OptiX 155/622H(Metro1000) STM-1/STM-4/STM-16 MSTP Optical Transmission System

V300R006

Product Description

Issue 01

Date 2009-03-10

Huawei Technologies Co., Ltd. provides customers with comprehensive technical support and service. For any assistance, please contact our local office or company headquarters.

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

Notice

The information in this document is subject to change without notice. Every effort has been made in the preparation of this document to ensure accuracy of the contents, but the statements, information, and recommendations in this document do not constitute a warranty of any kind, express or implied.

Contents

Figures

Tables

About This Document

Purpose

This document describes the OptiX 155/622H(Metro1000) (hereafter referred to as OptiX 155/622H) optical transmission system in terms of equipment, boards, protection, maintenance and management, hardware, and technical specifications, to help readers obtain a comprehensive understanding of the product. The OptiX 155/622H is managed by the network management system (hereafter referred to as T2000) of the transmission network.

Related Versions

The following table lists the product versions related to this document.

Product Name	Version
OptiX 155/622H	V300R006
OptiX iManager T2000	V200R007C02

Intended Audience

The intended audience of this document is as follows:

- Network planning engineer
- Data configuration engineer
- System maintenance engineer

Organization

This document is organized as follows.

Chapter	Description
1 Network Position and Network Application	This topic describes the network position and network application of the OptiX 155/622H.

Chapter	Description
2 Function	This topic describes the functions of the OptiX 155/622H.
3 Hardware	This topic describes the hardware system of the OptiX 155/622H.
4 Software Architecture	This topic describes the software system of the OptiX 155/622H.
5 Data Features	This topic describes the data features of the OptiX 155/622H.
6 Protection	This topic describes the protection mechanism of the OptiX 155/622H in terms of equipment-level protection, network-level protection, and clock protection.
7 Maintenance and Management	This topic describes the maintenance and network management capabilities of the OptiX 155/622H.
8 Technical Specifications	This topic describes the technical specifications and parameters of the OptiX 155/622H.
9 Standard Compliance	This topic provides the standards that the OptiX 155/622H complies with.
A Glossary	This topic provides the terms that are used in this document.
B Acronyms and Abbreviations	This topic provides the acronyms and abbreviations that are used in this document.

Conventions

Symbol Conventions

The following symbols may be found in this document. They are defined as follows.

Symbol	Description
DANGER	Indicates a hazard with a high level of risk, which if not avoided, will result in death or serious injury.
WARNING	Indicates a hazard with a medium or low level of risk, which if not avoided, could result in minor or moderate injury.
CAUTION	Indicates a potentially hazardous situation, which if not avoided, could cause equipment damage, data loss, and performance degradation, or unexpected results.
TIP	Indicates a tip that may help you solve a problem or save your time.

Symbol	Description
NOTE	Provides additional information to emphasize or supplement important points of the main text.

General Conventions

Convention	Description
Times New Roman	Normal paragraphs are in Times New Roman.
Boldface	Names of files, directories, folders, and users are in **boldface**. For example, log in as user **root**.
Italic	Book titles are in *italics*.
`Courier New`	Terminal displays are in Courier New.

Command Conventions

Convention	Description
Boldface	The keywords of a command line are in **boldface**.
Italic	Command arguments are in *italic*.
[ ]	Items (keywords or arguments) in square brackets [ ] are optional.
{ x | y | ... }	Alternative items are grouped in braces and separated by vertical bars. One item is selected.
[x | y | ...]	Optional alternative items are grouped in square brackets and separated by vertical bars. One item or none is selected.
{ x | y | ... } *	Alternative items are grouped in braces and separated by vertical bars. A minimum of one item or a maximum of all items can be selected.

GUI Conventions

Convention	Description
Boldface	Buttons, menus, parameters, tabs, windows, and dialog titles are in **boldface**. For example, click **OK**.
>	Multi-level menus are in **boldface** and are separated by the ">" signs. For example, choose **File** > **Create** > **Folder**.

Keyboard Operation

Format	Description
Key	Press the key. For example, press **Enter** and press **Tab**.
Key 1+Key 2	Press the keys concurrently. For example, pressing **Ctrl+Alt+A** means the three keys should be pressed concurrently.
Key 1, Key 2	Press the keys in turn. For example, pressing **Alt, A** means the two keys should be pressed in turn.

Mouse Operation

Action	Description
Click	Select and release the primary mouse button without moving the pointer.
Double-click	Press the primary mouse button twice continuously and quickly without moving the pointer.
Drag	Press and hold the primary mouse button and move the pointer to a certain position.

Update History

Updates between document issues are cumulative. Therefore, the latest document issue contains all updates made in previous issues.

Updates in Issue 01 (2009-03-10)

This document is the initial release of the OptiX 155/622H V300R006. Compared with the OptiX 155/622H V300R005, the updates are as follows:

- The description about the time synchronization function is added.
- The description about related features of the new board EFS4 is added.

Updates in Issue 02 (2008-09-10)

- The OI16D board is added.
- The known problem and the name of the product manual are modified.

Updates in Issue 01 (2008-07-01)

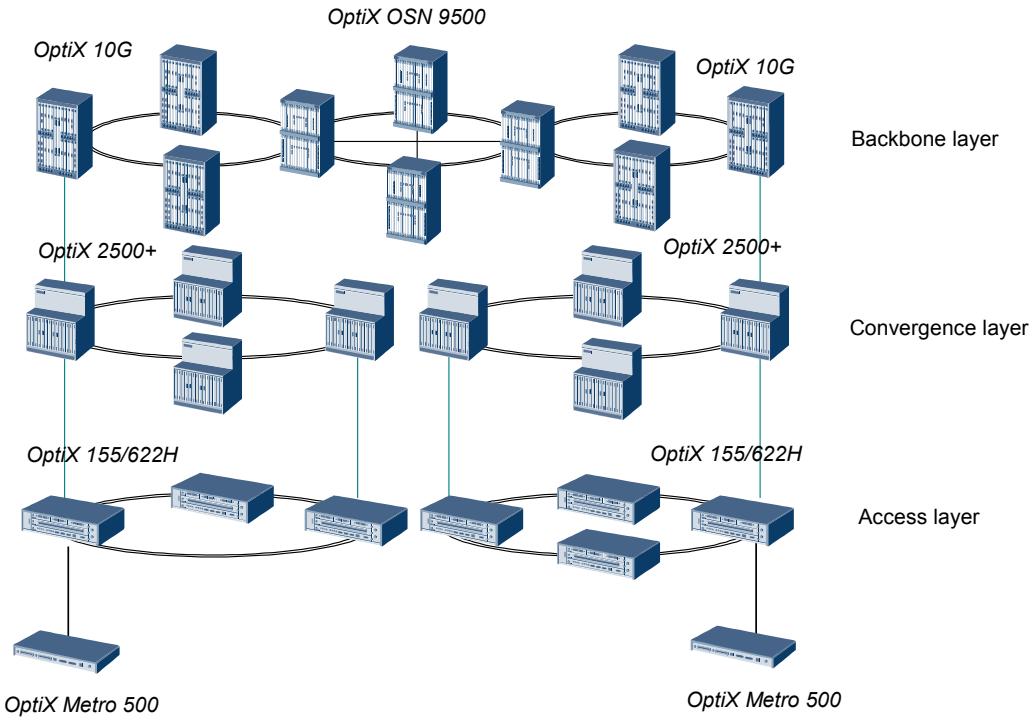
Initial release.

1 Network Position and Network Application

The OptiX 155/622H is a type of STM-1/STM-4/STM-16 case-shaped equipment developed by Huawei Technologies Co., Ltd. (hereafter referred to as Huawei). The OptiX 155/622H can access multiple types of services and can be used at the access layer of metropolitan area networks (MANs) and local transmission networks to access VIP private lines, wireless base stations, and digital subscriber line access multiplexers (DSLAMs).

Figure 1-1 shows the application of the OptiX 155/622H in a network.

Figure 1-1 Application of the OptiX 155/622H in a transmission network



2 Function

About This Chapter

The OptiX 155/622H provides the features of the traditional optical network equipment and supports various network-level protection schemes and NMS monitoring.

2.1 High Integration

The OptiX 155/622H is highly integrated.

The OptiX 155/622H is a case-shaped device with the dimensions of 436 mm (W) x 293 mm (D) x 86 mm (H). Except the power module and certain service boards, the cross-connect unit, clock unit, and orderwire unit are integrated on the SCB board. **Figure 2-1** and **Figure 2-2** show the appearance of the OptiX 155/622H.

Figure 2-1 Front view of the OptiX 155/622H

Figure 2-2 Rear view of the OptiX 155/622H

2.2 Service Access Capability

The OptiX 155/622H can access multiple types of services and can be interconnected with switches, wireless base stations, and Ethernet switches.

Table 2-1 lists the services that the OptiX 155/622H can access and the access capability for each type of service.

Table 2-1 Services supported by the OptiX 155/622H and the access capability for each type of service

Service Type	Maximum Access Capability of a Single OptiX 155/622H NE
SDH	16xSTM-1 (o), 6xSTM-1 (e), 8xSTM-4, 2xSTM-16 (o)
PDH	112xE1, 96xE1/T1, 9xE3/T3
Ethernet	24xFE (e), 8xFE (o), 3xGE (o)
DDN service	12xNx64 kbit/s (N ≤ 31), 48xFramed E1
SHDSL	24xSHDSL (E1, Nx64 kbit/s)

Service Type	Maximum Access Capability of a Single OptiX 155/622H NE
ATM	4xSTM-1 ATM
Audio and data	12xaudio + 4xRS-232 + 4xRS-422

2.3 Interface Type

The OptiX 155/622H provides multiple types of interfaces for SDH services, PDH services, and Ethernet services.

Table 2-2 lists the interface types provided by the OptiX 155/622H.

Table 2-2 Interface types provided by the OptiX 155/622H

Interface Type		Description	Connector Type
Service interface	SDH service	STM-1 optical interface, supporting the Ie-1, S-1.1, L-1.1, and L-1.2 optical interface types	SC/LC
		STM-1 optical interface, supporting the Ie-1, S-1.1, L-1.1, and L-1.2 optical interface types that use a single fiber for transmitting and receiving	SC
		STM-4 optical interface, supporting the Ie-4, S-4.1, L-4.1, and L-4.2 optical interface types	SC/LC
		STM-16 optical interface, supporting the S-16.1 optical interface type	LC
		STM-1 electrical interface	SMB
	PDH service	E1/T1 electrical interface	2 mm HM
		Framed E1 electrical interface	DB78 connector
		E3/T3 electrical interface	SMB
	Ethernet service	10BASE-T, 100BASE-TX	RJ-45
		100BASE-FX	LC
		1000BASE-SX/LX	LC
		1000BASE-FX	LC
	ATM service	STM-1 optical interface	LC
	Audio and data service	RS-232 or RS-422 data and audio interface	2 mm HM connector

Interface Type		Description	Connector Type
	DDN service	Physical interface complying with multiple protocols, including V.35, V. 24, X.21, RS-449, and EIA-530	2 mm HM connector
		Framed E1 electrical interface	DB78 connector
	G.SHDSL service	Single pair high-bit-rate digital subscriber line interface	RJ-11
Clock interface		The clock signals at the 120-ohm external clock interface: 2048 kbit/s or 2048 kHz	RJ-45
Time interface		Time reference output interface that supports 1pps (also called pulse per second) and time information, where 1pps uses the RS-422 level, and the time serial port uses the RS-232 level	RJ-45
Power interface		Two –48 V DC/–60 V DC power interfaces Two +24 V DC power interfaces	4-core socket
Environment monitoring interface		The EMU board provides the following interfaces: ● Twelve housekeeping signal inputs and six housekeeping signal outputs ● One RS-232/RS-422 serial communication interface	2 mm HM connector
		The SCB board provides the following interfaces: ● Four housekeeping signal inputs and two housekeeping signal outputs ● Four transparent data ports	RJ-45
Management interface		One modem interface	RJ-45
		One NM interface	RJ-45
Orderwire interface		One orderwire interface	RJ-11

2.4 Networking Capability

The OptiX 155/622H supports the capability of flexible networking. It supports point-to-point, chain, ring, and hub networking modes.

NE Type

The OptiX 155/622H supports 21.25 Gbit/s higher order cross-connection or 5 Gbit/s lower order cross-connection. It can be configured as multiple terminal multiplexers (TMs), add/drop multiplexers (ADMs), or multiple add/drop multiplexers (MADMs). It also supports service grooming and protection among multiple systems. In this way, the networking capability and the service grooming capability among networks are significantly improved.

Networking Mode

As the access equipment, the OptiX 155/622H can be used to construct hybrid networks with the Huawei Metro and OSN product series. It supports point-to-point, chain, ring, and hub networking modes. In addition, the OptiX 155/622H can also be used to construct hybrid networks with third-party equipment.

- Extended DCC Bytes

  The OptiX 155/622H uses the multiplex section overhead bytes D4–D12 as the physical channel to transmit the management information about Huawei equipment, and uses the regenerator section overhead bytes D1–D3 to transmit the management information about third-party equipment.

- Transparent Transmission of DCC Bytes

  The OptiX 155/622H uses the regenerator section overhead bytes D1–D3 as the physical channel to transmit the management information about Huawei equipment, and uses the multiplex section overhead bytes D4–D12 as one or multiple channels to transparently transmit the management information about third-party equipment.

- Management Information Transmission Through the External Clock Interface

  When the D1–D3 bytes of the third-party equipment cannot transmit the management information about the OptiX 155/622H, the external clock interface of the OptiX 155/622H can be used for this purpose.

- IP over DCC

  The OptiX 155/622H supports IP over DCC. When the OptiX 155/622H, third-party equipment, and the T2000 all support the IP feature, the network management information can be transparently transmitted through IP over DCC.

- OSI over DCC (TP4)

  The OptiX 155/622H supports OSI over DCC (TP4). When the OptiX 155/622H, third-party equipment, and T2000 all support OSI over DCC (TP4), the network management information can be transparently transmitted through OSI over DCC (TP4).

- SNMP

  The OptiX 155/622H supports the simple network management protocol (SNMP), and can achieve uniform network management when the network is constructed by the equipment of different vendors.

2.5 Protection Scheme

The OptiX 155/622H provides a comprehensive network protection system for all service types. In addition to SDH service protection schemes, it also provides protection for the data link layer of Ethernet services, thus realizing the hierarchical protection for services.

For the protection schemes supported by the OptiX 155/622H, see **6 Protection**.

2.6 Clock and Time Synchronization

The OptiX 155/622H supports the tracking of various types of clock sources and supports the clock synchronization in the SSM management. In addition, the OptiX 155/622H supports high precision time synchronization, which complies with the IEEE 1588 V2 standard.

2.6.1 Clock Synchronization

The OptiX 155/622H provides clock functions such as multiple synchronous clock sources and clock management.

The OptiX 155/622H supports the following clock functions:

- Input and output of two external clock sources with an interface impedance of 120 ohms. The 75-ohm interface can be provided by using a converter.
- Line clock source.
- Tributary clock source.
- Ethernet synchronous clock source.
- Non Synchronization Status Message (SSM), standard SSM, and extended SSM protocols.
- Tributary re-timing.
- Three clock working modes: locked, holdover and free-run.

For more details on the synchronous clock, see Clock in the *Feature Description* of this product.

2.6.2 High Precision Time Synchronization

The OptiX 155/622H provides the function of high precision time synchronization, which meets the requirement of the equipment for precise time synchronization. The time information is accessed into the SDH network and is then transmitted to the equipment that requires precise time, such as the 3G wireless base station equipment.

The OptiX 155/622H can input and output the time information through the Ethernet interface of the data board. In addition, it can also output the time information by multiplexing through the SYNC external clock interface and the COM3 and COM4 transparent data ports of the SCB board. The time information is carried by the line board or data board for synchronizing the time in the entire network.

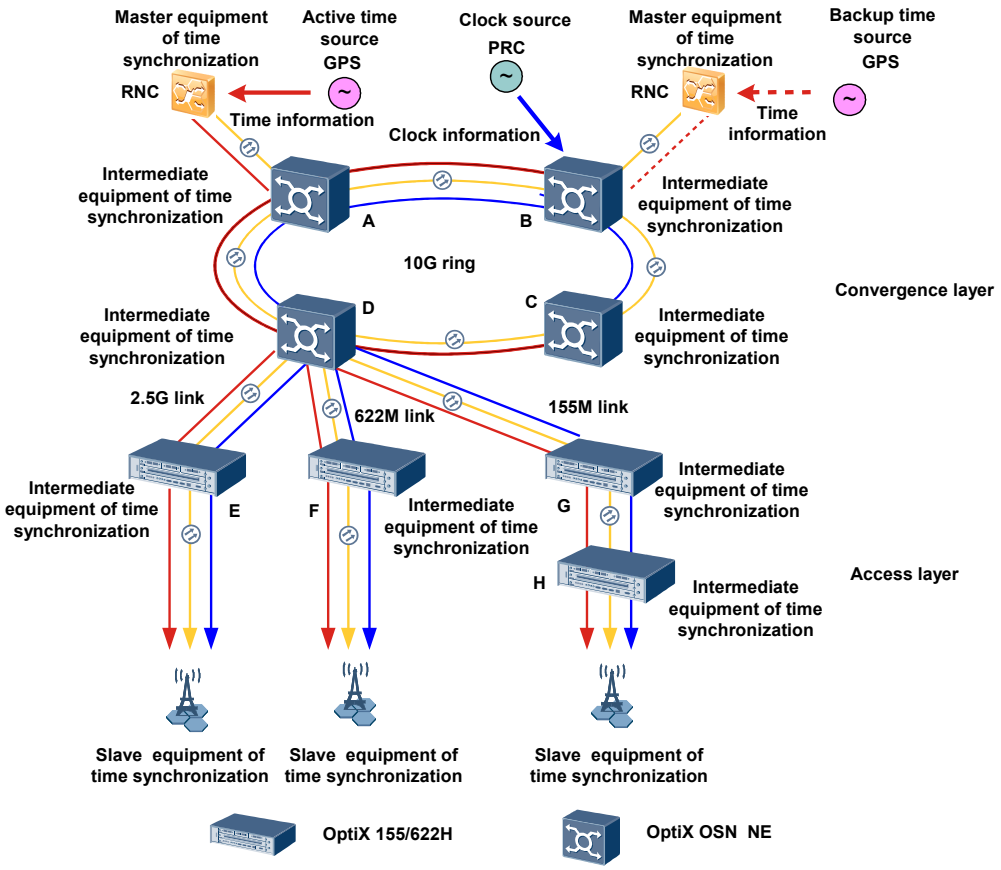
The following boards of the OptiX 155/622H support the time synchronization function:

- System control board SCB

- Line boards OI2S, OI2D, OI4, OI4D, and OI16D
- Ethernet interface board EFS4

Figure 2-3 shows the networking of the time synchronization application.

Figure 2-3 Networking of the time synchronization application



2.7 OAM Capability

The OptiX 155/622H can implement operation, administration and maintenance (OAM) on the network and the equipment.

2.7.1 Uniform NMS

The OptiX 155/622H is uniformly managed by the OptiX iManager T2000 transmission network management system (hereafter referred to as the T2000).

2.7.2 Power and Environment Monitoring

The OptiX 155/622H can monitor the power and environment.

2.7.3 PRBS Function

The OptiX 155/622H supports the pseudo-random binary sequence (PRBS) test function, which can be used for network self-check and maintenance.

2.7.4 Simulation Package Loading and Simulation Package Diffusion

The OptiX 155/622H supports quick and convenient software upgrade for the device through simulation package loading and simulation package diffusion.

2.7.1 Uniform NMS

The OptiX 155/622H is uniformly managed by the OptiX iManager T2000 transmission network management system (hereafter referred to as the T2000).

The T2000 provides management, maintenance and test functions for the entire optical transmission system in terms of faults, performance, configuration, and security. It can also provide end-to-end management according to the customer requirements. The T2000 improves the network service quality and reduces maintenance costs, thus ensuring reasonable utilization of network resources.

2.7.2 Power and Environment Monitoring

The OptiX 155/622H can monitor the power and environment.

The OptiX 155/622H provides –48 V/–60 V DC and +24 V DC power interfaces and can measure the input voltage and check the voltage status (severely undervoltage, undervoltage, overvoltage, and severely overvoltage).

By working with the 220 V assembly chassis, the OptiX 155/622H can access 220 V/110 V AC power.

The OptiX 155/622H also provides the alarm input and alarm output functions. The alarm input function can be used to remotely monitor the customer environment. The alarm output function can achieve centralized monitoring over all equipment alarms when the OptiX 155/622H is connected to the alarm interface of the centralized cabinet.

2.7.3 PRBS Function

The OptiX 155/622H supports the pseudo-random binary sequence (PRBS) test function, which can be used for network self-check and maintenance.

The PRBS function is mainly used for network self-test and maintenance. An NE that supports the PRBS function can be used as a simple test instrument to analyze whether a service path is faulty. By using the PRBS function, you can analyze the local NE and the entire network. Therefore, to carry out deployment or locate problems, you can perform a test without using a real test instrument.

The OptiX 155/622H supports the PRBS function for the tributary 2 Mbit/s service. The PRBS module is integrated in the tributary board, supports the query and automatic report of the PRBS result, and supports the PRBS test in the tributary direction and the cross-connect direction.

2.7.4 Simulation Package Loading and Simulation Package Diffusion

The OptiX 155/622H supports quick and convenient software upgrade for the device through simulation package loading and simulation package diffusion.

Simulation Package Loading

When you need to load the entire set of software to an NE, and the mapping between each board and software on the NE is defined according to the simulation software package format, you can use the function of simulation package loading to improve the loading efficiency.

The simulation software package contains the following software:

- The software that needs to be loaded to the NE
- The package description file that defines the loading attributes of various software

The simulation package loading has the following features:

- Simplifying the upgrade operation
- Improving the upgrade security
- Improving the upgrade efficiency

Simulation Package Diffusion

In simulation package diffusion, the software package to be loaded is diffused among NEs through an inter-NE diffusion protocol. The NEs in the entire network then try to download the software package simultaneously. In this manner, the efficiency of software package loading is highly improved, and less manual intervention and operations are required during this process.

The simulation package diffusion has the following features:

- Diffusing the software package layer by layer so that multiple NEs can download the software package concurrently
- Sharing the network load
- Balancing the utilization of network bandwidth

3 Hardware

About This Chapter

This topic describes the equipment structure, slot allocation, boards, and power converter system.

3.8 Data Interface Board

The data interface board of the OptiX 155/622H receives and transmits data signals.

3.9 ATM Interface Board AIUD/AIUQ

The AIUD and AIUQ boards transmit ATM services and provide protection for ATM services.

3.10 Tone and Data Access Board TDA

The TDA board receives and transmits audio signals and environment monitoring signals.

3.11 Environment Monitoring Unit EMU

The EMU board monitors the environment.

3.12 Power Converter System UPM

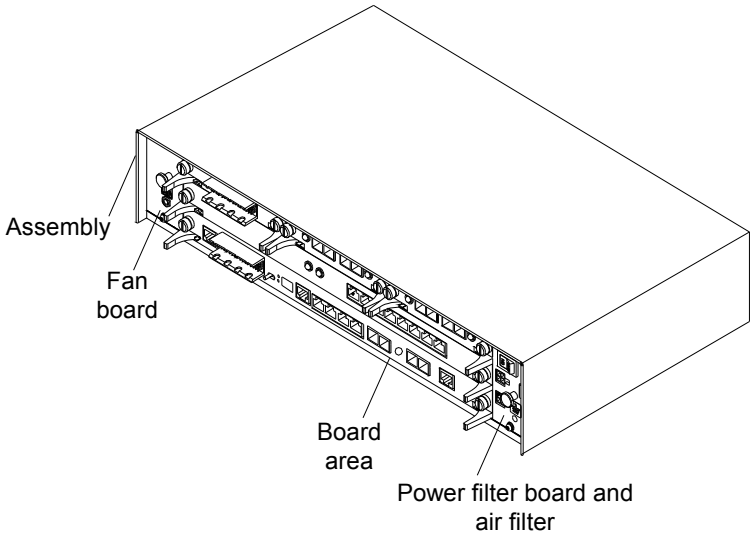
The uninterruptible power module (UPM) is a 220 V AC to –48 V DC power converter system that is used only by the OptiX 155/622H. The UPM consists of the double-channel hot backup AC/DC converter module, monitoring module, and storage battery.

3.1 Chassis

This topic describes the appearance of the equipment and provides the dimensions and weight of the equipment.

The OptiX 155/622H adopts a case-shaped structure with the dimensions of 436 mm (W) x 293 mm (D) x 86 mm (H). The OptiX 155/622H is designed in compliance with the standards of the 19-inch cabinet. In the maximum configuration, the weight of the OptiX 155/622H is not more than 10 kg, and the maximum power consumption is not more than 100 W. The OptiX 155/622H consists of a chassis, fan board, power filter board, air filter, and the boards installed in the board area. See **Figure 3-1**.

Figure 3-1 Equipment structure of the OptiX 155/622H



- Fan board: It is used for the heat dissipation of the equipment.
- Air filter and power filter board: The air filter together with the fan board is used for the ventilation and heat dissipation of the equipment. The power filter board inputs power for the equipment.
- Board area: It houses service boards and system control board, and provides various service interfaces and monitoring and management interfaces.

NOTE

If the power consumption of the hardware configuration exceeds 100 W, the system may become unstable.

3.2 Slot Allocation

The OptiX 155/622H provides seven physical slots for installing boards.

Figure 3-2 shows the slot layout of the OptiX 155/622H and **Table 3-1** lists the boards that can be installed in each slot.

Figure 3-2 Slot layout of the OptiX 155/622H

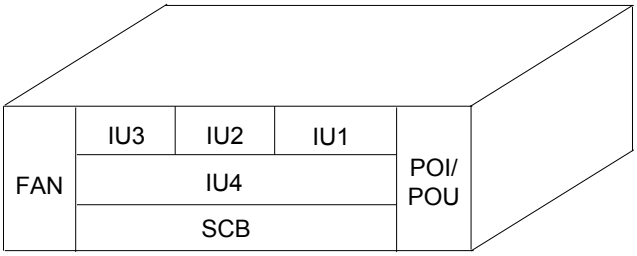


Table 3-1 Boards of the OptiX 155/622H

Board Name	Full Name	Valid Slot	Description
OI2S	1xSTM-1 optical interface board	IU1, IU2, and IU3	Ie-1, S-1.1, L-1.1, L-1.2, SC/LC
OI2D	2xSTM-1 optical interface board	IU1, IU2, IU3, and IU5[a]	Ie-1, S-1.1, L-1.1, L-1.2, SC/LC
SL1O	8xSTM-1 optical interface board	IU4	Ie-1, S-1.1, L-1.1, L-1.2, SC
SL1Q	4xSTM-1 optical interface board	IU4	Ie-1, S-1.1, L-1.1, L-1.2, SC
OI4	1xSTM-4 optical interface board	IU1, IU2, and IU3	Ie-4, S-4.1, L-4.1, L-4.2, SC/LC
OI4D	2xSTM-4 optical interface board	IU1, IU2, IU3, and IU5[a]	Ie-4, S-4.1, L-4.1, L-4.2, SC/LC
OI16D	2xSTM-16 optical interface board	IU5[a]	S-16.1, LC
SB2L	1xSTM-1 single-fiber bidirectional optical interface board	IU1, IU2, and IU3	S-1.1, L-1.1, SC (Only one left optical interface is available.)
SB2R	1xSTM-1 single fiber bidirectional optical interfaces board	IU1, IU2, and IU3	S-1.1, L-1.1, SC (Only one right optical interface is available.)
SB2D	2xSTM-1 single fiber bidirectional optical interface board	IU1, IU2, and IU3	S-1.1, L-1.1, SC
SLE	1xSTM-1 electrical interface board	IU1, IU2, and IU3	75-ohm STM-1 interface
SDE	2xSTM-1 electrical interface board	IU1, IU2, and IU3	75-ohm STM-1 interface

Board Name	Full Name	Valid Slot	Description
SP1S	4xE1 electrical interface board	IU1, IU2, and IU3	75-ohm/120-ohm E1 interface
SP1D	8xE1 electrical interface board	IU1, IU2 and IU3	75-ohm/120-ohm E1 interface
SP2D	16xE1 electrical interface board	IU1, IU2, IU3, and IU6[a]	75-ohm/120-ohm E1 interface
SM1S	4xE1/T1 electrical interface board	IU1, IU2, and IU3	75-ohm/120-ohm E1 interface or 100-ohm T1 interface
SM1D	8xE1/T1 electrical interface board	IU1, IU2, and IU3	75-ohm/120-ohm E1 interface or 100-ohm T1 interface
PD2S	16xE1 electrical interface board	IU4	75-ohm/120-ohm E1 interface
PD2D	32xE1 electrical interface board	IU4	75-ohm/120-ohm E1 interface
PD2T	48xE1 electrical interface board	IU4	75-ohm/120-ohm E1 interface
FP2D	16xFramed E1 electrical interface board	IU1, IU2, and IU3	75-ohm/120-ohm Framed E1 interface
PM2S	16xE1/T1 electrical interface board	IU4	75-ohm/120-ohm E1 interface or 100-ohm T1 interface
PM2D	32xE1/T1 electrical interface board	IU4	75-ohm/120-ohm E1 interface or 100-ohm T1 interface
PM2T	48xE1/T1 electrical interface board	IU4	75-ohm/120-ohm E1 interface or 100-ohm T1 interface
PE3S	1xE3 electrical interface board	IU1, IU2, and IU3	75-ohm E3 interface
PE3D	2xE3 electrical interface board	IU1, IU2, and IU3	75-ohm E3 interface
PE3T	3xE3 electrical interface board	IU1, IU2, and IU3	75-ohm E3 interface
PT3S	1xT3 electrical interface board	IU1, IU2, and IU3	75-ohm T3 interface

Board Name	Full Name	Valid Slot	Description
PT3D	2xT3 electrical interface board	IU1, IU2, and IU3	75-ohm T3 interface
PT3T	3xT3 electrical interface board	IU1, IU2, and IU3	75-ohm T3 interface
TDA	Multi-channel audio and data access unit	IU4	12xaudio + 4xRS-232 + 4xRS-422
SCB	System control board	SCB	● Provides two external clock input and output interfaces, two external time output interfaces, one NM interface, one orderwire interface, four data ports, and four input and two output alarm interfaces ● Provides 2xSTM-1 (S-1.1, SC/LC) or 2xSTM-4 (S-4.1, L-4.1, L-4.2, SC/LC) or 2xSTM-16 (S-16.1, LC) optical interfaces ● Provides 16xE1 (75-ohm/120-ohm) electrical interfaces
ET1O	8-port Ethernet service electrical interface board	IU4	10/100BASE-T
EF1	6-port Ethernet service interface board	IU4	10/100BASE-T, 100BASE-FX
ET1D	2-port Ethernet service electrical interface board	IU1, IU2, and IU3	10/100BASE-T
EFS	4-port Ethernet service interface board	IU1, IU2, and IU3	10/100BASE-T
EFS4	4-port Ethernet service interface board	IU1, IU2, and IU3	100BASE-T
EFT	4-port Ethernet service interface board	IU1, IU2, and IU3	10/100BASE-T
ET1	8-port Ethernet service interface board	IU4	10/100BASE-T
EGS	1-port Gigabit Ethernet optical interface board	IU1, IU2, and IU3	1000BASE-LX/SX

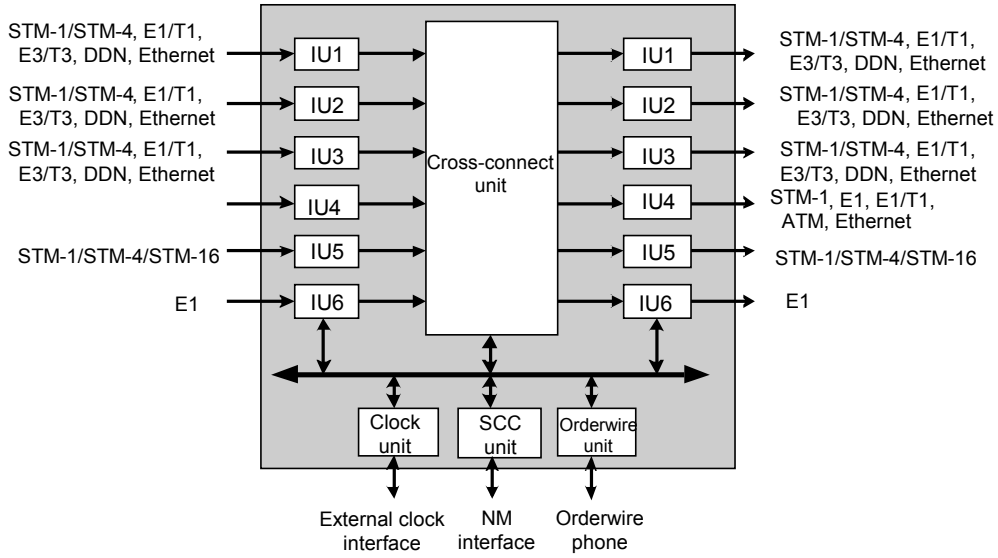
Board Name	Full Name	Valid Slot	Description
EFSC	12-port Ethernet service interface board	IU4	10/100BASE-T
ELT2	2-port Fast Ethernet optical interface board	IU1, IU2, and IU3	100BASE-FX
EGT	1-port Gigabit Ethernet transparent transmission board	IU1, IU2, and IU3	1000BASE-LX/SX
AIUD	2xATM optical interface board	IU4	Ie-1, S-1.1, L-1.1, L-1.2, SC
AIUQ	4xATM optical interface board	IU4	Ie-1, S-1.1, L-1.1, L-1.2, SC
SHLQ	Single-pair high-bit-rate digital subscriber line interface board	IU1, IU2, and IU3	Provides 4xG.SHDSL data service interfaces
N64	Nx64 kbit/s interface board	IU1, IU2, and IU3	Provides 2xV.35//V.24/X.21/RS-449/EIA-530-compliant interfaces, and 2xFramed E1 electrical interfaces
N64Q	4xNx64 kbit/s interface board	IU1, IU2, and IU3	Provides 4xV.35/V,24/X.21/RS-449/EIA-530-compliant interfaces
EMU	Environment monitoring unit	IU3	Provides two voltage monitoring and temperature monitoring interfaces, 12-input and 6-output alarm interfaces, and one RS-232/RS-422 serial communication interface
FAN	Fan board	FAN	-
POI/POU	Power filter board	POI/POU	Provides two channels of –48 V/–60 V or 24 V power supply
UPM (CAU)	Power monitoring unit	External	Provides power monitoring
a: IU5 and IU6 are the logical slots integrated on the SCB board.			

3.3 Board Type

With the cross-connect unit working as the core unit, the OptiX 155/622H consists of the SDH interface unit, PDH interface unit, Ethernet interface unit, cross-connect unit, clock unit, SCC unit, and orderwire unit.

Figure 3-3 shows the system architecture of the OptiX 155/622H.

Figure 3-3 System architecture of the OptiX 155/622H



NOTE

The boards that need to be inserted in slots IU5 and IU6 are integrated on the SCB board.

Table 3-2 Boards and functions of each unit

Unit	Board	Function
SDH interface unit	OI16D, OI2S, OI2D, SL1O, SL1Q, OI4, OI4D, SB2L, SB2R, SB2D, SLE, and SDE	• Accesses and processes STM-1/STM-4/STM-16 optical signals • Accesses and processes STM-1 electrical signals
PDH interface unit	SP1S, SP1D, SP2D, PD2S, PD2D, PD2T, SM1S, SM1D, PM2S, PM2D, PM2T, PE3S, PE3D, PE3T, PT3S, PT3D, and PT3T	Accesses and processes E1, E1/T1, and E3/T3 PDH electrical signals

Unit	Board	Function
Ethernet service processing unit	ET1, ET1O, ET1D, EF1, EFS, EFS4, EFSC, EGS, EFT, ELT2, and EGT	Accesses and processes 10/100BASE-T(X), 100BASE-FX, 1000BASE-LX/SX, 100BASE-FX, and 1000BASE-LX/SX Ethernet signals
Data service processing unit	SHLQ, N64, N64Q, FP2D, TDA	● Accesses and processes Nx64 kbit/s (N is 1–31) signals and Framed E1 signals ● Implements the cross-connection for the Nx64 kbit/s signals on the system side
ATM service processing unit	AIUD and AIUQ	Accesses and processes ATM signals
System control and communication unit	SCB	● Provides the interface for connecting the equipment to the NM ● Processes the overheads of SDH signals ● Processes orderwire signals ● Processes clock signals ● Implements the cross-connection ● Processes E1 signals and STM-1/STM-4/STM-16 optical signals
Environment monitoring unit	EMU	Monitors the operating voltage and operating temperature of the equipment, supports the input and output of housekeeping signals, and supports serial communication
Power input unit	POI/POU	Provides the power supply

3.4 System Control Board SCB

The SCB board integrates the functions of the line, tributary, cross-connect, clock, time, SCC, and orderwire modules.

Functions

The SCB board of the OptiX 155/622H integrates the functions of the line, tributary, cross-connect, clock, time, SCC, and orderwire modules. The functions of each module are as follows.

Line Module

- Provides two STM-1 or STM-4 or STM-16 optical interfaces. The STM-1 optical interface is named OI2D, the STM-4 optical interface OI4D and the STM-16 optical interface OI16D.
- The STM-1 optical interface supports the S-1.1, L-1.1, and L-1.2 interface types and uses the SC/LC connector.
- The STM-4 optical interface supports the S-4.1, L-4.1, and L-4.2 interface types and uses the SC/LC connector.
- The STM-16 optical interface supports the S-16.1 interface type and uses the LC connector.
- Provides two synchronous clock sources for the clock unit.
- Supports automatic laser shutdown (ALS).

Tributary Module

- Accesses 16 E1 signals.
- Supports the asynchronous mapping of E1 signals to VC-12s as defined in ITU-T G.703.
- Provides the 75-ohm unbalanced and 120-ohm balanced interfaces, whose characteristics comply with the requirements specified in ITU-T G.703.
- Processes the VC-12 path overheads, configures each service channel, monitors the alarms and performance of each service channel, and communicates with the SCC unit.
- Supports inloop and outloop to test the quality of E1 services or locate the fault, thus facilitating the maintenance.
- Provides the synchronous clock source for the clock unit.

Cross-Connect Module

- Supports cross-connections at the VC-4/VC-3/VC-12 level, and thus grooms services from line to line, from line to tributary, and from tributary to tributary.
- Supports 21.25 Gbit/s higher order cross-connection or 5 Gbit/s lower order cross-connection.

Clock and Time Module

- Provides two 2048 kHz or 2048 kbit/s external interfaces, whose impedance is 120 ohms.
- Supports three clock working modes: locked, holdover and free-run.
- Supports the multiplexing with the SYNC external clock interface and the COM2 and COM3 transparent data ports for outputting the time information.

SCC Module

- Exchanges information with other boards to configure equipment data and collect performance and alarm data.
- Provides a standard Ethernet NM interface and RS-232 data terminal equipment (DTE) interface to realize the equipment management by the T2000.

Orderwire Module

- Provides one orderwire interface for conference call and broadcast.
- Provides four RS-232 (RJ-45 type) serial data ports for point-to-multipoint equipment connection and transparent transmission of data.
- Provides four input and two output housekeeping interfaces. The input housekeeping interfaces monitor the status of the external equipment, and the output housekeeping interfaces output alarm indications and control the external equipment.

Application

As the core of the OptiX 155/622H, the SCB board grooms services, extracts clock signals, implements inter-board communication, and provides the orderwire function. As the line and tributary modules are integrated on the SCB board, the number of slots is reduced on the equipment.

3.5 SDH Interface Board

The OptiX 155/622H provides the following types of SDH interface boards: STM-1 optical interface board, STM-4 optical interface board, STM-16 optical interface board, and STM-1 electrical interface board. The SDH interface board receives and transmits STM-1 optical signals, STM-4 optical signals, STM-16 optical signals and STM-1 electrical signals, processes section overheads and higher order path overheads, and interprets pointers as defined in ITU-T G.783. In addition, the SDH interface board provides synchronous clock sources for the clock unit.

The OptiX 155/622H provides the following SDH interface boards.

3.5.1 STM-16 Optical Interface Board OI16D
The OI16D board accesses STM-16 optical signals and is currently integrated on SCB.

3.5.2 STM-4 Optical Interface Board OI4/OI4D
The OI4 and OI4D boards access STM-4 optical signals.

3.5.3 STM-1 Optical Interface Board OI2S/OI2D/SL1Q/SL1O
The OI2S, OI2D, SL1Q, and SL1O boards access STM-1 signals.

3.5.4 Single-Fiber STM-1 Interface Board SB2D/SB2L/SB2R
The SB2D, SB2L, and SB2R boards access single-fiber STM-1 optical signals.

3.5.5 STM-1 Electrical Interface Board SDE/SLE
The SDE and SLE boards access STM-1 electrical signals.

3.5.1 STM-16 Optical Interface Board OI16D

The OI16D board accesses STM-16 optical signals and is currently integrated on SCB.

Functions

- Accesses STM-16 optical signals.
- Provides the S-16.1 optical interface.
- Provides two synchronous clock sources for the clock unit.
- Supports MSP and SNCP.
- Supports the automatic laser shutdown (ALS) function.

- Provides data communication channel (DCC) and orderwire communication.
- Supports inloop and outloop.
- The optical interface on the OI16D board supports the LC connector. Using the LC connector can facilitate the maintenance for optical modules.

Application

When the OptiX 155/622H uses the OI16D board, the equipment can implement the following functions:

- Forms rings or chains operating at the STM-16 rate.
- Forms rings or chains operating at the STM-16 rate with other Huawei equipment, such as the OptiX 155/622 and the OptiX 2500+.
- Provides STM-16 optical interfaces for interconnection with third-party equipment.

3.5.2 STM-4 Optical Interface Board OI4/OI4D

The OI4 and OI4D boards access STM-4 optical signals.

Functions

- Accesses STM-4 optical signals.
- Provides optical interfaces: Ie-4, S-4.1, L-4.1, and L-4.2.
- OI4D provides two synchronous clock sources for the clock unit and OI4 provides one.
- Supports MSP and SNCP.
- Supports the automatic laser shutdown (ALS) function.
- Provides data communication channels (DCCs) and orderwire communication.
- Supports inloop and outloop.
- The optical interface on the OI4/OI4D board supports the SC connector and LC connector. Select the proper connector type according to different requirements. Using the LC connector can facilitate the maintenance of optical modules.

Application

When the OptiX 155/622H uses the OI4 board or the OI4D board, the equipment can implement the following functions:

- Forms rings or chains operating at the STM-4 rate.
- Forms rings or chains operating at the STM-4 rate with other Huawei equipment, such as the OptiX 155/622 and the OptiX 2500+.
- Provides STM-4 optical interfaces for interconnection with third-party equipment.

3.5.3 STM-1 Optical Interface Board OI2S/OI2D/SL1Q/SL1O

The OI2S, OI2D, SL1Q, and SL1O boards access STM-1 signals.

Functions

- Accesses STM-1 optical signals.

- Provides four types of optical interfaces: Ie-1, S-1.1, L-1.1 and L-1.2.
- The OI2S and OI2D boards can provide the synchronous clock source for the clock unit.
- Supports MSP and SNCP.
- Supports the ALS function.
- Provides DCCs and orderwire communication.
- Supports inloop and outloop.
- The OI2S and OI2D boards supports the pluggable optical module.

Table 3-3 lists the functions of the OI2S, OI2D, SL1Q, and SL1O boards.

Table 3-3 Functions of the OI2S, OI2D, SL1Q and SL1O boards

Item	OI2S	OI2D	SL1Q	SL1O
Number of interfaces	1xSTM-1	2xSTM-1	4xSTM-1	8xSTM-1
Optical interface type	Ie-1, S-1.1, L-1.1, and L-1.2			
Valid slot	IU1, IU2, and IU3	IU1, IU2, IU3, and IU5[a]	IU4	IU4
Type of connector	SC/LC	SC/LC	SC	SC
Number of synchronous clock sources	1	2	-	-
DCC communication	D1–D3 and D4–D12	D1–D3 and D4–D12	D1–D3	D1–D3
a: The IU5 is a logical slot that is integrated on the SCB board.				

Application

When the OptiX 155/622H uses the STM-1 optical interface board, the equipment can implement the following functions:

- Forms rings or chains operating at the STM-1 rate.
- Forms rings or chains operating at the STM-1 rate with other Huawei equipment, such as the OptiX 155/622 and the OptiX 2500+.
- Provides STM-1 interfaces for interconnection with third-party equipment.
- The SL1Q and SL1O boards do not support MSP but support SNCP. The SL1Q and SL1O boards are mainly connected to the low-level transmission equipment, such as the OptiX Metro 500 and the OptiX Metro 100.

3.5.4 Single-Fiber STM-1 Interface Board SB2D/SB2L/SB2R

The SB2D, SB2L, and SB2R boards access single-fiber STM-1 optical signals.

Functions

- Accesses STM-1 optical signals.
- Provides two types of optical interfaces: S-1.1 and L-1.1.
- Provides the single-fiber transceiver optical interface to receive and transmit optical signals at the same time by carrying the signals on two different wavelengths on one fiber.
- Supports ALS.
- Detects and reports the alarms and performance events on the line.
- Supports inloop and outloop.
- Supports linear MSP and unidirectional MSP.

Table 3-4 lists the functions of the SB2D, SB2L, and SB2R boards.

Table 3-4 Functions of the SB2D, SB2L, and SB2R boards

Item	SB2D	SB2L	SB2R
Number of interfaces	2xSTM-1	1xSTM-1	1xSTM-1
Valid slot	IU1, IU2, and IU3	IU1, IU2, and IU3	IU1, IU2, and IU3
Type of connector	SC	SC	SC
Transmit (Tx) and receive (Rx) wavelengths	Left optical interface: 1550 nm (Tx)/1310 nm (Rx) Right optical interface: 1310 nm (Tx)/1550 nm (Rx)	Only the left optical interface is available: 1550 nm (Tx)/1310 nm (Rx)	Only the right optical interface is available: 1310 nm (Tx)/1550 nm (Rx)

Application

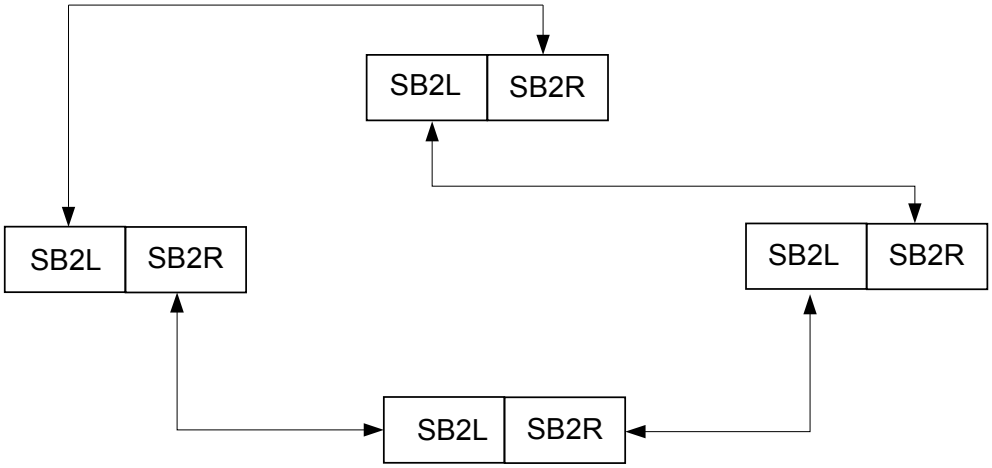
The SB2D, SB2L, and SB2R boards are applied to the network in the same way as the OI2S, OI2D, SL1Q, and SL1O boards. In the application, pay attention to the following points:

- In the case of the SB2D board, the transmit wavelength and receive wavelength of the left optical interface are 1550 nm and 1310 nm respectively, and the transmit wavelength and receive wavelength of the right interface are 1310 nm and 1550 nm respectively.
- In the case of the SB2L board, only the left optical interface is available. The transmit wavelength and receive wavelength are 1550 nm and 1310 nm respectively.
- In the case of the SB2R board, only the right optical interface is available. The transmit wavelength and receive wavelength are 1310 nm and 1550 nm respectively.
- When you use the single-fiber interface boards in networking, make sure that the wavelength of the receive interface and the wavelength of the transmit interface are matched. For example, a transmit interface operating at a wavelength of 1550 nm corresponds to a receive interface operating at a wavelength of 1550 nm, and a transmit

interface operating at a wavelength of 1310 nm corresponds to a receive interface with a wavelength of 1310 nm.

- When you use the SB2R and SB2L boards in networking, make sure that the SB2R and SB2L boards are used at adjacent sites, as shown in **Figure 3-4**.

Figure 3-4 Application of the SB2R and SB2L boards



3.5.5 STM-1 Electrical Interface Board SDE/SLE

The SDE and SLE boards access STM-1 electrical signals.

Functions

- Accesses STM-1 electrical signals.
- Detects and reports the alarms and performance events on the line.
- Supports inloop and outloop on the line.
- Provides the synchronous clock source for the clock unit.
- Supports inloop and outloop on the line.

Table 3-5 lists the functions of the SDE and SLE boards.

Table 3-5 Functions of the SDE and SLE boards

Comparison	SLE	SDE
Number of interfaces	1xSTM-1	2xSTM-1
Valid slot	IU1, IU2, and IU3	IU1, IU2, and IU3
Type of connector	SMB	SMB

Comparison	SLE	SDE
Number of synchronous clock sources	1	2

Application

When the OptiX 155/622H uses the SDE board or the SLE board, the equipment can implement the following functions:

- Receives and transmits STM-1 electrical signals when the OptiX 155/622H is connected to other Huawei equipment, such as the OptiX 155/622 and the OptiX 2500+.
- Interconnects with other equipment that provides STM-1 electrical interfaces, such as the microwave equipment, ATM electrical interface equipment, and other equipment with STM-1 electrical interfaces.

3.6 PDH Interface Board

The OptiX 155/622H provides the following types of PDH interface boards: E1 electrical interface board, E1/T1 electrical interface board, and E3/T3 electrical interface board. The PDH interface board receives and transmits PDH service signals, and provides synchronous clock sources for the clock unit.

The OptiX 155/622H provides the following PDH electrical interface boards.

3.6.1 E1 Electrical Interface Board SP1S/SP1D/SP2D/PD2S/PD2D/PD2T
The SP1S, SP1D, SP2D, PD2S, PD2D, and PD2T boards access E1 services.

3.6.2 E1/T1 Electrical Interface Board SM1S/SM1D/PM2S/PM2D/PM2T
The SM1S, SM1D, PM2S, PM2D, and PM2T boards access E1/T1 services.

3.6.3 E3/T3 Electrical Interface Board PE3S/PE3D/PE3T/PT3S/PT3D/PT3T
The PE3S, PE3D, PE3T, PT3S, PT3D, and PT3T boards access E3/T3 services.

3.6.1 E1 Electrical Interface Board SP1S/SP1D/SP2D/PD2S/PD2D/PD2T

The SP1S, SP1D, SP2D, PD2S, PD2D, and PD2T boards access E1 services.

Functions

- Accesses E1 services.
- Supports asynchronous mapping of E1 signals to VC-12s, as defined in ITU-T G.703.
- Provides the 75-ohm unbalanced and 120-ohm balanced interfaces, whose characteristics comply with related specifications defined in ITU-T G.703.
- Processes VC-12 path overheads, configures each service channel, monitors alarms and performance of each service channel, and communicates with the SCC unit.
- Supports inloop and outloop to test the quality of E1 signals or to locate the fault, thus facilitating the maintenance.

- Provides the synchronous clock source for the clock unit.

Table 3-6 lists the functions of the SP1S, SP1D, SP2D, PD2S, PD2D, and PD2T boards.

Table 3-6 Functions of the SP1S, SP1D, SP2D, PD2S, PD2D and PD2T boards

Item	SP1S	SP1D	SP2D	PD2S	PD2D	PD2T
Number of interfaces	4xE1	8xE1	16xE1	16xE1	32xE1	48xE1
Type of connector	2 mm HM connector					
Valid slot	IU1, IU2, and IU3	IU1, IU2, and IU3	IU1, IU2, IU3, and IU6[a]	IU4	IU4	IU4
Number of synchronous clock sources	1	2	2	2	4	6
a: The IU6 is a logical slot that is integrated on the SCB board.						

Application

The SP1S/SP1D/SP2D/PD2S/PD2D/PD2T board supports the following application:

- Connected to the E1 trunk cable of a switch for application in the local telephone network.
- Connected to the optical line terminal (OLT) and optical network unit (ONU) in the access network. In this way, the OptiX 155/622H can be applied in the access network.
- Interconnected with the communication equipment that provides standard E1 interfaces, such as mobile base stations, wireless access base stations, node machines in the digital data network (DDN), and routers of the Internet service provider (ISP) and LAN.

3.6.2 E1/T1 Electrical Interface Board SM1S/SM1D/PM2S/PM2D/PM2T

The SM1S, SM1D, PM2S, PM2D, and PM2T boards access E1/T1 services.

Functions

- Accesses E1/T1 services.
- Supports asynchronous mapping of E1/T1 signals to VC-12s as defined in ITU-T G.703 and multiplexing of TU-12s into TUG-2s.
- Provides the 100-ohm balanced interface for T1 signals and the 75-ohm unbalanced and 120-ohm balanced interfaces for E1 signals, whose characteristics comply with related specifications defined in ITU-T G.703.
- Selects E1/T1 signals through software.

- Processes the VC-12 path overheads, configures each service channel, monitors alarms and performance of each service channel, and communicates with the SCC unit.
- Supports inloop and outloop to test the quality of E1/T1 services or to locate the fault, thus facilitating the maintenance.
- Provides the synchronous clock source for the clock unit.

Table 3-7 lists the functions of the SM1S, SM1D, PM2S, PM2D, and PM2T boards.

Table 3-7 Functions of the SM1S, SM1D, PM2S, PM2D, and PM2T boards

Item	SM1S	SM1D	PM2S	PM2D	PM2T
Number of interfaces	4xE1/T1	8xE1/T1	16xE1/T1	32xE1/T1	48xE1/T1
Type of connector	2 mm HM connector				
Valid slot	IU1, IU2, and IU3	IU1, IU2, and IU3	IU4	IU4	IU4
Number of synchronous clock sources	1	2	2	4	6

Application

The SM1S/SM1D/PM2S/PM2D/PM2T board supports the following application:

- Connected to the OLT and ONU in the access network. In this way, the OptiX 155/622H can be applied in the access network.
- Interconnected with the communication equipment that provides standard E1 or T1 interfaces, such as mobile base stations, wireless access base stations, node machines in the DDN, and routers of the ISP and LAN.

3.6.3 E3/T3 Electrical Interface Board PE3S/PE3D/PE3T/PT3S/PT3D/PT3T

The PE3S, PE3D, PE3T, PT3S, PT3D, and PT3T boards access E3/T3 services.

Functions

- Accesses E3/T3 service signals.
- Supports asynchronous mapping of E3/T3 signals to VC-3s as defined in ITU-T G.703 and multiplexing of TU-3s into TUG-3s.
- Provides the 75-ohm unbalanced E3 interface and 100-ohm/120-ohm balanced T3 interface that comply with ITU-T G.703.
- Encodes/Decodes E3/T3 signals to implement the transmitting/receiving of high performance E3 or T3 signals.
- Maps E3/T3 PDH signals into VC-4s and demaps E3/T3 PDH signals from VC-4s.

- Provides the synchronous clock source for the clock unit.

Table 3-8 lists the functions of the PE3S, PE3D, PE3T, PT3S, PT3D, and PT3T boards.

Table 3-8 Functions of the PE3S, PE3D, PE3T, PT3S, PT3D, and PT3T boards

Item	PE3S	PE3D	PE3T	PT3S	PT3D	PT3T
Number of interfaces	1xE3	2xE3	3xE3	1xT3	2xT3	3xT3
Type of connector	SMB					
Valid slot	IU1, IU2, and IU3	IU1, IU2, and IU3	IU1, IU2, and IU3	IU1, IU2, and IU3	IU1, IU2, and IU3	IU1, IU2, and IU3
Interface impedance	75 ohms	75 ohms	75 ohms	100/120 ohms	100/120 ohms	100/120 ohms
Number of synchronous clock sources	1	2	2	1	2	2

Application

The PE3S/PE3D/PE3T/PT3S/PT3D/PT3T board is interconnected with the communication equipment that provides standard E3 or T3 interfaces.

3.7 Ethernet Interface Board

The OptiX 155/622H provides various Ethernet interface boards to receive and transmit FE and GE service signals.

According to the encapsulation protocol and mapping granularity, the Ethernet interface boards are classified into the following types.

3.7.1 ET1/ET1O/ET1D/EF1
The ET1, ET1O, ET1D, and EF1 boards support the multi-link point to point protocol (ML-PPP) only. The mapping granularity is VC-12. These boards transmit Ethernet services.

3.7.2 EFS/EFS4/EFT/EGS/EFSC/ELT2/EGT
The EFS, EFS4, EFT, EGS, EFSC, ELT2, and EGT boards support the generic framing procedure (GFP). The mapping granularities are VC-12 and VC-3. These boards transmit Ethernet services.

3.7.1 ET1/ET1O/ET1D/EF1

The ET1, ET1O, ET1D, and EF1 boards support the multi-link point to point protocol (ML-PPP) only. The mapping granularity is VC-12. These boards transmit Ethernet services.

Functions

- Provides 10M/100M Ethernet electrical interfaces and 100M optical interfaces, whose electrical characteristics, such as the flow control function, comply with IEEE 802.3x.
- Supports the working modes of auto-negotiation, 100M full-duplex/half-duplex and 10M full-duplex/half-duplex.
- Supports the ML-PPP encapsulation protocol with the encapsulation granularity of VC-12.
- Provides bandwidth sharing and statistical multiplexing based on virtual local area network (VLAN) and port to improve the bandwidth utilization.
- Supports Ethernet layer 2 switching.
- Supports isolation among different users, and VLAN isolation within one user.
- The ET1 and ET1D boards support Ethernet private line (EPL) services. The ET1O, ET1D, and EF1 boards support Ethernet private LAN (EPLAN) services.
- Supports multicast and broadcast.
- Supports the Rapid Spanning Tree Protocol (RSTP) to prevent broadcast storms.

Table 3-9 lists the functions of the ET1, ET1O, ET1D, and EF1 boards.

Table 3-9 Functions of the ET1, ET1O, ET1D, and EF1 boards

Board Feature		ET1	ET1O	ET1D	EF1
Number of FE electrical interfaces		8	8	2	4
Number of FE optical interfaces		-	-	-	2
Type of connector		RJ-45	RJ-45	RJ-45	Electrical interface: RJ-45 Optical interface: LC
Valid slot		IU4	IU4	IU1, IU2, and IU3	IU4
Working mode	Electrical interface	Auto-negotiation, 10M/100M full-duplex, 10M/100M half-duplex	Auto-negotiation, 10M/100M full-duplex, 10M/100M half-duplex	Auto-negotiation, 10M/100M full-duplex, 10M/100M half-duplex	Auto-negotiation, 10M/100M full-duplex, 10M/100M half-duplex
	Optical interface	-	-	-	100M full-duplex
Encapsulation protocol		ML-PPP			
VC-4 bandwidth on the SDH side		1	1	1	1

Board Feature	ET1	ET1O	ET1D	EF1
Bound bandwidth	48xE1	48xE1	16xE1	48xE1
Number of VCTRUNKs	16	16	16	16
Layer 2 switching	-	Supported	Supported	Supported
VLAN	Supported	Supported	Supported	Supported
EVPL	Supported	-	Supported	-
EPL	Supported	-	Supported	-
EPLAN	-	Supported	Supported	Supported
EVPLAN	-	-	-	-
Spanning tree	-	Supported	Supported	Supported
RMON	Supported	Supported	Supported	Supported
IGMP Snooping	-	Supported	Supported	Supported

Application

The ET1, ET1O, ET1D, and EF1 boards are interconnected with PCs, routers or Ethernet switches to transmit Ethernet services. Pay attention to the following points:

- The ET1 and ET1D boards support transparent transmission of services and are applicable to EPL services.
- The ET1O, ET1D, and EF1 boards support layer 2 switching of services and are applicable to EPLAN services.
- The EF1 board provides 100M optical interfaces and can be interconnected with the data equipment that provides 100M optical interfaces.
- The ET1, ET1O, ET1D, and EF1 boards use the same encapsulation protocol and mapping granularity. Hence, they can be interconnected with each other.

3.7.2 EFS/EFS4/EFT/EGS/EFSC/ELT2/EGT

The EFS, EFS4, EFT, EGS, EFSC, ELT2, and EGT boards support the generic framing procedure (GFP). The mapping granularities are VC-12 and VC-3. These boards transmit Ethernet services.

Functions

- Provides 10M/100M/1000M Ethernet interfaces, the electrical characteristics of which comply with IEEE 802.3x.
- Maps Ethernet services into VC-12s or VC-3s.
- The EFS, EGS, and EFSC boards support the GFP. The EFS4, EGT, EFT, and ELT2 boards support the GFP, link access procedure-SDH (LAPS), and high level data link control (HDLC).

- Receives and transmits test frames.
- Supports inloop and outloop for fast fault locating and troubleshooting.
- Counts test frames, reports the result, and generates alarms upon errors.
- The EFS, EFS4, EFSC, and EGS boards support the OAM function.
- The EFS, EFSC, EGS, and EFS4 boards support the auto-sensing function of the network cable.
- The EFS4 board supports the function of high precision time synchronization, which complies with the IEEE 1588 V2 standard.

Table 3-10 lists the functions of the EFS, EFS4, EFT, EGS, EFSC, ELT2, and EGT boards.

Table 3-10 Functions of the EFS, EFS4, EFT, EGS, EFSC, ELT2, and EGT boards

Board Feature		EFS	EFSC	EGS	EFT	ELT2	EGT	EFS4
Number of FE electrical interfaces		4	12	-	4	-	-	4
Number of FE optical interfaces		-	-	-	-	2	-	-
Number of GE optical interfaces		-	-	1	-	-	1	-
Type of connector		RJ-45	RJ-45	LC	RJ-45	LC	LC	RJ-45
Valid slot		IU1, IU2, and IU3	IU4	IU1, IU2, and IU3	IU1, IU2, and IU3	IU1, IU2, and IU3	IU1, IU2, and IU3	IU1, IU2, and IU3
Working mode	FE electrical interface	Auto-negotiation, 10M/100M full-duplex, 10M/100M half-duplex	Auto-negotiation, 10M/100M full-duplex, 10M/100M half-duplex	-	Auto-negotiation, 10M/100M full-duplex	-	-	Auto-negotiation, 100M full-duplex
	FE optical interface	-	-	-	-	100M full-duplex	-	-

Board Feature		EFS	EFSC	EGS	EFT	ELT2	EGT	EFS4
	GE optical interface	-	-	1000M full-duplex	-	-	Auto-negotiation, 1000M full-duplex	-
VC-4 bandwidth on the SDH side		4	4	4	2	2	2	4
Bound bandwidth		12xVC-3 or 126xVC-12 + 6xVC-3	12xVC-3 or 126xVC-12 + 6xVC-3	12xVC-3 or 126xVC-12 + 6xVC-3	6xVC-3 or 63xVC-12 + 3xVC-3	6xVC-3 or 63xVC-12 + 3xVC-3	6xVC-3 or 63xVC-12	12xVC-3 or 63xVC-12 + 9xVC-3
Number of VCTRUNKs		24	24	24	4	2	1	8
Layer 2 switching		Supported	Supported	Supported	-	-	-	Supported
VLAN		Supported	Supported	Supported	-	-	-	Supported
EVPL		Supported	Supported	Supported	-	-	-	Supported
EPL		Supported	Supported	Supported	Supported	Supported	Supported	Supported
EPLAN		Supported	Supported	Supported	-	-	-	Supported
EVPLAN		Supported	Supported	Supported	-	-	-	Supported
Spanning tree		Supported	Supported	Supported	-	-	-	Supported
GFP		Supported	Supported	Supported	Supported	Supported	Supported	Supported
LAPS		-	-	-	Supported	Supported	Supported	Supported
HDLC		-	-	-	Supported	Supported	Supported	Supported
Link state pass through (LPT)		Supported	Supported	Supported	Supported	Supported	Supported	Supported

Board Feature	EFS	EFSC	EGS	EFT	ELT2	EGT	EFS4
Test frame	Supported	Supported	Supported	Supported	Supported	Supported	Supported
CAR	Supported	Supported	Supported	-	-	-	Supported
CoS	Supported	Supported	Supported	-	-	-	Supported
Intra-board link aggregation group (LAG)	-	-	-	-	-	-	Supported
Port mirroring	-	-	-	-	-	-	Supported
IGMP snooping	Supported	Supported	Supported	-	-	-	Supported
LCAS V2	Supported	Supported	Supported	Supported	Supported	Supported	Supported
Ethernet OAM	Supported	Supported	Supported	-	-	-	Supported
RMON	Supported	Supported	Supported	Supported	Supported	Supported	Supported
QinQ	-	-	-	-	-	-	Supported

Application

The EFS, EFS4, EFT, EGS, EFSC, ELT2, and EGT boards can be interconnected with PCs, routers, or Ethernet switches to transmit Ethernet services. Pay attention to the following points:

- The EFS, EFS4, EGS, and EFSC boards support layer 2 switching and multi-protocol label switching (MPLS), and are applicable to EPL, EVPL, EPLAN, and EVPLAN services.
- The EGS and EGT boards provide 1000M optical interfaces and can be interconnected with the data equipment that provides 1000M optical interfaces.
- The EFT, ELT2, and EGT boards only support the transparent transmission of services and are applicable to EPL services.
- The ELT2 board provides 100M optical interfaces and can be interconnected with the data equipment that provides 100M optical interfaces.
- The EFS, EFS4, EFT, EGS, EFSC, ELT2, and EGT boards use the same encapsulation protocol and mapping granularity, and they can be interconnected with each other.
- The EFS, EFS4, EFSC, EGS, EFT, ELT2, and EGT boards support the LCAS V2.

3.8 Data Interface Board

The data interface board of the OptiX 155/622H receives and transmits data signals.

The OptiX 155/622H provides the following data interface boards.

3.8.1 Single Pair High-Bit-Rate Digital Subscriber Line Interface Board SHLQ
The SHLQ board transmits E1 signals and Nx64 kbit/s signals over a long distance.

3.8.2 Nx64kbit/s Interface Board N64/N64Q/FP2D
The N64, N64Q, and FP2D boards convert Nx64 kbit/s signals and Framed E1 signals into E1 signals.

3.8.1 Single Pair High-Bit-Rate Digital Subscriber Line Interface Board SHLQ

The SHLQ board transmits E1 signals and Nx64 kbit/s signals over a long distance.

Functions

- Provides four G.SHDSL electrical interfaces to transmit E1/V.35 services over a long distance on the existing twisted pair network by adopting the single pair high-bit-rate digital subscriber line (SHDSL) technology.
- The characteristics of interfaces comply with the corresponding specifications defined in ITU-T G.991.2.
- Transmits Framed E1 and Nx64 kbit/s data services in the G.SHDSL format, and can thus access remote E1 and Nx64 kbit/s signals.
- Processes the path overheads, configures each G.SHDSL service channel, and monitors the alarms and performance of each G.SHDSL service channel. In addition, this board implements the communication between the G.SHDSL service channels and the SCC unit.
- Supports inloop and outloop so that faults can be located quickly.
- Uses the RJ-11 connector.
- Provides one synchronous clock source for the clock unit.

Application

- This board accesses G.SHDSL services to the transmission equipment.
- This board extends the transmission distance of E1 signals to more than 3 km, or the transmission distance of 3x64 kbit/s signals to more than 6.5 km.

3.8.2 Nx64kbit/s Interface Board N64/N64Q/FP2D

The N64, N64Q, and FP2D boards convert Nx64 kbit/s signals and Framed E1 signals into E1 signals.

Functions

Table 3-11 Functions of the N64, N64Q, and FP2D boards

Board Feature	N64	N64Q	FP2D
Processing capability	Performs timeslot cross-connection for two NM or two monitoring signals (at Nx64 kbit/s), and E1 services (2xE1 signals from the interface side or 8xE1 signals from the line side), thus realizing re-integration of E1 services and timeslot extraction	Converts 4xNx64 kbit/s service signals into E1 signals and performs timeslot cross-connection, thus realizing re-integration of E1 services and timeslot extraction	Accesses 16xFramed E1 signals and provides time division cross-connect services at the 64 kbit/s level
Interface specification	Nx64 kbit/s interface: V.35/V.24/X.21/ RS-449/EIA-530 Framed E1 interface: CRC4 and non-CRC4	Nx64 kbit/s interface: V.35/X.21/RS-449/ V.24/RS-530/ RS-530A	Framed E1 interface: CRC4 and non-CRC4
Type of connector	2 mm HM	2 mm HM	DB78
Protection	Not supported	Not supported	Not supported
Loopback	Supports inloop and outloop for all ports	Supports inloop and outloop for all ports	Supports inloop and outloop for all ports
Alarm and performance event	Provides abundant alarms and performance events, which facilitates management and maintenance of the equipment	Provides abundant alarms and performance events, which facilitates management and maintenance of the equipment	Provides abundant alarms and performance events, which facilitates management and maintenance of the equipment

Application

The N64, N64Q, and FP2D boards are mainly applied to point-to-point, point-to-multipoint, and multipoint-to-multipoint transmission of the video conference systems and routers, and are used for convergence in the case of multi-point router access, and thus access V.35/V.24/X.21/ RS-449/EIA-530 multi-protocol interface services and Framed E1 services to transmission networks.

The FP2D board is applicable to DDN private networks of small and medium-sized enterprises, government departments, banks or security business halls.

3.9 ATM Interface Board AIUD/AIUQ

The AIUD and AIUQ boards transmit ATM services and provide protection for ATM services.

Functions

The AIUD board supports two external ports and two internal ports. The AIUQ board supports four external ports and four internal ports. The AIUD and AIUQ boards can be installed in slot IU4 of the OptiX 155/622H.

- Supports the configuration of multicast and point-to-point ATM services (including spatial multicast services and logical multicast services).
- Provides VP/VC connection-based 1+1/1:1 protection for ATM services. Eight protection configuration modes are available.
- Supports flow control for ATM services. Fifteen flow control modes are supported according to ITU-T Recommendations.
- Supports the ATM OAM function and continuity check (CC) by sending the loopback (LB) cell and CC cell, and captures the alarm indication signal (AIS) and the remote defect indication (RDI) signal.
- Supports the setting of the ATM port attributes. The ATM ports can be set according to the service requirements. Setting and querying the VP/VC sub-space are supported.
- Monitors ATM service alarms. All the alarms related to ATM features can be reported.
- Supports the performance measurement of ATM services. All the performance events related to ATM features can be counted.
- Supports the SDH features of ATM services.

Application

The AIUD and AIUQ boards mainly transmit and protect ATM services. The AIUD and AIUQ boards support the following services:

- Constant bit rate (CBR) services
- Real time variable bit rate (rt-VBR) services
- Non-real time variable bit rate (nrt-VBR) services
- Unspecified bit rate (UBR) services

The AIUD and AIUQ boards do not support available bit rate (VBR) services. The CBR services are applied to voice services, video services, and circuit emulation services at a constant bit rate. These services require guaranteed transmission bandwidth and latency. The rt-VBR services are applied to audio and video services at a variable bit rate. The nrt-VBR services are applied to data transmission. The UBR services are applied to LAN emulation and file transfer.

The services and traffic types supported by the OptiX 155/622H comply with IETF RFC2514, ATM Forum TM 4.0, and ATM Forum UNI 3.1. For details, see **Table 3-12**.

Table 3-12 ATM service types and traffic types

No.	Traffic Type	Service Type	Parameter
1	atmNoTrafficDescriptor	UBR	-
2	atmNoClpNoScr	UBR.1	Clp01Pcr
		CBR	Clp01Pcr
3	atmClpNoTaggingNoScr	CBR	Clp01Pcr, Clp0Pcr
4	atmClpTaggingNoScr	CBR	Clp01Pcr, Clp0Pcr
5	atmNoClpScr	nrt-VBR.1	Clp01Pcr, Clp01Scr, Mbs
6	atmClpNoTaggingScr	nrt-VBR.2	Clp01Pcr, Clp0Scr, Mbs
7	atmClpTaggingScr	nrt-VBR.3	Clp01Pcr, Clp0Scr, Mbs
8	atmClpTransparentNoScr	CBR.1	Clp01Pcr, Cdvt
9	atmClpTransparentScr	rt-VBR.1	Clp01Pcr, Clp01Scr, Mbs, Cdvt
10	atmNoClpTaggingNoScr	UBR.2	Clp01Pcr, Cdvt
11	atmNoClpNoScrCdvt	UBR	Clp01Pcr, Cdvt
		CBR	Clp01Pcr, Cdvt
12	atmNoClpScrCdvt	rt-VBR.1	Clp01Pcr, Clp01Scr, Mbs, Cdvt
13	atmClpNoTaggingScrCdvt	rt-VBR.2	Clp01Pcr, Clp0Scr, Mbs, Cdvt
14	atmClpTaggingScrCdvt	rt-VBR.3	Clp01Pcr, Clp0Scr, Mbs, Cdvt

3.10 Tone and Data Access Board TDA

The TDA board receives and transmits audio signals and environment monitoring signals.

Functions

- Provides 12 audio interfaces and four standard RS-232/RS-422 interfaces.
- The audio interface is 600-ohm balanced, which can be set to the feed-providing mode or non feed-providing mode for the user equipment.
- The RS-232/RS-422 data port transmits services at a maximum rate of 19.2 kbit/s.
- Processes the VC-12 path overheads, configures the E1 service bearer channel, monitors the alarms and performance of the E1 service bearer channel (excluding the audio and data services), and communicates with the SCC unit.
- Supports inloop and outloop to test services and locate faults.
- Provides the cross-connection at the 64 kbit/s level.

Application

The application of the TDA board is described as follows:

- The audio interface supports the point-to-point bidirectional service, which is called the private line service. This type of service is mainly applied to point-to-point application scenarios, such as banks and post bank cards. Usually, services are transmitted by a TDA board that is connected to a private line modem.
- The audio interface also supports the point-to-multipoint unidirectional service. This type of service is applied to the transmission of paging information.
- The RS-232 and RS-422 interfaces transmit environmental information, power monitoring information, and NM information. In addition, they can form a simple network with PCs.

Table 3-13 lists the transmission distances of the audio interface and the data interface.

Table 3-13 Transmission distances of the audio interface and data interface on the TDA board

Interface Type	Maximum Transmission Distance
Audio interface	4000 m
RS-232 asynchronous interface	15 m
RS-422 asynchronous interface	1000 m

3.11 Environment Monitoring Unit EMU

The EMU board monitors the environment.

Functions

The environment monitoring unit EMU provides the following environment monitoring functions:

- Monitors the voltage of two channels of –48 V power supply.
- Monitors the working temperature of the equipment.
- Provides 12 housekeeping inputs and six housekeeping outputs.
- Provides 1-channel RS-232/RS-422 serial communication.

Application

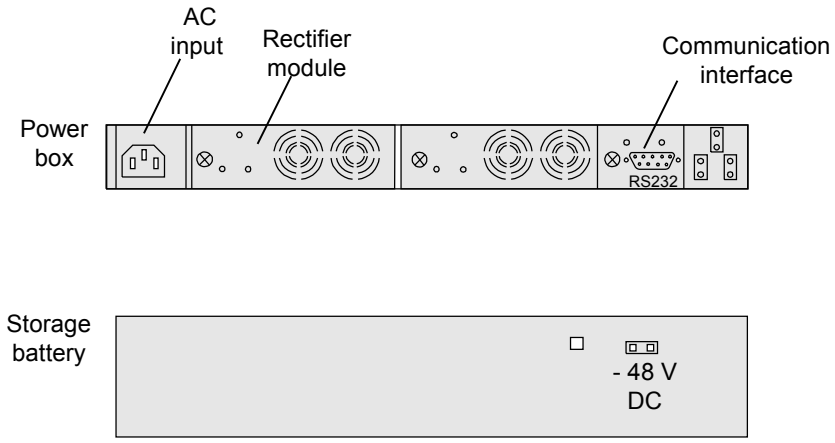
- This board detects and monitors the voltage of two channels of power supply at the same time, and reports the result to the T2000.
- This board monitors the working temperature of the OptiX 155/622H, and reports the result to the T2000.
- This board inputs external alarms and outputs equipment alarms through the housekeeping interface.
- The serial interface can be set to RS-232 or RS-422 to transparently transmit serial communication information of other equipment, such as the monitoring information.

3.12 Power Converter System UPM

The uninterruptible power module (UPM) is a 220 V AC to –48 V DC power converter system that is used only by the OptiX 155/622H. The UPM consists of the double-channel hot backup AC/DC converter module, monitoring module, and storage battery.

Figure 3-5 shows the composition of the UPM.

Figure 3-5 Composition of the UPM



3.12.1 Functions

The UPM functions as a backup of the equipment power supply. When the mains supply is interrupted, the UPM automatically enables the storage batteries to supply power, thus ensuring the uninterrupted power supply.

- The UPM provides two AC/DC rectifier modules with the hot backup design for power conversion. If one rectifier module fails, the other rectifier module takes over the load immediately so that the ongoing services are not affected. This feature significantly improves the stability of the system. Each rectifier module can support a load of 250 W. When only one rectifier module works, it can ensure that two sets of OptiX 155/622H in full configuration function normally or that four sets of OptiX 155/622H in standard configuration function normally.

- The UPM provides the monitoring module, which combines the functions of power monitoring and NMS monitoring. The monitoring module monitors and controls the parameters and status of the rectifier module, AC/DC power distribution, and storage battery group in real time, and then reports the parameters and status to the T2000. The storage batteries support the automatic management and the protection function. The monitoring module automatically measures the charging and discharging currents of the storage batteries, and controls the rectifier module to perform even charging, floating charging and current limitation on the storage batteries.
- The UPM provides protection for the storage batteries. When the mains supply is interrupted, the UPM automatically enables the storage batteries to supply power. The storage batteries can provide a normal power supply of five to six hours for the OptiX 155/622H in standard configuration.

3.12.2 UPM Power Converter Box

The UPM power converter box can convert power supplies.

The dimensions of the UPM power converter box are 436 mm (W) x 240 mm (D) x 44 mm (H).

Figure 3-6 and **Figure 3-7** show the appearance of the power converter box.

Figure 3-6 Appearance of the power converter box

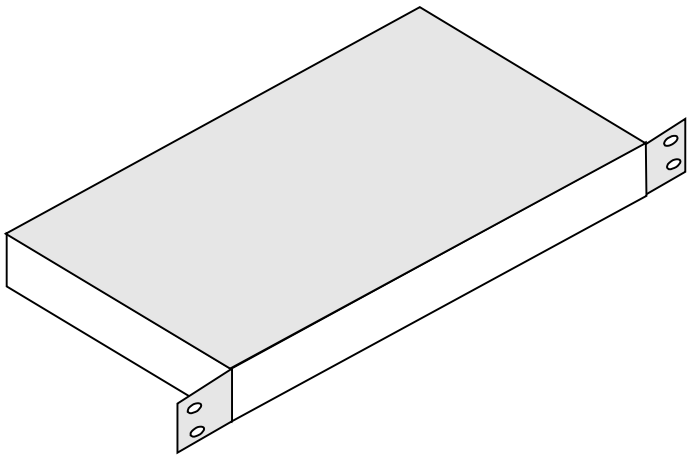
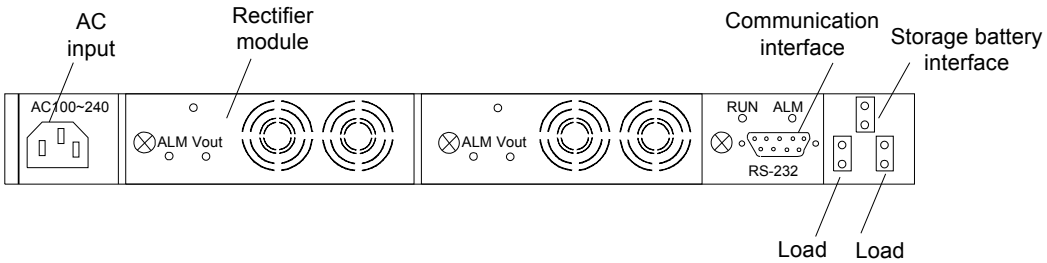


Figure 3-7 Rear view of the power converter box



3.12.3 Storage Battery

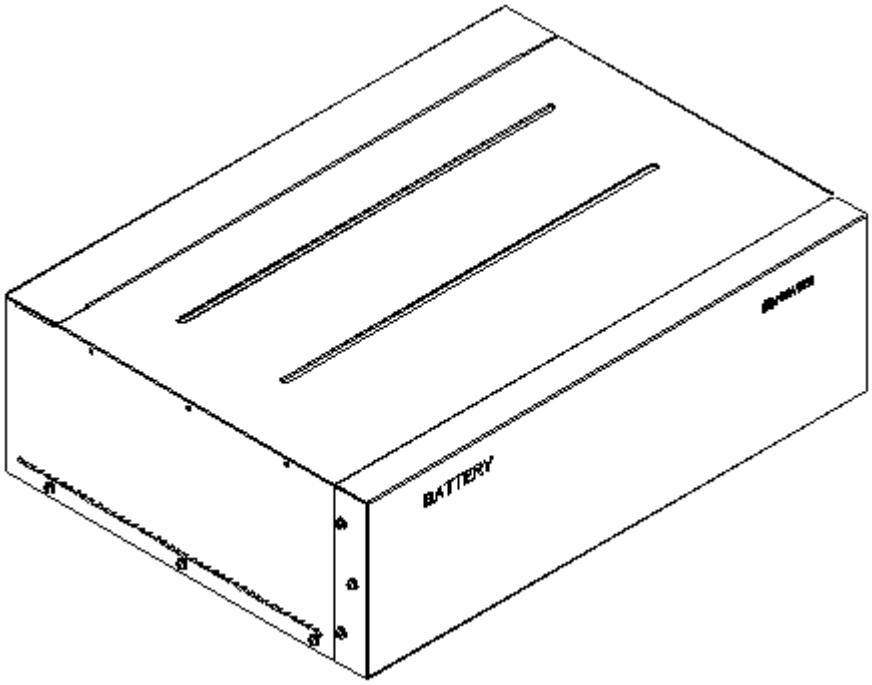
The storage battery can be installed in the storage battery box or on the storage battery tray. When the mains supply is interrupted, the UPM automatically enables the storage battery to supply power, thus ensuring uninterrupted power supply.

Storage Battery Box

The dimensions of the storage battery box are 436 mm (W) x 315 mm (D) x 133 mm (H).

Figure 3-8 shows the appearance of the storage battery box.

Figure 3-8 Storage battery box



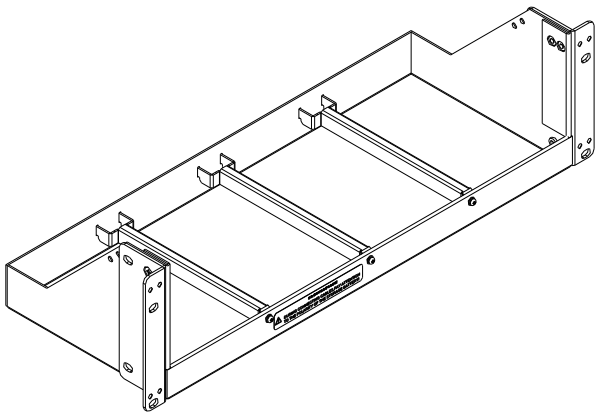
Storage Battery Tray

The storage battery tray can house the storage batteries of two types: 12 Ah and 20 Ah.

The dimensions of the storage battery tray are 436 mm (W) x 173.5 mm (D) x 125 mm (H).

Figure 3-9 shows the appearance of the storage battery tray.

Figure 3-9 Storage battery tray



4 Software Architecture

About This Chapter

4.1 Overview

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

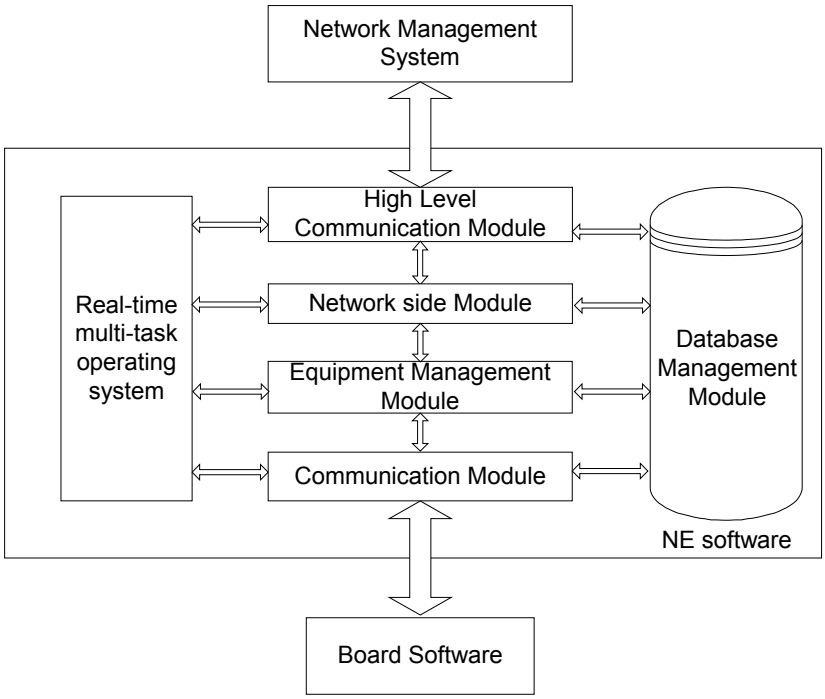
The entire software is distributed in three modules including board software, NE software and NM system.

The software resides respectively on functional boards, the SCC, and NM computer. Hierarchical structure ensures that it is highly reliable and efficient. Each layer performs specific functions and provides service for the upper layer.

Figure 4-1 shows the system software architecture.

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

Figure 4-1 Software architecture



4.2 Communication Protocols

Complete protocol stack and messages of Qx interface are described in ITU-T G.773, Q.811 and Q.812.

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

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

According to the Recommendations, 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, IP layer uses serial line internet protocol (SLIP).

4.3 Board Software

The board software runs on each board and it manages, monitors and controls the operation of the board.

It receives the commands issued from the NE software and reports the board status to the NE software through performance events and alarms.

The specific functions include:

- Alarm management
- Performance management
- Configuration management
- Communication management

It directly controls the functional circuits in corresponding boards and implements ITU-T compliant specific functions of the NE.

4.4 NE Software

The NE software manages, monitors and controls the board running on the NE. In addition, the NE software functions as a communication service unit between the T2000 and the boards so that the T2000 can control and manage the NE.

According to ITU-T M.3010, NE software is at the unit management layer in the telecommunication management network, performing NE function (NEF), partial mediation function (MF) and the OS function at the network unit layer.

Data communication function (DCF) provides the communication channel between NE and other equipment (including the mediation device, the T2000 and other NEs).

- Real-Time Multi-Task Operating System

  The NE software offers a real-time multi-task operating system to manage public resources and support application programs.

  It isolates the application programs from the processor and provides an application program execution environment, which is independent of the processor hardware.

- Communication and Control Module

  The communication and control module is the interface module between NE software and board software.

  According to related communication protocols, the communication and control module implements the communication between NE software and board software for information exchange and equipment maintenance.

  The communication and control module issues the board maintenance and operation commands sent from the NE software to the boards. The communication and control

module also reports the status, alarm and performance events of the boards to the NE software.

- Network Side (NS) Module

  The NS module is between the communication module and the equipment management module. It converts the data format between the user operation side (at the application layer) and the NE equipment management layer, and provides security control for the NE layer.

  Functionally, the NS module is divided into the following three submodules:

  - Qx interface module
  - Command line interface (CLI) module
  - Security management module

- Equipment Management Module

  The equipment management module is the core of the NE software for implementing NE management. It includes administrator and agent.

  The administrator can send NM operation commands and receive events.

  The agent can respond to the NM operation commands sent by the administrator, implement the operations on the managed object, and send performance events according to the status change of the managed object.

- High-Level Communication Module

  The high-level communication module implements the Message Communication Function (MCF) in the functional block of the transmission network equipment. It provides hardware interfaces through the control board, transports the Operation, Administration, Maintenance, and Provision (OAM&P) information, and exchanges management information between the T2000 and the NEs and between the NEs.

  It consists of the network communication module, serial communication module and ECC communication module.

- Database Management Module

  The database management module is an important part of the NE software.

  It includes two independent parts: data and program.

  The data is organized in the form of database, including the network database, alarm database, performance database and equipment database.

  The program manages and accesses the data in the database.

4.5 Network Management System

The NM system implements unified management over the optical transmission network, and maintains all OSN, SDH, Metro, DWDM NE equipment in the network.

In compliance with ITU-T Recommendations, it is an NM system that integrates standard management information model as well as object-oriented management technology.

It exchanges information with the NE software through the communication module to monitor and manage the network equipment.

The NM software runs on a workstation or PC, managing the equipment and the transmission network to help operate, maintain and manage the transmission equipment.

The management functions of the NM software include:

- Alarm management: collects, prompts, filters, browses, acknowledges, checks, clears, and counts alarms in real time; implements alarm insertion, alarm correlation analysis and fault diagnosis.
- Performance management: configures performance monitoring; browses, analyzes and prints performance data; forecasts medium-term and long-term performance; resets performance register.
- Configuration management: configures and manages interfaces, clocks, services, trails, subnets and time.
- Security management: provides NM user management, NE user management, NE login management, NE login locking, NE setting locking and local craft terminal (LCT) access control of the equipment.
- Maintenance management: provides loopback, board resetting, automatic laser shutdown (ALS) and optical fiber power detection; collects equipment data to help the maintenance personnel in troubleshooting.

5 Data Features

About This Chapter

The data features include Ethernet features, ATM features, and DDN features.

5.1 Ethernet Features

This topic describes the functions, application, and protection of the Ethernet features of the OptiX 155/622H.

5.1.1 Functions

The OptiX 155/622H provides various types of Ethernet boards to meet the requirements of different Ethernet services.

Table 5-1 lists the Ethernet boards that support the ML-PPP encapsulation protocol. **Table 5-2** lists the Ethernet boards that support the GFP encapsulation protocol.

Table 5-1 Functions of the ET1, ET1O, ET1D, and EF1 boards

Board Feature		ET1	ET1O	ET1D	EF1
Number of FE electrical interfaces		8	8	2	4
Number of FE optical interfaces		-	-	-	2
Type of connector		RJ-45	RJ-45	RJ-45	Electrical interface: RJ-45 Optical interface: LC
Valid slot		IU4	IU4	IU1, IU2, and IU3	IU4
Working mode	Electrical interface	Auto-negotiation, 10M/100M full-duplex, 10M/100M half-duplex	Auto-negotiation, 10M/100M full-duplex, 10M/100M half-duplex	Auto-negotiation, 10M/100/ full-duplex, 10M/100M half-duplex	Auto-negotiation, 10M/100M full-duplex, 10M/100M half-duplex
	Optical interface	-	-	-	100M full-duplex

Board Feature	ET1	ET1O	ET1D	EF1
Encapsulation protocol	ML-PPP			
Uplink bandwidth on the SDH side	1xVC-4	1xVC-4	1xVC-4	1xVC-4
Bound bandwidth	48xVC-12	48xVC-12	16xVC-12	48xVC-12
Number of VCTRUNKs	16	16	16	16
Layer 2 switching	-	Supported	Supported	Supported
VLAN	Supported	Supported	Supported	Supported
EPL	Supported	-	Supported	-
EVPL	-	-	-	-
EPLAN	-	Supported	Supported	Supported
EVPLAN	-	-	-	-
Spanning tree	-	Supported	Supported	Supported
IGMP Snooping	-	Supported	Supported	Supported
RMON	Supported	Supported	Supported	Supported

Table 5-2 Functions of the EFS, EFS4, EFT, EGS, EFSC, ELT2, and EGT boards

Function	EFS	EFSC	EGS	EFT	ELT2	EGT	EFS4
Number of FE electrical interfaces	4	12	-	4	-	-	4
Number of FE optical interfaces	-	-	-	-	2	-	-
Number of GE optical interfaces	-	-	1	-	-	1	-
Type of connector	RJ-45	RJ-45	LC	RJ-45	LC	LC	RJ-45
Valid slot	IU1, IU2, and IU3	IU4	IU1, IU2, and IU3	IU1, IU2, and IU3	IU1, IU2, and IU3	IU1, IU2, and IU3	IU1, IU2, and IU3

Function		EFS	EFSC	EGS	EFT	ELT2	EGT	EFS4
Working mode	FE electrical interfaces	Auto-negotiation, 10M/100M full-duplex, 10M/100M half-duplex	Auto-negotiation, 10M/10M full-duplex, 10M/100M half-duplex	-	Auto-negotiation, 10M/100M full-duplex	-	-	Auto-negotiation, 100M full-duplex
	FE optical interfaces	-	-	-	-	100M full-duplex	-	-
	GE optical interfaces	-	-	100M full-duplex	-	-	Auto-negotiation, 1000M full-duplex	-
Uplink bandwidth on the SDH side		4xVC-4	4xVC-4	4xVC-4	2xVC-4	2xVC-4	2xVC-4	4xVC-4
Bound bandwidth		12xVC-3 or 126xVC-12 + 6xVC-3	12xVC-3 or 126xVC-12 + 6xVC-3	12xVC-3 or 126xVC12 + 6 xVC-3	6xVC-3 or 63xVC12 + 3xVC-3	6xVC-3 or 63xVC12 + 3xVC-3	6xVC-3 or 63xVC-12	12xVC-3 or 63xVC-12 + 9xVC-3
Number of VCTRUNKs		24	24	24	4	2	1	8
Layer 2 switching		Supported	Supported	Supported	-	-	-	Supported
VLAN		Supported	Supported	Supported	-	-	-	Supported
EVPL		Supported	Supported	Supported	-	-	-	Supported
EPL		Supported	Supported	Supported	Supported	Supported	Supported	Supported
EPLAN		Supported	Supported	Supported	-	-	-	Supported

Function	EFS	EFSC	EGS	EFT	ELT2	EGT	EFS4
EVPLAN	Supported	Supported	Supported	-	-	-	Supported
Spanning tree	Supported	Supported	Supported	-	-	-	Supported
GFP	Supported	Supported	Supported	Supported	Supported	Supported	Supported
LAPS	-	-	-	Supported	Supported	Supported	Supported
HDLC	-	-	-	Supported	Supported	Supported	Supported
LPT	Supported	Supported	Supported	Supported	Supported	Supported	Supported
Test frame	Supported	Supported	Supported	Supported	Supported	Supported	Supported
CAR	Supported	Supported	Supported	-	-	-	Supported
CoS	Supported	Supported	Supported	-	-	-	Supported
Traffic management	-	-	-	-	-	-	Supported
Queue management	-	-	-	-	-	-	Supported
IGMP Snooping	Supported	Supported	Supported	-	-	-	Supported
LCAS V2	Supported	Supported	Supported	Supported	Supported	Supported	Supported
Ethernet OAM	Supported	Supported	Supported	-	-	-	Supported
RMON	Supported	Supported	Supported	Supported	Supported	Supported	Supported
QinQ	-	-	-	-	-	-	Supported
Port mirroring	-	-	-	-	-	-	Supported
Intra-board LAG	-	-	-	-	-	-	Supported

5.1.2 Application

The OptiX 155/622H provides the Ethernet service access function that is integrated on the SDH transmission platform. Hence, the OptiX 155/622H can transmit voice services and data services at the same time.

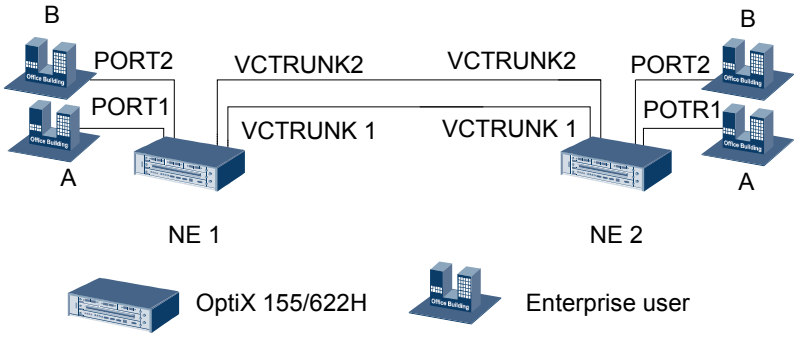
The OptiX 155/622H supports the following types of Ethernet services:

- EPL service
- EVPL service
- EPLAN service
- EVPLAN service

EPL Service

The EPL realizes the point-to-point transparent transmission of Ethernet services. As shown in **Figure 5-1**, the Ethernet services of different NEs are transmitted to the destination nodes thorough their respective VCTRUNKs. This ensures secure and reliable data transmission. In addition, the Ethernet services are protected by the SDH self-healing network.

Figure 5-1 PORT-based EPL service

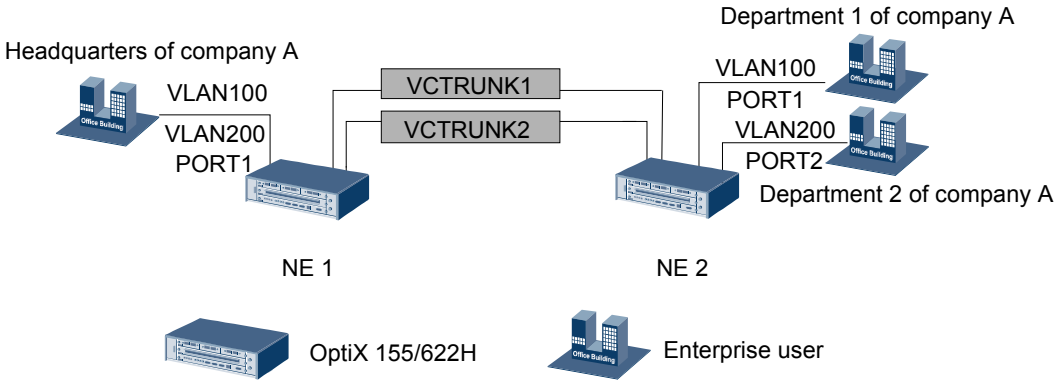


EVPL Service

The OptiX 155/622H supports the following two types of EVPL service:

PORT-shared EVPL: The services are isolated by VLAN tags and share the bandwidth. As shown in **Figure 5-2**, traffic classification is performed for the Ethernet service according to VLAN ID, to distinguish services from different departments of company A. The two services are transmitted over their respective VCTRUNKs.

Figure 5-2 PORT-shared EVPL service



VCTRUNK-shared EVPL: The OptiX 155/622H can converge and distribute the EVPL service in the following two modes.

- The VLAN ID-based mode, as shown in **Figure 5-3**.
- The QinQ-based mode, as shown in **Figure 5-4**.

Figure 5-3 VLAN ID-based EVPL service

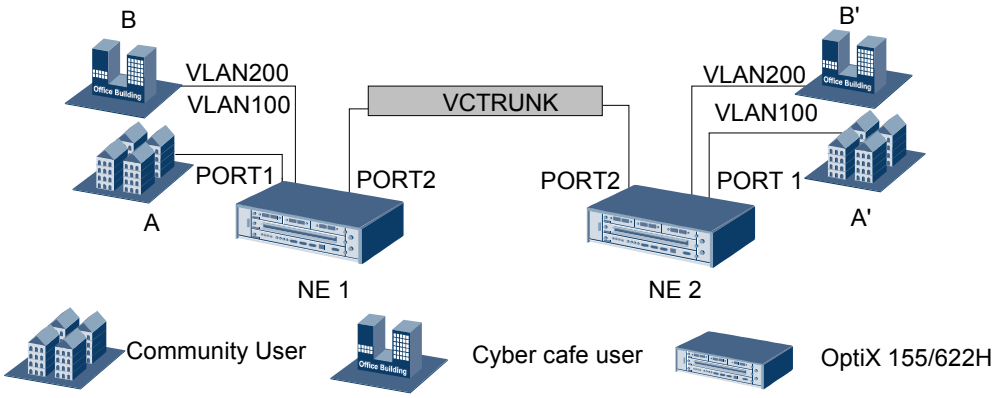
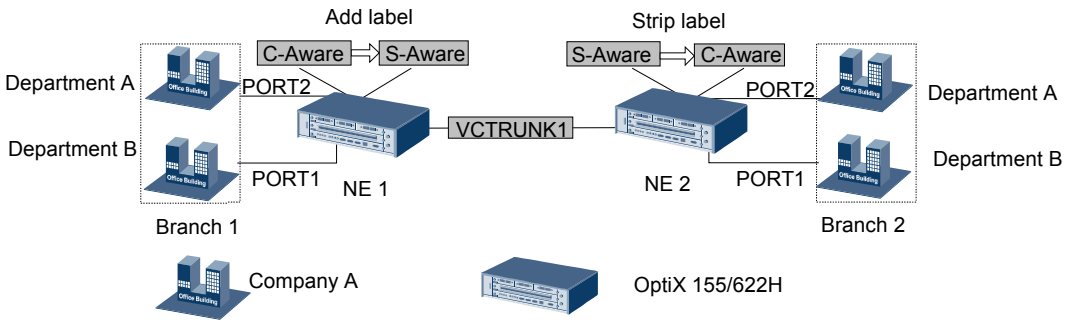


Figure 5-4 QinQ-based EVPL service

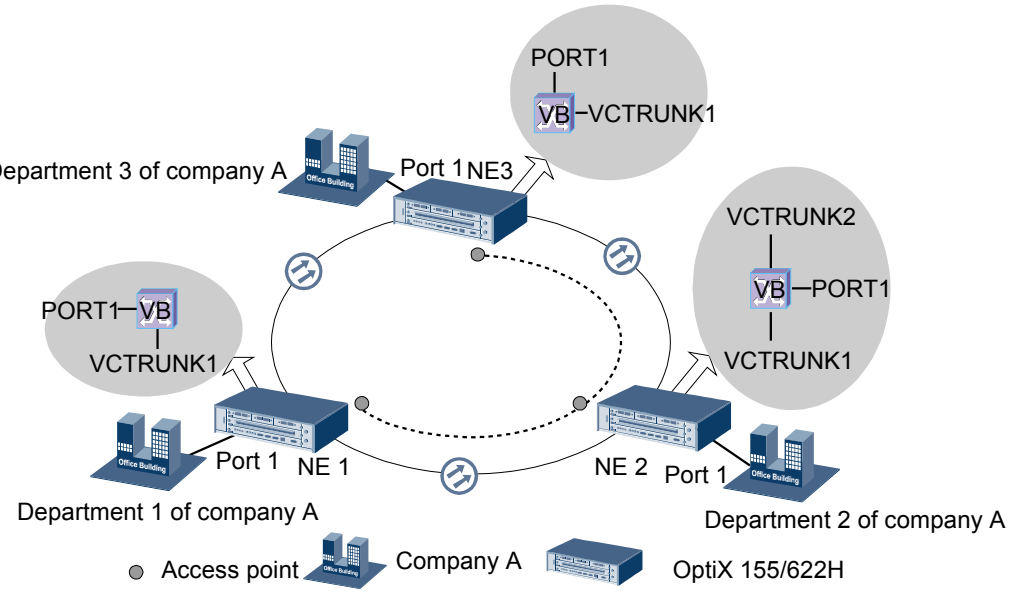


EPLAN Service

Through the EPLAN service, NEs can dynamically share the bandwidth. The OptiX 155/622H uses the virtual bridge (VB) or pure bridge to implement the layer 2 switching of Ethernet data. This is referred to as the EPLAN service.

Each NE in the system can created one or several VBs. Each VB establishes a media access control (MAC) address table. This table is updated periodically by self-learning. The accessed data is transmitted according to the destination MAC address. See **Figure 5-5**.

Figure 5-5 EPLAN service

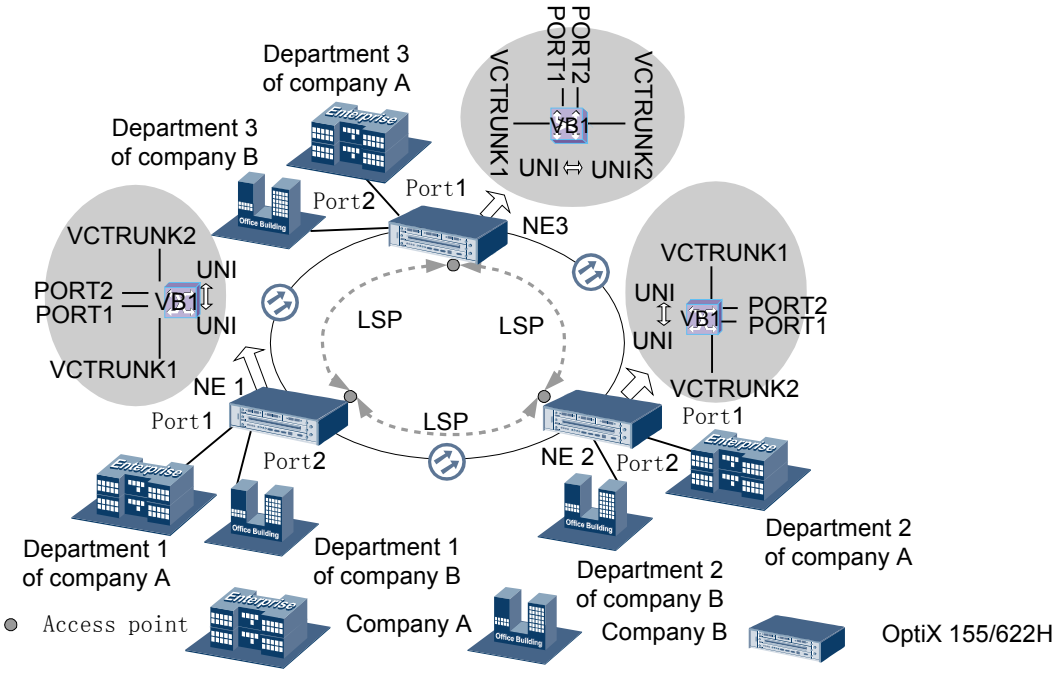


EVPLAN Service

Through the EVPLAN service, NEs can dynamically share the bandwidth and the service isolation between data of the same VLAN can be implementd. When the data services with the same VLAN ID are accessed into the same NE and dynamically share the bandwidth, the EVPLAN service an meet the service requirement.

As shown in **Figure 5-6**, the Ethernet board of the OptiX 155/622H uses the VB+VLAN filter table to implement the EVPLAN service.

Figure 5-6 EVPLAN service



5.1.3 Protection

The OptiX 155/622H provides hierarchical protection for Ethernet services.

- At the Ethernet service layer, the OptiX 155/622H supports the following protection schemes:
  - Link capacity adjustment scheme (LCAS)
  - Spanning Tree Protocol (STP)/Rapid Spanning Tree Protocol (RSTP)
  - Link state pass through (LPT)
  - Link aggregation group (LAG)
- At the optical transmission layer, the OptiX 155/622H supports the multiplex section protection (MSP) and sub-network connection protection (SNCP) schemes.

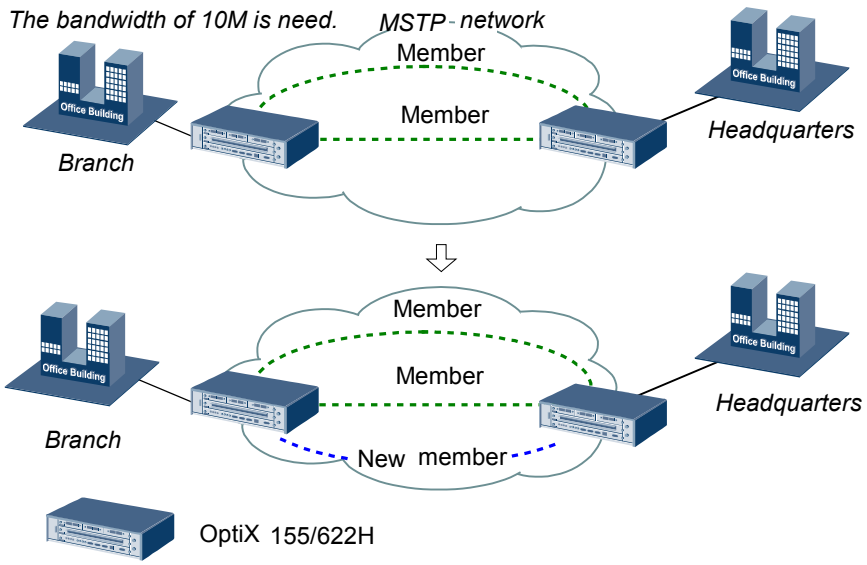
LCAS

LCAS provides an error tolerance mechanism to enhance the reliability of the virtual concatenation. LCAS provide the following functions:

- When applied to the virtual concatenation technology, LCAS can be used for configuring the system capacity, increasing or decreasing the number of concatenated VCs, and dynamically changing the bearer bandwidth.
- LCAS protects and restores failed members.

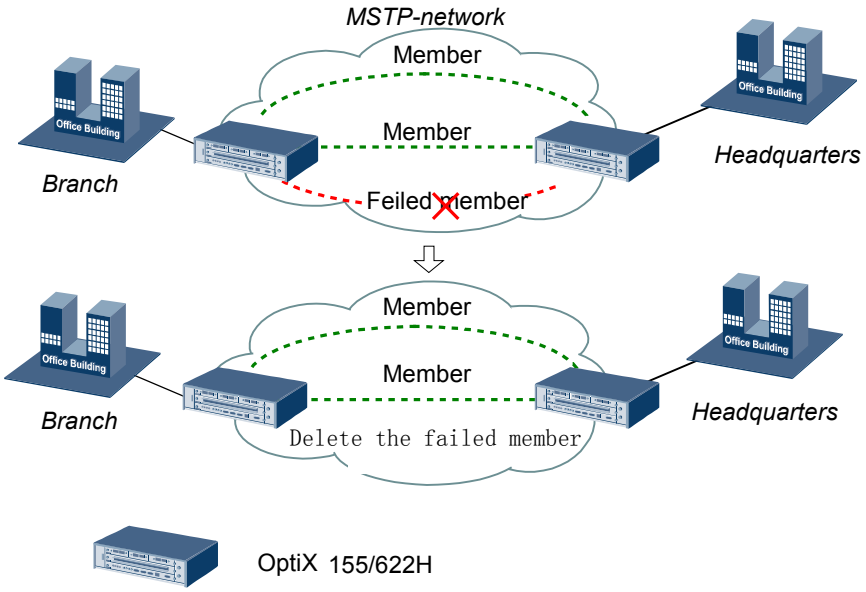
As shown in **Figure 5-7**, LCAS can dynamically add or delete members according to the requirements, and can thus dynamically increase or decrease the bandwidth. Services are not interrupted during the bandwidth adjustment.

Figure 5-7 Dynamic bandwidth adjustment by using LCAS



As shown in **Figure 5-8**, LCAS protects the Ethernet services. When certain members fail, they are automatically deleted, whereas other members transmit data normally. This ensures that the concatenation group is available. When the failed members are available again, they are automatically restored and data is loaded to these members again.

Figure 5-8 Protection for the virtual concatenation group through LCAS



For more details on LCAS, see LCAS in the *Feature Description* of this product.

STP/RSTP

The Ethernet board supports STP and RSTP. When STP or RSTP is enabled, the network topology is modified logically to prevent a broadcast storm. STP or RSTP realizes link protection by restructuring the topology.

For more details on STP and RSTP, see STP and RSTP in the *Feature Description* of this product.

LPT

LPT is a link-based protection scheme. In a network, when the active and standby ports between routers belong to different links, the LPT function is available for protection. When the working link becomes faulty, the LPT function is used to shut down the local port so that the peer router is informed of the abnormality of the working link. Hence, services are switched from the active port to the standby port and the services are protected.

The LPT function has two modes, point-to-point (P2P) and point-to-multipoint (P2MP).

For more details on LPT, see LPT in the *Feature Description* of this product.

LAG

LAG means that multiple links connecting to the same device are bound to increase the bandwidth and enhance the link reliability. The aggregated links can be regarded as one link. The features of LAG are as follows:

- Improving the link availability

  In an LAG, the LAG members back up each other dynamically. When a link is interrupted, another LAG member can take over its work immediately.
- Increasing the link bandwidth

  LAG provides an economical method for you to improve the link transmission rate. By binding multiple physical links, you can obtain a data link with higher bandwidth without upgrading the existing equipment. The total bandwidth of the link after aggregation is the sum of the bandwidth of the physical links.
  - Load sharing: The physical links of the same group can share the data traffic and back up each other.
  - Higher reliability: The members of the same group back up each other dynamically.

MSP and SNCP

MSP enables the signal between and including two multiplex section terminations (MSTs) to switch from the working section over to the protection section.

The principle of SNCP is "dual transmission and selective reception". The service receiver selects the better service from the two service sources sent by the service sender.

The Ethernet services support MSP and SNCP at the optical transmission layer.

5.2 ATM Features

This topic describes the functions, application, and protection of the ATM features of the OptiX 155/622H.

5.2.1 Functions

The OptiX 155/622H provides two types of ATM processing boards: AIUD and AIUQ.

The AIUD board can access and process two STM-1 ATM services and the AIUQ board can access and process four STM-1 ATM services.

Table 5-3 lists the functions of the AIUD and AIUQ boards.

Table 5-3 Functions of the AIUD and AIUQ boards

Item	AIUD	AIUQ
Interface on the front panel	2xSTM-1	4xSTM-1
Optical interface type	Ie-1, S-1.1, L-1.1, L-1.2, and Ve-1.2	Ie-1, S-1.1, L-1.1, L-1.2, and Ve-1.2
Type of connector	LC	
Optical module type	SFP	
Mapping mode	VC-3 and VC-4	
Service type	CBR, rt-VBR, nrt-VBR, and UBR	
Traffic type and QoS	IETF RFC2514 and ATM forum TM 4.0	
ATM multicast connection	Spatial multicast and logical multicast	
ATM protection (ITU-T I.630)	Unidirectional or bidirectional 1+1, 1:1, VP-Ring, and VC-Ring	
OAM function (ITU-T I.610)	AIS, RDI, loopback (LB), and Continuity check (CC)	

5.2.2 Application

The OptiX 155/622H supports the application of several types of ATM services.

Supported Service Types and Traffic Types

- The CBR service applies to the voice service, and the video service and circuit emulation service of a constant bit rate. These services require guaranteed transmission bandwidth and latency.
- The rt-VBR service applies to the audio and video service of a variable rate.
- The nrt-VBR service is mainly used for data transmission.
- The UBR service is generally used for LAN emulation and file transfer.

The service types and traffic types supported by the OptiX 155/622H meet the requirements specified in IETF RFC 2514, ATM Forum TM 4.0, and ATM Forum UNT 3.1. For more details, see **Table 5-4**.

Table 5-4 ATM service types and traffic types

No.	Traffic Type	Service Type	Parameter
1	atmNoTrafficDescriptor	UBR	-
2	atmNoClpNoScr	UBR.1	Clp01Pcr
		CBR	Clp01Pcr
3	atmClpNoTaggingNoScr	CBR	Clp01Pcr, Clp0Pcr
4	atmClpTaggingNoScr	CBR	Clp01Pcr, Clp0Pcr
5	atmNoClpScr	nrt-VBR.1	Clp01Pcr, Clp01Scr, Mbs
6	atmClpNoTaggingScr	nrt-VBR.2	Clp01Pcr, Clp0Scr, Mbs
7	atmClpTaggingScr	nrt-VBR.3	Clp01Pcr, Clp0Scr, Mbs
8	atmClpTransparentNoScr	CBR.1	Clp01Pcr, Cdvt
9	atmClpTransparentScr	rt-VBR.1	Clp01Pcr, Clp01Scr, Mbs, Cdvt
10	atmNoClpTaggingNoScr	UBR.2	Clp01Pcr, Cdvt
11	atmNoClpNoScrCdvt	UBR	Clp01Pcr, Cdvt
		CBR	Clp01Pcr, Cdvt
12	atmNoClpScrCdvt	rt-VBR.1	Clp01Pcr, Clp01Scr, Mbs, Cdvt
13	atmClpNoTaggingScrCdvt	rt-VBR.2	Clp01Pcr, Clp0Scr, Mbs, Cdvt
14	atmClpTaggingScrCdvt	rt-VBR.3	Clp01Pcr, Clp0Scr, Mbs, Cdvt

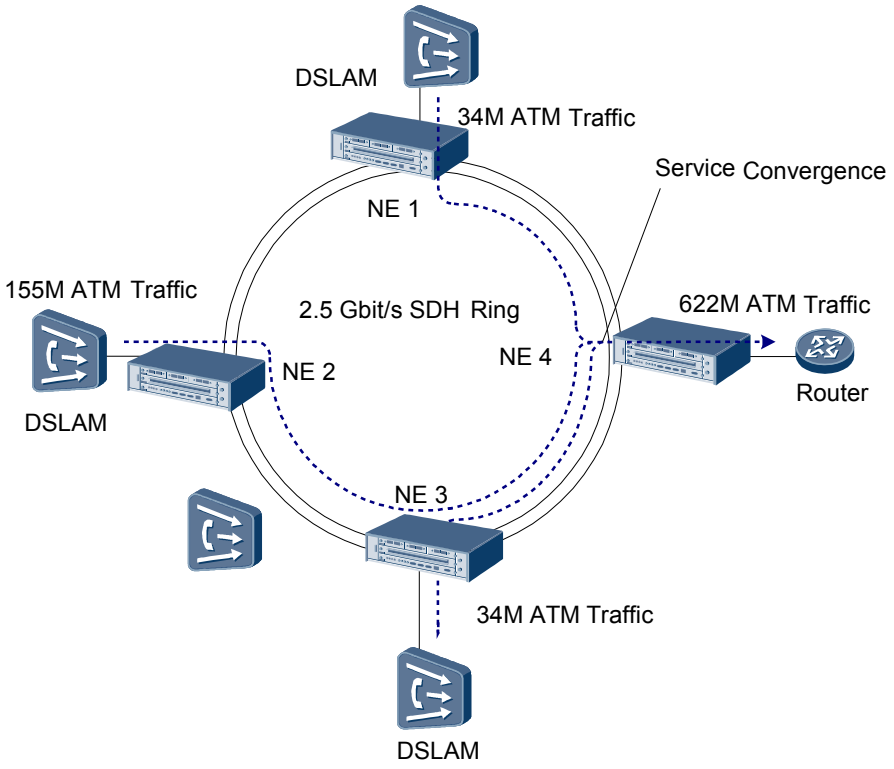
Application of Bandwidth-Exclusive ATM Services

When the bandwidth is not shared, ATM services are processed by the ATM service processing boards at the ATM layer of only the source NE and sink NE. On intermediate NEs, only the SDH timeslot pass-through is performed for these ATM services, without ATM layer processing.

In this case, each ATM service exclusively occupies a VC-3 or VC-4 path. At the central node, the ATM services are converged to an STM-1 or STM-4 optical port for output.

As shown in **Figure 5-9**, the 34 Mbit/s ATM services of NE1 and NE3 exclusively occupy a VC-3 bandwidth each. The 155 Mbit/s ATM service of NE2 exclusively occupies a VC-4 bandwidth. Only the SDH timeslot pass-through is performed at NE3. After the three services reach the central station NE4, they are converged by the ATM board and are output through the 622 Mbit/s optical port.

Figure 5-9 Application of bandwidth-exclusive ATM services

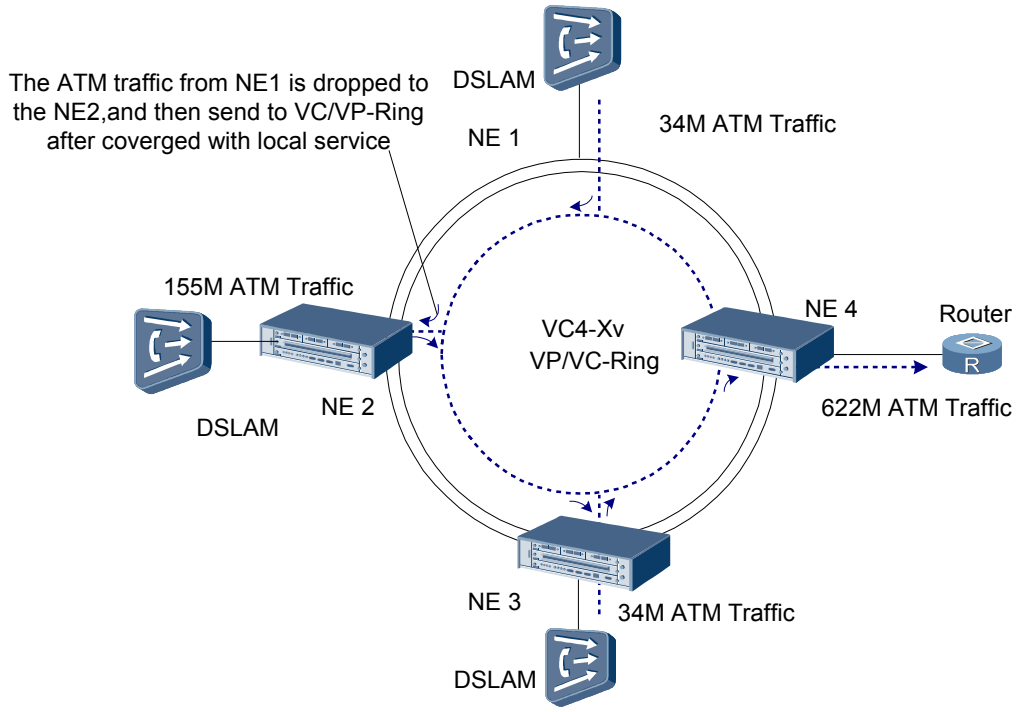


Application of Bandwidth-Shared ATM Services

The VP-Ring and VC-Ring realize the bandwidth sharing and the statistical multiplexing for ATM services. The ATM services on each NE share the same VC (VC-3, VC-4, or VC-4-xv) path and are processed at the ATM layer of all NEs.

As shown in **Figure 5-10**, NE1 accesses E3 ATM services from the tributary board and sends these services to the ATM board for ATM switching and protection configuration (1+1 or 1:1). Then, after these services are encapsulated into VC-4-xv, they are sent to the line by the cross-connect board. NE2 accesses STM-1 ATM services from the optical port, and then performs the ATM switching and protection configuration. At the same time, the ATM services from NE1 are dropped at NE2 for the processing at ATM layer. Then, the locally accessed services and the services from the upstream NE are encapsulated into the same VC-4-xv and sent to the downstream NE. The processing at NE3 and NE4 is similar. One VP-Ring or VC-Ring has a maximum bandwidth of 300 Mbit/s.

Figure 5-10 VP/VC-Ring



5.2.3 Protection

The ATM services of the OptiX 155/622H are protected at several layers.

The available protection schemes are as follows:

- Protection schemes at the ATM layer
- Protection schemes at the optical transmission layer, such as MSP and SNCP

Protection Schemes at the ATM Layer

Compliant with ITU-T I.630, protection schemes at the ATM layer are classified in different ways. For more details, see **Table 5-5**. You can select a combination of the following types according to the requirement, for example, 1+1 bidirectional non-revertive protection.

Table 5-5 Classification of ATM protection schemes

Item	Protection Type	
Classification Scheme	1+1 protection	1:1 protection
Switching direction	Unidirectional protection	Bidirectional protection
Connection level	VPC protection	VCC protection
Protection domain	Trail protection	Sub-Network Connection Protection (SNCP)

Item	Protection Type	
Revertive mode	Revertive	Non-revertive
Protected Object	Single connection protection	Group connection protection

Protection Schemes at the Optical Transmission Layer

The ATM service is also protected by the self-healing network at the optical transmission layer, where MSP and SNCP are available. You can set the hold-off time of for the ATM protection switching. When the network impairment occurs, the MSP or SNCP switching at the optical transmission layer can be triggered first. This realizes the protection for the working ATM service (in this case, the protection switching at the ATM layer is not triggered.)

5.3 DDN Features

This topic describes the functions and application of the DDN features of the OptiX 155/622H.

5.3.1 Functions

The OptiX 155/622H uses the N64, N64Q, and FP2D boards to access and process DDN services.

- The N64 board provides two V.35/V.21/RS-449/EIA-530 interfaces and two Framed E1 interfaces.
- The N64Q board provides four V.35/X.24/RS-449/V.24/RS-530/RS-530A interfaces.
- The FP2D board accesses 16 Framed E1 signals and provides time division cross-connect services at the 64 kbit/s level.

Table 5-6 lists the functions of the N64, N64Q, and FP2D boards.

Table 5-6 Functions of the N64, N64Q, and FP2D boards

Board Feature	N64	N64Q	FP2D
Processing capability	Performs timeslot cross-connection for two NM or two monitoring signals (at Nx64 kbit/s), and E1 services (two E1 signals from the interface side or eight E1 signals from the line side), thus realizing re-integration of E1 services and timeslot extraction.	Converts four Nx64 kbit/s service signals into E1 signals and performs timeslot cross-connection, thus realizing re-integration of E1 services and timeslot extraction.	Accesses 16 Framed E1 signals and provides time division cross-connect services at the 64 kbit/s level.
Interface specification	Nx64 kbit/s interface: V.35/V.24/X.21/RS-449/EIA-530 Framed E1 interface: CRC4 and non-CRC4	Nx64 kbit/s interface: V.35/X.21/RS-449/V.24/RS-530/RS-530A	Framed E1 interface: CRC4 and non-CRC4
Type of connector	2 mm HM	2 mm HM	DB78
Protection	Not supported	Not supported	Not supported
Loopback	Supports inloop and outloop for all ports.	Supports inloop and outloop for all ports.	Supports inloop and outloop for all ports.
Alarm and performance event	Provides abundant alarms and performance events, which facilitate management and maintenance for the equipment.	Provides abundant alarms and performance events, which facilitates management and maintenance for the equipment.	Provides abundant alarms and performance events, which facilitates management and maintenance for the equipment.

5.3.2 Application

When the DDN board is configured in the OptiX 155/622H, the SDH network can access and groom DDN services.

The N64 and N64Q boards mainly apply to point-to-point, point-to-multipoint, and multipoint-to-multipoint transmission of the video conference system and routers, and convergence in the case of multi-point routers access, thus realizing the accessing of the V.35/V.24/X.21/RS-449/EIA-530 multi-protocol interface services and Framed E1 services into transmission networks.

The FP2D board is applicable to the DDN private networks of small and medium-sized enterprises, government departments, banks, or security business halls.

5.3.3 Protection

The OptiX 155/622H provides the MSP and SNCP protection schemes on the SDH side.

6 Protection

About This Chapter

This topic describes the comprehensive protection mechanism of the OptiX 155/622H in terms of equipment-level protection, network-level protection, and clock protection.

6.1 Equipment-Level Protection

The OptiX 155/622H supports the following equipment-level protection schemes: 1+1 hot backup for the power input unit and board protection in case of abnormality.

6.1.1 1+1 Hot Backup for the Power Input Unit

The POI/POU board of the OptiX 155/622H inputs two channels of –48 V/–60 V DC power supply at the same time. These two channels of power supply share the load in normal cases. If one of them fails, the other power supply takes over the load to ensure that the equipment is operating normally.

6.1.2 Board Protection Schemes Under Abnormal Conditions

The protection schemes under abnormal conditions include power failure protection during software loading, overvoltage and undervoltage protection for the power supply, and software upgrading protection.

Power Failure Protection During Software Loading

The verification function is provided for applications and data. If the software loading is interrupted, the basic input/output system (BIOS) does not boot the application or data that is not successfully loaded. Instead, the BIOS waits for the loading until the software is successfully loaded.

Overvoltage and Undervoltage Protection for the Power Supply

The power board provides the lightning protection component to effectively protect the board from being damaged by transient high voltages (such as lightning). When the voltage is too low, the central processing unit (CPU) of the board is automatically reset and then the software can re-initialize the chip.

Software Upgrading Protection

As two sets of NE software are stored in the SCB board, the software of a new version can be loaded without affecting the currently running software. The software of a new version replaces the previous version after it is confirmed to be correct. This replacement does not affect the configuration information that is already set or the existing services on the NE. The software of a previous version can continue to function if software upgrading fails.

6.2 Network-Level Protection

The network-level protection includes SDH service protection, Ethernet service protection, and ATM service protection.

6.2.1 SDH Service Protection

The OptiX 155/622H supports the linear MSP, ring MSP, SNCP, inter-ring service protection, and fiber-shared virtual trail protection for SDH services.

Linear MSP

The linear MSP is mainly used in a chain network. The OptiX 155/622H supports the 1+1 and 1:N (N≤5) protection schemes. If the 1:N protection scheme is used, extra services can be transmitted on the protection system. The switching time of the linear MSP is less than 50 ms, which complies with ITU-T G.841.

MSP Ring

The OptiX 155/622H supports the two-fiber MS shared protection ring, which complies with ITU-T G.841. The switching time is less than 50 ms.

SNCP

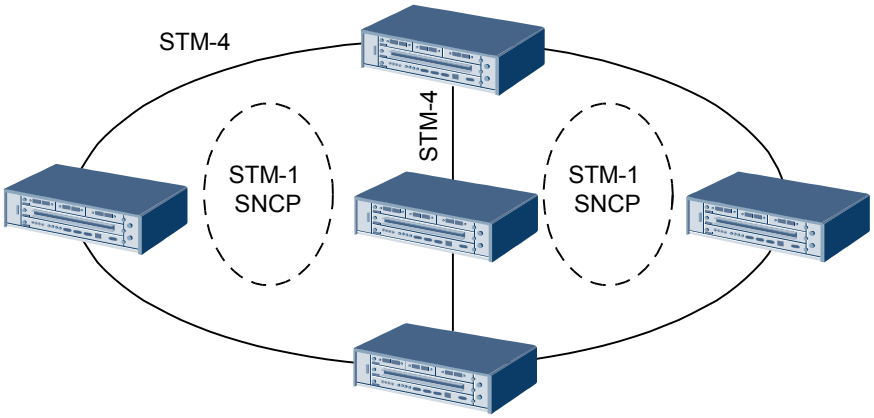
The OptiX 155/622H supports SNCP, which complies with ITU-T G.841. The OptiX 155/622H can still ensure a switching time that is less than 50 ms even when the switching of multiple services occurs.

Inter-Ring Service Protection

The OptiX 155/622H provides protection for services between rings that use different protection schemes (for example, between an SNCP ring and an MSP ring). This protection scheme complies with ITU-T G.842.

Fiber-Shared Virtual Trail Protection

Figure 6-1 Fiber-shared virtual trail protection



As shown in **Figure 6-1**, when the fiber-shared virtual trail protection is used, an STM-4 is logically divided into several lower order or higher order paths. These paths are connected to other links to form rings at the path layer. In addition, protection schemes, such as SNCP, can be configured accordingly for these rings at the path layer.

6.2.2 Ethernet Service Protection

The OptiX 155/622H provides hierarchical protection for data services. It supports various protection schemes at the Ethernet service layer and the SDH layer.

6.2.3 ATM Service Protection

The OptiX 155/622H supports the VP/VC connection-based 1+1/1:1 protection. When this protection scheme is used, eight configuration modes are available.

7 Maintenance and Management

About This Chapter

This topic describes the maintenance and network management capabilities of the OptiX 155/622H.

7.1 Equipment Maintenance

The OptiX 155/622H provides powerful maintenance functions.

The maintenance functions are as follows:

- The SCB board provides audible and visual alarms in case of emergency, thus assisting the network administrator in taking prompt measures.
- Provides the alarm input and output function, thus facilitating the collection of equipment alarms.
- The running status indicator and alarm indicator are available on each board, thus assisting the administrator in locating and handling faults promptly.
- Provides automatic shutdown function of the SDH single-mode optical interface.
- Provides the orderwire function for management personnel at different stations to communicate with each other.
- Dynamically monitors the equipment operation and alarm status of all stations in the network on the T2000.
- Supports the in-service upgrading and loading of the board software and NE software. The equipment also supports the remote loading of the board software and field programmable gate array (FPGA) with the error-loading-proof and resumable loading functions.
- Provides the remote maintenance function. In case of an equipment fault, the maintenance personnel can remotely maintain the equipment through the public telephone network.
- The PDH processing boards support the pseudo-random binary sequence (PRBS) test function, which can be used to remotely test bit errors.
- The service boards support inloop and outloop on ports.
- Provides the network time protocol (NTP) function to realize synchronization among NEs.
- Provides the Ethernet OAM function which complies with the IEEE 802.1ag and IEEE 802.3ah standards.
- The T2000 supports the fiber auto-discovery function.
- The T2000 supports the 2M PRBS test function.
- The T2000 can display the interface impedance.
- Supports centralized equipment management through the software. After the board is powered on, the board version matching is performed automatically.
- Provides the press-to-collect function for collecting fault data, which shortens the data collection time before the service recovery. You can collect the fault data selectively according to the actual conditions and can stop the collection process.
- Supports the loopback configuration on the port during the power-on process of the equipment, which meets the test requirement of one-time visit to the site.
- Supports the simulation package loading and simulation package diffusion functions.

7.2 Equipment Management

The OptiX 155/622H is uniformly managed by the T2000. Through the Qx interface or the human-machine language (MML) interface, the T2000 can manage the optical transmission system in the following aspects: faults, performance, configuration, and security. In addition,

the T2000 can also maintain and test the optical transmission system. The T2000 improves the quality of network services, reduces maintenance costs and ensures reasonable utilization of network resources.

8 Technical Specifications

About This Chapter

This topic provides the specifications related to the OptiX 155/622H.

8.1 General Specifications of the Equipment
The general specifications of the equipment include the system specifications, transmission performance, and protection performance.

8.2 Specifications of Optical Interfaces
The specifications of optical interfaces include the specifications of SDH optical interfaces and specifications of Ethernet optical interfaces.

8.3 Specifications of the Electrical Interface
The OptiX 155/622H supports the PDH electrical interface, DDN interface, 64 kbit/s interface, RS-232 interface, RS-422 interface, and orderwire interface.

8.4 Specifications of Ethernet Features
This topic provides the specifications for testing Ethernet features.

8.5 Specifications of Clock Timing and Synchronization
The specifications of clock timing and synchronization mainly include the output jitter, output frequency accuracy of the internal oscillator in the free-run mode, and long-term phase variation.

8.6 Safety Certification
The OptiX 155/622H has passed related safety certifications, such as EMC.

8.7 Requirements for the Environment
The OptiX 155/622H has different requirements for the environments for storage, transportation, and operation. This topic describes the requirements for these three types of environments.

8.8 Power Consumption and Weight of Each Board
This appendix provides the power consumption and weight of each board.

8.1 General Specifications of the Equipment

The general specifications of the equipment include the system specifications, transmission performance, and protection performance.

8.1.1 System Specifications

The system specifications of the OptiX 155/622H include the weight, dimensions, and power consumption.

Table 8-1 provides the weight, dimensions, and power consumption of the OptiX 155/622H.

Table 8-1 Weight, dimensions and power consumption

Equipment Name	Maximum Power Consumption	Maximum Weight	Dimensions
OptiX 155/622H	100 W	10 kg	436 mm (W) x 293 mm (D) x 86 mm (H)

NOTE

If the power consumption of the hardware configuration exceeds 100 W, the system may become unstable.

8.1.2 Transmission Performance

The transmission performance complies with ITU-T Recommendations.

Table 8-2 lists the transmission performance.

Table 8-2 Transmission performance

Performance	Description
Jitter at STM-N interface	Compliant with ITU-T G.813/G.825
Jitter at PDH interface	Compliant with ITU-T G.823/G.783
Bit error	Compliant with ITU-T G.826

8.1.3 Protection Performance

The protection performance complies with the ITU-T G.841 requirements.

Linear MSP

Table 8-3 lists the linear MSP parameters.

Table 8-3 Linear MSP parameters

Protection Type	Revertive Mode	Switching Protocol	Switching Time	Default WTR Time	Switching Condition
1+1 single-ended switching	Non-revertive	Not required	≤ 50 ms	-	Any of the following conditions triggers the switching: ● R_LOS ● R_LOC ● R_LOF ● MS_AIS ● B2_EXC ● B2_SD (optional) ● Forced switching ● Manual switching ● Exercise switching
1+1 single-ended switching	Revertive	Not required	≤ 50 ms	600s	
1+1 dual-ended switching	Non-revertive	APS protocol	≤ 50 ms	-	
1+1 dual-ended switching	Revertive	APS protocol	≤ 50 ms	600s	
1:N dual-ended switching	Revertive	APS protocol	≤ 50 ms	600s	

MSP Ring

Table 8-4 lists the MSP ring parameters.

Table 8-4 MSP ring parameters

Protection Type	Revertive Mode	Switching Protocol	Switching Mode	Switching Time	Default WTR Time	Switching Condition
Two-fiber bidirectional MSP	Revertive	APS protocol	• Forced switching • Manual switching • Exercise switching	≤ 50 ms	600s	Any of the following conditions triggers the switching: • R_LOS • R_LOC • R_LOF • MS_AIS • B2_EXC • B2_SD • Forced switching • Manual switching • Exercise switching
Two-fiber unidirectional MSP	Revertive	APS protocol	• Forced switching • Manual switching • Exercise switching	≤ 50 ms	600s	

SNCP

Table 8-5 lists the SNCP parameters.

Table 8-5 SNCP parameters

Protection Type	Revertive Mode	Switching Time	Default WTR Time	Switching Conditions
SNCP	Revertive	≤50 ms	600s	Any of the following alarms triggers the switching of VC4 level SNCP: • R_LOS • R_LOF • R_LOC • MS_AIS • B2_EXC • AU_AIS • AU_LOP • B3_EXC (Optional) • B3_SD (Optional)

Protection Type	Revertive Mode	Switching Time	Default WTR Time	Switching Conditions
	Non-revertive	≤50 ms	-	• HP_UNEQ (Optional) • HP_TIM (Optional) Any of the following alarms triggers the switching of VC3 level SNCP: • TU_LOP • TU_AIS • B3_EXC (Optional) • B3_SD (Optional) Any of the following alarms triggers the switching of VC12 level SNCP: • TU_LOP • TU_AIS • BIP_EXC (Optional) • BIP_SD (Optional)

8.1.4 Environmental Specifications

The equipment requires proper environment for normal operation.

The equipment can operate normally in the long term in the environment defined in **Table 8-6**.

Table 8-6 Environment specifications for long-term operation

Specifications	Description
Altitude	≤ 4000 m
Air pressure	70 kPa to 106 kPa

Specifications	Description
Temperature	0°C to 45°C
Relative humidity	10% to 90%
Anti-seismic performance	Compliant with ETS300-019-2-3-AMD

8.1.5 Electromagnetic Compatibility

The OptiX 155/622H is designed in accordance with the ETS 300 386 and ETS 300 127 standards stipulated by the ETSI. The equipment has passed the electromagnetic compatibility (EMC) related tests.

Table 8-7 lists the specifications of the electromagnetic compatibility test for the OptiX 155/622H.

Table 8-7 Specifications of the electromagnetic compatibility test

Test Item	Standard Compliance
Conducted emission	EN55022
Electrostatic discharge	EN61000-4-2
Inject current immunity	ENV50141
Immunity to radiated electrostatic fields	ENV50140

8.2 Specifications of Optical Interfaces

The specifications of optical interfaces include the specifications of SDH optical interfaces and specifications of Ethernet optical interfaces.

8.2.1 SDH Optical Interface
The specifications of the optical interface include the specifications of STM-1, STM-4, and STM-16 optical interfaces, permitted frequency deviation at the optical input interface, and bit error tolerance at the optical output interface.

8.2.2 Ethernet Optical Interface
The specifications of the Ethernet optical interface refers to the specifications of the optical interface on the Ethernet board.

8.2.1 SDH Optical Interface

The specifications of the optical interface include the specifications of STM-1, STM-4, and STM-16 optical interfaces, permitted frequency deviation at the optical input interface, and bit error tolerance at the optical output interface.

Specifications of the STM-1 Optical Interface

Table 8-8 lists the specifications of the STM-1 optical interface on the OptiX 155/622H.

Table 8-8 Specifications of the STM-1 optical interface

Item	Unit	Value			
Nominal bit rate	kbit/s	155520			
Type of optical interface	-	Ie-1	S-1.1	L-1.1	L-1.2
Operating wavelength range	nm	1261 to 1360	1261 to 1360	1280 to 1335	1480 to 1580
Type of optical fiber	-	Multi-mode SC	Single-mode SC/LC		
Maximum RMS spectral width (σ)	nm	80	7.7	3	-
Maximum –20 dB spectral width	nm	-	-	-	1
Minimum side mode suppression ratio	dB	-	-	-	30
Maximum mean launched power	dBm	–14	–8	0	0
Minimum mean launched power	dBm	–19	–15	–5	–5
Minimum extinction ratio	dB	8.2	8.2	10	10
Attenuation range	dB	0 to 7	0 to 12	10 to 28	10 to 28
Maximum dispersion	ps/nm	25	96	246	-
Minimum optical return loss of cable at S (including any connectors)	dB	-	-	-	20
Maximum discrete reflectance between S and R	dB	-	-	-	–25
Minimum sensitivity	dBm	–23	–28	–34	–34
Minimum overload	dBm	–14	–8	–3	0
Maximum optical path penalty	dB	1	1	1	1

Item	Unit	Value			
Maximum reflectance of receiver at R	dB	-	-	-	–25

Specifications of the STM-4 Optical Interface

Table 8-9 lists the specifications of the STM-4 optical interface on the OptiX 155/622H.

Table 8-9 Specifications of the STM-4 optical interface

Item	Unit	Value			
Nominal bit rate	kbit/s	622080			
Type of optical interface	-	Ie-4	S-4.1	L-4.1	L-4.2
Operating wavelength range	nm	1261 to 1360	1293 to 1334/1274 to 1356	1300 to 1325/1296 to 1300	1480 to 1580
Type of optical fiber	-	Multi-mode SC	Single-mode SC/LC		
Maximum RMS spectral width (σ)	nm	14.5	4/2.5	2.0/1.7	-
Maximum –20 dB spectral width	nm	-	-	-	< 1
Minimum side mode suppression ratio	dB	-	-	-	30
Maximum mean launched power	dBm	–8	–8	2	2
Minimum mean launched power	dBm	–15	–15	–3	–3
Minimum extinction ratio	dB	8.2	8.2	10	10
Attenuation range	dB	0 to 7	0 to 12	10 to 24	10 to 24
Maximum dispersion	ps/nm	13	46/74	92/109	2400
Minimum optical return loss of cable at S (including any connectors)	dB	-	-	20	24

Item	Unit	Value			
Maximum discrete reflectance between S and R	dB	-	-	–25	–27
Minimum sensitivity	dm	–23	–28	–28	–28
Minimum overload	dBm	–8	–8	–8	–8
Maximum optical path penalty	dB	1	1	1	1
Maximum reflectance of receiver at R	dB	-	-	–14	–27

Specifications of the STM-16 Optical Interface

Table 8-10 lists the specifications of the STM-16 optical interface on the OptiX 155/622H.

Table 8-10 Specifications of the STM-16 optical interface

Item	Unit	Value
Nominal bit rate	kbit/s	2666057
Type of optical interface	-	S-16.1
Transmission distance	km	2 to 25
Operating wavelength range	nm	1260 to 1360
Type of optical fiber	-	Single-mode LC
Mean launched power	dBm	–5 to 0
Receiver minimum sensitivity	dBm	–18
Minimum overload	dBm	0
Minimum extinction ratio	dB	8.2

Permitted Frequency Deviation at the Optical Input Interface

Table 8-11 lists the permitted frequency deviation at the optical input interface on the OptiX 155/622H.

Table 8-11 Permitted frequency deviation at the optical input interface

Item	Value		
Rate level of the optical interface	STM-1	STM-4	STM-16
Standard specification (ppm)	±20	±20	±20

Bit Rate Error Tolerance at the Optical Output Interface

Table 8-12 lists the bit rate error tolerance at the optical output interface on the OptiX 155/622H.

Table 8-12 Bit rate error tolerance at the optical output interface

Item	Value		
Rate level of the optical interface	STM-1	STM-4	STM-16
Standard specification (ppm)	±20	±20	±20

8.2.2 Ethernet Optical Interface

The specifications of the Ethernet optical interface refers to the specifications of the optical interface on the Ethernet board.

Specifications of the Ethernet Optical Interface

Table 8-13 lists the specifications of the optical interface on the EGS/EGT board. Table 8-14 lists the specifications of the optical interface on the ELT2 board.

Table 8-13 Specifications of the optical interface on the EGS/EGT board

Item	Value	
Interface type	1000BASE-SX	1000BASE-LX
Launched optical power (dBm)	–9.5 to –4	–11.5 to –3
Central wavelength (nm)	770 to 860	1270 to 1355
Overload optical power (dBm)	0	–3
Receiver sensitivity (dBm)	–17	–19
Extinction ratio (dB)	9	9

Table 8-14 Specifications of the optical interface on the ELT2 board

Item	Value	
Interface type	100BASE-SX, long-haul	100BASE-SX, short-haul
Type of optical fiber	Single-mode LC	Multi-mode LC
Launched optical power (dBm)	–15 to –8	–19 to –14
Receiver sensitivity (dBm)	–36	–32
Transmission distance (km)	15	2

8.3 Specifications of the Electrical Interface

The OptiX 155/622H supports the PDH electrical interface, DDN interface, 64 kbit/s interface, RS-232 interface, RS-422 interface, and orderwire interface.

8.3.1 PDH Electrical Interface
The specifications of the electrical interface include the bit rate error tolerance at the electrical output interface, permitted attenuation at the electrical input interface, permitted frequency deviation at the electrical input interface, and anti-interference capability of the electrical input interface.

8.3.2 DDN Interface
The OptiX 155/622H supports DDN interfaces.

8.3.3 64 kbit/s Interface
The specifications of the 64 kbit/s interface comply with ITU-T G.703.

8.3.4 RS-232 Interface
The specifications of the RS-232 interface comply with EIA RS-232.

8.3.5 RS-422 Interface
The specifications of the RS-422 interface comply with EIA RS-422.

8.3.6 Orderwire Interface
The specifications of the orderwire interface comply with ITU-T Recommendations.

8.3.1 PDH Electrical Interface

The specifications of the electrical interface include the bit rate error tolerance at the electrical output interface, permitted attenuation at the electrical input interface, permitted frequency deviation at the electrical input interface, and anti-interference capability of the electrical input interface.

Bit Rate Error Tolerance at the Electrical Output Interface

Table 8-15 lists the bit rate error tolerance at the electrical output interface on the OptiX 155/622H.

Table 8-15 Bit rate error tolerance at the electrical output interface

Item	Value			
Interface type	1544 kbit/s	2048 kbit/s	34368 kbit/s	44736 kbit/s
Specification (ppm)	±32	±50	±20	±20

Permitted Attenuation at the Electrical Input Interface

Table 8-16 lists the permitted attenuation at the electrical input interface on the OptiX 155/622H.

Table 8-16 Permitted attenuation at the electrical input interface

Item	Value			
Interface type	1544 kbit/s	2048 kbit/s	34368 kbit/s	44736 kbit/s
Specification (dB)	Not specified	0 to 6	0 to 12	Not specified

Permitted Frequency Deviation at the Electrical Input Interface

Table 8-17 lists the permitted frequency deviation at the electrical input interface on the OptiX 155/622H.

Table 8-17 Permitted Frequency Deviation at the electrical input interface

Item	Value			
Interface type	1544 kbit/s	2048 kbit/s	34368 kbit/s	44736 kbit/s
Specification (ppm)	±50	±50	±20	±20

Anti-Interference Capability of the Electrical Input Interface

Table 8-18 lists the specifications of the anti-interference capability of the electrical input interface on the OptiX 155/622H.

Table 8-18 Anti-interference capability of the electrical input interface

Item	Value		
Interface type	2048 kbit/s	1544 kbit/s	34768 kbit/s
Specification (SNR)	≥ 18 dB	≥ 18 dB	≥ 20 dB

8.3.2 DDN Interface

The OptiX 155/622H supports DDN interfaces.

Table 8-19 lists the specifications of DDN interfaces.

Table 8-19 Specifications of DDN interfaces

Interface Type	Description	Standard
Framed E1 interface	Framed E1 signal	Physical and electrical characteristics comply with ITU-T G.703. The frame structure complies with ITU-T G.704.
Nx64 kbit/s interface	V.35 interface	Complies with ITU-T V.35.
	V.24 interface	Complies with ITU-T V.24.
	X.21 interface	Complies with ITU-T X.21.
	RS-449 interface	Complies with EIA RS-449 (RS-423A and RS-422A).
	RS-530 interface	Complies with EIA RS-530.
	RS-530A interface	Complies with EIA RS-530A.

8.3.3 64 kbit/s Interface

The specifications of the 64 kbit/s interface comply with ITU-T G.703.

Table 8-20 lists the specifications of the 64 kbit/s interface.

Table 8-20 Specifications of the 64 kbit/s interface

Specifications	Description
Bit rate	64 kbit/s
Timing signals	From RX
Coding style	Compliant with ITU-T G.703
Output pulse waveform	Compliant with ITU-T G.703
Output interface characteristics	Compliant with ITU-T G.703
Input interface characteristics	Compliant with ITU-T G.703

8.3.4 RS-232 Interface

The specifications of the RS-232 interface comply with EIA RS-232.

Table 8-21 lists the specifications of the RS-232 interface.

Table 8-21 Specifications of the RS-232 interface

Specifications	Description
Bit rate	≤19.2 kbit/s
Mode	RS-232 Tx & Rx data only
Electrical levels	±5 V to ±15 V

8.3.5 RS-422 Interface

The specifications of the RS-422 interface comply with EIA RS-422.

Table 8-22 lists the specifications of the RS-422 interface.

Table 8-22 Specifications of the RS-422 interface

Specifications	Description
Bit rate	≤19.2 kbit/s
Mode	RS-422 Tx & Rx data only
Electrical levels	±2.0 V

8.3.6 Orderwire Interface

The specifications of the orderwire interface comply with ITU-T Recommendations.

Table 8-23 list the specifications of the orderwire interface.

Table 8-23 Specifications of the orderwire interface

Specifications	Description
Speech channel interface	
Impedance	600 ohms
Bandwidth	300 Hz–3400 Hz
Operating current	18 mA
Input gain	–4/0/0 dB
Output gain	0/–7/0 dB
Signalling	DTMF complying with ITU-T Rec. Q.23
Analog EOW extension	
Impedance	600 ohms

Specifications	Description
Bandwidth	300 Hz–3400 Hz
Tx level	–3.5 dBr ± 1 dBr
Rx level	–3.5 dBr ± 1 dBr

8.4 Specifications of Ethernet Features

This topic provides the specifications for testing Ethernet features.

Table 8-24 and Table 8-25 list the test specifications of major Ethernet features.

Table 8-24 Test specifications of the single-port 10M bidirectional full-duplex feature

Item		Value						
Number of bound VC-12s		5	5	5	5	5	5	5
Packet length (byte)		64	128	256	512	1024	1280	1518
Test result	Throughput [a]	≥ 95%	≥ 95%	≥ 95%	≥ 95%	≥ 90%	≥ 90%	≥ 90%
	Delay[b]	≤ 500 μs	≤ 500 μs	≤ 500 μs	≤ 700 μs	≤ 700 μs	≤ 700 μs	≤ 700 μs
	Ratio of frame loss[c]	< 5%	< 5%	< 5%	< 10%	< 10%	< 10%	< 10%

Table 8-25 Test specifications of the single-port 100M bidirectional full-duplex feature

Item		Value						
Number of bound VC-12s		48	48	48	48	48	48	48
Packet length (byte)		64	128	256	512	1024	1280	1518
Test result	Throughput [a]	≥ 95%	≥ 95%	≥ 95%	≥ 90%	≥ 90%	≥ 90%	≥ 88%
	Delay[b]	≤ 500 μs	≤ 500 μs	≤ 500 μs	≤ 700 μs	≤ 700 μs	≤ 700 μs	≤ 700 μs
	Frame loss ratio[c]	< 5%	< 5%	< 5%	< 10%	< 10%	< 10%	< 12%

a: This refers to the maximum frame rate that the system can bear when no frames are lost.

b: This refers to the interval that begins when the last bit of the input frame enters the input port and ends when the first bit of the output frame appears at the output port.

c: This refers to the ratio of the frames that should be forwarded (but are not forwarded due to insufficient resources) to total frames when the interface rate is constant.

8.5 Specifications of Clock Timing and Synchronization

The specifications of clock timing and synchronization mainly include the output jitter, output frequency accuracy of the internal oscillator in the free-run mode, and long-term phase variation.

8.5.1 Clock Interface Specifications

The specifications of the clock interface comply with ITU-T G.703.

Table 8-26 lists the specifications of the clock interface.

Table 8-26 Specifications of the clock interface

Specifications	Description
Output frequency accuracy	Compliant with G.813
Output jitter	0.05 UIpp (the bandwidth of the test filter is 20 Hz–100 kHz.)

8.5.2 Timing and Synchronization Performance

The timing and synchronization performance complies with ITU-T G.813.

Table 8-27 lists the timing and synchronization performance.

Table 8-27 Timing and synchronization performance

Performance	Description
Output jitter	Compliant with ITU-T G. 813
Output frequency in free-run mode	Compliant with ITU-T G. 813
Long-term phase variation in locked mode	Compliant with ITU-T G. 813

8.6 Safety Certification

The OptiX 155/622H has passed related safety certifications, such as EMC.

Table 8-28 lists the safety certifications that the OptiX 155/622H has passed.

Table 8-28 Safety certifications

Item	Standard
Electromagnetic compatibility (EMC)	CISPR22 Class A CISPR24 EN55022 Class A EN50024 ETSI EN 300 386 Class A ETSI ES 201 468 CFR 47 FCC Part 15 Class A ICES 003 Class A AS/NZS CISPR22 Class A GB9254 Class A VCCI Class A
Safety	IEC 60950-1 IEC/EN41003 EN 60950-1 UL 60950-1 CSA C22.2 No 60950-1 AS/NZS 60950-1 BS EN 60950-1 IS 13252 GB4943
Laser safety	FDA rules 21 CFR 1040.10 and 1040.11 IEC60825-1 IEC60825-2 EN60825-1 EN60825-2 GB7247

Item	Standard
Health	ICNIRP Guideline 1999-519-EC EN 50385 OET Bulletin 65 IEEE Std C95.1
Environment protection	RoHS

8.7 Requirements for the Environment

The OptiX 155/622H has different requirements for the environments for storage, transportation, and operation. This topic describes the requirements for these three types of environments.

8.7.1 Environment for Storage
The OptiX 155/622H has various requirements on the environment for storage.

8.7.2 Environment for Transportation
The OptiX 155/622H has various requirements on the environment for transportation.

8.7.3 Environment for Operation
The OptiX 155/622H has various requirements on the environment for operation.

8.7.1 Environment for Storage

The OptiX 155/622H has various requirements on the environment for storage.

Climate

Table 8-29 lists the requirements on the climate for storage.

Table 8-29 Requirements on the climate for storage

Item	Range
Altitude	≤ 5000 m
Air pressure	70 kPa to 106 kPa
Temperature	–40°C to +70°C
Temperature change rate	≤ 1°C/min
Relative humidity	10% to 100%
Solar radiation	≤ 1120 W/s^2
Heat radiation	≤ 600 W/s^2
Wind speed	≤ 30 m/s

Biological Environment

- Avoid reproduction of microbes, such as eumycete and mycete.
- Protect the storage environment against rodents.

Air Cleanness

- The air must be free from explosive, electric-conductive, magnetic-conductive or corrosive dust.
- **Table 8-30** lists the density requirements on the mechanically active substances in the storage environment.
- **Table 8-31** lists the density requirements on the chemically active substances in the storage environment.

Table 8-30 Density requirements on the mechanically active substances in the storage environment

Mechanical Active Substance	Content
Suspending dust	≤ 5.00 mg/m^3
Precipitable dust	≤ 20.0 $mg/m^2.h$
Gravel	≤ 300 mg/m^3

Table 8-31 Density requirements on the chemically active substances in the storage environment

Chemical Active Substance	Content
SO_2	≤ 0.30 mg/m^3
H_2S	≤ 0.10 mg/m^3
NO_2	≤ 0.50 mg/m^3
NH_3	≤ 1.00 mg/m^3
Cl_2	≤ 0.10 mg/m^3
HCl	≤ 0.10 mg/m^3
HF	≤ 0.01 mg/m^3
O_3	≤ 0.05 mg/m^3

Mechanical Stress

Table 8-32 lists the requirements on the mechanical stress in the storage environment.

Table 8-32 Requirements on the mechanical stress in the storage environment

Item	Sub-Item	Range	
Sinusoidal vibration	Displacement	≤ 7.0 mm	-
	Acceleration	-	20.0 m/s^2
	Frequency range	2 Hz to 9 Hz	9 Hz to 200 Hz
Unsteady state impact	Impulse response spectrum II	250 m/s^2	
	Static load	≤ 5 kPa	

NOTE

The impulse response spectrum refers to the maximum response curve of the acceleration generated by the equipment under the specified impulse motivation.

Impulse response spectrum II indicates that the duration of half-sine impulse response spectrum is 6 ms.

Static load refers to the pressure from the top, which the equipment in package can bear in the normal pile-up mode.

8.7.2 Environment for Transportation

The OptiX 155/622H has various requirements on the environment for transportation.

Climate

Table 8-33 lists the requirements on the climate for transportation.

Table 8-33 Requirements on the climate for transportation

Item	Range
Altitude	≤ 5000 m
Air pressure	70 kPa to 106 kPa
Temperature	-40°C to +70°C
Temperature change rate	≤3°C/min
Relative humidity	10% to 100%
Solar radiation	≤ 1120 W/s^2
Heat radiation	≤ 600 W/s^2
Wind speed	≤ 30 m/s

Biological Environment

- Avoid reproduction of microbes, such as eumycete and mycete.
- Protect the transportation environment against rodents.

Air Cleanness

- The air must be free from explosive, electric-conductive, magnetic-conductive or corrosive dust.
- Table 8-34 lists the density requirements on the mechanically active substances in the transportation environment.
- Table 8-35 lists the density requirements on the chemically active substances in the transportation environment.

Table 8-34 Density requirements on the mechanically active substances in the transportation environment

Mechanical Active Substance	Content
Suspending dust	No requirement
Precipitable dust	≤ 3.0 $mg/m^2.h$
Gravel	≤ 100 mg/m^3

Table 8-35 Density requirements on the chemically active substances in the transportation environment

Chemical Active Substance	Content
SO_2	≤ 0.30 mg/m^3
H_2S	≤ 0.10 mg/m^3
NO_2	≤ 0.50 mg/m^3
NH_3	≤ 1.00 mg/m^3
Cl_2	≤ 0.10 mg/m^3
HCl	≤ 0.10 mg/m^3
HF	≤ 0.01 mg/m^3
O_3	≤ 0.05 mg/m^3

Mechanical Stress

Table 8-36 lists the requirements on the mechanical stress in the transportation environment.

Table 8-36 Requirements on the mechanical stress in the transportation environment

Item	Sub-Item	Range		
Sinusoidal vibration	Displacement	≤ 7.5 mm	-	-
	Acceleration	-	≤ 20.0 m/s^2	≤ 40.0 m/s^2
	Frequency range	2 Hz to 9 Hz	9 Hz to 200 Hz	200 Hz to 500 Hz
Random vibration	Acceleration spectral density	10 m^2/s^3	3 m^2/s^3	1m^2/s^3
	Frequency range	2 Hz to 9 Hz	9 Hz to 200 Hz	200 Hz to 500 Hz
Unsteady state impact	Impulse response spectrum II	300 m/s^2		
	Static load	≤ 10 kPa		

NOTE

The impulse response spectrum refers to the maximum response curve of the acceleration generated by the equipment under the specified impulse motivation.

Impulse response spectrum II indicates that the duration of half-sine impulse response spectrum is 6 ms.

Static load refers to the pressure from the top, which the equipment in package can bear in the normal pile-up mode.

8.7.3 Environment for Operation

The OptiX 155/622H has various requirements on the environment for operation.

Climate

The requirements on the climate for the operation of the OptiX 155/622H are as follows:

- **Table 8-37** lists the requirements on the temperature and relative humidity.
- **Table 8-38** lists other requirements on the climate.

Table 8-37 Requirements on the temperature and relative humidity

Equipment Name	Temperature		Relative Humidity	
	Long-Term Operation	Short-Term Operation	Long-Term Operation	Short-Term Operation
OptiX 155/622H	0°C to 45°C	–5°C to 55°C	10% to 90%	5% to 95%

Equipment Name	Temperature		Relative Humidity	
	Long-Term Operation	Short-Term Operation	Long-Term Operation	Short-Term Operation
NOTE The temperature and humidity values are tested in the place 1.5 m above the floor and 0.4 m in front of the equipment. Short-term operation means that the consecutive working time of the equipment does not exceed 96 hours, and the accumulated working time every year does not exceed 15 days.				

Table 8-38 Other requirements on the climate

Item	Range
Altitude	≤ 4000 m
Air pressure	70 kPa to 106 kPa
Temperature change rate	≤ 5°C /h
Solar radiation	≤ 700 W/s^2
Heat radiation	≤ 600 W/s^2
Wind speed	≤ 1 m/s

Biological Environment

- Avoid reproduction of microbe, such as eumycete and mycete.
- Protect the operation environment against rodents.

Air Cleanness

- The air must be free from explosive, electric-conductive, magnetic-conductive or corrosive dust.
- **Table 8-39** lists the density requirements on the mechanically active substances in the operation environment.
- **Table 8-40** lists the density requirements on the chemically active substances in the operation environment.

Table 8-39 Density requirements on the mechanically active substances in the operation environment

Mechanical Active Substance	Content
Dust particle	≤ 3 x 10^5/m^3

Mechanical Active Substance	Content
Suspending dust	≤ 0.4 mg/m^3
Precipitable dust	≤ 15 mg/m^2.h
Gravel	≤ 100 mg/m^3

Table 8-40 Density requirements on the chemically active substances in the operation environment

Chemical Active Substance	Content
SO_2	≤ 0.20 mg/m^3
H_2S	≤ 0.006 mg/m^3
NH_3	≤ 0.05 mg/m^3
Cl_2	≤ 0.01 mg/m^3
HCl	≤ 0.10 mg/m^3
HF	≤ 0.01 mg/m^3
O_3	≤ 0.005 mg/m^3
CO	≤ 5.0 mg/m^3

Mechanical Stress

Table 8-41 lists the requirements on the mechanical stress in the operation environment.

Table 8-41 Requirements on the mechanical stress in the operation environment

Item	Sub-Item	Range	
Sinusoidal vibration	Displacement	≤ 3.5 mm	-
	Acceleration	-	≤ 10.0 m/s^2
	Frequency range	2 Hz to 9 Hz	9 Hz to 200 Hz
Unsteady state impact	Impulse response spectrum II	≤ 100 m/s^2	
	Static load	0	

Item	Sub-Item	Range
NOTE The impulse response spectrum refers to the maximum response curve of the acceleration generated by the equipment under the specified impulse motivation. Impulse response spectrum II indicates that the duration of half-sine impulse response spectrum is 6 ms. Static load refers to the pressure from the top, which the equipment in package can bear in the normal pile-up mode.		

8.8 Power Consumption and Weight of Each Board

This appendix provides the power consumption and weight of each board.

Table 8-42 provides the power consumption and weight of each board of the OptiX 155/622H.

Table 8-42 Power consumption and weight of each board

Board	Power Consumption (W)	Weight (kg)
OI16D	-	-
OI4	11.5	0.2
OI4D	12.5	0.2
OI2S	10	0.21
OI2D	11	0.22
SL1O	14	0.66
SL1Q	9	0.6
SB2D	11	0.2
SB2L	10	0.2
SB2R	10	0.2
SLE	9	0.21
SDE	10	0.22
SP1S	3.95	0.21
SP1D	5	0.24
SP2D	5.4	0.25
PD2S	11	0.54
PD2D	14.5	0.66
PD2T	18.5	0.77

Board	Power Consumption (W)	Weight (kg)
SM1S	4	0.2
SM1D	4.5	0.22
PM2S	9	0.52
PM2D	10	0.64
PM2T	11	0.74
PE3S	8	0.28
PE3D	8	0.28
PE3T	8	0.28
PT3S	8	0.28
PT3D	8	0.28
PT3T	8	0.28
ET1	26.1	0.74
ET1O	26.1	0.74
ET1D	15	0.26
EF1	25	0.68
EFT	8	0.26
ELT2	9	0.22
EGT	18.3	0.2
EFS	30.9	0.26
EFS4	10	0.3
EFSC	22	0.6
EGS	17	0.3
AIUD	23	0.66
AIUQ	25	0.68
N64	4	0.22
N64Q	5	0.20
FP2D	8.4	0.25
SHLQ	15	0.24
TDA	12	0.7

Board	Power Consumption (W)	Weight (kg)
SCB	24	0.8
EMU	2.3	0.25
FAN	8.3	0.3
POI/POU	3.5	0.15

9 Standard Compliance

About This Chapter

This topic lists the standards that the OptiX 155/622H complies with.

9.1 ITU-T Recommendations

Table 9-1 ITU-T recommendations

Recommendation	Description
G.652	Characteristics of a single-mode optical fiber cable
G.655	Characteristics of a non-zero dispersion-shifted single-mode optical fiber and cable
G.661	Definition and test methods for the relevant generic parameters of optical fiber amplifiers
G.662	Generic characteristics of optical fiber amplifier devices and sub-systems
G.663	Application related aspects of optical fiber amplifier devices and sub-systems
G.671	Transmission characteristics of optical components and subsystems
G.692	Optical interfaces for multichannel systems with optical amplifiers
G.702	Digital hierarchy bit rates
G.703	Physical/electrical characteristic of hierarchical digital interfaces
G.704	Synchronous frame structures used at 1544, 6312, 2048, 8448 and 44736 kbit/s hierarchical levels
G.7041	Generic framing procedure (GFP)
G.7042	Link capacity adjustment scheme (LCAS)
G.707	Network node interface for the synchronous digital hierarchy (SDH)
G.709	Interfaces for the Optical Transport Network (OTN)
G.773	Protocol suites for Q-interfaces for management of transmission systems
G.774 1-5	Synchronous Digital Hierarchy (SDH) management information model for the network element view
G.775	Loss of signal (LOS) and alarm indication signal (AIS) defect detection and clearance criteria
G.783	Characteristics of Synchronous Digital Hierarchy (SDH) equipment functional blocks
G.784	Synchronous Digital Hierarchy (SDH) management
G.803	Architectures of transport networks based on the Synchronous Digital Hierarchy (SDH)
G.811	Timing characteristics of primary reference clocks

Recommendation	Description
G.812	Timing requirements of slave clocks suitable for use as node clocks in synchronization networks
G.813	Timing characteristics of SDH equipment slave clocks (SEC)
G.823	The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy
G.824	The control of jitter and wander within digital networks which are based on the 1544 kbit/s hierarchy
G.825	The control of jitter and wander within digital networks which are based on the Synchronous Digital Hierarchy (SDH)
G.826	Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate
G.831	Management capabilities of transport networks based on the Synchronous Digital Hierarchy (SDH)
G.841	Types and characteristics of SDH network protection architectures
G.842	Cooperation of the SDH network protection structures
G.957	Optical interfaces of equipments and systems relating to the synchronous digital hierarchy
G.958	Digital line systems based on the synchronous digital hierarchy for use on optical fiber cables
I.121	Broadband aspects of ISDN
I.150	B-ISDN asynchronous transfer mode functional characteristics
I.311	B-ISDN general network aspects.
I.321	B-ISDN operation and maintenance principles and functions
I.361	B-ISDN ATM layer specification
I.630	ATM protection switching
M.3010	Principles for a telecommunication management network
Q.811	Lower layer protocol profiles for the Q3-interface
Q.812	Upper layer protocol profiles for the Q3-interface
V.24	List of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE)
V.35	Data transmission at 48 kilobits per second using 60-108 kHz group band circuits
V.28	Electrical characteristics for unbalanced double-current interchange circuits

Recommendation	Description
X.21	Use on public data networks of Data Terminal Equipment (DTE) which is designed for interfacing to synchronous V-Series modems
X.86	Ethernet over LAPS

9.2 IEEE Standards

Table 9-2 IEEE standards

Standard	Description
IEEE 802.1ad	Virtual Bridged Local Area Networks–Amendment 4: Provider Bridges
IEEE 802.1ag	Connectivity Fault Management
IEEE 802.1d	Media Access Control (MAC) Bridges
IEEE 802.1q	Virtual bridged local area networks
IEEE 802.3	Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specification
IEEE 802.3ae	Media access control (MAC) parameters, physical Layer, and management parameters for 10 Gbit/s operation
IEEE 802.3ah	Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications
IEEE 802.3u	Media access control (MAC) parameters, physical Layer, medium attachment units, and repeater for 100 Mbit/s operation, type 100Base-T
IEEE 802.3x	Standards for local and metropolitan area networks: specification for 802.3 full duplex operation
IEEE 802.3z	Media access control (MAC) parameters, physical Layer, repeater and management parameters for 1000 Mbit/s operation
IEEE 1588	Defines precise synchronization of clocks in measurement and control systems implemented with technologies

9.3 IETF Standards

Table 9-3 IETF standards

Standard	Description
RFC 2615 (1999)	PPP (Point-to-Point Protocol) over SONET/SDH

Standard	Description
RFC 1662 (1994)	PPP in HDLC-like Framing
RFC 1661 (1994)	The Point-to-Point Protocol (PPP)
RFC 1990	The PPP Multilink Protocol (MP)
RFC 2514	Definitions of textual conventions and OBJECT-IDENTITIES for ATM management

9.4 Environmental Standards

Table 9-4 Environmental standards

Standard	Description
IEC 60068-2	Basic Environmental Testing Procedures
IEC 60068-3-3	Environmental testing–Part 3: Background information–Subpart 3: Guidance. Seismic test methods for equipments
IEC 60721-2-6	Environmental conditions appearing in nature–Earthquake vibration
IEC 60721-3-1	Classification of environmental conditions–Part 3: Classification of groups of environmental parameters and their severities–Section 1: Storage
IEC 60721-3-3	Classification of environmental conditions–Part 3: Classification of groups of environmental parameters and their severities–Section 3: Stationary use at weatherprotected locations
ETS 300 019-1-1	Weatherprotected, not temperature-controlled storage locations
ETS 300 019-1-3:	Partly temperature-controlled location
NEBS GR-63-CORE	Network Equipment-Building System (NEBS) Requirements: Physical Protection

9.5 Safety Compliance Standards

Table 9-5 Safety compliance standards

Standard	Description
EN60825-1	Information technology equipment–safety
EN60825-2	Information technology equipment–safety
IEC/EN/UL 60950-1	Safety of information technology equipment including electrical business equipment

Standard	Description
CSA C22.2 No. 60950-1	Safety of information technology equipment

9.6 Protection Standards

Table 9-6 Protection standards

Standard	Description
IEC/EN/UL 60950-1	Protection of structures against lightning
ITU-T K.11	Principles of protection against overvoltage and overcurrents

A Glossary

1

1PPS Pulse per second, which, strictly speaking, is not a time synchronization signal. This is because 1PPS provides only the "gauge" corresponding to the UTC second, but does not provide the information about the day, month, or year. Therefore, 1PPS is used as the reference for frequency synchronization. On certain occasions, 1PPS can also be used on other interfaces for high precision timing.

1:N protection A 1:N protection architecture has N normal traffic signals, N working SNCs/trails and one protection SNC/trail. It may have one extra traffic signal.

100base-TX Physical layer specification for a 100 Mbit/s CSMA/CD local area network over two pairs of category 5 unshielded twisted-pair (UTP) or shielded twisted-pair (STP) wire.

10BASE-T Physical layer specification for a 10 Mbit/s CSMA/CD local area network over two pairs of twisted-pair telephone wire.

19-inch cabinet A cabinet which is 19 inches in width and 600 mm in depth, complying with the standards of the IEC297.

A

administrator A user who has the authority to access all the Management Domains of the EMLCore product. He has access to the whole network and to all the management functions.

AIS Alarm Indication Signal. A signal sent downstream in a digital network if an upstream failure has been detected and persists for a certain time.

alarm correlation analysis A process wherein alarm is raised within five seconds after alarm 1 is raised, and alarm 2 complies with the conditions defined in the alarm correlation analysis rule. You can either suppress alarm 2 or raise its severity level according to the behavior defined in the alarm correlation rule.

alarm indication signal A code sent downstream in a digital network as an indication that an upstream failure has been detected. It is associated with multiple transport layers.

alarm indication On the cabinet of an NE, there are three indicators with different colors indicating the current status of the NE. You can stop the NE alarm indication on the T2000.

alarm A visual or an audible indication to notify the person concerned that a failure or an emergency has occurred.

asynchronous A network where transmission system payloads are not synchronized and each network terminal runs on its own clock.

ATM Asynchronous Transfer Mode. A transfer mode in which the information is organized into cells. It is asynchronous in the sense that the recurrence of cells containing information from an individual user is not necessarily periodic. It is a protocol within OSI layer 1. An ATM cell consists of a 5 octet header followed by 48 octets of data.

attenuation Reduction of signal magnitude or signal loss, usually expressed in decibels.

automatic protection switching The ability of a network element to detect a failed working line and switch the service to a spare (protection) line. 1+1 APS pairs a protection line with each working line. 1:NPS provides one protection line for every n working lines.

auto-negotiation The rate/working mode of the communication party set as auto-negotiation is specified through negotiation according to the transmission rate of the peer party.

B

back up A method to copy the important data into another storage location in case that the original data is damaged or lost.

bandwidth Information-carrying capacity of a communication channel. Analog bandwidth is the range of signal frequencies that can be transmitted by a communication channel or network.

BITS Building Integrated Timing Supply. A building timing supply that minimizes the number of synchronization links entering an office. Sometimes referred to as a synchronization supply unit.

broadcast The act of sending a frame addressed to all stations on the network

C

CBR Constant Bit Rate. The CBR service category is used by connections that request a static amount of bandwidth which is continuously available during the connection lifetime. This amount of bandwidth is characterized by a peak cell Rate (PCR) value. One type of network that all network nodes are connected one after one to be in series.

CDVT Cell Delay Variation Tolerance. Information sent in the forward and backward directions to determine the upper bound of the tolerance admitted for the time interval between cells pertaining to a given cell flow. The backward CDVT values included in the IAM and MOD shall be interpreted as maximum acceptable values for the cell flow in the backward direction.

chain network One type of network that all network nodes are connected one after one to be in series.

channel The smallest subdivision of a circuit that provides a type of communication service; usually a path with only one direction.

circuit A communications path or network; usually a pair of channels providing bi-directional communication.

clock tracing The method to keep the time on each node being synchronized with a clock source in a network.

configuration management Configuration management enables inventory query of network configuration resources, including relevant configuration of NMS or SNMS, NE, subnet, links, SNC, route, TP, edge point, equipment, and so on. Real-time inventory change report can also be provided through this resource, it will be timely reported to the upper NMS to notify the carrier of the current network operation status and ensure data consistency of the upper NMSs.

connection A "transport entity" which consists of an associated pair of "unidirectional connections" capable of simultaneously transferring information in opposite directions between their respective inputs and outputs.

convergence The process of developing a model of the echo path which will be used in the echo estimator to produce the estimate of the circuit echo.

D

defect A limited interruption in the ability of an item to perform a required function.

digital signal An electrical or optical signal that varies in discrete steps. Electrical signals are coded as voltages, optical signals are coded as pulses of light.

drop The port on a network element where the service to an end customer may be connected, such as a tributary card on a SONET ADM. For example, a drop for a DS1 customer service may be provided by a VT1.5 card terminating a VT1.5 trail.

E

ECC Embedded Control Channel. An ECC provides a logical operations channel between SDH NEs, utilizing a data communications channel (DCC) as its physical layer.

EMU Environment Monitoring Unit. As one type of power and environment monitoring unit, EMU is installed on the top of the OptiX 155/622H equipment cabinet to monitor the environment variables, such as the power supply and temperature. With external signal input through the relay, fire alarm, smoke alarm, burglary alarm, and so on can be monitored as well. Displayed on the T2000, the change of environment can be monitored timely and accurately.

encapsulation In 1000BASE-X, the process by which a MAC packet is enclosed within a PCS code-group stream.

EPL Ethernet Private Line. An EPL service is a point-to-point interconnection between two UNIs without SDH bandwidth sharing. Transport bandwidth is never shared between different customers.

Ethernet A data link level protocol comprising the OSI model's bottom two layers. It is a broadcast networking technology that can use several different physical media, including twisted pair cable and coaxial cable. Ethernet usually uses CSMA/CD. TCP/IP is commonly used with Ethernet networks.

ETSI European Telecommunications Standards Institute

EVPL Ethernet Virtual Private Line. An EVPL service is a service that is both a line service and a virtual private service.

extra traffic Unprotected traffic that is carried over the protection channels when not occupied by working traffic. The extra traffic may be preempted to provide transport channel for protected or highly protected transport entities in the event of failure.

F

flow An aggregation of packets that have the same characteristics. On the T2000 or NE software, flow is a group of classification rules. On boards, it is a group of packets that have the same quality of service (QoS) operation. At present, two flows are supported: port flow and port +VLAN flow. Port flow is based on port ID and port+VLAN flow is based on port ID and VLAN ID. The two flows cannot coexist in the same port.

free-run mode An operating condition of a clock, the output signal of which is strongly influenced by the oscillating element and not controlled by servo phase-locking techniques. In this mode the clock has never had a network reference input, or the clock has lost external reference and has no access to stored data, that could be acquired from a previously connected external reference. Free-run begins when the clock output no longer reflects the influence of a connected external reference, or transition from it. Free-run terminates when the clock output has achieved lock to an external reference.

G

grooming Consolidating or segregating traffic for efficiency

I

input jitter tolerance The maximum amplitude of sinusoidal jitter at a given jitter frequency, which, when modulating the signal at an equipment input port, results in no more than two errored seconds cumulative, where these errored seconds are integrated over successive 30 second measurement intervals.

IP over DCC The IP Over DCC follows TCP/IP telecommunications standards and controls the remote NEs through the Internet. The IP Over DCC means that the IP over DCC uses overhead DCC byte (the default is D1-D3) for communication.

isolation A non-reciprocal optical device intended to suppress backward reflections along an optical fibre transmission line while having minimum insertion loss in the forward direction.

J

jitter Short waveform variations caused by vibration, voltage fluctuations, and control system instability.

jitter tolerance For STS-N electrical interfaces, input jitter tolerance is the maximum amplitude of sinusoidal jitter at a given jitter frequency, which results in no more than two errored seconds cumulative, when the signal is modulated at an equipment input port. These errored seconds are integrated over successive 30 second measurement intervals. Requirements on input jitter tolerance as just stated, are specified in terms of compliance with a jitter mask, which represents a combination of points. Each point corresponds to a minimum amplitude of sinusoidal jitter at a given jitter frequency which results in two or fewer errored seconds in a 30 second measurement interval when the signal is modulated at the equipment input port. For the OC-N optical interface, it is defined as the amplitude of the peak-to-peak sinusoidal jitter applied at the input of an OC-N interface that causes a 1 dB power penalty.

L

label A mark on a cable, a subrack, or a cabinet for identification.

laser The device that generates the directional light covering a narrow range of wavelengths. Laser light is more coherent than ordinary light. Semiconductor diode lasers are the used light source in fiber-optic system.

layer A concept used to allow the transport network functionality to be described hierarchically as successive levels; each layer being solely concerned with the generation and transfer of its characteristic information.

LCAS Link Capacity Adjustment Scheme. A solution features flexible bandwidth and dynamic adjustment. In addition, it provides a failure tolerance mechanism, which enhances the viability of virtual concatenations and enables the dynamic adjustment to bandwidth (non-service affecting).

link A "topological component" that provides transport capacity between two endpoints in different subnetworks via a fixed (i.e., inflexible routing) relationship. The endpoints are "subnetwork termination point pools" for SONET, and link termination points for ATM. Multiple links may exist between a pair of subnetworks. A link also represents a set of "link connections".

loopback The fault of each path on the optical fiber can be located by setting loopback for each path of the line. There are three loopback modes: no loopback, outloop, and inloop.

M

mapping A procedure by which tributaries are adapted into virtual containers at the boundary of an SDH network.

mean launched power The average power of a pseudo-random data sequence coupled into the fiber by the transmitter.

MPLS Multiprotocol Label Switching. It is a standard routing and switching technology platform, capable of supporting various high level protocols and services. The data transmission over an MPLS network is independent of route calculating. MPLS, as a connection-oriented transmission technology, guarantees QoS effectively, supports various technologies, and is independent of the link layer.

MSP A protection function that provides the capability for switching a signal between and including two MST functions, from a working to a protection channel.

MSTP Multi-service transmission platform. It is based on the SDH platform, capable of accessing, processing and transmitting TDM services, ATM services, and Ethernet services, and providing unified management of these services.

multicast Transmission of a frame to stations specified by a group address.

multiplex section overhead The multiplex section overhead comprises rows 5 to 9 of the SOH of the STM-N signal.

multiplex section protection A protection function that provides the capability for switching a signal between and including two MST functions, from a working to a protection channel.

multiplexing A procedure by which multiple lower order path layer signals are adapted into a higher order path or the multiple higher order path layer signals are adapted into a multiplex section.

O

optical interface	A device that allows two or more corresponding optical transmitting units to be connected.
overhead	Extra bits in a digital stream used to carry information besides traffic signals. Orderwire, for example, would be considered overhead information.

P

path protection	The working principle of path protection: When the system works in path protection mode, the PDH path uses the dual-fed and signal selection mode. Through the tributary unit and cross-connect unit, the tributary signal is sent simultaneously to the east and west lines. Meanwhile, the cross-connect matrix sends the signal dually sent from the opposite end to the tributary board through the active and standby buses, and the hardware of the tributary board automatically and selectively receive the signal from the two groups of buses automatically according to the AIS number of the lower order path.
PCR	Peak Cell Rate. An upper limit on the rate at which cells can be submitted on an ATM connection.
PDH	Plesiochronous Digital Hierarchy. PDH is the digital networking hierarchy that was used before the advent of SONET/SDH.
performance register	Performance register is the memory space for performance event counts, including 15-min current performance register, 24-hour current performance register, 15-min history performance register, 24-hour history performance register, UAT register and CSES register.
pointer	An indicator whose value defines the frame offset of a virtual container with respect to the frame reference of the transport entity on which it is supported.
procedure	A generic term for an action.
process	A generic term for a collection of actions.

R

receiver sensitivity	Receiver sensitivity is defined as the minimum acceptable value of average received power at point R to achieve a 1×10^{-10} BER.
reference clock	A clock of very high stability and accuracy that may be completely autonomous and whose frequency serves as a basis of comparison for the frequency of other clocks.
regenerator section overhead	The regenerator section overhead comprises rows 1 to 3 of the SOH of the STM-N signal.

remote defect indication (RDI)	A signal returned to the transmitting Terminating Equipment upon detecting a Loss of Signal, Loss of Frame, or AIS defect. RDI was previously known as FERF.

S

S1 byte	The byte defined in ITU-T to transmit the network synchronization status information.
SDH	Synchronous Digital Hierarchy. A hierarchical set of digital transport structures, standardized for the transport of suitably adapted payloads over physical transmission networks.
section	The portion of a SONET transmission facility, including terminating points, between (i) a terminal network element and a regenerator or (ii) two regenerators. A terminating point is the point after signal regeneration at which performance monitoring is (or may be) done.
section overhead	Nine bytes of overhead accessed, generated, and processed by section terminating equipment. This overhead supports functions such as framing the signal and performance monitoring.
service protection	The measures to make sure the service transmitting not to be damaged or corrupted.
side mode suppression ratio	The ratio of the largest peak of the total source spectrum to the second largest peak.
simple network management protocol	An IETF protocol for monitoring and managing systems and devices in a network. The data being monitored and managed is defined by a Management Information Base (MIB). The functions supported by the protocol are the request and retrieval of data, the setting or writing of data, and traps that signal the occurrence of events.
SSM	Synchronization Status Message. ITU-T defines S1 byte to transmit the network synchronization status information. It uses the lower four bits of the multiplex section overhead S1 byte to indicate 16 types of synchronization quality grades.
STM-N	Synchronous Transport Module. An STM is the information structure used to support section layer connections in the SDH. It consists of information payload and Section Overhead (SOH) information fields organized in a block frame structure which repeats every 125 ms. The information is suitably conditioned for serial transmission on the selected media at a rate which is synchronized to the network. A basic STM is defined at 155.520 bit/s.
subnet	The logical entity in the transmission network and comprises a group of network management objects. A subnet can contain NEs and other subnets. A subnet planning can enhance the organization of a network view.
synchronous	A network where transmission system payloads are synchronized to a master (network) clock and traced to a reference clock.

synchronous source	A clock providing timing services to connected network elements. This would include clocks conforming to Recommendations G.811, G.812 and G.813.

T

T2000	A subnet management system (SNMS). In the telecommunication management network architecture, the T2000 is located between the NE level and network-level, which can supports all NE level functions and part of the network-level management functions. See also NM.
TCP/IP	Transmission Control Protocol/Internet Protocol. Common name for the suite of protocols developed to support the construction of worldwide inter-networks.
timeslot	Single timeslot on a E1 digital interface, that is, a 64 kbit/s, synchronous, full-duplex data channel, typically used for a single voice connection.
trail	A type of transport entity, mainly engaged in transferring signal from the input of the trail source to the output of the trail sink, and monitoring the integrality of the transferred signal.
transceiver	An electronic device which has both transmit and receive capabilities.
tray	A discal component in the cabinet, which is used to place the chassis or other equipment.
TUG	Tributary unit group.

U

UNI	User Network Interface. It identifies the interface between the user and the ATM network node.

V

VC	Virtual container.
VLAN	Virtual local area network. A subset of the active topology of a Bridged Local Area Network. Associated with each VLAN is a VLAN Identifier (VID).

B Acronyms and Abbreviations

A	
AC	Alternating Current
ADM	add/drop multiplexer
AIS	Alarm Indication Signal
ALS	automatic laser shutdown
ATM	Asynchronous Transfer Mode
B	
BIOS	Basic Input/Output System
BITS	Building Integrated Timing Supply
C	
CAR	Committed Access Rate
CBR	Constant Bit Rate
CC	Connectivity Check
D	
DC	Direct Current
DCC	Data Communication Channel
DDN	Digital Data Network
DSLAM	Digital Subscriber Line Access Multiplexer
DTE	Data Terminal Equipments

E

ECC	Embedded Control Channel
EGT	Gigabit Ethernet Transparent Transmission Board
EPL	Ethernet Private Line
ETSI	European Telecommunications Standards Institute
EVPL	Ethernet Virtual Private Line
EPLAN	Ethernet Private LAN
EVPLAN	Ethernet Virtual Private LAN

F

FPGA	Field Programmable Gate Array

G

GE	Gigabit Ethernet
GFP	Generic Framing Procedure
GPS	Global Positioning System
GUI	Graphic User Interface

H

HDLC	High level Data Link Control

I

IEEE	Institute of Electrical and Electronics Engineers
IGMP	Internet Group Management Protocol
ISP	Internet Service Provider
ITU-T	International Telecommunication Union - Telecommunication Standardization Sector

L

LAG	Link Aggregation Group
LAN	Local Area Network
LAPS	Link Access Procedure-SDH
LB	Loopback

LC	Lucent Connector
LCT	Local Craft Terminal
LCAS	Link Capacity Adjustment Scheme
LPT	Link State Pass Through
M	
MCF	Message Communication Function
MPLS	Multiprotocol Label Switching
MSP	Multiplex Section Protection
MSTP	multiservice transport platform
MADM	Multiple Add/drop Multiplexer
MTIE	maximum time interval error
N	
NM	Network Manager
NMS	Network Management System
nrt-VBR	non-real time Variable Bit Rate
NTP	Network Time Protocol
O	
OAM	Operations, Administration and Maintenance
OLT	Optical Line Terminal
ONU	Optical Network Unit
OSI	Open Systems Interconnection
P	
PDH	Plesiochronous Digital Hierarchy
R	
rt-VBR	real time Variable Bit Rate
RDI	Remote Defect Indication
RNC	Radio Network Controller

RSTP	Rapid Spanning Tree Protocol
S	
SDH	Synchronous Digital Hierarchy
SFP	Small Form-Factor Pluggable
SHDSL	Single Pair High-bit-rate Digital Subscriber Line
SNCP	Sub-Network Connection Protection from the Function Tree.
SNMP	Simple Network Management Protocol
SSM	Synchronization Status Message
STM-1	SDH Transport Module -1
STM-4	SDH Transport Module -4
STP	Spanning Tree Protocol
T	
TM	Terminal Multiplexer
TMN	Telecommunication Management Network
U	
UBR	Unspecified Bit Rate
UPM	Uninterruptible Power Module
UNI	User Network Interface
UTC	Universal Time Coordinated
V	
VBR	Variable Bit Rate
VC	Virtual Container
VLAN	Virtual LAN
VP	Virtual Path