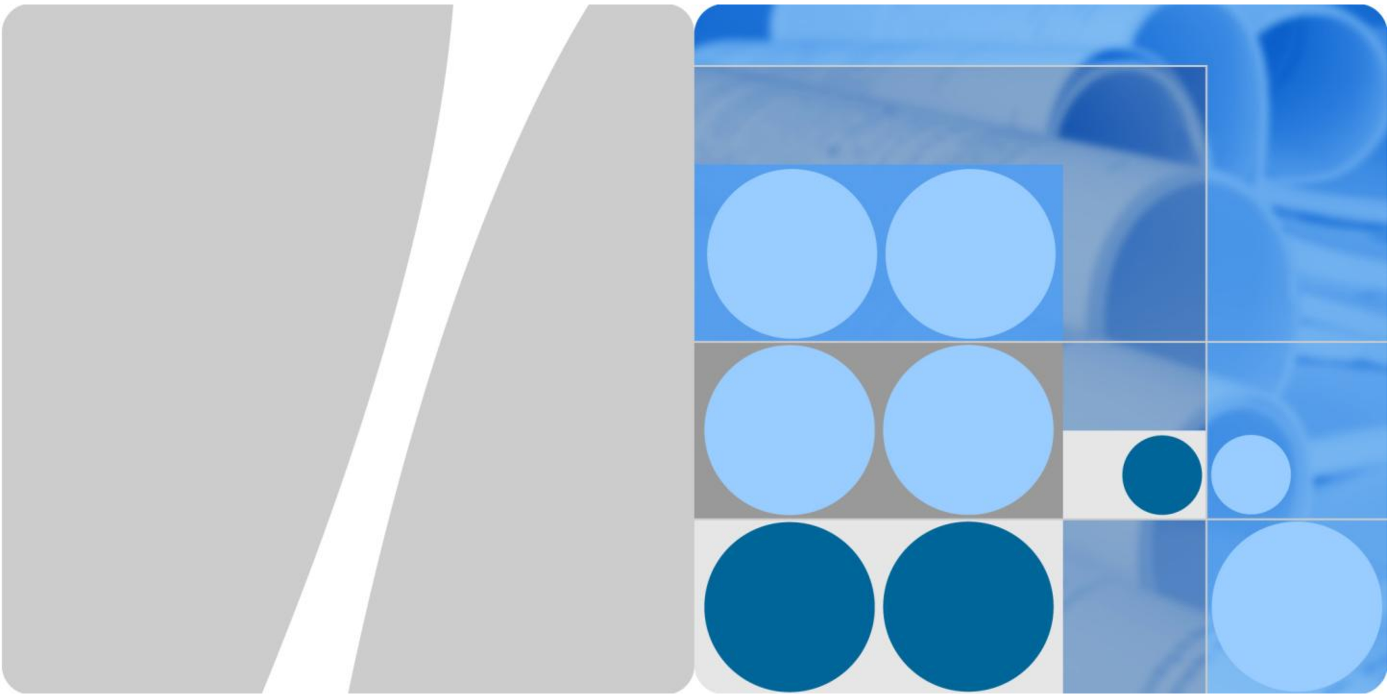

OptiX OSN 6800 Intelligent Optical Transport Platform V100R006C01

Product Overview

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HUAWEI TECHNOLOGIES CO., LTD.

Huawei Technologies Co., Ltd.

Address: Huawei Industrial Base
Bantian, Longgang
Shenzhen 518129
People's Republic of China

Website: http://www.huawei.com

Email: support@huawei.com

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1 Introduction

About This Chapter

The OptiX OSN 6800 is used for long haul backbone, area backbones, local networks, metropolitan convergence layers and metropolitan core layers.

As a one-box product (OTN+OCS), the equipment integrates functions such as WDM transport, ROADM, 40G, cross-connections of any granularity in the range of 100M to 40G, ASON, and rich management and protection.

1.1 Positioning

The OptiX OSN 6800 is used for long haul backbone, area backbones, local networks, metropolitan convergence layers and metropolitan core layers.

The OptiX OSN 6800 is for area backbones, local networks, metropolitan convergence layers and metropolitan core layers.

The OptiX OSN 6800 uses dense wavelength division multiplexing (DWDM) or coarse wavelength division multiplexing (CWDM) technologies to achieve transparent transmission with multiple services and large capacity.

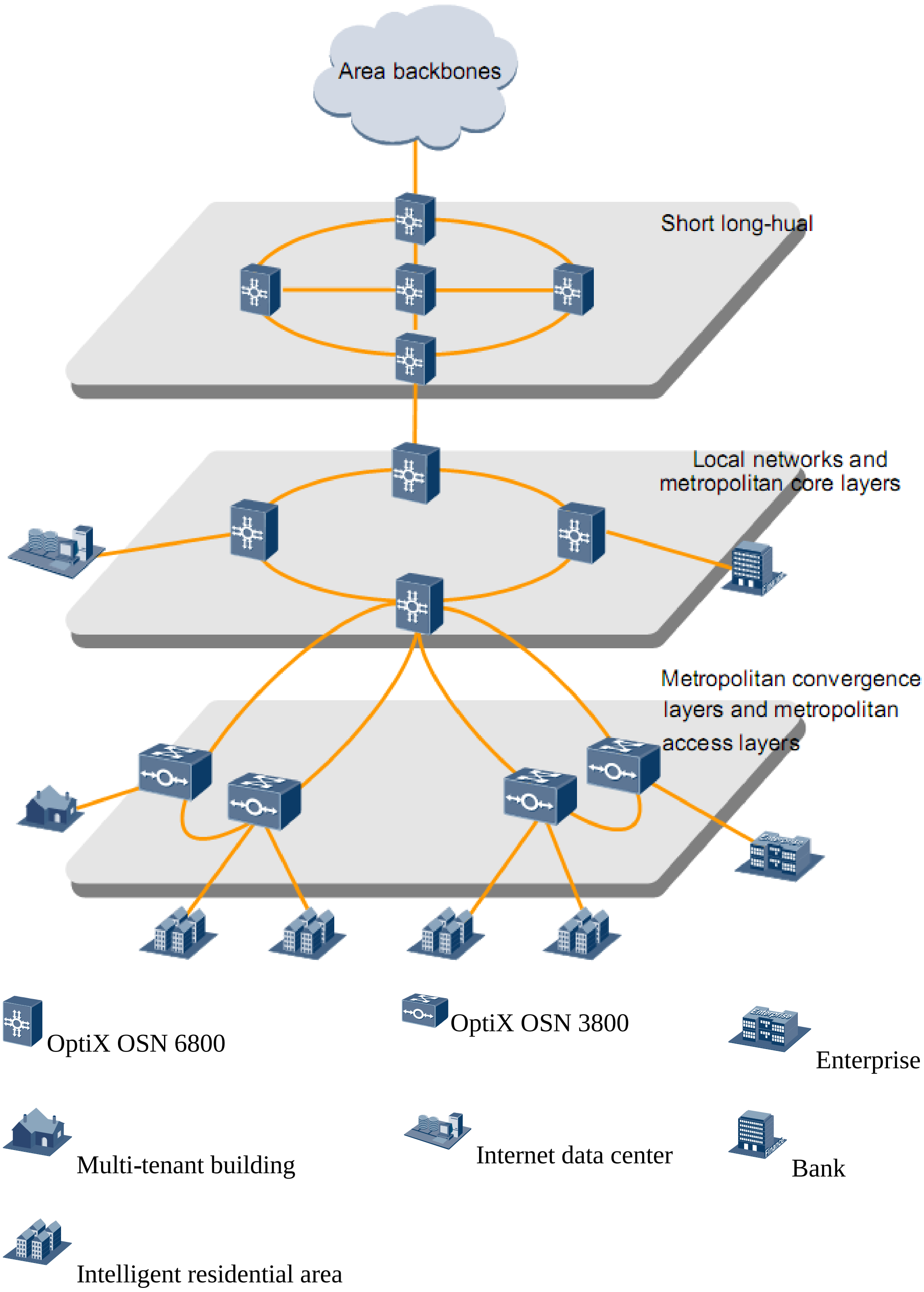
The OptiX OSN 6800 supports the following networking modes:

- Point-to-point network
- Chain network
- Ring network
- MESH network

It may also work with other WDM, SDH/SONET equipment to offer a complete Metro WDM solution.

Figure 1-1 shows the position of the OptiX OSN 6800 in the network hierarchy.

Figure 1-1 Position of the OptiX OSN 6800 in the network hierarchy



1.2 Product Features

As a one-box product (OTN+OCS), the equipment integrates functions such as WDM transport, ROADM, 40G, cross-connections of any granularity in the range of 100M to 40G, ASON, and rich management and protection.

Dynamic Optical-Layer Cross-Connections

Dynamic intra-ring grooming and inter-ring grooming can be realized using the ROADM board.

Dynamic optical layer grooming can be classified into intra-ring grooming and inter-ring grooming, or into two-dimensional grooming and multi-dimensional grooming.

Dimension refers to transmission direction. Two-dimensional grooming refers to wavelength grooming in two transmission directions. Multi-dimensional grooming refers to wavelength grooming in multiple transmission directions.

Flexible Electrical-Layer Cross-Connections

The equipment supports non-blocking electrical cross-connections, centralized cross-connections of massive services, and complex networking.

The OptiX OSN 6800 provides two types of electrical grooming.

- Integrated grooming of GE services, 10GE services, ODU1 signals and ODU2 signals
- Distributed grooming of GE services, ODU1 signals, OTU1 services and Any services

Full Service Access over Shared 10G and 40G Channels

The ODUk sub-wavelengths can be flexibly combined to share 10G/40G line bandwidth for transmission. This enables uniform carrying of any services over one wavelength and therefore improves wavelength utilization to a great extent.

Bandwidth is tailored for services. This improves the efficiency of transmission bandwidth and achieves "zero waste" of bandwidth.

Hybrid O/E Cross-Connections and Quick Service Deployment

Hybrid O/E cross-connections achieve flexible cross-connections of wavelength or sub-wavelength services. Quick service deployment helps reduce CapEx. On a flattened network, services are easy to plan, deploy, and expand. Much less time needs to be taken to provision a service.

High Reliability

The tributary/line separated structure maximizes the return on investment and reduces the number of spare parts. When service type changes, users only need to replace the tributary boards but fully reuse the existing line boards. The use of independent line and tributary boards reduces the number and type of spare parts from N x M to N + M (N, M > 2), thereby helping operators reduce construction costs.

Rich OAM, Easy Maintenance, and Lower OpEx

The rich O/E overhead information on OTN equipment leads to a more transparent network, facilitates fault identification, and helps reduce maintenance costs.

The PRBS function enables quick self-check of OTUs, quick assessment of channel performance, and quick fault identification.

The "5A" auto-adjustment function:

- Automatic level control (ALC) function effectively resolves the problem of attenuation of fibers operating over a long term.
- Automatic gain control (AGC) enables adaptation to transient changes in the number of wavelengths.
- Automatic power equilibrium (APE) enables auto-optimization of OSNR specification of each channel.
- Intelligent power adjustment (IPA) avoids personal injuries (to eyes or bodies) resulting from laser radiation in case of anomalies such as a fiber cut.
- The optical power adjust (OPA) is made to ensure that the input power of the OTU board and OA board meet the commissioning requirements.

Support monitor channel power, central wavelength, OSNR, and overall optical spectrum, and also supports remote real-time measurement of optical spectrum parameters.

2 Product Architecture

About This Chapter

The OptiX OSN 6800 system uses the L0 + L1 + L2 architecture. Ethernet switching is implemented on Layer 2, GE/10GE/ODUk/Any switching on Layer 1, and wavelength switching on Layer 0.

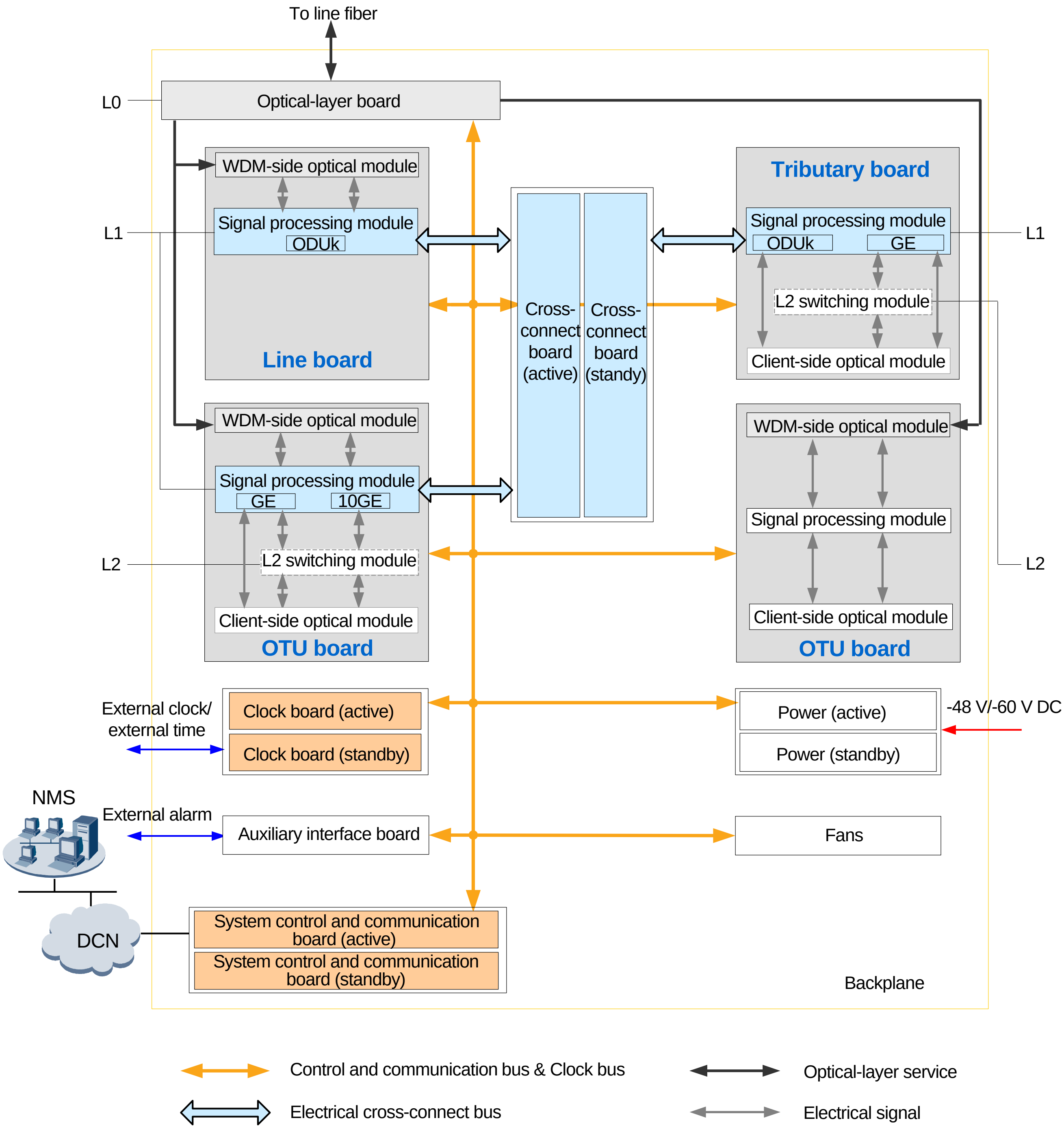
The system software includes the board software, NE software and the network management system.

2.1 System Architecture

The OptiX OSN 6800 system uses the L0 + L1 + L2 architecture. Ethernet switching is implemented on Layer 2, GE/10GE/ODUk/Any switching on Layer 1, and wavelength switching on Layer 0.

Figure 2-1 show the system architecture of the OptiX OSN 6800.

Figure 2-1 System architecture of the OptiX OSN 6800



Functions of modules are as follows:

- Optical-layer boards are classified into optical multiplexer and demultiplexer boards, optical add/drop multiplexing (OADM) boards, optical amplifier (OA) boards, optical supervisory channel (OSC) boards, optical spectrum analysis boards, optical variable attenuator boards, and optical power and dispersion equalization boards. These boards are intended to process optical-layer services, for example, to cross-connect wavelengths at the optical layer.

- Electrical-layer boards such as OTU, tributary, and line boards are used to process electrical-layer signals, and perform conversion between optical and electrical signals.
- For OptiX OSN 6800, OTU boards and tributary board have the L2 processing capabilities, and they can add, strip, and exchange VLAN tags, learn MAC addresses, and forward packets.
- As the control center of the entire system, the system control and communication (SCC) board cooperates with the network management system (NMS) to manage boards in the system and to implement inter-subrack communication.
- The clock board provides system clock signals and frame header signals to each service board, and synchronizes the local system time with the upstream system time, achieving clock and time synchronization.
- The power supply and fan systems with a redundancy protection design ensure highly-reliable equipment operation.
- The auxiliary interface board provides functional ports such as clock/time input/output ports, management serial port, alarm output and cascading ports, and alarm input/output ports.
- Inter-board communication and service cross-connections, clock synchronization, and power supplies are implemented using the backplane buses. Backplane buses include control and communication buses, clock buses, and power buses.

2.2 Hardware Architecture

2.2.1 Cabinet

In typical configuration, the OptiX OSN 6800 is installed in N63B cabinet.

The OptiX OSN 6800 has subracks are the basic working units. The subrack of the OptiX OSN 6800 has independent power supply and can be installed in N63B cabinet, or N66B cabinet.

N63B Cabinet Structure

The N63B is an ETSI middle-column cabinet with 300 mm depth, complying with the ETS 300-119 standard.

The following subracks can be installed on the N63B cabinet: OptiX OSN , OptiX OSN and OptiX OSN 6800.

The N63B cabinet consists of the rack (main frame), open-close type front door, rear panel fixed by screws, and side panels at the left and right sides.

Cabinet doors and side panels can be disassembled. The front door and side panels have grounding points. Keys to the front door of all N63B cabinets are the same.

Figure 2-2 shows the appearance of the N63B cabinet.

Figure 2-2 N63B cabinet appearance

Configuration of the Integrated N63B Cabinet

Typical configuration of the N63B cabinet involves settings of the following items: the subrack type, the number of subracks, DCM and CRPC frames, and the PDU model.

Table 2-1 lists the typical configurations of the N63B cabinet.

NOTE

There are two types of ETSI 300 mm rear-column cabinets: T63B and N63B. These two types of cabinets differ in color and door. You can perform an expansion installation on the T63B cabinet based on the typical configurations of the N63B cabinet.

Table 2-1 Typical configurations of the N63B cabinet

Typical Configuration	Number of Subracks and Frames	PDU Model	Circuit Breaker [a]	Maximum Power Consumption of Integrated Equipment [b]	Power Consumption for the Typical Configuration
1	2 x OptiX OSN 8800 T32	TN16	Eight 63 A circuit breakers	5400 W	< 4000 W
2	1 x OptiX OSN 8800 T32 + 2 x OptiX OSN 6800 + 2 x DCM frame	TN16	Four 63 A and four 32 A circuit breakers	5400 W	< 4000 W
3	1 x OptiX OSN 8800 T32 + 2 x OptiX OSN 8800 T16 + 1 x DCM frame	TN16	Eight 63 A circuit breakers	5000 W	< 4000 W
4	4 x OptiX OSN 8800 T16 + 1 x DCM frame	TN16	Eight 63 A circuit breakers	5000 W	< 4000 W
5	3 x OptiX OSN 8800 T16 +1 x OptiX OSN 6800 + 2 x DCM frame	TN16	Six 63 A and two 32 A circuit breakers	5000 W	< 4000 W
6	2 x OptiX OSN 8800 T16 + 2 x OptiX OSN 6800 + 2 x DCM frame	TN16	Four 63 A and four 32 A circuit breakers	5000 W	< 4000 W
7	1 x OptiX OSN 8800 T16 + 3 x OptiX OSN 6800 + 2 x DCM frame	TN16	Two 63 A and six 32 A circuit breakers	5000 W	< 4000 W
8	4 x OptiX OSN 6800 + 1 x DCM frame	TN11	Four 63 A circuit breakers	4800 W	< 4000 W
9	3 x OptiX OSN 6800 + 2 x CRPC frame + 3 x DCM frame	TN11	Four 63 A circuit breakers	4800 W	< 4000 W

Typical Configuration	Number of Subracks and Frames	PDU Model	Circuit Breaker [a]	Maximum Power Consumption of Integrated Equipment [b]	Power Consumption for the Typical Configuration

a: This column lists the number of circuit breakers required on the PDF.

b: The maximum power consumption of the integrated equipment refers to the maximum power consumption of the cabinet or the maximum heat dissipation capacity of the integrated equipment. The power consumption of the integrated equipment can not exceed the maximum power consumption.

NOTE

In the case of transmission equipment, power consumption is generally transformed into heat consumption. Hence, heat consumption (BTU/h) and power consumption (W) can be converted to each other in the formula: Heat consumption (BTU/h) = Power consumption (W) / 0.2931 (Wh).

Power consumption for the typical configuration refers to the average power consumption of the device in normal scenarios. The maximum power consumption refers to the maximum power consumption of the device under extreme conditions.

N66B Cabinet Structure

The N66B is an ETSI middle-column cabinet with 600 mm depth, complying with the ETS 300-119 standard.

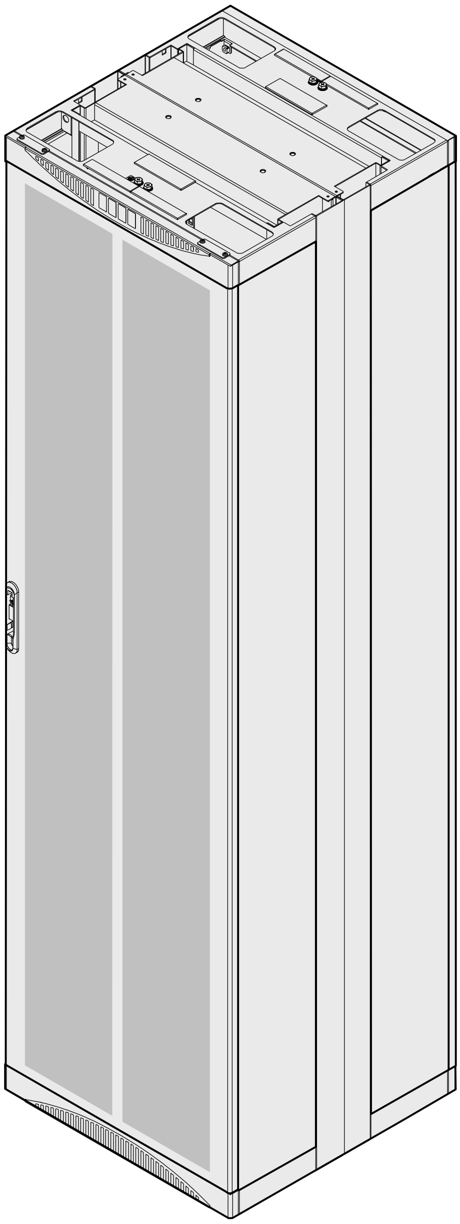
The following subracks can be installed on the N66B cabinet: OptiX OSN , OptiX OSN , OptiX OSN , and OptiX OSN 6800.

The N66B cabinet consists of the rack (main frame), open-close type front and rear doors, and side panels at the left and right sides.

Cabinet doors and side panels can be disassembled. The front door and side panels have grounding points. Keys to the front and rear doors of all N63B cabinets are the same.

Figure 2-3 shows the appearance of the N66B cabinet.

Figure 2-3 N66B cabinet appearance



Configuration of the Integrated N66B Cabinet

Typical configuration of the N66B cabinet involves settings of the following items: the subrack type, the number of subracks, DCM and CRPC frames, and the PDU model.

Table 2-2 lists the typical configurations of the N66B cabinet.

Table 2-2 Typical configurations of the N66B cabinet

Typical Configuration	Number of Subracks and Frames	PDU Mode	Circuit Breaker [a]	Maximum Power Consumption of Integrated Equipment [b]	Power Consumption for the Typical Configuration
1	1 x OptiX OSN 8800 T64 + 2 x OptiX OSN 8800 T32 + 2 x DCM frame	TN16	Sixteen 63 A circuit breakers	10800 W	< 6000 W
2	1 x OptiX OSN 8800 T64 + 4 x OptiX OSN 6800 + 4 x DCM frame	TN16	Eight 63 A and eight 32 A circuit breakers	10800 W	< 6000 W
3	1 x OptiX OSN 8800 T64 + 4 x OptiX OSN 8800 T16 + 2 x DCM frame	TN16	Sixteen 63 A circuit breakers	10000 W	< 6000 W

a: This column lists the number of circuit breakers required on the PDF.

b: The maximum power consumption of the integrated equipment refers to the maximum power consumption of the cabinet or the maximum heat dissipation capacity of the integrated equipment. The power consumption of the integrated equipment do not exceed the maximum power consumption.

NOTE

In the case of transmission equipment, power consumption is generally transformed into heat consumption. Hence, heat consumption (BTU/h) and power consumption (W) can be converted to each other in the formula: Heat consumption (BTU/h) = Power consumption (W) / 0.2931 (Wh).

Power consumption for the typical configuration refers to the average power consumption of the device in normal scenarios. The maximum power consumption refers to the maximum power consumption of the device under extreme conditions.

2.2.2 Subrack

The OptiX OSN 6800 takes subracks as the basic working units.

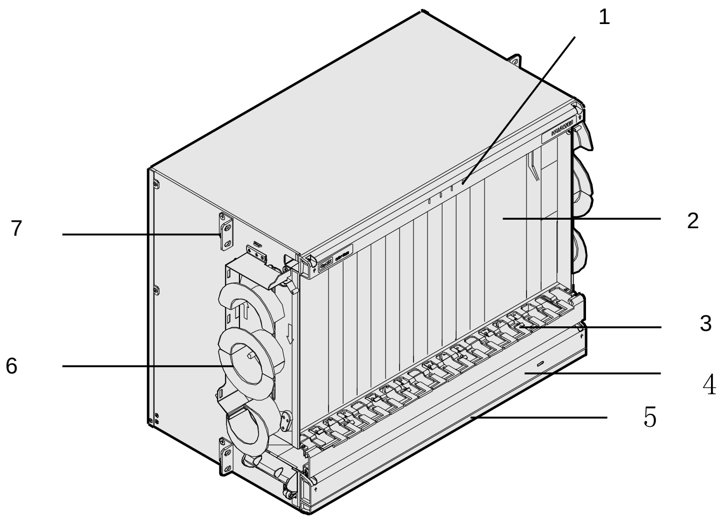
Subracks should be installed in the cabinet with 50 mm spacing above and below to allow airing. The DC power distribution box in the cabinet supply power to the subrack, and the subracks has independent power supply.

Structure

Subracks are the basic working units of the OptiX OSN 6800. The subrack of the OptiX OSN 6800 has an independent power supply.

Figure 2-4 shows the structure of the subrack.

Figure 2-4 OptiX OSN 6800 subrack structure diagram



1. Indicator	2. Board area	3. Fiber cabling area
4. Fan tray assembly	5. Air filter	6. Fiber spool
7. Mounting ear		

NOTE

The interface area is behind the indicator panel in the upper part of the subrack. Remove the indicator panel before you connect cables.

- Indicators: indicate the running status and alarm status of the subrack.
- Board area: All service boards are installed in this area. 21 slots are available.
- Fiber cabling area: Fiber jumpers from the ports on the front panel of each board are routed to the fiber cabling area before being routed on a side of the open rack. The mechanical VOA is also installed in this area.
- Fan tray assembly: Fan tray assembly contains ten fans that provide ventilation and heat dissipation for the subrack.
- Air filter: The air filter protects the subrack from dust in the air and requires periodic cleaning.
- Fiber spool: Fixed fiber spools are on two sides of the subrack. Extra fibers are coiled in the fiber spool on the open rack side before being routed to another subrack.
- Mounting ears: The mounting ears attach the subrack in the cabinet.
- Interface area: The interface area provides functional interfaces, such as management interface, inter-subrack communication interface, alarm output and cascading interface, alarm input and output interface. It is behind the subrack indicator panel.

Table 2-3 Mechanical specifications of the OptiX OSN 6800

Item	Specification
Dimensions	497 mm (W) x 295 mm (D) x 400 mm (H) (19.6 in. (W) × 11.6 in. (D) × 15.7 in. (H))
Weight (empty subrack[a])	13 kg (28.6 lb.)

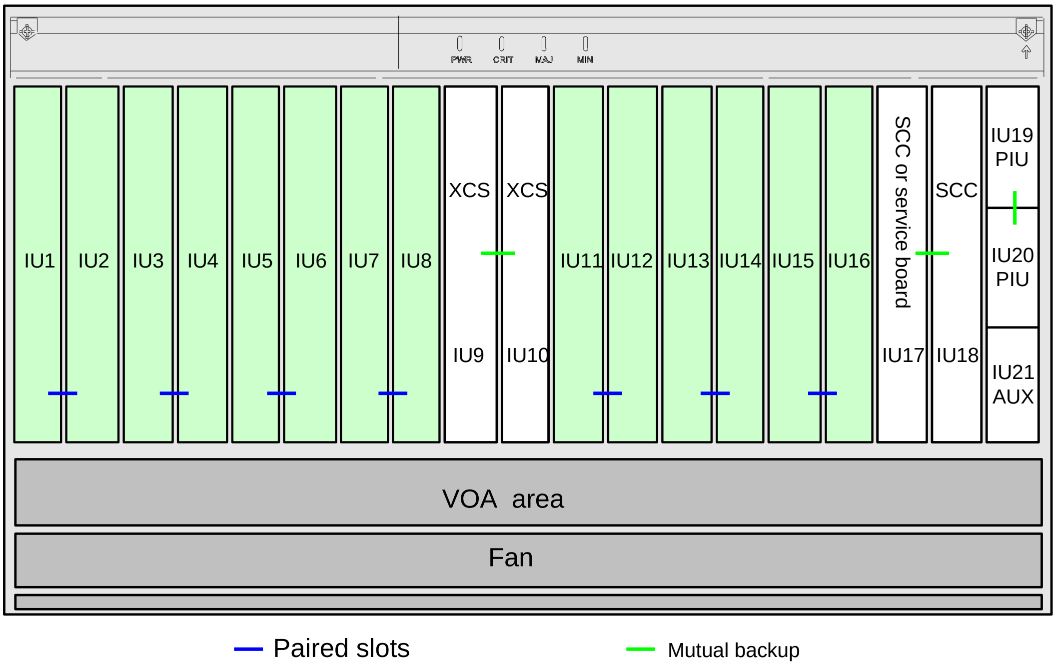
Item	Specification
a: An empty subrack means no boards are installed in the board area, and no fan tray assembly or air filter is installed.	

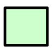
Slot Description

The board area of the subrack has 21 slots, labeled IU1 to IU21 from left to right.

Slots of the subrack are shown in Figure 2-5.

Figure 2-5 Slots of the subrack



- : houses service boards and supports service cross-connections.
- IU15 and IU16 are also available for the STG.
- Pair slots refer to a pair of slots whose resident boards' overhead can be processed by the buses on the backplanes. For the two boards in the paired slots, the inter-board cross-connection can be directly configured, and the cross-connect grooming of services can be achieved without the cross-connect board. The pair slots support distributed grooming.

2.2.3 Board

Function Boards

There are many types of functional boards, such as optical transponder boards and optical multiplexer/demultiplexer boards.

The boards can be divided into several functional boards, as shown in Table 2-4.

Table 2-4 Functional boards

Functional boards	Boards
Optical transponder board	ECOM, L4G, LDGD, LDGS, LDMD, LDX, LEM24, LEX4, LDMS, LDM, LQG, LQM, LQMD, LQMS, LSX, LSQ, LSXR, LWX2, LWXD, LWXS, LOG, LOM, LSXL, LSXLR, LOA,TMX
Tributary board	TBE, TDG, TDX, TQS, TQM, TOM, TOG, TQX, TSXL
Line board	NS2, ND2, NQ2, NS3
PID board	PTQX, ELQX, BMD4, BMD8
Optical multiplexer/demultiplexer board	FIU, D40, D40V, M40, M40V, ITL, SFIU
Fixed optical add/drop multiplexer board	CMR2, CMR4, DMR1, MR2, MR4, MR8, MR8V, SBM2
Reconfigurable optical add and drop multiplexer board	RMU9, RDU9, ROAM, WSD9, WSM9, WSMD2, WSMD9, WSMD4
Optical amplifier board	CRPC, HBA ,OAU1, OBU1, OBU2, DAS1
Cross-connect unit and system and communication unit	AUX, SCC, XCS
Optical supervisory channel (OSC) board	SC1, SC2, HSC1, ST2
Clock board	STG
Optical protection board	DCP, OLP, SCS
Spectrum analyzer board	MCA4, MCA8, OPM8, WMU
Variable optical attenuator board	VA1, VA4
Optical power and dispersion equalizing board	DCU, GFU, TDC

2.2.4 Small Form-Factor Pluggable (SFP) Module

There are four types of pluggable optical modules: the enhanced small form-factor pluggable (eSFP), the small form-factor pluggable plus (SFP+), the tunable 10 Gbit/s small form-factor pluggable (TXFP) and the 10 Gbit/s small form-factor pluggable (XFP). Because they are pluggable, when you need to adjust the type of accessed services or replace a faulty optical module, you can directly replace it without replacing its dominant board.

2.3 Software Architecture

The system software includes the board software, NE software and the network management system.

2.3.1 Overview

The system software is of a modular design. Each module provides specific functions and works with the other modules.

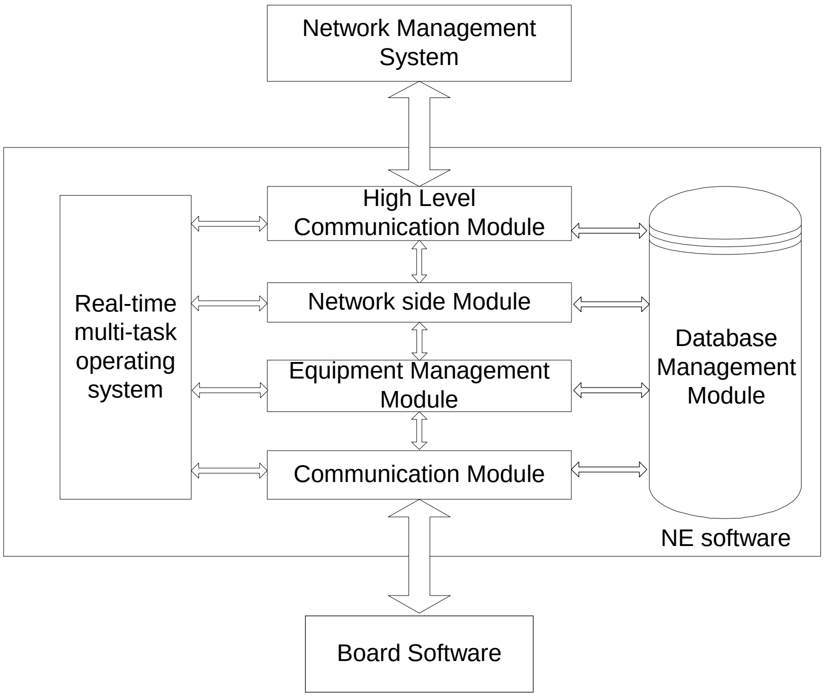
The entire software is distributed in three modules including board software, NE software and NM system.

The system software is designed with a hierarchical structure. Each layer performs specific functions and provides service for the upper layer.

The system software architecture is shown in Figure 2-6.

In the diagram, all the modules are NE software except the "Network Management System" and "Board Software" modules.

Figure 2-6 Software architecture



2.3.2 Communication Protocols and Interfaces

The Qx interface is used for communication. Complete protocol stack and messages of the Qx interface are described in ITU-T G.773, Q.811 and Q.812.

The Qx interface is mainly used to connect the mediation device (MD), Q adaptation (QA) and NE (NE) equipment with the operating system (OS) through local communication network (LCN).

At present, QA is provided by the NE management layer. MD and OS are provided by the NM layer. They are connected to each other through the Qx interface.

According to the Recommendations, the Qx interface provided by the system is developed on the basis of TCP/IP connectionless network layer service (CLNS1) protocol stack.

In addition, to support remote access of the NM through Modem, the IP layer uses serial line internet protocol (SLIP).

3 Functions and Features

About This Chapter

The OptiX OSN 6800 supports synchronous digital hierarchy (SDH) service, synchronous optical network (SONET), Ethernet service, storage area network (SAN) service, optical transmission network (OTN) service, video service and others.

The OptiX OSN 6800 provides two types of electrical grooming.

The OptiX OSN 6800 provides various types of equipment-level protection and network-level protection.

The OptiX OSN 6800 supports the Ethernet features and mainly supports the following Ethernet services: EPL, EVPL (QinQ), and EPLAN.

The optical power management includes IPA, IPA of Raman System, ALC, APE , EAPE, OPA and AGC.

This chapter describes the WDM technologies and functions implemented on the OptiX OSN 6800.

OptiX OSN 6800 supports the physical layer clock and PTP clock to realize the synchronization of the clock and the time.

An automatically switched optical network (ASON) is a new-generation optical transmission network.

3.1 Service Access

The OptiX OSN 6800 supports synchronous digital hierarchy (SDH) service, synchronous optical network (SONET), Ethernet service, storage area network (SAN) service, optical transmission network (OTN) service, video service and others.

3.1.1 Service Types

The OptiX OSN 6800 supports synchronous digital hierarchy (SDH) services, synchronous optical network (SONET) services, Ethernet services, storage area network (SAN) services, optical transmission network (OTN) services, and video services.

Table 3-1 lists the service types and rates that the OptiX OSN 6800 supports.

Table 3-1 Service types and rates that the OptiX OSN 6800 supports

Service Category	Service Type	Service Rate	Reference Standard
SDH	STM-1	155.52 Mbit/s	ITU-T G.707 ITU-T G.691 ITU-T G.957 ITU-T G.693 ITU-T G.783 ITU-T G.825
	STM-4	622.08 Mbit/s	
	STM-16	2.5 Gbit/s	
	STM-64	9.95 Gbit/s	
	STM-256	39.81 Gbit/s	
SONET	OC-3	155.52 Mbit/s	GR-253-CORE GR-1377-CORE ANSI T1.105
	OC-12	622.08 Mbit/s	
	OC-48	2.5 Gbit/s	
	OC-192	9.95 Gbit/s	
	OC-768	39.81 Gbit/s	
Ethernet service	FE	125 Mbit/s	IEEE 802.3u
	GE	1.25 Gbit/s	IEEE 802.3z
	10GE WAN	9.95 Gbit/s	IEEE 802.3ae
	10GE LAN	10.31 Gbit/s	
SAN service	ESCON	200 Mbit/s	ANSI X3.296 ANSI X3.230 ANSI X3.303
	FICON	1.06 Gbit/s	
	FICON Express	2.12 Gbit/s	
	FC100	1.06 Gbit/s	
	FC200	2.12 Gbit/s	
	FC400	4.25 Gbit/s	
	FC800	8.5 Gbit/s	

Service Category	Service Type	Service Rate	Reference Standard
	FC1200	10.51 Gbit/s	
	FICON4G	4.25 Gbit/s	
	FICON8G	8.5 Gbit/s	
	ISC 1G	1.06 Gbit/s	IBM GDPS(Geographically Dispersed Parallel Sysplex) Protocol
	ISC 2G	2.12 Gbit/s	
	ETR	16 Mbit/s	
	CLO	16 Mbit/s	
	InfiniBand 2.5G	2.5 Gbit/s	InfiniBand TM Architecture Release 1.2.1
	InfiniBand 5G	5 Gbit/s	
	FDDI	125 Mbit/s	ISO 9314
OTN service	OTU1	2.67 Gbit/s	ITU-T G.709 ITU-T G.959.1
	OTU2	10.71 Gbit/s	
	OTU2e	11.10 Gbit/s	
	OTU3	43.02 Gbit/s	
Video service	HD-SDI	1.485 Gbit/s	SMPTE 292M
	DVB-ASI	270 Mbit/s	EN 50083-9
	SDI	270 Mbit/s	SMPTE 259M
	3G-SDI	2.97 Gbit/s	SMPTE 424M

3.1.2 Capability of Service Access

The capability of service access is listed in Table 3-2.

Table 3-2 Capability of service access

Service Type	Maximum of Service Amount for a Board	Maximum of Service Amount for a Subrack
FE	22	132
GE	22	132
10GE LAN	4	30
10GE WAN	4	30
STM-256/OC-768	1	8

Service Type	Maximum of Service Amount for a Board	Maximum of Service Amount for a Subrack
STM-64/OC-192	4	34
STM-16/OC-48	4	68
STM-4/OC-12	8	88
STM-1/OC-3	8	96
OTU1	4	68
OTU2	2	34
OTU2e	2	34
OTU3	1	17
ESCON	8	96
FC100/FICON	8	72
FC200/FICON Express	4	36
FC400/FICON 4G	2	14
FC800/FICON 8G	1	17
FC1200	1	17
HD-SDI	8	136
FDDI	8	136
DVB-ASI/SDI	8	136
3G-SDI	8	136
ISC 1G	8	136
ISC 2G	4	68
ETR	1	17
CLO	1	17
InfiniBand 2.5G	4	68
InfiniBand 5G	2	34

3.2 Electrical Layer Grooming

The OptiX OSN 6800 provides two types of electrical grooming.

- Integrated grooming of GE services, 10GE services, ODU1 signals and ODU2 signals
- Distributed grooming of GE services, ODU1 signals and Any services

If the boards support centralized and distributed cross-connections, and they are housed in paired slots, use distributed grooming with precedence.

3.2.1 Integrated Grooming

The OptiX OSN 6800 implements integrated grooming using cross-connect boards. As shown in Figure 3-1, when an XCS board is in the subrack, the XCS board can realize full cross connection among the 14 slots of IU1-IU8 and IU11-IU16.

The OptiX OSN 6800 supports integrated grooming of GE services, 10GE services, ODU1 signals or ODU2 signals by the XCS board:

- It supports a maximum of 180 Gbit/s cross grooming capacity of GE services.
- It supports a maximum of 360 Gbit/s cross grooming capacity of 10GE services.
- It supports a maximum of 360 Gbit/s cross-connect capacity of ODU1 signals.
- It supports a maximum of 360 Gbit/s cross-connect capacity of ODU2 signals.

Figure 3-1 Slots in the OptiX OSN 6800

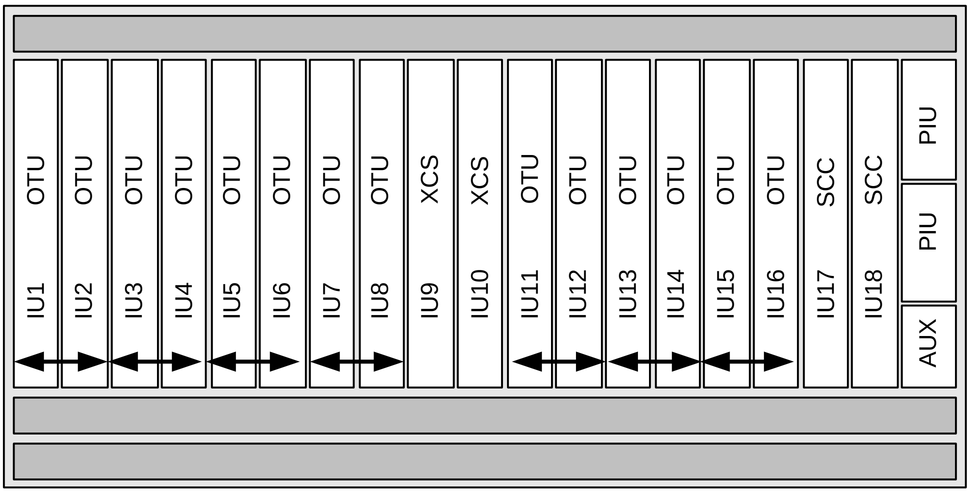


Table 3-3 lists the services supported by the OTU board integrated grooming.

Table 3-3 Services supported by the OTU board integrated grooming

Board	Integrated Grooming
TN11ECOM	GE services
TN11LOG TN12LOG	GE services
TN11L4G	GE services
TN11LDGS TN11LDGD	GE services
LEM24	10GE services

Board	Integrated Grooming
LEX4	10GE services
TN13LQM	GE services
TN11LQMD TN11LQMS	GE services
TN12LQMD TN12LQMS	GE services
TN11LQG	GE services
TN11ND2 TN12ND2 TN52ND2 TN53ND2	ODU1 signals ODU2 signals ODU2e signals
TN51NQ2 TN52NQ2 TN53NQ2	ODU1 signals ODU2 signals ODU2e signals
TN11NS2	ODU1 signals
TN12NS2 TN52NS2 TN53NS2	ODU1 signals ODU2 signals ODU2e signals
TN11NS3 TN52NS3	ODU2 signals ODU2e signals
TN11TBE	GE services
TN11TDG	GE services ODU1 signals
TN11TDX	ODU1 signals
TN12TDX TN52TDX TN53TDX	ODU2 signals ODU2e signals
TN11TQS	ODU1 signals
TN11TQM	ODU1 signals
TN12TQM	ODU1 signals
TN11TQX TN52TQX TN55TQX	ODU2 signals ODU2e signals
TN11TOM	GE services

Board	Integrated Grooming
	ODU1 signals
TN52TOM	ODU1 signals
TN52TOG	ODU1 signals
TN11TSXL	ODU2 signals ODU3 signals

3.2.2 Distributed Grooming

The OptiX OSN 6800 implements distributed grooming based on buses between paired slots. Therefore, distributed cross-connections are also referred as paired cross-connections.

The OptiX OSN 6800 supports seven pair slots: IU1 and IU2, IU3 and IU4, IU5 and IU6, IU7 and IU8, IU11 and IU12, IU13 and IU14, IU15 and IU16. The paired slots support distributed grooming except IU9 and IU10 which is shown in Table 3-4.

Table 3-4 lists the distributed grooming supported by the OTU.

Table 3-4 Services supported by the OTU board distributed grooming.

Board	Distributed Grooming
TN11ECOM	GE services
TN11LOG TN12LOG	GE services
TN11L4G	GE services
TN11LDGS TN11LDGD	GE services
TN11LQG	GE services
TN13LQM	GE services Any services
TN11LQMS TN11LQMD	GE services Any services
TN12LQMS TN12LQMD	GE services Any services
TN11NS2	ODU1 signals
TN11TBE	GE services
TN11TDG	GE services ODU1 signals
TN11TDX	ODU1 signals

Board	Distributed Grooming
TN11TQS	ODU1 signals
TN11TQM	GE services ODU1 signals Any services
TN12TQM	GE services ODU1 signals Any services
TN11TOM	GE services ODU1 signals Any services
TN52TOM	GE services Any services

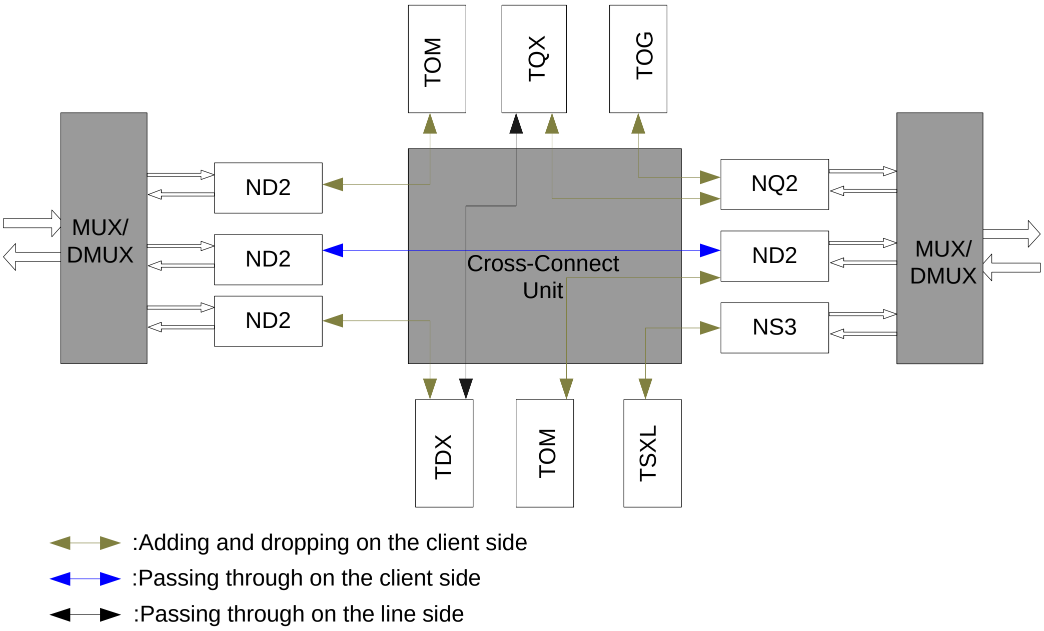
3.2.3 Application Scenario

The following three typical applications are supported by electrical grooming.

- Passing through on the client side: The services are input from a client-side port of the local station and are output through another client-side port. The services are not transmitted through the fiber line.
- Adding and dropping on the client side: The services of the other stations are transmitted through the fiber to a WDM-side port of the local station, and are output through a client-side port, or the client services are input from the local station and are transmitted to the other station through the fiber.
- Passing through on the line side: The services are not added or dropped at the local station. The local station functions as a regeneration station and sends the services from one side of the fiber line to the other side.

The application of electrical layer grooming is shown in Figure 3-2.

Figure 3-2 Application of electrical layer grooming



3.3 Optical Layer Grooming

Distribution solutions of medium wavelength resource of WDM equipment are as follows:

- Fixed optical add/drop multiplexer (FOADM)
- Reconfigurable optical add/drop multiplexer (ROADM)

The FOADM solution cannot adjust the distribution of wavelength resource according to the service development.

The ROADM solution realizes reconfiguration of wavelengths by blocking or cross-connecting of wavelengths. This ensures that the static distribution of the wavelength resource is flexible and dynamic. ROADM with U2000 can remotely and dynamically adjust the status of wavelength adding/dropping and passing through. A maximum of 80 wavelengths can be adjusted.

In the case where one link, fiber or dimension fails in the ROADM solution, other links, fibers and dimensions remain unaffected. This is attributed to three factors: gain locking of optical amplifiers, service separation and wavelength blocking of the ROADM solution.

The ROADM solution has the following advantages:

3.4 Transmission System

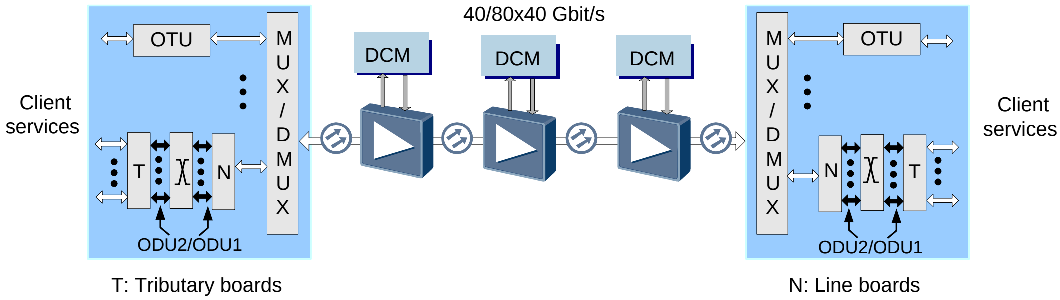
3.4.1 40 Gbit/s

The OptiX OSN 6800 provides a 40/80 x 40 Gbit/s transmission solution.

- 40 Gbit/s non-coherent transmission solution

Figure 3-3 shows the a typical application of the 40 Gbit/s non-coherent transmission solution.

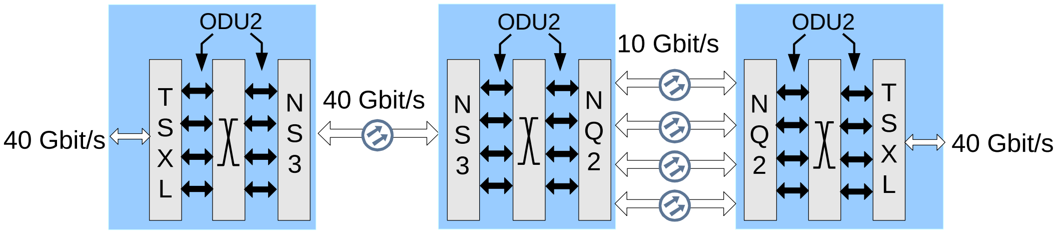
Figure 3-3 Typical application of the 40 Gbit/s transmission solution



- 40 Gbit/s inverse multiplexing solution

  In an OptiX OSN 6800 system, 40 Gbit/s services can be transmitted over a 10 Gbit/s network, as shown in Figure 3-4.

Figure 3-4 Transmission of 40 Gbit/s services over a 10 Gbit/s network

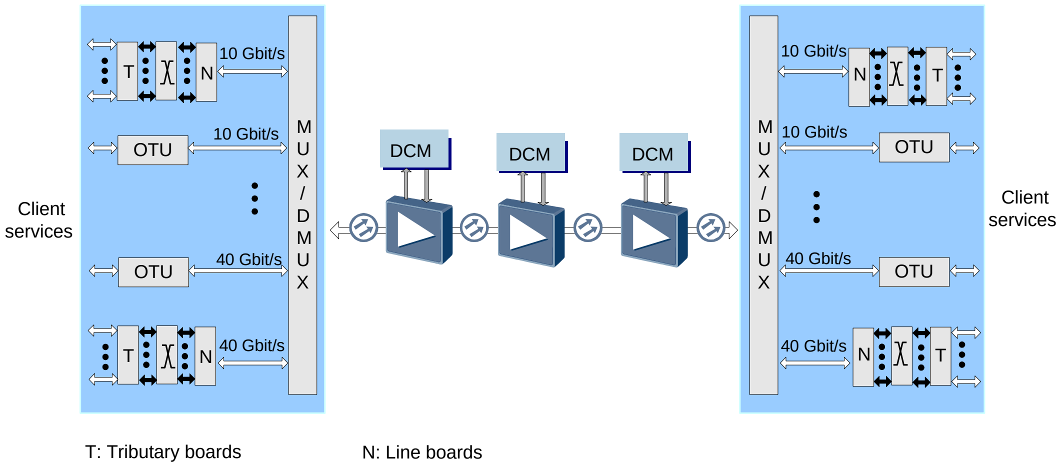


3.4.2 10 Gbit/s, 40 Gbit/s, 100 Gbit/s Hybrid Transmission

With the emergence of service requirements, the existing 10 Gbit/s WDM transmission system may be gradually upgraded to the 40 Gbit/s transmission system. When this occurs, the hybrid transmission of the 40 Gbit/s and 10 Gbit/s signals becomes very important.

The OptiX OSN 6800 supports hybrid transmission of 10 Gbit/s signals, 40 Gbit/s non-coherent signals, 40 Gbit/s coherent signals, and 100 Gbit/s coherent signals, and any of their combinations. Thanks to this feature, the incumbent networks can be upgraded to ones with larger capacity based on proper system designs of system performance parameters, protecting operators' investments while addressing the increasing bandwidth demands. Figure 3-5 shows hybrid transmission of 100 Gbit/s, 40 Gbit/s, and 10 Gbit/s signals.

Figure 3-5 Hybrid transmission of 40 Gbit/s and 10 Gbit/s signals in the non-coherent system



3.4.3 Transmission Distance

- For 40 Gbit/s rate in 40-wavelength system, supports a maximum of 20 x 22 dB transmission without electrical regenerator.
- For 40 Gbit/s rate in 80-wavelength system, supports a maximum of 18 x 22 dB transmission without electrical regenerator.
- For 10 Gbit/s rate in 40-wavelength system, supports a maximum of 32 x 22 dB transmission without electrical regenerator.
- For 10 Gbit/s rate in 80-wavelength system, supports a maximum of 25 x 22 dB transmission without electrical regenerator.
- For 2.5 Gbit/s rate, supports a maximum of 25 x 22 dB transmission without electrical regenerator.
- For 10 Gbit/s rate system, supports a maximum of 1 x 82 dB single-span ultra long-distance transmission.
- For CWDM systems, supports a maximum of 80 km transmission distance.

Huawei OSN series WDM equipment supports various links or spans based on different modulation schemes for systems with diversified channel spacing.

Table 3-5 2.5 Gbit/s system span

Channel Spacing	Modulation Scheme	22 dB Span
100 GHz	NRZ	25 x 22 dB

Table 3-6 10 Gbit/s system span

Channel Spacing	Modulation Scheme	22 dB Span
100 GHz	DRZ	32 x 22 dB
	NRZ	27 x 22 dB

Channel Spacing	Modulation Scheme	22 dB Span
	NRZ (XFP)	27 x 22 dB
50 GHz	DRZ	25 x 22 dB
	NRZ	22 x 22 dB
	NRZ (XFP)	22 x 22 dB

Table 3-7 40 Gbit/s system span

Channel Spacing	Modulation Scheme	22 dB Span
100 GHz	DQPSK	20 x 22 dB
50 GHz	ODB	8 x 22 dB
	DQPSK	18 x 22 dB

3.5 Protection

The OptiX OSN 6800 provides various types of equipment-level protection and network-level protection.

3.5.1 Equipment Level Protection

The OptiX OSN 6800 provides cross-connect board 1+1 protection, inter-subrack communication protection, SCC board 1+1 protection, DC input protection, redundancy protection for fans and centralized power protection.

Cross-Connect Board 1+1 Protection

The XCS adopts 1+1 backup.

Service boards receive signals and process overheads. Then, the boards transmit the signals to the active and the standby XCSs. The active and the standby XCSs send the data after cross-connection to service boards. Service boards select the data from the XCSs. Configuration of the active XCS is the same as the configuration of the standby XCS. The two boards are independent of each other. Forcible switching can be performed between the two XCS boards without affecting the existing services.

The cross matrix of the active XCS is the same the cross matrix of the standby XCS. When the standby XCS receives information about abnormal active XCS or when the NM system issues a switching command, the standby XCS takes over the work from the active XCS, sets itself to be in working status, and reports a switching event.

There are two types of switching for the 1+1 protection switching of XCSs:

- Automatic switching

When the service boards detect the abnormal status of XCSs or buses, a switching is performed. The switching does not need to be performed manually.

- Manual switching

  When a switching is required in a test during the normal running of the active and the standby XCSs, the switching can be performed manually.

NOTE

When a switching occurs between the cross-connect boards, a switching also occurs between the clock boards.

SCC Board 1+1 Protection

The SCC adopts 1+1 backup.

The service boards receive signals and process overheads. Then, the boards transmit the overheads to both the active and the standby SCCs. The active and the standby SCCs send the data after overhead processing to service boards. The service boards select the data according to the status of SCCs. Configuration of the active SCC is the same as the configuration of the standby SCC. The two boards are independent of each other.

The communication between SCCs and other boards is performed mainly through Ethernet. When the status is normal, the data on service boards and the standby SCC is from the active SCC. There is no inter-board communication between the standby SCC and service boards. Only when the standby SCC is in the working mode, it has inter-board communication with other boards.

When the active SCC is in normal status, the standby SCC is in backup status. When the standby SCC receives information about abnormal active SCC or when the NM system issues a switching command, the standby SCC takes over the work from the active SCC, sets itself to be in working status, and reports a switching event.

There are two types of switching for the 1+1 protection switching of SCCs:

- Automatic switching

  The SCC detects its own status through hardware or software. If it is in the abnormal status, a switching is performed automatically. The switching is performed by the board and no manual operation is required.

- Manual switching

  When a switching is required in a test during the normal running of the active and the standby SCCs, the switching can be performed manually.

DC Input Protection

The power supply system supports two -48 V/-60V DC power inputs for mutual backup. Therefore, the equipment remains normal when any of the two DC inputs is faulty.

Centralized Power Protection

The system performs distributed power supply and integrated protection on the secondary power of the optical boards in the main optical path.

The system control and communication (SCC) board contains power backup unit (PBU) and can provide 1:N power backup for the system. The system uses the SCC board to provide integrated power protection and secondary power backup upon the +3.3 V power supply of the optical boards in the main optical path in every subrack.

When the system detects a power fault (overvoltage or undervoltage) in the optical boards in the main optical path, the PBU begins to supply power within 600μs to ensure that the board works normally.

CAUTION

- The PBU supports power supply switching of one board. The working power supply is off when there is overvoltage and switches to the PBU. The working power supply remains on when there is undervoltage and switches to the PBU.
- When a board with a faulty power module is inserted in the system, it obtains power supply from the PBU and affects the normal working of the board that is protected by the PBU. Therefore, ensure that the board inserted in the system has a normal power module.

Redundancy Protection for Fans

In the OptiX OSN 6800 system, each subrack is divided into five partitions in terms of heat dissipation. The speed of fans in each partition is regulated independently. When one of the fans is faulty, the other fan in the partition runs at its full speeds.

Inter-Subrack Communication Protection

Subracks of an NE can be cascaded in various modes. When subracks are cascaded to form a ring, the NE provides working and protection Ethernet communication channels for communication between the master and slave subracks. In this case, when the working channel is faulty, services are switched to the protection channel, achieving protection for inter-subrack communication.

3.5.2 Network Level Protection

The OptiX OSN 6800 protects a network in the following ways:

- Optical line protection system
- Optical channel protection
  - Intra-board 1+1 protection
  - Client-side 1+1 protection
- Subnetwork connection protection (SNCP)
  - Sub-wavelength SNCP (SW SNCP)
  - ODUk SNCP
  - VLAN SNCP
  - Tributary SNCP
  - Master Slave SNCP (MS SNCP)
- ODUk SPRing protection
- Optical wavelength shared protection (OWSP)
- Ethernet protection
  - Board-level protection
  - Ethernet ring protection (ERPS)

- Link aggregation group (LAG)
- Distributed link aggregation group (DLAG)
- Distribute board protect system (DBPS)
- Spanning tree protocol (STP) or rapid spanning tree protocol (RSTP)
- Multiple spanning tree protocol (MSTP)
- Link state pass through (LPT)

The security and survivability of a network can be further enhanced through an automatic switched optical network (ASON), which is generally referred to as intelligent optical network.

As a main networking mode of ASON, mesh features high flexibility and scalability. On a mesh network, to make the interrupted services available, you can immediately restore the services through the rerouting mechanism in addition to the traditional protection scheme such as 1+1 protection and shared protection scheme such as ODUk SPRing. That is, the mesh network can support traditional protection schemes, dynamic restoration of services, and service restoration mechanisms in case of protection failures. In this manner, services are not interrupted if the resources are available.

The network level protection classifications are listed in Table 3-8.

Table 3-8 Service protection classifications

Category	Sub-Category	Description
Optical line protection	Optical line protection	It uses the dual fed and selective receiving function of the OLP board to protect line fibers between adjacent stations by using diverse routing.
Optical channel protection	Client-side 1+1 protection	It uses the dual fed and selective receiving function of the OLP/DCP/SCS board to protect the OTU and the OCh fibers.
	Intra-board 1+1 protection	It uses the dual fed and selective receiving function of the OTU/OLP/DCP board to protect the OCh fibers by using diverse routing.
SNCP	SW SNCP protection	It uses the dual fed and selective receiving function of the electrical layer grooming to protect the line board and the OCh fibers. The cross-connect granularity is GE services or Any services.
	ODUk SNCP protection	It uses the dual fed and selective receiving function of the electrical layer grooming to protect the line board and the OCh fibers. The cross-connect granularity is ODU1 signals and ODU2 signals.
	VLAN SNCP protection	It uses the dual fed and selective receiving function of L2 module to protect the Ethernet service. The protection granularity is the service with VLAN.
	Tributary SNCP	Protects the tributary service by using the dual-fed and selectively-receiving function at the electrical cross-connect layer. The cross-connect granularity is ODU1 signals and ODU2 signals.

Category	Sub-Category	Description
	MS SNCP	Protects the TBE board in conjunction with the inter-subrack or inter-NE DBPS protection. The protected services include 10GE services or GE services.
ODUk SPRing protection	ODUk SPRing protection	It applies to the ring network with distributed services. This protection uses two different ODU1 or ODU2 channels to achieve the protection of multiple services between all stations.
OWSP	OWSP	It applies to the ring networks. This protection uses two different wavelengths to achieve the protection of one wavelength of service between all stations.
Ethernet protection	DLAG	Protects the TBE board. The protected services include 10GE services and GE services.
	Board-level protection	It is used to protect all services of the TBE board.
	DBPS protection	Protects the Ethernet board in conjunction with the SW SNCP or MS SNCP or ERPS. The protected services include 10GE services or GE services.
	Ethernet ring protection switching (ERPS)	This protection type is based on the traditional Ethernet mechanism and uses the ring network automatic protection switching (R-APS) protocol to realize quick protection switching in the Ethernet ring network.
	STP/RSTP	When the STP or RSTP is started, it logically modifies the network topology to avoid a broadcast storm. The STP or RSTP provides link protection by restructuring the topology.
	MSTP	In the case of the Ethernet user network where loops exist, the MSTP generates the tree topology according to VLAN IDs of the Ethernet packets. Thus, the broadcast storm is avoided and the network traffic is balanced according to the VLAN IDs of the Ethernet packets.
	LAG	In this protection mode, multiple links that are connected to the same equipment are bundled together to increase the bandwidth and improve link reliability.
	LPT	The link-state pass through (LPT) is used to detect and report the faults that occur at the service access node and in the intermediate transmission network. The LPT notifies the equipment at two ends in the transmission network of starting the backup network at the earliest time for communication, thus making sure the normal transmission of the important data.

Category	Sub-Category	Description
ASON protection	Optical-layer ASON	Protects services of OCh wavelength level.
	Electrical-layer ASON	Protects services of ODUk wavelength level.

3.6 Data Characteristics

The OptiX OSN 6800 supports the Ethernet features and mainly supports the following Ethernet services: EPL, EVPL (QinQ), and EPLAN.

3.6.1 OAM

The OptiX OSN 6800 provides rich OAM functions to monitor services, detect faults, and identify faults at each service layer.

ETH-OAM

ETH-OAM improves the Ethernet Layer 2 maintenance method and provides powerful maintenance functions for service connectivity verification, deployment commissioning, and network fault location.

The ETH-OAM is a protocol based on the MAC layer. It checks Ethernet links by transmitting OAM protocol packets. The protocol is independent from the transmission medium. The OAM packets are processed only at the MAC layer, having no impact on other layers on the Ethernet. In addition, as a low-rate protocol, the ETH-OAM protocol occupies low bandwidth. Therefore, this protocol does not affect services carried on the link.

Comparison between ETH-OAM and the maintenance and fault locating method on the existing network:

- The current frame test method is based on only the encapsulation format where the same type of data is contained. This test method is not applicable to other encapsulation formats (such as GFP encapsulation format and HDLC encapsulation format) where different types of data is contained.
- The current port loopback function focuses on all packets at the port. The loopback cannot be performed for a specific service selectively.
- ETH-OAM can detect hardware faults.
- ETH-OAM can detect and locate faults automatically.

Huawei Ethernet service processing boards realize the ETH-OAM function that complies with IEEE 802.1ag and IEEE 802.3ah. The combination of IEEE 802.1ag and IEEE 802.3ah provides a complete Ethernet OAM solution.

The IEEE 802.1ag OAM function can be achieved through the continuity test, loopback test, link trace test, and OAM_Ping test.

- The link trace (LT) test is used to locate the faulty point.
- The loopback (LB) is used to test the link state bidirectionally.

- The continuity check (CC) is used to test the link state unidirectionally.
- The OMA_Ping test is used to test the in-service packet loss ratio and hold-off time.

IEEE 802.3ah OAM is realized through the OAM auto-discovery, link performance detection, fault locating, remote loopback, self-loop test, and loop port shutdown.

- The OAM auto-discovery is used to check whether the opposite end supports the IEEE 802.3ah OAM protocol.
- The link performance monitoring is used to monitor the BER performance.
- The fault detection is used to detect faults and inform the opposite end of the detected faults.
- The remote loopback is used to locate fault test the link performance.
- The self-loop test is used to test the self-loop ports.
- The loop port shutdown is used to block self-loop ports to solve the port loop problems.

RMON

Remote monitoring (RMON) is intended to monitor performance of Ethernet ports (ports and VCTRUNK) and collect performance data for fault detection and performance reporting.

RMON supports Ethernet statistics groups and history Ethernet groups as follows:

- Ethernet statistics group: supports real-time statistics and query of packet length and packet status at an Ethernet port.
- History Ethernet group: supports statistics and query of history performance data such as packet length and packet status at an Ethernet port. This enables a user to query the history statistics data at an Ethernet port in a given period.

Test Frame

Test frames are data packets used to test connectivity of a network that carries Ethernet services. Test frames are mainly used to commission Ethernet services during deployment and identify faults of Ethernet services.

Test frames can be encapsulated in GFP packets. The test frames on interconnected boards must be encapsulated in the same format.

- GFP packets: GFP management frame format. The packets are sent along the same path as GFP management frames.

3.7 Optical Power Management

The optical power management includes IPA, IPA of Raman System, ALC, APE , EAPE, OPA and AGC.

With the IPA, IPA of Raman System, ALC, APE, EAPE, OPA and AGC functions, the WDM equipment of Huawei OSN series provides optical power equalization of all channels, groups of channels and a particular channel.

3.8 WDM Technologies

This chapter describes the WDM technologies and functions implemented on the OptiX OSN 6800.

3.8.1 DWDM and CWDM Technical Specifications

The OptiX OSN 6800 supports two wavelength division multiplexing technologies: dense wavelength division multiplexing (DWDM) and coarse wavelength division multiplexing (CWDM) technologies. This section describes the technical specifications and transmission capacity of the product using the two technologies.

There are no limits for wavelengths transmitted over G.652, G.654, and G.655 fibers used with the OptiX OSN 6800. To realize 40-wavelength transmission, the wavelengths transmitted over G.653 fiber should be within 196.05 THz to 194.1 THz.

- DWDM includes 40-wavelength system and 80-wavelength system. The wavelengths are in the C band compliant with ITU-T G.694.1.
  - Each C-band 40-wavelength system with a channel spacing of 100 GHz can transmit a maximum of 40 wavelengths. It supports services of 2.5 Gbit/s, 5 Gbit/s, 10 Gbit/s and 40 Gbit/s.
  - Each C-band 80-wavelength system with a channel spacing of 50 GHz can transmit a maximum of 80 wavelengths. It supports services of 10 Gbit/s and 40 Gbit/s.
  - C-band 80-wavelength systems consist of even and odd wavelengths. The information about odd and even wavelengths is provided below:
  - C_EVEN: indicates even-numbered wavelengths. In total there are 40 even wavelengths. The center frequency of the even wavelengths is within the range of 192.100 THz to 196.000 THz (center wavelength is within the range of 1529.55 nm to 1560.61 nm) and the frequency spacing is 100 GHz.
  - C_ODD: indicates odd-numbered wavelengths. In total there are 40 odd wavelengths. The center frequency of the odd wavelengths is within the range of 192.150 THz to 196.050 THz (center wavelength is within the range of 1529.16 nm to 1560.20 nm) and the frequency spacing is 100 GHz.
  - The 40-wavelength system can be upgraded to the 80-wavelength system smoothly.
- CWDM with a channel spacing of 20 nm can access up to eight wavelengths. It applies to services rated at 2.5 Gbit/s and 5 Gbit/s. The wavelengths are in the C band compliant with ITU-T G.694.2.

DWDM wavelengths can be transported in the window of CWDM 1531 nm to 1551 nm to expand the CWDM system capacity. Figure 3-6 shows the expansion of wavelength allocation. With this expansion scheme, a CWDM system can transmit a maximum of 26 DWDM wavelengths at 100 GHz channel spacing. If the DWDM wavelength is 50 GHz in channel spacing, a CWDM system can transmit a maximum of 50 DWDM wavelengths.

Figure 3-6 DWDM wavelength expansion and allocation in the CWDM system

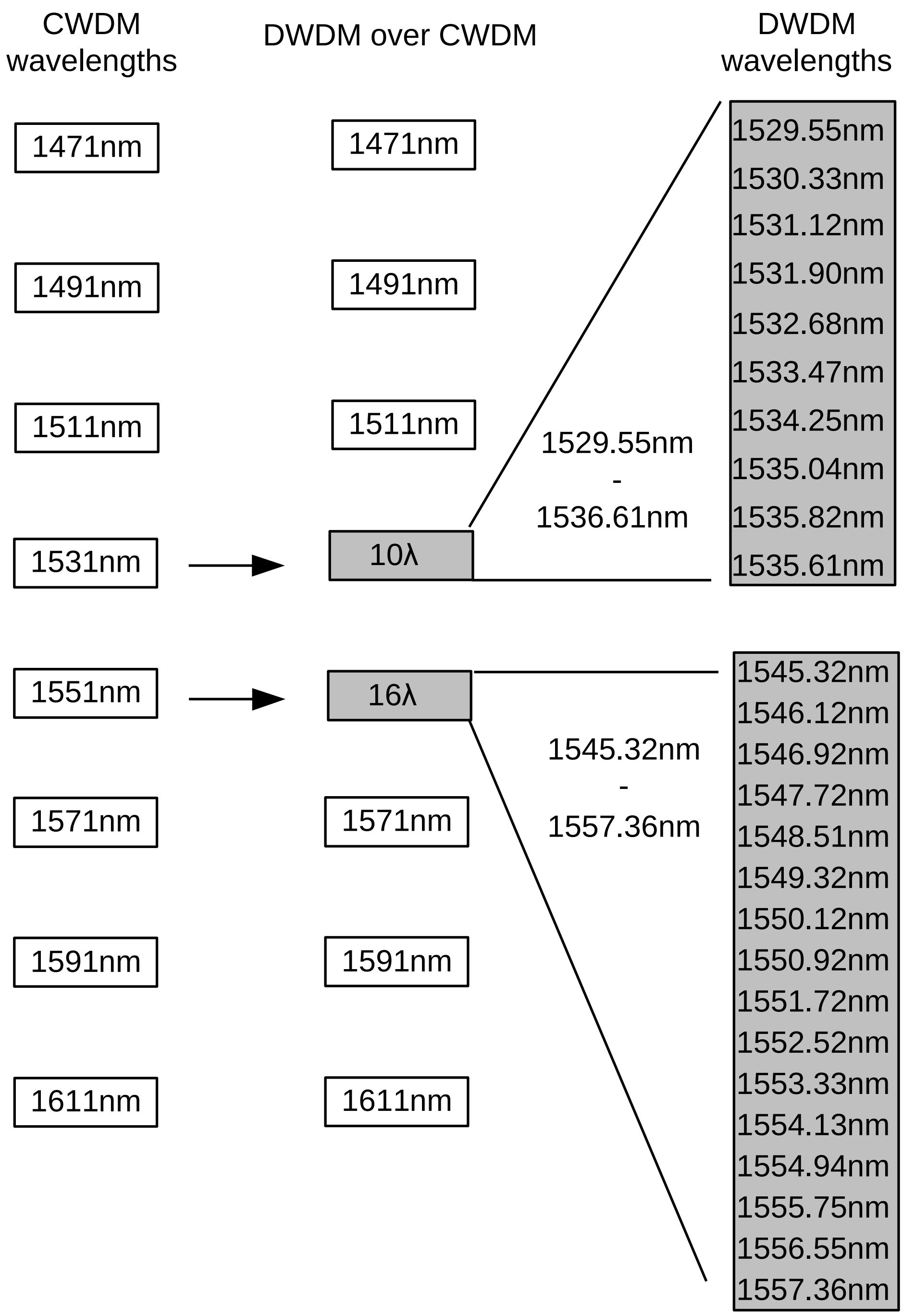
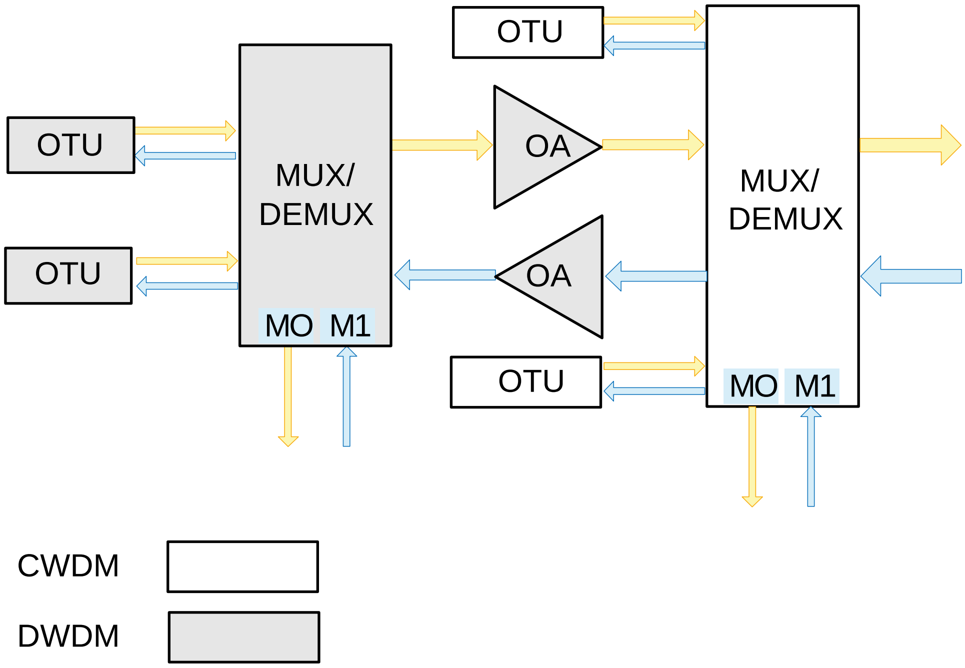


Figure 3-7 shows the equipment configuration in which DWDM wavelengths are transported in the window of CWDM 1531 nm to 1551 nm. The DWDM wavelengths need to pass through the DWDM MUX/DEMUX and CWDM MUX/DEMUX. Hence, the optical amplifier unit needs to be configured in between.

Figure 3-7 Application of the DWDM wavelength in the CWDM system



3.8.2 Nominal Central Wavelength and Frequency of the DWDM System

Table 3-9 Wavelengths and frequencies of a C-band 80-channel (spacing of 50 GHz) system

Wavelength No.	Central Frequency (THz)	Central Wavelength (nm)	Wavelength No.	Central Frequency (THz)	Central Wavelength (nm)
1	196.05	1529.16	41	194.05	1544.92
2	196.00	1529.55	42	194.00	1545.32
3	195.95	1529.94	43	193.95	1545.72
4	195.90	1530.33	44	193.90	1546.12
5	195.85	1530.72	45	193.85	1546.52
6	195.80	1531.12	46	193.80	1546.92
7	195.75	1531.51	47	193.75	1547.32
8	195.70	1531.90	48	193.70	1547.72
9	195.65	1532.29	49	193.65	1548.11
10	195.60	1532.68	50	193.60	1548.51
11	195.55	1533.07	51	193.55	1548.91

Wavelength No.	Central Frequency (THz)	Central Wavelength (nm)	Wavelength No.	Central Frequency (THz)	Central Wavelength (nm)
12	195.50	1533.47	52	193.50	1549.32
13	195.45	1533.86	53	193.45	1549.72
14	195.40	1534.25	54	193.40	1550.12
15	195.35	1534.64	55	193.35	1550.52
16	195.30	1535.04	56	193.30	1550.92
17	195.25	1535.43	57	193.25	1551.32
18	195.20	1535.82	58	193.20	1551.72
19	195.15	1536.22	59	193.15	1552.12
20	195.10	1536.61	60	193.10	1552.52
21	195.05	1537.00	61	193.05	1552.93
22	195.00	1537.40	62	193.00	1553.33
23	194.95	1537.79	63	192.95	1553.73
24	194.90	1538.19	64	192.90	1554.13
25	194.85	1538.58	65	192.85	1554.54
26	194.80	1538.98	66	192.80	1554.94
27	194.75	1539.37	67	192.75	1555.34
28	194.70	1539.77	68	192.70	1555.75
29	194.65	1540.16	69	192.65	1556.15
30	194.60	1540.56	70	192.60	1556.55
31	194.55	1540.95	71	192.55	1556.96
32	194.50	1541.35	72	192.50	1557.36
33	194.45	1541.75	73	192.45	1557.77
34	194.40	1542.14	74	192.40	1558.17
35	194.35	1542.54	75	192.35	1558.58
36	194.30	1542.94	76	192.30	1558.98
37	194.25	1543.33	77	192.25	1559.39
38	194.20	1543.73	78	192.20	1559.79
39	194.15	1544.13	79	192.15	1560.20
40	194.10	1544.53	80	192.10	1560.61

3.8.3 Nominal Central Wavelengths of the CWDM System

Table 3-10 Nominal central wavelengths of the CWDM system

Wavelength No.	Wavelength (nm)	Wavelength No.	Wavelength (nm)
11	1471	15	1551
12	1491	16	1571
13	1511	17	1591
14	1531	18	1611

3.8.4 GE ADM

The product provides the add/drop multiplexing (ADM) function for GE service and supports cross grooming for GE service granules.

Technical Background

At the convergence layer of the MAN, the transmission and protection of large gigabit Ethernet (GE) services need be considered. If the WDM transmission equipment supports service grooming at the sub-wavelength level, the WDM network can be developed from a static network to a network that can be configured dynamically. In this situation, pass-through, adding/dropping, and loopback for each GE service can be performed independently at any station and these operations do not affect services in other channels. Automatic GE service configuration can be achieved by using remote management.

Advantages in Application

The OptiX OSN 6800 DWDM provides the add/drop multiplexing (ADM) function for GE services. It has the capability of cross-connection grooming for GE service granularity. It achieves electrical signal-based service convergence and grooming at Layer 1, and provides flexible and reliable networking configuration solution with a data service application in MAN.

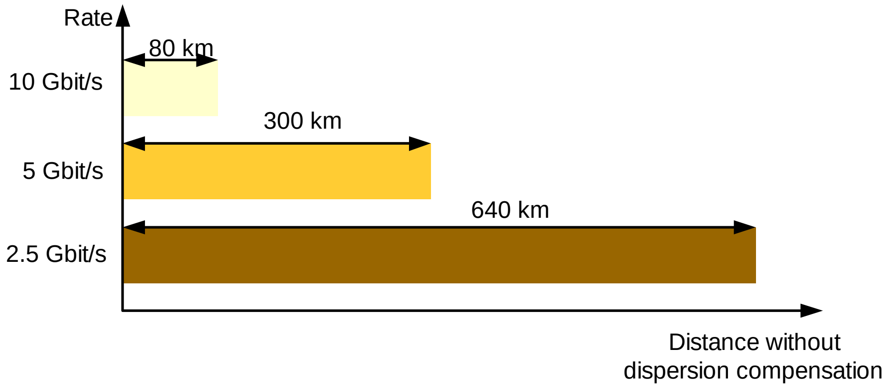
The OptiX OSN 6800 DWDM system uses the L4G, LDGD, LDGS, LQG, LOG, LQM, LQMD, LQMS, LEM24, LEX4, TBE, TDG, TQM and TOM boards to achieve GE ADM.

The GE ADM technology has the following features and advantages:

- 5 Gbit/s line rate

  The line rate of the LQG and L4G boards are 5 Gbit/s. These boards support the transmission of 300 km without dispersion compensation. Expensive EDC or other line coding solutions are not required. Compared with the traditional line rates of 2.5 Gbit/s and 10 Gbit/s, the 5 Gbit/s line rate achieves the best transport cost in each bit unit distance. See Figure 3-8.

Figure 3-8 Comparison of distance without dispersion compensation between the 2.5 Gbit/s, 5 Gbit/s, and 10 Gbit/s line rates



- Dynamic network

  The GE ADM technology achieves grooming at the sub-wavelength level. It dynamically configures the network structure and transport routes, optimizes the configuration according to the network resources, and develops the WDM network from static to dynamic. If a network contains preserved bandwidth resources, you only need to specify the source and sink ports on the U2000. The system automatically creates the best route path and provides services fast.
- Electrical regeneration

  The GE ADM technology achieves pass-through at the electrical layer of services at the sub-wavelength level. It also realizes the 3 R functions of the electrical regenerator. Therefore, the special electrical regenerator board is not required and the initial investment is decreased.
- Low expansion cost

  During data network expansion, the cross-connection grooming of the GE ADM technology ensures smooth service upgrade and lowers the expansion cost.
- High wavelength utilization

  The GE ADM technology shares the bandwidth of the same wavelength between different nodes and increases the bandwidth utilization of each wavelength.
- End-to-end configuration and management

  The GE ADM technology allows remote end-to-end configuration, management, and monitoring of GE services on the U2000, decreasing maintenance costs.
- Reliable QoS

  The GE ADM provides performance monitoring and bit errors on the WDM side and the client side. The system can monitor the status and quality of service transmission in real time.

Implementation Scheme

The backplanes of the OptiX OSN 6800 use the high-speed data bus. With the large-capacity space division cross-connection technology and powerful processing capacity of the Ethernet Layer 2, the OptiX OSN 6800 DWDM system can independently distribute, converge, and groom the GE services at the wavelength or sub-wavelength level of single equipment. The cross-connection of each wavelength and the end-to-end management of services at the sub-wavelength level can be achieved inside a single piece of equipment.

With the remote configuration and management of the U2000, the GE services accessed into the OptiX OSN 6800 DWDM system can be groomed, multiplexed, protected, looped back at each node without affecting services in other channels.

The backplane bus with the GE ADM feature provided by the OptiX OSN 6800 DWDM system covers the slots of the subrack.

3.8.5 Typical Application

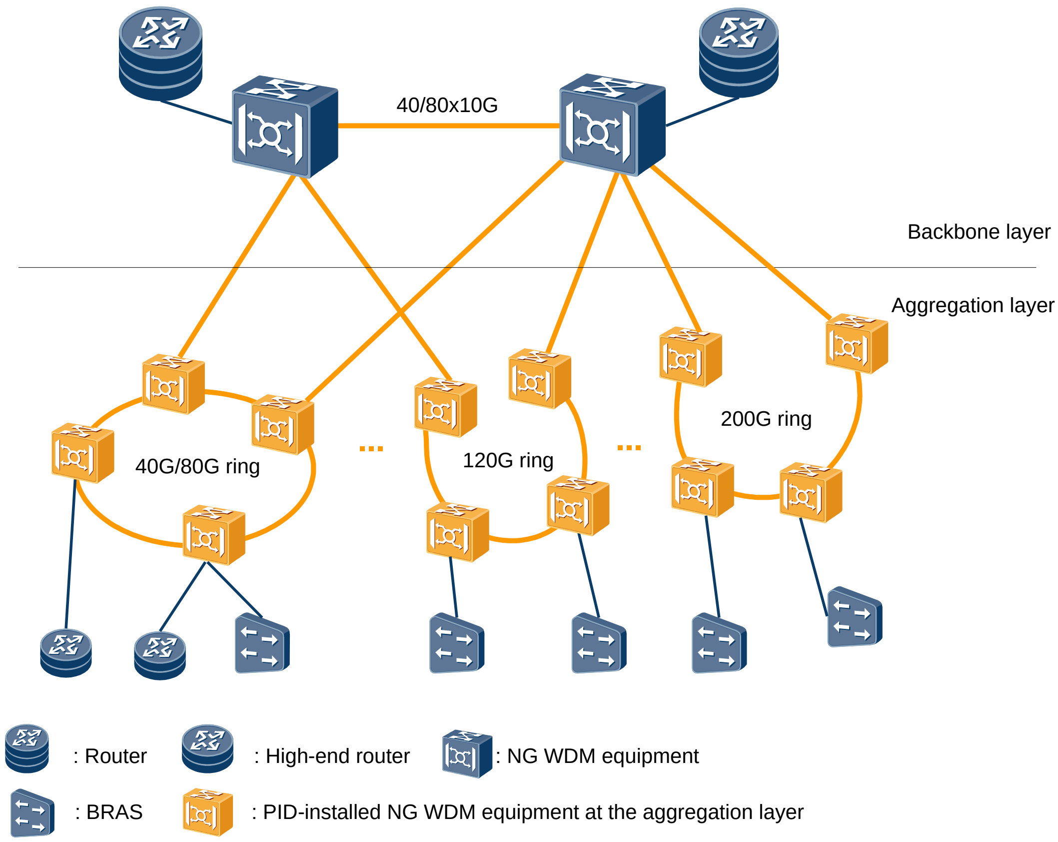
This section describes typical PID application.

PID helps to effectively eliminate bandwidth and O&M bottlenecks on a WAN, leveraging the features such as large capacity, high integration, versatile multi-service access, small size, and environment-friendly design. On a WAN, a 40G/80G/120G aggregation ring based on PID boards only is recommended, eliminating commissioning while enabling quick service provision.

Typical network 1: WAN for a small or medium-sized city

At the OTN aggregation layer, two to six aggregation rings can be deployed with two to four NEs in each ring. A PID board(s) is used on each NE's line side. Build a 40G/80G/120G network using PID groups as required. On each aggregation ring, services are electrically regenerated by the PID and cross-connect boards at each site. NEs at the OTN backbone layer are interconnected with NEs on aggregation rings through PID boards. Figure 3-9 shows the details.

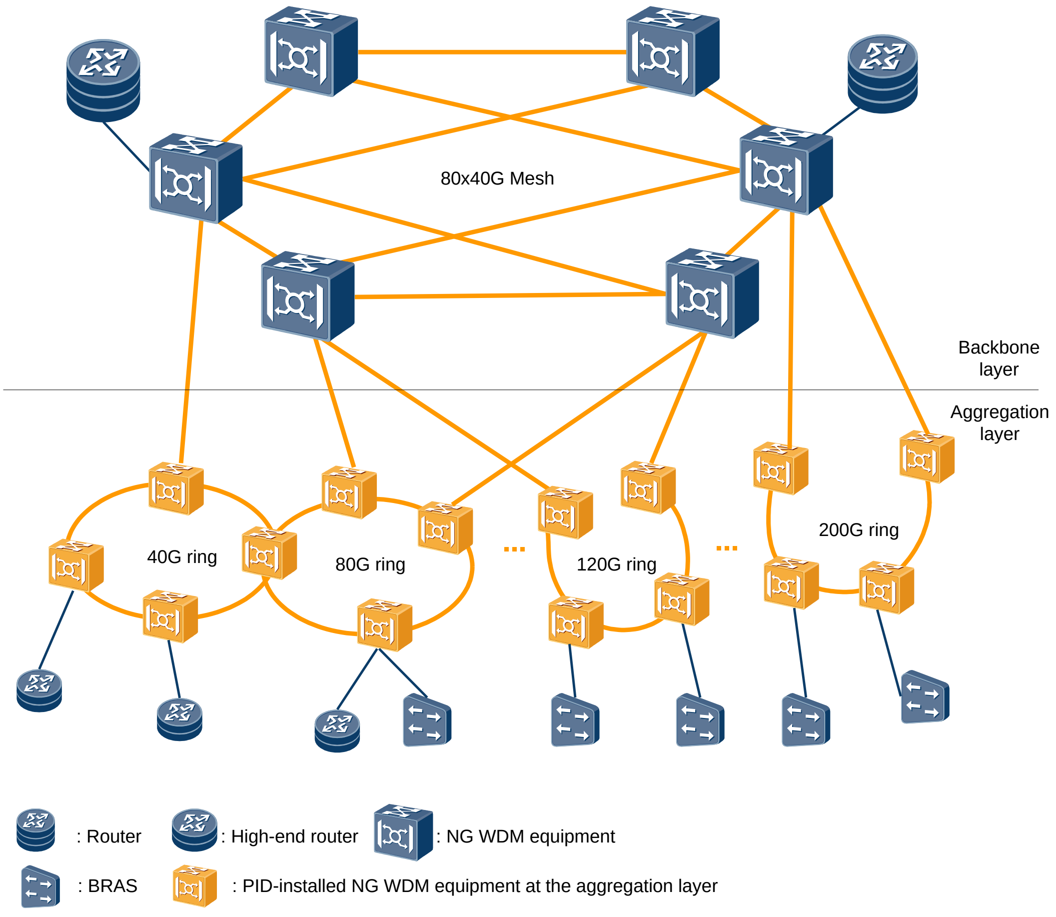
Figure 3-9 WAN for a medium or large-sized city



Typical network 2: WAN for a medium or large-sized city

At the OTN aggregation layer, 13 to 20 aggregation rings can be deployed with two to four NEs in each ring. A PID board(s) is used on each NE's line side. Build a 40G/80G/120G network using PID groups as required. On each aggregation ring, services are electrically regenerated by the PID and cross-connect boards at each site. NEs at the OTN backbone layer are interconnected with NEs on aggregation rings through PID boards. Figure 3-10 shows the details.

Figure 3-10 WAN for a medium or large-sized city



3.9 Clock Feature

OptiX OSN 6800 supports the physical layer clock and PTP clock to realize the synchronization of the clock and the time.

The physical clock extracts the clock from the serial bit stream at the physical layer to realize the synchronization of the frequency.

The Precision Time Protocol (PTP) clock complies with the IEEE 1588 v2 protocol. IEEE 1588 v2 is a synchronization protocol, which realizes time synchronization based on the timestamp generated during the exchanging of protocol packets. It provides the nanosecond accuracy to meet the requirements of 3G base stations.

3.9.1 Physical Clock

OptiX OSN 6800 supports the physical clock synchronization. Physical-layer synchronization is classified into the SDH/PDH synchronization in the traditional SDH field and synchronous Ethernet.

OptiX OSN 6800 extracts the timing signals by the following methods:

- Extracts 2M/1.5M timing signals from the external clock interface of an NE.
- Extracts timing signals from optical signals that the line board receives.

OptiX OSN 6800 extracts input and output of two 75-ohm or two 120-ohm external clock sources.

OptiX OSN 6800 extracts three clock working modes, that is, the tracing, holdover, and free-run modes. The timing signals from optical signals that 1.5 Mbit/s timing signals, 2 Mbit/s timing signals and the line board receives also process and transfer synchronization status messages (SSM).

- Tracing mode: It is the normal working mode. In this mode, the local clock is synchronized with the input reference clock signals. An ASON NE not only supports the traditional clock tracing mode, but also supports the ASON clock tracing mode.
- Holdover mode: When all timing reference signals are lost, the clock enters into the holdover mode. In this mode, the clock takes timing reference from the last frequency information saved before the loss of timing reference signals. This mode can be used to cope with an interruption of external timing signals.
- Free-run mode: When all timing reference signals are lost and the clock losses the saved configuration data about the timing reference, the clock starts tracing the internal oscillator of the NE.

The synchronization process of the physical clock is as follows:

- The clock processing module of each NE extracts the clock signals from the serial bit stream on the line and selects a clock source.
- The clock phase-locked loop traces one of the line clocks and generates the system clock.
- The system clock is used as the transmit clock on the physical layer. It is transferred to the downstream.

The synchronous physical clock has the following features:

- The synchronous physical clock is easy to realize and is highly reliable.
- The synchronous physical clock adopts the synchronization status information (SSM) to indicate clock quality and exclusive OAM packets to transfer the SSM.

3.9.2 PTP Clock (IEEE 1588 v2)

A Precision Time Protocol (PTP) clock complies with the IEEE 1588 v2 protocol and can realize synchronization of frequency and time.

IEEE 1588 v2 is a synchronization protocol, which realizes frequency and time synchronization based on the timestamp generated during the exchange of protocol packets. It provides the nanosecond accuracy to meet the requirements of 3G base stations.

NOTE

To achieve PTP clock synchronization, all NEs on the clock link should support the IEEE 1588 v2 protocol.

BMC Algorithm

For the PTP clock, the best master clock (BMC) algorithm is adopted to select the clock source.

The best master clock (BMC) algorithm compares data describing two or more clocks to determine which data describes the better clock, and selects the better clock as the clock source. The BMC algorithm includes the following algorithms:

- Data set comparison algorithm: The NE determines which of the clocks is better, and selects the better clock as the clock source. If an NE receives two or more channels of clock signals from the same grandmaster clock (GMC), the NE selects one channel of the clock signals that traverses the least number of nodes as the clock source.
- State decision algorithm: The state decision algorithm determines the next state of the port based on the results of the data set comparison algorithm.

Clock Architecture

There are three models for the IEEE 1588 v2 clock architecture.

- OC (Ordinary Clock): A clock that has a single IEEE 1588 v2 port and the clock needs to be restored. It may serve as a source of time (master clock), or may synchronize to another clock (slave clock).
- BC (Boundary Clock): A clock that has multiple IEEE 1588 v2 ports and the clock needs to be restored. It may serve as the source of time, (master clock), and may synchronize to another clock (slave clock).
- TC (Transparent Clock): A device that measures the time taken for a PTP event message to transit the device and provides this information to clocks receiving this PTP event message. That is, the clock device functions as an intermediate clock device to transparently transmit the clock and process the delay, but does not restore the clock. It can effectively deal with the accumulated error effects resulting from the master and slave hierarchical architecture. In this manner, the TC ensures that the clock/time synchronization precision meets the application requirement.

  The TC is classified into peer-to-peer (P2P) TC and end-to-end (E2E) TC according to the delay processing mechanism.

  - P2P TC: When the PTP packets are transmitted to the P2P TC, the P2P TC corrects both the residence time of the PTP packets and the transmission delay of the link connected to the receive port. The P2P TC is mainly used in the MESH networking.
  - E2E TC: When the PTP packets are transmitted to the E2E TC, the E2E TC corrects only the residence time of the PTP packets. The E2E delay computation mechanism between the master and slave clocks is adopted. The intermediate nodes do not process the transmission delay but transparently transmit the PTP packets. The E2E TC is mainly used in the chain networking.

OptiX OSN 6800 can support the OC, BC, TC, TC+OC, BC + physical-layer clock, and TC+BC at present.

3.10 ASON Management

An automatically switched optical network (ASON) is a new-generation optical transmission network.

With integration of SONET/SDH functionality, effective IP technology, large-capacity WDM/OTN, and revolutionary network control software, ASON lays a foundation for flexible and scalable next generation optical networks, which are easy to operate and manage, and less expensive to operate.

Introducing ASON into WDM networks brings the following benefits:

- High reliability: Protection and restoration together improve network reliability and service security.
- Easy to use: Network resources and topologies are easy to discover and end-to-end services can be quickly created.
- Easy to manage: Trail resources are manageable and predictable, and services can be automatically reverted to their original trails.
- Investment saving: A mesh network ensures higher resource usage and enables quick expansion (plug-and-play).
- New service types: Service level agreement (SLA) ensures differentiated services.

WDM/OTN equipment is an effective service carrier. However, only the capability of carrying services (on the transport plane) does not qualify WDM/OTN equipment as advanced and future-oriented equipment, which also requires outstanding performance in bandwidth usage, flexibility, manageability, maintainability, reliability, and protection capability. It has become a trend to implement a control plane over the transport plane of the WDM/OTN equipment.

The limitations on the WDM/OTN equipment are removed after the ASON technology is implemented on the WDM/OTN equipment. Because of the ASON technology, the WDM/OTN equipment features high reliability, flexibility, bandwidth utilization, maintainability, and manageability and supports different service levels and quick deployment of services. Further, the operability of a WDM/OTN network is highly improved because of the features supported by the ASON technology, such as automatic discovery of resources, traffic engineering, dynamic bandwidth adjustment, and interconnection and communication technologies.

4 Network Application

About This Chapter

The OptiX OSN 6800 supports point-to-point network, chain network, ring network and MESH network.

4.1 Networking and Applications

The OptiX OSN 6800 supports point-to-point network, chain network, ring network and MESH network.

4.1.1 Basic Networking Modes

The OptiX OSN 6800 supports point-to-point networking, chain networking, ring networking, and mesh networking.

Different networking modes are applied to different application scenarios. You need to select the required networking mode according to the service requirements.

Point-to-Point Network

A point-to-point network is the basic application. It is used for end-to-end service transmission. The other networking modes are based on point-to-point networking mode, which is the basic network. A point-to-point network is generally used to transmit common voice services, private line data services, and storage services.

Chain Network

The chain network with OADM(s) is suitable when wavelengths need to be added/dropped and passed through. A chain network has similar service types as a point-to-point network, but the chain network is more flexible than the point-to-point network. It can be applicable not only to the point-to-point service, but also to the convergence service and broadcast service dedicated for simple networking.

Ring Network

Network security and reliability are key factors that indicate the quality of the services provided by network operators. Because of its high survivability, the ring network is the dominant networking mode in MAN DWDM network planning. The ring network has the widest application range. It can be applied to the point-to-point service, convergence service, and broadcast service. It can diversify into complex network structures, such as tangent rings, intersecting rings, and rings with chains.

Mesh Network

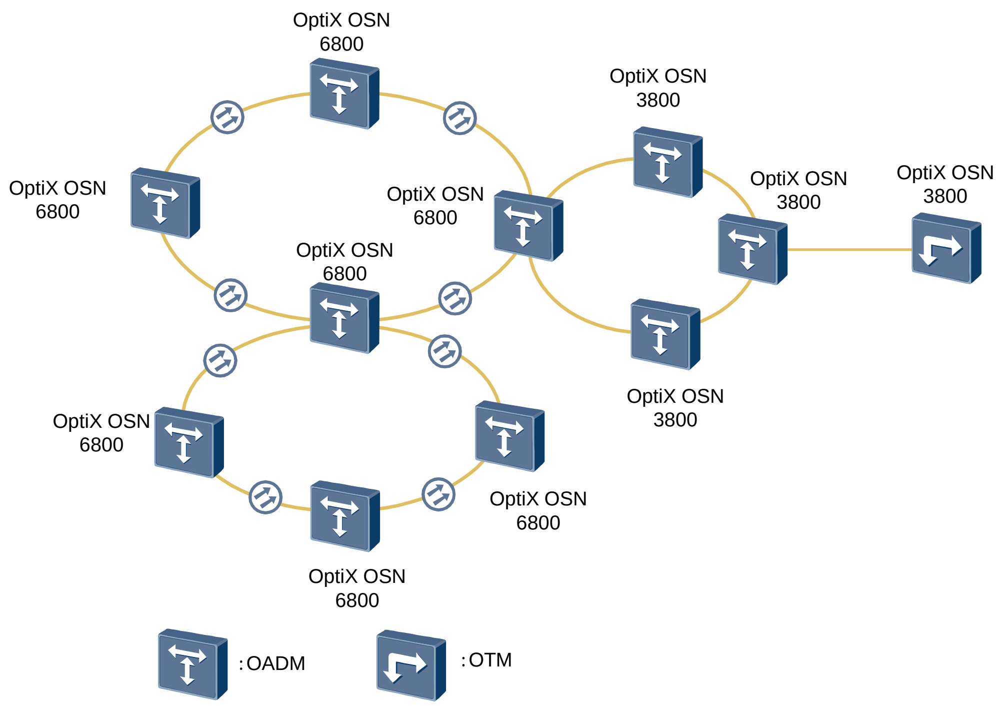
Mesh networks have no node bottleneck and ensure unblocked services through alternative routes during equipment failure. In a mesh network, more than one route is available between two nodes. The mesh network has high service transmission reliability, and the mesh topology is a mainstream networking mode for ASON networks. Mesh networking features flexibility and scalability. It is widely used in ASON networks.

4.1.2 Typical Networking

The OptiX OSN 6800 can be networked with other WDM and SDH or SONET equipment to achieve a complete transport solution.

Figure 4-1 shows the typical networking.

Figure 4-1 Typical networking



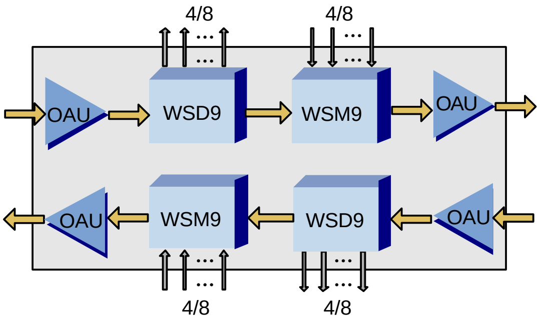
WSS Grooming Solution

ROADM in wavelength selective switch (WSS) mode is applicable to intra-ring grooming and inter-ring grooming.

At a network node, ROADM in WSS mode can freely change the add/drop status or pass-through status of a wavelength, and does not interrupt a service in the change process. ROADM can work with tunable lasers to flexibly groom wavelengths.

WSS enables output of any wavelength through any port. A port in WSS mode can be used as either a port for local wavelength adding or dropping or a multi-directional MS port. WSS can work with WSS or a coupler to build ROADM, as shown in Figure 4-2.

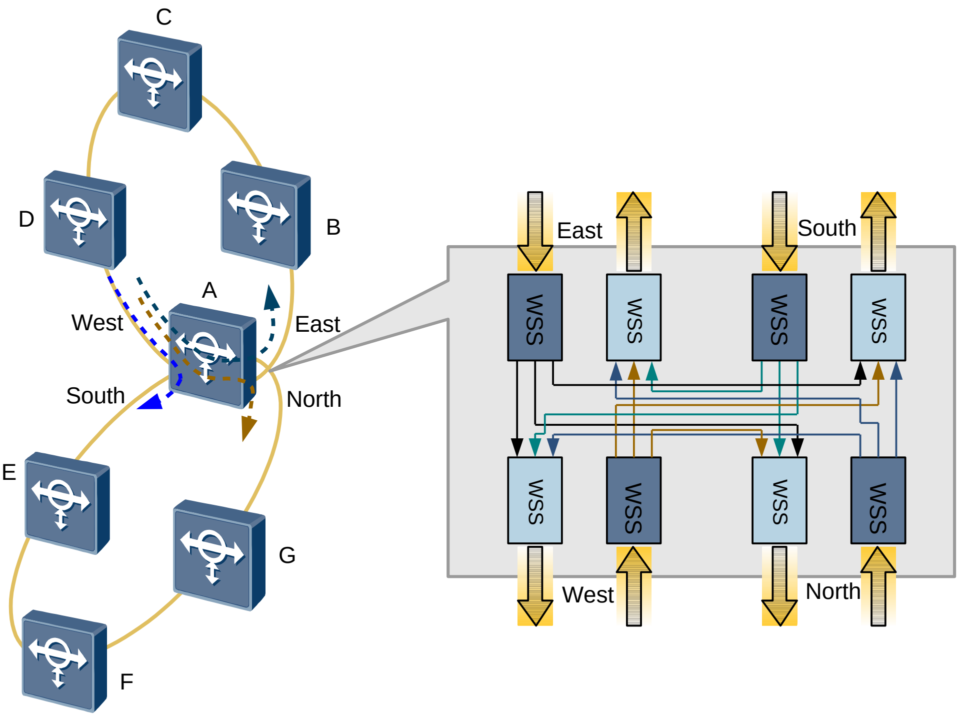
Figure 4-2 Functional diagram of a WSS-based ROADM node



WSS realizes colorless wavelength add/drop. Users can set the add/drop or pass-through state of wavelengths on the NMS. In addition, the dynamic wavelength status can be adjusted remotely and the services can be fast provisioned.

WSS supports the wavelength grooming in multiple directions and the multi-dimensional ROADM structure. With WSS, the wavelength resources of multi-directional node on a ring with chain or intersecting rings network are reconfigurable, as shown in Figure 4-3.

Figure 4-3 Inter-ring grooming ROADM solution



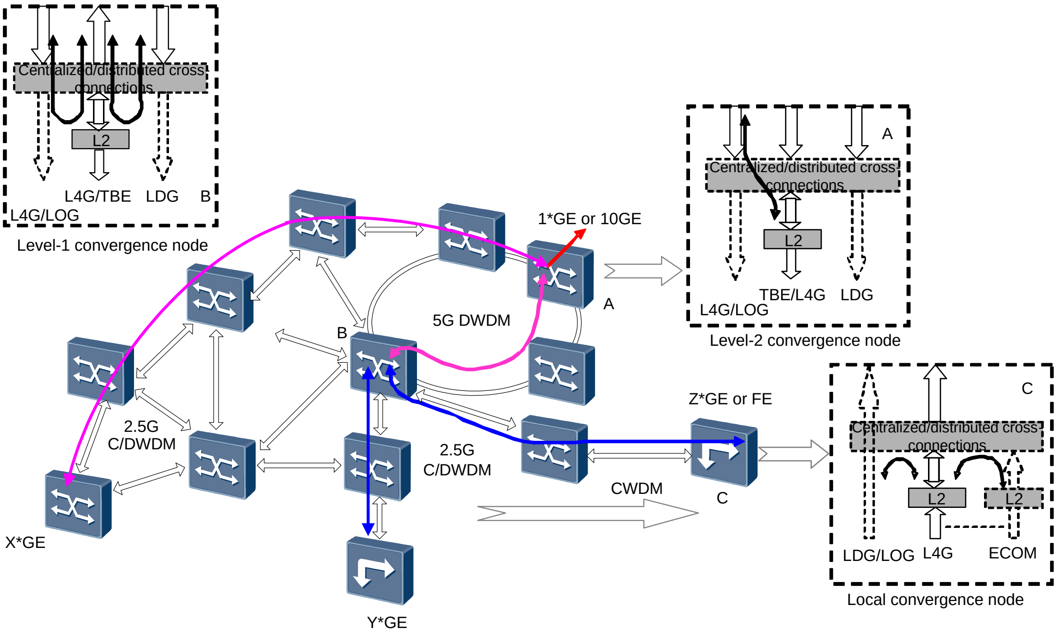
GE Ethernet Convergence Solution

The equipment provides Ethernet Layer 2 convergence boards, such as the TBE, L4G, LEM24, LEX4, to achieve local FE-to-GE convergence and GE-to-GE/10GE network-wide convergence. For details, see Figure 4-4.

Service convergence may be local convergence or network-wide multi-level convergence.

- Generally, for local convergence, multiple local client-side ports access services at the same time but there is still idle bandwidth. If the service routes are the same or partially the same, the services can be forwarded to the same port based on the VLAN information and then send to the line side. For details, see station C in Figure 4-4.
- If the service volume is low after convergence or service routes are not completely the same, a Layer 2 convergence board on the transmission trail, such as the L4G and TBE, can combine the converged services and locally added services, and assign a route to the combined services. This process is referred to multi-level convergence. For details, see station B in Figure 4-4.
- A level-1 convergence node has the same functions as a local convergence node, except for that the local convergence node converges services from multiple client-side ports to the system side, while the level 1 convergence node converges services from multiple system-side ports to the client side. For details, see station A in Figure 4-4.

Figure 4-4 GE Ethernet convergence solution



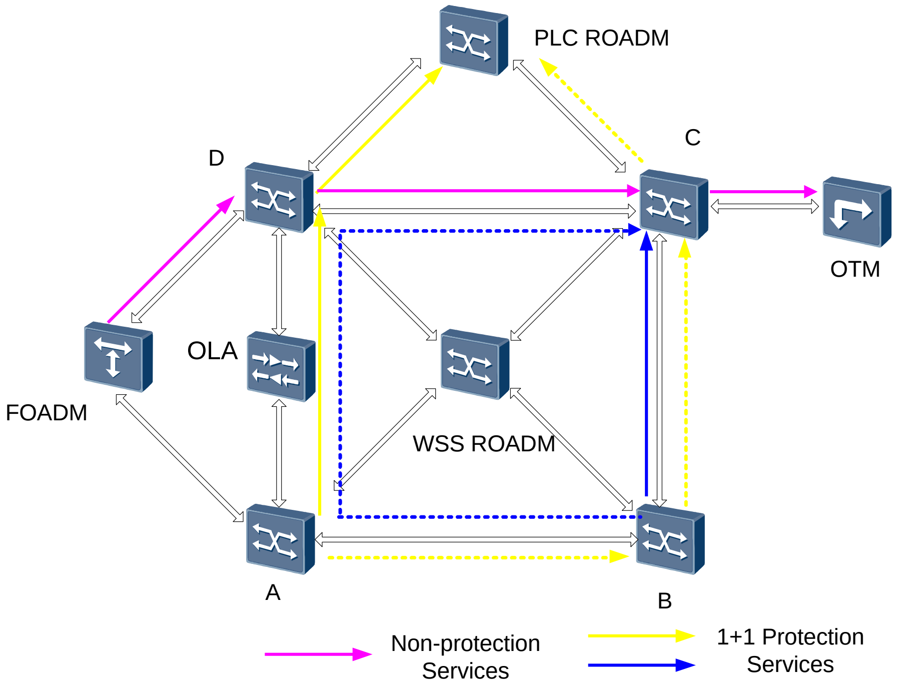
WDM ASON Solution

The equipment supports the ASON control plane. With the ASON control plane and WDM features such as ROADM, FOADM, and optical wavelength/sub-wavelength protection, the equipment provides an ideal WDM ASON solution.

At the core layer of a network, a mesh network is built with WSS/ROADM for wavelength rerouting. At network edges, ring and chain networks are built with traditional FOADM, OTM, or PLC ROADM, as the service volume is low and fiber resources are insufficient. For details, see Figure 4-5.

An ASON network provides the same protection solutions as a traditional network does. In addition, GMPLS and WSS together provide wavelength rerouting for services under no protection or 1+1 protection on a mesh network. This helps improve survivability of services.

Figure 4-5 WDM ASON solution



5 About the ASON

About This Chapter

The ASON, the automatically switched optical network, is a new generation of the optical transmission network, all called ASON optical network. This section describes some basic concepts of the ASON and application of the ASON software.

NOTE

The electrical-layer ASON for the OptiX OSN 6800 is used only in specified offices.

The ASON software provided by Huawei can be applied to the OptiX OSN series products to support the evolution from traditional network to ASON network. It complies with the ITU and IETF ASON/GMPLS-related standards.

5.1 Overview

The ASON software provided by Huawei can be applied to the OptiX OSN series products to support the evolution from traditional network to ASON network. It complies with the ITU and IETF ASON/GMPLS-related standards.

5.1.1 Background and Advantages

Compared with the WDM network, the transmission network that applies the new ASON technology shows advantages in service configuration, bandwidth utilization and protection schemes.

In the traditional transmission network, the WDM transmission equipment functions as fibers. Currently, the WDM transmission equipment also carries services. As a result, more requirements are for the operability of the WDM equipment. The traditional network has the following problems:

- The service configuration is complex and capacity expansion or service provision takes a long period.
- The bandwidth utilization is of a low rate and low efficiency. In a ring network, half of the bandwidth should be reserved.
- Just a few protection schemes are available and the performance of self-healing protection is poor.

The ASON has been developed to solve these problems. This technology involves signaling switching and a control plane to enhance its network connection management and recovery capability. It supports end-to-end service configuration and the service level agreement (SLA).

Service Configuration

Traditional WDM networks are generally chains and rings. The trails and timeslots of their services are manually configured ring by ring and point by point, which consumes a lot of time and effort. As networks become increasingly large and complicated, this service configuration mode cannot meet the rapidly increasing user demands.

The ASON successfully solves this problem by end-to-end service configuration. To configure a service, you only need to specify its source node, sink node and protection type; the network automatically performs the required operations.

Bandwidth Utilization

Traditional WDM optical transmission networks have a large amount of resources reserved and lack advanced service protection, and the restore and routing functions. In contrast, with the routing function the ASON can provide protection by reserving fewer resources, thus increasing network resource utilization.

Protection and Restoration

Chain and ring are the main topologies used in a traditional WDM network. Optical line protection or board-level protection are the main protection schemes for the services. In ASON, mesh is the main topology. Besides protections, the dynamic restoring function is available to restore the services dynamically. In addition, when there are multiple failures in a network, the services can be restored as many as possible.

According to the difference in the service restoration time, multiple service types are defined in ASON networks to meet different customer requirements.

5.1.2 Features of the ASON

As a new technology on the transmission network, the ASON has its own features.

Compared with the traditional network, the ASON has the following features:

- Supports the route calculation strategy that is based on optics parameters and eliminates the route that does not comply with optics parameters automatically.
- Supports the automatic adjustment of wavelengths during rerouting or optimization, which solves the wavelength conflict problem. (For OTN network)
- Wavelengths can be automatically allocated for newly created services.
- Configures end-to-end services automatically.
- Discovers the topology automatically.
- Provides mesh networking that enhances the survivability of the network.
- Supports different services which are provided with different levels of protection.
- Provides traffic engineering and dynamically adjusts the network logic topology in real time to optimize the configuration of network resources.

6 Technical Specifications

About This Chapter

6.1 General Specifications

6.1.1 Cabinet Specifications

Table 6-1 lists the typical configurations of the N63B cabinet.

Table 6-1 Technical specifications of the N63B cabinet

Item	Specification
Dimensions	600 mm (W) x 300 mm (D) x 2200 mm (H)
Weight (kg)	60 kg
Standard working voltage	-48 V DC or -60 V DC
Working voltage range	-40 V DC to -72 V DC

Table 6-2 lists the typical configurations of the N66B cabinet.

Table 6-2 Technical specifications of the N66B cabinet

Item	Specification
Dimensions	600 mm (W) x 600 mm (D) x 2200 mm (H)
Weight (kg)	85 kg
Standard working voltage	-48 V DC or -60 V DC
Working voltage range	-40 V DC to -72 V DC

6.1.2 Subrack Specifications

Table 6-3 Mechanical specifications of the OptiX OSN 6800

Item	Specification
Dimensions	497 mm (W) x 295 mm (D) x 400 mm (H) (19.6 in. (W) × 11.6 in. (D) × 15.7 in. (H))
Weight (empty subrack[a])	13 kg (28.6 lb.)
a: An empty subrack means no boards are installed in the board area, and no fan tray assembly or air filter is installed.	

Table 6-4 Requirements on voltage and current of an OptiX OSN 6800

Item	Requirement
Rated working current	25 A (-48 V)
Nominal working voltage	-48 V DC/-60 V DC
Working voltage range	-40 V DC to -72 V DC

Table 6-5 Power consumption of an OptiX OSN 6800

Item	Value
Maximum subrack power consumption	1350 W

Table 6-6 Power consumption of the subrack in typical configuration in an OptiX OSN 6800

<table>
<tr><th colspan="3">Unit Name</th><th>Typical Power Consumption at 25°C (77°F)[a]</th><th>Maximum Power Consumption at 55°C (131°F)[a]</th><th>Remarks</th></tr>
<tr><td rowspan="3">Subrack</td><td colspan="2">OTU subrack</td><td>566</td><td>722.2</td><td>17 x 10G OTU (LSX), 1 x SCC, 2 x PIU, 1 x AUX, and 1 x fan tray assembly</td></tr>
<tr><td rowspan="2">OTM subrack</td><td>Subrack 1</td><td>566</td><td>722.2</td><td>17 x 10G OTU (LSX), 1 x SCC, 2 x PIU, 1 x AUX, and 1 x fan tray assembly</td></tr>
<tr><td>Subrack 2</td><td>168.7</td><td>281.6</td><td>1 x M40V, 1 x D40, 1 x OAU101, 1 x OBU103, 1 x FIU, 1 x SC1, 1 x SCC, 2 x PIU, 1 x AUX, and 1 x fan tray assembly</td></tr>
</table>

Unit Name			Typical Power Consumption at 25°C (77°F)[a]	Maximum Power Consumption at 55°C (131°F)[a]	Remarks
	OLA subrack		144.9	253.9	2 x OAU101s, 2 x FIU, 1 x SC2, 1 x SCC, 2 x PIU, 1 x AUX, and 1 x fan tray assembly
	FOADM subrack		292.3	418.3	2 x OAU101, 2 x VA4, 2 x OBU103, 2 x MR4, 4 x 10G OTU (LSX), 2 x FIU, 1 x SC2, 1 x SCC, 2 x PIU, 1 x AUX, and 1 x fan tray assembly
	ROADM subrack (2 x dimensions)	Subrack 1	87.4	96.4	1 x M40, 1 x D40, 2 x WSMD2, 2 x DAS1, 1 x SCC, 2 x PIU, 1 x AUX, and 1 x fan tray assembly
		Subrack 2	566	722.2	17 x 10G OTU (LSX), 1 x SCC, 2 x PIU, 1 x AUX, and 1 x fan tray assembly
	ROADM subrack (4 x dimensions)[b]	Subrack 1	160	268.8	1 x WSMD4, 1 x DAS1, 1 x M40, 1 x D40, 1 x SCC, 2 x PIU, 1 x AUX, and 1 x fan tray assembly
		Subrack 2	160	268.8	1 x WSMD4, 1 x DAS1, 1 x M40, 1 x D40, 1 x SCC, 2 x PIU, 1 x AUX, and 1 x fan tray assembly
		Subrack 3	160	268.8	1 x WSMD4, 1 x DAS1, 1 x M40, 1 x D40, 1 x SCC, 2 x PIU, 1 x AUX, and 1 x fan tray assembly
		Subrack 4	160	268.8	1 x WSMD4, 1 x DAS1, 1 x M40, 1 x D40, 1 x SCC, 2 x PIU, 1 x AUX, and 1 x fan tray assembly
	OTN subrack	Optical subrack	168.7	281.6	1 x M40V, 1 x D40, 1 x OBU103, 1 x OAU101, 1 x SC1, 1 x FIU, 1 x SCC, 2 x PIU, 1 x AUX, and 1 x fan tray assembly
		Electrical subrack	557	723.8	10 x ND2, 2 x TQX, 2 x TOA, 2 x XCS, 1 x SCC, 2 x PIU, 1 x AUX, and 1 x fan tray assembly
Cabin	OTM cabinet (40x10 Gbit/s)		1422.2	1951.1	2 x OTU subrack and 1 x OTM subrack 2

Unit Name		Typical Power Consumption at 25°C (77°F)[a]	Maximum Power Consumption at 55°C (131°F)[a]	Remarks
et				
a: Indicates that the power consumption of the subrack and cabinet is the value in a certain configuration. The value is for reference only. The actual power consumption of the chassis and cabinet is calculation based on the power consumption of each module. b: Subrack 1 and subrack 2 are used as subracks in the line dimensions at a four-dimension RADOM station; subrack 3 and subrack 4 are used as subracks for adding/dropping local services. Service boards can be configured in another subrack.				

Table 6-7 OptiX OSN 6800 equipment predicted reliability

System Availability	Mean Time to Repair (MTTR)	Mean Time Between Failures (MTBF)
0.99999098	4 hours	51.64 years

NOTE

The predicted reliability specifications vary according to system configurations.

A Power Consumption, Weight, and Valid Slots of Boards

This chapter describes the power consumption, weight, and valid slots of the boards used in the OptiX OSN 6800 system.

The power consumption, weight, and valid slots of the boards for the OptiX OSN 6800 system are shown in Table A-1. The values listed in the following table indicate the power consumption of the boards when they normally work at 25 ℃ and 55 ℃.

Table A-1 Power consumption, weight and valid slots of the OptiX OSN 6800 boards

Board	Module Type	Typical Power Consumption at 25°C (77°F) (W)	Maximum Power Consumption at 55°C (131°F)(W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots
TN11AUX	-	12.0	17.0	0.5/1.1	1	IU21
TN11BMD4	-	0.2	0.3	1.2/2.7	1	IU1-IU17
TN11BMD8	-	0.2	0.3	1.5/3.3	2	IU1-IU16
TN11CMR2	-	0.2	0.3	0.8/1.8	1	IU1-IU17
TN11CMR4	-	0.2	0.3	0.9/2.0	1	IU1-IU17
TN11CRPC01	-	110.0	121.0	4.0/8.8	-	-
TN11CRPC03	-	70.0	77.0	4.2/9.2	-	-
TN11D40	-	10.0	13.0	2.2/4.8	3	IU1-IU15
TN12D40	-	10.0	13.0	2.0/4.4	2	IU1-IU16
TN11D40V	-	38.5	42.3	2.3/5.1	3	IU1-IU15
TN11DAS1	-	22	28.6	1.4/3.1	1	IU1-IU8, IU11-IU16

Board	Module Type	Typical Power Consumption at 25°C (77°F) (W)	Maximum Power Consumption at 55°C (131°F)(W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots
TN11DCP/TN12DCP	-	6.8	7.5	1.0/2.2	1	IU1-IU17
TN11DCU	-	0.2	0.3	1.5/3.3	1	IU1-IU17
TN11DMR1	-	0.2	0.3	0.7/1.5	1	IU1-IU17
TN11ECOM	-	19.6	21.6	1.0/2.2	1	IU1-IU8, IU11-IU16
TN12ELQX	-	86.2	99.2	1.7/3.7	1	IU1, IU4, IU5, IU8, IU11, IU14
TN11FIU/TN12FIU	-	4.2	4.6	1.0/2.2	1	IU1-IU17
TN13FIU	-	0.2	0.3	1.0/2.2	1	IU1-IU17
TN11SFIU	-	0.2	0.3	1.0/2.2	1	IU1-IU17
TN11GFU	-	0.2	0.3	0.9/2.0	1	IU1-IU17
TN11HBA	-	47.0	75.0	3.0/6.6	3	IU2-IU16
TN11HSC1	-	8	8.8	1.0/2.2	1	IU1-IU17
TN11ITL	-	0.2	0.3	1.2/2.6	1	IU1-IU17
TN12ITL	-	10	11.5	1.2/2.6	1	IU1-IU17
TN11L4G	3400 ps/nm-C Band-Fixed Wavelength-NRZ-APD	50.0	55.0	1.4/3.1	1	IU1-IU8, IU11-IU16
	3400 ps/nm-C Band-Tunable Wavelength-NRZ-APD	53.0	58.0			
TN11LDGD	12800 ps/nm-C Band-Fixed Wavelength-NRZ-PIN 12800 ps/nm-C Band-Fixed Wavelength-	34.0	37.4	1.4/3.1	1	IU1-IU8, IU11-IU16

Board	Module Type	Typical Power Consumption at 25°C (77°F) (W)	Maximum Power Consumption at 55°C (131°F)(W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots
	NRZ-APD 6500 ps/nm-C Band-Fixed Wavelength-NRZ-PIN 3200 ps/nm-C Band-Fixed Wavelength-NRZ-APD 1600 ps/nm-CWDM Band-Fixed Wavelength-NRZ-APD					
	12800 ps/nm-C Band-Tunable Wavelength-NRZ-APD 6400 ps/nm-C Band-Tunable Wavelength-NRZ-APD (Four Channels-Tunable)	38.0	41.8			
TN11LDGS	12800 ps/nm-C Band-Fixed Wavelength-NRZ-PIN 12800 ps/nm-C Band-Fixed Wavelength-NRZ-APD 6500 ps/nm-C Band-Fixed Wavelength-	32.0	35.2	1.2/2.6	1	IU1-IU8, IU11-IU16

Board	Module Type	Typical Power Consumption at 25°C (77°F) (W)	Maximum Power Consumption at 55°C (131°F)(W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots
	NRZ-PIN 3200 ps/nm-C Band-Fixed Wavelength-NRZ-APD 1600 ps/nm-CWDM Band-Fixed Wavelength-NRZ-APD					
	12800 ps/nm-C Band-Tunable Wavelength-NRZ-APD 6400 ps/nm-C Band-Tunable Wavelength-NRZ-APD (Four Channels-Tunable)	36.0	39.6			
TN12LDM	-	22.6	24.8	1.1/2.4	1	IU1-IU17
TN11LDMD	-	26.9	29.6	1.2/2.6	1	IU1-IU17
TN11LDMS	-	26.9	29.6	1.1/2.4	1	IU1-IU17
TN12LDX	800 ps/nm-C Band (Odd & Even Wavelengths)-Fixed Wavelength-NRZ-PIN-XFP	44.5	51.2	1.6/3.5	1	IU1-IU17
	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN-X	45.5	52.2			

Board	Module Type	Typical Power Consumption at 25°C (77°F) (W)	Maximum Power Consumption at 55°C (131°F)(W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots
	FP					
TN11LEM24	-	81.0	83.0	1.0/2.2	2	IU1-IU7, IU11-IU15
TN11LEX4	-	64.0	67.0	0.7/1.5	1	IU1-IU8, IU11-IU16
TN11LOA	800 ps/nm-C Band (Odd & Even Wavelengths)-Fixed Wavelength-NRZ-PIN-XFP	31.8	36	1.19/2.64	1	IU1-IU8, IU11-IU16
	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN-XFP	32.8	37			
	10Gbit/s Multirate - 10km 10Gbit/s Multirate - 40km	31.8	36			
TN11LOG	800 ps/nm-C Band (odd & even wavelengths)-Fixed Wavelength-NRZ-PIN 800 ps/nm-C Band-Fixed Wavelength-NRZ-PIN	40.0	45.0	1.6/3.5	1	IU1-IU8, IU11-IU16
	1200 ps/nm-C Band-Tunable Wavelength-NRZ-PIN 1200	43.0	48.0			

Board	Module Type	Typical Power Consumption at 25°C (77°F) (W)	Maximum Power Consumption at 55°C (131°F)(W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots
	ps/nm-C Band-Tunable Wavelength-NRZ-APD					
	800 ps/nm-C Band-Tunable Wavelength-DRZ-PIN	43.5	48.5			
	4800 ps/nm-C Band-Tunable Wavelength-ODB-APD	55.0	60.5			
TN12LOG	800 ps/nm-C Band (Odd & Even Wavelengths)-Fixed Wavelength-NRZ-PIN-XFP	37.0	41.44	1.2/2.6	1	IU1-IU8, IU11-IU16
	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN-XFP	38.0	42.44			
	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN	41.61	46.6			
	800 ps/nm-C Band-Tunable Wavelength-DRZ-PIN	43.04	48.0			
	10Gbit/s Multirate - 10km 10Gbit/s	37.0	41.44			

Board	Module Type	Typical Power Consumption at 25°C (77°F) (W)	Maximum Power Consumption at 55°C (131°F)(W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots
	Multirate - 40km 10Gbit/s Multirate - 80km					
TN11LOM	800 ps/nm-C Band (odd & even wavelengths) -Fixed Wavelength-NRZ-PIN 800 ps/nm-C Band-Fixed Wavelength-NRZ-PIN	92.7	101.7	2.3/5.1	2	IU1-IU16
	1200 ps/nm-C Band-Tunable Wavelength-NRZ-PIN 1200 ps/nm-C Band-Tunable Wavelength-NRZ-APD	92.9	101.9			
	800 ps/nm-C Band-Tunable Wavelength-DRZ-PIN	93.4	102.7			
	4800 ps/nm-C Band-Tunable Wavelength-ODB-APD	98.2	108.0			
TN12LOM[a]	800 ps/nm-C Band (Odd & Even Wavelengths)-Fixed	61.8	69.2	1.1/2.4	1	IU1-IU17

Board	Module Type	Typical Power Consumption at 25°C (77°F) (W)	Maximum Power Consumption at 55°C (131°F)(W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots
	Wavelength-NRZ-PIN-XFP					
	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN-XFP	62.8	70.2			
	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN	64.8	72.6			
	800 ps/nm-C Band-Tunable Wavelength-DRZ-PIN	66.7	75.0			
TN11LQG	3400 ps/nm-C Band-Fixed Wavelength-NRZ-APD	28.4	32.0	1.3/2.9	1	IU1-IU8, IU11-IU16
	3400 ps/nm-C Band-Tunable Wavelength-NRZ-APD	31.0	34.4			
	5 Gbit/s Multirate (eSFP CWDM)-50 km 5 Gbit/s Multirate (eSFP CWDM)-70 km	23.18	26.0			
TN13LQM	-	32.6	35.9	1.1/2.4	1	IU1-IU8, IU11-IU16
TN11LQMD	12800	57.1	65.7	1.4/3.1	1	IU1-IU8,

Board	Module Type	Typical Power Consumption at 25°C (77°F) (W)	Maximum Power Consumption at 55°C (131°F)(W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots
	ps/nm-C Band-Fixed Wavelength-NRZ-PIN 12800 ps/nm-C Band-Fixed Wavelength-NRZ-APD 6500 ps/nm-C Band-Fixed Wavelength-NRZ-PIN 3200 ps/nm-C Band-Fixed Wavelength-NRZ-APD 1600 ps/nm-CWDM Band-Fixed Wavelength-NRZ-APD					IU11-IU16
	12800 ps/nm-C Band-Tunable Wavelength-NRZ-APD 6400 ps/nm-C Band-Tunable Wavelength-NRZ-APD (Four Channels-Tunable)	61.1	67.2			
TN12LQMD	-	31.1	35.0	1.4/3.1	1	IU1-IU8, IU11-IU16
TN11LQMS	12800 ps/nm-C Band-Fixed	56.3	64.5	1.3/2.9	1	IU1-IU8, IU11-IU16

Board	Module Type	Typical Power Consumption at 25°C (77°F) (W)	Maximum Power Consumption at 55°C (131°F)(W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots
	Wavelength-NRZ-PIN 12800 ps/nm-C Band-Fixed Wavelength-NRZ-APD 6500 ps/nm-C Band-Fixed Wavelength-NRZ-PIN 3200 ps/nm-C Band-Fixed Wavelength-NRZ-APD 1600 ps/nm-CWDM Band-Fixed Wavelength-NRZ-APD					
	12800 ps/nm-C Band-Tunable Wavelength-NRZ-APD 6400 ps/nm-C Band-Tunable Wavelength-NRZ-APD (Four Channels-Tunable)	60.4	66.4			
TN12LQMS	-	29.0	32.3	1.3/2.9	1	IU1-IU8, IU11-IU16
TN11LSX	800 ps/nm-C Band (odd & even wavelengths)-Fixed	47.7	50.1	1.3/2.9	1	IU1-IU17

Board	Module Type	Typical Power Consumption at 25°C (77°F) (W)	Maximum Power Consumption at 55°C (131°F)(W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots
	Wavelength-NRZ-PIN 800 ps/nm-C Band-Fixed Wavelength-NRZ-PIN					
	1200 ps/nm-C Band-Tunable Wavelength-NRZ-PIN 1200 ps/nm-C Band-Tunable Wavelength-NRZ-APD	47.9	50.9			
	800 ps/nm-C Band-Tunable Wavelength-DRZ-PIN	49.7	52.7			
	4800 ps/nm-C Band-Tunable Wavelength-ODB-APD	52.7	55.7			
TN12LSX	800 ps/nm-C Band (odd & even wavelengths)-Fixed Wavelength-NRZ-PIN 800 ps/nm-C Band-Fixed Wavelength-NRZ-PIN	30.5	36.6	1.4/3.1	1	IU1-IU17
	1200 ps/nm-C Band-Tunable	30.7	36.8			

Board	Module Type	Typical Power Consumption at 25°C (77°F) (W)	Maximum Power Consumption at 55°C (131°F)(W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots
	Wavelength-NRZ-PIN 1200 ps/nm-C Band-Tunable Wavelength-NRZ-APD					
	800 ps/nm-C Band-Tunable Wavelength-DRZ-PIN	32.5	39			
	4800 ps/nm-C Band-Tunable Wavelength-ODB-APD	35.5	42.6			
TN13LSX	800 ps/nm-C Band (Odd & Even Wavelengths)-Fixed Wavelength-NRZ-PIN-XFP	27.0	30.4	1.1/2.4	1	IU1-IU17
	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN-XFP	28.0	31.4			
	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN	29.4	32.8			
	800 ps/nm-C Band-Tunable Wavelength-DRZ-PIN	29.5	33.9			

Board	Module Type	Typical Power Consumption at 25°C (77°F) (W)	Maximum Power Consumption at 55°C (131°F)(W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots
TN11LSXL	400 ps/nm-C Band-Tunable Wavelength-DRZ-PIN	103.0	110.0	5.0/11.0	4	IU1-IU14
	500 ps/nm-C Band-Tunable Wavelength-ODB-PIN	98.0	101.0			
TN12LSXL	500 ps/nm-C Band-Tunable Wavelength-ODB-PIN	74.0	81.0	4.1/9.0	3	IU3-IU17
	500 ps/nm-C Band-Tunable Wavelength-DQPSK-PIN	84.0	94.0			
TN11LSXLR	400 ps/nm-C Band-Tunable Wavelength-DRZ-PIN	87.0	90.0	3.1/6.8	4	IU1-IU14
	500 ps/nm-C Band-Tunable Wavelength-ODB-PIN	82.0	85.0			
TN11LSQ	800 ps/nm-C Band-Tunable Wavelength-ODB-PIN	75	82	2.5/5.5	2	IU2-IU17
	800 ps/nm-C Band-Tunable Wavelength-DQPSK-PIN	82	89			
TN12LSXLR	500 ps/nm-C Band-Tunable	75	79	2.5/5.5	2	IU2-IU17

Board	Module Type	Typical Power Consumption at 25°C (77°F) (W)	Maximum Power Consumption at 55°C (131°F)(W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots
	Wavelength-DQPSK-PIN					
	500 ps/nm-C Band-Tunable Wavelength-ODB-PIN	67.0	70.0			
TN11LSXR	800 ps/nm-C Band (odd & even wavelengths) -Fixed Wavelength-NRZ-PIN 800 ps/nm-C Band-Fixed Wavelength-NRZ-PIN	34.8	37.8	1.2/2.6	1	IU1-IU17
	1200 ps/nm-C Band-Tunable Wavelength-NRZ-PIN 1200 ps/nm-C Band-Tunable Wavelength-NRZ-APD	35.0	38			
	800 ps/nm-C Band-Tunable Wavelength-DRZ-PIN	36.8	39.8			
	4800 ps/nm-C Band-Tunable Wavelength-ODB-APD	39.8	42.8			
TN11LWX2	-	38.5	42.4	1.3/2.9	1	IU1-IU17
TN11LWXD	-	35.8	39.4	1.2/2.6	1	IU1-IU17

Board	Module Type	Typical Power Consumption at 25°C (77°F) (W)	Maximum Power Consumption at 55°C (131°F)(W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots
TN11LWXS/ TN12LWXS	-	33.9	37.3	1.1/2.4	1	IU1-IU17
TN11M40	-	10.0	13.0	2.2/4.8	3	IU1-IU15
TN12M40	-	10.0	13.0	2.0/4.4	2	IU1-IU16
TN11M40V	-	20.0	25.0	2.3/5.1	3	IU1-IU15
TN12M40V	-	16.0	26.0	2.3/5.1	2	IU1-IU16
TN11MCA4	-	8.0	8.5	1.9/4.2	2	IU1-IU16
TN11MCA8	-	12.0	13.0	1.9/4.2	2	IU1-IU16
TN11MR2	-	0.2	0.3	0.9/2.0	1	IU1-IU17
TN11MR4	-	0.2	0.3	0.9/2.0	1	IU1-IU17
TN11MR8	-	0.2	0.3	1.0/2.2	2	IU1-IU16
TN11MR8V	-	7.7	8.6	1.0/2.2	2	IU1-IU16
TN11ND2	800 ps/nm-C Band (Odd & Even Wavelength)-Fixed Wavelength-NRZ-PIN	61.1	68.4	1.6/3.5	1	IU1-IU8, IU11-IU16
	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN	62.7	70.2			
	800 ps/nm-C Band-Tunable Wavelength-DRZ-PIN	68.4	76.6			
TN12ND2	800 ps/nm-C Band-Tunable Wavelength-DRZ-PIN	62.0	69.0	1.6/3.5	1	IU1-IU8, IU11-IU16
	800 ps/nm-C Band-Tunable Wavelength-	57.2	64.0			

Board	Module Type	Typical Power Consumption at 25°C (77°F) (W)	Maximum Power Consumption at 55°C (131°F)(W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots
	NRZ-PIN					
	800 ps/nm-C Band (Odd & Even Wavelengths)-Fixed Wavelength-NRZ-PIN-XFP 10Gbit/s Multirate - 10km 10Gbit/s Multirate - 40km 10 Gbit/s Multirate-80 km	46.0	52.0			
TN52ND2	800 ps/nm-C Band-Tunable Wavelength-DRZ-PIN	67.8	74.6	1.4/3.1	1	IU1-IU8, IU11-IU16
	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN	70.5	77.5			
TN53ND2	800 ps/nm-C Band (Odd & Even Wavelengths)-Fixed Wavelength-NRZ-PIN-XFP	25	28	1.2/2.6	1	IU1-IU8, IU11-IU16
	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN-XFP					
	10Gbit/s Multirate -					

Board	Module Type	Typical Power Consumption at 25°C (77°F) (W)	Maximum Power Consumption at 55°C (131°F)(W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots
	10km 10Gbit/s Multirate - 40km					
TN51NQ2	800 ps/nm-C Band (Odd & Even Wavelengths)-Fixed Wavelength-NRZ-PIN-XFP	88.0	95.0	1.6/3.5	1	IU1-IU8, IU11-IU16
	10Gbit/s Multirate - 10km 10Gbit/s Multirate - 40km 10Gbit/s Multirate - 80km					
	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN-XFP					
TN52NQ2	800 ps/nm-C Band (Odd & Even Wavelengths)-Fixed Wavelength-NRZ-PIN-XFP	88.0	97.0	2.0/4.4	1	IU1-IU8, IU11-IU16
	10Gbit/s Multirate - 10km 10Gbit/s Multirate - 40km					
	800 ps/nm-C Band-Tunabl					

Board	Module Type	Typical Power Consumption at 25°C (77°F) (W)	Maximum Power Consumption at 55°C (131°F)(W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots
	e Wavelength-NRZ-PIN-XFP					
TN53NQ2	800 ps/nm-C Band (Odd & Even Wavelengths)-Fixed Wavelength-NRZ-PIN-XFP	46.5	50	1.6/3.5	1	IU1-IU8, IU11-IU16
	10Gbit/s Multirate - 10km 10Gbit/s Multirate - 40km					
	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN-XFP					
TN11NS2	800 ps/nm-C Band (odd & even wavelengths)-Fixed Wavelength-NRZ-PIN 800 ps/nm-C Band-Fixed Wavelength-NRZ-PIN	38.0	41.8	1.2/2.64	1	IU1-IU8, IU11-IU16
	1200 ps/nm-C Band-Tunable Wavelength-NRZ-PIN 1200 ps/nm-C Band-Tunabl	39.0	42.9			

Board	Module Type	Typical Power Consumption at 25°C (77°F) (W)	Maximum Power Consumption at 55°C (131°F)(W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots
	e Wavelength-NRZ-APD					
	800 ps/nm-C Band-Tunable Wavelength-DRZ-PIN	41.0	45.1			
	4800 ps/nm-C Band-Tunable Wavelength-ODB-APD	44.0	48.4			
TN12NS2	800 ps/nm-C Band (Odd & Even Wavelength)-Fixed Wavelength-NRZ-PIN	38.8	43.4	1.2/2.64	1	IU1-IU8, IU11-IU16
	1200 ps/nm-C Band-Tunable Wavelength-NRZ-PIN 1200 ps/nm-C Band-Tunable Wavelength-NRZ-APD	39.4	44.1			
	800 ps/nm-C Band-Tunable Wavelength-DRZ-PIN	39.7	44.46			
	4800 ps/nm-C Band-Tunable Wavelength-ODB-APD	42.5	47.6			

Board	Module Type	Typical Power Consumption at 25°C (77°F) (W)	Maximum Power Consumption at 55°C (131°F)(W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots
	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN	30.32	34.0			
	800 ps/nm-C Band (Odd & Even Wavelengths)-Fixed Wavelength-NRZ-PIN-XFP	25.35	28.39			
TN52NS2	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN	46.5	51.1	1.3/2.86	1	IU1-IU8, IU11-IU16
	800 ps/nm-C Band-Tunable Wavelength-DRZ-PIN	49.1	54.01			
TN53NS2	800 ps/nm-C Band (Odd & Even Wavelengths)-Fixed Wavelength-NRZ-PIN-XFP	20	24	1.0/2.2	1	IU1-IU8, IU11-IU16
	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN-XFP	21	25			
	10Gbit/s Multirate - 10km 10Gbit/s Multirate - 40km	20	24			

Board	Module Type	Typical Power Consumption at 25°C (77°F) (W)	Maximum Power Consumption at 55°C (131°F)(W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots
TN11NS3	500 ps/nm-C Band-Tunable Wavelength-ODB-PIN	92	101.2	2.5/5.5	2	IU2-IU8, IU12-IU16
	500 ps/nm-C Band-Tunable Wavelength-DQPSK-PIN	67.0	75.0			
TN52NS3	500 ps/nm-C Band-Tunable Wavelength-DQPSK-PIN	118.0	130.0	2.4/5.3	2	IU2-IU8, IU12-IU16
	500 ps/nm-C Band-Tunable Wavelength-ODB-PIN	110.0	118.0			
	800 ps/nm-C Band-Tunable Wavelength-DQPSK-PIN	118.0	130.0			
TN54NS3	800 ps/nm-C Band-Tunable Wavelength-DQPSK-PIN	73.0	80.0	1.8/3.96	1	IU1-IU8, IU11-IU16
	800 ps/nm-C Band-Tunable Wavelength-ODB-PIN	60.0	65.0			
		62.0	69.0			
TN55NS3	-	135	150	2.6/5.73	2	IU2-IU8, IU12-IU16
TN11OAU101	-	18.0	24.0	1.8/4.0	2	IU2-IU17
TN11OAU10	-	14.0	18.0	1.8/4.0	2	IU2-IU17

Board	Module Type	Typical Power Consumption at 25°C (77°F) (W)	Maximum Power Consumption at 55°C (131°F)(W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots
2						
TN11OAU103	-	18.0	24.0	1.8/4.0	2	IU2-IU17
TN11OAU105	-	22.0	29.0	1.8/4.0	2	IU2-IU17
TN12OAU100	-	11.0	14.0	1.8/4.0	2	IU2-IU17
TN12OAU101	-	12.0	15.0	1.8/4.0	2	IU2-IU17
TN12OAU102	-	10.0	13.0	1.8/4.0	2	IU2-IU17
TN12OAU103	-	12.0	15.0	1.8/4.0	2	IU2-IU17
TN12OAU105	-	15.0	21.0	1.8/4.0	2	IU2-IU17
TN13OAU101	-	12.0	15.0	1.6/3.6	1	IU1-IU17
TN13OAU103	-	12.0	15.0	1.6/3.6	1	IU1-IU17
TN13OAU105	-	15.0	21.0	1.6/3.6	1	IU1-IU17
TN11OBU101	-	11.0	13.0	1.3/2.9	1	IU1-IU17
TN11OBU103	-	13.0	15.0	1.3/2.9	1	IU1-IU17
TN11OBU104	-	12.0	14.0	1.3/2.9	1	IU1-IU17
TN12OBU101	-	10.0	11.0	1.1/2.4	1	IU1-IU17
TN12OBU103	-	11.0	12.0	1.1/2.4	1	IU1-IU17
TN12OBU104	-	10.0	12.0	1.1/2.4	1	IU1-IU17
TN12OBU1P1	-	10.0	11.0	1.1/2.4	1	IU1-IU17
TN11OBU20	-	17.0	24.0	1.9/4.2	2	IU2-IU17

Board	Module Type	Typical Power Consumption at 25°C (77°F) (W)	Maximum Power Consumption at 55°C (131°F)(W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots
5						
TN12OBU205	-	14.0	19.0	1.6/3.5	2	IU2-IU17
TN11OLP	-	6.0	6.6	0.9/2.0	1	IU1-IU17
TN12OLP	-	4.0	4.5	1.0/2.2	1	IU1-IU17
TN11OPM8	-	12.0	15.0	1.2/2.6	1	IU1-IU17
TN11PIU	-	24.0	38.0	0.5/1.1	1	IU19, IU20
TN12PTQX	-	93.4	107.6	3/6.6	2	IU2-IU3, IU6-IU7, IU12-IU13
TN11RDU9	-	6	6.6	1.1/2.4	1	IU1-IU17
TN11RMU901	-	7.7	8.6	1.1/2.4	1	IU1-IU17
TN11RMU902	-	8.2	9.0			
TN11ROAM	-	66.0	72.6	3.2/7.0	3	IU1-IU15
TN11SBM2	-	0.2	0.3	0.8/1.8	1	IU1-IU17
TN11SC1/ TN12SC1	-	11.0	14.9	1.0/2.2	1	IU1-IU17
TN11SC2/ TN12SC2	-	13.5	14.5	1.0/2.2	1	IU1-IU17
TN11ST2	-	17.5	19.5	0.95/2.09	1	IU1-IU8, IU11–IU16
TN11SCC	-	27.0	30.0	1.2/2.6	1	IU17, IU18
TN51SCC	-	18.0	20.0	1.2/2.6	1	IU17, IU18
TN52SCC	-	23.0	25.1	1.0/2.2	1	IU17, IU18
TN11SCS	-	0.2	0.3	0.8/1.8	1	IU1-IU17
TN11STG	-	8.7	9.57	1.1/2.4	1	IU15, IU16
TN11TBE	-	40.7	44.8	1.4/3.1	1	IU1-IU8, IU11-IU16
TN11TDC	-	13.0	15.0	0.5/1.1	1	IU1-IU17
TN11TDG	-	30.0	33.0	1.1/2.4	1	IU1-IU8, IU11-IU16

Board	Module Type	Typical Power Consumption at 25°C (77°F) (W)	Maximum Power Consumption at 55°C (131°F)(W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots
TN11TDX	-	78.0	80.0	1.3/2.8	1	IU1-IU8, IU11-IU16
TN12TDX	-	37.4	40.7	1.4/3.1	1	IU1-IU8, IU11-IU16
TN52TDX	-	57.3	63.0	1.4/3.1	1	IU1-IU8, IU11-IU16
TN53TDX	-	25	35.0	1.5/3.3	1	IU1-IU8, IU11-IU16
TN11TMX	800 ps/nm-C Band (odd & even wavelengths)-Fixed Wavelength-NRZ-PIN 800 ps/nm-C Band-Fixed Wavelength-NRZ-PIN	40.3	44.3	1.4/3.1	1	IU1-IU17
	1200 ps/nm-C Band-Tunable Wavelength-NRZ-PIN 1200 ps/nm-C Band-Tunable Wavelength-NRZ-APD	42.1	46.4			
	800 ps/nm-C Band-Tunable Wavelength-DRZ-PIN	44.5	51.2			
	4800 ps/nm-C Band-Tunable Wavelength-ODB-APD	48.4	55.7			

Board	**Module Type**	**Typical Power Consumption at 25°C (77°F) (W)**	**Maximum Power Consumption at 55°C (131°F)(W)**	**Weight (kg/lb.)**	**Number of Occupied Slots**	**Valid Slots**
TN12TMX	800 ps/nm-C Band (Odd & Even Wavelengths)-Fixed Wavelength-NRZ-PIN-XFP	31.4	36.1	1.2/2.6	1	IU1-IU17
	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN-XFP	32.4	37.1			
	800 ps/nm-C Band-Tunable Wavelength-DRZ-PIN	41.0	45.5			
	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN	39.0	43.7			
	10Gbit/s Multirate - 10km 10Gbit/s Multirate - 40km 10Gbit/s Multirate - 80km	31.4	36.1			
TN52TOG	-	41.8	46.0	0.85/1.87	1	IU1-IU8, IU11-IU16
TN11TOM	-	55.0	60.0	1.4/3.1	1	IU1-IU8, IU11-IU16
TN52TOM	-	81	89.1	1.5/3.3	1	IU1-IU8, IU11-IU16
TN11TQM	-	50.3	57.6	1.2/2.6	1	IU1-IU8, IU11-IU16

Board	Module Type	Typical Power Consumption at 25°C (77°F) (W)	Maximum Power Consumption at 55°C (131°F)(W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots
TN12TQM	-	25.0	27.5	1.1/2.4	1	IU1-IU8, IU11-IU16
TN11TQS	-	43.0	47.3	1.2/.6	1	IU1-IU8, IU11-IU16
TN11TQX	-	65.0	71.2	1.5/3.3	1	IU1-IU8, IU11-IU16
TN52TQX	-	91.5	100.0	1.6/3.5	1	IU1-IU8, IU11-IU16
TN55TQX	-	45.0	50.0	1.6/3.5	1	IU1-IU8, IU11-IU16
TN11TSXL	-	90.2	96.0	2.5/5.5	2	IU2-IU8, IU12-IU16
TN11VA1/TN12VA1	-	6.5	7.2	1.0/2.2	1	IU1-IU17
TN11VA4/TN12VA4	-	8.5	9.4	1.0/2.2	1	IU1-IU17
TN11WMU	-	12.0	15.0	1.0/2.2	1	IU1-IU17
TN11WSD9	-	17.0	18.7	2.2/4.8	2	IU1-IU16
TN12WSD9	-	25.4	28.5	2.7/5.94	2	IU1-IU16
TN13WSD9	-	25.4	28.5	2.9/6.38	3	IU1-IU15
TN11WSM9	-	17.0	18.7	2.2/4.8	2	IU1-IU16
TN12WSM9	-	25.4	28.5	2.7/5.94	2	IU1-IU16
TN13WSM9	-	25.4	28.5	2.9/6.38	3	IU1-IU15
TN11WSMD2	-	17.0	18.7	3.2/7.0	2	IU1-IU16
TN11WSMD4	-	17.0	18.7	3.2/7.0	2	IU1-IU16
TN12WSMD4	-	12.0	15.0	2.6/5.7	2	IU1-IU16
TN11WSMD9	-	25	30	3.1/6.8	2	IU1-IU16
TN11XCS	-	20.0	22.0	1.0/2.2	1	IU9, IU10
TN12XCS	-	25.0	27.5	1.2/2.6	1	IU9, IU10
a: When the FC extension function of the TN12LOM board is used, the power consumption of the board						

Board	Module Type	Typical Power Consumption at 25°C (77°F) (W)	Maximum Power Consumption at 55°C (131°F)(W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots
increases by another 2 W.						