OptiX OSN 8800 T64/T32 Intelligent Optical Transport Platform V100R006C01

Product Overview

Issue 03

Date 2012-03-29

HUAWEI TECHNOLOGIES CO., LTD.

Trademarks and Permissions

Notice

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

Contents

1 Introduction

About This Chapter

The OptiX OSN 8800 T32 and OptiX OSN 8800 T64 are mainly applicable to the backbone core layers. They are also applicable to the core layers and metropolitan convergence layers.

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

1.1 Positioning

The OptiX OSN 8800 T32 and OptiX OSN 8800 T64 are mainly applicable to the backbone core layers. They are also applicable to the core layers and metropolitan convergence layers.

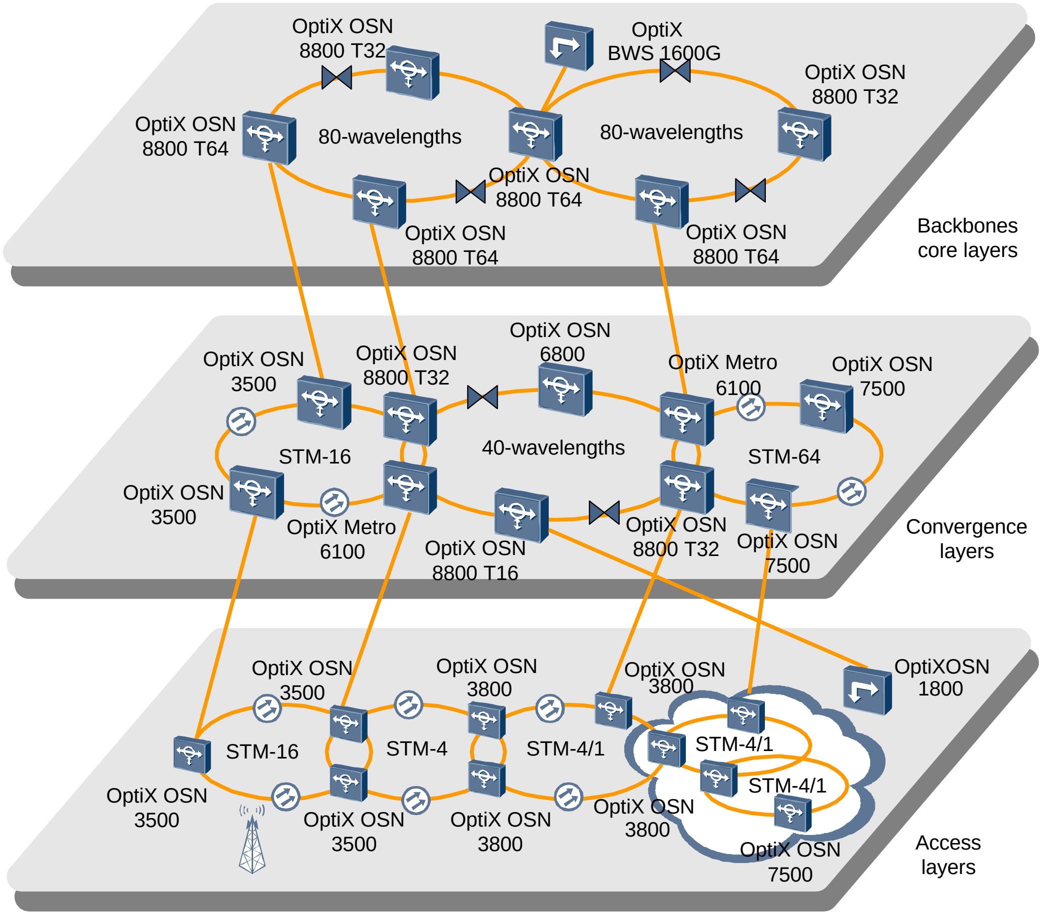
The OptiX OSN 8800 T32 and OptiX OSN 8800 T64 can be used with the metropolitan DWDM equipment, SDH equipment, and data communication equipment at the backbone layer to provide a large-capacity transport channel for services and network egresses. The OptiX OSN 8800 T32 and OptiX OSN 8800 T64 apply to the long-distance and large-capacity transmission of nation-level trunk and inter-province trunk to maximally meet the requirements of large-capacity and ultra-long haul transmission for carriers. In addition, the OptiX OSN 8800 T32 and OptiX OSN 8800 T64 provide carriers with a stable platform for multi-service operation and future network capacity expansion.

The OptiX OSN 8800 T32 and OptiX OSN 8800 T64 use dense wavelength division multiplexing (DWDM) technologies to achieve transparent transmission with multiple services and large capacity. It not only provides service grooming at the optical layer on a wavelength basis by using the ROADM technology, but also provides sub-wavelength grooming based on ODUflex/ODU3/ODU2/ODU1/ODU0. This improves the flexibility in service grooming and bandwidth utilization to a great extent.

The OptiX OSN 8800 can interconnect with the OptiX OSN 6800/OptiX OSN 3800/OptiX OSN 1800 to form an end-to-end OTN network. Also, they can interconnect with the OptiX BWS 1600G to form a WDM network. Typically, the OptiX OSN 8800 is applied to the OTN network. In addition, the OptiX OSN 8800 can interconnect with the NG SDH/PTN or data communication equipment to form a hybrid network, realizing a complete transport solution.

This is usually applied to the OCS network. Figure 1-1 and Figure 1-2 show the position of the OptiX OSN 8800 T32 and OptiX OSN 8800 T64 in the overall network hierarchy.

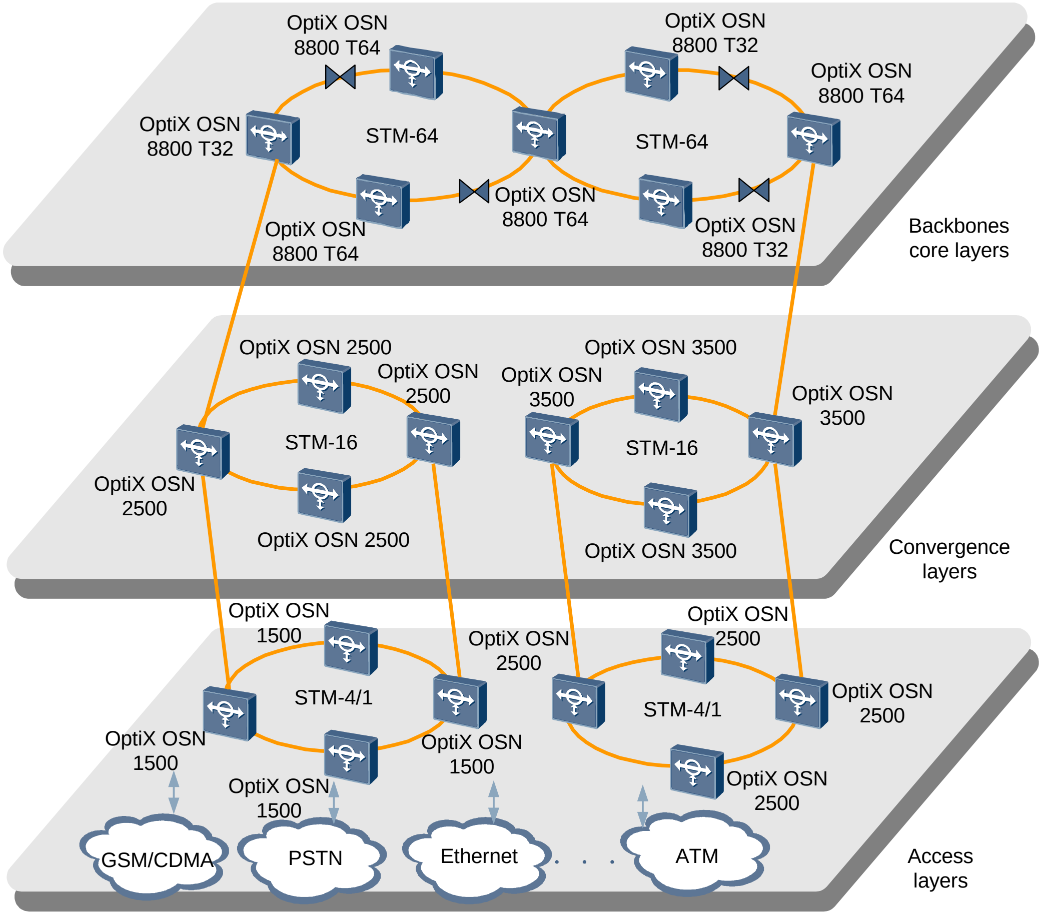
Figure 1-1 Position of the OptiX OSN 8800 in the network hierarchy (OTN network)



NOTE

The OptiX OSN 8800 provides OptiX OSN 8800 T64 subracks, OptiX OSN 8800 T32 subracks and OptiX OSN 8800 T16 subracks.

Figure 1-2 Position of the OptiX OSN 8800 in the network hierarchy (OCS network)



NOTE
The OptiX OSN 8800 provides OptiX OSN 8800 T64 subracks and OptiX OSN 8800 T32 subracks.

1.2 Product Features

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

Transmission Equipment with High Integration and Ultra Capacity

The equipment is of high integration, which enables flexible service configuration. A network built with the equipment is easy to design, to expand, and to maintain, and requires a smaller number of spare parts.

The equipment supports access of massive services and centralized cross-connections and management of the services. This avoids assembly of multiple subracks. The equipment is of high integration. For example, one PID chip is integrated with tens of photoelectric components to achieve 12 x 10G transmission.

When used as an 80/40-channel system, the OptiX OSN 8800 supports:

- Service access over one channel of 2.5 Gbit/s, 10 Gbit/s, 40 Gbit/s.
- Transmission of 10 Gbit/s services over a distance of 5000 km, 40 Gbit/s services over a distance of 2000 km without electrical regeneration.
- Ultra long-haul transmission of 10 Gbit/s services over a 1 x 82 dB single span.

The OptiX OSN 8800 CWDM systems support service access over eight wavelengths. Each wavelength supports a maximum rate of 2.5 Gbit/s.

The ASIC and PID technologies enable design of a board with high density and help reduce power consumption of each port. Ultra cross-connections help reduce bridging at many ODF and also save space in telecommunications rooms.

The OptiX OSN 8800 T32 supports centralized cross-connections through a cross-connect board. The OptiX OSN 8800 T32 provides one type of cross-connection boards, that is, XCH. It supports hybrid cross-connections of ODU0, ODU1, ODU2, ODU3, and ODUflex signals, and supports a 1.28 Tbit/s cross-connect capacity to the maximum.

The OptiX OSN 8800 T64 provides three types of cross-connect boards, that is, XCT, SXH and SXM. The XCT must be used together with SXH or SXM. The OptiX OSN 8800 T64 supports hybrid cross-connections of ODU0, ODU1, ODU2, ODU3, and ODUflex signals, and supports a 2.56 Tbit/s cross-connect capacity to the maximum.

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.

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 8800 system uses the L0 + L1 + L2 architecture. Ethernet switching is implemented on Layer 2, ODUk/VC switching on Layer 1, and wavelength switching on Layer 0.

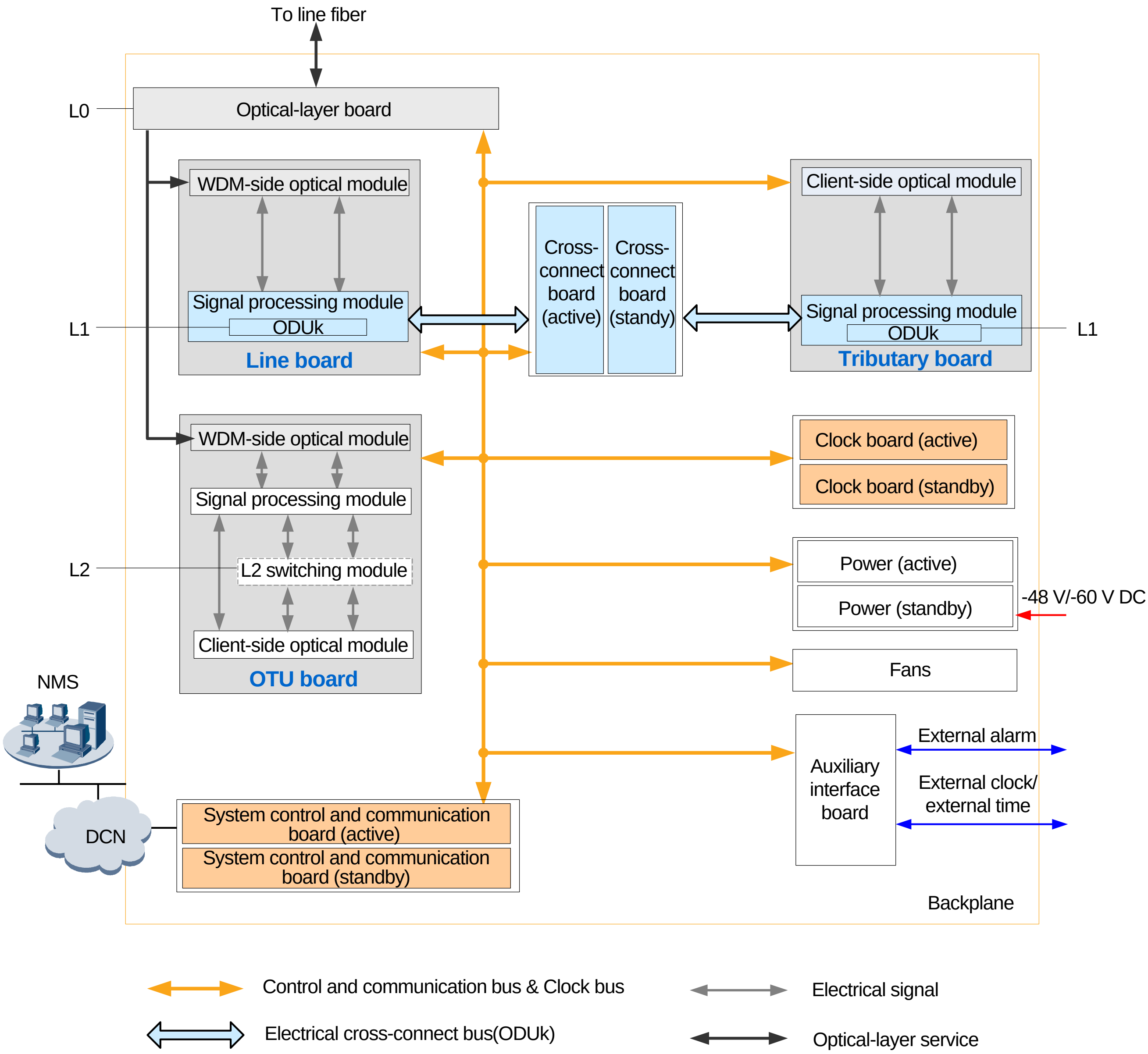
The system software includes the board software, NE software and the network management system.

2.1 System Architecture

The OptiX OSN 8800 system uses the L0 + L1 + L2 architecture. Ethernet switching is implemented on Layer 2, ODUk/VC switching on Layer 1, and wavelength switching on Layer 0.

Figure 2-1 and Figure 2-2 show the system architecture of the OptiX OSN 8800 used as an OTN and an OCS system, respectively.

Figure 2-1 System architecture of the OptiX OSN 8800 (OTN)

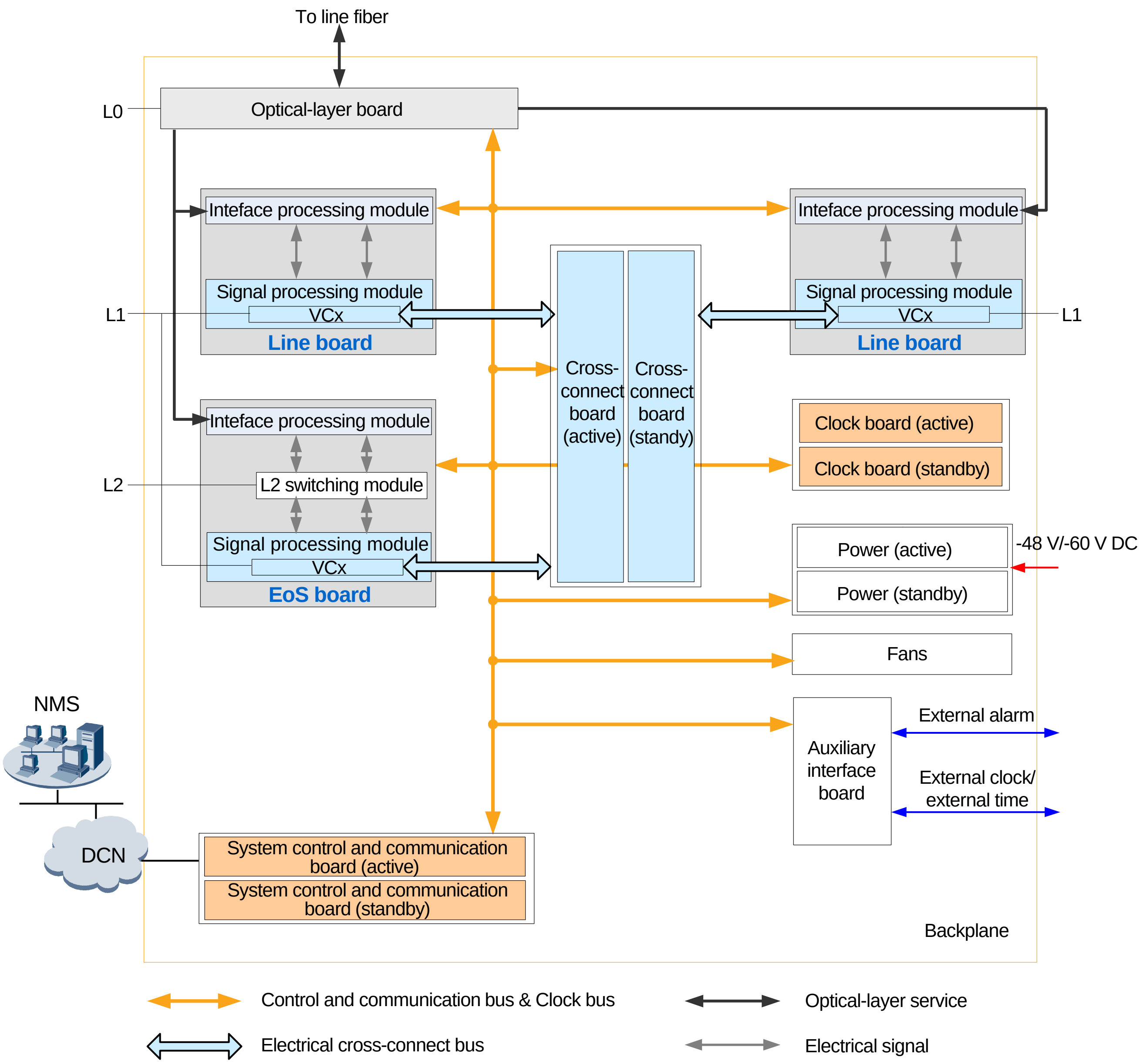


NOTE

In Figure 2-1, **L2 switching module** is marked in a dotted line box, indicating that not all the OTU or tributary boards provide a Layer 2 switching module.

- An OTU board equipped with a Layer 2 switching module is referred to as an Ethernet over WDM (EoW) board.
- A tributary board equipped with a Layer 2 switching module is referred to as an Ethernet over OTN (EoO) board.

Figure 2-2 System architecture of the OptiX OSN 8800 (OCS)



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. The OptiX OSN 8800 uses a tributary-line-separate architecture, and a centralized cross-connect unit to flexibly groom electrical-layer signals at different granularities.
- For OptiX OSN 8800, EoO, EoW, Ethernet over SDH (EoS) boards 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 8800 T32 is installed in N63B cabinet. The OptiX OSN 8800 T64 is installed in N66B cabinet. In typical configuration, the OptiX OSN 8800 T32 and the OptiX OSN 8800 T16 are installed in N63B cabinet. The OptiX OSN 8800 T64 is installed in N66B cabinet.

The OptiX OSN 8800 T32/ has subracks as the basic working units. The subrack of the OptiX OSN 8800 T32 has independent power supply and can be installed in N63B cabinet, or N66B cabinet.

The OptiX OSN 8800 T64 has subracks as the basic working units. The subrack of the OptiX OSN 8800 T64 has independent power supply and can be installed in 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 8800 T32, 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 2-3 shows the appearance of the N63B cabinet.

Figure 2-3 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 + 1 x DCM frame	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.

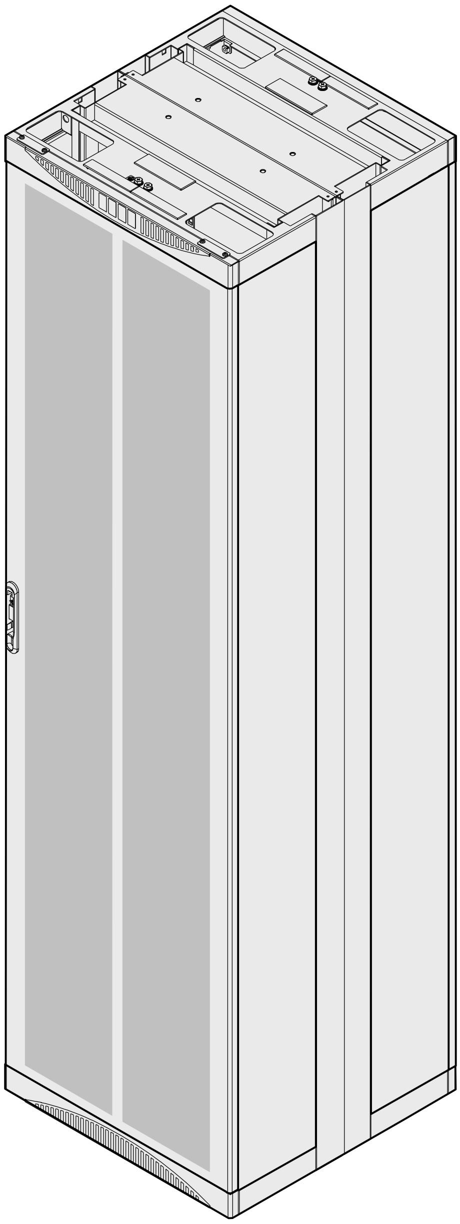
The following subracks can be installed on the N66B cabinet: OptiX OSN 8800 T64, OptiX OSN 8800 T32, OptiX OSN , and OptiX OSN 6800.

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 2-4 shows the appearance of the N66B cabinet.

Figure 2-4 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 8800 T64 and OptiX OSN 8800 T32 take 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. The air circuit breaker has a rated value of 60 A.

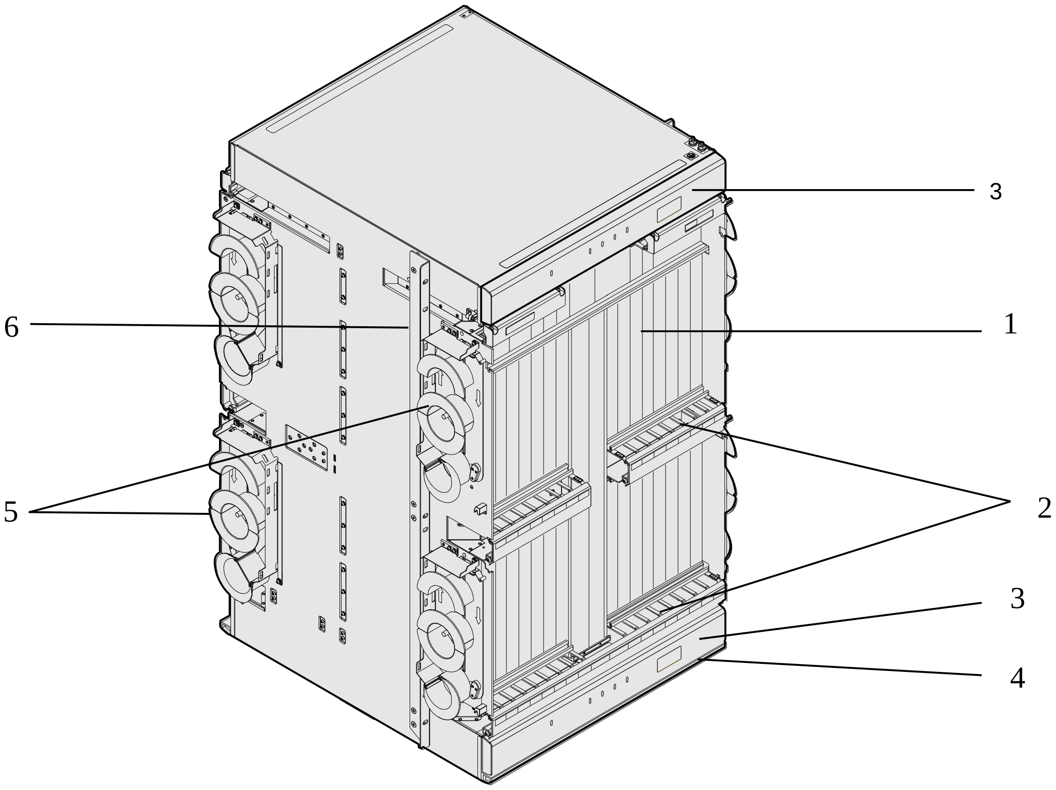
Structure of the OptiX OSN 8800 T64

Subracks are the basic working units of the OptiX OSN 8800 T64. Each subrack has independent power supply.

Figure 2-5 shows the structure of the OptiX OSN 8800 T64 subrack.

Table 2-3 describes the mechanical specifications of the 8800 T64 subrack.

Figure 2-5 OptiX OSN 8800 T64 subrack structure



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

- Board area: All the boards are installed in this area. 93 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.
- Fan tray assembly: Four fan tray assemblies are available for this subrack. Each fan tray assembly contains three fans that provide ventilation and heat dissipation for the subrack. The front panel of the fan tray assembly has four indicators that indicate fan status and related information.

NOTE

For detailed descriptions of the fan tray assembly, see Fan.

- Air filter: It 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.

Table 2-3 Mechanical specifications of the OptiX OSN 8800 T64

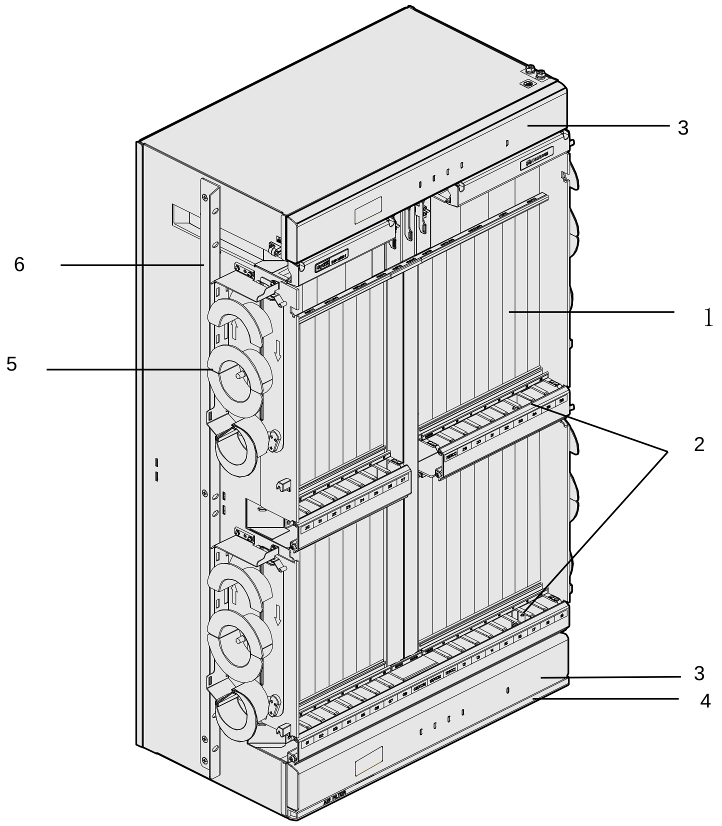
Item	Specification
Dimensions	498 mm (W) ×580 mm (D) ×900 mm (H) (19.6 in. (W) ×22.8 in. (D) ×35.4 in. (H))
Weight (empty subrack[a])	65 kg (143 lb.)
a: An empty subrack means no boards are installed in the board area, and no fan tray assembly or air filter is installed.	

Structure of the OptiX OSN 8800 T32

Subracks are the basic working units of the OptiX OSN 8800 T32. Each subrack has independent power supply.

Figure 2-6 shows the structure of the OptiX OSN 8800 T32 subrack.

Figure 2-6 OptiX OSN 8800 T32 subrack structure diagram



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

- Board area: All the boards are installed in this area. 50 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.
- Fan tray assembly: Fan tray assembly contains three fans that provide ventilation and heat dissipation for the subrack. The front panel of the fan tray assembly has four indicators that indicate subrack status.

NOTE
For detailed descriptions of the fan tray assembly, see Fan.

- Air filter: It 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.

Table 2-4 Mechanical specifications of the OptiX OSN 8800 T32

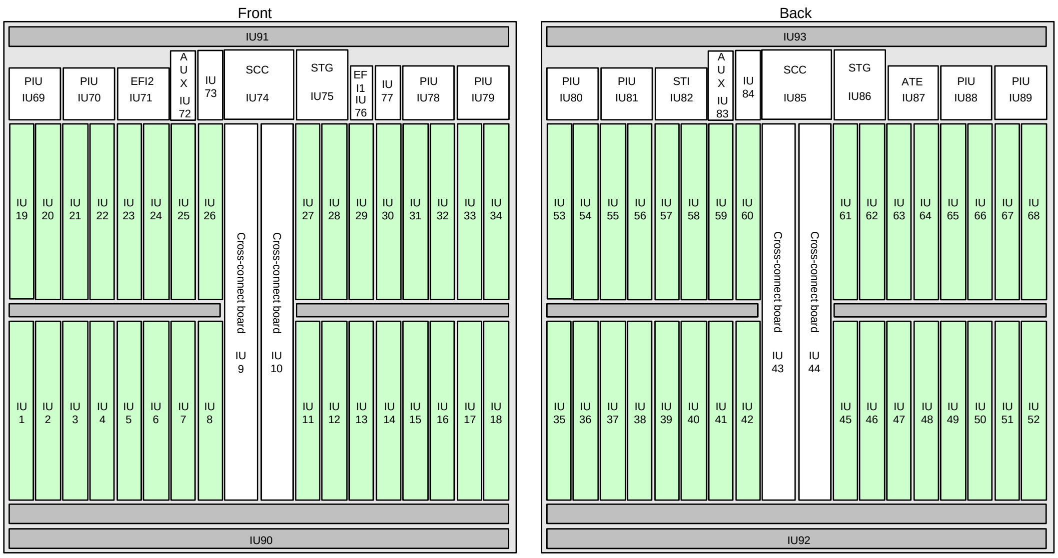
Item	Specification
Dimensions	498 mm (W) × 295 mm (D) × 900 mm (H) (19.6 in. (W) × 11.6 in. (D) × 35.4 in. (H))
Weight (empty subrack[a])	35 kg (77.1 lb.)
a: An empty subrack means no boards are installed in the board area, and no fan tray assembly or air filter is installed.	

Slot Distribution of the OptiX OSN 8800 T64

The board area and interface area of an OptiX OSN 8800 T64 subrack provide 93 slots.

Slots of the OptiX OSN 8800 T64 subrack are shown in Figure 2-7.

Figure 2-7 Slots of the OptiX OSN 8800 T64 subrack



- : houses service boards and supports service cross-connections.
- IU9 and IU43 are reserved for the cross-connect board (XCT).
- IU10 and IU44 are reserved for the cross-connect board (SXM/SXH).
- IU73, IU77 and IU84 are reserved for future use.
- The following table provides the slots for housing active and standby boards of the subrack.

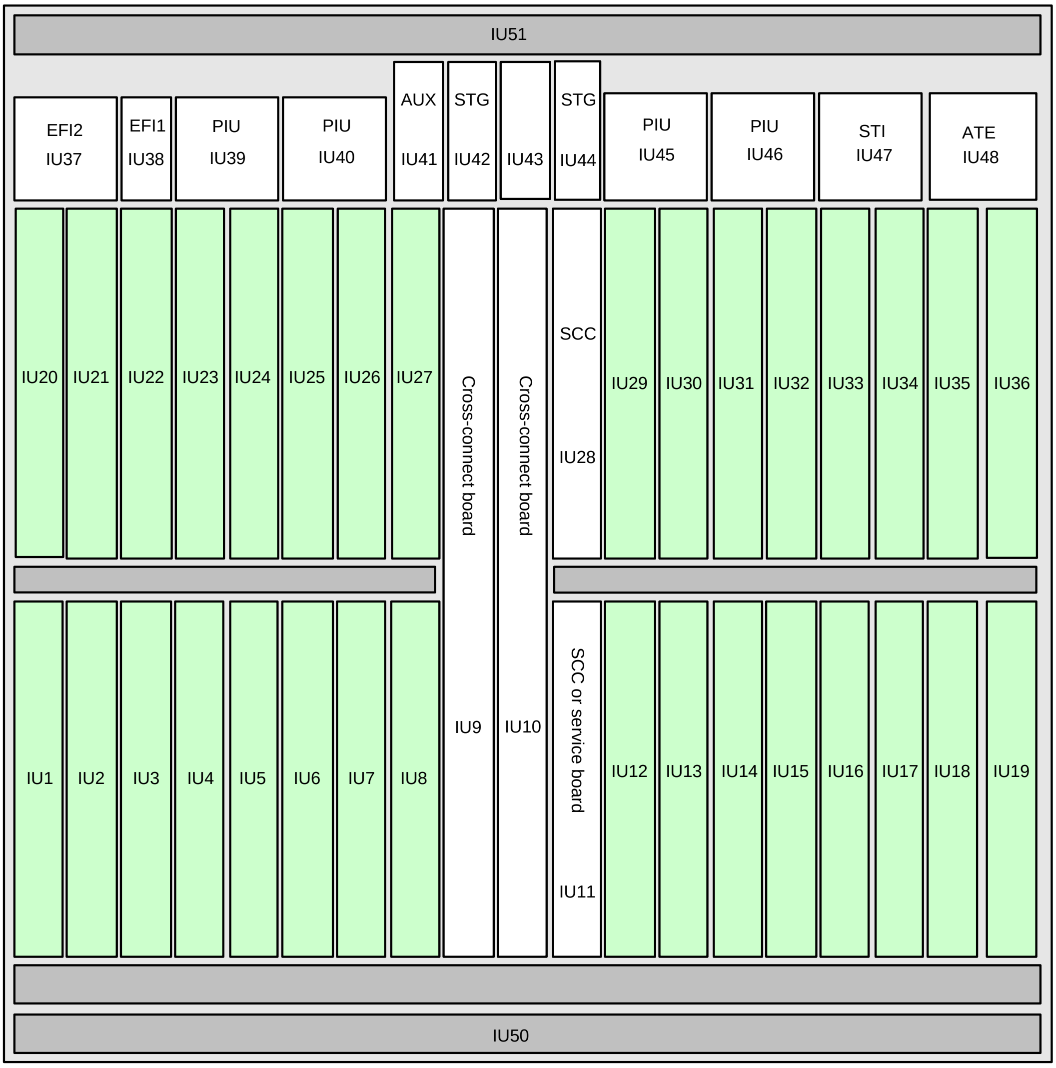
Board	Slots for Active and Standby Boards
PIU	IU69 & IU78, IU70 & IU79, IU80 & IU88, and IU81 &IU89
SCC	IU74 & IU85
STG	IU75 & IU86
SXM/SXH	IU10 & IU44
XCT	IU9 & IU43

Slot Distribution of the OptiX OSN 8800 T32

The board area and interface area of the OptiX OSN 8800 T32 subrack provide 50 slots.

Slots of the OptiX OSN 8800 T32 subrack are shown in Figure 2-8.

Figure 2-8 Slots of the OptiX OSN 8800 T32 subrack



- : houses service boards and supports service cross-connections.
- IU9 and IU10 are reserved for the cross-connect board (XCH/XCM).
- IU43 is reserved for future use.
- The following table provides the slots for housing active and standby boards of the subrack.

Board	Slots for Active and Standby Boards
PIU	IU39 & IU45 and IU40 & IU46
SCC	IU28 & IU11
STG	IU42 & IU44
XCH/XCM	IU9 & IU10

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 2-5.

Table 2-5 Functional boards

Functional boards	Boards
Optical transponder board	LDM, LDMD, LDMS, LDX, LEM24, LEX4, LOG, LOM, LQM, LQMD, LQMS, LSQ, LSXL, LSXLR, LSX, LSXR, LOA, LWXS, TMX
Tributary board	TOM, TQX, TDX, TOG, TOA, THA, TSXL
Line board	NS2, ND2, NS3, NQ2
PID board	NPO2, NPO2E, ENQ2, PQ2
OCS board	BPA, EGSH, SF64A, SLH41, SLO16, SLQ64, SF64, SFD64, SL64, SLD64, SLQ16, EAS2
Cross-connect unit and system and communication unit	AUX, SCC, XCH, XCM[a], SXH[b], SXM[b], XCT[b]
Optical multiplexer/demultiplexer board	FIU, D40, D40V, M40, M40V, ITL, SFIU
Fixed optical add and drop multiplexer board	MR8V, CMR2, CMR4, DMR1, SBM2, MR8, MR2, MR4
Reconfigurable optical add and drop multiplexer board	ROAM, RDU9, RMU9, WSD9, WSM9, WSMD2, WSMD4, WSMD9
Optical amplifier board	CRPC, OAU1, OBU1, OBU2, HBA, DAS1
Optical supervisory channel (OSC) board	SC1, SC2, HSC1, ST2
Clock board	STG
Optical protection board	DCP, OLP, SCS
Spectrum analyzer board	MCA4, MCA8, WMU, OPM8
Optical power and dispersion equalizing board	DCU, GFU, TDC
Variable optical attenuator board	VA1, VA4
Interface Board	ATE, EFI1, EFI2, STI
a: Only the OptiX OSN 8800 T32 supports the board.	

Functional boards	Boards
b: Only the OptiX OSN 8800 T64 supports the board.	

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.

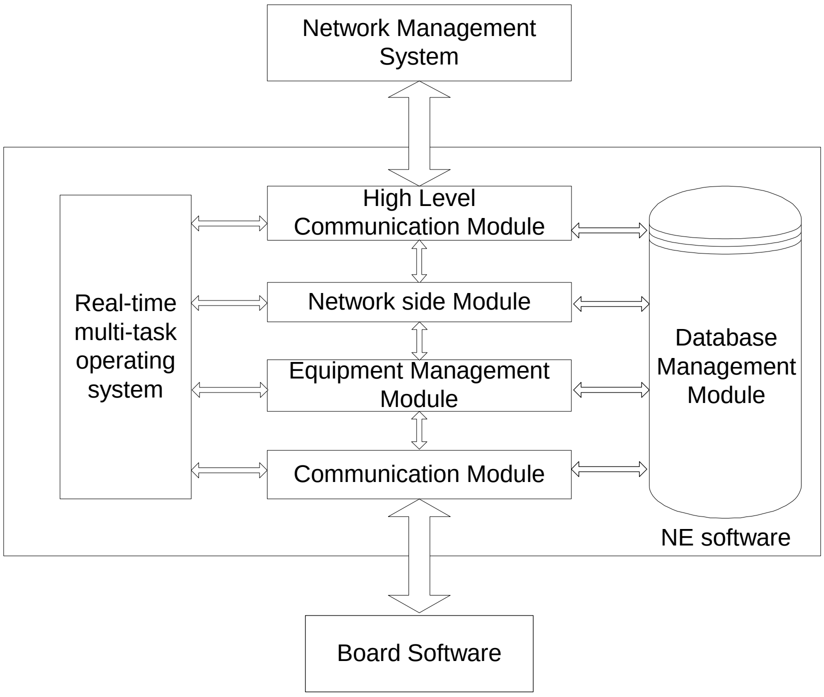
The entire software is distributed in three modules including board software, NE software and NM system.

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 2-9.

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

Figure 2-9 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

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

3.1 Service Access

The OptiX OSN 8800 T64/8800 T32 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 8800 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 and Table 3-2 lists the service types and rates that the OptiX OSN 8800 supports.

Table 3-1 Service types and rates that the OptiX OSN 8800 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	

Service Category	Service Type	Service Rate	Reference Standard
	FC200	2.12 Gbit/s	
	FC400	4.25 Gbit/s	
	FC800	8.5 Gbit/s	
	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

Table 3-2 Service types that the OptiX OSN 8800(OCS) supports

Service Category	Service Type	Reference Standard
SDH	• SDH standard services: STM-1/STM-4/STM-16/STM-64 • SDH standard cascaded services: VC-4-4c/VC-4-16c/VC-4-64c • SDH services with FEC: STM-64	• ITU-T G.707 • ITU-T G.691 • ITU-T G.957 • ITU-T G.783 • ITU-T G.825

Service Category	Service Type	Reference Standard
Ethernet service	• GE services • 10GE services	• IEEE 802.3u

3.1.2 Capability of Service Access

Table 3-3 lists the capability of service access when the OptiX OSN 8800 T64/8800 T32 functions as the equipment in the OCS system. Table 3-4 lists the capability of service access when the OptiX OSN 8800 T64/8800 T32 functions as the equipment in the OTN system.

Table 3-3 Capability of service access in the OCS system

Service Type	Maximum of Service Amount for a Board	Maximum of Service Amount for an 8800 T32 Subrack	Maximum of Service Amount for an 8800 T64 Subrack
STM-1	16	512	1024
STM-4	16	512	1024
STM-16	8	256	512
STM-64	4	128	256
GE	16	512	1024

Table 3-4 Capability of service access in the OTN system

Service Type	Maximum of Service Amount for a Board	Maximum of Service Amount for an 8800 T32 Subrack	Maximum of Service Amount for an 8800 T64 Subrack
FE	22	448	896
GE	22	336	672
10GE LAN	4	64	128
10GE WAN	4	64	128
STM-256/OC-768	1	16	32
STM-64/OC-192	4	64	128
STM-16/OC-48	16	256	512
STM-4/OC-12	16	400	816
STM-1/OC-3	16	448	896

Service Type	Maximum of Service Amount for a Board	Maximum of Service Amount for an 8800 T32 Subrack	Maximum of Service Amount for an 8800 T64 Subrack
OTU1	16	256	512
OTU2/OTU2e	4	64	128
OTU3	1	16	32
ESCON	16	448	896
FC100/FICON	16	336	672
FC200/FICON Express/InfiniBand 2.5G	16	336	672
FC400/FICON4G/InfiniBand 5G	2	64	128
FC800/FICON 8G	1	100	204
FC1200	1	32	64
ISC 1G	8	256	512
ISC 2G	4	128	256
ETR/CLO	8	128	256
HD-SDI	8	256	512
FDDI	8	256	512
DVB-ASI/SDI	16	448	896
3G-SDI	8	256	512

3.2 Electrical Layer Grooming

The OptiX OSN 8800 T64/8800 T32 supports the integrated grooming of electrical layer signals.

3.2.1 OTN Centralized Grooming

The OptiX OSN 8800 T32 provides cross-connect boards to achieve centralized cross-connections and supports full cross-connections between slots IU1-IU8, IU12-IU27, IU29-IU36 with a cross-connect capacity of 40 Gbit/s for each slot. The equipment has a cross-connect capacity of 1.28 Tbit/s. The equipment supports centralized cross-connections of ODUflex, ODU0, ODU1, ODU2, and ODU3 signals.

The OptiX OSN 8800 T64 provides cross-connect boards to achieve centralized cross-connections and supports full cross-connections between slots IU1-IU8, IU11-IU42, IU45-IU68 with a cross-connect capacity of 40 Gbit/s for each slot. The equipment has a cross-connect capacity of 2.56 Tbit/s. The equipment supports centralized cross-connections of ODUflex, ODU0, ODU1, ODU2, and ODU3 signals.

Centralized Grooming

Table 3-5 lists the services supported by the tributary board and the line board centralized grooming.

Table 3-5 Services supported by the tributary board and the line board centralized grooming

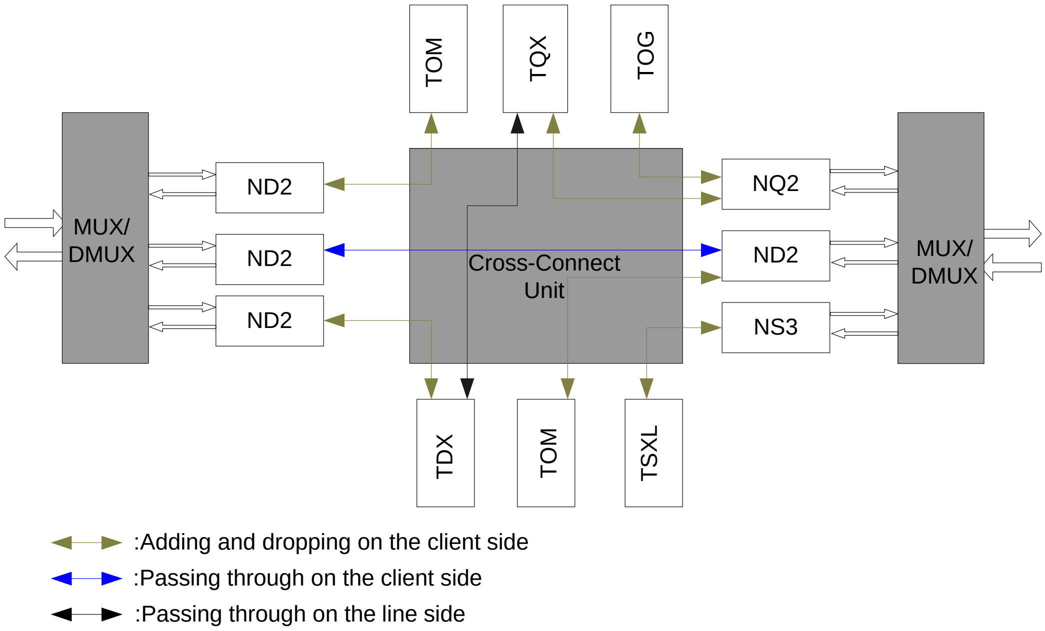
Board	Centralized Grooming
TN52ND2	ODU0 signals, ODU1 signals, ODU2/ODU2e signals
TN53ND2	ODU0 signals, ODU1 signals, ODU2/ODU2e signals, ODUflex signals
TN52NS2	ODU0 signals, ODU1 signals, ODU2/ODU2e signals
TN53NS2	ODU0 signals, ODU1 signals, ODU2/ODU2e signals, ODUflex signals
TN52NS3	ODU0 signals, ODU1 signals, ODU2/ODU2e signals
TN54NS3	ODU0 signals, ODU1 signals, ODU2/ODU2e signals, ODU3 signals
TN52NQ2 TN54NQ2	ODU0 signals, ODU1 signals, ODU2/ODU2e signals
TN53NQ2	ODU0 signals, ODU1 signals, ODU2/ODU2e signals, ODUflex signals
TN52TDX	ODU2/ODU2e signals
TN53TDX	ODU2/ODU2e signals, ODUflex signals
TN52TQX TN53TQX	ODU2/ODU2e signals
TN55TQX	ODU2/ODU2e signals, ODUflex signals
TN52TOM	ODU0 signals, ODU1 signals
TN54TOA	ODU0 signals, ODU1 signals , ODUflex signals
TN54THA	ODU0 signals, ODU1 signals
TN52TOG	ODU0 signals
TN53TSXL	ODU3 signals

Application of Electrical-Layer Grooming

Three types of typical application are supported by electrical grooming, for detail, see Figure 3-1.

- 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. This is, 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 then 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.

Figure 3-1 Application of electrical-layer grooming



3.2.2 OCS Centralized Grooming

When the OptiX OSN 8800 T32 used as an OCS device, it can realize full cross-connection among the 32 slots of IU1-IU8, IU12-IU27 and IU29-IU36 with the XCM board. It supports a maximum of 1.28 Tbit/s grooming of VC-4 or 80 Gbit/s grooming of VC-3/VC-12 signals.

When the OptiX OSN 8800 T64 used as an OCS device, it can realize full cross-connection among the 64 slots of IU1-IU8, IU11-IU42 and IU45-IU68 with the SXM board. It supports a maximum of 1.28 Tbit/s grooming of VC-4 or 80 Gbit/s grooming of VC-3/VC-12 signals.

Table 3-6 lists the services supported by the SDH service processing boards centralized grooming.

Table 3-6 Services supported by the SDH service processing boards centralized grooming

Board	Centralized Grooming
EAS2	VC-4 signals
EGSH	VC-12 signals VC-3 signals VC-4 signals
SF64A	VC-12 signals VC-3 signals VC-4 signals
SF64	VC-12 signals VC-3 signals VC-4 signals
SFD64	VC-12 signals VC-3 signals VC-4 signals
SL64	VC-12 signals VC-3 signals VC-4 signals
SLD64	VC-12 signals VC-3 signals VC-4 signals
SLH41	VC-12 signals VC-3 signals VC-4 signals
SLO16	VC-12 signals VC-3 signals VC-4 signals
SLQ16	VC-12 signals VC-3 signals VC-4 signals
SLQ64	VC-12 signals VC-3 signals VC-4 signals

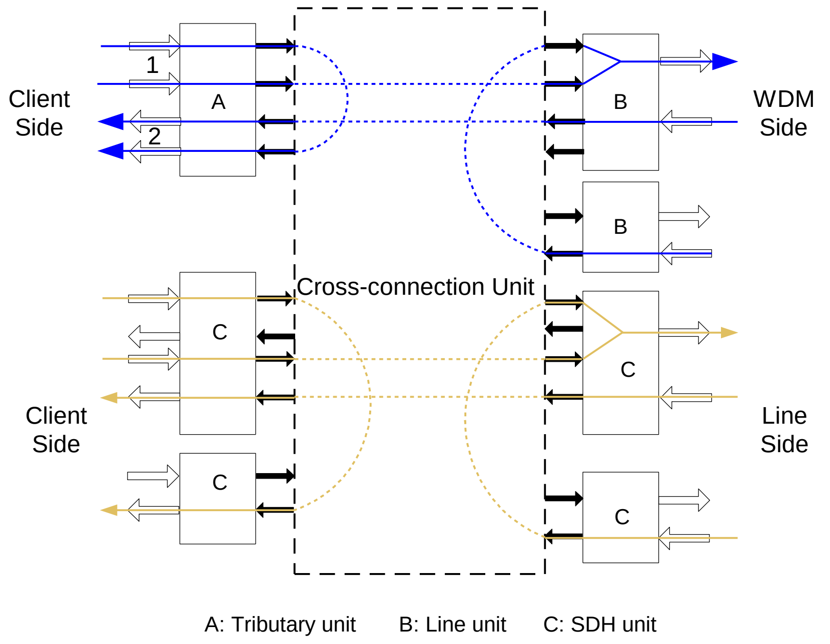
Application of Electrical Layer Grooming

The following three types of typical application 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. This is, 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 then are output through a client-side port, or the client services are input from the local station and are transmitted to the other stations 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

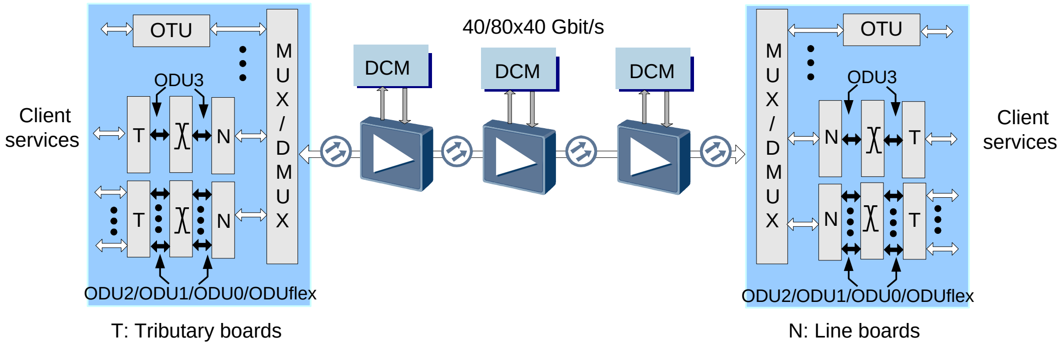
3.4.1 40 Gbit/s

The OptiX OSN 8800 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

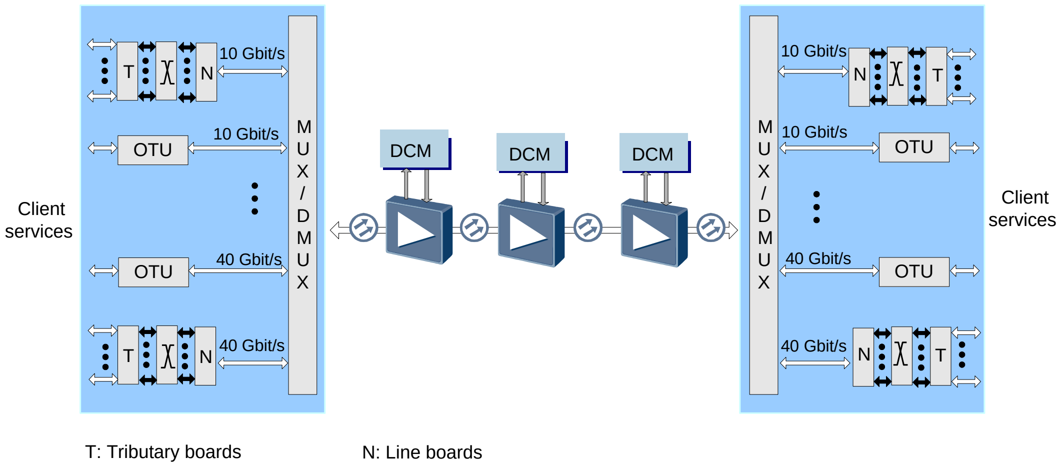


3.4.2 10 Gbit/s, 40 Gbit/s, 100 Gbit/s Hybrid Transmission

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 8800 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 3-4 shows hybrid transmission of 100 Gbit/s, 40 Gbit/s, and 10 Gbit/s signals.

Figure 3-4 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 the 40-wavelength system, a maximum of 20 x 22 dB transmission without electrical regenerator is supported.
- For 40 Gbit/s rate in the 80-wavelength system, a maximum of 18 x 22 dB transmission without electrical regenerator is supported.
- For 10 Gbit/s rate in the 40-wavelength system, a maximum of 32 x 22 dB transmission without electrical regenerator is supported.
- For 10 Gbit/s rate in the 80-wavelength system, a maximum of 25 x 22 dB transmission without electrical regenerator is supported.
- For 2.5 Gbit/s rate, a maximum of 25 x 22 dB transmission without electrical regenerator is supported.
- For 10 Gbit/s rate system, supports a maximum of 1 x 82 dB single-span ultra long-distance transmission.
- For the CWDM systems, a maximum of 80 km transmission distance is supported.

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

Table 3-7 2.5 Gbit/s system span

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

Table 3-8 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 3-9 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 8800 T32/8800 T64 provides various types of equipment-level protection and network-level protection.

3.5.1 Equipment Level Protection

The OptiX OSN 8800 T32 and OptiX OSN 8800 T64 provide cross-connect board 1+1 protection, SCC board 1+1 protection, STG board 1+1 protection, inter-subrack communication protection, DC input protection, redundancy protection for fans and redundancy protection for optical and performance monitoring boards.

Cross-Connect Board 1+1 Protection

The cross-connect board adopts 1+1 backup. It is recommended that active and standby cross-connect boards be of the same type.

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

The cross matrix of the active cross-connect board is the same the cross matrix of the standby cross-connect board. When the standby cross-connect board receives information about abnormal active cross-connect board or when the NM system issues a switching command, the standby cross-connect board takes over the work from the active cross-connect board, 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 cross-connect boards:

- Automatic switching

  When the service boards detect the abnormal status of cross-connect boards or buses, a switching is performed automatically. 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 cross-connect boards, the switching can be performed manually.

NOTE

When a switching occurs between the cross-connect boards, a switching also occurs between the active and standby 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.

STG Board 1+1 Protection

The clock board STG adopts 1+1 backup. The two STGs serve as mutual backups. When both of them are normal, one of them functions as the active board, and the other functions as the standby board. Service boards select the clock source according to the status of the two STGs. When the active STG is faulty, an active/standby switching occurs. Then, the standby STG becomes active, and the services boards select the clock from the current active STG according to the status of the two STGs.

Configuration of the active STG is the same as the configuration of the standby STG. The two boards are independent of each other. When the active clock board is in abnormal state, the standby clock board automatically takes over the work. Hence, there is no impact on the normal operation of the equipment.

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

- Automatic switching

  The STG 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 STGs, the switching can be performed manually.

NOTE

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

DC Input Protection

The power supply system supports four -48 V/-60 V DC power inputs for mutual backup in OptiX OSN 8800 T32 subrack. The power supply system adopts the switched-mode power supply mode for two areas, that is, the blue-slot area and the yellow-slot area, as shown in Figure 3-5. Each area is configured with a pair of power supplies of mutual backup: one pair is IU39 and IU45, and the other pair is IU40 and IU46. The normal operation of the equipment is not affected in the case of failure of any external input -48 V/-60V power supply. Figure 3-5 shows the two pairs of power supplies of mutual backup.

The power supply system supports eight -48 V/-60 V DC power inputs for mutual backup in OptiX OSN 8800 T64 subrack. The subrack adopts switched-mode power supply scheme for four areas which are shown in Figure 3-6. The area has the same color is defined as one area. Each area is configured with a pair of power supplies in mutual backup: IU69 and IU78, IU70 and IU79, IU80 and IU88, and IU81 and IU89. The normal operation of the equipment is not affected in the case of failure of any external input -48 V/-60V power supply. Figure 3-6 shows the four pairs of power supplies of mutual backup.

Figure 3-5 Power distribution and supply in 8800 T32 subrack

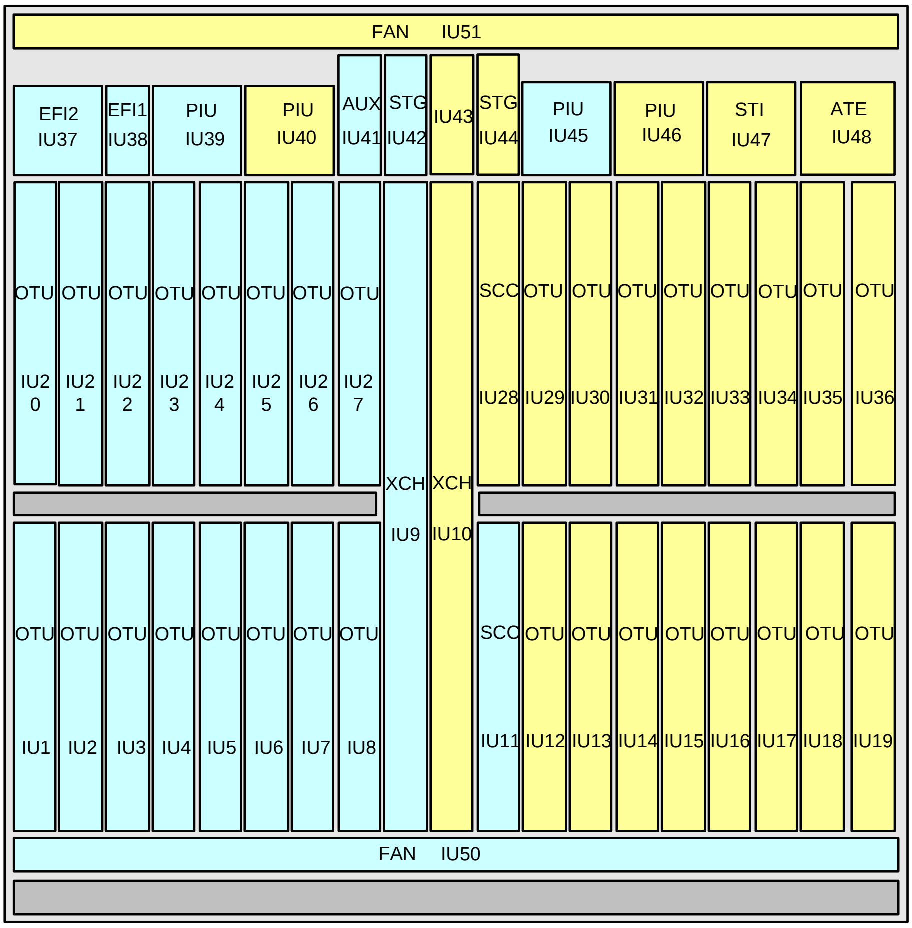
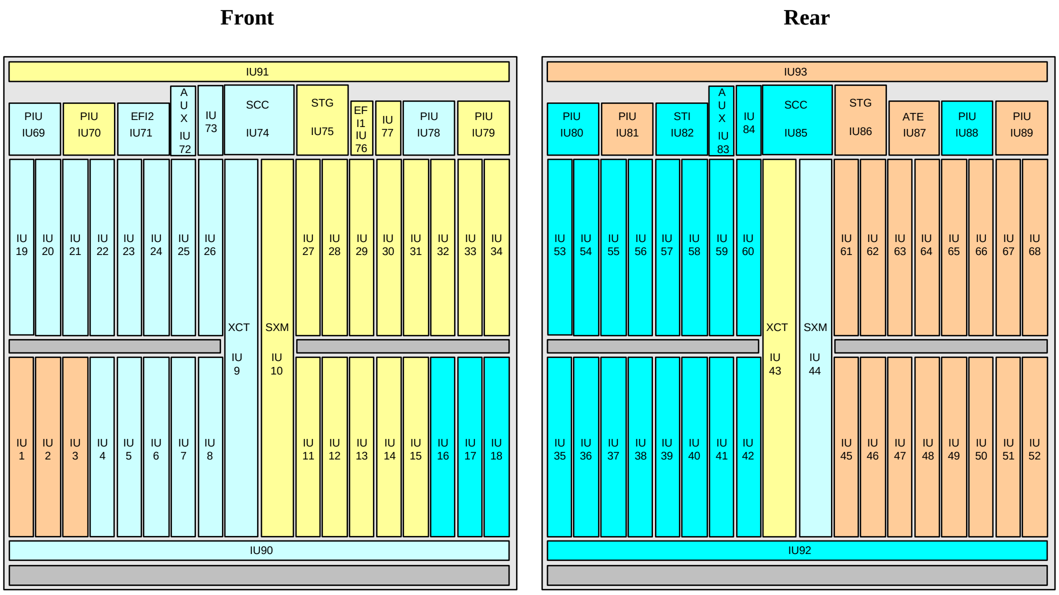


Figure 3-6 Power distribution and supply in 8800 T64 subrack



Redundancy Protection for Fans

In the OptiX OSN 8800 T32 system, each subrack has two fan areas. In the OptiX OSN 8800 T64 system, each subrack has four fan areas. And each fan area has three fans for heat dissipation. The speed of each fan can be adjusted independently and the failure of any fan does not affect the other fans.

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

OptiX OSN 8800 T32/8800 T64 provides various network protection schemes, including WDM protection schemes and a great variety of data service protection schemes.

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.

WDM Protection

The OptiX OSN 8800 T32/8800 T64 provides various types of WDM protection, as listed in Table 3-10.

For principles of the protections, refer to the *Feature Description*.

Table 3-10 WDM protection

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	The intra-board cross-connections on the TOM board implement the dual fed and selective receiving function.

Category	Sub-Category	Description
	Protection	In this manner, the SW SNCP protection protects the OCh fiber.
	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 ODU0 signals, ODU1 signals, ODU2 signals and ODU3 signals.
	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 ODU0 signals, ODU1 signals, ODU2 signals and ODU3 signals.
	VLAN SNCP protection	Uses the dual-fed selective receiving function of a L2 module to protect Ethernet services. The protection granularity is the service with VLAN.
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.
ASON protection	Optical-layer ASON	Protects services of OCh wavelength level.
	Electrical-layer ASON	Protects services of ODUk wavelength level.

SDH Protection

The OptiX OSN 8800 T32/8800 T64 provides various types of SDH protection, as listed in Table 3-11.

For details on the working principle of each type of protection, see the *Feature Description*.

Table 3-11 Service protection classifications

Category	Subcategory	Description
Linear MSP	1+1 linear MSP	It realizes dual transmitting and selective receiving by using two fibers. In this manner, it provides protection for the services on the link.
	1:N (N ≤ 14) linear MSP	It protects services by providing one protection fiber for N working fibers.
MSP Ring	Two-fiber bidirectional MSP	In this protection mode, half of the capacity of the fibers in each transmission direction is

Category	Subcategory	Description
	ring	assigned to the service channel, and the other half of the capacity is assigned for the protection channel. The service timeslot and protection timeslot in each direction are transmitted over the same fiber. That is, the service signals and protection signals are transmitted at the same time over the same fiber.
	Four-fiber bidirectional MSP ring	In this protection mode, two fibers are used in the transmit and protection directions. One of the fibers in each direction is used to transmit the working service, and the other fiber is used to transmit the protection service.
Transoceanic MSP Ring	A transoceanic MSP ring can be a two-fiber bidirectional MS shared protection ring or a four-fiber bidirectional MS shared protection ring. When the network fails, the ring path is switched between the source and sink nodes of the service rather than on two adjacent nodes of the failed node to avoid multiple transoceanic events of the services, which increase the delay of transmission in the long-haul transmission network (for example, the marine system).	
SNCP	In this protection mode, the service protection is implemented by means of dual transmitting and selective receiving. That is, the services are dual transmitted at the source but selectively received at the sink.	
Sub-network connection tunnel protection (SNCTP)	The SNCTP provides the protection path at the VC-4 level. When the working path is faulty, all its services are switched to the protection path.	
Ethernet protection	Ethernet ring protection	This protection type is based on the traditional Ethernet mechanism and uses the Ethernet operation, administration, and maintenance (OAM) function and ring network automatic protection switching (R-APS) protocol to realize quick protection switching in the Ethernet ring network.
	LCAS	This protection type dynamically adjusts the number of virtual containers required for service mapping to provide protection for virtually concatenated services.
	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.
	STP/RSTP	When the STP or RSTP is started, it logically modifies the network topology to avoid a broadcast storm. The STP or RSTP realizes link protection by restructuring the topology.

Category	Subcategory	Description
	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.
	DLAG	The distributed link aggregation group (DLAG) is a board-level port protection technology used to detect unidirectional fiber cuts and to negotiate with the opposite end. In the case of a link down failure on a port or a hardware failure on a board, the services can automatically be switched to the slave board, thus realizing 1+1 protection for the inter-board ports.
ASON protection	Protects services of STM-N, VC-4, VC-3.	

Data Protection

The OptiX OSN 8800 T32/8800 T64 provides various types of data protection, as listed in Table 3-12.

For details on the working principle of each type of protection, see the *Feature Description*.

Table 3-12 Data protection

Protection	Description
DBPS protection	DBPS protection works with Ethernet ring protection to protect the links between Ethernet boards and BRAS, and also protect services at 10GE and GE ports on Ethernet boards.
Ethernet ring protection	Based on the traditional Ethernet mechanism and APS protocol specific to a ring network, Ethernet ring protection achieves fast protection switching of an Ethernet ring network.
LAG	An LAG binds multiple links on the same equipment, increasing the bandwidth and improving link reliability.
STP and RSTP	When the STP or RSTP is running, it modifies the logical network topology to avoid a broadcast storm. The RSTP can achieve link protection by restructuring the network topology.
MSTP	In the case of a user Ethernet network with a loop, MSTP can generate a tree topology by VLAN IDs of Ethernet packets to avoid a broadcast storm, and can also achieve load sharing by VLAN IDs of user packets.
LPT	The link state pass through (LPT) is used to detect and report the faults that

Protection	Description
	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.

3.6 Data Characteristics

The OptiX OSN 8800 T32/8800 T64 supports the Ethernet features and mainly supports the following Ethernet services: EPL, EVPL (QinQ), and EPLAN.

3.6.1 OAM

The OptiX OSN 8800 T32/8800 T64 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, IPA of PID, ALC, APE , EAPE, OPA and AGC.

With the IPA, IPA of Raman System, IPA of PID, 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 8800 T32/8800 T64.

3.8.1 DWDM and CWDM Technical Specifications

The OptiX OSN 8800 T32/8800 T64 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 8800 T32/OptiX OSN 8800 T64. 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, 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 only applies to services rated at 2.5 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 3-7 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 3-7 DWDM wavelength expansion and allocation in the CWDM system

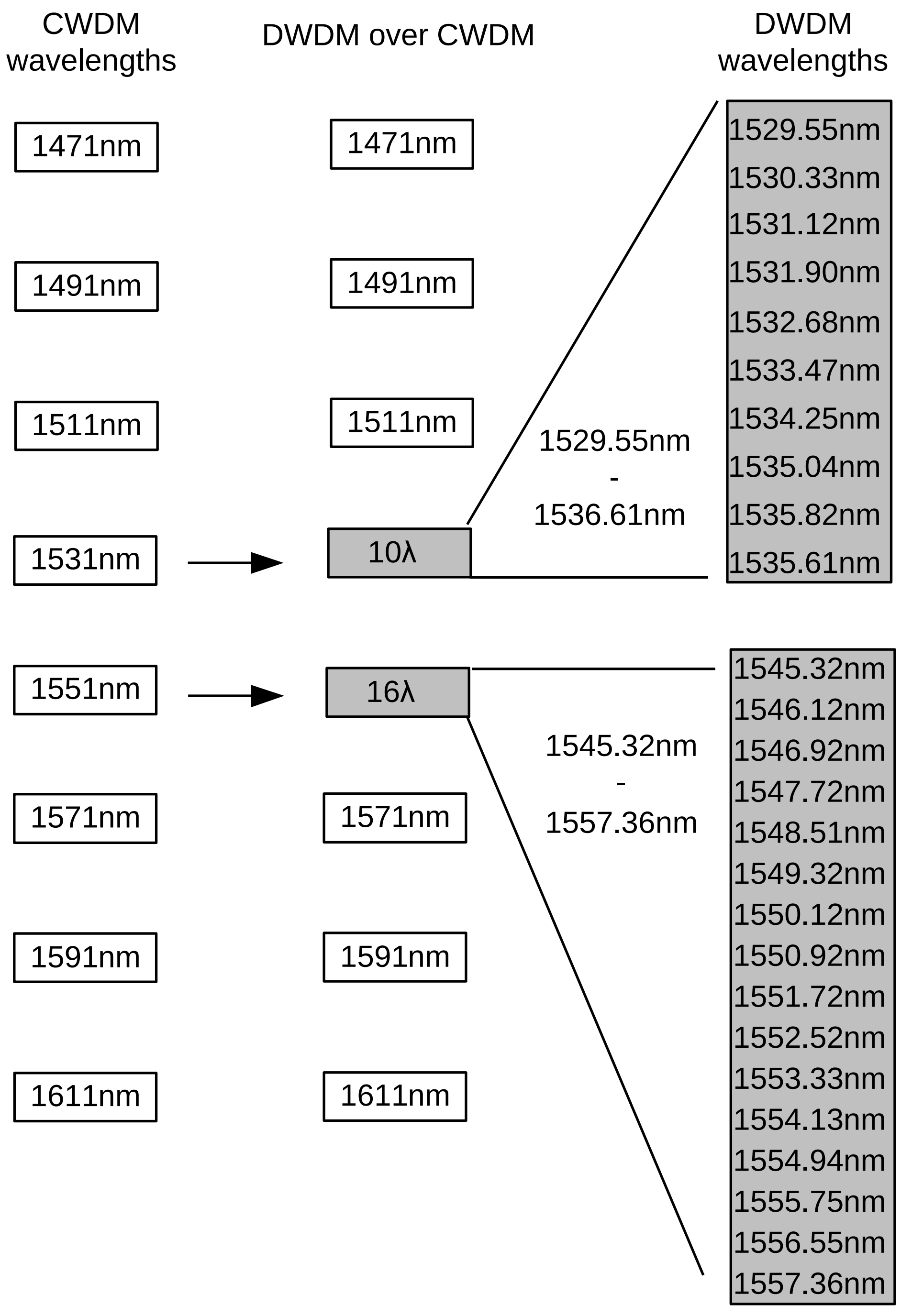
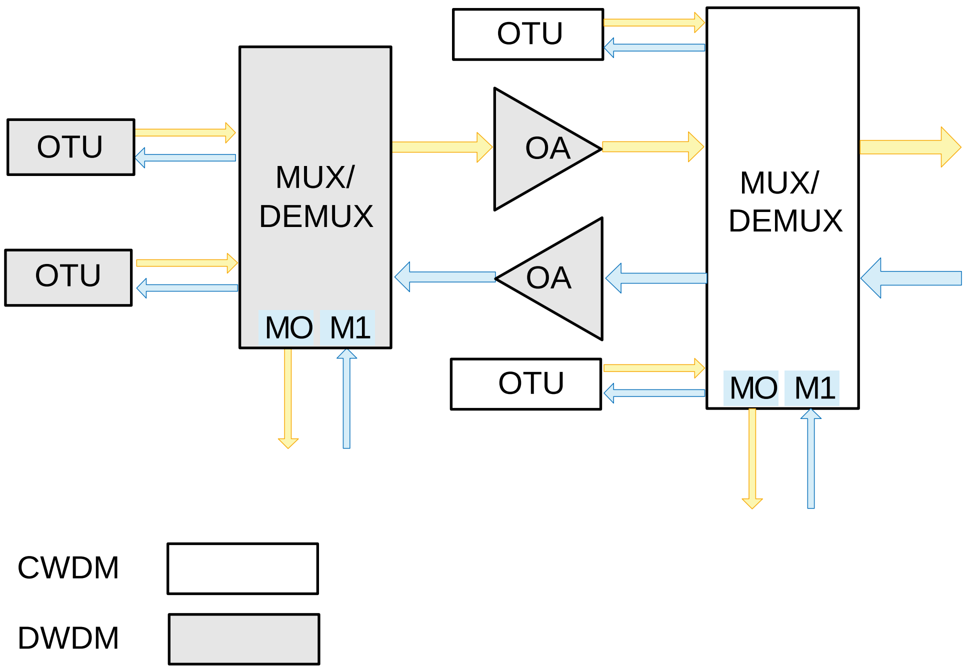


Figure 3-8 shows the equipment configuration in which DWDM wavelengths are transported in the window of CWDM 1531 nm to 1551 nm. The DWDM wavelengths need to pass through the DWDM MUX/DEMUX and CWDM MUX/DEMUX. Hence, the optical amplifier unit needs to be configured in between.

Figure 3-8 Application of the DWDM wavelength in the CWDM system



3.8.2 Nominal Central Wavelength and Frequency of the DWDM System

Table 3-13 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 3-14 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 Typical Application

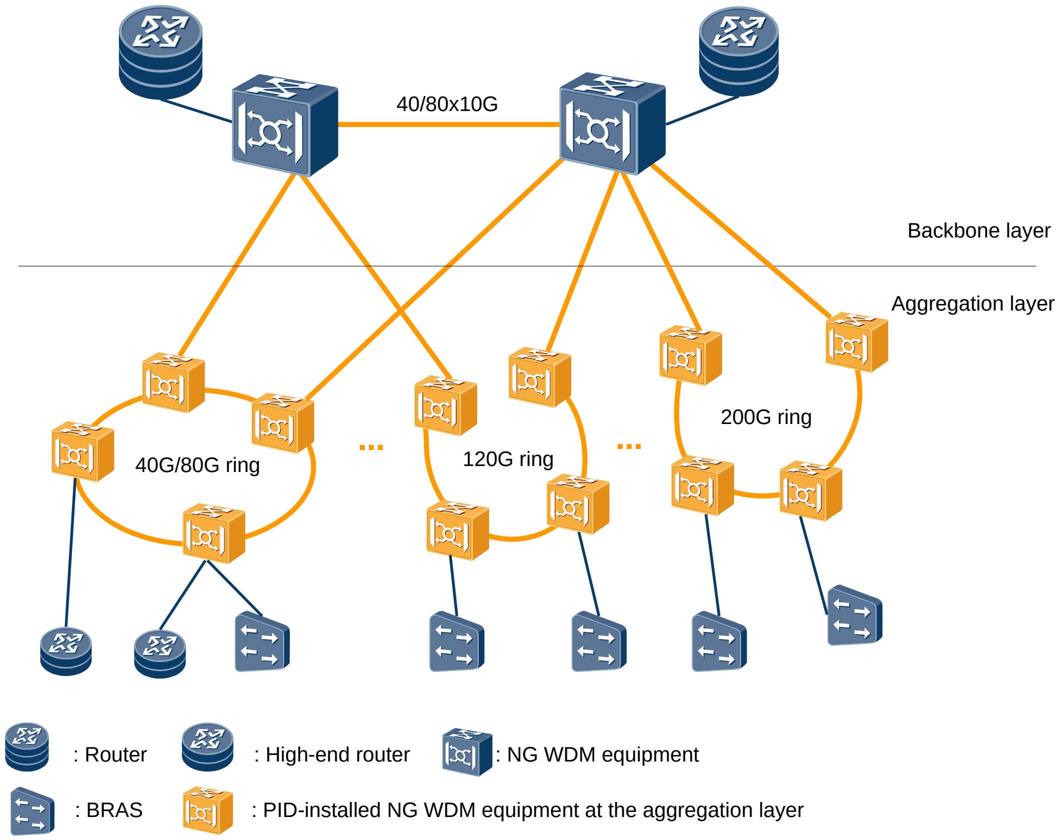
This section describes typical PID application.

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/200G 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/200G 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.

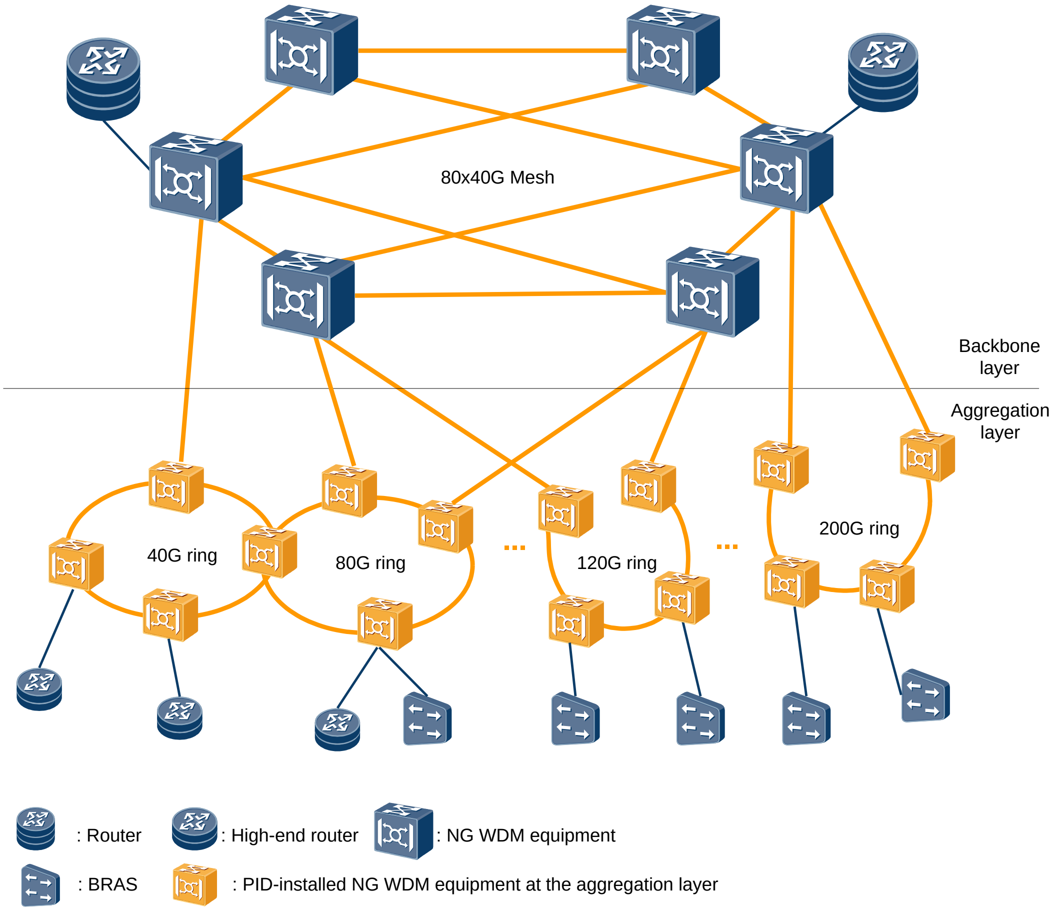
Figure 3-9 WAN for a medium or large-sized city



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/200G 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



3.8.5 ODUflex

The OptiX OSN 8800 supports the flexible optical data unit flexible (ODUflex) technique. Using the ODUflex technique, the OptiX OSN 8800 can adapt itself to various services such as video, storage, and data services, and is able to provide future IP services.

Introduction to ODUflex

OptiX OSN 8800 T64/T32/T16 of earlier versions supports only four types of ODUk mappings: ODU0 (1.25G), ODU1 (2.5G), ODU2 (10G), and ODU3 (40G). Services can be mapped only to fixed bandwidth. Therefore, service mapping is not flexible and bandwidth waste may result.

ITU-T defines ODUk with flexible bandwidth (ODUflex for short) to avoid bandwidth waste caused by service mapping.

ODUflex has the following features:

- The bandwidth required for ODUflex is about N x bandwidth of each ODTUk timeslot ($1 \leq N \leq 8$).
- The ODTUk timeslot is the basic unit of ODUk frames and each ODTUk timeslot has the bandwidth of 1.25Gbit/s.

NOTE

- ODTUk timeslots are basic units of ODUk frame signals. That is, ODUflex signals consist of multiple ODTUk timeslots. Each ODTUk timeslots provides 1.25 Gbit/s bandwidth. One ODU0 signal equals one ODTUk timeslot and ODU1 signal equals two ODTUk timeslots.

For example, when a 3G-SDI service at a rate of 2.97 Gbit/s is received on the client side, the bandwidth usage is as follows:

- When ODUflex is not used for service mapping, the mapping path is 3G-SDI -> ODU2 -> OTU2. In this case, the service occupies all the bandwidth (10 Gbit/s) of ODU2 and wastes about 7 Gbit/s bandwidth.
- When ODUflex is used for service mapping, the mapping path is 3G-SDI -> ODUflex -> ODU2 -> OTU2. Only three ODTUk timeslots are occupied and the left five ODTUk timeslots are available for other services. Each ODTUk timeslot provides 1.25 Gbit/s bandwidth; therefore, 6.25 Gbit/s (5 x 1.25 Gbit/s) bandwidth is saved.

ODUflex Applications

- Transport of generic CBR signals

  ODUflex can be used to transmit constant bit rate (CBR) services on an optical transport network (OTN). The services whose CBRs are higher than 2.48832 Gbit/s are mapped to an ODUflex (CBR) container in bit synchronization mode. Functions such as end-to-end performance monitoring and protection switching are feasible on the ODUflex (CBR) container. The overheads and monitoring management modes of ODUflex services and traditional ODUk (k= 0, 1, 2, 3) are the same. For the application scenarios, see Figure 3-11 and Figure 3-12.

  Figure 3-11 shows how ODUflex is used to transport generic CBR signals. An FC400 service occupies four ODTUk timeslots and is mapped to an ODUflex container; a 3G-SDI service occupies three ODTUk timeslots and is mapped to an ODUflex container. In this way, the FC400 and 3G-SDI services share the same OTU2 wavelength.

  Figure 3-12 shows how ODU2 is used to transport generic CBR signals. The FC400 and 3G-SDI services are mapped to different ODU2 containers, and therefore they occupy different OTU2 wavelengths.

Figure 3-11 Transport of generic CBR signals (ODUflex)

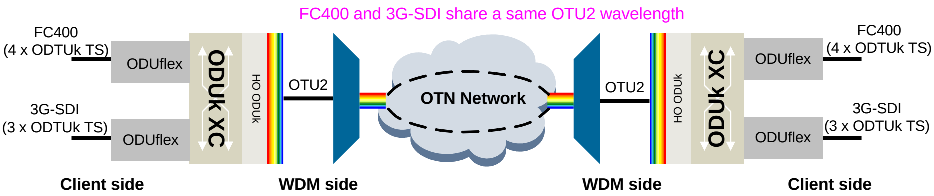
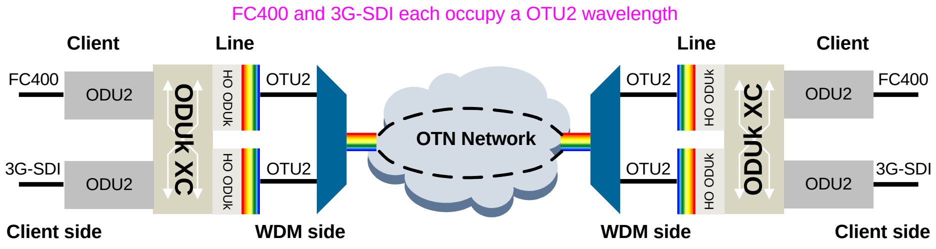


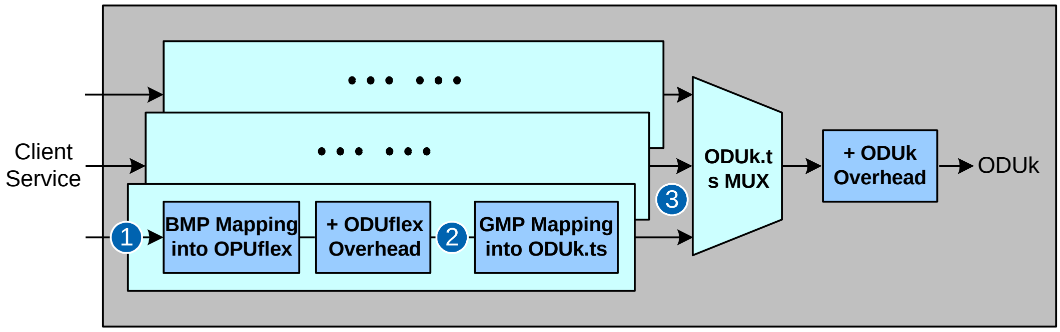
Figure 3-12 Transport of generic CBR signals (ODU2)



ODUflex Implementation

Figure 3-13 shows how an ODUflex signal is mapped and multiplexed.

Figure 3-13 ODUflex mapping and multiplexing method



1. The client signals are mapped into an OPUflex frame using the bit-synchronous mapping procedure (BMP) or GPF-F mapping method. The OPUflex frame changes into an ODUflex frame after it carries an ODUflex frame header.
2. The ODUflex frame is mapped into N ODTUk timeslots by using the generic mapping procedure (GMP).
3. Multiple ODTUk timeslots are multiplexed into a standard ODUk frame after an ODUk frame header is inserted.

ODUflex Signal Types

Table 3-15 lists the current boards that support transmission of signals through ODUflex frames.

Table 3-15 ODUflex signal transmission

Applicable Board	Encapsulation Mode	Client Signal Type	ODUflex Mapping Path
TN11LOA	ODUflex(CBR)	FC400/FC800/3G-SDI	Client signal->ODUflex->ODU2->OTU2
TN54TOA		FC400/3G-SDI	Client

Applicable Board	Encapsulation Mode	Client Signal Type	ODUflex Mapping Path
TN53TDX, TN55TQX		FC800	signal->ODUflex
TN53NQ2, TN53ND2, TN53NS2		-	ODUflex->ODU2->OTU2

3.8.6 Mapping and Multiplexing

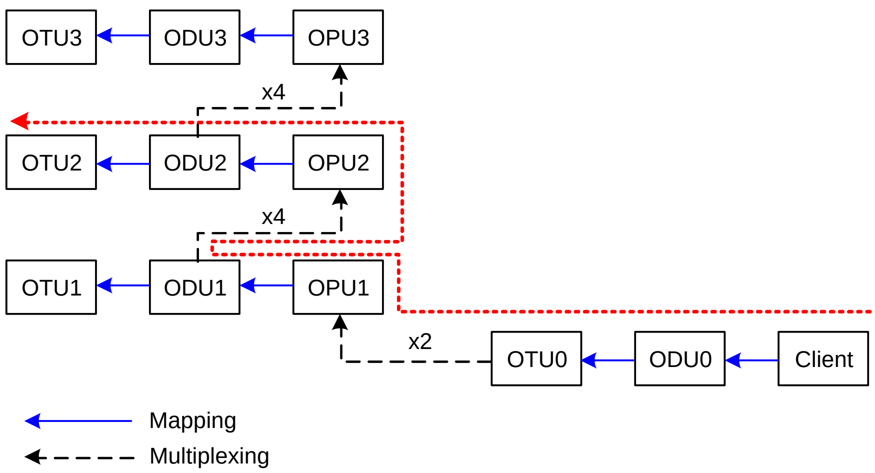
This section describes how client signals are mapped and multiplexed on Huawei transport equipment in addition to the mapping paths and required timeslots.

H-L Multiplexing Hierarchy

In the high-order (H) and low-order (L) multiplexing hierarchy, client signals in an OTN system are sent to the line for transmission after the H-L multiplexing processes. For low-order multiplexing, a client signal is multiplexed into a low order (LO) ODUk signal. For high-order multiplexing, an LO ODUk signal is multiplexed into a high order (HO) ODUk signal, which is then transmitted on the line. Before OptiX OSN 8800 V100R005, client signals are mapped and multiplexed level by level. For example, to map a client signal into an ODU2 signal, the client signal must go through the client->ODU0->ODU1->ODU2 process. However, in OptiX OSN 8800 V100R005 and later versions, which support the H-L multiplexing hierarchy, the mapping process is simplified as client->ODU0->ODU2.

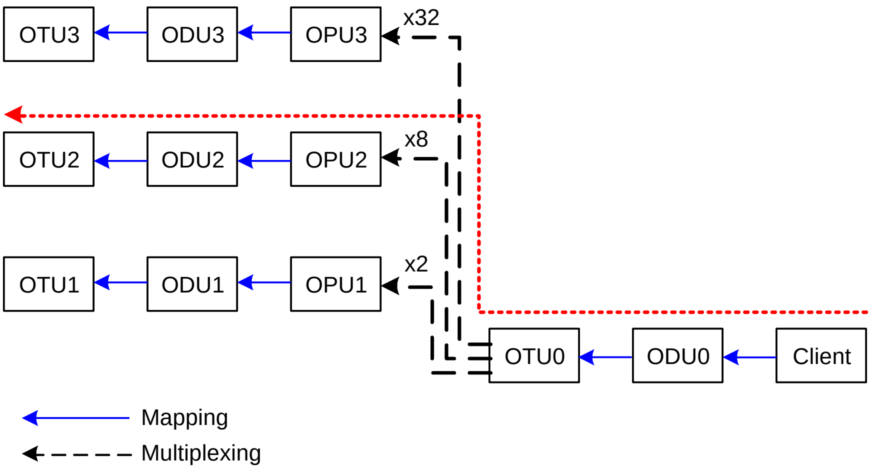
The following describes how the TN52TOG and TN52ND2 boards map and multiplex client signals level by level using a GE signal as an example. To map the GE signal into an ODU2 signal before sending the signal into the cross-connect board, the equipment of a version earlier than V100R005 must perform the client-> ODU0 ->ODU1->ODU2 process, which is marked as red in Figure 3-14.

Figure 3-14 Level-by-level mapping and multiplexing



For the equipment of V100R006C01 or a later version, boards such as the LOA board support H-L multiplexing and can map a client signal into an ODU2 signal according to the client->ODU0->ODU2 process. Then the equipment sends the ODU2 signal to the cross-connect board. The H-L multiplexing process is marked as red in Figure 3-15.

Figure 3-15 H-L mapping and multiplexing

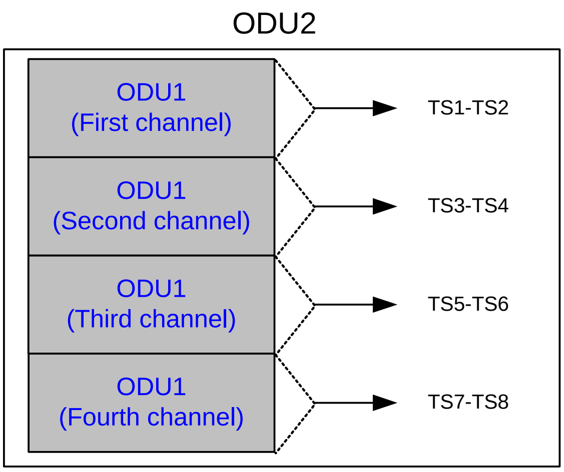


Mixed Mapping and Multiplexing

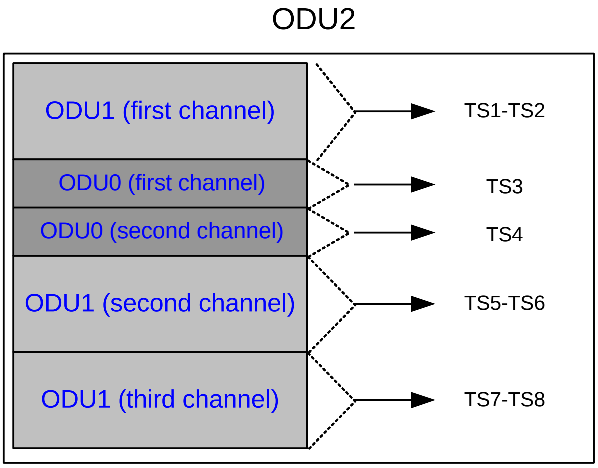
The equipment supports mapping and multiplexing of lower order ODUk signals into higher order ODUk signals. For example, the equipment can map and multiplex a mixture of ODU0 and ODU1 signals into an ODU2 frame.

Each ODUk frame occupies some TS sub-timeslots. TS sub-timeslots may be occupied in the following modes:

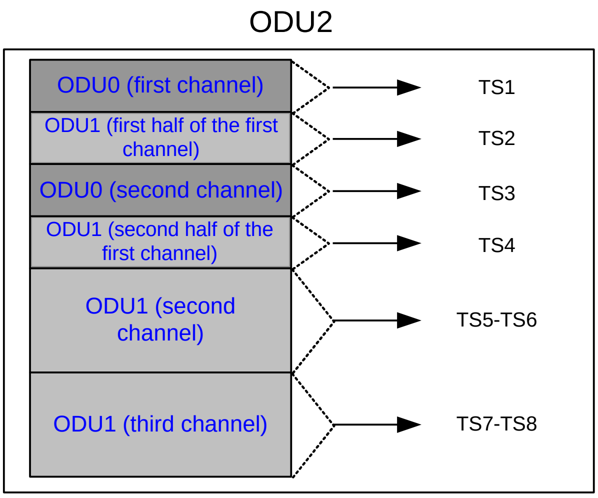
- Completely fixed consecutive occupation: Each ODUk signal occupies a fixed TS sub-timeslot if hybrid mapping or multiplexing is not supported. For example, the second ODU1 channel occupies TS3 and TS4.



- Initially fixed consecutive occupation: The fixed occupation relationships will be changed after hybrid mapping and multiplexing are supported. For example, ODU1 may occupy TS5 and TS6.



- Flexible and inconsecutive occupation: Timeslots are assigned more flexibly. For example, the first ODU1 channel occupies TS2 and TS4, which are inconsecutive timeslots.



3.9 Clock Feature

OptiX OSN 8800 T32 and OptiX OSN 8800 T64 support 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 8800 T32 and OptiX OSN 8800 T64 support the physical clock synchronization. Physical-layer synchronization is classified into the SDH/PDH synchronization in the traditional SDH field and synchronous Ethernet.

OptiX OSN 8800 T32 and OptiX OSN 8800 T64 extract 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.
- Pick-up clock signals from the line side of SDH unit.

OptiX OSN 8800 T32 and OptiX OSN 8800 T64 extract input and output of two 75-ohm or two 120-ohm external clock sources.

OptiX OSN 8800 T32 and OptiX OSN 8800 T64 extract 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 8800 T32 and OptiX OSN 8800 T64 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:

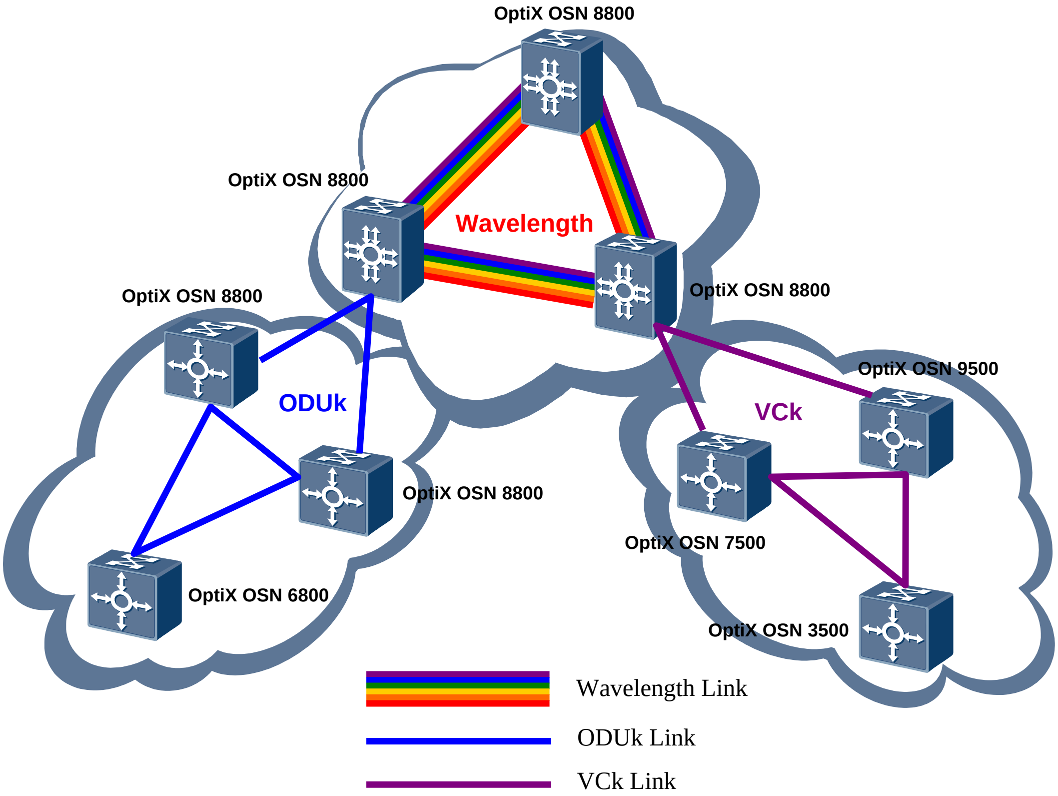
- High reliability: Protection and restoration together improve network reliability and service security.
- Easy to use: Network resources and topologies are easy to discover and end-to-end services can be quickly created.
- Easy to manage: Trail resources are manageable and predictable, and services 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.

In addition, the OptiX OSN 8800 is also capable of cross-connecting services at the SDH layer. Therefore, WDM ASON equipment can be networked with WDM ASON equipment or SDH ASON equipment to enable cross-connections at multiple granularities and multiple layers, as shown in Figure 3-16.

Figure 3-16 Flexible networking and multi-layer service cross-connections



4 Network Application

About This Chapter

The OptiX OSN 8800 T32 and OptiX OSN 8800 T64 support the point-to-point networking, chain networking, ring networking, and mesh networking. It can be networked with other WDM and SDH equipment to realize a complete transport solution.

4.1 Networking and Applications

The OptiX OSN 8800 T32 and OptiX OSN 8800 T64 support the point-to-point networking, chain networking, ring networking, and mesh networking. It can be networked with other WDM and SDH equipment to realize a complete transport solution.

4.1.1 Basic Networking Modes

The OptiX OSN 8800 supports point-to-point networking, chain networking, ring networking, and mesh networking. It can be networked with other WDM and SDH or SONET equipment to realize a complete transport solution.

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 for a scenario where 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 applicable 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 the high survivability, ring network is a dominant networking mode in MAN DWDM network planning. The ring network has the widest application range. It can be applicable 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 ring with chain.

Mesh Network

A large number of nodes are connected by straight routes on a 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. Thus, the mesh network has high service transmission reliability, and the mesh topology is a mainstream networking mode for ASON networks. The mesh networking features flexibility and scalability. It is widely used in ASON networks.

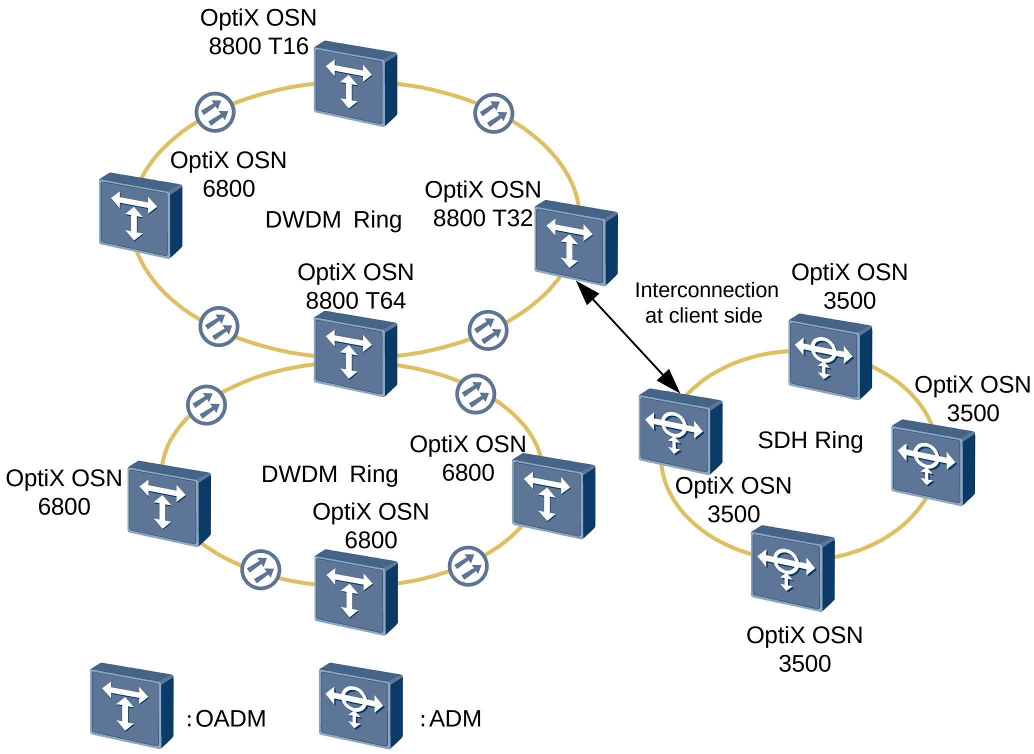
4.1.2 Typical OTN Networking

The OptiX OSN 8800 can be jointly used not only with the OptiX OSN 6800 or OptiX OSN 3800 to form a complete OTN end-to-end network, but also with the OptiX BWS 1600G or OptiX Metro 6100 to form a WDM network. The OTN or WDM network is then used to transmit the services from the NG SDH/PTN or data communication equipment. In this manner, the OptiX OSN 8800 T32 and OptiX OSN 8800 T64 implement a complete transport solution.

Typical OTN Networking

When working with the OptiX OSN 6800, the OptiX OSN 8800 T32 and OptiX OSN 8800 T64 can form an OTN network or a DWDM ring to transport or add/drop services on the WDM line. Figure 4-1 shows the typical OTN networking.

Figure 4-1 Typical OTN networking



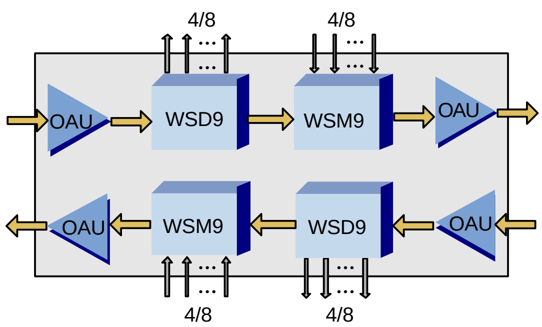
WSS Grooming Solution

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.

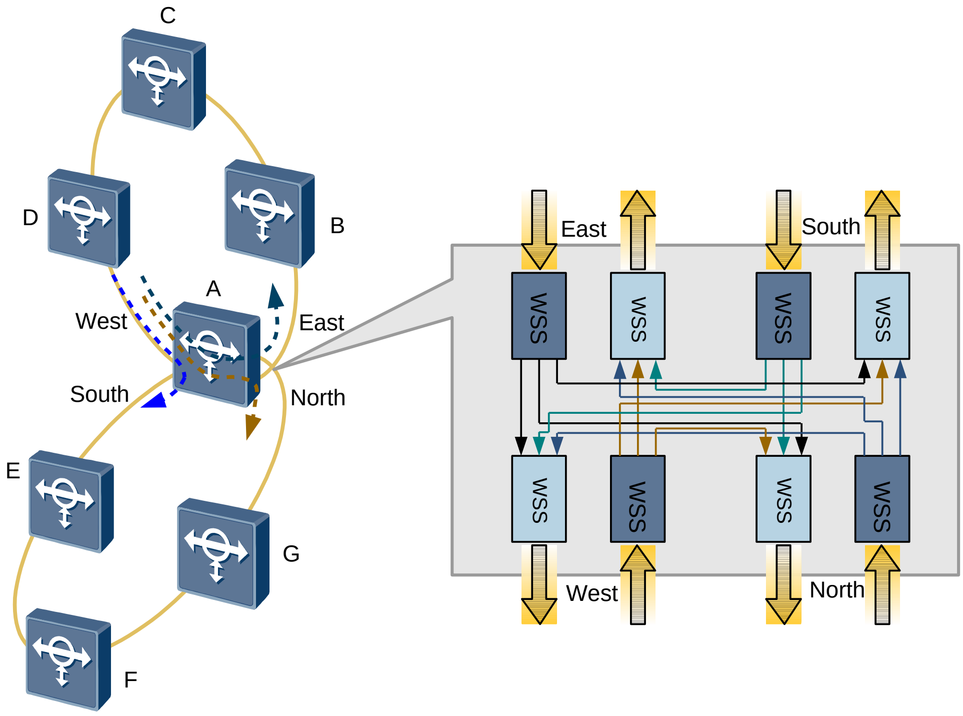
Figure 4-2 Functional diagram of a WSS-based ROADM node



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

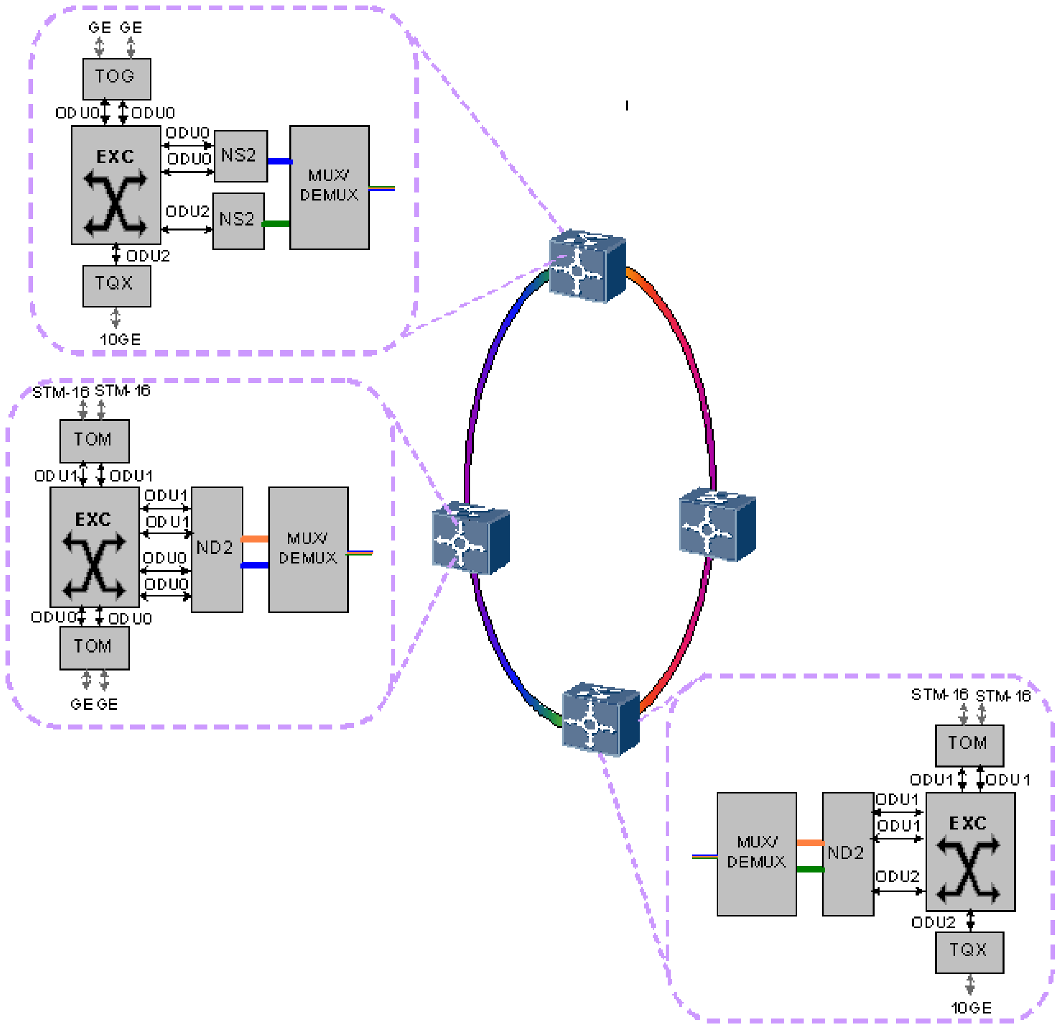


Application of Electrical-Layer Grooming

The OptiX OSN 8800 grooms services by means centralized cross-connections.

The OptiX OSN 8800 supports ODUflex, ODU0, ODU1, ODU2, and ODU3 cross-connections. GE, 2.5G, and 10G services can share bandwidth to improve bandwidth utilization. As shown in Figure 4-4, a GE service and a 2.5G service share a wavelength.

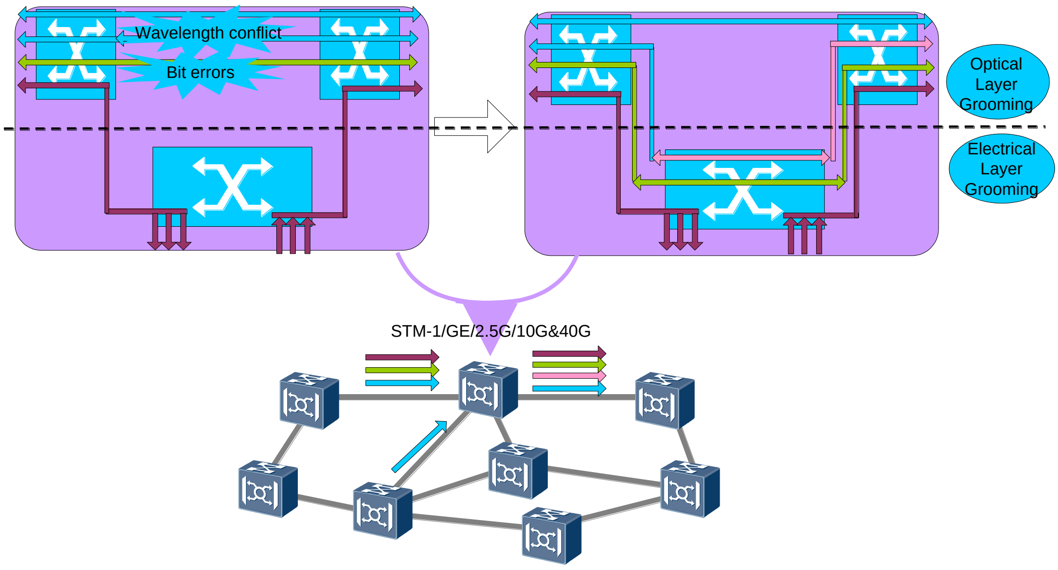
Figure 4-4 Application of electrical-layer grooming



Optical-Electrical Convergence Solution

At the service access end, the equipment cross-connects multi-rate services to 40G channels for transmission. At a service pass-through station, the equipment fast transmits services by means of ROADM optical cross-connections. At the service receive end, the equipment drops 40G services from the line by processing electrical-layer cross-connections. If a wavelength conflict occurs during optical-layer cross-connections, the equipment can convert wavelengths by means of electrical-layer cross-connections. In addition, when the transmission distance exceeds the limit, electrical regeneration can be used. As shown in Figure 4-5, the wavelengths of two services conflict. In this case, wavelengths can be converted by means of electrical-layer cross-connections. When the performance of the line deteriorates and results in bit errors, electrical regeneration can be used to transmit services.

Figure 4-5 Application of electrical-layer grooming



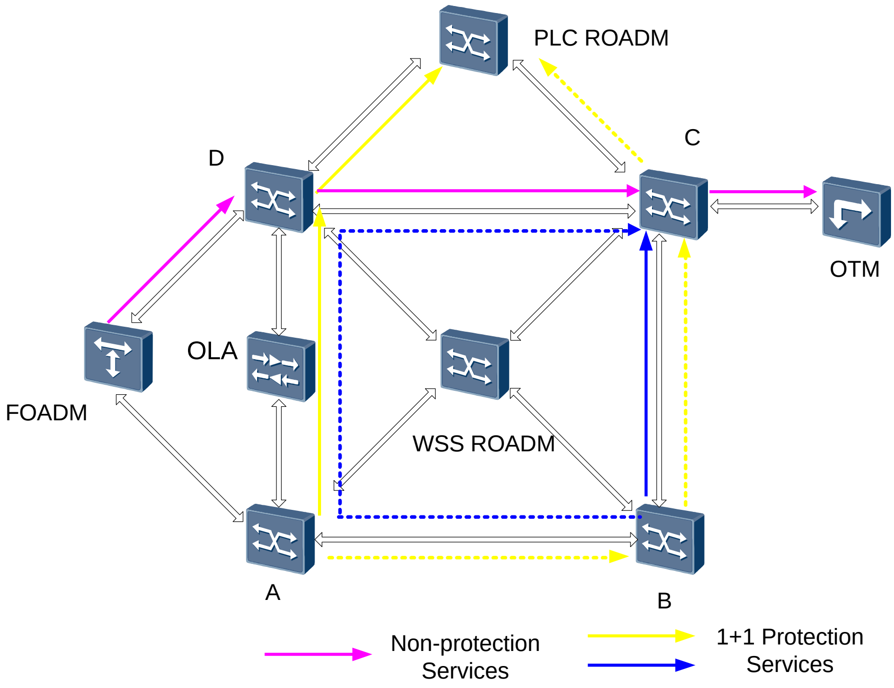
WDM ASON Solution

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 4-6.

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 4-6 WDM ASON solution



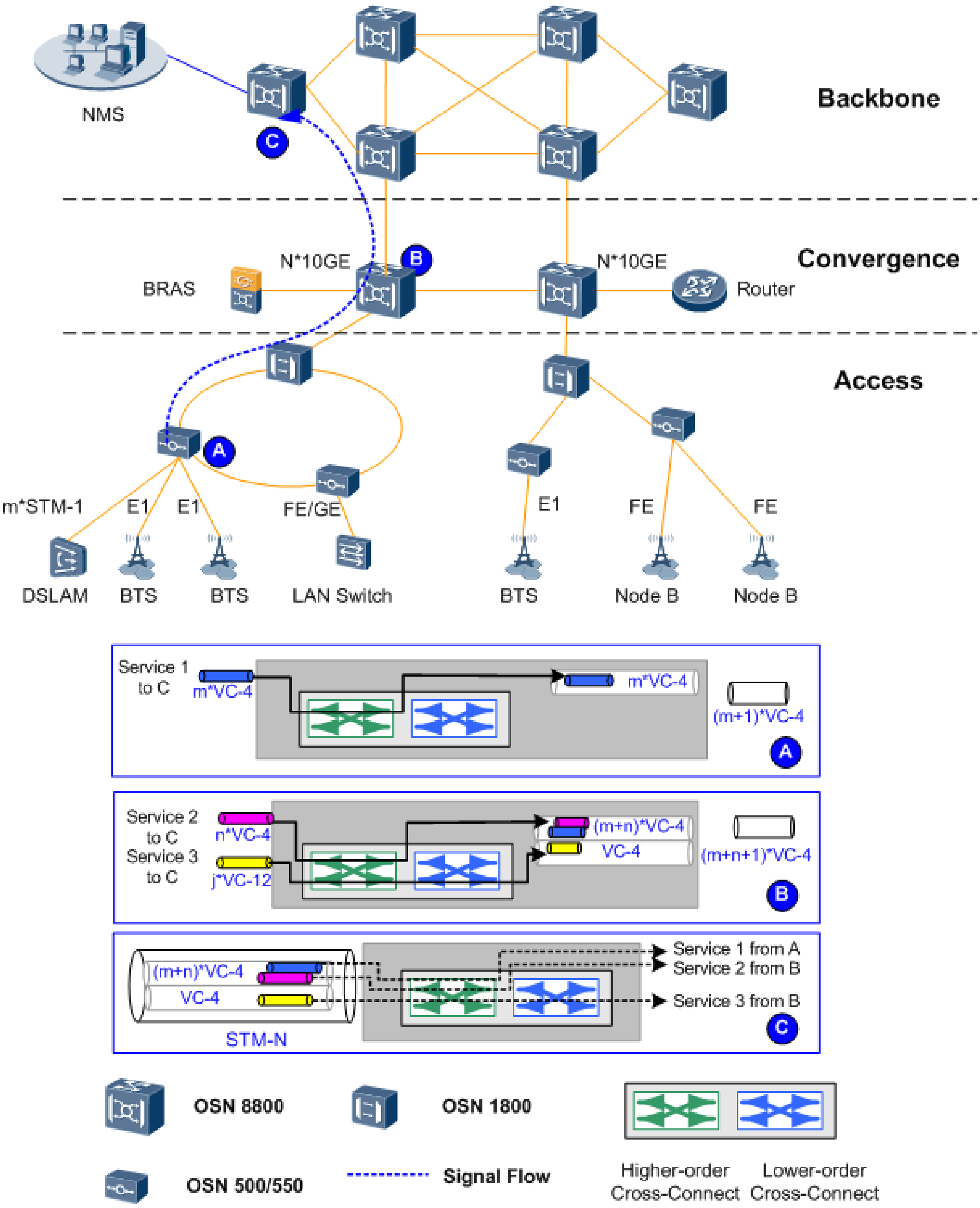
4.1.3 Typical OCS Networking

Networking for Multi-Granularity Service Grooming, Service Convergence and Bandwidth Switching

The OptiX OSN 8800 can provide the networking application of the multi-granularity service grooming and service convergence functions.

Figure 4-7 shows the networking application of the multi-granularity service grooming and service convergence functions of the OptiX OSN 8800. The OptiX OSN 8800 implement the large-capacity grooming of STM-64, STM-16, STM-4, STM-1 services. The OptiX OSN OptiX OSN 8800 can form a hybrid network with different equipment such as DWDM and MSTP.

Figure 4-7 Networking configuration of the OptiX OSN 8800 performing multi-granularity service grooming and service convergence



Networking Application of Ethernet Services

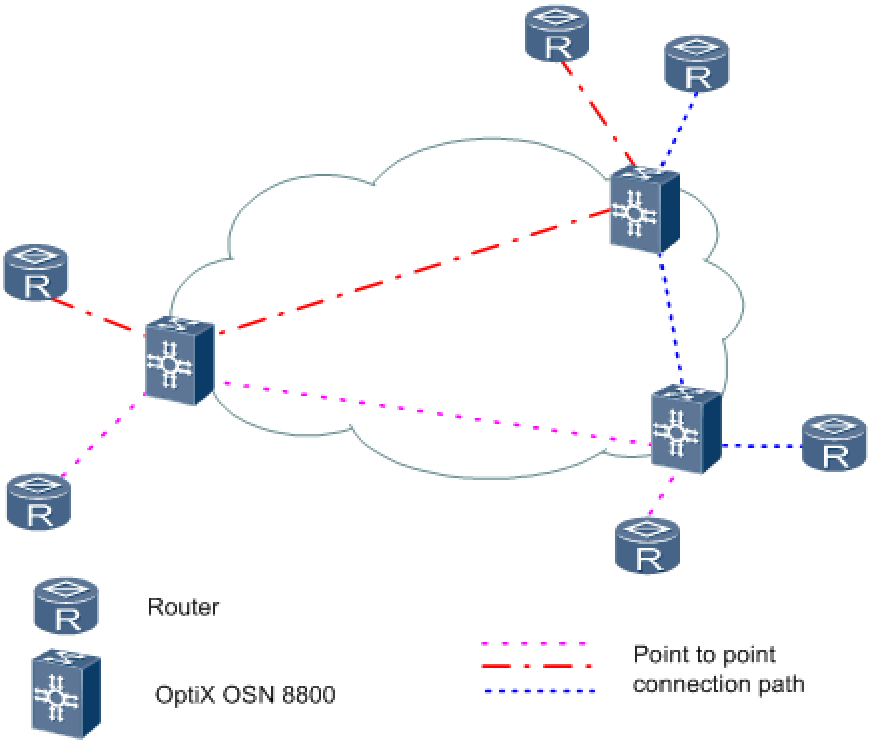
The networking application of Ethernet services includes point-to-point networking for the GE/10GE service, Layer 2 switching networking for the GE/10GE service, and transparent transmission networking for the GE service.

Point-to-Point Networking for the GE/10GE Service

A large and flexible bandwidth is required by Internet service provider (ISP) and application service provider (ASP) for efficient service connection. The OptiX OSN 8800 provides a direct GE service interface. Therefore, the point-to-point transmission of the Ethernet services over a long distance can be realized over the SDH networks.

Figure 4-8 shows the flexible networking modes of the OptiX OSN 8800. The network can be a chain, a ring, a mesh network or a combination of these three modes.

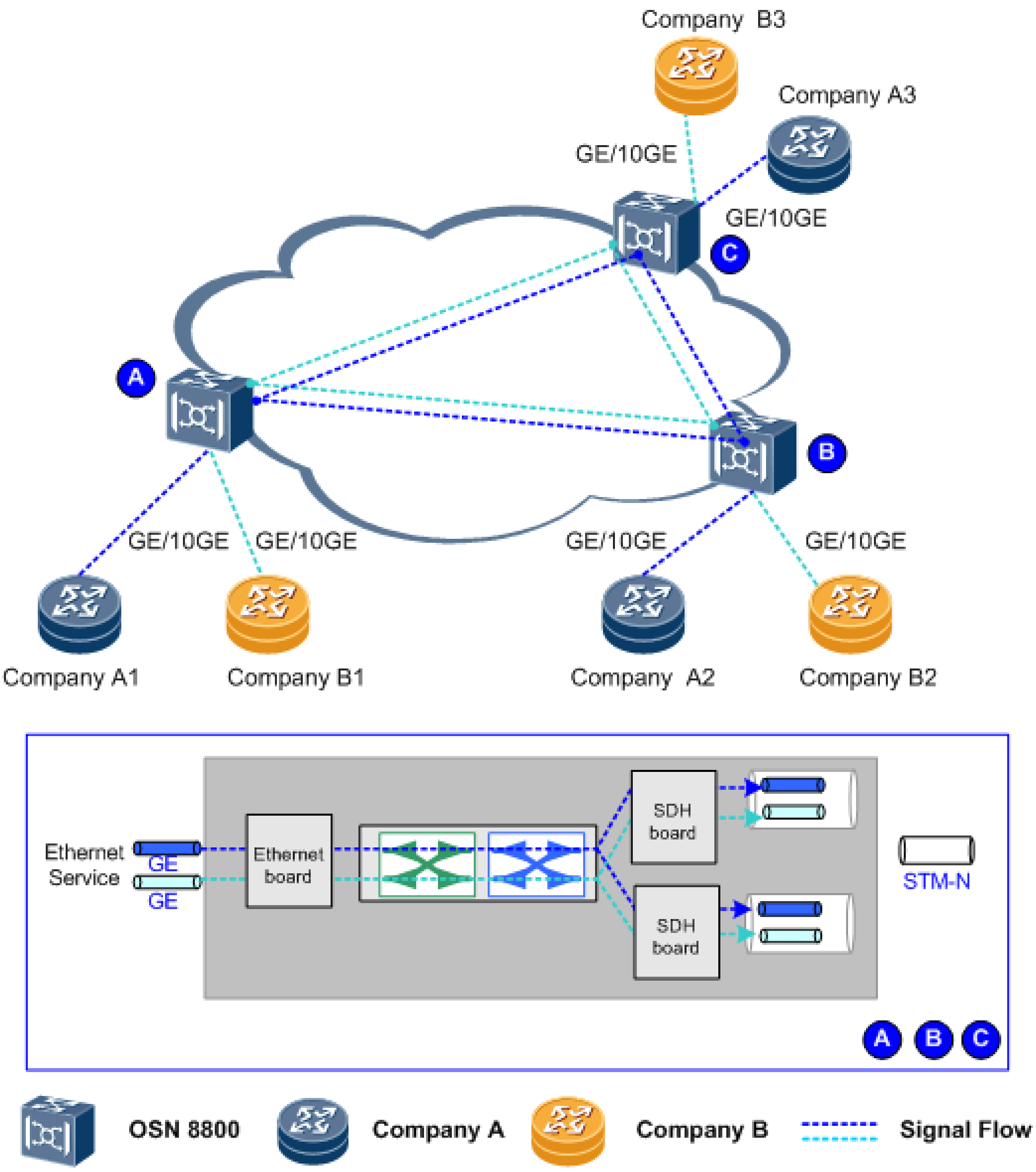
Figure 4-8 Point-to-point connection of the GE/10GE service



Layer 2 Switching Networking for the GE/10GE Service

The OptiX OSN 8800 equipment provides the Layer 2 switching boards to achieve the Layer 2 switching from a GE/10GE service to a GE/10GE service.

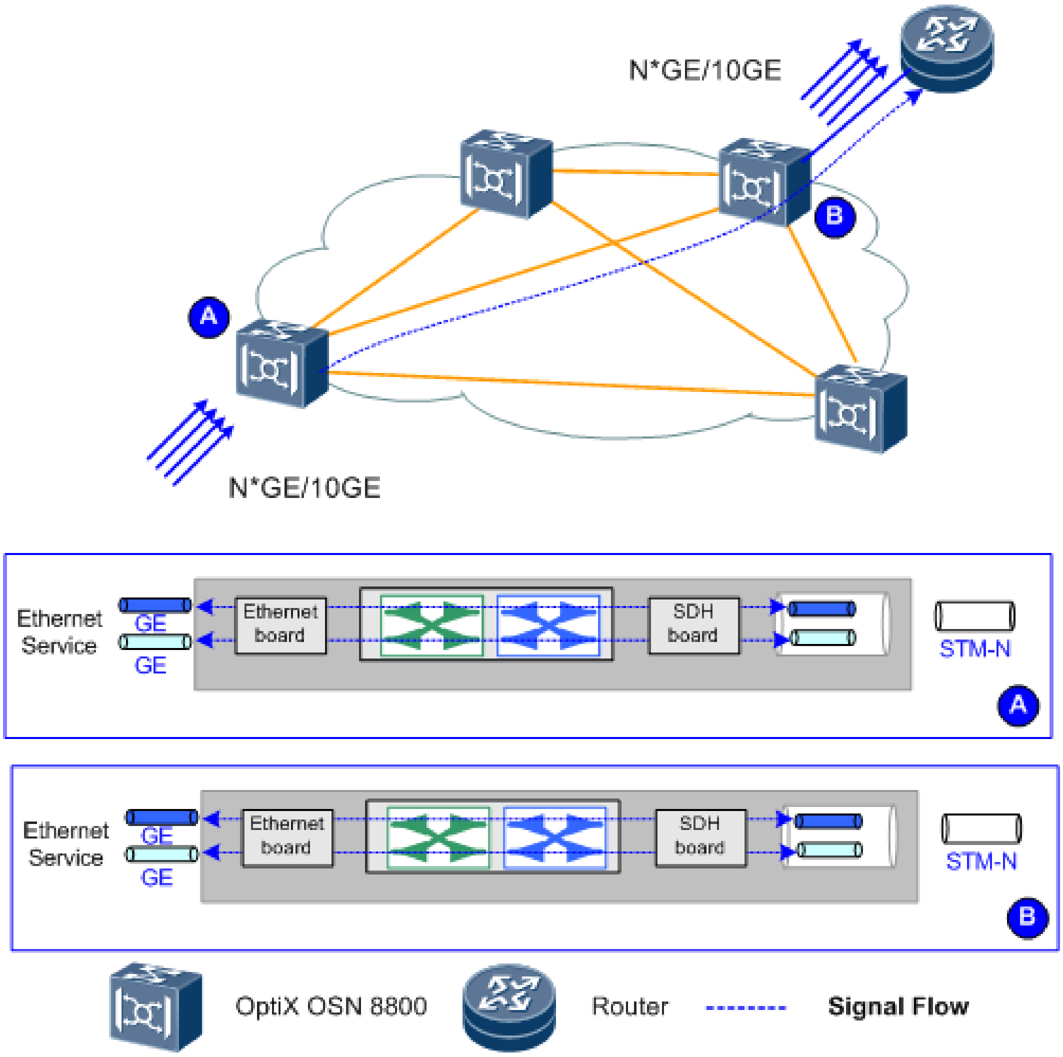
Figure 4-9 Transparent Transmission Networking for the GE/10GE Service



Transparent Transmission Networking for the GE/10GE Service

The Layer 2 switching boards of the OptiX OSN 8800 equipment can transparently transmit the GE/10GE service. Moreover, it can be directly accessed to a router.

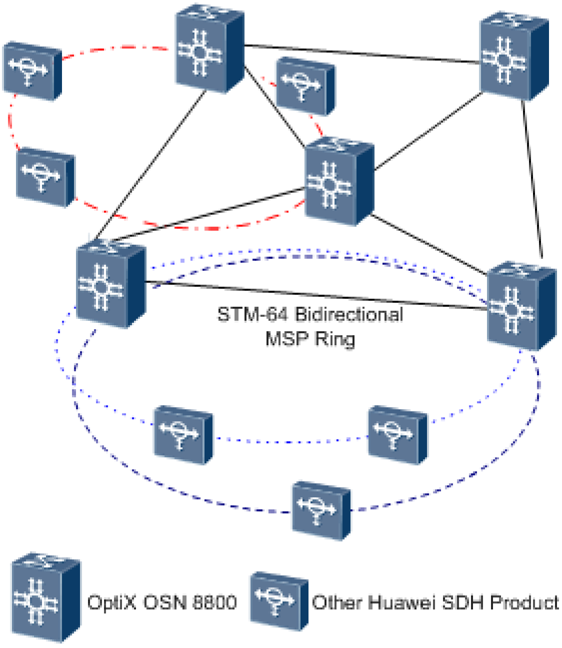
Figure 4-10 Transparent transmission of GE/10GE services



Networking with SDH Equipment to Be the Metropolitan Backbone Node

The OptiX OSN 8800 node features powerful service grooming capability and stronger survivability. The abundant service interfaces of the OptiX OSN 8800 meet the demand for grooming services in the metropolitan backbone network. It can simplify the networking topology and can be deployed in a hybrid network together with the other OptiX OSN product. Working with the end-to-end trail management function of the U2000, the OptiX OSN 8800 can be operated and maintained in simpler and more convenient manner.

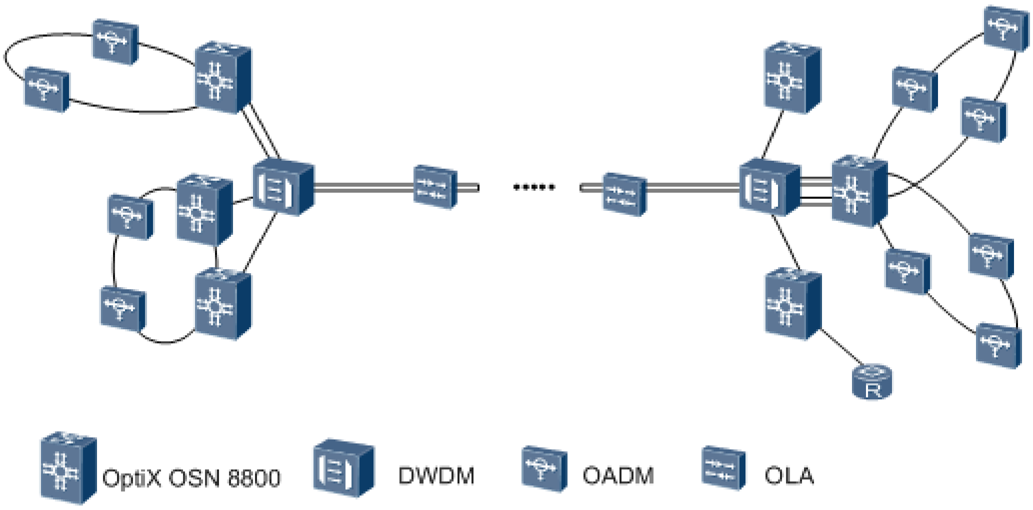
Figure 4-11 Network of the OptiX OSN 8800 combined with the OptiX OSN product



Networking with DWDM Equipment to Be the Supertrunk Backbone Node

The OptiX OSN 8800 can work with the OptiX BWS 1600 to increase the regenerator-free span-crossing distance.

Figure 4-12 Networking application of the OptiX OSN 8800 and the DWDM equipment



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.

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, bandwidth requirement 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

NOTE
The predicted reliability specifications vary according to system configurations.

OptiX OSN 8800 T64

Table 6-3 Mechanical specifications of the OptiX OSN 8800 T64

Item	Specification
Dimensions	498 mm (W) × 580 mm (D) × 900 mm (H) (19.6 in. (W) × 22.8 in. (D) × 35.4 in. (H))
Weight (empty subrack[a])	65 kg (143 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 8800 T64

Item	Requirement
Rated working current	200 A (Independent power supplies to four sections of each subrack, with 50A for each section)
Nominal working voltage	-48V DC/-60V DC
Working voltage range	-40V DC to -72V DC

Table 6-5 Power consumption of an OptiX OSN 8800 T64

Item	Value
Maximum subrack power consumption[a]	6500 W
Typical configuration power consumption (OTN)	less than 3700 W
Typical configuration power consumption (OCS)	less than 2700 W
a: The maximum subrack power consumption refers to the theoretical power consumption obtained when boards with the highest power consumption are installed in every slot on the subrack.	

Table 6-6 Power consumption of the common units in an OptiX OSN 8800 T64

Unit Name		Typical Power Consumption at 25°C (77°F) (W)[a]	Maximum Power Consumption at 55°C (131°F) (W)[a]	Remarks
Subrack	OTU subrack	1804.6	2827.9	32 x LDX, 1 x SCC, 8 x PIU, 2 x AUX, 1 x EFI1, 1 x EFI2, 1 x ATE, and 4 x fan tray assembly
	OTU electrical cross-connect subrack	1839.1	2776.7	2 x XCT, 2 x SXM, 20 x NQ2, 1 x SCC, 8 x PIU, 5 x TOA, 5 x TQX, 2 x AUX, 1 x EFI1, 1 x EFI2, 1 x ATE, and 4 x fan tray assembly
	OTM subrack	963.8	1860.3	1 x M40V, 1 x D40, 1 x OAU1, 1 x OBU1, 20 x LDX, 1 x SCC, 1 x SC2, 8 x PIU, 8 x AUX, 1 x EFI1, 1 x EFI2, 1 x ATE, and 4 x fan tray assembly
OCS System		1920	2830	2 x SXM, 20 x SLD64, 8 x SLO16, 4 x SLQ16, 4 x SLH41, 4 x EGSH, 2 x STG, 1 x STI, 2 x SCC, 8 x PIU, 2 x AUX, 1 x EFI1, 1 x EFI2, 1 x ATE, and 4 x fan tray assembly
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 consumed by the chassis and cabinet is a calculation based on the power consumption of each module.				

Table 6-7 OptiX OSN 8800 T64 equipment predicted reliability

System Availability	Mean Time to Repair (MTTR)	Mean Time Between Failures (MTBF)
0.9999922	4 hours	58.68 years

OptiX OSN 8800 T32

Table 6-8 Mechanical specifications of the OptiX OSN 8800 T32

Item	Specification
Dimensions	498 mm (W) × 295 mm (D) × 900 mm (H)

Item	Specification
	(19.6 in. (W) × 11.6 in. (D) × 35.4 in. (H))
Weight (empty subrack[a])	35 kg (77.1 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 6-9 Requirements on voltage and current of an OptiX OSN 8800 T32

Item	Requirement
Rated working current	100 A (Independent power supplies to two sections of each subrack, with 50A for each section)
Nominal working voltage	-48V DC/-60V DC
Working voltage range	-40V DC to -72V DC

Table 6-10 Power consumption of an OptiX OSN 8800 T32

Item	Value
Maximum subrack power consumption[a]	3500 W
Recommended typical configuration power consumption (OTN)	less than 2000 W
Recommended typical configuration power consumption (OCS)	less than 2250 W
a: The maximum subrack power consumption refers to the theoretical power consumption obtained when boards with the highest power consumption are installed in every slot on the subrack.	

Table 6-11 Power consumption of the subrack in typical configuration in an OptiX OSN 8800 T32

Unit Name		Typical Power Consumption at 25°C (77°F) (W)[a]	Maximum Power Consumption at 55°C (131°F) (W)[a]	Remarks
Subrack	OTU subrack	1633.4	2254.6	32 x LDX, 1 x SCC, 4 x PIU, 1 x AUX, 1 x EFI1, 1 x EFI2, 1 x ATE, and 2 x fan tray assembly

Unit Name		Typical Power Consumption at 25°C (77°F) (W)[a]	Maximum Power Consumption at 55°C (131°F) (W)[a]	Remarks
	OTU electrical cross-connect subrack	1641.6	2166.5	2 x XCH, 20 x NQ2, 1 x SCC, 4 x PIU, 5 x TQX, 5 x TOA, 1 x AUX, 1 x EFI1, 1 x EFI2, 1 x ATE, and 2 x fan tray assembly
	OTM subrack	792.5	1287.1	1 x M40V, 1 x D40, 1 x OAU1, 1 x OBU1, 12 x LDX, 1 x SCC, 4 x PIU, 1 x AUX, 1 x EFI1, 1 x EFI2, 1 x ATE, and 2 x fan tray assembly
	OLA subrack	290.3	706	4 x OBU1, 4 x VA1, 1 x SC2, 1 x SCC, 4 x PIU, 1 x AUX, 1 x EFI1, 1 x EFI2, 1 x ATE, and 2 x fan tray assembly
	OADM subrack	974	1497.2	2 x OAU1, 2 x MR8V, 16 x LDX, 1 x SC2, 1 x SCC, 4 x PIU, 1 x AUX, 1 x EFI1, 1 x EFI2, 1 x ATE, and 2 x fan tray assembly
		378.2	811	2 x M40V, 2 x D40, 2 x FIU, 1 x SC2, 2 x RMU9, 2 x WSM9, 2 x OAU1, 2 x OBU1, 1 x SCC, 4 x PIU, 1 x AUX, 1 x EFI1, 1 x EFI2, 1 x ATE, and 2 x fan tray assembly
		373.1	306.6	2 x M40, 2 x D40, 2 x WSMD9, 2 x DAS1, 1 x SCC, 4 x PIU, 1 x AUX, 1 x EFI1, 1 x EFI2, 1 x ATE, and 2 x fan tray assembly
OCS System		1281	1757	2 x XCMs, 10 x SLQ64, 8 x SLO16, 2 x SLH41, 2 x EGSH, 2 x STG, 1 x STI, 2 x SCC, 4 x PIU, 1 x AUX, 1 x EFI1, 1 x EFI2, 1 x ATE, and 2 x fan tray assembly
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 consumed by the chassis and cabinet is a calculation based on the power consumption of each module.				

Table 6-12 OptiX OSN 8800 T32 equipment predicted reliability

System Availability	Mean Time to Repair (MTTR)	Mean Time Between Failures (MTBF)
0.99999244	4 hours	60.40 years

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 8800 T32 and OptiX OSN 8800 T64 system.

The power consumption, weight, and valid slots of the boards for the OptiX OSN 8800 T32 and OptiX OSN 8800 T64 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 ℃.

The power consumption, weight, and valid slots of the cross-connect boards for the OptiX OSN 8800 T32 and OptiX OSN 8800 T64 system are shown in Table A-2.

Table A-1 Power consumption, weight and valid slots of the OptiX OSN 8800 T32 and OptiX OSN 8800 T64 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 of 8800 T32	Valid Slots of 8800 T64
TN51AUX	-	17.5	19	0.5/1.1	1	IU41	IU72, IU83
TN51ATE	-	0.3	0.3	0.2/0.4	1	IU48	IU87
TN11CMR2	-	0.2	0.3	0.8/1.8	1	IU1-IU8, IU11-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN11CMR4	-	0.2	0.3	0.9/2.0	1	IU1-IU8, IU11-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN11CRPC01	-	110.0	121.0	4.0/8.8	-	Installed outside	Installed outside
TN11CRPC03	-	70.0	77.0	4.2/9.2	-	Installed outside	Installed outside

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 of 8800 T32	Valid Slots of 8800 T64
TN11D40	-	10.0	13.0	2.2/4.8	3	IU1-IU6, IU11-IU17, IU20-IU25, IU29-IU34	IU1-IU6, IU11-IU16, IU19-IU24, IU27-IU32, IU35-IU40, IU45-IU50, IU53-IU58, IU61-IU66
TN12D40	-	10.0	13.0	2.0/4.4	2	IU1-IU7, IU11-IU18, IU20-IU26, IU29-IU35	IU1-IU7, IU11-IU17, IU19-IU25, IU27-IU33, IU35-IU41, IU45-IU51, IU53-IU59, IU61-IU67
TN11D40V	-	38.5	42.3	2.3/5.1	3	IU1-IU6, IU11-IU17, IU20-IU25, IU29-IU34	IU1-IU6, IU11-IU16, IU19-IU24, IU27-IU32, IU35-IU40, IU45-IU50, IU53-IU58, IU61-IU66
TN11DAS1	-	22	28.6	1.4/3.1	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN11DCP	-	6.8	7.5	1.0/2.2	1	IU1-IU8, IU11-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN12DCP	-	6.8	7.5	1.0/2.2	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN11DCU	-	0.2	0.3	1.5/3.3	1	IU1-IU8, IU11-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN11DMR1	-	0.2	0.3	0.7/1.5	1	IU1-IU8, IU11-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN51EFI1	-	5.0	7.0	0.2/0.4	1	IU38	IU76

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 of 8800 T32	Valid Slots of 8800 T64
TN51EFI2	-	13.0	15.0	0.3/0.7	1	IU37	IU71
TN54ENQ2	-	40.0	44.0	0.9/2.0	1	IU1, IU5, IU12, IU16, IU20, IU24, IU29, IU33	IU1, IU5, IU11, IU15, IU19, IU23, IU27, IU31, IU35, IU39, IU45, IU49, IU53, IU57, IU61, IU65
TN12FIU	-	4.2	4.6	1.0/2.2	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN13FIU	-	0.2	0.3	1.0/2.2	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN11GFU	-	0.2	0.3	0.9/2.0	1	IU1-IU8, IU11-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN11HBA	-	47.0	75.0	3/6.6	3	IU2-IU7, IU12-IU18, IU21-IU26, IU30-IU35	IU2-IU7, IU12-IU17, IU20-IU25, IU28-IU33, IU36-IU41, IU46-IU51, IU54-IU59, IU62-IU67
TN11HSC1	-	8	8.8	1.0/2.2	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN11ITL	-	0.2	0.3	1.2/2.6	1	IU1-IU8, IU11-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN12ITL	-	10	11.5	1.2/2.6	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68

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 of 8800 T32	Valid Slots of 8800 T64
TN12LDM	-	22.6	24.8	1.1/2.4	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN11LDMD	-	26.9	29.6	1.2/2.6	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN11LDMS	-	26.9	29.6	1.1/2.4	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN12LDX	800 ps/nm-C Band (Odd & Even Wavelengths)-Fixed Wavelength-NRZ-PIN-XFP	44.5	51.2	1.6/3.5	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN-XFP	45.5	52.2				
TN11LEM24	-	81.0	83.0	1.0/2.2	2	IU1-IU7, IU12-IU18, IU20-IU26, IU29-IU35	IU1-IU7, IU11-IU17, IU19-IU25, IU27-IU33, IU35-IU41, IU45-IU51, IU53-IU59, IU61-IU67
TN11LEX4	-	64.0	67.0	0.7/1.5	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN11LOA	800 ps/nm-C Band (Odd & Even Wavelengths)-Fixed	31.8	36	1.19/2.64	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68

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 of 8800 T32	Valid Slots of 8800 T64
	Wavelength-NRZ-PIN-XFP						
	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, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
	1200 ps/nm-C Band-Tunable Wavelength-NRZ-PIN 1200 ps/nm-C Band-Tunable	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 of 8800 T32	Valid Slots of 8800 T64
	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, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
	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-Tuna	43.04	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 of 8800 T32	Valid Slots of 8800 T64
	ble Wavelength-DRZ-PIN						
	10Gbit/s Multirate - 10km 10Gbit/s Multirate - 40km 10Gbit/s Multirate - 80km	37.0	41.44				
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-IU7, IU12-IU18, IU20-IU26, IU29-IU35	IU1-IU7, IU11-IU17, IU19-IU25, IU27-IU33, IU36-IU41, IU45-IU51, IU53-IU59, IU61-IU67
	1200 ps/nm-C Band-Tunable Wavelength-NRZ-PIN 1200 ps/nm-C Band-Tunable Wavelength-NRZ-APD	92.9	101.9				

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 of 8800 T32	Valid Slots of 8800 T64
	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 Wavelength-NRZ-PIN-XFP	61.8	69.2	1.1/2.4	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
	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-PI	66.7	75.0				

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 of 8800 T32	Valid Slots of 8800 T64
	N						
TN13LQM	-	32.6	35.9	1.1/2.4	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN12LQMD	-	31.1	35.0	1.4/3.1	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN12LQMS	-	29.0	32.3	1.3/2.9	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
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-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
	1200 ps/nm-C Band-Tunable Wavelength-NRZ-PIN 1200 ps/nm-C Band-Tunable Wavelength-NRZ-APD	30.7	36.8				
	800 ps/nm-C	32.5	39				

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 of 8800 T32	Valid Slots of 8800 T64
	Band-Tunable Wavelength-DRZ-PIN						
	4800 ps/nm-C Band-Tunable Wavelength-ODB-APD	35.5	42.6				
TN13LSX	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN	29.4	32.8	1.1/2.4	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
	800 ps/nm-C Band-Tunable Wavelength-DRZ-PIN	29.5	33.9				
	800 ps/nm-C Band (Odd & Even Wavelengths)-Fixed Wavelength-NRZ-PIN-XFP	27.0	30.4				
	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN-XFP	28.0	31.4				

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 of 8800 T32	Valid Slots of 8800 T64
TN12LSXL	500 ps/nm-C Band-Tunable Wavelength-ODB-PIN	74.0	81.0	4.1/9.0	3	IU3-IU8, IU14-IU19, IU22-IU27, IU31-IU36	IU3-IU8, IU13-IU18, IU21-IU26, IU29-IU34, IU38-IU42, IU47-IU52, IU55-IU60, IU63-IU68
	500 ps/nm-C Band-Tunable Wavelength-DQPSK-PIN	84.0	94.0				
TN11LSQ	800 ps/nm-C Band-Tunable Wavelength-ODB-PIN	75	82	2.5/5.5	2	IU2-IU8, IU12-IU19, IU21-IU27, IU30-IU36	IU2-IU8, IU12-IU18, IU20-IU26, IU28-IU34, IU36-IU42, IU46-IU52, IU54-IU60, IU62-IU68
	800 ps/nm-C Band-Tunable Wavelength-DQPSK-PIN	82	89				
TN12LSXLR	500 ps/nm-C Band-Tunable Wavelength-DQPSK-PIN	75.0	79.0	2.5/5.5	2	IU2-IU8, IU13-IU19, IU21-IU27, IU30-IU36	IU2-IU8, IU12-IU18, IU20-IU26, IU28-IU34, IU36-IU42, IU46-IU52, IU54-IU60, IU62-IU68
	500 ps/nm-C Band-Tunable Wavelength-ODB-PIN	67.0	70.0				

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 of 8800 T32	Valid Slots of 8800 T64
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-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
	1200 ps/nm-C Band-Tunable Wavelength-NRZ-PIN 1200 ps/nm-C Band-Tunable Wavelength-NRZ-APD	35.0	38.0				
	800 ps/nm-C Band-Tunable Wavelength-DRZ-PIN	36.8	39.8				
	4800 ps/nm-C Band-Tunable Wavelength-ODB-AP	39.8	42.8				

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 of 8800 T32	Valid Slots of 8800 T64
	D						
TN12LWXS	-	33.9	37.3	1.1/2.4	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
N3EAS2	-	78	91	1.1/2.4	1	IU1-IU8, IU12-IU27, IU29-IU36	-
N1EGSH	-	89.3	98.2	1.2/2.6	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
N1SF64A	-	35.7	39.3	0.9/2.0	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
N3SLH41	-	48.5	53.4	1.0/2.2	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
N4SLO16	-	21.5	23.7	0.8/1.8	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
N4SLQ64	-	37.2	40.9	1.4/3.1	1	IU1-IU8, IU12-IU27, IU29-IU36	-
N4SF64	-	27.3	29.3	0.7/1.5	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
N4SFD64	-	38.2	42.0	1.2/2.6	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
N4SLD64	-	20.3	22.1	1.1/2.4	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
N4SL64	-	15.2	16.7	0.6/1.3	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
N4SLQ16	-	12.8	13.9	0.7/1.5	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68

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 of 8800 T32	Valid Slots of 8800 T64
TN11M40	-	10.0	13.0	2.2/4.8	3	IU1-IU6, IU11-IU17, IU20-IU25, IU29-IU34	IU1-IU6, IU11-IU16, IU19-IU24, IU27-IU32, IU35-IU40, IU45-IU50, IU53-IU58, IU61-IU66
TN12M40	-	10.0	13.0	2.0/4.4	2	IU1-IU7, IU11-IU18, IU20-IU26, IU29-IU35	IU1-IU7, IU11-IU17, IU19-IU25, IU27-IU33, IU35-IU41, IU45-IU51, IU53-IU59, IU61-IU67
TN11M40V	-	20.0	25.0	2.3/5.1	3	IU1-IU6, IU11-IU17, IU20-IU25, IU29-IU34	IU1-IU6, IU11-IU16, IU19-IU24, IU27-IU32, IU35-IU40, IU45-IU50, IU53-IU58, IU61-IU66
TN12M40V	-	16.0	26.0	2.3/5.1	2	IU1-IU7, IU11-IU18, IU20-IU26, IU29-IU35	IU1-IU7, IU11-IU17, IU19-IU25, IU27-IU33, IU35-IU41, IU45-IU51, IU53-IU59, IU61-IU67
TN11MCA4	-	8.0	8.5	1.9/4.2	2	IU1-IU7, IU11-IU18, IU20-IU26, IU29-IU35	IU1-IU7, IU11-IU17, IU19-IU25, IU27-IU33, IU35-IU41, IU45-IU51, IU53-IU59, IU61-IU67
TN11MCA8	-	12.0	13.0	1.9/4.2	2	IU1-IU7, IU11-IU18, IU20-IU26,	IU1-IU7, IU11-IU17, IU19-IU25,

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 of 8800 T32	Valid Slots of 8800 T64
						IU29-IU35	IU27-IU33, IU35-IU41, IU45-IU51, IU53-IU59, IU61-IU67
TN11MR2	-	0.2	0.3	0.9/2.0	1	IU1-IU8, IU11-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN11MR4	-	0.2	0.3	0.9/2.0	1	IU1-IU8, IU11-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN11MR8	-	0.2	0.3	1.0/2.2	2	IU1-IU7, IU11-IU18, IU20-IU26, IU29-IU35	IU1-IU7, IU11-IU17, IU19-IU25, IU27-IU33, IU35-IU41, IU45-IU51, IU53-IU59, IU61-IU67
TN11MR8V	-	7.7	8.6	1.0/2.2	2	IU1-IU7, IU12-IU18, IU20-IU26, IU29-IU35	IU1-IU7, IU11-IU17, IU19-IU25, IU27-IU33, IU35-IU41, IU45-IU51, IU53-IU59, IU61-IU67
TN52ND2	800 ps/nm-C Band-Tunable Wavelength-DRZ-PIN	67.8	74.6	1.4/3.1	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN	70.5	77.5				
TN53ND2	800	25	28	1.2/2.6	1	IU1-IU8,	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 of 8800 T32	Valid Slots of 8800 T64
	ps/nm-C Band (Odd & Even Wavelengths)-Fixed Wavelength-NRZ-PIN-XFP					IU12-IU27, IU29-IU36	IU11-IU42, IU45-IU68
	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN-XFP						
	10Gbit/s Multirate - 10km 10Gbit/s Multirate - 40km						
TN54NPO2	-	134.0	147.0	1.9/4.2	2	IU3, IU7, IU14, IU18, IU22, IU26, IU31, IU35	IU3, IU7, IU13, IU17, IU21, IU25, IU29, IU33, IU37, IU41, IU47, IU51, IU55, IU59, IU63, IU67
TN55NPO2	-	143.0	157.3	1.7/3.6	2	IU3, IU7, IU14, IU18, IU22, IU26, IU31, IU35	IU3, IU7, IU13, IU17, IU21, IU25, IU29, IU33, IU37, IU41,

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 of 8800 T32	Valid Slots of 8800 T64
							IU47, IU51, IU55, IU59, IU63, IU67
TN55NPO2E	-	143.0	157.3	1.7/3.6	2	IU3, IU7, IU14, IU18, IU22, IU26, IU31, IU35	IU3, IU7, IU13, IU17, IU21, IU25, IU29, IU33, IU37, IU41, IU47, IU51, IU55, IU59, IU63, IU67
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, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
	10Gbit/s Multirate - 10km 10Gbit/s Multirate - 40km						
	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN-XFP						
TN53NQ2	800 ps/nm-C	46.5	50	1.6/3.5	1	IU1-IU8, IU12-IU27,	IU1-IU8, IU11-IU42,

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 of 8800 T32	Valid Slots of 8800 T64
	Band (Odd & Even Wavelengths)-Fixed Wavelength-NRZ-PIN-XFP					IU29-IU36	IU45-IU68
	10Gbit/s Multirate - 10km 10Gbit/s Multirate - 40km						
	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN-XFP						
TN54NQ2	800 ps/nm-C Band (Odd & Even Wavelengths)-Fixed Wavelength-NRZ-PIN-XFP 800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN-XFP 10Gbit/s Multirate - 10km 10Gbit/s Multirate - 40km	53	58.3	1.6/3.5	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68

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 of 8800 T32	Valid Slots of 8800 T64
TN52NS2	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN	46.5	51.1	1.3/2.86	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
	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, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
	800 ps/nm-C Band-Tunable Wavelength-NRZ-PIN-XFP	21	25				
	10Gbit/s Multirate - 10km 10Gbit/s Multirate - 40km	20	24				
TN54NS3	800 ps/nm-C Band-Tunable Wavelength-DQPSK-	73.0	80.0	1.8/3.96	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68

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 of 8800 T32	Valid Slots of 8800 T64
	PIN						
	800 ps/nm-C Band-Tunable Wavelength-ODB-PIN	60.0	65.0				
TN11OAU101	-	18.0	24.0	1.8/4.0	2	IU2-IU8, IU12-IU19, IU21-IU27, IU30-IU36	IU2-IU8, IU12-IU18, IU20-IU26, IU28-IU34, IU36-IU42, IU46-IU52, IU54-IU60, IU62-IU68
TN11OAU102	-	14.0	18.0	1.8/4.0	2	IU2-IU8, IU12-IU19, IU21-IU27, IU30-IU36	IU2-IU8, IU12-IU18, IU20-IU26, IU28-IU34, IU36-IU42, IU46-IU52, IU54-IU60, IU62-IU68
TN11OAU103	-	18.0	24.0	1.8/4.0	2	IU2-IU8, IU12-IU19, IU21-IU27, IU30-IU36	IU2-IU8, IU12-IU18, IU20-IU26, IU28-IU34, IU36-IU42, IU46-IU52, IU54-IU60, IU62-IU68
TN11OAU105	-	22.0	29.0	1.8/4.0	2	IU2-IU8, IU12-IU19, IU21-IU27, IU30-IU36	IU2-IU8, IU12-IU18, IU20-IU26, IU28-IU34, IU36-IU42, IU46-IU52, IU54-IU60, IU62-IU68
TN12OAU100	-	11.0	14.0	1.8/4.0	2	IU2-IU8, IU12-IU19, IU21-IU27,	IU2-IU8, IU12-IU18, IU20-IU26,

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 of 8800 T32	Valid Slots of 8800 T64
						IU30-IU36	IU28-IU34, IU36-IU42, IU46-IU52, IU54-IU60, IU62-IU68
TN12OAU101	-	12.0	15.0	1.8/4.0	2	IU2-IU8, IU12-IU19, IU21-IU27, IU30-IU36	IU2-IU8, IU12-IU18, IU20-IU26, IU28-IU34, IU36-IU42, IU46-IU52, IU54-IU60, IU62-IU68
TN12OAU102	-	10.0	13.0	1.8/4.0	2	IU2-IU8, IU12-IU19, IU21-IU27, IU30-IU36	IU2-IU8, IU12-IU18, IU20-IU26, IU28-IU34, IU36-IU42, IU46-IU52, IU54-IU60, IU62-IU68
TN12OAU103	-	12.0	15.0	1.8/4.0	2	IU2-IU8, IU12-IU19, IU21-IU27, IU30-IU36	IU2-IU8, IU12-IU18, IU20-IU26, IU28-IU34, IU36-IU42, IU46-IU52, IU54-IU60, IU62-IU68
TN12OAU105	-	15.0	21.0	1.8/4.0	2	IU2-IU8, IU12-IU19, IU21-IU27, IU30-IU36	IU2-IU8, IU12-IU18, IU20-IU26, IU28-IU34, IU36-IU42, IU46-IU52, IU54-IU60, IU62-IU68
TN13OAU101	-	12.0	15.0	1.6/3.5	1	IU1-IU8, IU11-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN13OAU103	-	12.0	15.0	1.6/3.5	1	IU1-IU8, IU11-IU27,	IU1-IU8, IU11-IU42,

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 of 8800 T32	Valid Slots of 8800 T64
						IU29-IU36	IU45-IU68
TN13OAU105	-	15.0	21.0	1.6/3.5	1	IU1-IU8, IU11-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN11OBU101	-	11.0	13.0	1.3/2.9	1	IU1-IU8, IU11-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN11OBU103	-	13.0	15.0	1.3/2.9	1	IU1-IU8, IU11-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN11OBU104	-	12.0	14.0	1.3/2.9	1	IU1-IU8, IU11-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN12OBU101	-	10.0	11.0	1.1/2.4	1	IU1-IU8, IU11-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN12OBU1P1	-	10.0	11.0	1.1/2.4	1	IU1-IU8, IU11-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN12OBU103	-	11.0	12.0	1.1/2.4	1	IU1-IU8, IU11-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN12OBU104	-	10.0	12.0	1.1/2.4	1	IU1-IU8, IU11-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN11OBU205	-	17.0	24.0	1.9/4.2	2	IU2-IU8, IU12-IU19, IU21-IU27, IU30-IU36	IU2-IU8, IU12-IU18, IU20-IU26, IU28-IU34, IU36-IU42, IU46-IU52, IU54-IU60, IU62-IU68
TN12OBU205	-	14.0	19.0	1.6/3.5	2	IU2-IU8, IU12-IU19, IU21-IU27, IU30-IU36	IU2-IU8, IU12-IU18, IU20-IU26, IU28-IU34, IU36-IU42, IU46-IU52, IU54-IU60,

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 of 8800 T32	Valid Slots of 8800 T64
							IU62-IU68
TN11OLP	-	6.0	6.6	0.9/2.0	1	IU1-IU8, IU11-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN12OLP	-	4.0	4.5	1.0/2.2	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN11OPM8	-	12.0	15.0	1.2/2.6	1	IU1-IU8, IU11-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN51PIU	-	1.8	1.8	0.5/1.1	1	IU39, IU40, IU45, IU46	IU69-IU70, IU78-IU81, IU88-IU89
TN16PIU	-	3.0	3.6	0.65/1.43	1	IU39, IU40, IU45, IU46	IU69, IU70, IU78, IU79, IU80, IU81, IU88, IU89
TN11RDU9	-	6	6.6	1.1/2.4	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN11RMU901	-	7.7	8.6	1.1/2.4	1	IU1-IU8, IU11-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN11RMU902	-	8.2	9.0	1.1/2.4	1	IU1-IU8, IU11-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN11ROAM	-	66.0	72.6	3.2/7.0	3	IU1-IU6, IU11-IU17, IU20-IU25, IU29-IU34	IU1-IU6, IU11-IU16, IU19-IU24, IU27-IU32, IU35-IU40, IU45-IU50, IU53-IU58, IU61-IU66
TN12SC1	-	11.0	14.9	1.0/2.2	1	IU1-IU8, IU12-IU27,	IU1-IU8, IU11-IU42,

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 of 8800 T32	Valid Slots of 8800 T64
						IU29-IU36	IU45-IU68
TN12SC2	-	13.5	14.5	1.0/2.2	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN51SCC	-	18.0	20.0	1.2/2.6	1	IU11, IU28	-
TN52SCC	-	23.0	25.1	1.0/2.2	1	IU11, IU28	-
TNK2SCC	-	26.7	29.3	0.9/2.0	1	-	IU74, IU85
TN11SCS	-	0.2	0.3	0.8/1.8	1	IU1-IU8, IU11-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN11SFIU	-	0.2	0.3	1.0/2.2	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN11ST2	-	17.5	19.5	0.95/2.09	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN52STG	-	13.0	14.1	0.5/1.1	1	IU42, IU44	-
TNK2STG	-	14.0	16.0	0.5/1.1	1	-	IU75, IU86
TN52STI	-	1.5	1.5	0.3/0.7	1	IU47	IU82
TN11TDC	-	13.0	15.0	0.5/1.1	1	IU1-IU8, IU11-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN52TDX	-	57.3	63.0	1.4/3.1	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN53TDX	-	25	35.0	1.5/3.3	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN54THA	-	35.0	40.0	1.5/3.3	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN11TMX	800 ps/nm-C Band (odd & even wavelength	40.3	44.3	1.4/3.1	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68

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 of 8800 T32	Valid Slots of 8800 T64
	s)-Fixed 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	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				
TN12TMX	800 ps/nm-C Band-Tunable	32.4	37.1	1.2/2.7	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68

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 of 8800 T32	Valid Slots of 8800 T64
	Wavelength-NRZ-PIN-XFP						
	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				
	800 ps/nm-C Band (Odd & Even Wavelengths)-Fixed Wavelength-NRZ-PIN-XFP	31.4	36.1				
	10Gbit/s Multirate - 10km 10Gbit/s Multirate - 40km 10Gbit/s Multirate - 80km	31.4	36.1				
TN54TOA	-	23.0	25.0	0.7/1.6	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN52TOG	-	41.8	46.0	0.85/1.87	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68

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 of 8800 T32	Valid Slots of 8800 T64
TN52TOM	-	81.0	89.1	1.5/3.3	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN52TQX	-	91.5	100.0	1.6/3.5	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN53TQX	-	45.0	50.0	1.6/3.5	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN55TQX	-	45.0	50.0	1.6/3.5	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN53TSXL	-	75.0	83.0	1.4/3.1	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN12VA1	-	6.5	7.2	1.0/2.2	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN12VA4	-	8.5	9.4	1.0/2.2	1	IU1-IU8, IU12-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN11WMU	-	12.0	15.0	1.0/2.2	1	IU1-IU8, IU11-IU27, IU29-IU36	IU1-IU8, IU11-IU42, IU45-IU68
TN12WSD9	-	25.4	28.5	2.7/6.0	2	IU1-IU7, IU12-IU18, IU20-IU26, IU29-IU35	IU1-IU7, IU11-IU17, IU19-IU25, IU27-IU33, IU35-IU41, IU45-IU51, IU53-IU59, IU61-IU67
TN13WSD9	-	25.4	28.5	2.9/6.4	3	IU1-IU6, IU12-IU17, IU20-IU25, IU29-IU34	IU1-IU6, IU11-IU16, IU19-IU24, IU27-IU32, IU35-IU40, IU45-IU50, IU53-IU58, IU61-IU66

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 of 8800 T32	Valid Slots of 8800 T64
TN12WSM9	-	25.4	28.5	2.7/6.0	2	IU1-IU7, IU12-IU18, IU20-IU26, IU29-IU35	IU1-IU7, IU11-IU17, IU19-IU25, IU27-IU33, IU35-IU41, IU45-IU51, IU53-IU59, IU61-IU67
TN13WSM9	-	25.4	28.5	2.9/6.4	3	IU1-IU6, IU12-IU17, IU20-IU25, IU29-IU34	IU1-IU6, IU11-IU16, IU19-IU24, IU27-IU32, IU35-IU40, IU45-IU50, IU53-IU58, IU61-IU66
TN11WSMD2	-	17.0	18.7	3.2/7.0	2	IU1-IU7, IU121-IU18, IU20-IU26, IU29-IU35	IU1-IU7, IU11-IU17, IU19-IU25, IU27-IU33, IU35-IU41, IU45-IU51, IU53-IU59, IU61-IU67
TN11WSMD4	-	17.0	18.7	3.2/7.0	2	IU1-IU7, IU121-IU18, IU20-IU26, IU29-IU35	IU1-IU7, IU11-IU17, IU19-IU25, IU27-IU33, IU35-IU41, IU45-IU51, IU53-IU59, IU61-IU67
TN12WSMD4	-	12.0	15.0	2.6/5.7	2	IU1-IU7, IU12-IU18, IU20-IU26, IU29-IU35	IU1-IU7, IU11-IU17, IU19-IU25, IU27-IU33, IU35-IU41, IU45-IU51, IU53-IU59, IU61-IU67
TN11WSMD9	-	25	30	3.1/6.8	2	IU1-IU7, IU121-IU18,	IU1-IU7, IU11-IU17, IU19-IU25,

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 of 8800 T32	Valid Slots of 8800 T64
						IU20-IU26, IU29-IU35	IU27-IU33, IU36-IU41, IU45-IU51, IU53-IU59, IU61-IU67
a: When the FC extension function of the TN12LOM board is used, the power consumption of the board increases by another 2 W.							

Table A-2 Power consumption, weight and valid slots of the OptiX OSN 8800 T32 and OptiX OSN 8800 T64 cross-connect boards

Board	Power Consumption at 25°C (77°F) (W)	Power Consumption at 55°C (131°F) (W)	Power Consumption at Warm Backup (25°C, 77°F) (W)	Power Consumption at Warm Backup (55°C, 131°F) (W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots of 8800 T32	Valid Slots of 8800 T64
TNK2SXM+TNK2XCT	530–3.6 x (64–n)	583–3.6 x (64–n)	190	210	3.74(8.1)+3.6(7.9)	1+1	-	TNK2SXM : IU10, IU44 TNK2XCT : IU9, IU43
TNK2SXM+TNK4XCT	378–2.5 x (64–n)	416–2.5 x (64–n)	173	190	3.74(8.1)+2.9(6.3)	1+1	-	TNK2SXM : IU10, IU44 TNK4XCT : IU9, IU43
TNK4SXM+TNK2X	324–2.5 x (64–n)	356–2.5 x (64–n)	114	125	3.0(6.6)+3.6(7.9)	1+1	-	TNK4SXM : IU10,

Board	Power Consumption at 25°C (77°F) (W)	Power Consumption at 55°C (131°F) (W)	Power Consumption at Warm Backup (25°C, 77°F) (W)	Power Consumption at Warm Backup (55°C, 131°F) (W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots of 8800 T32	Valid Slots of 8800 T64
CT								IU44 TNK2XCT : IU9, IU43
TNK2SXH+TNK2XCT	470–3.6 x (64–n)	517–3.6 x (64–n)	130	143	3.74(7.9)+3.6(7.9)	1+1	-	TNK2SXH : IU10, IU44 TNK2XCT : IU9, IU43
TNK2SXH+TNK4XCT	318–2.5 x (64-n)	350–2.5 x (64-n)	113	124	3.74(7.9)+2.9(6.3)	1+1	-	TNK2SXH : IU10, IU44 TNK4XCT : IU9, IU43
TNK4SXH+TNK2XCT	321–2.5 x (64-n)	353–2.5 x (64-n)	112	123	2.68(5.9)+3.6(7.9)	1+1	-	TNK4SXH : IU10, IU44 TNK2XCT : IU9, IU43
TNK4SXM+TNK4XCT	188–1.2 x (64–n)	207–1.32 x (64–n)	97	107	3.0(6.6)+2.9(6.3)	1+1	-	TNK4SXM : IU10, IU44 TNK4XCT : IU9, IU43
TNK4SXH+T	169–1.2 x	186–1.32 x	95	105	2.68(5.9)+2.9(	1+1	-	TNK4SXH :

Board	Power Consumption at 25°C (77°F) (W)	Power Consumption at 55°C (131°F) (W)	Power Consumption at Warm Backup (25°C, 77°F) (W)	Power Consumption at Warm Backup (55°C, 131°F) (W)	Weight (kg/lb.)	Number of Occupied Slots	Valid Slots of 8800 T32	Valid Slots of 8800 T64
NK4XCT	(64–n)	(64–n)			6.3)			IU10, IU44 TNK4XCT : IU9, IU43
TN52XCH01	243 - 3.6 x (32 - n)	267.3 - 3.6 x (32 - n)	65	72	3.4/7.5	1	IU9, IU10	-
TN52XCH02	101 - 1.12 x (32 - n)	111 - 1.12 x (32 - n)	43	47.3	3.4/7.5	1	IU9, IU10	-
TN52XCM01	339 - 3.6 x (32 - n) -80 x m	368 - 3.6 x (32 - n) -80 x m	125	138	3.8/8.4	1	IU9, IU10	-
TN52XCM02	124 - 1.12 x (32 - n) -23 x m	136.4 - 1.12 x (32 - n) -23 x m	67	73.7	3.8/8.4	1	IU9, IU10	-

NOTE

When the OptiX OSN 8800 T64 subrack grooms electrical-layer signals through the backplane, the XCT must be configured with SXM or SXH.

"n" is equal to the total number of tributary, line, and PID boards housed in a subrack.

- If a subrack is configured with VC-3 or VC-12 cross-connections, "m" is equal to 0.
- If a subrack is not configured with any VC-3 or VC-12 cross-connections, "m" is equal to 1.