. A block is a specified grouping of bits.

Far-End Receive Failure (FERF)

An indication returned to a transmitting Network Element that the receiving Network Element has detected an incoming section failure. Also known as RDI (Remote Detect Indication).

Fault

Term used when a circuit pack has a hard (not temporary) fault and cannot perform its normal function.

Fault Management

Collecting, processing, and forwarding of autonomous messages from network elements.

Fiber Distributed Data Interface (FDDI)

Fiber interface that connects computers and distributes data among them.

File Transfer and Access Management (FTAM)
FTAM is the Open Systems Interconnection (OSI) standard for file transfer, file access, and file management.

Flash EPROM
A technology that combines the nonvolatility of EPROM with the in-circuit reprogrammability of EEPROM (electrically-erasable PROM).

Folded Rings
Folded (collapsed) rings are rings without fiber diversity. The terminology derives from the image of folding a ring into a linear segment.

Forced
Term used when a circuit pack (either working or protection) has been locked into a service-providing state by user command.

Forced Switch to Protection
The WaveStar CIT command that forces the protection group to be the "Active Unit." The clear command is required to remove the Forced Switch state. While in the Forced Switch state the system may not switch the active unit either automatically, by means of the WaveStar CIT Forced Switch, or Manual Switch command.

Forward Error Correction (FEC)
A technique used by a receiver to correct errors incurred during transmissions over a communications channel without requiring retransmission of any information by the transmitter. FEC typically involves a convolution of the transmitter using a common algorithm and embedding sufficient redundant information in the data block to allow the receiver to correct. While this technique is processor-intensive, it improves the efficiency of the network.

Frame
The smallest block of digital data being transmitted.

Frame Relay (FR)
A form of packet switching that relies on high-quality phone lines to minimize errors. It is very good at handling high-speed, bursty data over wide area networks. The frames are variable lengths and error checking is done at the end points.

Framework
An assembly of equipment units, such as a rack, that is capable of housing shelves.

Free Running
An operating condition of a clock in which its local oscillator is not locked to an internal synchronization reference and is using no storage techniques to sustain its accuracy.

FT-2000 ADR
Lucent Technologies' OC-48 rate Add/Drop Rings lightwave Terminal for 2-fiber BLSRs. It is designed primarily for interoffice applications. It supports adds, drop, and through connections for DS3/EC-1, OC-3, IS-3, and OC-12.

G

Gateway Network Element (GNE)
A network element that passes information between other network elements and management systems through a data communication network.

H

Hard Failure
An unrecoverable nonsymptomatic (primary) failure that causes signal impairment or interferes with critical network functions, such as DCC operation.

High Level Data Link Control (HDLC)
OSI reference model datalink layer protocol.

Holdover
An operating condition of a clock in which its local oscillator is not locked to an external reference but is using storage techniques to maintain its accuracy with respect to the last known frequency comparison with a synchronization reference.

Host Controller
The NSAP of the subject NE.

Hot Keys
A keyboard key or key combination that invokes a particular command.

Hot Standby
A circuit pack ready for fast, automatic placement into operation to replace an active circuit pack. It has the same signal as the service going through it, so that choice is all that is required.

Human Machine Language (MML)
A standard language developed by the ITU for describing the interaction between humans and dumb terminals.

I

Idle
An output port not cross-connected to an input port.

Idle Code
A signal transmitted downstream automatically from an idle output port. It can also be transmitted downstream by a manual command from a cross-connected output port.

Include
A user initiated command, at the WaveStar CIT, to restore an entity to service.

Individual Controller Start-Up Stage A
The amount of time from power-on reset until transmission is established for an individual controller. This should normally be less than 2.5 minutes.

Individual Controller Start-Up Stage B
The amount of time from power-on reset until the individual controller is completely available for any external commands. This should normally be less than 3 minutes.

Insert
To physically insert a circuit pack into a slot, thus causing a system-initiated restoral of an entity into service and/or creation of an entity and associated attributes.

In-Service (IS)
A memory administrative state for ports. IS refers to a port that is fully monitored and alarmed.

Integrated Transport Management Network Module (ITM NM)
Lucent Technologies' integrated network management system that provides a broad end-to-end view of the SONET network.

Integrated Transport Management SubNetwork Controller (ITM SNC)
Lucent Technologies' SONET element management layer system that provides fault, configuration, and security functions through the use of a GUI.

Interface Capacity
The total number of STS-1/STM-1 equivalents (bidirectional) tributaries in all transmission interfaces with which a given I/O Shelf can be equipped at one time. The interface capacity varies with equipage.

I/O Complex
There are two types of I/O Complexes: local and remote (future). A local I/O Complex is one or more collocated Universal I/O Bays that are electrically cabled to an associated Switch Complex. A remote I/O Complex (future) is one or more I/O Bays that are located up to 1000 cable-feet away from and optically connected (using optical remoting) to an associated Switch Complex.

J Jitter

Short term variations of amplitude and frequency components of a digital signal from their ideal position in time.

L Lead Time

The time interval between placement of a product order and receipt of the product.

Lightguide Build-Out (LBO)
An attenuating (signal-reducing) element used to keep an optical output signal strength within desired limits.

Lightguide Cross-Connect (LGX)
A SONET device that contains ports for optical fiber connections to an optical network element (NE). An LGX is used to make and change connections to an NE without changing the cabling on the NE itself.

Line
A transmission medium, together with the associated equipment, required to provide the means of transporting information between two consecutive network elements. One network element originates the line signal; the other terminates it.

Line Build Out (LBO)
An equalizer network that guarantees the proper signal level and shape at the DSX panel.

Line Controller Local Area Network (LCLAN)
The internal local area network that provides communications between the controlled circuit packs.

Line Protection
The optical interfaces can be protected by line protection. Line protection switching protects against failures of line facilities, including the interfaces at both ends of a line, the optical fibers, and any equipment between the two ends. Line protection includes protection of equipment failures.

Line Timing
Refers to a network element that derives its timing from an incoming OC-N/STM-N signal.

Link
The mapping between in-ports and out-ports. It specifies how components are connected to one another.

Literal Character
A letter, digit, or symbol that is entered in a command. The first hyphen in UNIT-{1-64} is a literal character; the braces and the second hyphen are not literal characters.

Local Area Network (LAN)
A communications network that covers a limited geographic area, is privately owned and user administered, is mostly used for internal transfer of information within a business, is normally contained within a single building or adjacent group of buildings, and transmits data at a very rapid speed.

Local I/O Complex
A local I/O Complex is one or more co-located Universal I/O Bays that are electrically cabled to an associated Switch Complex.

Location
An identifier for a specific circuit pack, interface module, interface port, or communications link.

Lockout of Protection
The WaveStar CIT command that prevents the system from switching traffic to the protection line from a working line. If the protection line is active when a "Lockout of Protection" is entered – this command causes the working line to be selected. The protection line is then locked from any Automatic, Manual, or Forced protection switches.

Lockout State
The Lockout State shall be defined for each working or protection circuit pack. The two permitted states are: None – no lockout is set for the circuit pack, Set – the circuit pack has been locked out. The values (None & Set) shall be taken independently for each working or protection circuit pack.

Logical Tributary
With regards to electrical ports and unprotected optical ports – a logical tributary is the same as the port tributary. With regards to port protection groups – a logical tributary is a path-level unit of bandwidth within a port protection group.

Loopback
Type of diagnostic test used to compare an original transmitted signal with the resulting received signal. A loopback is established when the received optical or electrical external transmission signal is sent from a port or tributary input directly back toward the output.

Loop Timing
A special case of line timing. It applies to network elements that have only one OC-N/STM-N interface. For example, terminating nodes in a linear network are loop timed.

Loss Budget
Loss (in dB) of optical power due to the span transmission medium (includes fiber loss and splice losses).

Loss of Frame (LOF)
A failure to synchronize to an incoming signal.

Loss of Pointer (LOP)
A failure to extract good data from a signal payload.

Loss of Signal (LOS)
The complete absence of an incoming signal.

M

M23-Format
A standard framing format used for DS3 signals produced by multiplexing 28 DS1s into a DS3 (sometimes referred to as M13-format, without C-bit parity).

Major
Indicates a service-affecting failure, main or unit controller failure, or power supply failure.

Maintenance Condition
An equipment state in which some normal service functions are suspended, either because of a problem or to perform special functions (copy memory) that can not be performed while normal service is being provided.

Manual Switch State
A protection group shall enter the Manual Switch State upon the initiation and successful completion of the Manual Switch command. The protection group leaves the Manual Switch state by means of the Clear or Forced Switch commands. While in the Manual Switch state the system may switch the active unit automatically if required for protection switching.

Mapping
The logical association of one set of values, such as addresses on one network, with quantities or values of another set, such as devices or addresses on another network.

Mediation Device (MD)
Allows for exchange of management information between Operations System and Network Elements.

Mid-Span Meet
The capability to interface between two lightwave network elements of different vendors. This applies to high-speed optical interfaces.

Minor (MN)
Indicates a non-service-affecting failure of equipment or facility.

Miscellaneous Discrete Interface
Allows an operations system to control and monitor equipment collocated within a set of input and output contact closures.

Mixed Module
One of the ways the bottom portion of an SDH Universal I/O Shelf or a Universal I/O Shelf, the Facility Interface Sub-Shelf, may be populated. A combination of OC48/STM16, OC12/STM4, OC3/STM1, and DS3EC1/8 port units is used to populate a Mixed Module (Universal I/O Shelf). A combination of OC48/STM16, OC12/STM4, OC3/STM1, and STM1E/4 port units is used to populate a Mixed Module (an SDH Universal I/O Shelf).

Modify
A user initiated command, at the WaveStar CIT, to modify attributes within an existing entity.

Module
Term used to designate an equipped shelf. For example, a SWIF Module is a Switch Interface Sub-Shelf that

is equipped with SWIF packs.

Multiplexer
A device (circuit pack) that combines two or more transmission signals into a combined signal on a shared medium.

Multiplexer Section Shared Protection Ring (MS-SPRing)
A ring in which protection switching is accomplished by switching working traffic into protection time slots in the line going in the opposite direction around the ring. MS-SPRings are functionally equivalent to SONET Bidirectional Line-Switched Rings (BLSRs).

Multiplexing
The process of combining multiple signals into a larger signal at the transmitter by a multiplexer. The large signal is then split into the original smaller signals at the receiver by a demultiplexer.

N

Network Element (NE)
A node in a telecommunication network that supports network transport services and is directly manageable by a management system.

Network Monitoring and Analysis (NMA)
An operations system designed by Telcordia which is used to monitor network facilities.

Network Service Access Point (NSAP) Address
Network Service Access Point Address (used in the OSI network layer 3). An automatically assigned number that uniquely identifies a Network Element for the purposes of routing DCC messages.

Node
A network element in a ring or, more generally, in any type of network. In a network element supporting interfaces to more than one ring, node refers to an interface that is in a particular ring. Node is also defined as all equipment that is controlled by one system controller. A node is not always directly manageable by a management system.

Non-Blocking Service Cross-Connection Capacity
The service cross-connection capacity that is guaranteed to the user to be free from blocking. The system architecture allows for terminating a total transmission capacity on the transmission interfaces that is in excess of the non-blocking service cross-connection capacity of the system. Only the capacity that can be terminated on the main cross-connection fabric without blocking makes up the non-blocking service cross-connection capacity.

Non-Preemptible Protection Access (NPPA)
Non-preemptible protection access increases the available span capacity for traffic which does not require protection by a ring, but which cannot be preempted.

Non-Revertive Switching

In non-revertive switching, an active and standby line exist on the network. When a protection switch occurs, the standby line is selected to support traffic, thereby becoming the active line. The original active line then becomes the standby line. This status remains in effect even when the fault clears. That is, there is no automatic switch back to the original status.

Non-Volatile Memory (NVM)

Memory that retains its stored data after power has been removed. An example of NVM would be a hard disk.

No Request State

This is the routine-operation quiet state in which no external command activities are occurring.

Not Monitored (NMON)

A provisioning state for equipment that is not monitored or alarmed.

O

On-Cable Identifier

Also known as the Physical Shelf Identifier. This is a user provisionable parameter.

One-Way Path-Protected Cross-Connection

A two-legged interconnection between two STS-N/STM-N input tributaries and one STS-N/STM-N output tributary. It consists of one path protected group with two legs, a working leg and a protection leg. The path protection group is provisioned to provide path-level protection switching for all the constituent signals carried by the cross-connection. Each leg must be at the same cross-connection rate.

One-Way Point-to-Point Cross-Connection

A one-legged interconnection, that supports one-way transmission, between an input tributary and an output tributary at a particular transmission rate (for example, STS-1/STM-1).

One-Way Roll Cross-Connection

An operation consisting of moving the INPUT of any existing leg of any cross-connection from a given tributary to a second tributary, while leaving the output unchanged. Typically, a roll is used as a tail-end switch in a facility or tributary rolling operation, whereby traffic is moved from the facility to another or from one tributary to another on the facility. The head-end side of a facility or tributary roll usually has a bridge established (in one NE) so that the traffic flows on both the old and new facilities. This serves to minimize the signal interruption time when the roll is carried out to that introduced by the roll itself (in the other NE). A roll is inherently a one-way operation, but because facilities are generally two-way, a head-end bridge/tail-end roll sequence is typically done on both directions.

Open 4-Fiber BLSR/MS-SPRing

When only two ports of the BLSR/MS-SPRing are selected, then the user can provision the two ports in either of two ways, (a) one port as the “West Working Port” and one port as “West Protection Port”, or (b) one port as the “East Working Port” and one port as “East Protection Port.” This arrangement is also

sometimes referred to as a one-sided node.

Open Ring Network
A network formed of a linear chain-shaped configuration of network elements. Each network element connects to two others, one on each side, except for two network elements at the ends which are connected on only one side. A closed ring can be formed by adding a connection between the two end nodes.

Open Systems Interconnection (OSI)
Referring to the OSI reference model, a logical structure for network operations standardized by the International Standards Organization (ISO).

Operations Interface
Any interface providing you with information on the system behavior or control. These include the equipment LEDs, user panel, WaveStar CIT, office alarms, and all telemetry interfaces.

Operations Interworking (OI)
The capability to access, operate, provision, and administer remote systems through craft interface access from any site in a SONET/SDH network or from a centralized operations system.

Operations System (OS)
A central computer-based system used to provide operations, administration, and maintenance functions.

Operations System for Intelligent Network Elements (OPS/INE)
A Telcordia configuration management operations system.

Operator
A user of the system with operator-level user privileges.

Optical Carrier 3/Synchronous Transport Module 1 (OC3/STM1)
The OC3/STM1 port unit provides a bidirectional port which is provisionable at either the OC-3- or STM-1-rate. The OC3/STM1 port unit is used in the OC3/STM1 Optical Modules and the Mixed Modules of the Facility Interface Sub-Shelf.

Optical Carrier 12/Synchronous Transport Module 4 (OC12/STM4)
The OC12/STM4 port unit provides a bidirectional port which is provisionable at either the OC-12- or STM-4-rate. The OC12/STM4 port unit is used in the OC12/STM4 Optical Modules and the Mixed Modules of the Facility Interface Sub-Shelf.

Optical Carrier 48/Synchronous Transport Module 16 (OC48/STM16)
The OC48/STM16 port unit provides a bidirectional port which is provisionable at either the OC-48- or STM-16-rate. The OC48/STM16 port unit is used in the OC48/STM16 Optical Modules and the Mixed Modules of a Facility Interface Sub-Shelf.

Optical Carrier 192/Synchronous Transport Module 64 (OC192/STM64)
The OC192/STM64 port unit provides a bidirectional port which is provisionable at either the OC-192- or STM-64-rate. The OC192/STM64 port unit is used in the OC192/STM64 Optical Module of the Facility/SWIF Interface Sub-Shelf of the 10G I/O Shelf.

Optical Carrier N (OC-N)
An optical carrier signal at the SONET rate of N, where N equals 1, 3, 12, 48, or 192. The basic rate of an OC-1 signal is 51.84 Mb/s, equivalent to an STS-1, with other values of N direct multiples of this basic rate.

Optical Channel
An OC-N/STM-N wavelength within an optical line signal. Multiple channels, differing by 1.5m in wavelength, are multiplexed into one signal.

Optical Line Signal
A multiplexed optical signal containing multiple wavelengths or channels.

Optical Module
One of the three ways the bottom portion of a Universal I/O Shelf, the Facility Interface Sub-Shelf of a Universal I/O Shelf, may be populated. Either OC48/STM16, OC12/STM4, or OC3/STM1 port units are used to populate optical modules. The Facility/SWIF Interface Sub-Shelf of a 10G I/O Shelf may be equipped with OC192/STM64 port units.

Original Value Provisioning
Preprogramming of a system's original values at the factory. These values can be overridden using local or remote provisioning.

Outage
A disruption of service that lasts for more than 1 second.

Out-of-Service
The circuit pack is not providing its normal service function (removed from either the working or protection state) either because of a system problem or because the pack has been removed from service.

P

Parameter
A variable that is given a value for a specified application. A constant, variable, or expression that is used to pass values between components.

Parity Check
Tests whether the number of ones (or zeros) in an array of binary bits is odd or even; used to determine that the received signal is the same as the transmitted signal.

Pass-Through
Paths that are cross-connected directly across an intermediate node in a network.

Path
A logical connection between the point at which a standard frame format for the signal at the given rate is assembled, and the point at which the standard frame format for the signal is disassembled.

Path Overhead (POH)
Informational bytes assigned to, and transported with the payload until the payload is demultiplexed. It provides for integrity of communication between the point of assembly of a virtual container and its point of disassembly.

Path Protection Group
The part of a cross-connection topology that is provisioned to provide path-level protection switching for all the constituent signals carried by the cross-connection. A path protection group can be identified as an entity by its logical output tributary and its cross-connection rate. A path protection group consists of one or more constituent path selectors.

Path Terminating Equipment
Network elements in which the path overhead is terminated.

Performance Monitoring (PM)
Measures the quality of service and identifies degrading or marginally operating systems (before an alarm would be generated).

Peripheral Control and Timing Facility Interface (PCTFI)
A proprietary physical link interface supporting the transport of 21x2 Mb/s signals.

Platform
A family of equipment and software configurations designed to support a particular application.

Plesiochronous Network
A network that contains multiple subnetworks, each internally synchronous and all operating at the same nominal frequency, but whose timing may be slightly different at any particular instant.

Polarization Mode Dispersion (PMD)
Output pulse broadening due to random coupling of the two polarization modes in an optical fiber.

Port (also called Line)
The physical interface, consisting of both an input and output, where an electrical or optical transmission interface is connected to the system and may be used to carry traffic between network elements. The words “port” and “line” may often be used synonymously. “Port” emphasizes the physical interface, and “line” emphasizes the interconnection. Either may be used to identify the signal being carried.

Port Protection Group
A user provisioned association of protected optical interface ports. This association is used for line protection. The group of ports represent both a protection switching entity and also a set of lines that carry

services to/from another network element. The port protection groups also determine the set of logical tributaries from and to which cross-connections can be provisioned.

Port State Provisioning
A feature that allows a user to suppress alarm reporting and performance monitoring during provisioning by supporting multiple states (automatic, in-service, and not monitored) for low-speed ports.

Port Tributary
A path-level unit of bandwidth within a port, or the constituent signal/signals being carried in this unit of bandwidth. It may generally be assumed that a port tributary is an STS-1/STM-1 tributary unless specified otherwise. For a port which is NOT in a port protection group (electrical port or unprotected group), a port tributary is the same entity as a logical tributary.

Port Unit
A transmission circuit pack that receives and transmits optical or electrical signals.

PPROC/FO
The PPROC/FO circuit pack, located in the CTL/Switch Interface Sub-Shelf of the 10G I/O Shelf, provides an interface between the OC192/STM64 port units and the SWITCH/STS768 packs.

Preprovisioning
The process by which the user specifies parameter values for an entity in advance of some of the equipment being present. These parameters are maintained only in NVM. These modifications are initiated locally or remotely by either a CIT or an OS. Preprovisioning provides for the decoupling of manual intervention tasks (for example, install circuit packs) from those tasks associated with configuring the node to provide services (for example, specifying the entities to be cross-connected).

Primary (PRI)
Designates a CTL/MEM circuit pack as the primary storage device for WaveStar BandWidth Manager.

Proactive Maintenance
Refers to the process of detecting degrading conditions not severe enough to initiate protection switching or alarming, but indicative of an impending signal failure or signal degrade defect.

Protection
Extra capacity (channels, circuit packs) in transmission equipment that is not intended to be used for service, but rather to serve as backup against equipment failures.

Protection Access
To provision traffic to be carried by protection tributaries when the port tributaries are not being used to carry the protected working traffic.

Protection AID
This shall be the port AID which has been assigned to be the protection port.

Protection Group Configuration
The members of a group and their roles, for example, working protection, line number, etc.

Protection Path
One of two signals entering a path selector used for path protection switching or dual ring interworking. The other is the working path. The designations working and protection are provisioned by the user, whereas the terms active path and standby path indicate the current protection state.

Protection Port Alarm Status
The highest alarm status associated with the protection port. Values shall be: Critical, Major, Minor, or Not Alarmed.

Protection State
When the working unit is currently considered active by the system and that it is carrying traffic. The "active unit state" specifically refers to the receive direction of operation — since protection switching is unidirectional.

Protection Tributary
A port tributary which can be used to protect the traffic carried by a working tributary in a port protection group, or a Logical Tributary that is associated with a Working Tributary within a common port protection group.

Provisioned (PROV)
Indicating that a circuit pack is ready to perform its intended function. A provisioned circuit pack can be active (ACT), in-service (IS), standby (STBY), provisioned out-of-service (POS), or out-of-service (OOS).

Provisioning
The modification of certain programmable parameters that define how the node functions with various installed entities. These modifications are initiated locally or remotely by either a CIT or an OS. They may arrive at the node via the IAO LAN, CIT port, or any DCC channel. The provisioned data is maintained in NVM and/or hardware registers.

R Radio Buttons

A standard Windows control that allows a user to select from a fixed set of mutually exclusive choices (also referred to as option buttons).

Reactive Maintenance
Refers to detecting defects/failures and clearing them.

Rearrangement
An internal roll feature that allows for removing fragmented bandwidths between shelves. The roll is an "errorless roll" between connections. The rearrangement function allows the repositioning of STS-1/ STM-1 or STS-3/STM-1 tributaries from the SWITCH/STS576 to the BSW or the HS switch. The reason

for repositioning tributaries is to make STS-1s/STM-1s contiguous, and therefore, prevent blocking situations when cross-connecting concatenated signals.

Receive-Direction
The direction towards the Network Element.

Regeneration
The process of reconstructing a digital signal to eliminate the effects of noise and distortion.

Reliability
The ability of a software system performing its required functions under stated conditions for a stated period of time. The probability for an equipment to fulfill its function. Some of the ways in which reliability is measured are: MTBF (Mean Time Between Failures) expressed in hours; Availability = (MTBF)/(MTBF+MTTR)(%) [where MTTR = mean time to restore]; outage in minutes per year; failures per hour; percentage of failures per 1,000 hours.

Remote Defect Indication (RDI)
An indication returned to a transmitting terminal that the receiving terminal has detected an incoming section failure. [Previously called far-end-receive failure (FERF).]

Remote Failure Indication (RFI)
A signal that alerts upstream path-terminating equipment that a downstream failure has been alarmed along the path. This action prevents multiple alarms from being activated for the same failure and ensures that a technician is dispatched to correct the failure. (Previously called yellow signals.)

Remote Network Element
Any Network Element that is connected to the referenced Network Element through either an electrical or optical link. It may be the adjacent node on a ring, or N nodes away from the reference. It also may be at the same physical location but is usually at another (remote) site.

Remove
A user initiated command at the WaveStar CIT to delete an entity and its associated attributes from the system.

Reservations
Allows the user the option of “reserving” any tributaries on any transmission interfaces for the following two purposes: first, to enhance cross-connection completion performance and second, to allow an OS that does not have all of the information needed to make such cross-connections. The reservation of a tributary creates a two-way connection for that tributary between the transmission interface (for example, OC48/STM16, etc.) and the interface to the main cross-connection fabric (SWIF circuit pack), but not through the main cross-connect fabric (BSW). If tributaries at both ends of a desired cross-connection have these established connections, then a subsequent request to make a cross-connection between these tributaries needs only to operate on the main cross-connect fabric, not on the main fabric plus two interface shelf fabrics.

Retrieve
A user initiated command at the WaveStar CIT to retrieve an entity state/status from the NE.

Return to Zero
A code form having two information states (termed zero and one) and having a third state or an at-rest condition to which the signal returns during each period.

Revertive
A protection switching mode in which, after a protection switch occurs, the equipment returns to the nominal configuration (that is, the working equipment is active, and the protection equipment is standby) after any failure conditions that caused a protection switch to occur, clear, or after any external switch commands are reset. (See “Non-Revertive.”)

Revertive Switching
In revertive switching, there is a working and protection high-speed line, circuit pack, etc. When a protection switch occurs, the protection line, circuit pack, etc. is selected. When the fault clears, service “reverts” to the working line.

Right Click
To select an object by pressing and releasing the right mouse button which brings up a Right Click Pop-up Menu. The default command may be brought up by double-clicking on an object with the right mouse button.

Right Click Pop-up Menu (RCPM)
A menu which is displayed at the location of a selected object; the commands contained within the RCPM are contextually relevant to that object. Users may configure mouse buttons to their preferences, so that the pop-up menu may in fact be accessed via the left mouse button. The default menu item, if any, is shown in bold.

Ring
A configuration of nodes comprised of network elements connected in a circular fashion. Under normal conditions, each node is interconnected with its neighbor and includes capacity for transmission in either direction between adjacent nodes. Path switched rings use a head-end bridge and tail-end switch. Line switched rings actively reroute traffic over the protection capacity.

Ring Side
When an optical interface is provisioned as a member of a port protection group for a specific type of protection, the port (line) is assigned a ring-side (West or East) and/or line name (working or protection) to identify its role. A 4-fiber BLSR/MS-SPRing has four lines identified by West and East ring-sides and as working and protection lines within each side. With 1+1 line protection there are two lines identified as working and protection lines. With 1xN line protection there are N+1 lines identified as working lines through N and a protection line.

Roll Cross-Connection

A user operation which results in moving the input of any existing leg of any cross-connection from a given tributary to a second tributary, while leaving the output unchanged. Typically, a roll is used as a tail-end switch in a “facility or tributary rolling” operation, whereby traffic is moved from one facility to another or from one tributary to another on a facility. The head-end side of a facility or tributary roll usually has a bridge established (in one NE) so that the traffic flows on both the old and new facilities, minimizing the signal interruption time when the roll is carried out to that introduced by the roll itself (in the other NE). A roll is inherently a one-way operation, but because facilities are generally two-way, a head-end bridge/tail-end roll sequence is typically done on both directions.

Router

An interface between two networks. While routers are like bridges, they work differently. Routers provide more functionality than bridges. For example, they can find the best route between any two networks, even if there are several different networks in between. Routers also provide network management capabilities such as load balancing, partitioning of the network, and trouble-shooting.

S

SDH I/O Bay

An SDH I/O Bay is capable of housing two SDH Universal I/O Shelves. The SDH Universal I/O Shelves are each divided into a Switch Interface Sub-Shelf and a Facility Interface Sub-Shelf.

SDH Universal I/O Shelf

An SDH Universal I/O Shelf may be housed in an SDH I/O Bay or a 10G/SDH I/O Bay. The SDH Universal I/O Shelves are each divided into a Switch Interface Sub-Shelf and a Facility Interface Sub-Shelf.

Secondary (SEC)

Designates a secondary CTL/MEM circuit pack as the secondary storage device for WaveStar BandWidth Manager.

Section

The portion of a transmission facility, including terminating points, between a terminal network element and a line-terminating network element, or two line-terminating network elements.

Section Layer

The second of the four levels in a standard SONET signal, used to transport an STS frame across a physical medium. This layer uses the photonic layer to form the physical transport.

Self-Healing

A network’s ability to automatically recover from the failure of one or more of its components.

Server

Computer in a computer network that performs dedicated main tasks which generally require sufficient performance.

Severely Errored Seconds (SES)
This performance monitoring parameter is a second in which a signal failure occurs, or more than a preset amount of coding violations (dependent on the type of signal) occur.

Service
The operational mode of a physical entity that indicates that the entity is providing service. This designation will change with each switch action.

Service Cross-Connection Capacity
The capacity that can be used for carrying service traffic. Any cross-connection capacity that is required for transmission interface protection switching is separate and does not reduce the service cross-connection capacity.

Service Preserving Reset
A reset on a controller that does not cause transmission hardware devices to be reset. Transmission service is preserved in the sense that the devices continue to operate and carry service.

Service Preserving Reset With Database Reload from NVM
A service preserving reset in which the database will be loaded from NVM into RAM and device settings will be rewritten to reflect values stored in NVM. If the values in NVM disagree with current device settings in hardware, then transmission could be impacted when new device settings are written.

Shelf View
A graphical depiction of one shelf. Selectable objects in this view are the shelf, the slots/circuit packs, and the ports.

Shortcut Key
A keyboard key or key combination that invokes a particular command. Also referred to as an accelerator key or a hot key.

Signal-to-Noise Ratio (SNR)
The relative strength of signal compared to noise.

Signal Rate
An attribute that defines the bit-rate and format of the signal. The signal rate is defined by the STS-N path-level signal bit-rate and format including the presence or absence of concatenation.

Single-Ended Operations
Provides operations support from a single location to remote Network Elements in the same SONET subnetwork. With this capability you can perform operations, administration, maintenance, and provisioning on a centralized basis. The remote Network Elements can be those that are specified for the current release.

Single-Mode Fiber (SM)
An 8-m diameter low-loss, long-span optical fiber typically operating at either 1310 nm, 1550 nm, or both.

Site Address
The unique address for a Network Element.

Slot
A physical position in a shelf for holding a circuit pack and connecting it to the backplane. This term is also used loosely to refer to the collection of ports or tributaries connected to a physical circuit pack placed in a slot.

Slot Provisioned
A slot will transition from empty to equipped when the circuit pack insertion is detected, validated, and the hardware registers are loaded. The slot remains so provisioned until the object is deprovisioned.

Software Backup
The process of saving an image of the current network element's databases, which are contained in its NVM, to a remote location. The remote location could be the WaveStar CIT or an OS.

Software Download
The process of transferring a generic (full or partial) or provisioned database from a remote entity to the target network element's memory. The remote entity may be the WaveStar CIT or an OS. The download procedure uses bulk transfer to move an uninterpreted binary file into the network element.

Software ID
Number that provides the software version information for the system.

Software Installation
The process of actually interpreting and unpacking the binary program of data, that was loaded in the NVM by a previous software download operation, and copying the constituent data items to their designated locations within the network element's memory.

Software Restore
The inverse of a Software Backup. The process of simultaneously copying the backed-up database, from the remote location, to the current network element's Primary-0 NVM and Primary-1 NVM.

Software Upgrade
A combination of the (a) software download, (b) install, and (c) commit process. An upgrade is performed when the system software is to be changed to a new release.

Span
An uninterrupted bidirectional fiber section between two network elements.

Span Growth
A type of growth in which one wavelength is added to all lines before the next wavelength is added.

Squelch Map
This map contains information for each cross-connection in a ring and indicates the source and destination nodes for the low-speed circuit that is part of the cross-connection. This information is used to prevent traffic misconnection in rings with isolated nodes or segments.

Standby
The circuit pack is in service but is not providing service functions. It is ready to be used to replace a similar circuit pack either by protection or by duplex switching.

Standby Path
One of two signals entering a constituent path selector, the standby path is the path not currently being selected.

State
The state of a circuit pack indicates whether it is defective or normal (ready for normal use).

Status
The indication of a short-term change in the system.

STM-1 Equivalent
Unit of cross-connection capacity in terms of STM-1 bandwidth units, independent of the actual mix of cross-connection rates.

STM1E/4
Port unit that provides 4 bidirectional ports at the STM-1e-rate.

STM1e Connector Panel
The two panels on one or both sides of a Facility Interface Sub-Shelf (SDH Universal I/O Shelf) containing STM1E/4 port units. The STM1e Connector Panels provide an interface between the STM1E/4 port units and the backplane via 43-type or 1.6/5.6 connectors.

STS-1E
Now referred to as EC-1. A signal typically carried by coaxial cables from one equipment location to another. The term EC-1 refers to the organization and data rate of the signal and also to the voltage template the signal must conform to and the impedances for which the voltage template is valid.

STS-1 Equivalent
Unit of cross-connection capacity in terms of STS-1 bandwidth units, independent of the actual mix of cross-connection rates.

STS-1
The basic building block logical signal in the SONET standard with a data rate of 51.84 Mb/s.

STSX-1
Digital cross-connect used to interconnect equipment, provide patch capability, and provide test access at the STS-1 level.

Subnetwork
A group of interconnected/interrelated Network Elements. The most common connotation is a synchronous network in which the Network Elements have data communications channel (DCC) connectivity.

Superframe Format (SF)
A DS1 framing format in which 24 DS0 timeslots plus a coded framing bit are are organized into a frame which is repeated 12 times to form the superframe.

Suppression
A process where service-affecting alarms that have been identified as an “effect” are not displayed to a user.

SWIF Module
A SWIF Module is a Switch Interface Sub-Shelf equipped with either one pair (96 STS-1/32 STM-1 equivalents) or two pairs (192 STS-1/64 STM-1 equivalents) of SWIF packs.

Switch Bay
A Switch Bay is equipped with a fully-equipped Switch Shelf. The spaces above and below the Switch Shelf are reserved for future features.

Switch Center (SWC)
Logical grouping of BSW switch packs, TMG/STRAT3 circuit packs and SWIEX circuit packs in a Switch Shelf. The number of these circuit packs needed for a SWC depends on the size of the switch.

Switch Complex
The 4608/1536 Switch Complex includes two Switch Bays or one Control/Switch Bay and one Switch Bay. The 9216/3072 Switch Complex includes four Switch Bays or one Control/Switch Bay and three Switch Bays. Each bay is equipped with one fully-equipped Switch Shelf.

Switch Interface (SWIF)
The SWIF circuit pack converts TXI data format into the byte-sliced format utilized by the BSW circuit pack.

Switch Interface Capacity
The service-carrying capacity STS-1/in STM-1 equivalent “Inter-Connection Links” between the transmission interface shelves and the main cross-connection fabric. Each STS-1/STM-1 equivalent of switch interface bandwidth interconnects to one STS-1/STM-1 equivalent of main fabric bandwidth (that is to say, one STS-1/STM-1 equivalent inlet and one STS-1/STM-1 equivalent outlet). The sum of all the

switch interface capacity that can be equipped in the system is equal to the non-blocking service cross-connection capacity of the system.

Switch Interface Sub-Shelf
The top portion of a Universal I/O Shelf which may be equipped, depending on the port units and circuit packs used, with either one or two pairs of SWIF circuit packs. The Switch Interface Sub-Shelf provides the interface between the transmission port units in the Facility Interface Sub-Shelf and the main switch fabric provided by the Switch Shelves.

SWITCH/DS3EC1
Port unit responsible for implementing DS3EC1/8 1x12 protection switching for up to 96 DS3 or EC-1 signals.

SWITCH/STM1E4
Port unit responsible for implementing STM1E/4 1x8 protection switching.

Switch Shelf
The Switch Shelf is located in the middle of a Switch Bay or below a System Controller Shelf in a Control/Switch Bay. A fully-equipped Switch Shelf contains 16 BSW circuit packs (for 4608/1536 switching) and two TMG and SWIEX circuit packs.

Synchronization Messaging
Synchronization messaging is used to communicate the quality of network timing, internal timing status, and timing states throughout a subnetwork.

Synchronous
The essential characteristic of time scales or signals such that their corresponding significant instances occur at precisely the same average rate, generally traceable to a single Stratum-1 source.

Synchronous Digital Hierarchy (SDH)
A hierarchical set of digital transport structures, standardized for the transport of suitable adapted payloads over transmission networks.

Synchronous Network
The synchronization of transmission systems with synchronous payloads to a master (network) clock that can be traced to a reference clock.

Synchronous Optical Network (SONET)
The North American standard for the rates and formats that defines optical signals and their constituents.

Synchronous Payload
Payloads that can be derived from a network transmission signal by removing integral numbers of bits from every frame. Therefore, no variable bit-stuffing rate adjustments are required to fit the payload in the transmission signal.

Synchronous Payload Envelope (SPE)
The combined payload and path overhead of an STS-1, STS-3c, STS-12c or STS-48c signal.

Synchronous Transport Signal (STS, STS-N)
The basic logical building block signal for SONET with a rate of 51.84 Mb/s for an STS-1 signal and a rate of N times 51.84 Mb/s for an STS-N signal.

Synchronous Transport Signal, Level N, Concatenated (STS-Nc)
A concatenated SONET payload signal at the STS-N rate, where N equals 3, 12, or 48. For example, an STS-3c signal is constructed by concatenating three STS-1 signals into a signal that uses a single path overhead, rather than three.

System Controller Bay
The bottom shelf is available to house the NCC and the middle shelf is equipped with a System Controller Shelf.

System Controller Shelf
Located in the middle shelf of the System Controller Bay or the top of a Control/Switch Bay, the System Controller Shelf houses the main controllers for WaveStar BandWidth Manager.

System View
A graphical depiction of the entire Network Element. Selectable objects in this view are the bays and shelves.

T

T1
A carrier system that transmits at the rate of 1.544 Mb/s (a DS1 signal).

T2
A carrier system that transmits at the rate of 6.312 Mbps (a DS2 signal).

T3
A carrier system that transmits at the rate of 44.736 Mbps (a DS3 signal).

Target Identifier (TID)
A provisionable parameter that is used to identify a particular Network Element within a network. It is a character string of up to 20 characters where the characters are letters, digits, or hyphens (-).

Telcordia Technologies
Telcordia Technologies (formerly Bellcore) is a well-recognized telecommunications' standards organization.

Test Access
A set of cross-connection topologies used in conjunction with a testing system to monitor and "split" signal

paths for purposes of fault isolation.

Through (or Continue) Cross-Connection
A cross-connection within a ring, where the input and output tributaries have the same tributary number but are in lines opposite each other.

Threshold-Crossing Alert (TCA)
A message type sent from a Network Element that indicates that a certain performance monitoring parameter has exceeded a specified threshold.

Through Timing
Refers to a network element that derives its transmit timing in the east direction from a received line signal in the east direction and its transmit timing in the west direction from a received line signal in the west direction.

Time Division Multiplexing (TDM)
A technique for transmitting a number of separate data, voice, and/or video signals simultaneously over one communications medium by interleaving a portion of each signal one after another.

Time Slot Assignment (TSA)
A capability that allows any tributary in a ring to be cross-connected to any tributary in any lower-rate, non-ring interface or to the same-numbered tributary in the opposite side of the ring.

Time Slot Interchange (TSI)
The ability of the user to assign cross-connections between any tributaries of any lines within a Network Element. Three types of TSI can be defined: Hairpin TSI, Interring TSI (between rings), and Intraring TSI (within rings).

Timing/Stratum 3 (TMG/STRAT3)
TMG/STRAT3 circuit pack provides a Stratum 3 clock for its shelves.

Tooltip
A standard Windows control that provides a small pop-up window that provides descriptive text (such as a label) for a control or graphic object.

Transaction Language One (TL1)
A machine-to-machine communications language that is a subset of ITU's human-machine language.

Transmit-Direction
The direction outwards from the Network Element.

Tributary
A path-level unit of bandwidth within a port, or the constituent signal(s) being carried in this unit of bandwidth, for example, an STS-1 tributary within an OC-N port.

True Wave™ Optical Fiber
Lucent Technologies' fiber generally called non-zero dispersion-shift fiber, with a controlled amount of chromatic dispersion designed for amplified systems in the 1550/1310 nm range.

Two-Way Point-to-Point Cross-Connection
A two-legged interconnection, that supports two-way transmission, between two and only two tributaries.

Two-Way Roll
The operation which moves a two-way cross-connection between tributary i and tributary j to a two-way cross-connection between the same tributary i and a new tributary k with a single user command.

U

Unavailable Seconds (UAS)
In performance monitoring, the count of seconds in which a signal is declared failed or in which 10 consecutively severely errored seconds (SES) occurred, until the time when 10 consecutive non-SES occur.

Unidirectional Path-Switched Ring (UPSR)
Path-Switched rings employ redundant fiber optic transmission facilities in a pair configuration, with one fiber transmitting in one direction (for example, East) and the backup fiber transmitting in the other direction (for example, West). If the primary ring fails, then the protection ring takes over.

Universal I/O Bay
A Universal I/O Bay is capable of housing two Universal I/O Shelves. The Universal I/O Shelves are each divided into a Switch Interface Sub-Shelf and a Facility Interface Sub-Shelf.

Universal I/O Shelf
A Universal I/O Shelf may be housed in a Universal I/O Bay or a 10G/Universal I/O Bay. The Universal I/O Shelves are each divided into a Switch Interface Sub-Shelf and a Facility Interface Sub-Shelf.

Upstream
At or towards the source of the considered transmission stream, for example, looking in the opposite direction of transmission.

Upstream Pack
Given a pack-to-pack interface, the upstream pack is the transmitting pack.

User Privilege
Permits a user must perform on the computer system on which the system software runs.

User-to-Network Interface (UNI)
The specifications for the procedures and protocols between a user and the Asynchronous Transfer Mode (ATM) network.

V

Value
A number, text string, or other menu selection associated with a parameter.

Variable
An item of data named by an identifier. Each variable has a type, such as Int or Object, and a scope.

Violation Monitor and Removal (VMR)
A provisionable mode for DS3 output that causes parity violations to be monitored and corrected before the DS3 signal is B3ZS encoded.

Virtual
Refers to artificial objects created by a computer to help the system control shared resources.

Virtual Circuit
A logical connection through a data communication (for example, X.25) network.

Virtual Tributary (VT)
A structure designed for transport and switching of sub-STS-1 payloads. There are currently four sizes: VT1.5 (1.728 Mb/s), VT2 (2.304 Mb/s), VT3 (3.456 Mb/s), and VT6 (6.912 Mb/s).

Virtual Tributary Group (VT-G)
A 9-row by 12-column structure (108 bytes) that carries one or more VTs of the same size. Seven VT groups (756 bytes) are byte interleaved with the VT-organized synchronous payload envelope.

Voice Frequency (VF) Circuit
A 64 kilobit per second digitized signal.

Volatile Memory
Type of memory that is lost if electrical power is interrupted.

VT1.5 Tributary
A SONET logical signal with a data rate of 1.728 Mbps. In the 9-row structure of the STS-1 SPE, a VT1.5 occupies three columns. VT-structured STS-1 SPEs are divided into seven VT groups. Each VT group occupies twelve columns of the 9-row structure and, for VT1.5s, contains four VTs per group.

W

Wait-to-Restore (WTR)
Applies to revertive switching operation. The protection group enters the WTR state when all Equipment Fail (EF) conditions are cleared, but the system has not yet reverted back to its working line. The protection group remains in the WTR state until the Wait-to-Restore timer completes the WTR time interval.

Wait to Restore Time (WRT)
Corresponds to the time to wait before switching back after a failure has cleared (in a revertive protection

scheme). The WRT can be between 0 and 15 minutes, in increments of one minute.

Wavelength Add/Drop (WAD)
The process of adding and dropping wavelengths to provide more efficient transmission.

Wavelength Division Multiplexing (WDM)
A means of increasing the information-carrying capacity of an optical fiber by simultaneously transmitting signals at different wavelengths.

Wavelength Interchange
The ability to change the wavelength associated with an OC-N signal into another wavelength.

WaveStar Optical Line System
Lucent Technologies' lightwave transmission system. Utilizing DWDM technology, the system combines multiple signals of different wavelengths, transmits the resulting signal over a single fiber, and then demultiplexes the signal at the receive end.

WaveStar SNMS
WaveStar SubNetwork Management System (formerly known as ITM SNC [Integrated Transport Management SubNetwork Controller]).

Wide Area Network (WAN)
A communication network that uses common-carrier provided lines and covers an extended geographical area.

Wideband Communications
Voice, data, and/or video communication at digital rates from 64 kb/s to 2 Mb/s.

Wizard
A form of user assistance that automates a task through a dialog with the user.

Working
Label attached to a physical entity. In case of revertive switching the working line or unit is the entity that is carrying service under normal operation. In case of nonrevertive switching the label has no particular meaning.

Working AID
This shall be the port AID which has been assigned to be the working port.

Working Path
One of two signals entering a constituent path selector, the working path is the path carried by the working cross-connection leg of the path protection group.

Working Port Alarm Status
The highest alarm status associated with the working port. Values are: Critical, Major, Minor, or Not Alarmed.

Working State
A working unit that is currently considered active by the system and is carrying traffic in the working state.

Working Tributary (same as "service tributary")
A Logical Tributary. A member of a Protection Group. The tributary that is currently carrying traffic, but, which can be protected.

X

X.25 Interface/Protocol
The ITU packet-switched interface standard for terminal access that specifies three protocol layers: physical, link, and packet for connection to a packet-switched data network.

X-Terminal
Workstation that can support an X-Windows interface.

Z

Zero Code Suppression
A technique used to reduce the number of consecutive zeros in a line-coded signal (B3ZS, B8ZS).

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