OptiX RTN 980 Radio Transmission System

V100R007C10

Product Description

Issue 02

Date 2015-04-30

HUAWEI TECHNOLOGIES CO., LTD.

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Notice

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About This Document

Related Versions

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

Product Name	Version
OptiX RTN 980	V100R007C10
iManager U2000	V200R014C60

Intended Audience

This document is intended for network planning engineers.

Familiarity with the basic knowledge related to digital microwave communication technology will help you apply the information in this document.

Symbol Conventions

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

Symbol	Description
DANGER	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

Symbol	Description
NOTICE	Indicates a potentially hazardous situation which, if not avoided, could result in equipment damage, data loss, performance deterioration, or unanticipated results. NOTICE is used to address practices not related to personal injury.
NOTE	Calls attention to important information, best practices and tips. NOTE is used to address information not related to personal injury, equipment damage, and environment deterioration.

General Conventions

The general conventions that may be found in this document are defined as follows.

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`	Examples of information displayed on the screen are in `Courier New`.

Update History

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

Updates in Issue 02 (2015-04-30) Based on Product Version V100R007C10

This document is the second release for the V100R007C10 product version.

Update	Description
1.2 Components	Added descriptions about XMC-3 ODUs.
6.1.1.6 Microwave Work Modes (ISV3 board)	

Update	Description
6.1.3.6 Receiver Sensitivity (ISV3 board)	
6.1.2 Frequency Band	
6.1.5 Transceiver Performance	
6.1.1.7 Microwave Work Modes (ISM6 board)	Added descriptions about XMC-3 ODUs and IS6 running mode.
6.1.3.7 Receiver Sensitivity (ISM6 board)	
6.1.1.8 Throughput of an EPLA Group	Added descriptions about IS6 running mode.

Updates in Issue 01 (2014-12-30) Based on Product Version V100R007C10

This document is the first release for the V100R007C10 product version.

Contents

1 Introduction

About This Chapter

The OptiX RTN 980 is a product in the OptiX RTN 900 radio transmission system series.

1.1 Network Application
The OptiX RTN 900 is a new generation TDM/Hybrid/Packet integrated microwave transmission system developed by Huawei. It provides a seamless microwave transmission solution for mobile communication network or private networks.

1.2 Components
The OptiX RTN 980 adopts a split structure. The system consists of the IDU 980 and the ODU. Each ODU is connected to the IDU 980 through an IF cable.

1.1 Network Application

The OptiX RTN 900 is a new generation TDM/Hybrid/Packet integrated microwave transmission system developed by Huawei. It provides a seamless microwave transmission solution for mobile communication network or private networks.

OptiX RTN 900 Product Family

The OptiX RTN 900 series provide a variety of service interfaces and can be installed easily and configured flexibly. The OptiX RTN 900 series provide a solution that can integrate TDM microwave, Hybrid microwave, and Packet microwave technologies according to the networking scheme for the sites, achieving smooth upgrade from TDM microwave to Hybrid microwave, and from Hybrid microwave to Packet microwave. This solution meets the transmission requirements of 2G, 3G, and LTE services while also allowing for future network evolution and convergence.

There are five types of OptiX RTN 900 Packet microwave products: OptiX RTN 905, OptiX RTN 910, OptiX RTN 950, OptiX RTN 950A, and OptiX RTN 980. Users can choose the product best suited for their site.

NOTE

The OptiX RTN 910 does not provides V100R006C10 or late version.

Table 1-1 OptiX RTN 900 product family

Product Name	IDU Appearance	Characteristic
OptiX RTN 905		● 1 U high IDU. ● Five types of integrated chassis (1A/2A/1C/1E/2E). ● One or two microwave links.
OptiX RTN 910		● 1 U high IDU. ● Boards pluggable. ● Integrated service ports on system control, switching, and timing boards. ● One or two IF boards.
OptiX RTN 950		● 2 U high IDU. ● Boards pluggable. ● 1+1 protection for system control, switching, and timing boards. ● A maximum of six IF boards.

Product Name	IDU Appearance	Characteristic
OptiX RTN 950A		● 2 U high IDU. ● Boards pluggable. ● Integrated service ports on system control, switching, and timing boards. ● A maximum of six IF boards.
OptiX RTN 980		● 5 U high IDU. ● Boards pluggable. ● 1+1 protection for system control, switching, and timing boards. ● Integrated service ports on system control, switching, and timing boards. ● A maximum of fourteen IF boards.

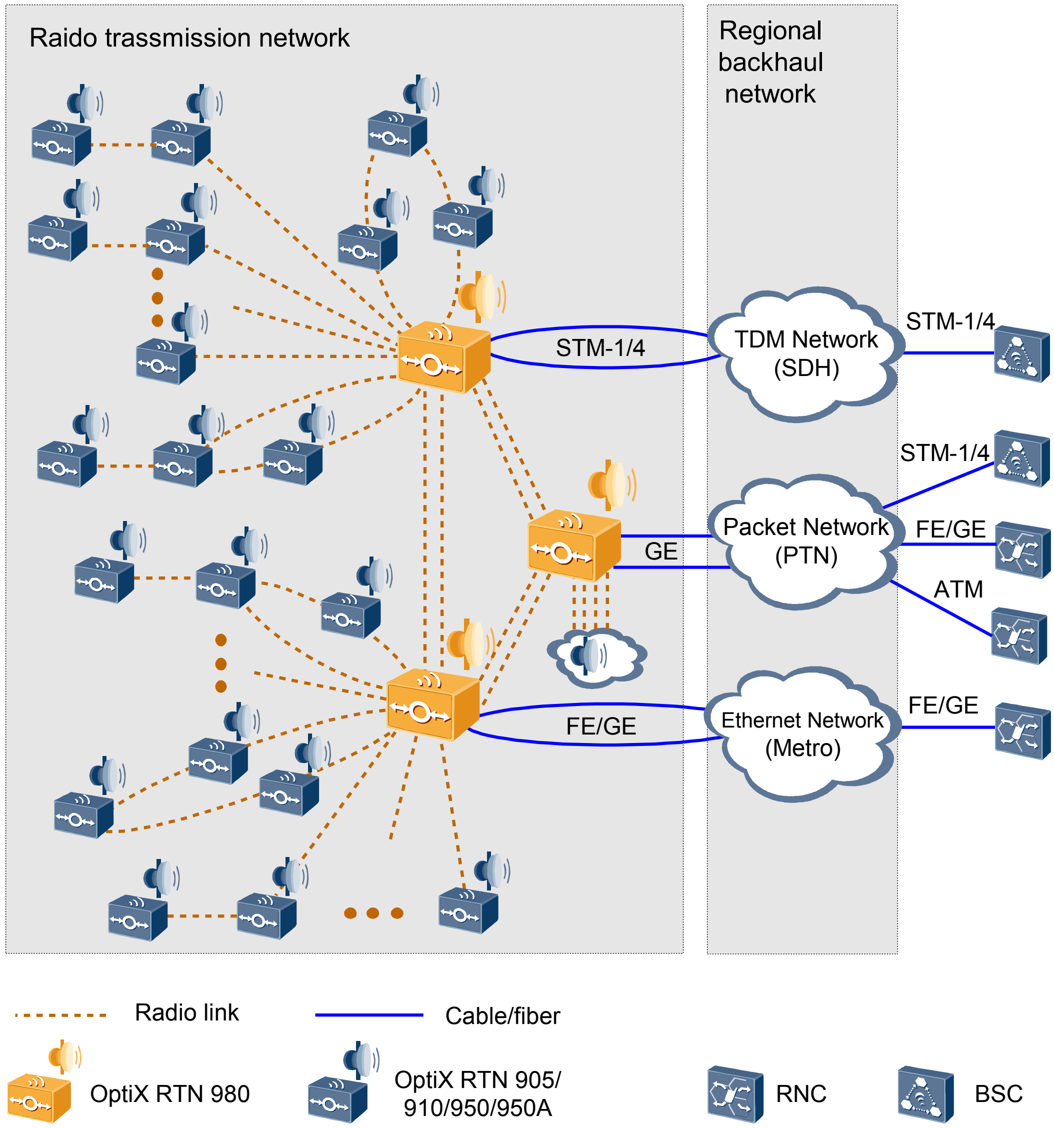
OptiX RTN 980

The OptiX RTN 980 is large-capacity nodal microwave equipment deployed at the convergence layer. It supports the convergence of up to 20 radio links, and supports multiple protection schemes. **Figure 1-1** shows the microwave transmission solution provided by the OptiX RTN 980.

NOTE

The OptiX RTN 980 supports a wide range of interfaces and service bearer technologies, and is therefore compatible with varied backhaul networks. Specifically, packet services can be backhauled through TDM networks, and TDM services can be backhauled through packet networks.

Figure 1-1 Microwave transmission solution provided by the OptiX RTN 980



1.2 Components

The OptiX RTN 980 adopts a split structure. The system consists of the IDU 980 and the ODU. Each ODU is connected to the IDU 980 through an IF cable.

IDU 980

The IDU 980 is the indoor unit for an OptiX RTN 980 system. It receives and multiplexes services, performs service processing and IF processing, and provides the system control and communications function.

Table 1-2 lists the basic features of the IDU 980.

Table 1-2 Features of the IDU 980

Item	Description
Chassis height	5U
Pluggable	Supported
Number of radio directions	1 to 20
RF configuration mode	● N+0 non-protection configuration ● Nx(1+0) non-protection configuration ● 1+1 protection configuration ● N+1 protection configuration ● XPIC configuration
Service interface type	● E1 interface ● STM-1 optical/electrical interface ● STM-4 optical interface ● FE optical/electrical interface ● GE optical/electrical interface ● 10GE optical interface

Figure 1-2 Appearance of the IDU 980

ODU

The ODU is the outdoor unit for the OptiX RTN 900. It converts frequencies and amplifies signals.

The OptiX RTN 900 product series can use the RTN 600 ODU and RTN XMC ODU, covering the entire frequency band from 6 GHz to 42 GHz.

Table 1-3 RTN XMC ODUs that the OptiX RTN 980 supports

Item	Description		
	High-Power ODU		
ODU type	XMC-2	XMC-2H	XMC-3
Frequency band	6/7/8/10/10.5/11/13/15/18/23/26/28/32/38/42 GHz	6/7/8/11 GHz	13/15/18/23/26/28/32/38 GHz
Highest-order Modulation	2048QAM (13/15/18/23/38 GHz, 7/8 GHz XMC-2E) 1024QAM (6/10/10.5/11/26/28/32/42 GHz) 256QAM (7/8 GHz Normal)	2048QAM	4096QAM (13/15/18/23/26 GHz) 2048QAM (28/32/38 GHz)
Channel spacing	3.5/7/14/28/40/50/56 MHz **NOTE** The 10.5 GHz frequency band does not support 40/50/56 MHz channel spacing.	7/14/28/40/50/56 MHz	3.5/7/14/28/40/50/56 MHz (13/15/18/23/38 GHz) 7/14/28/40/50/56 MHz (26/28 GHz) 7/14/28/40/50/56/112 MHz (32 GHz)

Table 1-4 RTN 600 ODUs that the OptiX RTN 980 supports

Item	Description		
	High-Power ODU	Standard Power ODU	Low Capacity ODU
ODU type	HP, HPA	SP, SPA	LP
Frequency band	6/7/8/10/10.5/11/13/15/18/23/26/28/32/38 GHz (HP ODU) 6/7/8/11/13/15/18/23 GHz (HPA ODU)	7/8/11/13/15/18/23/26/38 GHz (SP ODU) 6/7/8/11/13/15/18/23 GHz (SPA ODU)	7/8/11/13/15/18/23 GHz

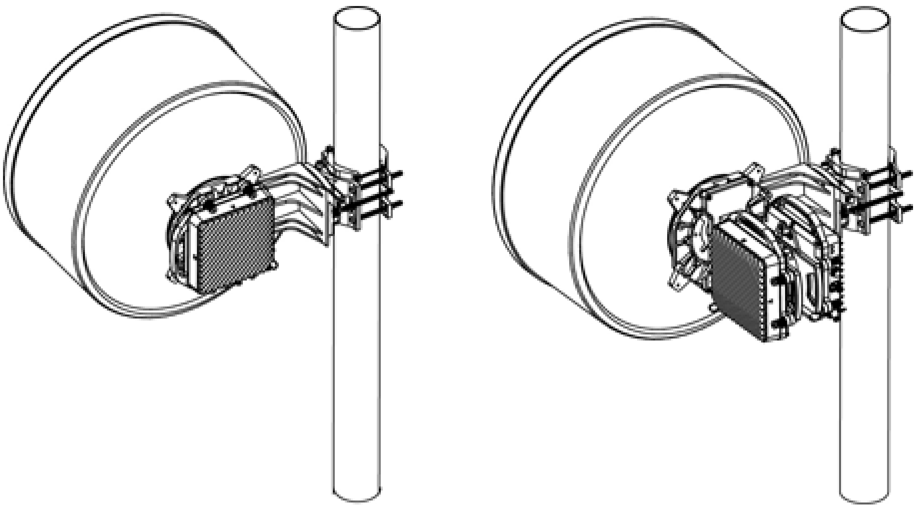
Item	Description		
	High-Power ODU	Standard Power ODU	Low Capacity ODU
Highest-order Modulation	256QAM	256QAM	16QAM
Channel spacing	7/14/28/40/56 MHz (6/7/8/10/11/13/15/18/23/26/28/32/38 GHz) 7/14/28 MHz (10.5 GHz)	3.5/7/14/28 MHz	3.5/7/14/28 MHz

There are two methods for mounting the ODU and the antenna: direct mounting and separate mounting.

- The direct mounting method is generally adopted when a small- or medium-diameter and single-polarized antenna is used. In this situation, if one ODU is configured for one antenna, the ODU is directly mounted at the back of the antenna. If two ODUs are configured for one antenna, an RF signal combiner/splitter (hence referred to as a hybrid coupler) must be mounted to connect the ODUs to the antenna. **Figure 1-3** illustrates the direct mounting method.

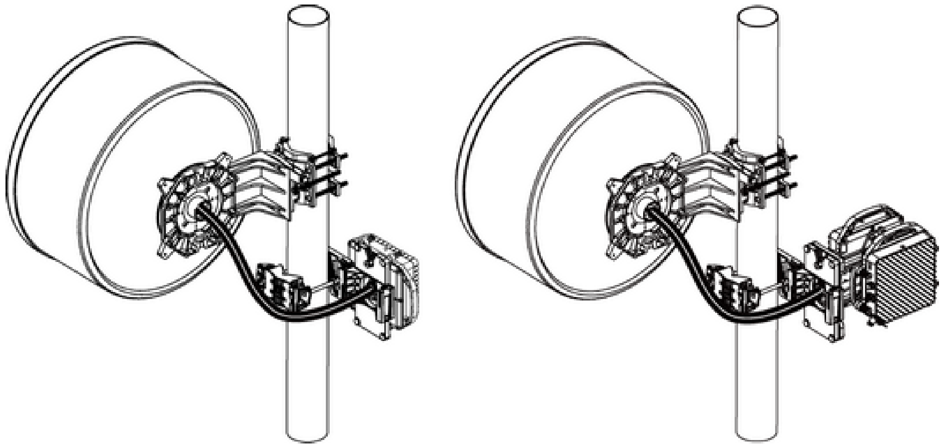
  The direct mounting method can also be adopted when a small- or medium-diameter and dual-polarized antenna is used. Two ODUs are mounted onto an antenna using an orthomode transducer (OMT). The method for installing an OMT is similar to that for installing a hybrid coupler.

  Figure 1-3 Direct mounting



- The separate mounting method is adopted when a large- or medium-diameter and single- or dual-polarized antenna is used. **Figure 1-4** shows the separate mounting method. In this situation, a hybrid coupler can be mounted (two ODUs share one feed boom).

Figure 1-4 Separate mounting



NOTE

The OptiX RTN 980 provides an antenna solution that covers the entire frequency band, and supports single-polarized antennas and dual-polarized antennas with diameters of 0.3 m to 3.7 m along with the corresponding feeder system.

2 Functions and Features

About This Chapter

The OptiX RTN 980 provides a wide assortment of functions and features to ensure the quality and efficiency of service transmission.

2.9 Ethernet Service Processing Capability
The OptiX RTN 980 has powerful Ethernet service processing capability.

2.10 QoS
The OptiX RTN 980 provides improved quality of service (QoS) and supports the following eight types of per-hop behaviors (PHBs): BE, AF1, AF2, AF3, AF4, EF, CS6, and CS7. Therefore, network carriers can offer various QoS levels of service guarantees and build networks that carry data, voice, and video services.

2.11 Clock Features
The OptiX RTN 980 supports clock synchronization and IEEE 1588v2 time synchronization, meeting the clock and time synchronization requirements of mobile networks. In addition, the OptiX RTN 980 provides an advanced clock protection mechanism.

2.12 Protection Capability
The OptiX RTN 980 provides a variety of protection schemes.

2.13 Network Management
The OptiX RTN 980 supports multiple network management (NM) modes and provides comprehensive NM information exchange schemes.

2.14 Easy Installation
The OptiX RTN 980 supports several installation modes. That is, the installation is flexible and convenient.

2.15 Easy Maintenance
The OptiX RTN 980 provides plentiful maintenance features that effectively reduce the costs associated with maintaining the equipment.

2.16 Security Management
The OptiX RTN 980 can prevent unauthorized logins and operations, ensuring equipment management security.

2.17 Energy Saving
The OptiX RTN 980 uses various types of technologies to reduce the amount of energy that the device consumes. The device:

2.18 Environmental Protection
The OptiX RTN 980 is designed to meet or exceed environmental protection requirements. The product complies with the RoHS directive and WEEE directive.

2.1 Microwave Types

The microwave type is determined by the IF board and the configured working mode.

2.1.1 SDH/PDH Microwave

The SDH microwave refers to the microwave that transmits SDH services. The PDH microwave refers to the microwave that transmits only PDH services (mainly, the E1 services).

NOTE

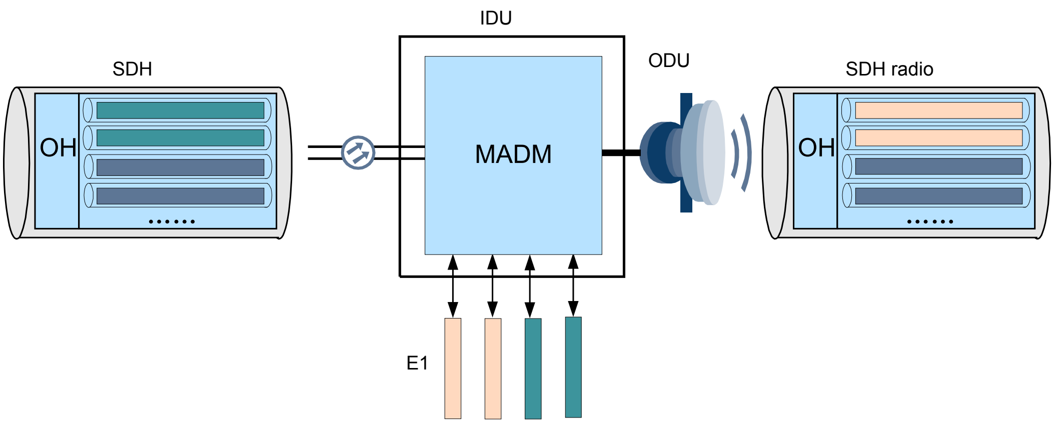
The IF1 board can work in TU-12-based PDH microwave mode or STM-1-based SDH microwave mode.

The ISU2/ISX2/ISV3/ISM6 board can work in SDH mode to support transmission of one STM-1 or two STM-1s.

SDH Microwave

Unlike conventional SDH microwave equipment, the OptiX RTN 980 has a built-in MADM. The MADM grooms services to the microwave port through cross-connections, maps the services into the STM-1-based or 2xSTM-1-based microwave frames, and then transmits the frames. With this capability, services are flexibly groomed and the optical network and the microwave network are seamlessly converged.

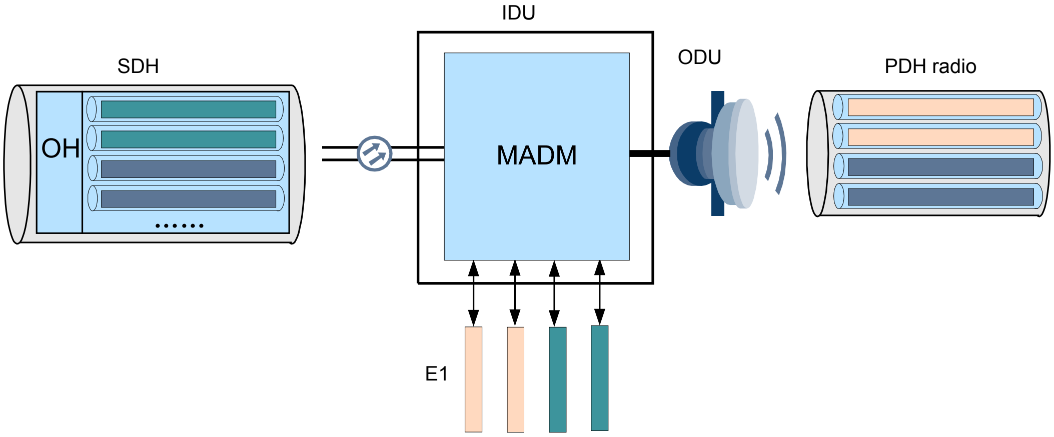
Figure 2-1 SDH microwave



PDH Microwave

Unlike conventional PDH microwave equipment, the OptiX RTN 980 has a built-in MADM. The MADM grooms E1 services to the microwave port for further transmission. With this capability, services are flexibly groomed and the optical network and the microwave network are seamlessly converged.

Figure 2-2 PDH microwave



2.1.2 Hybrid/Packet Integrated IP Microwave

The Hybrid/Packet integrated IP microwave (Integrated IP radio for short) can transmit one type among or a combination of Native TDM services, Native Ethernet services, and PWE3 packet services according to software settings. Therefore, the Integrated IP radio achieves a smooth upgrade from Hybrid microwave to Packet microwave.

IP Microwave Classification

IP microwave can transmit packet services and support the AM function. The packet services transmitted can be Native Ethernet services or packet services encapsulated in PWE3. Conventional IP microwave is divided into two different types: Hybrid microwave and Packet microwave.

- Hybrid microwave: Native TDM services and Native Ethernet services can be transmitted through the air interface.
- Packet microwave: TDM services, ATM/IMA services, and Ethernet services after PWE3 encapsulation are transmitted through the air interface.

As IP microwave evolves, the OptiX RTN 980 supports Integrated IP radio. As a result, the equipment can support Hybrid microwave and Packet microwave at the same time, and can simultaneously transmit multiple types of services at air interfaces.

NOTE

The IFU2/IFX2/ISU2/ISX2/ISV3/ISM6 board supports Integrated IP radio.

Integrated IP radio

To achieve flexible grooming of TDM services and packet services on the Integrated IP radio, the OptiX RTN 980 is embedded with dual service planes: TDM service processing plane and packet service processing plane. TDM services and packet services can be flexibly transmitted over the Integrated IP radio, as shown in **Figure 2-3**.

- TDM service processing plane

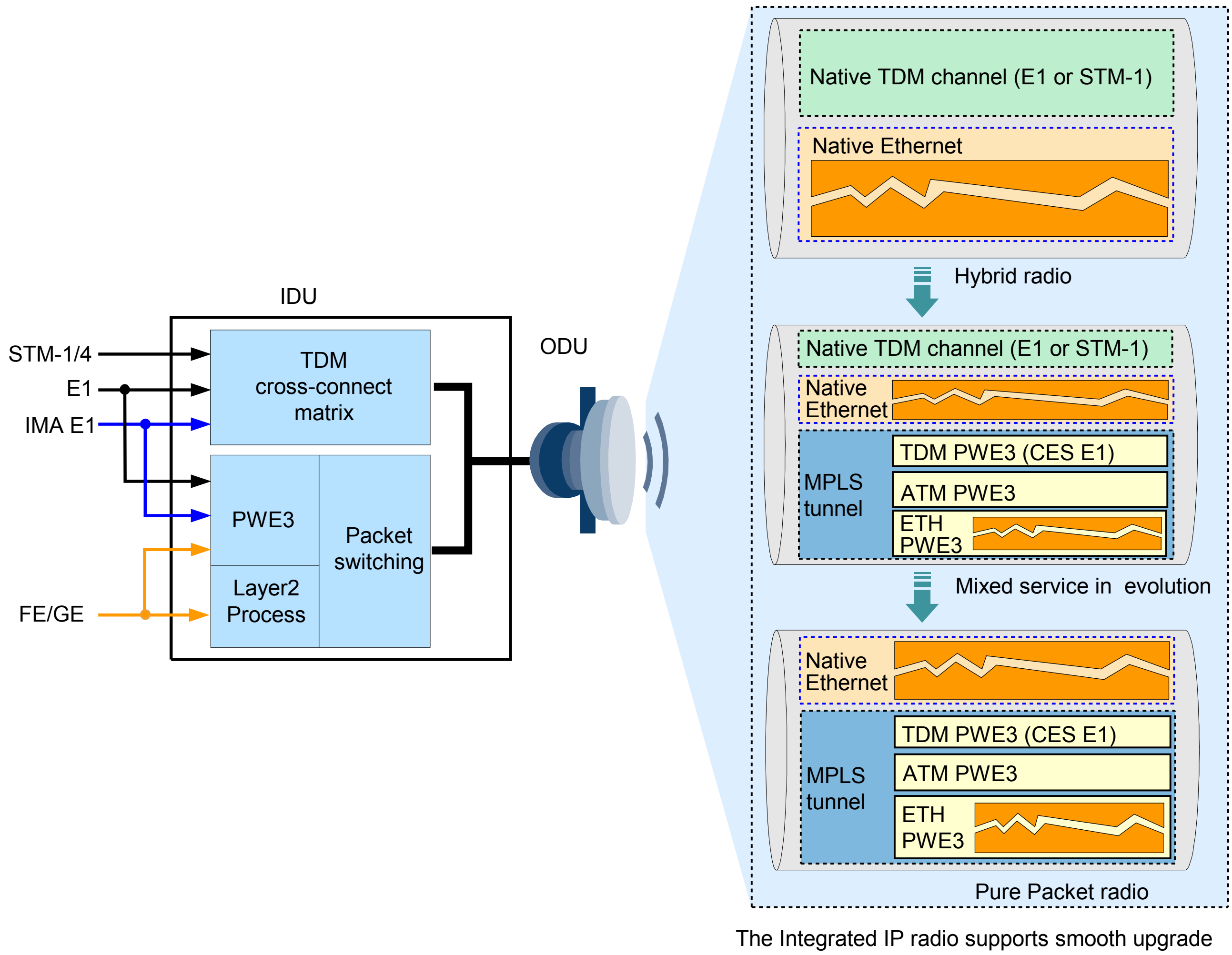
Performs cross-connections on the incoming TDM services (E1 services or STM-1 services), and transmits the services to the microwave ports.

- Packet service processing plane

  Performs PWE3 emulation on the incoming services (E1 services, ATM/IMA services, and Ethernet services), encapsulates them into the MPLS packets, and transmits the Ethernet frames that bear the MPLS packets to the microwave ports. However, Ethernet services can be directly transmitted to the microwave ports in Native mode after Layer 2 switching.

Native TDM services, MPLS packets, or Native Ethernet services need to be groomed to the microwave port, encapsulated into microwave frames, and then transmitted on microwave links. The Integrated IP radio serves as Hybrid microwave when TDM services are scheduled to the microwave port over the TDM service processing plane and Ethernet services are scheduled to the microwave port over the packet service processing plane; the Integrated IP radio serves as Packet microwave when TDM services are encapsulated into MPLS/PWE3 packets on the packet service processing plane and then scheduled to the microwave port.

Figure 2-3 Hybrid/Packet integrated IP microwave



The Hybrid/Packet integrated IP microwave has the following features:

- Transmits one, or several of the TDM services, MPLS/PWE3 services, and Native Ethernet services.
- Supports the AM function. E1 services and packet services can be configured with priority. When AM is switched to the reference mode, the services with higher priority are transmitted with preference.

NOTE

The OptiX RTN 980 supports VLAN sub-interfaces, therefore transmitting MPLS/PWE3 Ethernet services and Native Ethernet services over one port.

2.2 Modulation Strategy

OptiX RTN 980 supports fixed modulation and adaptive modulation.

2.2.1 Fixed Modulation

Fixed modulation refers to a modulation policy in which a modulation scheme is adopted invariably to provide constant air interface bandwidth for a running radio link.

When the OptiX RTN 980 uses fixed modulation, the modulation scheme and the channel spacing can be set by using software.

- The SDH/PDH radio link uses fixed modulation.
- The Integrated IP radio link supports fixed modulation. Various combinations of modulation schemes and channel spacings can be set.

2.2.2 Adaptive Modulation

The adaptive modulation (AM) technology adjusts the modulation scheme automatically based on channel quality.

Modulation Scheme and Air-interface Capacity

When the AM technology is adopted, in the case of the same channel spacing, the microwave service bandwidth varies according to the modulation scheme; the higher the modulation efficiency, the higher the bandwidth of the transmitted services.

- When the channel quality is good (such as on days when weather conditions are favorable), the equipment adopts a high-efficiency modulation scheme to transmit more user services. This improves transmission efficiency and spectrum utilization of the system.
- When the channel quality deteriorates (such as on days with adverse weather), the equipment adopts a low-efficiency modulation scheme to transmit only higher-priority services within the available bandwidth while discarding lower-priority services. This method improves anti-interference capabilities of the radio link, which helps ensure the link availability for higher-priority services.

Modulation Scheme Shift and Service Priorities

In Integrated IP radio mode, the equipment supports the AM technology. With configurable priorities for E1 services and packet services, the transmission is controlled based on the service bandwidth and QoS policies corresponding to the current modulation scheme. The highest-priority services are transmitted with precedence.

NOTE

In Integrated IP radio mode, when the equipment transmits STM-1 services and packet services at the same time, STM-1 services have highest priority and their transmission is ensured.

- Priorities of E1 services

  The priorities of E1 services are assigned based on the number of E1 services that each modulation scheme can transmit. When modulation scheme switching occurs, only the E1 services whose number is specified in the new modulation scheme can be transmitted and the excess E1 services are discarded.

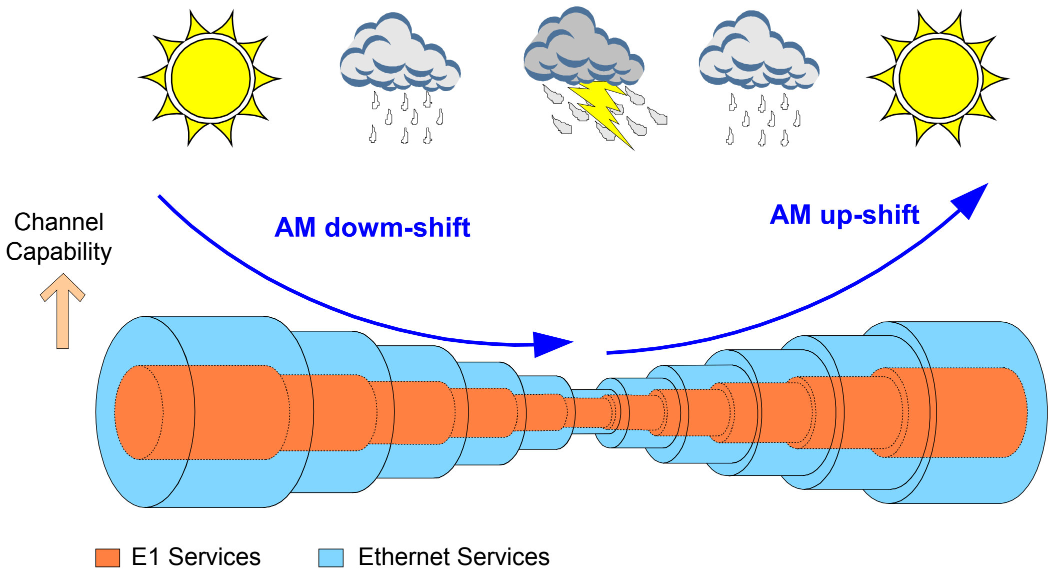
- Priorities of packet services

  With the QoS technology, packet services are scheduled to queues with different priorities. The services in different queues are transmitted to the microwave port after running the queue scheduling algorithm. When modulation scheme switching occurs, certain queues may be congested due to insufficient capacity at the air interface. As a result, certain services or all the services in these queues are discarded.

Adaptive Modulation

Figure 2-4 shows the service changes caused by shifts among six modulation schemes as an example. The orange part indicates E1 services. The blue part indicates packet services. The closer the service is to the outside of the cylinder in the figure, the lower the service priority. Under all channel conditions, the service capacity varies according to the modulation scheme. When the channel conditions are unfavorable (during adverse weather conditions), lower-priority services are discarded.

Figure 2-4 Adaptive modulation



Characteristics

The AM technology used by the OptiX RTN 980 has the following characteristics:

- The lowest-efficiency modulation scheme (also called reference scheme or modulation scheme of guaranteed capacity) and the highest-efficiency modulation scheme (also called nominal scheme or modulation scheme of full capacity) used by the AM can be configured.

  For modulation schemes that Integrated IP radio IF boards support, see **6.1.1 Microwave Work Modes**.
- In AM, when modulation schemes are switched, the transmit frequency, receive frequency, and channel spacing remain unchanged.
- In AM, modulation schemes are switched step-by-step.
- In AM, modulation scheme switching is hitless. When the modulation scheme is downshifted, high-priority services will not be affected when low-priority services are discarded. The switching is successful even when 100 dB/s channel fast fading occurs.

2.3 RF Configuration Modes

The OptiX RTN 980 supports 1+0 non-protection configuration, N+0 non-protection configuration, 1+1 protection configuration, N+1 protection configuration, and XPIC configuration.

Table 2-1 shows the RF configuration modes supported by the OptiX RTN 980. For detail, refer to **Typical RF Configuration Modes**.

Table 2-1 RF configuration modes

Configuration Mode	Maximum Number of Groups
1+0 non-protection configuration	20
1+1 protection configuration (1+1 HSB/FD/SD)	10
N+0 non-protection configuration	10 (N = 2)
N+1 protection configuration	10 (N = 1)
XPIC configuration	10

NOTE

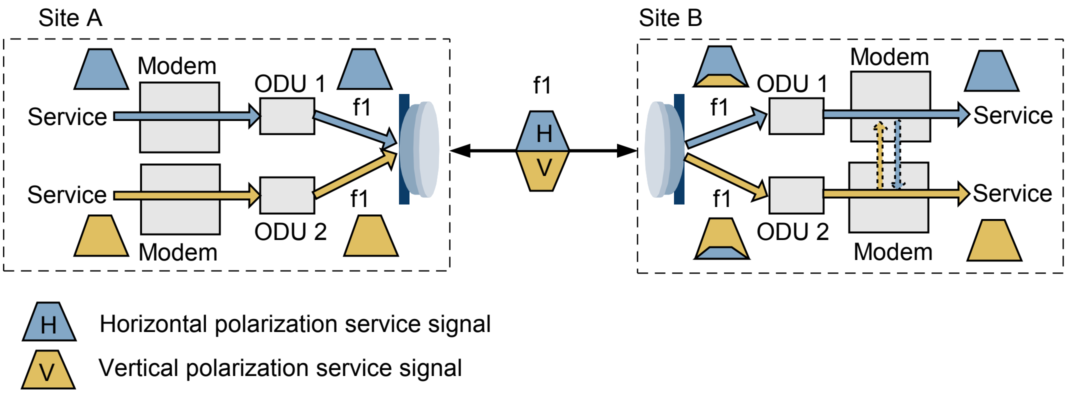
- The maximum number of groups listed in the table can be supported only when ISM6 boards and XMC ODUs work together.
- The OptiX RTN 980 supports coexistence of multiple 1+0, 1+1, N+0, or N+1 groups as long as the number of microwave links is within the allowed range.
- 1+0 configuration in N directions is also called Nx(1+0) configuration.
- When two microwave links in 1+0 non-protection configuration form a microwave ring network, the specific RF configuration (namely, east and west configuration) is formed. On a Hybrid microwave ring network, SNCP can be configured for SDH/PDH services and ERPS can be configured for Ethernet services. On a packet microwave ring network, MPLS APS or PW APS can be configured for packet services.
- PDH microwave does not support N+1 protection or XPIC configuration.
- XPIC groups can coexist with N+0 or N+1 groups. Two XPIC groups can form a 1+1 protection group.

2.4 Cross-Polarization Interference Cancellation

Cross-polarization interference cancellation (XPIC) technology is used together with co-channel dual-polarization (CCDP). The application of the two technologies doubles the wireless link capacity over the same channel.

CCDP transmission adopts a horizontally polarized wave and a vertically polarized wave on one channel to transmit two channels of signals. Ideally, for CCDP transmissions, there will not be any interference between the two orthogonal signals although they are on the same frequency. In actual practice, despite the orthogonality of the two signals, interference between the signals inevitably occurs due to cross-polarization discrimination (XPD) of the antenna and channel degradation. To cancel the interference, XPIC technology is used to receive signals horizontally and vertically. The signals in the two directions are then processed and the original signals are recovered from interfered signals.

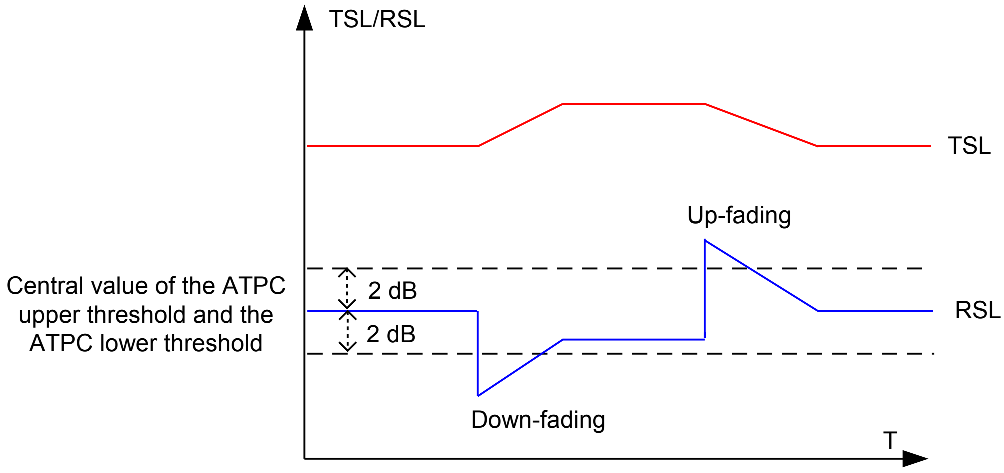
Figure 2-5 CCDP channel configuration and XPIC technology



2.5 Automatic Transmit Power Control

Automatic transmit power control (ATPC) enables the output power of the transmitter to automatically trace the level fluctuation at the receive end within the ATPC control range. This feature reduces the interference with neighboring systems and residual BER.

Figure 2-6 Relationship between the RSL and TSL



2.6 Capacity

The OptiX RTN 980 is a high-capacity device.

2.6.1 Air Interface Capacity

Air interface capacity refers to the service capacity of a microwave link.

The air interface capacity depends on the IF board, ODU type, and microwave work mode. Air interface capacities described in this section are the maximum capacities over a single microwave link. With the help of N+1, LAG, and PLA functions, larger air-interface capacities are supported between microwave sites.

Table 2-2 Air interface capacities

IF Board	Microwave Link	Maximum Air Interface Capacity		
		TDM Services	Ethernet Throughput at Air Interfaces (Mbit/s)[a]	XPIC Configuration[b]
IF1	PDH radio	53xE1	N/A	Not supported
	SDH radio	1xSTM-1	N/A	
IFU2	Integrated IP radio	75xE1	360 to 420	Not supported
IFX2	Integrated IP radio	75xE1	360 to 410	Supported
ISU2	SDH radio	2xSTM-1	N/A	Not supported

IF Board	Microwave Link	Maximum Air Interface Capacity		
		TDM Services	Ethernet Throughput at Air Interfaces (Mbit/s)[a]	XPIC Configuration[b]
	Integrated IP radio	75xE1 or 1xSTM-1	360 to 456	
ISX2	SDH radio	2xSTM-1	N/A	Supported
	Integrated IP radio	75xE1 or 1xSTM-1	360 to 456	
ISV3	SDH radio	2xSTM-1	N/A	Supported
	Integrated IP radio	75xE1 or 1xSTM-1	504 to 636 (none-XPIC) 450 to 575 (XPIC)	
ISM6	SDH radio	2xSTM-1	N/A	Supported
	Integrated IP radio	75xE1 or 1xSTM-1	504 to 636 (none-XPIC, IS3 mode) 450 to 575 (XPIC, IS3 mode)	

NOTE

- a: ISU2, ISX2, ISV3, and ISM6 boards support frame header compression at air interfaces, which significantly improves the equivalent throughout of Ethernet services at air interfaces in specific scenarios. For details, see **Microwave Work Modes**.
- b: The XPIC function doubles the service capacity of the microwave channel at the same frequency bandwidth. When running in the IS2 mode, the ISV3 board can work with the ISX2 board to implement the XPIC function. ISM6 boards support only intra-board XPIC.

2.6.2 Cross-Connect Capacity

The OptiX RTN 980 has a built-in MADM and provides 128x128 VC-4 higher order cross-connections and VC-12/VC-3 lower order cross-connections equivalent to 32x32 VC-4s.

2.6.3 Switching Capacity

The OptiX RTN 980 has a built-in packet switching platform with the switching capacity of 22 Gbit/s (with CSHN) or 43 Gbit/s (with CSHNA) .

2.7 Interfaces

The OptiX RTN 980 provides a variety of interfaces.

2.7.1 Service Interfaces

The OptiX RTN 980 provides the interfaces that converge SDH services and Ethernet services on the system control, switching, and timing board, and it is able to provide a wide-assortment of service interfaces by configuring appropriate service interface boards.

Table 2-3 lists the types and number of service interfaces that the system control, switching, and timing board supports for the OptiX RTN 980.

Table 2-3 Types and number of service interfaces that the system control, switching, and timing board supports

System Control, Switching, and Timing Board	Service Interface	Quantity
CSHN	GE electrical interface (RJ45): 10/100/1000BASE-T(X), or GE optical interface (SFP): 1000BASE-SX, 1000BASE-LX	2
	STM-4 optical interface (SFP), or STM-1 optical/electrical interface (SFP)	2
CSHNA	GE electrical interface (RJ45) or GE/FE optical interface (SFP): ● GE electrical interface: 10/100/1000BASE-T(X) ● GE optical interface: 1000BASE-SX/LX/VX/ZX/BX ● FE optical interface: 100BASE-FX/LX/VX/ZX/BX	2
	GE electrical interface (RJ45): 10/100/1000BASE-T(X)	2
	STM-4 optical interface (SFP), or STM-1 optical/electrical interface (SFP)	2

NOTE
The CSHNA board provides four GE interfaces, of which two can be GE electrical interfaces (RJ45) or GE optical interfaces (SFP), and the other two can be only GE electrical (RJ45) interfaces.

Table 2-4 lists the types and number of service interfaces that each service interface board supports for the OptiX RTN 980.

Table 2-4 Types and number of service interfaces that each service interface board supports

Service Interface Board	Service Interface	Quantity
EM6T/EM6TA	FE electrical interface (RJ45): 10/100BASE-T(X)	4
	GE electrical interface (RJ45): 10/100/1000BASE-T(X)	2
EM6F/EM6FA	FE electrical interface (RJ45): 10/100BASE-T(X)	4
	GE electrical interface (SFP) or GE/FE optical interface (SFP): ● GE electrical interface: 10/100/1000BASE-T(X) ● GE optical interface: 1000BASE-SX/LX/VX/ZX/BX ● FE optical interface: 100BASE-FX/LX/VX/ZX/BX	2
EG4	GE electrical interface (RJ45) or GE/FE optical interface (SFP): ● GE electrical interface: 10/100/1000BASE-T(X) ● GE optical interface: 1000BASE-SX/LX/VX/ZX/BX ● FE optical interface: 100BASE-FX/LX/VX/ZX/BX	2
	GE electrical interface (RJ45): 10/100/1000BASE-T(X)	2
EG4P	GE electrical interface (RJ45) or GE/FE optical interface (SFP): ● GE electrical interface: 10/100/1000BASE-T(X) ● GE optical interface: 1000BASE-SX/LX/VX/ZX/BX ● FE optical interface: 100BASE-FX/LX/VX/ZX/BX	2
	GE electrical interface with power supply (RJ45): 10/100/1000BASE-T(X)	2

Service Interface Board	Service Interface	Quantity
EX1	10GE optical interface (SFP): ● WAN mode: 10GBASE-SW/10GBASE-LW/10GBASE-EW/10GBASE-ZW ● LAN mode: 10GBASE-SR/10GBASE-LR/10GBASE-ER/10GBASE-ZR	1
EFP8	FE electrical interface (RJ45): 10/100BASE-T(X)	8
EMS6	FE electrical interface (RJ45): 10/100BASE-T(X)	4
	GE electrical interface (SFP) or GE optical interface (SFP): ● GE electrical interface: 10/100/1000BASE-T(X) ● GE optical interface: 1000BASE-SX/LX/VX/ZX	2
SP3S	75-ohm or 120-ohm E1 interface	16
SP3D	75-ohm or 120-ohm E1 interface	32
CQ1	Channelized STM-1 electrical interface (SFP) or Channelized STM-1 optical interface (SFP): Ie-1, S-1.1, L-1.1, L-1.2, S-1.1-BX, L-1.1-BX	4
SL1D/SL1DA	STM-1 electrical interface (SFP) or STM-1 optical interface (SFP): Ie-1, S-1.1, L-1.1, L-1.2	2
ML1	75-ohm or 120-ohm Smart E1 interface: supports CES E1, ATM/IMA E1, ML-PPP E1, and Fractional E1	16
MD1	75-ohm or 120-ohm Smart E1 interface: supports CES E1, ATM/IMA E1, ML-PPP E1, and Fractional E1	32

NOTE

- Smart E1 interfaces support multiple protocols through software configuration. Smart E1 interfaces on the OptiX RTN 980 support CES E1, ATM/IMA E1, ML-PPP and Fractional E1.
- Fractional E1 interfaces can make use of specific 64 kbit/s timeslots in framed E1 services. If the E1 interface is applied to Fractional CES, certain timeslots in E1 services are emulated. If the E1 interface is applied to Fractional IMA, certain timeslots in E1 services serve as the member links of IMA groups.
- Channelized STM-1 interfaces (c-STM-1) support the channelization of STM-1 into 63 E1 channels. The E1 channels support CES and ML-PPP.

2.7.2 Management and Auxiliary Ports

The OptiX RTN 980 provides the management and auxiliary ports through the system control, switching, and timing board and the auxiliary board.

Management and Auxiliary Ports

Table 2-5 Types and number of management and auxiliary ports

Port	Description	Quantity (board)
External clock port[a]	2,048 kbit/s or 2,048 kHz clock input and output port	1 (CSHN/CSHNA)
External time port[a, b]	External time input or output port (RS-422 level, 1PPS+TOD or DCLS format)	2 (CSHN/CSHNA)
Management port	10/100BASE-T(X) NM port	1 (CSHN/CSHNA)
	NM serial port	1 (CSHN/CSHNA)
	10/100BASE-T(X) NM cascading port	1 (CSHN/CSHNA)
Auxiliary port	Orderwire port	1 (AUX)
	RS-232 asynchronous data port	1 (AUX)
	64 kbit/s synchronous data port[c]	1 (AUX)
	Wayside E1 port[a]	1 (CSHN/CSHNA)
Alarm port	Alarm input port	3 (CSHNA) 4 (AUX)
	Alarm output port	1 (CSHNA) 2 (AUX)
Outdoor cabinet monitoring port[b]	RS-485 outdoor cabinet monitoring port	1 (CSHN/CSHNA)
Type-A USB port	USB port for USB flash drive, supporting database backup, database restoration, and NE software upgrades using a USB flash drive	1 (CSHNA)

Port	Description	Quantity (board)
Mini USB port	USB port for NMS, supporting NE management when the Web LCT is connected.	1 (CSHNA)

NOTE

- a: The external clock port, external time port 1, and wayside E1 port are combined into one physical port. This port can also transparently transmit the DCC bytes, orderwire overhead bytes, and synchronous/asynchronous data overhead bytes. However, this port can implement only one function at a time.
- b: External time port 2 and the outdoor cabinet monitoring port are combined into one physical port. This port can implement only one function at a time.
- c: The 64 kbit/s synchronous data port can transparently transmit the orderwire byte. However, one port can implement only one of the following two functions: 64 kbit/s synchronous data port and transparent transmission of the orderwire byte.
- The number of external clock ports or the number of management ports listed in the table is the number of ports provided by one Control, switching, and timing board.

Auxiliary Service Channel

Auxiliary services and NM messages are transmitted by overhead bytes over a radio link. For details, see **Table 2-6**.

Table 2-6 Auxiliary services channels provided by each microwave port

Service/Message Type	Microwave Frame Overhead	
	Quantity of Paths	Path Rate
Asynchronous data service	1	≤ 19.2 kbit/s
Synchronous data service	1	64 kbit/s
Orderwire phone service	1	64 kbit/s
Wayside E1 service	1	2048 kbit/s (in the SDH radio link)
DCC path	1	• 64 kbit/s (in the PDH radio link which the capacity is lower than 16xE1) • 192 kbit/s (in the PDH radio link which the capacity is not lower than 16xE1) • 192 kbit/s, 576kbit/s, or 768kbit/s (in the SDH radio link) • 192 kbit/s (in Integrated IP radio link)

2.8 MPLS/PWE3 Functions

The OptiX RTN 980 uses an MPLS that is optimized for the telecom bearer network as the packet forwarding mechanism for packet transmission of carrier-class services. The OptiX RTN 980 uses PWE3 technology as the service bearer technology to implement MPLS network access for various types of services.

Table 2-7 MPLS/PWE3 functions

<table>
<tr><th colspan="3">Function and Feature</th><th>Description</th></tr>
<tr><td rowspan="4">MPLS tunnel</td><td colspan="2">Setup mode</td><td>Static LSPs</td></tr>
<tr><td colspan="2">Bearer mode</td><td>● Ethernet port
● IP microwave port
● MLPPP link</td></tr>
<tr><td colspan="2">Protection</td><td>1:1 MPLS tunnel APS</td></tr>
<tr><td colspan="2">OAM</td><td>● MPLS OAM that complies with ITU-T Y. 1710 and ITU-T Y.1711
● MPLS-TP LSP OAM that complies with ITU-T Y.1731
● LSP ping and LSP traceroute functions</td></tr>
<tr><td rowspan="6">PWE3</td><td rowspan="3">TDM PWE3</td><td>Emulation mode</td><td>● SAToP
● CESoPSN</td></tr>
<tr><td>Packet loading time</td><td>125 μs to 5000 μs</td></tr>
<tr><td>Jitter compensation buffering time</td><td>375 μs to 16000 μs</td></tr>
<tr><td rowspan="3">ATM PWE3</td><td>Mapping mode</td><td>● 1-to-1 ATM VCC mapping
● N-to-1 ATM VCC mapping
● 1-to-1 ATM VPC mapping
● N-to-1 ATM VPC mapping</td></tr>
<tr><td>Maximum number of concatenated cells</td><td>31</td></tr>
<tr><td>Cell concatenation wait time</td><td>100 μs to 50000 μs</td></tr>
</table>

Function and Feature			Description
		Transparently transmitted ATM service	Supported
	ETH PWE3	Encapsulation mode	● Raw mode ● Tagged mode
		Service type	● E-Line ● E-Aggr ● E-LAN (VPLS)
	Setup mode		Static PWs
	Control Word		supported
	Number of PWs		Supports a maximum of 1024 PWs.
	Protection		1:1 PW APS
	OAM		● PW OAM that complies with ITU-T Y.1710 and ITU-T Y.1711 ● MPLS-TP PW OAM that complies with ITU-T Y.1731 ● VCCV ● PW ping and PW traceroute functions ● ITU-T Y.1731-compliant packet loss measurement, delay measurement, and delay variation measurement ● Intelligent service fault diagnosis
	MS-PW		Supported
	Configurable bandwidth		Supported

2.9 Ethernet Service Processing Capability

The OptiX RTN 980 has powerful Ethernet service processing capability.

Table 2-8 Ethernet service processing capability

Item	Description
Ethernet service type	● Native Ethernet services: E-Line service and E-LAN service ● PW-carried Ethernet services: E-Line service, E-Aggr service, and E-LAN (VPLS) service

Item	Description
Range of maximum frame length	1518 bytes to 9600 bytes
VLAN	● Adds, deletes, and switches VLAN tags that comply with IEEE 802.1q/p, and forwards packets based on VLAN tags. ● Processes packets based on the port tag attribute (Tag/Hybrid/Access). ● The VLAN ID ranges from 1 to 4094.
MAC address	● The E-LAN service supports the MAC address self learning capability in two learning modes: SVL and IVL. ● MAC addresses can be filtered; that is, MAC addresses can be blacklisted. ● Static MAC address entries can be set. ● The capacity of the MAC address table is 16 k (including static entities and blacklist entities). ● The MAC address aging time can be configured.
Spanning tree	Supports the MSTP protocol, and generates only the Common and Internal Spanning Tree (CIST). The functions of the MSTP protocol are equal to those of the RSTP protocol.
IGMP Snooping	Supported
Link aggregation (LAG)	Applies to the FE/GE port and microwave port. ● Supports manual aggregation and static aggregation ● Supports load sharing and non-load sharing. ● The load sharing hash algorithm is implemented based on MAC addresses, IP addresses, or MPLS labels, and supports the specified mode and automatic mode.
Physical link aggregation	Supports PLA and EPLA fucntions. PLA and EPLA are Layer 1 link aggregation group (L1 LAG) technology, which shares load based on the bandwidth at the physical layer to achieve link aggregation. Physical link aggregation does not use the Hash algorithm and is independent of service flow compositions and therefore makes full use of link bandwidth. ● A PLA group supports a maximum of two member links. ● An EPLA group supports a maximum of four member links.
ERPS	Supports ITU-T G.8032v1/v2-compliant single-ring or multi-ring network protection for Ethernet services.
LPT	Disables the remote Ethernet port that is connected to the user equipment when the transmission network or local port fails.
QoS	Supports QoS. For details, see **2.10 QoS**.

Item	Description
Traffic control function	Supports the IEEE 802.3x-compliant traffic control function.
ETH-OAM	• Supports IEEE 802.1ag- and IEEE 802.3ah-compliant ETH-OAM functions. • Supports ITU-T Y.1731-compliant ETH-OAM functions, supports packet loss measurement, delay measurement, and delay variation measurement.
Ethernet performance monitoring	• Supports IETF RFC2819-compliant RMON performance monitoring. • Measures real-time and historical traffic and bandwidth utilization for ports. • Measures real-time and historical performance events for DS domains, flows, VLANs, traffics on UNI side, PWs, and egress queues. • Measures packet loss due to congestion for flows. • Measures packet loss due to congestion for PWs and egress queues.
Synchronous Ethernet	Supports ITU-T G.8261- and ITU-T G.8262-compliant synchronous Ethernet.
EoPDH	Supported. The EFP8 board provides the EoPDH function.
EoSDH	Supported. The EMS6 board provides the EoSDH function.

NOTE

- The E-Line service is an Ethernet private line service. The OptiX RTN 980 supports a maximum of 1024 E-Line services.
  - For Native Ethernet services, the OptiX RTN 980 supports E-Line services based on the port, port +VLAN, and port+QinQ.
  - For PW-carried Ethernet services, the OptiX RTN 980 supports E-Line services based on the port, and port+VLAN.
- The E-Aggr service is an Ethernet aggregation service. The OptiX RTN 980 supports E-Aggr services from multiple UNIs to one PW and E-Aggr services from multiple PWs to one UNI. The OptiX RTN980 supports a maximum of 128 E-Aggr services.
- The E-LAN service is an Ethernet local area network (LAN) service.
  - For Native Ethernet services, the OptiX RTN 980 supports the E-LAN service based on the 802.1d bridge, 802.1q bridge, and 802.1ad bridge. The bridge supports a maximum of 1024 logical ports.
  - For PW-carried Ethernet services, the OptiX RTN 980 supports virtual private LAN services (VPLS) based on virtual switch instances (VSI). The OptiX RTN 980 supports a maximum of 128 VSIs and 512 logical ports.

2.10 QoS

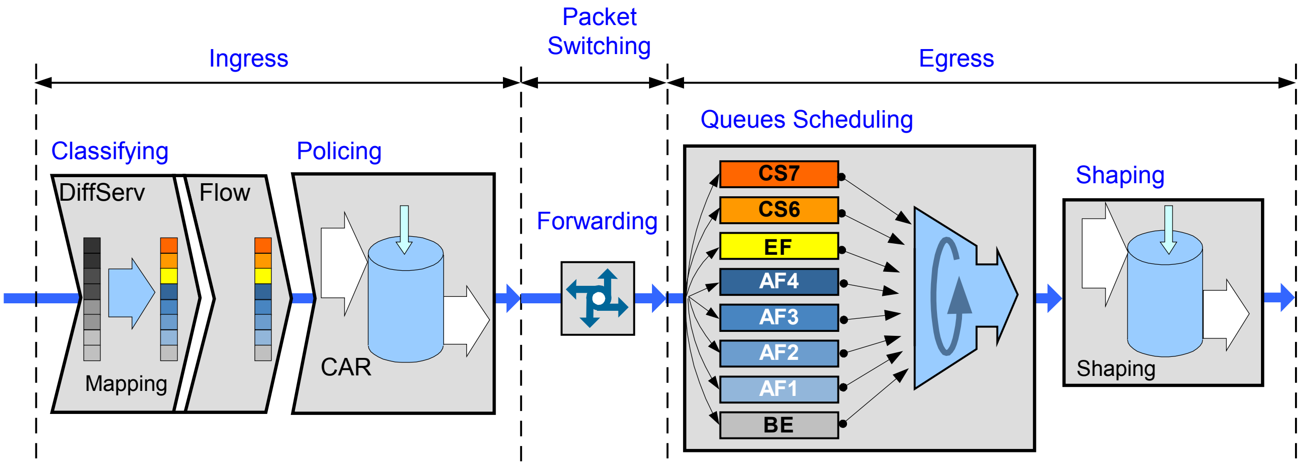
The OptiX RTN 980 provides improved quality of service (QoS) and supports the following eight types of per-hop behaviors (PHBs): BE, AF1, AF2, AF3, AF4, EF, CS6, and CS7.

Therefore, network carriers can offer various QoS levels of service guarantees and build networks that carry data, voice, and video services.

Table 2-9 QoS features

Feature	Performance
DiffServv	● For Ethernet services, supports mapping the Ethernet service into different PHB service levels based on the C-VLAN priority, S-VLAN priority, IP DSCP value, and MPLS EXP value. ● For ATM services, supports flexible mapping between the ATM service categories (CBR, UBR, UBR+, rtVBR, and nrtVBR) and PHB service levels. ● For CES services, the PHB service level of each CES service can be set manually (EF by default).
Traffic classification	Supports port traffic classification based on VLAN ID, VLAN priority, MAC address, or DSCP.
Traffic policing	Supports flow-based traffic policing and the setting of PIR and CIR in steps of 64 kbit/s.
Queue scheduling	● Each Ethernet port or Integrated IP radio port supports eight levels of priority scheduling. ● Flexibly sets the queue scheduling scheme for each Ethernet port and Integrated IP radio port. The queue scheduling modes include SP, SP +WRR, and WRR.
Congestion avoidance	Drops packets in tail drop mode or weighted random early detection (WRED) mode.
Traffic shaping	● Supports the shaping for the specified port, priority queue, or service flow. ● Supports a step of 64 kbit/s for the PIR and CIR.

Figure 2-7 Typical QoS application (Native Ethernet services)



2.11 Clock Features

The OptiX RTN 980 supports clock synchronization and IEEE 1588v2 time synchronization, meeting the clock and time synchronization requirements of mobile networks. In addition, the OptiX RTN 980 provides an advanced clock protection mechanism.

Clock synchronization

Table 2-10 Clock synchronization features

Item	Description
Equipment clock	Supports the three modes as defined in ITU-T G.813: tracing mode, holdover mode, and free-run mode.
Clock synchronization	Supports the following clock sources: ● SDH line clock ● E1 tributary clock ● Radio link clock ● Synchronous Ethernet clock ● Channelized STM-1 line clock ● E1 clock of the E1 channel mapped in Channelized STM-1 ● 2048 kbit/s or 2048 kHz external clock ● IEEE 1588v2 clock ● IEEE 1588 ACR clock
SSM protocol/Extended SSM protocol	Supported. SSM information can be transmitted in the following interfaces: ● SDH line ● SDH radio link ● Integrated IP radio link ● Synchronization Ethernet interface ● 2048 kbit/s external clock interface, supporting the SSM protocol and not supporting the extended SSM protocol
Tributary clock	● Supports retiming for Native E1 and CES E1 services. ● Supports the transparent transmission of E1 clocks. ● Supports CES ACR clocks.
Channelized STM-1 line clock re-timing	Supported. CQ1 boards can use the receive clock of STM-1 signals as transmit clock.
Output of the external clock	Supported (120-ohm interface complying with G.703, 2048 kbit/s or 2048 kHz mode)

Time synchronization

Table 2-11 Time synchronization features

Item	Description
Clock Model	OC, BC, TC, TC+BC
Input of the external time	Supported
Time source selection and protection	• BMC algorithm • Static selection for time sources
Time synchronization	Supports the following time sources: • IEEE 1588v2 clock • External time interface
Time transparent transmission	Transparent transmission of IEEE 1588v2 time signals
Output of the external time	Supported

2.12 Protection Capability

The OptiX RTN 980 provides a variety of protection schemes.

Table 2-12 Protection schemes

<table>
<tr><th colspan="2">Item</th><th>Description</th></tr>
<tr><td rowspan="3">Equipment-level protection</td><td>Power input</td><td>1+1 hot backup</td></tr>
<tr><td>Internal power module</td><td>1+1 hot backup</td></tr>
<tr><td>Control, switching, and timing board</td><td>1+1 hot backup</td></tr>
<tr><td colspan="2" rowspan="2">Radio links</td><td>1+1 HSB/SD/FD protection</td></tr>
<tr><td>N+1 protection</td></tr>
<tr><td rowspan="2">TDM services</td><td>E1/VC12/VC4</td><td>SNCP protection</td></tr>
<tr><td>STM-1/STM-4</td><td>1+1 or 1:N linear multiplex section protection (STM-1/STM-4)
Two-fiber bi-directional multiplex section protection ring (STM-4)</td></tr>
</table>

Item		Description
Ethernet services	Ethernet links	LAG protection
	Radio links	LAG protection
		PLA protection and EPLA protection
Native Ethernet network		ERPS protection
		MSTP protection
L2VPN	MPLS	MPLS tunnel 1:1 protection
	PW	PW 1:1 APS/FPS
	ATM over E1	IMA protection
	Tunnel over E1	ML-PPP protection
	Channelized STM-1	1:1 linear multiplex section protection

2.13 Network Management

The OptiX RTN 980 supports multiple network management (NM) modes and provides comprehensive NM information exchange schemes.

NM Mode

The OptiX RTN 980 supports the following NM modes:

- Per-NE management (for example, management of a local NE or a remote NE) by the iManager Web LCT
- Central management of OptiX RTN NEs and other OptiX NEs by the iManager U2000
- SNMP agent-based management, which allows operators to query alarms, performance events, NE parameters and service parameters by performing SNMP GET operations, and to configure NE parameters and service parameters by performing SNMP SET operations

LLDP Function

The OptiX RTN 980 and another device (such as a base station) that are both enabled with the Link Layer Discovery Protocol (LLDP) can discover each other. The LLDP function helps to archive:

- Display of the topology of a network that comprises different types of equipment on an NMS.
- Simplified fault diagnosis.

NM Information Exchange Schemes

The OptiX RTN 980 supports inband DCN and outband DCN.

Table 2-13 DCN information exchange schemes

Item			Specifications
DCN channel	DCC bytes	Integrated IP radio	Three DCC bytes that are defined by Huawei
		SDH radio	D1-D3, D4-D12, or D1-D12 bytes
		SDH line	D1-D3, D4-D12, or D1-D12 bytes
		Channelized STM-1 line	D1-D3, D4-D12, or D1-D12 bytes
		PDH radio	One or three DCC bytes that are defined by Huawei
		External clock port	Supports the transmission of DCC bytes through the external clock port.
	Network management port		Supports one network management Ethernet port or one network management Ethernet cascade port.
	Inband DCN	Integrated IP radio	The inband DCN channel is marked with the VLAN tag and its bandwidth is configurable.
		FE/GE port	The inband DCN channel is marked with the VLAN tag and its bandwidth is configurable.
		Smart E1 port	The inband DCN signals are carried by ML-PPP links. The inband DCN channel is marked with the VLAN tag and its bandwidth is configurable.
		Channelized STM-1 port	The inband DCN signals are carried by ML-PPP links. The inband DCN channel is marked with the VLAN tag and its bandwidth is configurable.
Network management protocol	HWECC protocol		Supported
	IP protocols		Supported
	L2 DCN		Supported

2.14 Easy Installation

The OptiX RTN 980 supports several installation modes. That is, the installation is flexible and convenient.

An IDU can be installed on the following types of cabinets and surfaces:

- In a 300 mm or 600 mm ETSI cabinet
- In a 450 mm or 600 mm 19-inch cabinet
- In an open rack
- In an outdoor cabinet

An ODU supports two installation modes: direct mounting and separate mounting.

2.15 Easy Maintenance

The OptiX RTN 980 provides plentiful maintenance features that effectively reduce the costs associated with maintaining the equipment.

2.15.1 Equipment-level OAM

The hardware and software design of the OptiX RTN980 takes the convenience of fault diagnosis and maintenance into consideration.

Table 2-14 describes the OAM functions supported by the OptiX RTN 980.

Table 2-14 Equipment-level OAM

Function	Description
Management and monitoring	● The OptiX RTN 980 can be managed together with optical transmission equipment by the U2000. ● Supports various alarms and performance events. ● Supports RMON performance statistics on various types of objects. ● Supports the monitoring and graphic display of key radio transmission performance indicators such as microwave transmit power, received power, signal to noise ratio (SNR), and air-interface BER. ● Supports the monitoring and graphic display of Ethernet performance specifications such as port traffic and bandwidth utilization.
Hardware maintenance	● Each IDU board has running and alarm status indicators. ● All the indicators and cable ports are available on the front panel of the IDU. ● The system control, switching, and timing board, IF board, service board, and fan board support hot swapping.
Diagnosis and Testing	● Supports PRBS tests by IF ports. ● Supports PRBS tests by Native E1 and CES E1 ports. ● Simulates Ethernet meters to test packet loss, delay, and throughput. ● Supports various loopback types over service ports and IF ports.

Function	Description
Packet service OAM	● Supports IEEE 802.1ag- and IEEE 802.3ah-compliant ETH OAM functions. ● Supports ITU-T Y.1731-compliant packet loss measurement, delay measurement, and delay variation measurement for Ethernet services. ● Supports the ITUT-T Y.1711-compliant MPLS OAM function and LSP ping/traceroute. ● Supports the ITUT-T Y.1711-compliant PW OAM function and PW ping/traceroute. ● Supports the ITU-T Y.1731-compliant MPLS-TP LSP OAM and PW OAM functions.
Database management	● Remotely backs up and restores the NE database by using the U2000. ● The CF card that stores the configuration data and software can be replaced online. Therefore, users can load the data or upgrade the software by replacing the CF card. ● Two copies of software and data are stored in the flash memory of the system control, switching, and timing board to meet the smooth upgrade requirements.
Software management	● Remotely loads NE software and data by using the U2000 and provides a quick NE upgrade solution. ● Supports the NSF function. SDH/PDH services and Ethernet E-Line services are not interrupted during warm resets on NE software. ● Supports hot patch loading. Users can upgrade software without interrupting services. ● Supports software version rollback so that original system services are restored despite software upgrade failures.

2.15.2 Packet Services OAM (TP-Assist)

The OptiX RTN 980 works with the iManager U2000 to allow hierarchy OAM of packet services. Packet OAM supports end-to-end service configuration, acceptance tests, and fault locating, therefore simplifying operation and maintenance of packet services.

Table 2-15 describes the packet OAM functions supported by the OptiX RTN 980.

Table 2-15 Packet OAM (TP-Assist)

OAM Stage	Subitem	Description
End-to-end service configuration	End-to-end packet service configuration	● Supports end-to-end configuration of Native E-Line/E-LAN services. ● Supports end-to-end configuration of MPLS tunnel and ETH PWE3.
	Automatic deployment of alarm management	● Automatically configures end-to-end ETH OAM during Native Ethernet service configuration and supports connectivity tests and alarm reporting. ● Automatically configures end-to-end MPLS-TP OAM during MPLS tunnel service configuration and supports connectivity tests and alarm reporting. ● Automatically configures end-to-end ETH-OAM during ETH PWE3 service configuration and supports connectivity tests and alarm reporting.
Acceptance tests	Service connectivity tests	● Supports one-click connectivity test of Native E-Line and E-LAN services. ● Supports one-click connectivity test of the E-Line services carried by MPLS tunnels.
	Service performance tests	● Supports one-click test on packet loss, delay, and delay variation of Native E-Line and E-LAN services. ● Supports one-click test on packet loss, delay, and delay variation of the E-Line services carried by MPLS tunnels. ● Simulates Ethernet meters to test packet loss, delay, and throughput.
Fault locating	Port IP ping	● Supports local ping at UNI ports. ● Supports remote ping at UNI ports.
	Port monitoring	● Reports alarms indicating Ethernet signal loss. ● Reports alarms indicating Ethernet port auto-negotiation failures (half-duplex alarm).
	Service loopback detecting	● Detects loopbacks in E-Line services. ● Automatically disables the service ports involved in a loop.
	Intelligent fault diagnosis	● Checks the integrity of hardware, software, and configuration along a service path. ● Detects zero traffic and packet loss along a service path.

OAM Stage	Subitem	Description
	Performance statistics	● Measures real-time and historical performance events for Ports, DS domains, flows, VLANs, UNI-side services, PWs, tunnel, and egress queues. ● Measures packet loss due to congestion for flows, PWs bandwidth, and egress queues.
	Performance monitoring	● Reports traffic threshold-crossing alarms by DS domain, VLAN, V-UNI, PW, and egress queue. ● Reports port bandwidth utilization threshold-crossing alarms. ● Reports packet loss threshold-crossing alarms for flows, PWs bandwidth, and egress queues. ● Reports zero-traffic alarms for Ports, DS domains, flows, VLANs, UNI-side services, PWs, and egress queues.

2.16 Security Management

The OptiX RTN 980 can prevent unauthorized logins and operations, ensuring equipment management security.

Hardware Security

The OptiX RTN 980 adopts high-reliability hardware design to ensure that the system runs properly under security threats.

The following hardware preventive measures are provided:

- Microwave interfaces: The FEC encoding mode is adopted and the adaptive time-domain equalizer for baseband signals is used. This enables the microwave interfaces to tolerate strong interference. Therefore, an interceptor cannot restore the contents in a data frame if coding details and service configurations are not obtained.
- Modular design: Control units are separated from service units and service units are separated from each other. In this manner, a fault on any unit can be properly isolated, minimizing the impact of the fault on other units in the system.
- CPU flow control: Data flow sent to the CPU for processing is classified and controlled to prevent the CPU from being attacked by a large number of packets. This ensures that the CPU operates properly under attacks.

Software Security

The OptiX RTN 980 processes two categories of data: O&M data and service data. The preceding data is transmitted over independent physical paths or logical paths and does not affect each other. Therefore, services on the OptiX RTN 950 are processed on two planes:

- Management plane

  The management plane provides access to the required equipment and management functions, such as managing accounts and passwords, communication protocols, and alarm reporting. The security feature of the management plane enables secure device access, concentrated management, and thorough security audit.

- Data plane

  The data plane processes service data that enters the devices and forwards service data packets according to hardware forwarding entries. On one hand, the data plane prevents user service packets from being intercepted, modified, or deleted, which endangers the confidentiality and completeness of user data. On the other hand, the data plane ensures the control of hardware forwarding actions, preventing forwarding entries from being attacked or modified. In this manner, the forwarding plane of the devices can function stably and reliably.

Table 2-16lists the security functions provided by the OptiX RTN 980.

Table 2-16 Security functions

Plane	Function	Description
Management plane	Account and password management	Manages and saves device maintenance accounts.
	Local authentication and authorization	Checks account validity and performs authorization.
	RADIUS authorization and authentication	Checks account validity and remotely performs authorization in the concentrated mode, reducing the maintenance cost.
	Security log	Records actions about account management.
	Operation log	Records non-query operations.
	SYSLOG Management	Functions as a standard solution for saving logs offline, effectively resolving the deficient saving space problem.
	TCP/IP protocol stack attack prevention	Provides basic TCP/IP attack prevention capability, such as attacks from incorrect IP packets, ICMP ping/ jolt, and DoS.
	Access Control List (ACL)	Provides ACL based on IP addresses and port numbers.
	SSL/TLS encryption communication	Supports SSL3.0/TLS1.0 and provides secure encrypted tunnels based on security certifications.
	SSH security communication	Provides the SSHv2 server and SFTP client service.

Plane	Function	Description
	OSPF route protocol	Provides OSPFv2, capable of standard MD5 authentication.
	NTP protocol	Provides NTPv3, capable of MD5 authentication and authorization control.
	SNMP management protocol	Provides SNMPv3, capable of security authentication and data encryption functions.
Data plane	Flow control	Monitors port traffic. Suppresses multicast packets, discards unknown unicast/multicast packets, and uses QoS to control service traffic.
	Discarding of error packets	Discards invalid error packets. For example, a packet whose size is smaller than 46 bytes.
	Loop avoidance	Detects loopback at services ports, blocks loopback, and supports service loopback detection of Ethernet ports.
	Layer 2 service access control	Provides the access control capabilities: filtering of static MAC addresses, blacklist, learning and forbidding of MAC addresses, and filtering based on complex traffic classification.
	Service isolation	Provides three isolation methods: Layer 2 logical isolation, horizontal isolation, and physical isolation.
	Strict isolation of user services	Strictly isolates MPLS services within the carrier networks and from client-side services.

2.17 Energy Saving

The OptiX RTN 980 uses various types of technologies to reduce the amount of energy that the device consumes. The device:

- Uses a streamlined scheme for board design.
- Replaces ordinary chips with ASIC chips that consume less power.
- Uses high-efficiency power modules.
- Supports intelligent adjustment of the fan speed that dissipates heat in a timely manner, reduces power consumption, and minimizes noise.
- Shuts down idle FE/GE ports and SFP optical modules.

2.18 Environmental Protection

The OptiX RTN 980 is designed to meet or exceed environmental protection requirements. The product complies with the RoHS directive and WEEE directive.

- The OptiX RTN 980 undergoes a compulsory packing process that limits the size of the package containing the equipment and accessories to three times that of the equipment dimensions.
- The product is designed for easy unpacking. In addition, all hazardous substances contained in the packaging decompose quickly.
- Every plastic component that weighs over 25 g is labeled according to the standards of ISO 11469 and ISO 1043-1 to ISO 1043-4. All components and packages of the equipment are provided with standard labels for recycling.
- Plugs and connectors are easy to find and the associated operations can be performed using standard tools.
- All the accompanying materials (such as labels) are easy to remove. Certain types of identifying information (such as silkscreens) are printed on the front panel or chassis.

3 Product Structure

About This Chapter

This chapter describes the system architecture, hardware architecture, and software architecture of the product, in addition to how the system processes service signals.

The OptiX RTN 980 consists of a series of functional units, including the service interface unit, timeslot cross-connect unit, packet switching unit, IF unit, control unit, clock unit, auxiliary interface unit, fan unit, power unit, and ODU.

The OptiX RTN 980 adopts a split structure. The system consists of the IDU 980 and the ODU. An ODU is connected to the IDU 980 through an IF cable. The IF cable transmits IF service signals and the O&M signals of the ODU and also supplies -48 V DC power to the ODU.

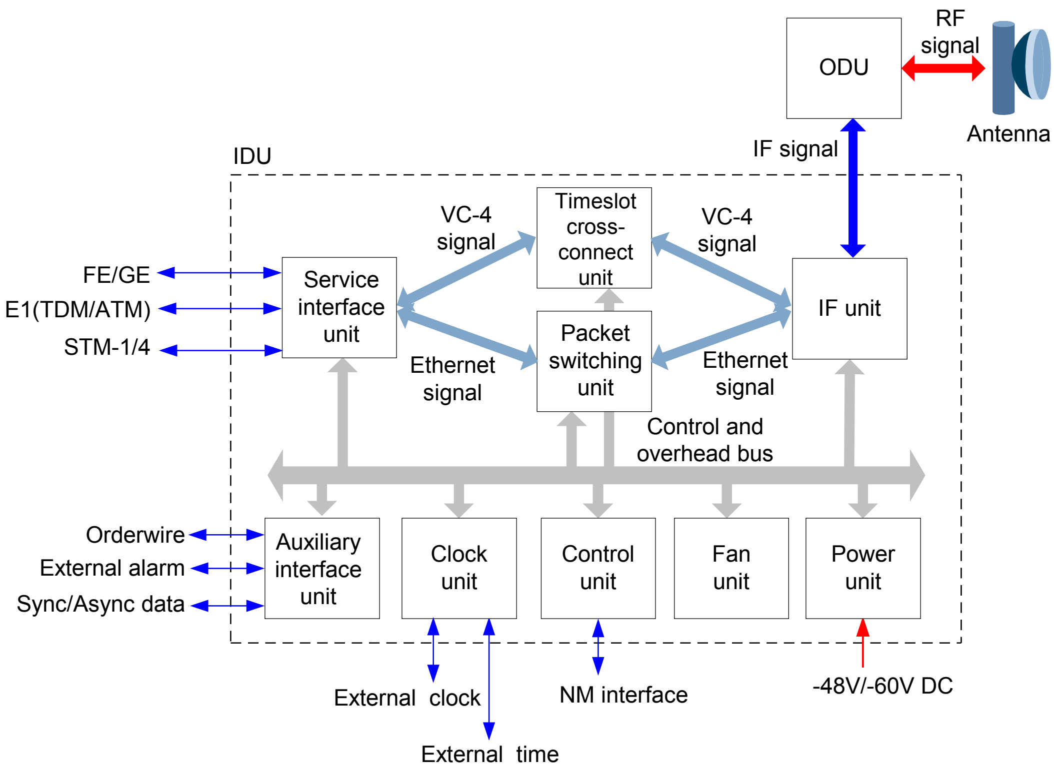
The OptiX RTN 980 software consists of the NMS software, IDU software, and ODU software.

The signal processing flows for the SDH/PDH microwave, Hybrid microwave, and packet microwave are different.

3.1 System Architecture

The OptiX RTN 980 consists of a series of functional units, including the service interface unit, timeslot cross-connect unit, packet switching unit, IF unit, control unit, clock unit, auxiliary interface unit, fan unit, power unit, and ODU.

Figure 3-1 Block diagram



NOTE

With the EoPDH function, Ethernet services can be transmitted over SDH/PDH microwave.

Table 3-1 Functional units

Functional Unit	Function
Service interface unit	● Receives/Transmits TDM E1 signals. ● Receives/Transmits ATM/IMA E1 signals, and demultiplexes ATM services from ATM/IMA E1 signals. ● Receives/Transmits STM-1/4 signals. ● Receives/Transmits FE/GE signals. ● Uses the EoSDH/EoPDH function to encapsulate Ethernet services into SDH or E1 signals. ● Performs E1/ATM/Ethernet service emulation based on PWE3.

Functional Unit	Function
Timeslot cross-connect unit	Provides the cross-connect function and grooms TDM services.
Packet switching unit	● Processes Ethernet services and forwards packets. ● Processes MPLS labels and forwards packets. ● Processes PW labels and forwards packets.
IF unit	● Maps service signals to microwave frame signals and demaps microwave frame signals to service signals. ● Performs conversion between microwave frame signals and IF analog signals. ● Provides the O&M channel between the IDU and the ODU. ● Supports FEC.
Control unit	● Provides the system communications and control. ● Provides the system configuration and management. ● Collects alarms and monitors performance. ● Processes overheads.
Clock unit	● Traces the clock source signal and provides various clock signals for the system. ● Supports input and output of external clock. ● Supports input or output of external time signal. ● Provides the time synchronization function.
Auxiliary interface unit	● Provides the orderwire interface. ● Provides the synchronous/asynchronous data interface. ● Provides the external alarm input/output interface.
Power unit	● Accesses -48 V/-60 V DC power. ● Provides DC power for the IDU. ● Provides -48 V DC power for the ODU.
Fan unit	Provides air cooling for the IDU.
ODU	● Converts IF signals into RF signals. ● Amplifies RF signals.

3.2 Hardware Structure

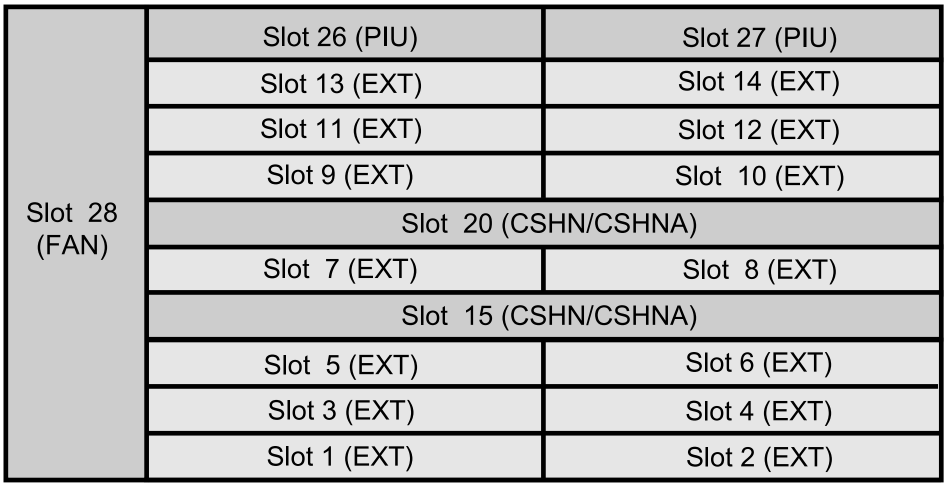
The OptiX RTN 980 adopts a split structure. The system consists of the IDU 980 and the ODU. An ODU is connected to the IDU 980 through an IF cable. The IF cable transmits IF service signals and the O&M signals of the ODU and also supplies -48 V DC power to the ODU.

3.2.1 IDU

The IDU 980 is the indoor unit of the OptiX RTN 980.

The IDU 980 uses a card plug-in design. It implements different functions by configuring different types of boards. All extended service boards are hot-swappable.

Figure 3-2 IDU slot layout



NOTE

"EXT" represents an extended slot, which can house any type of IF board or interface board.

Table 3-2 List of the IDU boards

Board Acronym	Board Name	Valid Slot	Description
CSHN	Hybrid system control, switching, and timing board	Slot 15/20	● Provides full time division cross-connections with higher order cross-connect capacity of 128x128 VC-4s and lower order cross-connect capacity of 32x32 VC-4s. ● Provides packet switching capacity of 22 Gbit/s. ● Performs system communication and control. ● Provides the clock processing function, supports one external clock input/output and two external time inputs/outputs. External time interface 1 shares a port with the external clock interface. ● Provides one Ethernet NM interface, one NM serial interface, and one NM cascading interface. ● Provide two STM-4 optical interfaces or two STM-1 optical/electrical interfaces equipped with SFP modules. ● Provides two GE interfaces. Each GE interface can use the RJ45 electrical module or SFP optical module. ● Provides one Huawei outdoor cabinet monitoring interface. The outdoor cabinet monitoring interface shares a port with external time interface 2.

Board Acronym	Board Name	Valid Slot	Description
CSHNA	Hybrid system control, switching, and timing board	Slot 15/20	● Provides full time division cross-connections with higher order cross-connect capacity of 128x128 VC-4s and lower order cross-connect capacity of 32x32 VC-4s. ● Provides packet switching capacity of 43 Gbit/s. ● Performs system communication and control. ● Provides the clock processing function, supports one external clock input/output and two external time inputs/outputs. External time interface 1 shares a port with the external clock interface. ● Provides one Ethernet NM interface, one NM serial interface, and one NM cascading interface. ● Provide two STM-4 optical interfaces or two STM-1 optical/electrical interfaces equipped with SFP modules. ● Provides four GE interfaces, of which two can be GE electrical interfaces (RJ45) or GE optical interfaces (SFP), and the other two can be only GE electrical (RJ45) interfaces. ● Provides a Type A USB port that supports software upgrades, data backup, and command script loading using a USB flash drive. ● Provides a Mini USB port to connect to a local maintenance terminal. ● Provides one Huawei outdoor cabinet monitoring interface. The outdoor cabinet monitoring interface shares a port with external time interface 2. ● Provides three-input and one-output external alarm interfaces.
ISU2	Universal IF board	Slot 1 to slot 14	● Provides one IF interface. ● Supports modulation schemes from QPSK to 256QAM. ● Supports integrated IP radio and SDH radio. The supported service modes are Native E1+Ethernet, Native STM-1+Ethernet or SDH. ● Supports the AM function. ● Supports bandwidth acceleration at air interfaces (Ethernet frame header compression). ● Supports the PLA function. ● Supports the EPLA function when using CSHNA.

Board Acronym	Board Name	Valid Slot	Description
ISX2	Universal XPIC IF board	Slot 1 to slot 14	• Provides one IF interface. • Supports modulation schemes from QPSK to 256QAM. • Supports integrated IP radio and SDH radio. The supported service modes are Native E1+Ethernet, Native STM-1+Ethernet or SDH. • Supports the XPIC function. • Supports the AM function. • Supports the AM booster function. • Supports bandwidth acceleration at air interfaces (Ethernet frame header compression). • Supports the PLA function. • Supports the EPLA function when using CSHNA.

ISV3	Versatile IF board	Slot 1 to slot 14	• Provides one IF interface.
			• Supports multiple IF running modes:
			  – IS3: The highest-order modulation mode is 2048QAM. When working in IS3 mode, ISV3 boards can interconnect with each other or with RTN 905.
			  – IS2: The highest-order modulation mode is 256QAM. When working in IS2 mode, ISV3 boards can interconnect with ISU2/ISX2 boards.
			• Supports integrated IP microwave and SDH microwave. The supported service modes are Native E1+Ethernet, Native STM-1+Ethernet or SDH.
			• Supports the XPIC function.
			• Supports the AM function.
			• Supports bandwidth acceleration at air interfaces (Ethernet frame header compression).
			• Supports enhanced compression at air interfaces (Ethernet payload compression).
			• Supports the PLA function.
			• Supports the EPLA function when using CSHNA.

Board Acronym	Board Name	Valid Slot	Description
ISM6	Two-channel versatile IF board	Slot 1 to slot 14	• Provides two IF interfaces. The two IF interfaces can be used together or independently. • Supports multiple IF running modes: – IS6: The highest-order modulation mode is 4096QAM. The maximum channel spacing is 112 MHz (in witch the highest-order modulation mode is 512QAM). – IS3: The highest-order modulation mode is 2048QAM. When working in IS3 mode, ISM6 boards can interconnect with ISV3 baords or RTN 905. – IS2: The highest-order modulation mode is 256QAM. When working in IS2 mode, ISM6 boards can interconnect with ISU2/ISX2 boards. • Supports integrated IP radio and SDH radio. Available service modes include Native E1 +Ethernet, Native STM-1+Ethernet, and SDH. • Supports 1+1 protection, which is implemented based on the two IF channels on the board. • Supports XPIC, which is implemented based on the two IF channels on the board. • Supports 1+1 protection for an XPIC group, which is implemented based on two boards. • Supports intra-board PLA. • Supports EPLA when working with the CSHNA board. • Supports AM. • Supports bandwidth acceleration at air interfaces (Ethernet frame header compression). • Hardware ready for the multiple-input multiple-output (MIMO) function.
IF1	SDH IF board	Slot 1 to slot 14	• Provides one IF interface. • Supports modulation schemes from QPSK to 128QAM. • Supports the TU-based PDH radio solution and the STM-1-based SDH radio solution.

Board Acronym	Board Name	Valid Slot	Description
IFU2	Universal IF board	Slot 1 to slot 14	● Provides one IF interface. ● Supports modulation schemes from QPSK to 256QAM. ● Supports integrated IP microwave in Native E1 +Ethernet service mode. ● Supports the AM function. ● Supports the EPLA function when using CSHNA.
IFX2	Universal XPIC IF board	Slot 1 to slot 14	● Provides one IF interface. ● Supports modulation schemes from QPSK to 256QAM. ● Supports integrated IP microwave in Native E1 +Ethernet mode. ● Supports the XPIC function. ● Supports the AM function. ● Supports the EPLA function when using CSHNA.
SL1D	2xSTM-1 interface board	Slot 1 to slot 14	Uses SFP modules to provide two STM-1 optical/ electrical interfaces.
SL1DA	2xSTM-1 interface board	Slot 1 to slot 6	● Uses SFP modules to provide two STM-1 optical/ electrical interfaces. ● Support K byte transparent transmission.
CQ1	4-port channelized STM-1 interface board	Slot 1 to slot 14	● Uses the SFP optical module to provide four channelized STM-1 optical/electrical interfaces. ● Supports CES E1 and ML-PPP E1 functions for E1s in STM-1 frame. ● Supports transmission of overhead bytes over CES E1.
EM6T	6-port RJ45 Ethernet/ Gigabit Ethernet interface board	Slot 1 to slot 14	● Provides four FE electrical interfaces. ● Provides two GE electrical interfaces that are compatible with the FE electrical interface. ● Supports synchronous Ethernet.
EM6F	4-port RJ45 + 2-port SFP Fast Ethernet/ Gigabit Ethernet interface board	Slot 1 to slot 14	● Provides four FE electrical interfaces. ● Uses SFP modules to provide two GE/FE optical interfaces or GE electrical interfaces. The GE electrical interfaces are compatible with the FE electrical interfaces. ● Supports the synchronous Ethernet.

Board Acronym	Board Name	Valid Slot	Description
EM6TA	6-port RJ45 Ethernet/ Gigabit Ethernet interface board	Slot 1 to slot 14	● Provides four FE electrical interfaces. ● Provides two GE electrical interfaces that are compatible with the FE electrical interface. ● Supports the synchronous Ethernet. ● Supports the IEEE 1588v2 feature.
EM6FA	4-port RJ45 + 2-port SFP Fast Ethernet/ Gigabit Ethernet interface board	Slot 1 to slot 14	● Provides four FE electrical interfaces. ● Uses SFP modules to provide two GE/FE optical interfaces or GE electrical interfaces. The GE electrical interfaces are compatible with the FE electrical interfaces. ● Supports the synchronous Ethernet. ● Supports the IEEE 1588v2 feature.
EG4	2-port RJ45/SFP + 2-port RJ45 Gigabit Ethernet interface board	Slot 1 to slot 14	● Provides four GE interfaces, of which two can be RJ45 GE electrical interfaces or SFP GE optical interfaces, and the other two can be only RJ45 GE electrical interfaces. The GE electrical interfaces are compatible with the FE electrical interfaces. ● Supports the synchronous Ethernet. ● Supports the IEEE 1588v2 feature.
EG4P	2-port RJ45/SFP + 2-port RJ45 Gigabit Ethernet interface board with the power supply function	Slot 1 to slot 14	● Provides four GE interfaces, of which two can be RJ45 GE electrical interfaces or SFP GE optical interfaces, and the other two can be only RJ45 GE electrical interfaces and support the power over Ethernet function. The GE electrical interfaces are compatible with the FE electrical interfaces. ● Supports the synchronous Ethernet. ● Supports the IEEE 1588v2 feature.
EX1	1x10GE interface board	slot 1 to slot 2	● Uses XFP modules to provide one 10GE interface. ● Supports synchronous Ethernet. ● Supports IEEE 1588v2. **NOTE** The RTN 980 supports EX1 boards only if it houses CSHNA boards.

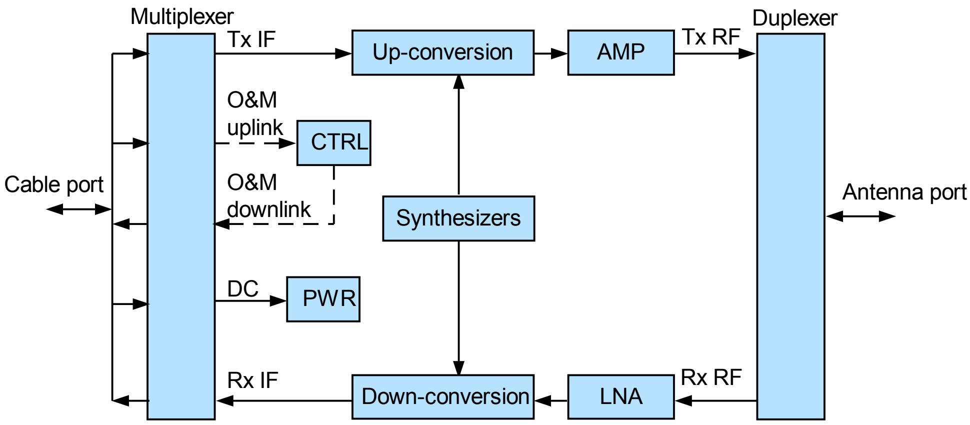
Board Acronym	Board Name	Valid Slot	Description
EFP8	8-port RJ45 FE EoPDH processing board with the switching function	Slot 1 to slot 14	• Provides eight FE electrical interfaces. • Bridges to the packet plane through one internal GE interface. • Supports the processing of EoPDH services. • Supports Ethernet transparent transmission services and Layer 2 switching services. • Supports synchronous Ethernet.
EMS6	4-port RJ45 and 2-port SFP FE/GE EoSDH processing board with the switching function	Slot 1 to slot 6	• Provides four FE electrical interfaces. • Uses SFP modules to provide two GE optical interfaces or GE electrical interfaces. The GE electrical interfaces are compatible with the FE electrical interfaces. • Bridges to the packet plane through one internal GE interface. • Supports the processing of EoSDH services. • Supports Ethernet transparent transmission services and Layer 2 switching services. • Supports synchronous Ethernet.
ML1	16xE1 (Smart) tributary board	Slot 1 to slot 14	• Provides sixteen 75-ohm or 120-ohm Smart E1 interfaces. • Supports CES E1, ATM/IMA E1, ML-PPP E1, and Fractional E1.
MD1	32xE1 (Smart) tributary board	Slot 1 to slot 14	• Provides thirty-two 75-ohm or 120-ohm Smart E1 interfaces. • Supports CES E1, ATM/IMA E1, ML-PPP E1, and Fractional E1.
SP3S	16xE1 tributary board	Slot 1 to slot 14	Provides sixteen 75-ohm or 120-ohm TDM E1 interfaces.
SP3D	32xE1 tributary board	Slot 1 to slot 14	Provides thirty-two 75-ohm or 120-ohm TDM E1 interfaces.
AUX	Auxiliary interface board	Slot 1 to slot 14	Provides one orderwire interface, one asynchronous data interface, one synchronous data interface, and four-input and two-output external alarm interfaces.
PIU	Power board	slot 26/27	Provides one -48 V/-60 V DC power input.
FAN	Fan board	slot 28	Cools and ventilates the IDU.

3.2.2 ODU

The ODU is an integrated system that is available in several models. The architectures and working principles of the various ODU models are similar.

Block Diagram

Figure 3-3 Block diagram of the ODU



Signal Processing in the Transmit Direction

The multiplexer splits the signal from the IF cable into a 350 MHz IF signal, a 5.5 MHz O&M uplink signal, and a -48 V DC power signal.

In the transmit direction, the IF signal is processed as follows:

1. After the up-conversion, filtering, and amplification are completed, the IF signal is converted into the RF signal and then is sent to the AMP amplifier unit.
2. The AMP amplifies the RF signal (the output power of the signal can be controlled by the IDU software).
3. After the amplification, the RF signal is sent to the antenna through the duplexer.

The O&M uplink signal is a 5.5 MHz ASK-modulated signal and is demodulated in the CTRL control unit.

The -48 V DC power signal is sent to the PWR power unit where the secondary power supply that uses a different voltage is generated and provided to the modules of the ODU.

Signal Processing in the Receive Direction

The duplexer separates the RF signal from the antenna signal. The RF signal is amplified in the low noise amplifier (LNA). After the down-conversion, filtering, and amplification are completed, the RF signal is converted into the 140 MHz IF signal and then is sent to the multiplexer.

The O&M downlink signal is modulated under the ASK scheme in the CTRL unit. The 10 MHz signal is generated through the modulation and is sent to the multiplexer. The CTRL unit also detects the received signal power through the RSSI detection circuit and provides the RSSI interface.

The IF signal and the O&M downlink signal are combined in the multiplexer and then are sent to the IDU through the IF cable.

3.3 Software Structure

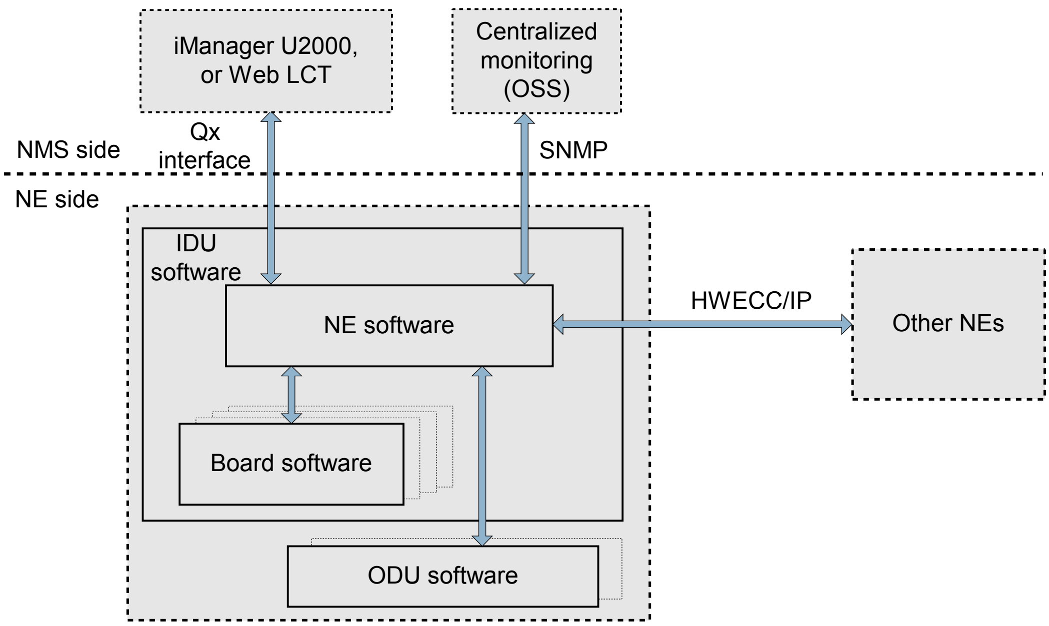
The OptiX RTN 980 software consists of the NMS software, IDU software, and ODU software.

Functional Block Diagram

The OptiX RTN 980 software consists of IDU software and ODU software, as shown in **Figure 3-4**.

- The OptiX RTN 980 uses Qx interfaces to communicate with the iManager U2000 or Web LCT. The Qx interfaces are management protocol interfaces designed for Huawei's OptiX equipment. The protocol stack and messages used by Qx interfaces are developed based on ITU-T G.773, ITU-T Q.811, and ITU-T Q.812.
- The OptiX RTN 980 provides a Simple Network Management Protocol (SNMP) agent, so a third-party centralized NMS can query alarms, performance events, and many configuration data through SNMP interfaces.
- OptiX NEs send network management messages with each other using the HWECC protocol or IP protocol.

Figure 3-4 Software architecture



IDU Software

The IDU software consists of NE software and board software.

- The NE software manages, monitors, and controls the running status of the IDU. Through the NE software, the NMS communicates with boards, and manages the NE. The NE software communicates with the ODU software to manage and control the operation of the ODU.
- The board software manages and controls the running status of other boards of the IDU except the system control, switching, and timing board. The board software of the Ethernet interface board or Ethernet processing board is stand-alone and runs board CPU. Software of other boards is integrated as software modules with the NE software and runs in the CPU of the system control, switching, and timing board.

ODU Software

The ODU software manages and controls the running status of the ODU. The ODU software controls the running of the ODU based on the parameters transmitted by the IDU software. The ODU running status is reported to the IDU software.

3.4 Service Signal Processing Flow

The signal processing flows for the SDH/PDH microwave, Hybrid microwave, and packet microwave are different.

3.4.1 SDH/PDH Microwave

This section describes how an IF1 board transmits the E1 services that the SP3S receives. It serves as an example to illustrate the processing flow for SDH/PDH microwave service signals.

Figure 3-5 Service signal processing flow of the SDH/PDH microwave

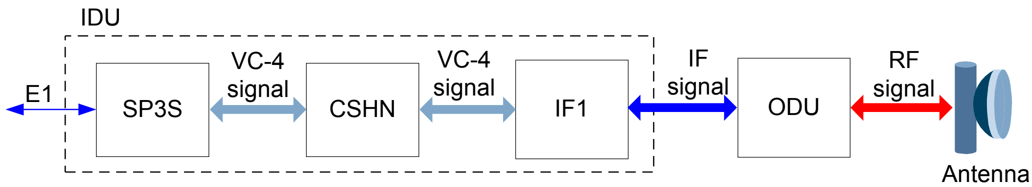


Table 3-3 Service signal processing flow of the SDH/PDH microwave in the transmit direction

NO.	Component	Signal Processing Description
1	SP3S	● Receives E1 signals. ● Performs HDB3 decoding. ● Maps E1 service signals into VC-12 signals. ● Multiplexes the VC-12 signals into VC-4 signals. ● Transmits the VC-4 signals to the timeslot cross-connect unit of the CSHN.

NO.	Component	Signal Processing Description
2	CSHN	The timeslot cross-connect unit grooms VC-12 signals to the VC-4 signals of the IF1 board.
3	IF1	• Demultiplexes the VC-12 signals to be transmitted from VC-4 signals. • Maps the VC-12 signals into the TU-12-based or STM-1-based microwave frame payload, and adds microwave frame overheads and pointers to form complete microwave frames. • Performs FEC coding. • Performs digital modulation. • Performs D/A conversion. • Performs analog modulation. • Combines the analog IF signals and ODU O&M signals. • Transmits the combined signals and -48 V power to the ODU through the IF cable.
4	ODU	• Splits the analog IF signals, ODU O&M signals, and -48 V power. • Converts the analog IF signals into RF signals through up conversions and amplification. • Transmits the RF signals to the antenna through the waveguide.

Table 3-4 Service signal processing flow of the SDH/PDH microwave in the receive direction

NO.	Component	Signal Processing Description
1	ODU	• Isolates and filters RF signals. • Converts the RF signals into analog IF signals through down conversions and amplification. • Combines the IF signals and the ODU O&M signals. • Transmits the combined signals to the IF board through the IF cable.

NO.	Component	Signal Processing Description
2	IF1	● Splits the received analog IF signals and ODU O&M signals. ● Performs A/D conversion for the IF signals. ● Performs digital demodulation. ● Performs time domain adaptive equalization. ● Performs FEC decoding. ● Synchronizes and descrambles the frames. ● Extracts overheads from microwave frames. ● Extracts VC-12 signals from the microwave frames and multiplexes the VC-12 signals into VC-4 signals. ● Transmits the VC-4 signals to the timeslot cross-connect unit of the CSHN.
3	CSHN	The timeslot cross-connect unit grooms VC-12 signals to the VC-4 signals of the SP3S.
4	SP3S	● Demultiplexes VC-12 signals from VC-4 signals. ● Demaps E1 service signals from the VC-12 signals. ● Performs HDB3 coding. ● Outputs E1 signals.

3.4.2 Hybrid Microwave

This section describes how an ISU2 board transmits E1 services that the SP3S board receives and FE/GE services that the CSHN board receives. It serves as an example to illustrate the processing flow for Hybrid microwave service signals.

Figure 3-6 Service signal processing flow of the Hybrid microwave

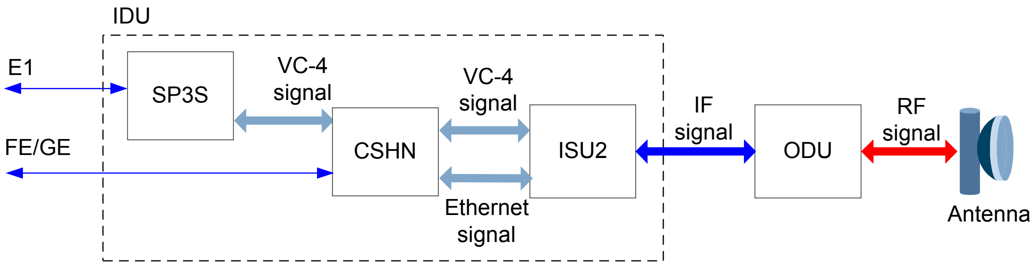


Table 3-5 Service signal processing flow of the Hybrid microwave in the transmit direction

NO.	Component	Signal Processing Description
1	SP3S	● Receives E1 signals. ● Performs HDB3 decoding. ● Maps E1 service signals into VC-12 signals. ● Multiplexes the VC-12 signals into VC-4 signals. ● Transmits the VC-4 signals to the timeslot cross-connect unit of the CSHN.
	CSHN (Ethernet interface unit)	● Receives FE/GE signals. ● Performs decoding. ● Aligns frames, strips preamble codes, and processes CRC codes. ● Forwards Ethernet frames to the packet switching unit of the CSHN.
2	CSHN	● Based on the service configuration, the timeslot cross-connect unit grooms VC-12 signals to the VC-4 signals of the ISU2 board. ● The packet switching unit processes Ethernet frames based on the configuration and the Layer 2 protocol, and then forwards the processed Ethernet frames to the ISU2 through the microwave port.
3	ISU2	● Selects the proper modulation scheme based on the current channel quality. ● Demultiplexes the VC-12 signals to be transmitted from VC-4 signals. ● Demaps E1 service signals from the VC-12 signals. ● Maps the E1 service signals and Ethernet frames into the microwave frame payload, and adds microwave frame overheads to form complete microwave frames. ● Performs FEC coding. ● Performs digital modulation. ● Performs D/A conversion. ● Performs analog modulation ● Combines the analog IF signals and ODU O&M signals. ● Transmits the combined signals and -48 V power to the ODU through the IF cable.

NO.	Component	Signal Processing Description
4	ODU	• Splits the analog IF signals, ODU O&M signals, and -48 V power. • Converts the analog IF signals into RF signals through up conversions and amplification. • Transmits the RF signals to the antenna through the waveguide.

Table 3-6 Service signal processing flow of the Hybrid microwave in the receive direction

NO.	Component	Signal Processing Description
1	ODU	• Isolates and filters RF signals. • Converts the RF signals into analog IF signals through down conversions and amplification. • Combines the IF signals and the ODU O&M signals. • Transmits the combined signals to the IF board through the IF cable.
2	ISU2	• Splits the received analog IF signals and ODU O&M signals. • Performs A/D conversion. • Performs digital demodulation. • Performs time domain adaptive equalization. • Performs FEC decoding. • Synchronizes and descrambles the frames. • Extracts overheads from microwave frames. • Extracts E1 service signals from the microwave frames and maps the E1 service signals into VC-12 signals. • Multiplexes the VC-12 signals into VC-4 signals and transmits the VC-4 signals to the timeslot cross-connect unit of the CSHN. • Extracts Ethernet frames from microwave frames, and transmits the Ethernet frames to the packet switching unit of the CSHN.
3	CSHN	• Based on the service configuration, the timeslot cross-connect unit grooms VC-12 signals to the VC-4 signals of the SP3S. • The packet switching unit processes Ethernet frames based on the configuration and the Layer 2 protocol, and then forwards the processed Ethernet frames to the Ethernet interface unit.

NO.	Component	Signal Processing Description
4	SP3S	● Demultiplexes VC-12 signals from VC-4 signals. ● Demaps E1 service signals from the VC-12 signals. ● Performs HDB3 coding. ● Outputs E1 signals.
	CSHN (Ethernet interface unit)	● Aligns frames, adds preamble codes, and processes CRC codes. ● Performs coding. ● Outputs FE/GE signals.

3.4.3 Packet Microwave

This section describes how an ISU2 board transmits the TDM E1 and ATM/IMA E1 services that the ML1 receives, and the FE/GE services that the CSHN receives. It serves as an example to illustrate the processing flow for Packet microwave service signals.

Figure 3-7 Flow of service signal processing

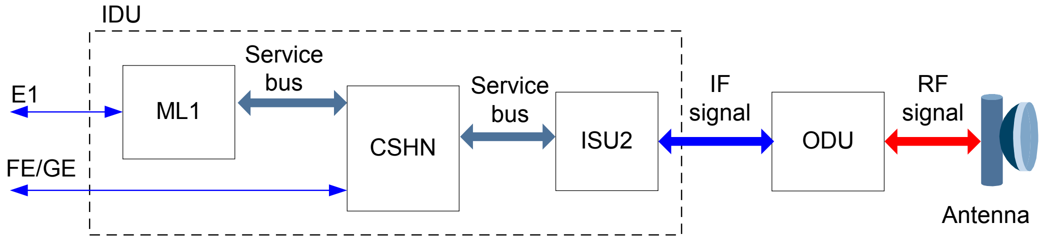


Table 3-7 Service signal processing in the transmit direction

NO.	Component	Signal Processing Description
1	ML1	● Receives TDM E1 signals and ATM/IMA E1 signals. ● Extracts service payloads from TDM E1 signals and performs the PWE3 encapsulation to form the Ethernet frames that carry PW packets. ● Demultiplexes ATM cells from ATM/IMA E1 signals and performs the PWE3 encapsulation to form the Ethernet frames that carry PW packets. ● Forwards Ethernet frames to the packet switching unit of the CSHN.

NO.	Component	Signal Processing Description
	CSHN (Ethernet interface unit)	● Receives FE/GE signals. ● Performs decoding. ● Delimits frames, strips preambles, and processes cyclic redundancy check (CRC) codes. ● Forwards Ethernet frames to the packet switching unit of the CSHN.
2	CSHN	● Performs Layer 2 processing for the Ethernet signals that are transmitted from the Ethernet interface unit based on the configuration and the Layer 2 protocol, and then performs PWE3 encapsulation to form the Ethernet frames that carry PW packets. ● Processes the Ethernet frames that carry and isolate PW packets based on the service configuration and the Layer 3 protocol, and then forwards the processed Ethernet frames to ISU2.
3	ISU2	● Selects the proper modulation scheme based on the quality of the channel. ● Receives the Ethernet signals transmitted from the CSHN. ● Forms Ethernet service signals and microwave frame overheads into microwave frames. ● Performs FEC coding. ● Performs digital modulation. ● Performs D/A conversion. ● Performs analog modulation ● Combines the analog IF signals and ODU O&M signals. ● Transmits the combined signals and -48 V power to the ODU through the IF cable.
4	ODU	● Splits the analog IF signals, ODU O&M signals, and -48 V power. ● Converts the analog IF signals into RF signals through up conversions and amplification. ● Transmits the RF signals to the antenna through the waveguide.

Table 3-8 Service signal processing flow in the receive direction

NO.	Component	Signal Processing Description
1	ODU	● Isolates and filters RF signals. ● Converts the RF signals into analog IF signals through down conversions and amplification. ● Combines the IF signals and the ODU O&M signals. ● Transmits the combined signals to the IF boards.
2	ISU2	● Splits the received analog IF signals and ODU O&M signals. ● Performs A/D conversion. ● Performs digital demodulation. ● Performs time domain adaptive equalization. ● Performs FEC decoding. ● Synchronizes and descrambles the frames. ● Extracts overheads from microwave frames. ● Extracts Ethernet frames from microwave frames, and transmits the Ethernet frames to the packet switching unit of the CSHN.
3	CSHN	● Processes the Ethernet frames that carry PW packets based on the service configuration and the Layer 3 protocol, and then forwards the processed Ethernet frames. ● Forwards Ethernet frames to the ML1 directly. In the case of the Ethernet frames that need to be forwarded to the Ethernet interface unit, extracts Ethernet frames from PW packets, performs layer 2 processing based on the configuration and the Layer 2 protocol, and then forwards the Ethernet frames to the Ethernet interface unit.
4	ML1	● Extracts ATM cells, and TDM E1 service payloads from PW packets. ● Multiplexes the ATM cells into the ATM/IMA E1 signals inversely. ● Performs HDB3 coding. ● Outputs E1 signals.
	CSHN (Ethernet interface unit)	● Delimits frames, adds preambles, and processes CRC codes. ● Performs coding. ● Outputs FE/GE signals.

4 Networking and Applications

About This Chapter

The OptiX RTN 980 provides complete microwave transmission solutions and supports various types of networking solutions to meet the diverse customer requirements.

4.1 Typical Network Topologies

The OptiX RTN 980 supports various network topologies.

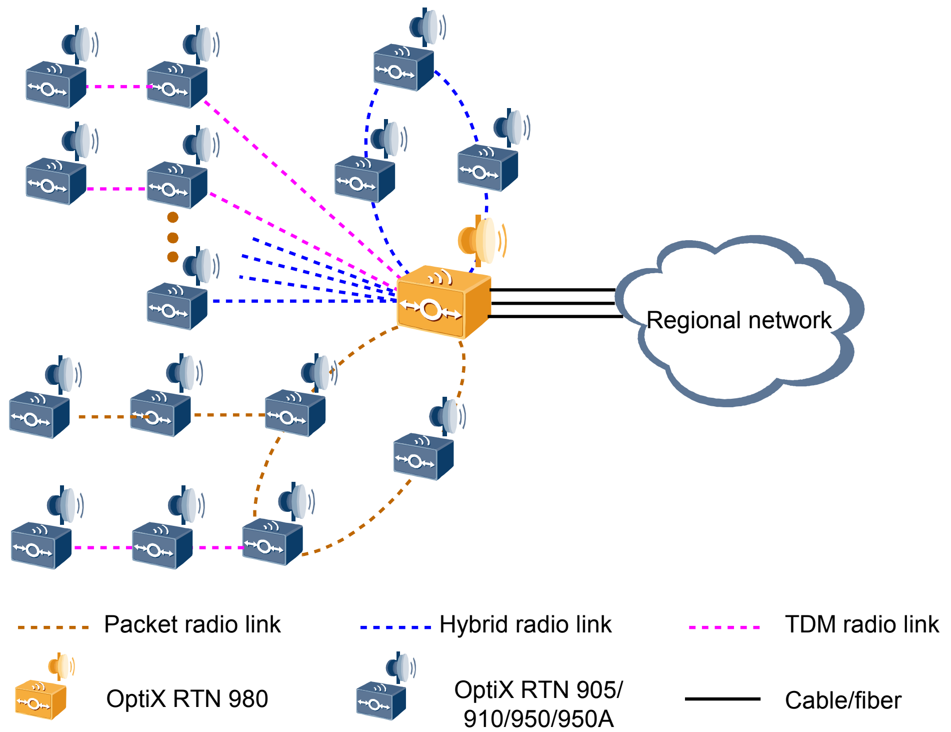
4.1.1 Multi-directional Nodal Convergence

The OptiX RTN 980 supports the nodal convergence of radio links in a maximum of 20 directions, and supports various transmission modes in the upstream direction.

Network Diagram

As nodal microwave equipment, the OptiX RTN 980 supports the convergence of large-capacity radio links in multi-directions. Figure 4-1 provides an example.

Figure 4-1 Multi-directional Nodal Convergence



Convergence of Radio Links

- Supports the convergence of radio links in a maximum of 20 directions.
- Supports the convergence of TDM radio links, Hybrid radio links, and Packet radio links at the same time.
- Supports the convergence of microwave chain subnets and the microwave ring subnets.

Upstream Transmission

- Supports the convergence of the TDM microwave services and Hybrid microwave services, and then transmission of them to the TDM network and the metropolitan Ethernet network in upstream direction in Native mode.
- Supports the convergence of the Packet microwave services, and then direct transmission of them to the PSN in the upstream direction by swapping MPLS labels.
- Supports the convergence of the TDM microwave services and Hybrid microwave services, encapsulation of them by the MPLS/PWE3 protocol, and then transmission of them to the PSN as gateway equipment.

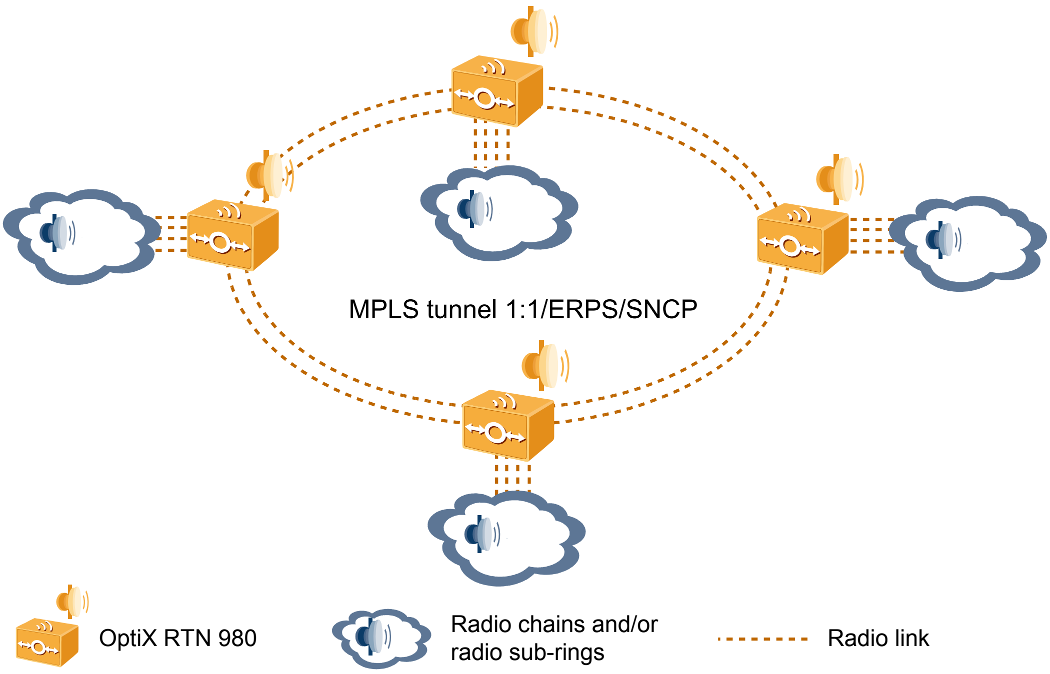
4.1.2 Large-Capacity Microwave Convergence Ring

The OptiX RTN 980 can form a large-capacity convergence ring and support various protection schemes for a ring network.

Network Diagram

OptiX RTN 980 can form a large-capacity convergence ring. **Figure 4-2** provides an example.

Figure 4-2 Large-capacity convergence ring



Types of Radio Links

- The OptiX RTN 980 on the convergence ring can converge the services on the microwave sub-ring or microwave sub-link.
- The radio links on the convergence ring can use XPIC, N+1, and other RF configuration modes to achieve large-capacity transmission.

- When using Hybrid radio links, the convergence ring can converge the Hybrid microwave services or TDM microwave services directly.
- When using Packet radio links, the convergence ring can do as follows:
  - Converge the Packet microwave services at the access layer and transmit them to the PSN directly for service backhaul.
  - Converge the Hybrid microwave services or TDM microwave services, encapsulate them into packet signals through the MPLS/PWE3 technology on the OptiX RTN 980, and transmit them to the PSN directly for service backhaul.

Protection Schemes

- On the Hybrid microwave convergence ring, the TDM services can be configured with SNCP, and the Ethernet services can be configured with ERPS.
- On the Packet microwave convergence ring, the services can be configured with the MPLS tunnel 1:1 protection or PW 1:1 protection.

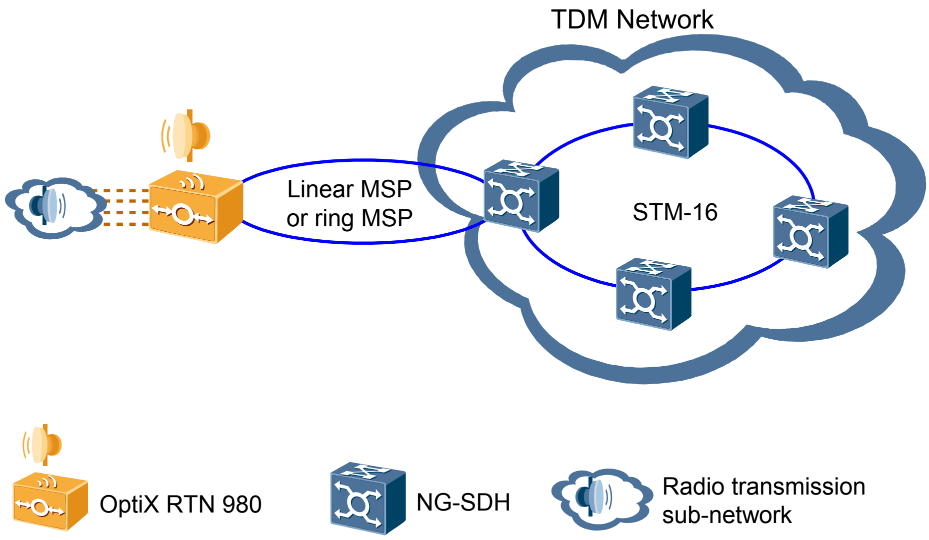
4.1.3 Upstream Networking

The OptiX RTN 980 can form a ring network with the upstream equipment, or can be connected to the upstream equipment through a protection link, to achieve reliable service backhaul.

Upstream Networking of TDM Services

The OptiX RTN 980 can form a two-fiber bidirectional MS shared protection ring with SDH equipment through the STM-4 ports, or can be connected to MSTP equipment through the STM-1/STM-4 ports configured with the 1+1/1:1 linear MSP. **Figure 4-3** provides an example of the upstream networking of TDM services.

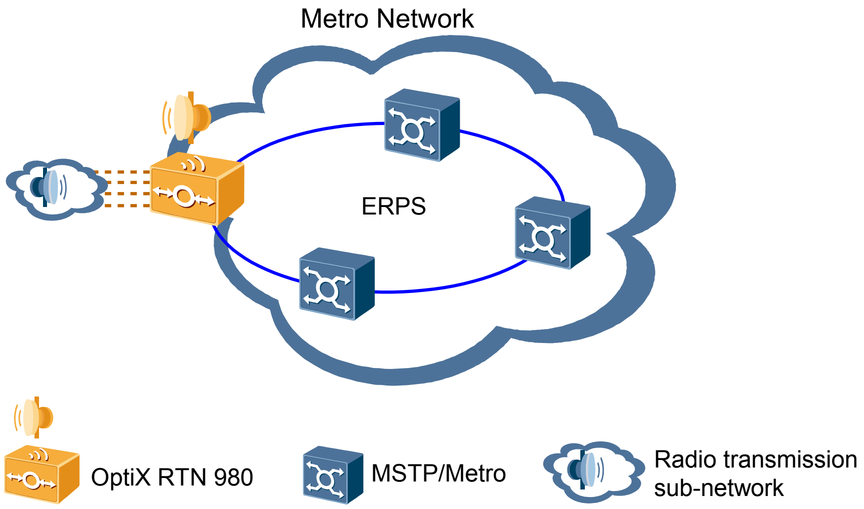
Figure 4-3 Upstream ring network of TDM services



Upstream Networking of Ethernet Services

The OptiX RTN 980 can form an ERPS ring with the metropolitan area network (MAN) equipment through the GE ports, or can be connected to the MAN equipment through the FE/GE ports configured with the LAG protection. **Figure 4-4** provides an example of the upstream networking for Ethernet services.

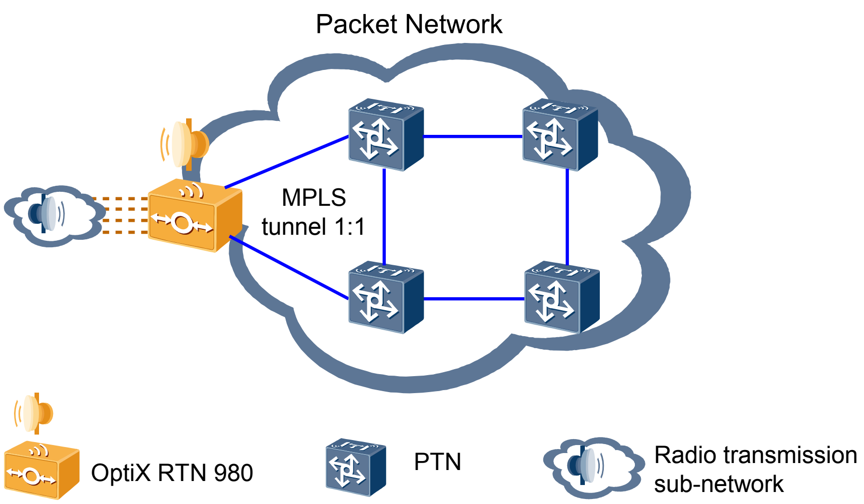
Figure 4-4 Upstream ring network for Ethernet services



Upstream Networking of MPLS Services

The OptiX RTN 980 can form a ring network or a mesh network with MPLS packet switching equipment through the GE ports. MPLS tunnel 1:1 protection is adopted. **Figure 4-5** provides an example of the upstream networking of MPLS services.

Figure 4-5 Upstream ring network of MPLS services

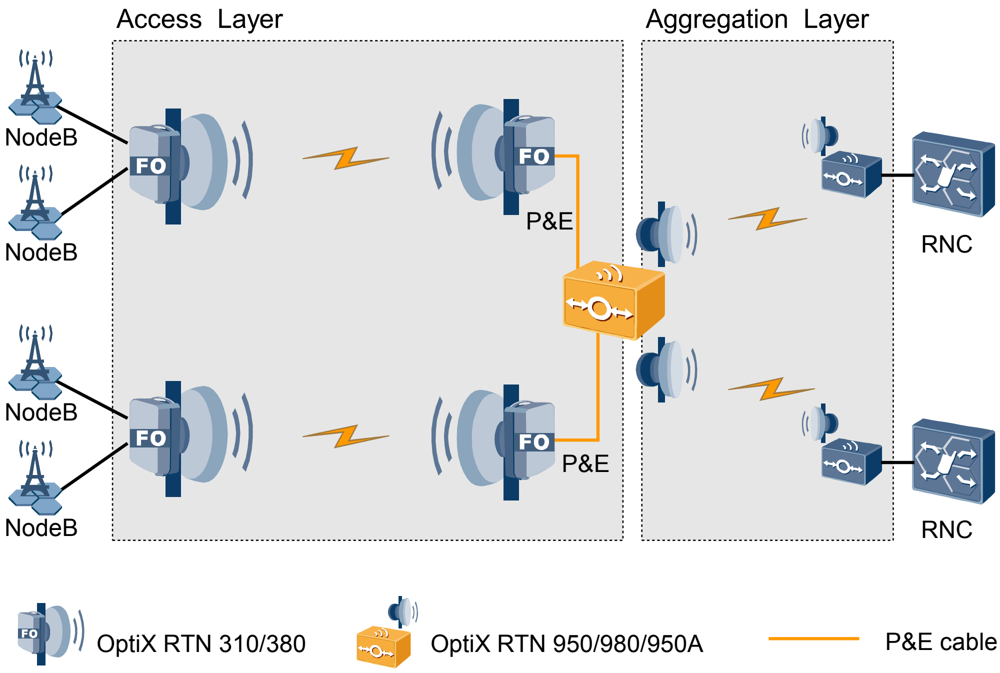


4.2 Networking with the OptiX RTN 310/380

The OptiX RTN 980 supports power over Ethernet function. It can be cooperated with the OptiX RTN 310/380 (a full outdoor equipment) directly, and works as service convergence nodes.

The OptiX RTN 310/380 integrates service interfaces, IF modules, and an RF modules. The OptiX RTN 980 does not need to use IF boards when working with the OptiX RTN 310/380. The OptiX RTN 980 can be equipped with an EG4P board which provides power over Ethernet function. The EG4P board is connected to the OptiX RTN 310/380 with P&E cables, which transmits Ethernet signals and supplies power for the OptiX RTN 310/380.

Figure 4-6 Networking with the OptiX RTN 310/380



4.3 Feature Application (MPLS Packet Service)

The MPLS/PWE3 technology allows for the transmission of multiple types of services in packet switching networks. The OptiX RTN 980 can transmit three types of packet services: CES services, ATM services, and Ethernet services.

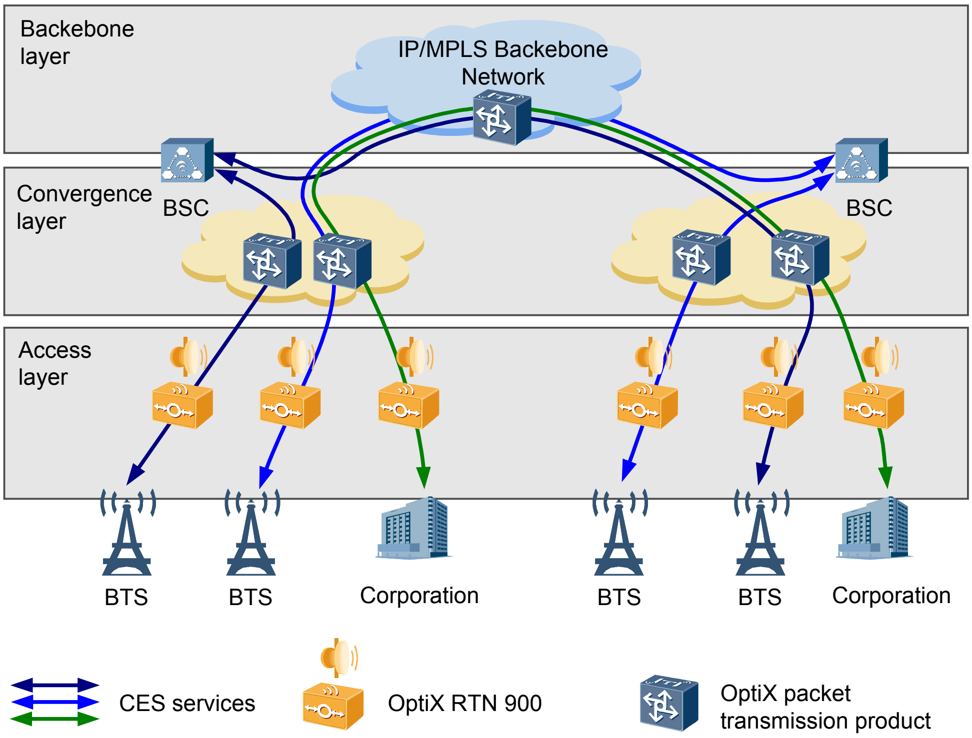
4.3.1 CES Services

On the OptiX RTN 980, CES services are constructed using the TDM PWE3 technology. That is, TDM E1 services are encapsulated into PW packets, and the PW packets are transmitted through a PW on the PSN.

Application Example

Circuit emulation service (CES) is mainly used to transmit mobile backhauled services and enterprise private line services. As shown in **Figure 4-7**, a 2G base station or an enterprise private line connects to the OptiX RTN 980 through a TDM line. The OptiX RTN 980 encapsulates the TDM signals into packets, and then transmits the packets to the opposite end through a PW on the PSN.

Figure 4-7 Example of CES services



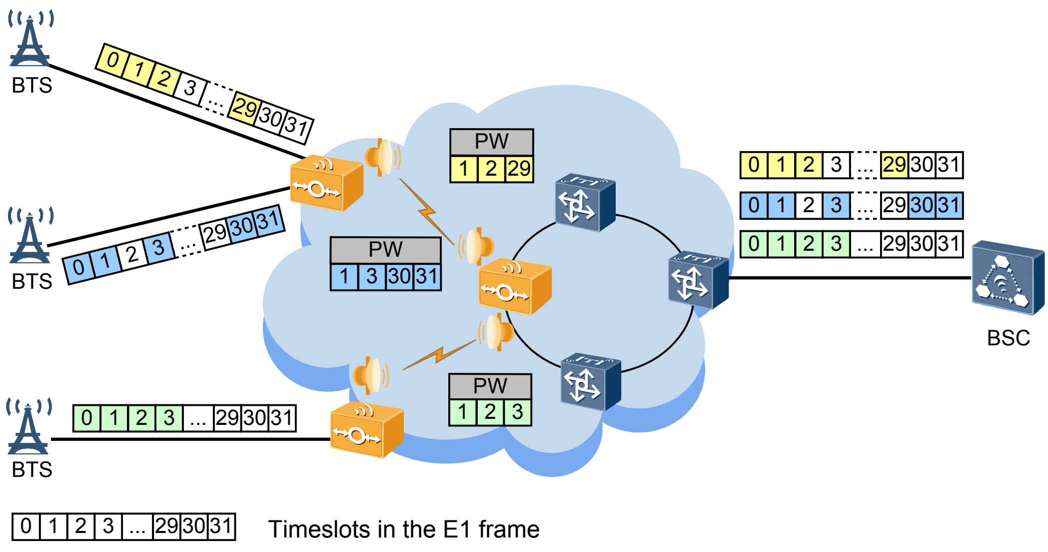
Emulation Modes

The OptiX RTN 980 supports CES services in structured emulation mode and non-structured emulation mode.

- The structured emulation mode is the CESoPSN mode. The equipment is aware of the frame structure, framing mode, and timeslot information in the TDM circuit.
- The non-structured emulation mode is the SAToP mode. The equipment is not aware of the frame structure. Instead, the equipment considers the TDM signals as consecutive bit streams, and then emulates and transparently transmits the TDM signals.

As shown in **Figure 4-8**, the OptiX RTN 980 in CESoPSN mode supports the compression of idle 64 kbit/s timeslots in TDM E1 signals to save transmission bandwidth.

Figure 4-8 Compression of idle 64 kbit/s timeslots in TDM E1 signals

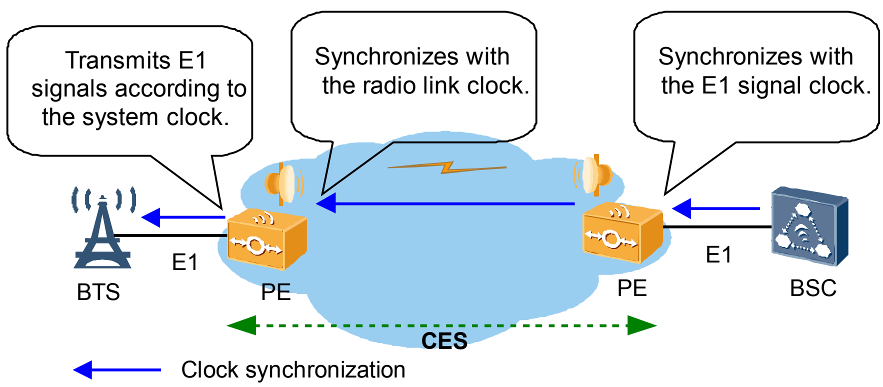


Service Clocks

Clock information is an important feature of TDM services. The OptiX RTN 980 supports the retiming clocks and CES ACR clocks of CES services.

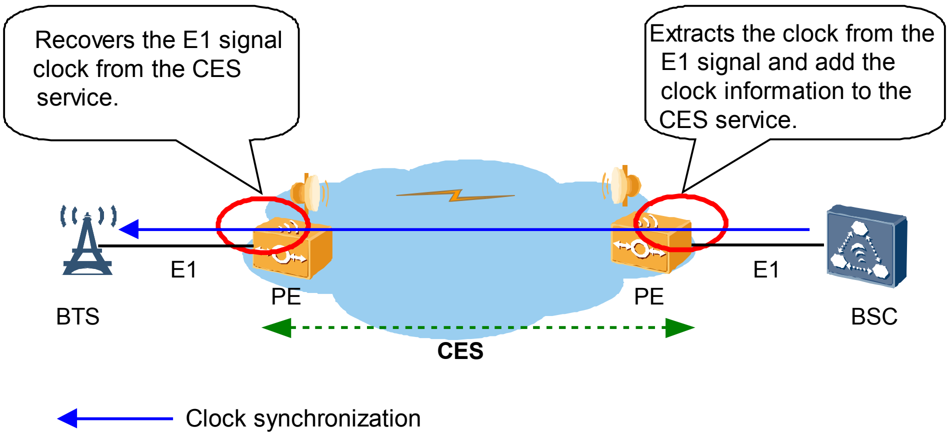
In retiming synchronization mode, the system clocks of all PEs on the network are synchronized. The system clock of a PE is considered as the service transmit clock (retiming). As shown in **Figure 4-9**, the system clock of BTS synchronizes itself with the service clock of PE. In this manner, all PEs and CEs are synchronous, and the transmit clocks of TDM services on all CEs and PEs are synchronous.

Figure 4-9 Retiming synchronization mode of CES service clocks



In ACR mode, the clock is extracted from the TDM interface on the PE on the ingress side. On the PE on the egress side, the clock of the emulated TDM service is recovered based on the clock information in the CES service. **Figure 4-10** shows the retiming synchronization mode of CES service clocks.

Figure 4-10 Adaptive synchronization mode of CES service clocks



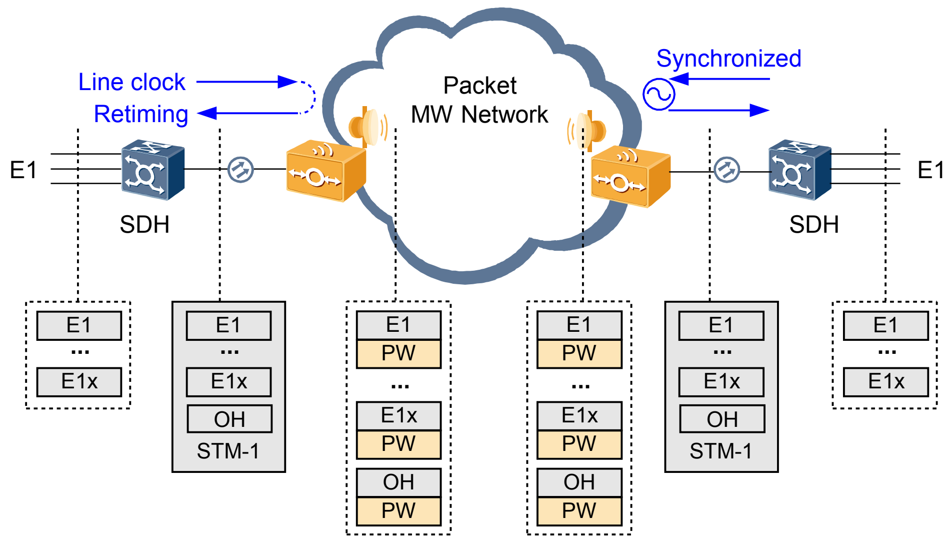
Channelized STM-1 Emulation

The OptiX RTN 980 supports the transparent transmission of STM-1 services in packet networks through CES emulation of channelized STM-1 services. As shown in **Figure 4-11**, section overhead bytes and 63xE1 signals in STM-1 frames can be encapsulated into CES services for transmission in packet networks.

During channelized STM-1 emulation, line clock synchronization across the SDH network can be implemented in the following two modes:

- The system clock of the OptiX RTN 980 is synchronized with SDH equipment through SDH line clocks.
- The OptiX RTN 980 derives the transmit clock from the receive clock through the line-clock retiming function. Therefore, the receive clock and transmit clock are synchronous on the SDH equipment.

Figure 4-11 Channelized STM-1 emulation



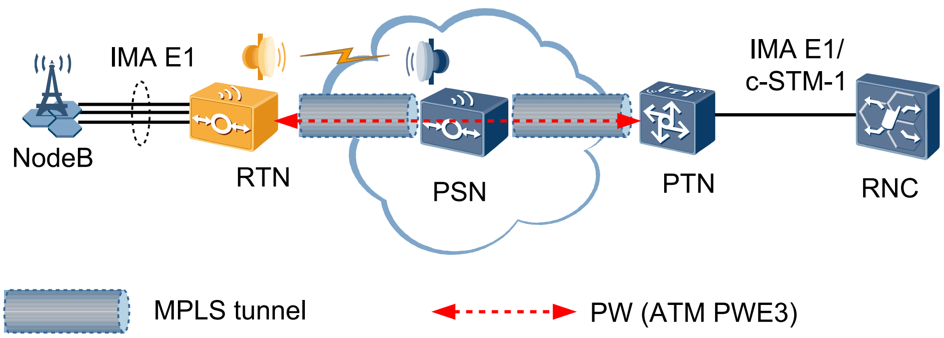
4.3.2 ATM/IMA Services

The OptiX RTN 980 supports ATM PWE3 services. The ATM/IMA E1 technology is used to transmit ATM services to the OptiX RTN equipment, and then the ATM cells are encapsulated into PW packets. The packets are then transmitted in the MPLS tunnel on the PSN.

Application Example

ATM/IMA services are mainly backhauled services of base stations. With the ATM/IMA E1 technology, the ATM services from NodeB are transmitted to the OptiX RTN 980. On the OptiX RTN 980, PWE3 emulation is performed for the ATM services. Then, the services are transmitted over PWs in MPLS tunnels across the PSN towards the RNC. Before being sent to the RNC, the services are decapsulated on the OptiX PTN/RTN equipment. **Figure 4-12** shows the application example.

Figure 4-12 Example of ATM/IMA services



ATM/IMA Services on the UNI Side

On the UNI side, the OptiX RTN 980 supports the following ATM/IMA functions:

- Supports the IMA E1 technology in which an IMA group is comprised of E1 links.
- Supports the Fractional IMA technology in which an IMA group is comprised of Fractional E1 links.

ATM PWE3 Services on the NNI Side

On the NNI side, the OptiX RTN 980 supports the following ATM PWE3 functions:

- One-to-one VCC mapping scheme: One VCC is mapped into one PW.
- N-to-one VCC mapping scheme: N (N≤32) VCCs are mapped into one PW.
- One-to-one VPC mapping scheme: One VPC is mapped into one PW.
- N-to-one VPC mapping scheme: N (N≤32) VPCs are mapped into one PW.
- On one PW, a maximum of 31 ATM cells can be concatenated.
- ATM transparent service.

4.3.3 Ethernet Services

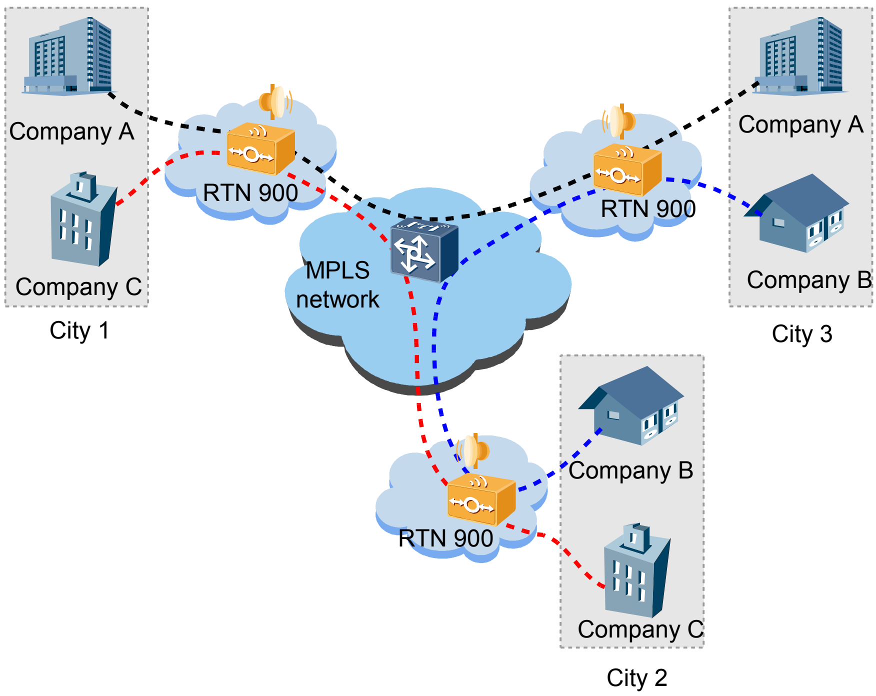
The OptiX RTN 980 supports Ethernet PWE3 services. Therefore, PWs can be used to transmit E-Line services, E-Aggr services and E-LAN Services (VPLS).

E-Line Services

The E-Line technology is used to transmit isolated Ethernet private line services.

Figure 4-13 illustrates an example of how E-Line services are applied on the OptiX RTN 980. Company A has branches in City 1 and City 3; Company B has branches in City 2 and City 3; Company C has branches in City 1 and City 2. The branches of Company A, Company B, and Company C each have specific data communication requirements. In this application scenario, the OptiX RTN 980 can provide E-Line services for Company A, Company B, and Company C that can meet each of their respective needs while ensuring that the service data of each company is separated.

Figure 4-13 Example of E-Line services



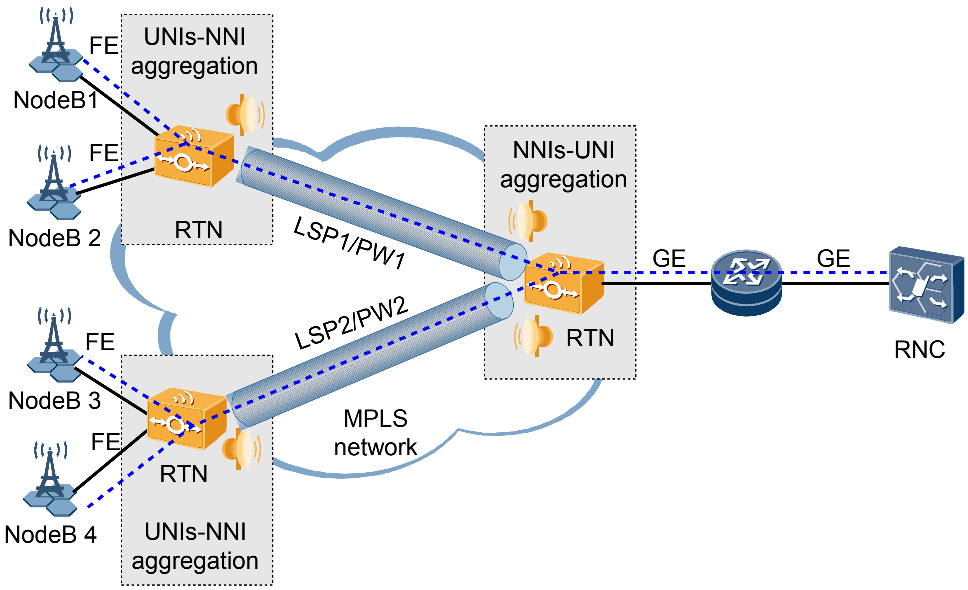
E-Aggr Services

The E-Aggr technology is used to transmit multipoint-to-point bidirectional aggregation services. An E-Aggr service has multiple aggregation sources and one aggregation sink. The aggregation sources can communicate with the aggregation sink, but the aggregation sources are isolated from each other.

E-Aggr services are distinguished based on VLAN tag switching. E-Aggr services simplify service configuration, and QoS processing can be performed at aggregation points.

Figure 4-14 shows the application of E-Aggr services on a mobile bearer network. On the base station side, services from different base stations are aggregated to a PW; on the RNC side, services on multiple PWs are aggregated at an interface and then transmitted to the RNC.

Figure 4-14 Example of E-Aggr services



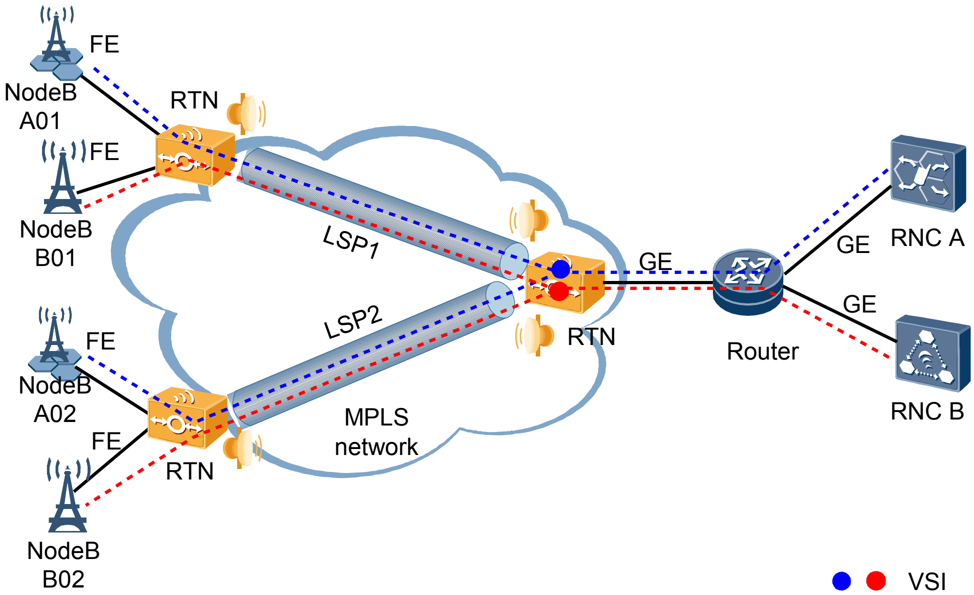
VPLS Services

Virtual private LAN service (VPLS) is a Layer 2 virtual private network (VPN) technology that provides multipoint connectivity over a Multiprotocol Label Switching (MPLS) network.

VPLS uses virtual switch instances (VSIs) to enable Layer 2 forwarding. One VPN corresponds to one VSI to which PWs and UNI ports can be mounted. Each VSI maintains a forwarding table that includes MAC addresses and their associated PWs or V-UNIs, and forwards traffic based on table entries. The OptiX RTN 980 can be configured with multiple VSIs to support coexistence of multiple VPNs.

Figure 4-15 shows a mobile backhaul network. The NodeBs that belong to the same RNC use VLAN IDs to differentiate services, and they use the same group of VLAN IDs. To isolate services between the two RNCs (as well as their NodeBs) while enabling VPN communication between each RNC and their NodeBs, you can create two VSIs on the convergence RTN node.

Figure 4-15 Example of VPLS services



4.4 Feature Application (Traversing the Original Network)

When carriers build microwave networks, the original local backhaul networks may not be suitable for transmitting the services carried on microwave networks. In this case, the OptiX RTN 980 can provide features that enable services to traverse the local backhaul networks.

4.4.1 Traversing a TDM Network by Using the EoPDH/EoSDH Feature

The EoPDH/EoSDH feature provides a solution that transmits Ethernet services over E1 signals so that carriers can transmit Ethernet services on the existing TDM networks.

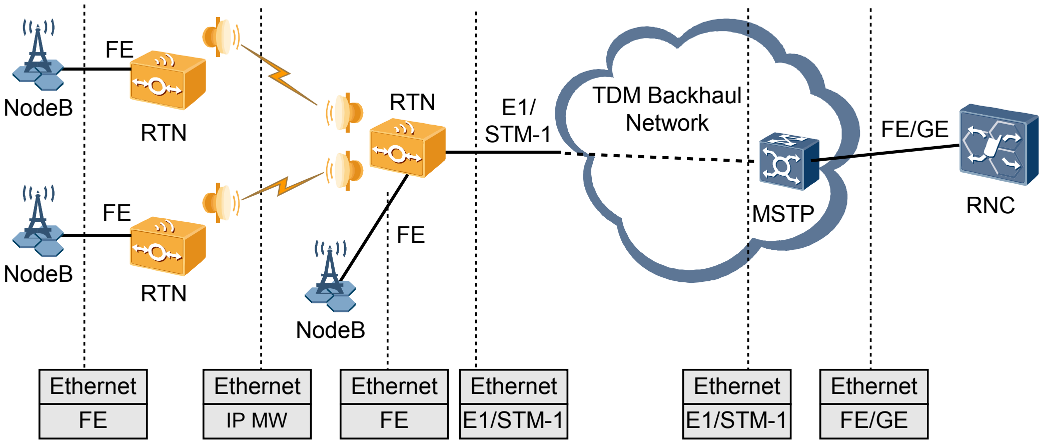
In most cases, a new radio access network transmits the Ethernet services from 3G base stations in Native mode over the Integrated IP radio links, but a large number of TDM networks exist on the local backhaul network at the convergence layer; therefore, Ethernet service cannot be directly transmitted. In this case, the OptiX RTN 980 at the convergence node of microwave services can use the EoPDH/EoSDH feature to transmit Ethernet services.

The EoPDH/EoSDH feature is used to encapsulate the Ethernet services on the Integrated IP radio links or the Ethernet services locally added into E1/STM-1 signals. The feature then transmits the Ethernet services over the existing TDM networks. At the last node on the TDM network, the MSTP or RTN equipment that supports the EoPDH/EoSDH feature is used to decapsulate the Ethernet services for transmission. For details, see **Figure 4-16**.

NOTE

With the application of the EoPDH/EoSDH feature, the Ethernet services that are encapsulated into E1 signals can also be transmitted over SDH/PDH radio links provided by the IF1 board. In this case, the IF board need not be replaced. In addition, the TDM radio network that is comprised of the OptiX RTN 980 NEs can be upgraded to a multi-service network that supports Ethernet service transmission.

Figure 4-16 Traversing a TDM network using the EoPDH/EoSDH feature



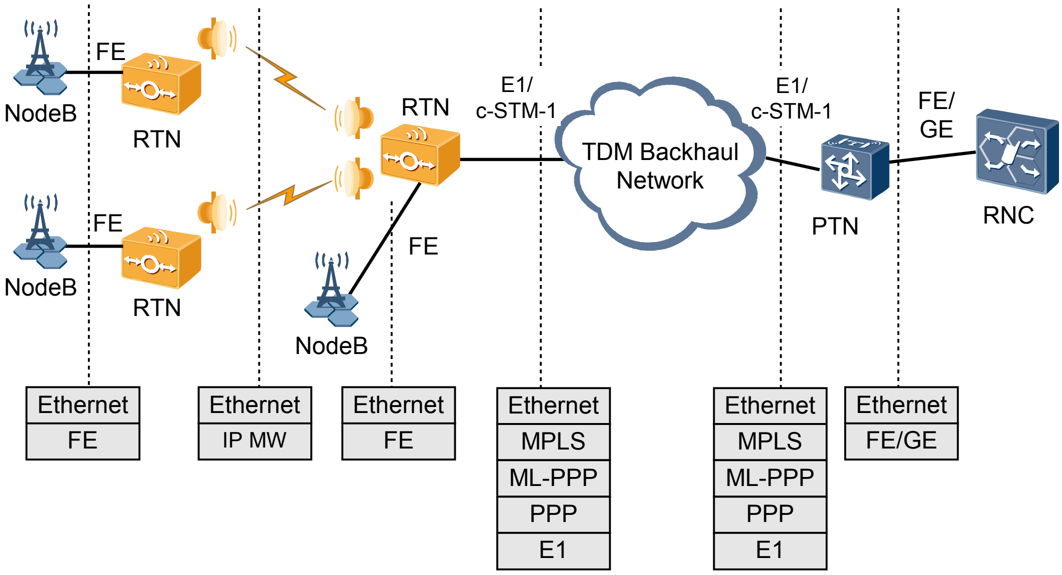
4.4.2 Using ML-PPP to Transmit Services Through a TDM Network

The multilink PPP (ML-PPP) technology is a solution in which E1 is used to bear MPLS tunnels. Using ML-PPP, carriers can transmit packet services through the existing TDM network.

During the evolution to packet backhaul networks, base station services received through E1, ATM/IMA, or FE/GE interfaces are backhauled as packet services by using the MPLS/PWE3 technology. However, legacy TDM-based backhaul networks or TDM leased lines cannot backhaul packet services directly. Packet backhaul can be implemented by using the ML-PPP function on OptiX RTN 980, the convergence node of microwave services. The ML-PPP function bundles multiple E1s into an ML-PPP group to carry MPLS tunnels and backhaul packet services. E1 channels on CQ1, a channelized STM-1 board, can also be bundled into an ML-PPP group.

As shown in **Figure 4-17**, ML-PPP helps the equipment to encapsulate the packet services on the Integrated IP radio links or the Ethernet services locally added into E1 signals and then to transmit the Ethernet services over the existing TDM networks. After the services traverse a TDM network, the OptiX PTN equipment (or OptiX RTN equipment) decapsulates Ethernet services before transmission.

Figure 4-17 Using ML-PPP to transmit services through a TDM network

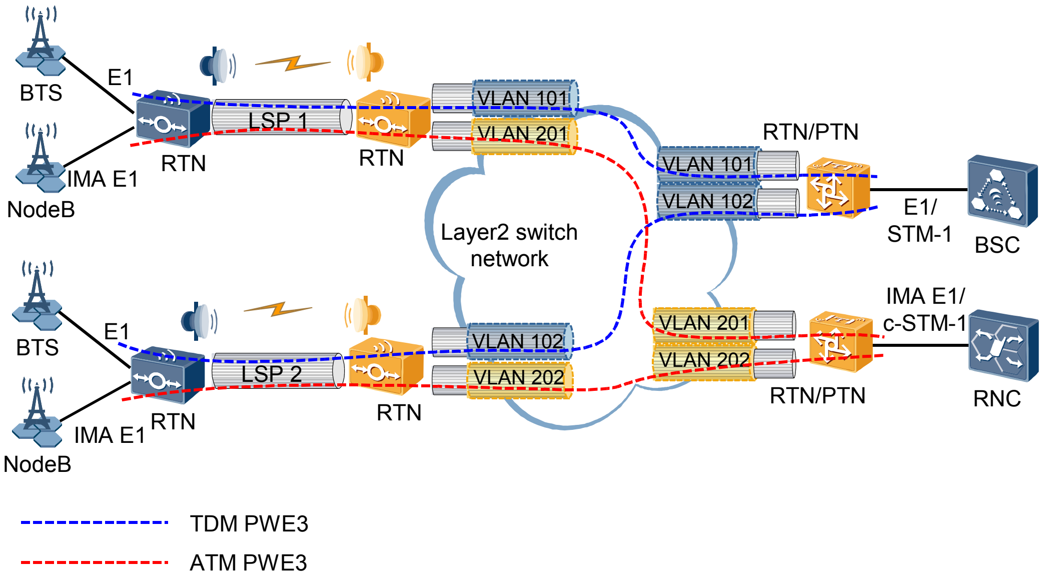


4.4.3 Traversing a Layer 2 Network by Using VLAN Sub-interfaces

The method of adding VLAN IDs to MPLS tunnels enables the MPLS tunnels to traverse a Layer 2 network. This means that carriers can use their live Layer 2 networks to transmit packet services.

Generally, all NEs that an LSP traverses support MPLS. In certain circumstances, however, LSPs need to traverse a Layer 2 network (such as a metropolitan Ethernet network) that does not support MPLS. As shown in **Figure 4-18**, BTSs and NodeBs are located at the same site, and they transmit services to the BSC and RNC by using the MPLS or PWE3 technology. These services are transmitted to the Layer 2 network separately. The BSC and RNC are located at different convergence sites. In this scenario, the VLAN sub-interface technology can be used to create sub-interfaces with different VLAN IDs on an Ethernet port, therefore adding VLAN IDs to Ethernet frames that carry these LSPs. (LSPs and VLAN IDs have one-to-one mappings.) Within the Layer 2 network, services are transmitted based on VLAN IDs rather than MPLS, enabling LSPs to traverse the Layer 2 network.

Figure 4-18 MPLS tunnels traversing a Layer 2 network using VLAN sub-interfaces



5 Network Management System

About This Chapter

This chapter describes the network management solution and the NMS software that constitutes this solution.

5.1 Network Management Solution

Huawei offers a complete transmission network management solution compliant with TMN for different function domains and customer groups on telecommunication networks.

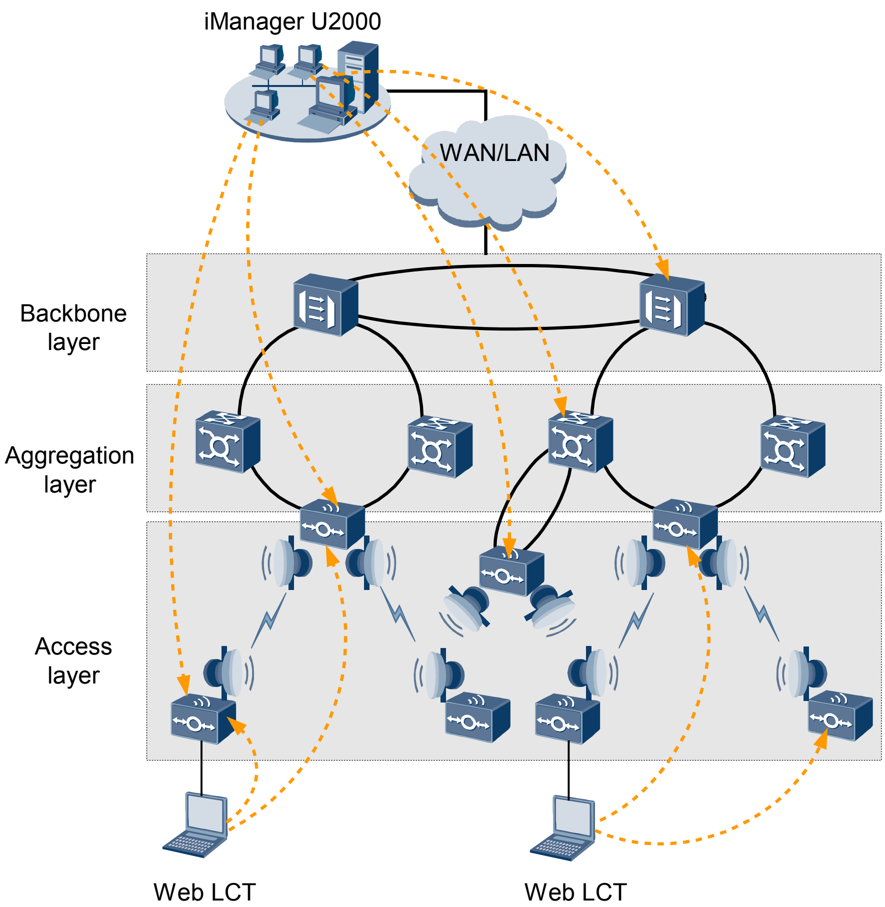
The NM solutions consist of the following:

- **iManager U2000 Web LCT local maintenance terminal**

  The Web LCT, a Web-based local maintenance terminal, is used to manage local and remote NEs on a per-site or hop basis.
- **iManager U2000 unified network management system**

  The iManager U2000, a network-level management system, is used to manage Huawei transmission equipment such as the OptiX RTN, PTN, MSTP, and WDM equipment.

Figure 5-1 Network management solution for transmission networks



5.2 Web LCT

The Web LCT is a local maintenance terminal. The Web LCT provides the following management functions at the NE layer: NE management, alarm management, performance management, configuration management, communication management, security management, and HOP management.

Function Overview

Table 5-1 Management functions of Web LCT

Function	Description
NE Management	● Search of NEs ● Addition/Deletion of NEs ● Login or logout of NEs ● Start NE Explorer
Alarm Management	● Setting of alarm monitoring strategies ● Viewing of alarms ● Deletion of alarms
Performance Management	● Setting of performance monitoring strategies ● Viewing of performance events ● Resetting of performance registers
Configuration Management	● Basic NE information configuration ● Radio link configuration ● Protection configuration ● Interface configuration ● Service configuration ● Clock configuration
Communication Management	● Communication parameter management ● DCC management ● Inband DCN management ● L2DCN management ● HWECC protocol management ● IP protocol management
Security Management	● NE user management ● NE user group management ● LCT access control ● Online user management ● NE security parameters ● NE security log ● NMS user management ● NMS log management ● File transmission protocol management (FTP or SFTP)

Function	Description
HOP Management	● Parameters on both ends of a hop can be set on the same interface. ● After the parameters on one end of a hop are set, the parameters on the other end are assigned values accordingly.

5.3 U2000

The U2000 is a network-level network management system. A user can access the U2000 server through a U2000 client to manage Huawei transport subnets in a unified manner. The U2000 can provide NE-level and network-level management functions.

Function Overview

Table 5-2 Management Functions of U2000

Functional Module		Description
NE level management		● NE panel browsing ● Built-in NE explorer implementing all-around NE-level management
Network level management	Topology management	● Physical topology view ● End-to-end topology management of services ● Clock view ● Automatic topology discovery ● Customized topology view ● Backup gateway configuration
	Network-level alarm management	● Networkwide alarm monitoring, statistics, and management ● Customized alarm query templates ● Alarm correlation analysis ● Alarm time localization ● Alarm notification ● Alarm dumping

Functional Module		Description
	Network-level performance management	● Creation of performance monitoring templates ● Scheduled monitoring and real-time monitoring ● Browsing of historical performance data ● Graphic display of performance data ● Comparison of performance data in different periods or based on different resources ● Historical performance data dump
	Network-level configuration management	● End-to-end configuration of TDM services ● End-to-end configuration of MPLS tunnels and PWE3 services ● End-to-end configuration of Native E-Line/E-LAN services
	Network-level diagnosis and test	● One-click connectivity test of packet services ● One-click performance test of packet services ● One-click smart diagnosis of packet service faults
	Network-level communication management	● DCC view management ● Inter-NE Ping and Traceroute tests
	Network-level security management	● Account policy management ● User group management ● Rights management ● RADIUS authentication on user rights ● SSLv3 encrypted communication between U2000 server and U2000 client ● SSLv3 encrypted communication between U2000 server and gateway NE ● Access Control List (ACL) management of the U2000 server ● Access Control List (ACL) management of the gateway NE
Inventory management		● Inventory management of equipment such as NEs, boards, and ports ● Inventory management of fibers and links
Log management		● Management of NMS operation logs, system logs, and security logs ● NE Security Log management ● NE Syslog management

Functional Module	Description
Database management	● NMS database backup and restoration ● NE database backup and restoration ● Synchronization between NE data and NMS data
NE Software management	● NE software loading and upgrading ● NE Software database management ● NE data saving, backup, and restoration
Report management	● Management of alarm reports, log reports, and resource reports ● Viewing reports by using Internet Explorer ● Output of report files
Northbound interface	● SNMP, CORBA, and XML northbound interfaces ● Performance text interfaces

6 Technical Specifications

About This Chapter

This chapter describes the technical specifications of the OptiX RTN 980.

6.1 RF Performance

This chapter describes the radio frequency (RF) performance and various technical specifications related to microwaves.

6.1.1 Microwave Work Modes

This section lists the microwave work modes that the OptiX RTN 980 supports base on IF boards.

6.1.1.1 Microwave Work Modes (IF1 board)

The IF1 board supports SDH/PDH microwave work modes.

NOTE

The channel spacings supported by the OptiX RTN 980 comply with ETSI standards. Channel spacings 14/28/56 MHz apply to most frequency bands; but channel spacings 13.75/27.5/55 MHz apply to the 18 GHz frequency band.

Table 6-1 SDH/PDH microwave work modes (IF1 board)

Service Capacity	Modulation Scheme	Channel Spacing (MHz)
4xE1	QPSK	7
4xE1	16QAM	3.5
8xE1	QPSK	14 (13.75)
8xE1	16QAM	7
16xE1	QPSK	28 (27.5)
16xE1	16QAM	14 (13.75)
22xE1	32QAM	14 (13.75)
26xE1	64QAM	14 (13.75)
35xE1	16QAM	28 (27.5)
44xE1	32QAM	28 (27.5)
53xE1	64QAM	28 (27.5)
STM-1	128QAM	28 (27.5)

6.1.1.2 Microwave Work Modes (IFU2 board)

The IFU2 board supports Integrated IP microwave work modes.

NOTE

The channel spacings supported by the OptiX RTN 980 comply with ETSI standards. Channel spacings 14/28/56 MHz apply to most frequency bands; but channel spacings 13.75/27.5/55 MHz apply to the 18 GHz frequency band.

Table 6-2 Integrated IP microwave work modes (IFU2 board)

Channel Spacing (MHz)	Modulation Scheme	Maximum Number of E1s in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)
7	QPSK	5	9 to 12
7	16QAM	10	20 to 24
7	32QAM	12	24 to 29
7	64QAM	15	31 to 37
7	128QAM	18	37 to 44
7	256QAM	21	43 to 51
14 (13.75)	QPSK	10	20 to 23
14 (13.75)	16QAM	20	41 to 48
14 (13.75)	32QAM	24	50 to 59
14 (13.75)	64QAM	31	65 to 76
14 (13.75)	128QAM	37	77 to 90
14 (13.75)	256QAM	43	90 to 104
28 (27.5)	QPSK	20	41 to 48
28 (27.5)	16QAM	40	82 to 97
28 (27.5)	32QAM	52	108 to 125
28 (27.5)	64QAM	64	130 to 150
28 (27.5)	128QAM	75	160 to 180
28 (27.5)	256QAM	75	180 to 210
56 (55)	QPSK	40	82 to 97
56 (55)	16QAM	75	165 to 190
56 (55)	32QAM	75	208 to 240
56 (55)	64QAM	75	260 to 310
56 (55)	128QAM	75	310 to 360
56 (55)	256QAM	75	360 to 420

NOTE

For the integrated IP microwave work mode that the IFU2/IFX2 board supports:

- The throughput specifications listed in the tables are based on untagged Ethernet frames with a length ranging from 64 bytes to 1518 bytes
- E1 services need to occupy the corresponding bandwidth of the air interface capacity. The bandwidth remaining after the E1 service capacity is subtracted from the air interface capacity can be provided for Ethernet services.

6.1.1.3 Microwave Work Modes (IFX2 board)

The IFX2 board supports Integrated IP microwave work modes.

NOTE

The channel spacings supported by the OptiX RTN 980 comply with ETSI standards. Channel spacings 14/28/56 MHz apply to most frequency bands; but channel spacings 13.75/27.5/55 MHz apply to the 18 GHz frequency band.

Table 6-3 Integrated IP microwave work modes (IFX2 board)

Channel Spacing (MHz)	Modulation Scheme	Maximum Number of E1s in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)
7	QPSK	4	9 to 11
7	16QAM	9	19 to 23
7	32QAM	11	24 to 29
7	64QAM	14	31 to 36
14 (13.75)	QPSK	9	20 to 23
14 (13.75)	16QAM	19	40 to 47
14 (13.75)	32QAM	24	50 to 59
14 (13.75)	64QAM	30	63 to 73
14 (13.75)	128QAM	36	75 to 88
28 (27.5)	QPSK	19	41 to 48
28 (27.5)	16QAM	40	84 to 97
28 (27.5)	32QAM	49	103 to 120
28 (27.5)	64QAM	63	130 to 150
28 (27.5)	128QAM	75	160 to 180
28 (27.5)	256QAM	75	180 to 210

Channel Spacing (MHz)	Modulation Scheme	Maximum Number of E1s in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)
56 (55)	QPSK	39	83 to 97
56 (55)	16QAM	75	165 to 190
56 (55)	32QAM	75	210 to 245
56 (55)	64QAM	75	260 to 305
56 (55)	128QAM	75	310 to 360
56 (55)	256QAM	75	360 to 410

NOTE
For the IFX2 board, the microwave work modes are the same regardless of whether the XPIC function is enabled or disabled.

When the channel spacing is 7 MHz or 14 MHz and the XPIC function is enabled, the IFX2 board only supports the XMC-2 ODU.

When the XPIC function is enabled and the frequency band is 26 GHz to 42 GHz, the 7MHz/64QAM and 14MHz/128QAM work modes are not supported.

NOTE

For the integrated IP microwave work mode that the IFU2/IFX2 board supports:

- The throughput specifications listed in the tables are based on untagged Ethernet frames with a length ranging from 64 bytes to 1518 bytes
- E1 services need to occupy the corresponding bandwidth of the air interface capacity. The bandwidth remaining after the E1 service capacity is subtracted from the air interface capacity can be provided for Ethernet services.

6.1.1.4 Microwave Work Modes (ISU2 board)

The ISU2 board supports SDH microwave work modes and Integrated IP microwave work modes.

NOTE

The channel spacings supported by the OptiX RTN 980 comply with ETSI standards. Channel spacings 14/28/56 MHz apply to most frequency bands; but channel spacings 13.75/27.5/55 MHz apply to the 18 GHz frequency band.

SDH Microwave Work Modes

Table 6-4 SDH microwave work modes (ISU2 board)

Service Capacity	Modulation Scheme	Channel Spacing (MHz)
STM-1	128QAM	28 (27.5)

Service Capacity	Modulation Scheme	Channel Spacing (MHz)
2xSTM-1	128QAM	56 (55)
2xSTM-1	256QAM	50

Integrated IP Microwave Work Modes

Table 6-5 Integrated IP microwave work modes (ISU2, E1 + Ethernet)

Channel Spacing (MHz)	Modulation Scheme	Maximum Number of E1s in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Without Compression	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
3.5	QPSK	2	4 to 5	4 to 6	4 to 6	4 to 10
3.5	16QAM	4	9 to 11	9 to 13	9 to 13	9 to 20
7	QPSK	5	10 to 13	10 to 15	10 to 22	10 to 33
7	16QAM	10	20 to 26	20 to 30	20 to 44	20 to 66
7	32QAM	12	25 to 32	25 to 36	25 to 54	25 to 80
7	64QAM	15	31 to 40	31 to 47	31 to 67	31 to 100
7	128QAM	18	37 to 47	37 to 56	37 to 80	37 to 119
7	256QAM	20	41 to 53	41 to 62	41 to 90	42 to 134
14 (13.75)	QPSK	10	20 to 26	20 to 31	20 to 44	20 to 66
14 (13.75)	16QAM	20	41 to 52	41 to 61	41 to 89	41 to 132
14 (13.75)	32QAM	24	51 to 65	51 to 77	51 to 110	51 to 164
14 (13.75)	64QAM	31	65 to 83	65 to 96	65 to 140	65 to 209
14 (13.75)	128QAM	37	76 to 97	76 to 113	76 to 165	76 to 245
14 (13.75)	256QAM	42	87 to 111	87 to 131	87 to 189	88 to 281
28 (27.5)	QPSK	20	41 to 52	41 to 62	41 to 89	41 to 132
28 (27.5)	16QAM	40	82 to 105	82 to 124	82 to 178	83 to 265
28 (27.5)	32QAM	52	107 to 136	107 to 161	107 to 230	107 to 343
28 (27.5)	64QAM	64	131 to 168	131 to 198	131 to 283	132 to 424
28 (27.5)	128QAM	75	155 to 198	155 to 233	155 to 333	156 to 495

Channel Spacing (MHz)	Modulation Scheme	Maximum Number of E1s in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Without Compression	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
28 (27.5)	256QAM	75	181 to 230	181 to 272	181 to 388	182 to 577
56 (55)	QPSK	40	82 to 105	82 to 124	82 to 178	83 to 265
56 (55)	16QAM	75	166 to 212	166 to 250	165 to 356	167 to 533
56 (55)	32QAM	75	206 to 262	206 to 308	206 to 437	207 to 659
56 (55)	64QAM	75	262 to 333	262 to 388	262 to 567	264 to 836
56 (55)	128QAM	75	309 to 396	309 to 466	309 to 656	311 to 983
56 (55)	256QAM	75	360 to 456	360 to 538	360 to 777	362 to 1000
40	QPSK	27	56 to 72	56 to 84	56 to 122	57 to 182
40	16QAM	55	114 to 145	114 to 172	114 to 247	114 to 366
40	32QAM	71	147 to 187	147 to 221	147 to 318	148 to 474
40	64QAM	75	181 to 230	181 to 272	181 to 388	182 to 583
40	128QAM	75	215 to 272	215 to 323	215 to 456	216 to 691
40	256QAM	75	249 to 318	249 to 375	249 to 538	251 to 800
50	QPSK	35	73 to 92	73 to 107	73 to 153	73 to 235
50	16QAM	71	148 to 186	148 to 216	148 to 309	148 to 473
50	32QAM	75	191 to 240	191 to 278	191 to 398	191 to 610
50	64QAM	75	235 to 295	235 to 340	235 to 490	235 to 750
50	128QAM	75	275 to 345	275 to 400	275 to 570	275 to 875
50	256QAM	75	317 to 396	317 to 459	317 to 659	317 to 1000

Table 6-6 Integrated IP microwave work modes (ISU2 board, Native STM-1 + Ethernet service)

Channel Spacing (MHz)	Modulation Scheme	Number of STM-1 Services in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Without Compression	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
28 (27.5)	128QAM	1	155 to 198	155 to 233	155 to 333	156 to 495
28 (27.5)	256QAM	1	181 to 230	181 to 272	181 to 388	182 to 577
40	64QAM	1	181 to 230	181 to 272	181 to 388	182 to 583
40	128QAM	1	215 to 272	215 to 323	215 to 456	216 to 691
40	256QAM	1	249 to 318	249 to 375	249 to 538	251 to 800
50	32QAM	1	191 to 240	191 to 278	191 to 398	191 to 610
50	64QAM	1	235 to 295	235 to 340	235 to 490	235 to 750
50	128QAM	1	275 to 345	275 to 400	275 to 570	275 to 875
50	256QAM	1	317 to 396	317 to 459	317 to 659	317 to 1000
56 (55)	16QAM	1	166 to 212	166 to 250	165 to 356	167 to 533
56 (55)	32QAM	1	206 to 262	206 to 308	206 to 437	207 to 659
56 (55)	64QAM	1	262 to 333	262 to 388	262 to 567	264 to 836
56 (55)	128QAM	1	309 to 396	309 to 466	309 to 656	311 to 983
56 (55)	256QAM	1	360 to 456	360 to 538	360 to 777	362 to 1000

NOTE

For the integrated IP microwave work mode that the ISU2/ISX2 board supports:

- The throughput specifications listed in the tables are based on the following conditions.
  - Without compression: untagged Ethernet frames with a length ranging from 64 bytes to 9600 bytes
  - With L2 frame header compression: untagged Ethernet frames with a length ranging from 64 bytes to 9600 bytes
  - With L2+L3 frame header compression (IPv4): UDP messages, untagged Ethernet frames with a length ranging from 64 bytes to 9600 bytes
  - With L2+L3 frame header compression (IPv6): UDP messages, S-tagged Ethernet frames with a length ranging from 92 bytes to 9600 bytes
- E1/STM-1 services need to occupy the corresponding bandwidth of the air interface capacity. The bandwidth remaining after the E1/STM-1 service capacity is subtracted from the air interface capacity can be provided for Ethernet services.

6.1.1.5 Microwave Work Modes (ISX2 board)

The ISX2 board supports SDH microwave work modes and Integrated IP microwave work modes.

NOTE

The channel spacings supported by the OptiX RTN 980 comply with ETSI standards. Channel spacings 14/28/56 MHz apply to most frequency bands; but channel spacings 13.75/27.5/55 MHz apply to the 18 GHz frequency band.

SDH Microwave Work Modes

Table 6-7 SDH microwave work modes (ISX2 board@IS2-mode)

Service Capacity	Modulation Scheme	Channel Spacing (MHz)
STM-1	128QAM	28 (27.5)
2xSTM-1	128QAM	56 (55)
2xSTM-1	256QAM	50
NOTE For the ISX2 board in SDH service mode, the microwave work modes are the same regardless of whether the XPIC function is enabled or disabled.		

Integrated IP Microwave Work Modes

Table 6-8 Integrated IP microwave work modes (ISX2 board, E1 + Ethernet service, XPIC disabled)

Channel Spacing (MHz)	Modulation Scheme	Maximum Number of E1s in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Without Compression	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
7	QPSK	5	10 to 13	10 to 15	10 to 22	10 to 33
7	16QAM	10	20 to 26	20 to 30	20 to 44	20 to 66
7	32QAM	12	25 to 32	25 to 36	25 to 54	25 to 80
7	64QAM	15	31 to 40	31 to 47	31 to 67	31 to 100
7	128QAM	18	37 to 47	37 to 56	37 to 80	37 to 119
7	256QAM	20	41 to 53	41 to 62	41 to 90	42 to 134
14 (13.75)	QPSK	10	20 to 26	20 to 31	20 to 44	20 to 66
14 (13.75)	16QAM	20	41 to 52	41 to 61	41 to 89	41 to 132

Channel Spacing (MHz)	Modulation Scheme	Maximum Number of E1s in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Without Compression	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
14 (13.75)	32QAM	24	51 to 65	51 to 77	51 to 110	51 to 164
14 (13.75)	64QAM	31	65 to 83	65 to 96	65 to 140	65 to 209
14 (13.75)	128QAM	37	76 to 97	76 to 113	76 to 165	76 to 245
14 (13.75)	256QAM	42	87 to 111	87 to 131	87 to 189	88 to 281
28 (27.5)	QPSK	20	41 to 52	41 to 62	41 to 89	41 to 132
28 (27.5)	16QAM	40	82 to 105	82 to 124	82 to 178	83 to 265
28 (27.5)	32QAM	52	107 to 136	107 to 161	107 to 230	107 to 343
28 (27.5)	64QAM	64	131 to 168	131 to 198	131 to 283	132 to 424
28 (27.5)	128QAM	75	155 to 198	155 to 233	155 to 333	156 to 495
28 (27.5)	256QAM	75	181 to 230	181 to 272	181 to 388	182 to 577
56 (55)	QPSK	40	82 to 105	82 to 124	82 to 178	83 to 265
56 (55)	16QAM	75	166 to 212	166 to 250	165 to 356	167 to 533
56 (55)	32QAM	75	206 to 262	206 to 308	206 to 437	207 to 659
56 (55)	64QAM	75	262 to 333	262 to 388	262 to 567	264 to 836
56 (55)	128QAM	75	309 to 396	309 to 466	309 to 656	311 to 983
56 (55)	256QAM	75	360 to 456	360 to 538	360 to 777	362 to 1000
40	QPSK	27	56 to 72	56 to 84	56 to 122	57 to 182
40	16QAM	55	114 to 145	114 to 172	114 to 247	114 to 366
40	32QAM	71	147 to 187	147 to 221	147 to 318	148 to 474
40	64QAM	75	181 to 230	181 to 272	181 to 388	182 to 583
40	128QAM	75	215 to 272	215 to 323	215 to 456	216 to 691
40	256QAM	75	249 to 318	249 to 375	249 to 538	251 to 800
50	QPSK	35	73 to 92	73 to 107	73 to 153	73 to 235
50	16QAM	71	148 to 186	148 to 216	148 to 309	148 to 473
50	32QAM	75	191 to 240	191 to 278	191 to 398	191 to 610
50	64QAM	75	235 to 295	235 to 340	235 to 490	235 to 750

Channel Spacing (MHz)	Modulation Scheme	Maximum Number of E1s in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Without Compression	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
50	128QAM	75	275 to 345	275 to 400	275 to 570	275 to 875
50	256QAM	75	317 to 396	317 to 459	317 to 659	317 to 1000

Table 6-9 Integrated IP microwave work modes (ISX2, E1 + Ethernet, XPIC enabled)

Channel Spacing (MHz)	Modulation Scheme	Maximum Number of E1s in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Without Compression	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
7	QPSK	4	10 to 13	10 to 15	10 to 22	10 to 33
7	16QAM	9	20 to 26	20 to 30	20 to 44	20 to 66
7	32QAM	11	25 to 32	25 to 36	25 to 54	25 to 80
7	64QAM	14	31 to 40	31 to 47	31 to 67	31 to 100
14 (13.75)	QPSK	9	20 to 26	20 to 31	20 to 44	20 to 66
14 (13.75)	16QAM	19	41 to 52	41 to 61	41 to 89	41 to 132
14 (13.75)	32QAM	24	51 to 65	51 to 77	51 to 110	51 to 164
14 (13.75)	64QAM	30	65 to 83	65 to 96	65 to 140	65 to 209
14 (13.75)	128QAM	36	76 to 97	76 to 113	76 to 165	76 to 245
28 (27.5)	QPSK	20	41 to 52	41 to 62	41 to 89	41 to 132
28 (27.5)	16QAM	40	82 to 105	82 to 124	82 to 178	83 to 265
28 (27.5)	32QAM	52	107 to 136	107 to 161	107 to 230	107 to 343
28 (27.5)	64QAM	64	131 to 168	131 to 198	131 to 283	132 to 424
28 (27.5)	128QAM	75	155 to 198	155 to 233	155 to 333	156 to 495
28 (27.5)	256QAM	75	181 to 230	181 to 272	181 to 388	182 to 577
56 (55)	QPSK	40	82 to 105	82 to 124	82 to 178	83 to 265
56 (55)	16QAM	75	166 to 212	166 to 250	165 to 356	167 to 533

Channel Spacing (MHz)	Modulation Scheme	Maximum Number of E1s in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Without Compression	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
56 (55)	32QAM	75	206 to 262	206 to 308	206 to 437	207 to 659
56 (55)	64QAM	75	262 to 333	262 to 388	262 to 567	264 to 836
56 (55)	128QAM	75	309 to 396	309 to 466	309 to 656	311 to 983
56 (55)	256QAM	75	360 to 456	360 to 538	360 to 777	362 to 1000
40	QPSK	27	56 to 72	56 to 84	56 to 122	57 to 182
40	16QAM	55	114 to 145	114 to 172	114 to 247	114 to 366
40	32QAM	71	147 to 187	147 to 221	147 to 318	148 to 474
40	64QAM	75	181 to 230	181 to 272	181 to 388	182 to 583
40	128QAM	75	215 to 272	215 to 323	215 to 456	216 to 691
40	256QAM	75	249 to 318	249 to 375	249 to 538	251 to 800
50	QPSK	35	73 to 92	73 to 107	73 to 153	73 to 235
50	16QAM	71	148 to 186	148 to 216	148 to 309	148 to 473
50	32QAM	75	191 to 240	191 to 278	191 to 398	191 to 610
50	64QAM	75	235 to 295	235 to 340	235 to 490	235 to 750
50	128QAM	75	275 to 345	275 to 400	275 to 570	275 to 875
50	256QAM	75	317 to 396	317 to 459	317 to 659	317 to 1000

NOTE

When the channel spacing is 7 MHz or 14 MHz and the XPIC function is enabled, the ISX2 board only supports the XMC-2 ODU.

When the XPIC function is enabled and the frequency band is 26 GHz to 42 GHz, the 7MHz/64QAM and 14MHz/128QAM work modes are not supported.

Table 6-10 Integrated IP microwave work modes (ISX2 board, Native STM-1 + Ethernet service)

Channel Spacing (MHz)	Modulation Scheme	Number of STM-1 Services in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Without Compression	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
28 (27.5)	128QAM	1	155 to 198	155 to 233	155 to 333	156 to 495
28 (27.5)	256QAM	1	181 to 230	181 to 272	181 to 388	182 to 577
40	64QAM	1	181 to 230	181 to 272	181 to 388	182 to 583
40	128QAM	1	215 to 272	215 to 323	215 to 456	216 to 691
40	256QAM	1	249 to 318	249 to 375	249 to 538	251 to 800
50	32QAM	1	191 to 240	191 to 278	191 to 398	191 to 610
50	64QAM	1	235 to 295	235 to 340	235 to 490	235 to 750
50	128QAM	1	275 to 345	275 to 400	275 to 570	275 to 875
50	256QAM	1	317 to 396	317 to 459	317 to 659	317 to 1000
56 (55)	16QAM	1	166 to 212	166 to 250	165 to 356	167 to 533
56 (55)	32QAM	1	206 to 262	206 to 308	206 to 437	207 to 659
56 (55)	64QAM	1	262 to 333	262 to 388	262 to 567	264 to 836
56 (55)	128QAM	1	309 to 396	309 to 466	309 to 656	311 to 983
56 (55)	256QAM	1	360 to 456	360 to 538	360 to 777	362 to 1000

NOTE
For the ISX2 board in STM-1 + Ethernet service mode, the microwave work modes are the same regardless of whether the XPIC function is enabled or disabled.

NOTE

For the integrated IP microwave work mode that the ISU2/ISX2 board supports:

- The throughput specifications listed in the tables are based on the following conditions.
  - Without compression: untagged Ethernet frames with a length ranging from 64 bytes to 9600 bytes
  - With L2 frame header compression: untagged Ethernet frames with a length ranging from 64 bytes to 9600 bytes
  - With L2+L3 frame header compression (IPv4): UDP messages, untagged Ethernet frames with a length ranging from 64 bytes to 9600 bytes
  - With L2+L3 frame header compression (IPv6): UDP messages, S-tagged Ethernet frames with a length ranging from 92 bytes to 9600 bytes
- E1/STM-1 services need to occupy the corresponding bandwidth of the air interface capacity. The bandwidth remaining after the E1/STM-1 service capacity is subtracted from the air interface capacity can be provided for Ethernet services.

6.1.1.6 Microwave Work Modes (ISV3 board)

The ISV3 board supports the SDH microwave work mode and the Integrated IP microwave work mode.

NOTE

The channel spacings supported by the OptiX RTN 980 comply with ETSI standards. Channel spacings 14/28/56 MHz apply to most frequency bands; but channel spacings 13.75/27.5/55 MHz apply to the 18 GHz frequency band.

IF Running Modes and Microwave Work Modes

The ISV3 board supports two IF running modes: IS3 and IS2. **Table 6-11** describes the IF running modes and **Table 6-12** describes the microwave work modes.

Table 6-11 IF running modes

IF Running Mode	Application Scenario
IS3 mode	IS3 is the default mode applicable to air-interface interconnection between the ISV3 and the ISV3 or applicable to air-interface interconnection between the ISV3 and the OptiX RTN 905. There are 13 types of modulation modes in IS3 mode: QPSK Strong, QPSK, 16QAM Strong, 16QAM, 32QAM, 64QAM, 128QAM, 256QAM, 512QAM, 512QAM Light, 1024QAM, 1024QAM Light, and 2048QAM, among which 2048QAM is used only when AM is enabled. For details on the microwave work modes, see **Table 6-15** to **Table 6-19**.

IF Running Mode	Application Scenario
IS2 mode	IS2 is an optional mode applicable to air-interface interconnection between the ISV3 and the ISU2/ISX2 board. There are six types of modulation modes in IS2 mode: QPSK, 16QAM, 32QAM, 64QAM, 128QAM, and 256QAM. ● When XPIC is disabled, microwave work modes supported by the ISV3 board are the same as those supported by the ISU2 board. For details on the microwave work modes, see **Table 6-4**, **Table 6-5**, and **Table 6-6** in **6.1.1.4 Microwave Work Modes (ISU2 board)**. ● When XPIC is enabled, microwave work modes supported by the ISV3 board are the same as those supported by the ISX2 board. For details on the microwave work modes, see **Table 6-7**, **Table 6-9**, and **Table 6-10** in **6.1.1.5 Microwave Work Modes (ISX2 board)**.

Table 6-12 Overview of Microwave work modes

Channel Spacing	Modulation Mode Range (IS3 Running mode)		Modulation Mode Range (IS2 Running mode)	
	non-XPIC	XPIC	non-XPIC	XPIC
3.5 MHz	N/A		QPSK to 16QAM	N/A
7 MHz	QPSK Strong to 1024QAM	QPSK Strong to 128QAM	QPSK to 256QAM	QPSK to 64QAM[a]
14 MHz	QPSK Strong to 1024QAM Light	QPSK Strong to 256QAM	QPSK to 256QAM	QPSK to 128QAM[b]
28 MHz	QPSK Strong to 2048QAM	QPSK Strong to 1024QAM	QPSK to 256QAM	
56 MHz	QPSK Strong to 2048QAM	QPSK Strong to 1024QAM Light	QPSK to 256QAM	
40 MHz	QPSK Strong to 2048QAM	QPSK Strong to 1024QAM	QPSK to 256QAM	
50 MHz	N/A		QPSK to 256QAM	

NOTE

- When IF boards work in IS3 mode together with XMC ODUs, highest-order modulation schemes for different channel spacing and frequency bands are listed in **Table 6-13** and **Table 6-14**.
- When IF boards work in IS3 mode together with HP, HPA, SP, or SPA ODUs, only QPSK Strong to 256QAM are supported.
- When IF boards work in IS2 mode, the XPIC function is enabled and the 7/14 MHz channel spacing is used, the IF boards can work with only XMC-2 ODUs.
  - a: When the XPIC function is enabled and the channel spacing is 7 MHz, the 64QAM modulation is not supported for a frequency band within the range from 26 GHz to 42 GHz.
  - b: When the XPIC function is enabled and the channel spacing is 14 MHz, the 128QAM modulation is not supported for a frequency band within the range from 26 GHz to 42 GHz.

Table 6-13 Highest-order modulation in IS3 mode (non-XPIC, XMC ODUs)

Type	Frequency band	Maximum Modulation @ Channel Spacing				
		7 MHz	14 MHz	28 MHz	40 MHz	56 MHz
XMC-2	6 GHz	256QAM	256QAM	512QAM Light	512QAM Light	1024QAM
	7/8 GHz (Normal)	256QAM	256QAM	256QAM	256QAM	256QAM
	7/8 GHz (XMC-2E)	256QAM	256QAM	2048QAM	2048QAM	2048QAM
	10/11 GHz	1024QAM	1024QAM Light	1024QAM Light	1024QAM Light	1024QAM Light
	13/15/18/23 GHz	1024QAM	1024QAM Light	2048QAM	2048QAM	2048QAM
	26 GHz	1024QAM	1024QAM Light	1024QAM Light	1024QAM Light	1024QAM Light
	28/32 GHz	256QAM	256QAM	512QAM Light	512QAM Light	1024QAM
	38 GHz	512QAM Light	1024QAM	2048QAM	2048QAM	2048QAM
	42 GHz	512QAM Light	1024QAM	1024QAM Light	1024QAM Light	1024QAM Light
XMC-2H	6/7/8/11 GHz (XMC-2H)	1024QAM	1024QAM Light	2048QAM	2048QAM	2048QAM
XMC-3	13GHz	1024QAM	1024QAM Light	2048QAM	2048QAM	2048QAM
	15/18/23/26 GHz	1024QAM	1024QAM Light	2048QAM	2048QAM	2048QAM
	28 GHz	512QAM	1024QAM	2048QAM	2048QAM	2048QAM
	32/38 GHz	512QAM Light	1024QAM	2048QAM	2048QAM	2048QAM

NOTE
For 13/15/18/23/38 GHz XMC-2 ODUs, only those manufactured since November 2014 support 2048QAM. A 38 GHz XMC-2 ODU supports 2048QAM only when it operates at the normal temperature and when the matching IF cable is longer than 60 m.

Table 6-14 Highest-order modulation in IS3 mode (XPIC, XMC ODUs)

Type	Frequency band	Maximum Modulation @ Channel Spacing				
		7 MHz	14 MHz	28 MHz	40 MHz	56 MHz
XMC-2	6 GHz	128QAM	256QAM	256QAM	256QAM	512QAM

Type	Frequency band	Maximum Modulation @ Channel Spacing				
		7 MHz	14 MHz	28 MHz	40 MHz	56 MHz
	7/8 GHz (Normal)	128QAM	256QAM	256QAM	256QAM	256QAM
	7/8 GHz (XMC-2E)	128QAM	256QAM	1024QAM	1024QAM	1024QAM Light
	10/11 GHz	128QAM	256QAM	512QAM Light	1024QAM	1024QAM Light
	13/15/18/23/26 GHz	128QAM	256QAM	1024QAM	1024QAM	1024QAM Light
	28/32 GHz	128QAM	256QAM	256QAM	256QAM	512QAM
	38/42 GHz	128QAM	256QAM	512QAM	512QAM Light	512QAM Light
XMC-2H	6/7/8/11 GHz (XMC-2H)	128QAM	256QAM	1024QAM	1024QAM	1024QAM Light
XMC-3	13/15/18/23 GHz	128QAM	256QAM	1024QAM	1024QAM	1024QAM Light
	26 GHz	128QAM	256QAM	512QAM Light	1024QAM	1024QAM Light
	28/32/38GHz	128QAM	256QAM	512QAM	512QAM Light	512QAM Light

SDH Microwave Work Mode

Table 6-15 SDH microwave work modes (ISV3 board@IS3-mode)

Service Capacity	Modulation Scheme	Channel Spacing (MHz)
STM-1	128QAM	28 (27.5)
2×STM-1	128QAM	56 (55)

NOTE
For the ISV3 board in SDH service mode, the microwave work modes are the same regardless of whether the XPIC function is enabled or disabled.

Integrated IP Microwave Work Mode (IS3-Mode)

Table 6-16 Integrated IP microwave work modes (ISV3 @IS3-mode, E1 + Ethernet, XPIC disabled)

Channel Spacing (MHz)	Modulation Scheme	Maximum Number of E1s in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Without Compression	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
7	QPSK Strong	4	8 to 10	8 to 13	8 to 20	8 to 26
7	QPSK	5	10 to 13	10 to 16	10 to 25	10 to 33
7	16QAM Strong	8	17 to 22	17 to 26	17 to 41	18 to 55
7	16QAM	10	20 to 26	20 to 32	21 to 49	21 to 66
7	32QAM	12	25 to 32	25 to 39	26 to 61	26 to 81
7	64QAM	15	32 to 40	32 to 50	33 to 77	33 to 102
7	128QAM	18	37 to 48	38 to 58	38 to 90	39 to 120
7	256QAM	20	42 to 53	42 to 65	43 to 101	44 to 135
7	512QAM	21	45 to 57	45 to 69	46 to 107	46 to 143
7	512QAM Light	22	48 to 61	48 to 74	49 to 115	50 to 153
7	1024QAM	23	51 to 65	51 to 79	52 to 122	53 to 163
14 (13.75)	QPSK Strong	8	17 to 22	17 to 27	17 to 41	18 to 55
14 (13.75)	QPSK	10	21 to 26	21 to 32	21 to 50	21 to 66
14 (13.75)	16QAM Strong	16	35 to 45	35 to 55	36 to 84	36 to 113
14 (13.75)	16QAM	20	41 to 53	42 to 64	42 to 99	43 to 133
14 (13.75)	32QAM	24	52 to 66	52 to 80	53 to 124	54 to 166
14 (13.75)	64QAM	31	65 to 83	66 to 101	67 to 156	68 to 208
14 (13.75)	128QAM	37	77 to 98	78 to 120	79 to 185	80 to 247
14 (13.75)	256QAM	42	88 to 112	89 to 137	90 to 211	92 to 282
14 (13.75)	512QAM	44	94 to 119	94 to 145	96 to 224	97 to 299
14 (13.75)	512QAM Light	46	100 to 127	101 to 155	102 to 240	104 to 320

Channel Spacing (MHz)	Modulation Scheme	Maximum Number of E1s in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Without Compression	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
14 (13.75)	1024QAM	48	104 to 131	104 to 161	106 to 248	108 to 331
14 (13.75)	1024QAM Light	50	109 to 138	110 to 169	111 to 260	113 to 347
28 (27.5)	QPSK Strong	17	36 to 46	36 to 56	37 to 87	38 to 116
28 (27.5)	QPSK	20	42 to 54	43 to 66	43 to 102	44 to 135
28 (27.5)	16QAM Strong	34	73 to 93	74 to 114	75 to 176	76 to 234
28 (27.5)	16QAM	40	86 to 109	86 to 133	88 to 205	89 to 274
28 (27.5)	32QAM	52	110 to 139	110 to 170	112 to 262	114 to 350
28 (27.5)	64QAM	64	135 to 172	136 to 210	138 to 324	141 to 432
28 (27.5)	128QAM	75	160 to 203	162 to 248	164 to 383	167 to 511
28 (27.5)	256QAM	75	183 to 232	184 to 284	187 to 438	190 to 584
28 (27.5)	512QAM	75	196 to 249	198 to 304	200 to 469	204 to 626
28 (27.5)	512QAM Light	75	210 to 266	212 to 325	214 to 502	218 to 670
28 (27.5)	1024QAM	75	217 to 275	219 to 337	222 to 520	226 to 693
28 (27.5)	1024QAM Light	75	228 to 289	230 to 353	233 to 545	237 to 727
28 (27.5)	2048QAM	75	245 to 306	248 to 379	250 to 585	254 to 780
56 (55)	QPSK Strong	34	73 to 93	74 to 114	75 to 176	76 to 235
56 (55)	QPSK	40	86 to 109	87 to 133	88 to 206	89 to 275
56 (55)	16QAM Strong	68	148 to 188	150 to 230	151 to 355	154 to 473
56 (55)	16QAM	75	173 to 220	175 to 269	177 to 415	180 to 553
56 (55)	32QAM	75	217 to 275	219 to 336	222 to 519	226 to 692
56 (55)	64QAM	75	273 to 346	275 to 423	279 to 653	284 to 871
56 (55)	128QAM	75	323 to 409	326 to 501	330 to 772	336 to 1000
56 (55)	256QAM	75	369 to 467	372 to 571	376 to 882	384 to 1000

Channel Spacing (MHz)	Modulation Scheme	Maximum Number of E1s in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Without Compression	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
56 (55)	512QAM	75	395 to 501	398 to 612	404 to 945	411 to 1000
56 (55)	512QAM Light	75	423 to 536	426 to 655	432 to 1000	440 to 1000
56 (55)	1024QAM	75	447 to 567	451 to 693	456 to 1000	465 to 1000
56 (55)	1024QAM Light	75	481 to 609	485 to 745	491 to 1000	500 to 1000
56 (55)	2048QAM	75	504 to 636	507 to 780	512 to 1000	522 to 1000
40	QPSK Strong	23	50 to 63	50 to 77	51 to 119	52 to 159
40	QPSK	27	58 to 74	58 to 90	59 to 139	60 to 186
40	16QAM Strong	46	100 to 127	101 to 156	102 to 240	104 to 321
40	16QAM	55	117 to 149	118 to 182	120 to 281	122 to 375
40	32QAM	71	150 to 190	151 to 232	153 to 359	156 to 478
40	64QAM	75	185 to 235	187 to 287	189 to 443	193 to 591
40	128QAM	75	219 to 278	221 to 339	224 to 524	228 to 699
40	256QAM	75	253 to 321	255 to 392	258 to 605	263 to 807
40	512QAM	75	268 to 340	270 to 415	274 to 641	279 to 855
40	512QAM Light	75	287 to 363	289 to 444	293 to 686	298 to 915
40	1024QAM	75	302 to 383	304 to 468	309 to 723	314 to 964
40	1024QAM Light	75	317 to 402	320 to 491	324 to 758	330 to 1000
40	2048QAM	75	333 to 418	335 to 515	338 to 795	345 to 1000

Table 6-17 Integrated IP microwave work modes (ISV3 @IS3-mode, E1 + Ethernet, XPIC enabled)

Channel Spacing (MHz)	Modulation Scheme	Maximum Number of E1s in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Without Compression	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
7	QPSK Strong	3	8 to 10	8 to 12	8 to 19	8 to 25
7	QPSK	4	10 to 12	10 to 15	10 to 24	10 to 32
7	16QAM Strong	6	16 to 21	17 to 26	17 to 40	17 to 53
7	16QAM	9	20 to 25	20 to 31	20 to 48	21 to 64
7	32QAM	11	24 to 31	25 to 38	25 to 59	25 to 79
7	64QAM	14	31 to 39	31 to 48	32 to 74	32 to 99
7	128QAM	17	36 to 46	37 to 56	37 to 87	38 to 117
14 (13.75)	QPSK Strong	8	16 to 21	17 to 26	17 to 40	17 to 53
14 (13.75)	QPSK	9	20 to 25	20 to 31	20 to 48	21 to 64
14 (13.75)	16QAM Strong	16	34 to 43	34 to 53	35 to 82	35 to 109
14 (13.75)	16QAM	19	40 to 51	40 to 62	41 to 97	42 to 129
14 (13.75)	32QAM	24	50 to 64	51 to 78	51 to 121	52 to 161
14 (13.75)	64QAM	30	63 to 80	64 to 98	65 to 152	66 to 202
14 (13.75)	128QAM	36	75 to 95	76 to 116	77 to 180	78 to 240
14 (13.75)	256QAM	40	85 to 107	85 to 131	86 to 203	88 to 270
28 (27.5)	QPSK Strong	17	36 to 46	36 to 56	37 to 87	38 to 116
28 (27.5)	QPSK	20	42 to 54	43 to 66	43 to 102	44 to 135
28 (27.5)	16QAM Strong	34	73 to 93	74 to 114	75 to 176	76 to 234
28 (27.5)	16QAM	40	86 to 109	86 to 133	88 to 205	89 to 274
28 (27.5)	32QAM	52	110 to 139	110 to 170	112 to 262	114 to 350
28 (27.5)	64QAM	64	135 to 172	136 to 210	138 to 324	141 to 432
28 (27.5)	128QAM	75	160 to 203	162 to 248	164 to 383	167 to 511
28 (27.5)	256QAM	75	182 to 230	183 to 281	185 to 434	189 to 579

Channel Spacing (MHz)	Modulation Scheme	Maximum Number of E1s in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Without Compression	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
28 (27.5)	512QAM	75	188 to 239	190 to 292	192 to 450	196 to 601
28 (27.5)	512QAM Light	75	201 to 255	203 to 312	206 to 482	210 to 643
28 (27.5)	1024QAM	75	215 to 272	216 to 333	219 to 513	223 to 685
56 (55)	QPSK Strong	34	73 to 93	74 to 114	75 to 176	76 to 235
56 (55)	QPSK	40	86 to 109	87 to 133	88 to 206	89 to 275
56 (55)	16QAM Strong	68	148 to 188	150 to 230	151 to 355	154 to 473
56 (55)	16QAM	75	173 to 220	175 to 269	177 to 415	180 to 553
56 (55)	32QAM	75	217 to 275	219 to 336	222 to 519	226 to 692
56 (55)	64QAM	75	273 to 346	275 to 423	279 to 653	284 to 871
56 (55)	128QAM	75	323 to 409	326 to 501	330 to 772	336 to 1000
56 (55)	256QAM	75	365 to 462	368 to 565	372 to 872	379 to 1000
56 (55)	512QAM	75	379 to 481	382 to 588	387 to 907	395 to 1000
56 (55)	512QAM Light	75	406 to 514	409 to 629	414 to 971	422 to 1000
56 (55)	1024QAM	75	433 to 548	436 to 670	441 to 1000	450 to 1000
56 (55)	1024QAM Light	75	454 to 575	458 to 703	463 to 1000	472 to 1000
40	QPSK Strong	23	50 to 63	50 to 77	51 to 119	52 to 159
40	QPSK	27	58 to 74	58 to 90	59 to 139	60 to 186
40	16QAM Strong	46	100 to 127	101 to 156	102 to 240	104 to 321
40	16QAM	55	117 to 149	118 to 182	120 to 281	122 to 375
40	32QAM	71	150 to 190	151 to 232	153 to 359	156 to 478
40	64QAM	75	185 to 235	187 to 287	189 to 443	193 to 591
40	128QAM	75	219 to 278	221 to 339	224 to 524	228 to 699
40	256QAM	75	251 to 318	253 to 389	256 to 600	261 to 800

Channel Spacing (MHz)	Modulation Scheme	Maximum Number of E1s in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Without Compression	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
40	512QAM	75	257 to 326	259 to 399	263 to 615	268 to 821
40	512QAM Light	75	275 to 349	277 to 427	281 to 658	286 to 878
40	1024QAM	75	293 to 372	296 to 454	300 to 701	305 to 935

Table 6-18 Integrated IP microwave work modes (ISV3 board @IS3 mode, STM-1 + Ethernet, XPIC disabled)

Channel Spacing (MHz)	Modulation Scheme	Number of STM-1 Services in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Without Compression	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
28 (27.5)	128QAM	1	160 to 203	162 to 248	164 to 383	167 to 511
28 (27.5)	256QAM	1	183 to 232	184 to 284	187 to 438	190 to 584
28 (27.5)	512QAM	1	196 to 249	198 to 304	200 to 469	204 to 626
28 (27.5)	512QAM Light	1	210 to 266	212 to 325	214 to 502	218 to 670
28 (27.5)	1024QAM	1	217 to 275	219 to 337	222 to 520	226 to 693
28 (27.5)	1024QAM Light	1	228 to 289	230 to 353	233 to 545	237 to 727
28 (27.5)	2048QAM	1	245 to 306	248 to 379	250 to 585	254 to 780
56 (55)	16QAM	1	173 to 220	175 to 269	177 to 415	180 to 553
56 (55)	32QAM	1	217 to 275	219 to 336	222 to 519	226 to 692
56 (55)	64QAM	1	273 to 346	275 to 423	279 to 653	284 to 871
56 (55)	128QAM	1	323 to 409	326 to 501	330 to 772	336 to 1000
56 (55)	256QAM	1	369 to 467	372 to 571	376 to 882	384 to 1000
56 (55)	512QAM	1	395 to 501	398 to 612	404 to 945	411 to 1000
56 (55)	512QAM Light	1	423 to 536	426 to 655	432 to 1000	440 to 1000

Channel Spacing (MHz)	Modulation Scheme	Number of STM-1 Services in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Without Compression	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
56 (55)	1024QAM	1	447 to 567	451 to 693	456 to 1000	465 to 1000
56 (55)	1024QAM Light	1	481 to 609	485 to 745	491 to 1000	500 to 1000
56 (55)	2048QAM	1	504 to 636	507 to 780	512 to 1000	522 to 1000
40	64QAM	1	185 to 235	187 to 287	189 to 443	193 to 591
40	128QAM	1	219 to 278	221 to 339	224 to 524	228 to 699
40	256QAM	1	253 to 321	255 to 392	258 to 605	263 to 807
40	512QAM	1	268 to 340	270 to 415	274 to 641	279 to 855
40	512QAM Light	1	287 to 363	289 to 444	293 to 686	298 to 915
40	1024QAM	1	302 to 383	304 to 468	309 to 723	314 to 964
40	1024QAM Light	1	317 to 402	320 to 491	324 to 758	330 to 1000
40	2048QAM	1	333 to 418	335 to 515	338 to 795	345 to 1000

Table 6-19 Integrated IP microwave work modes (ISV3 board @IS3-mode, STM-1 + Ethernet, XPIC enabled)

Channel Spacing (MHz)	Modulation Scheme	Number of STM-1 Services in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Without Compression	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
28 (27.5)	128QAM	1	160 to 203	162 to 248	164 to 383	167 to 511
28 (27.5)	256QAM	1	182 to 230	183 to 281	185 to 434	189 to 579
28 (27.5)	512QAM	1	188 to 239	190 to 292	192 to 450	196 to 601
28 (27.5)	512QAM Light	1	201 to 255	203 to 312	206 to 482	210 to 643
28 (27.5)	1024QAM	1	215 to 272	216 to 333	219 to 513	223 to 685
56 (55)	16QAM	1	173 to 220	175 to 269	177 to 415	180 to 553

Channel Spacing (MHz)	Modulation Scheme	Number of STM-1 Services in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Without Compression	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
56 (55)	32QAM	1	217 to 275	219 to 336	222 to 519	226 to 692
56 (55)	64QAM	1	273 to 346	275 to 423	279 to 653	284 to 871
56 (55)	128QAM	1	323 to 409	326 to 501	330 to 772	336 to 1000
56 (55)	256QAM	1	365 to 462	368 to 565	372 to 872	379 to 1000
56 (55)	512QAM	1	379 to 481	382 to 588	387 to 907	395 to 1000
56 (55)	512QAM Light	1	406 to 514	409 to 629	414 to 971	422 to 1000
56 (55)	1024QAM	1	433 to 548	436 to 670	441 to 1000	450 to 1000
56 (55)	1024QAM Light	1	454 to 575	458 to 703	463 to 1000	472 to 1000
40	64QAM	1	185 to 235	187 to 287	189 to 443	193 to 591
40	128QAM	1	219 to 278	221 to 339	224 to 524	228 to 699
40	256QAM	1	251 to 318	253 to 389	256 to 600	261 to 800
40	512QAM	1	257 to 326	259 to 399	263 to 615	268 to 821
40	512QAM Light	1	275 to 349	277 to 427	281 to 658	286 to 878
40	1024QAM	1	293 to 372	296 to 454	300 to 701	305 to 935

NOTE

For the integrated IP microwave work modes (@IS3 mode) that the ISV3 board supports:

- The throughput specifications listed in the tables are based on the following conditions.
  - Without compression: untagged Ethernet frames with a length ranging from 64 bytes to 1518 bytes
  - With L2 frame header compression: untagged Ethernet frames with a length ranging from 64 bytes to 1518 bytes
  - With L2+L3 frame header compression (IPv4): UDP messages, C-tagged Ethernet frames with a length ranging from 64 bytes to 1518 bytes
  - With L2+L3 frame header compression (IPv6): UDP messages, S-tagged Ethernet frames with a length ranging from 92 bytes to 1518 bytes
- E1/STM-1 services need to occupy the corresponding bandwidth of the air interface capacity. The bandwidth remaining after the E1/STM-1 service capacity is subtracted from the air interface capacity can be provided for Ethernet services.

6.1.1.7 Microwave Work Modes (ISM6 board)

The ISM6 board supports the SDH microwave work mode and the Integrated IP microwave work mode.

NOTE

On ISM6 boards, the backplane bandwidth for TDM services is 2xVC-4 (equivalent to 2xSTM-1 or 126xE1), and the maximum backplane bandwidth for packet services is 1 Gbit/s or 2.5 Gbit/s. Total service capacity does not exceed the backplane bandwidth when two IF channels are used together.

- If working with CSHN boards, an ISM6 board in any of slots 1 to 6 provides a maximum of 2.5 Gbit/s backplane bandwidth, and that in any of slots 7 to 14 provides a maximum of 1 Gbit/s backplane bandwidth;
- If working with CSHNA boards, the maximum backplane bandwidth of an ISM6 board is as following:
  - Slot 1 or 2: 2.5 Gbit/s
  - Slot 3 to 6: 2.5 Gbit/s (when EPLA is configured) or 1 Gbit/s (when EPLA is not configured)
  - Slot 7 to 14: 1 Gbit/s

IF Running Modes and Microwave Working Modes

ISM6 boards can work in three types of IF running modes: IS6, IS3, and IS2. **Table 6-20** describes the IF running modes and microwave working modes.

Table 6-20 IF running modes and microwave working modes

IF Running Mode	Application Scenario
IS6	• The IS6 mode provides high bandwidth and large capacity. • The IS6 mode supports 12 types of modulation modes, including QPSK Strong, QPSK, 16QAM Strong, 16QAM, 32QAM, 64QAM, 128QAM, 256QAM, 512QAM, 1024QAM, 2048QAM, and 4096QAM, among which 4096QAM is used only when AM is enabled. • The XMC-3 ODU supports the IS6 mode. • For information about the highest-order modulation scheme supported by each frequency band, see **Table 6-21** to **Table 6-22**. • For information about the supported radio working modes, see **Table 6-23** to **Table 6-27**.
IS3	• The IS3 mode provides large capacity. When working in this mode, ISM6 boards can interconnect with ISV3 boards or with OptiX RTN 905. • The IS3 mode supports 13 types of modulation modes, including QPSK Strong, QPSK, 16QAM Strong, 16QAM, 32QAM, 64QAM, 128QAM, 256QAM, 512QAM, 512QAM Light, 1024QAM, 1024QAM Light, and 2048QAM, among which 2048QAM is used only when AM is enabled. • ISM6 boards in IS3 mode can work with the XMC-2, XMC-2H, and XMC-3 ODU. • ISM6 boards working in IS3 mode support the same radio working modes as ISV3 boards. For details, see **6.1.1.6 Microwave Work Modes (ISV3 board)**.

IF Running Mode	Application Scenario
IS2	● The IS2 mode provides standard capacity. When working in this mode, ISM6 boards can interconnect with ISU2/ISX2 boards. ● The IS2 mode supports six types of modulation modes: QPSK, 16QAM, 32QAM, 64QAM, 128QAM, and 256QAM. ● ISM6 boards in IS2 mode can work with the XMC-2, XMC-2H, and XMC-3 ODU. ● ISM6 boards working in IS2 mode and with XPIC disabled support the same radio working modes as ISU2 boards. For information about the supported radio working modes, see **Table 6-4**, **Table 6-5**, and **Table 6-6** in **6.1.1.4 Microwave Work Modes (ISU2 board)**. ● ISM6 boards working in IS2 mode and with XPIC enabled support the same radio working modes as ISX2 boards. For information about the supported radio working modes, see **Table 6-7**, **Table 6-9**, and **Table 6-10** in **6.1.1.5 Microwave Work Modes (ISX2 board)**.

Table 6-21 Highest-order modulation scheme supported by the IS6 mode (XPIC disabled, the XMC-3 ODU used)

Frequency band	Maximum Modulation @ Channel Spacing					
	7 MHz	14 MHz	28 MHz	40 MHz	56 MHz	112 MHz
13/15/18/23/26 GHz	1024QAM	2048QAM	4096QAM	4096QAM	4096QAM	N/A
28/38 GHz	1024QAM	2048QAM	2048QAM	2048QAM	2048QAM	N/A
32 GHz	1024QAM	2048QAM	2048QAM	2048QAM	2048QAM	512QAM

NOTE

- At the 28 GHz or 32 GHz frequency band, 14 MHz/2048QAM is supported only when AM is enabled and ATPC is disabled.
- The 4096QAM modulation scheme is supported only when AM is enabled and ATPC is disabled. When the 4096QAM modulation scheme is used, IF cables must meet the following conditions:
  - For 26 GHz frequency band: an IF cable must be shorter than 30 m or longer than 40 m when using 28 MHz channel spacing; an IF cable must be shorter than 30 m or longer than 80 m when using 40/50 MHz channel spacing.
  - For 13/15/18/23 GHz frequency bands, please contact Huawei engineers to obtain the IF cable requirements.

Table 6-22 Highest-order modulation scheme supported by the IS6 mode (XPIC enabled, the XMC-3 ODU used)

Frequency band	Maximum Modulation @ Channel Spacing					
	7 MHz	14 MHz	28 MHz	40 MHz	56 MHz	112 MHz
13/15/18/23/26 GHz	512QAM	1024QAM	2048QAM	2048QAM	2048QAM	N/A
28/38 GHz	512QAM	1024QAM	1024QAM	1024QAM	1024QAM	N/A
32 GHz	512QAM	1024QAM	1024QAM	1024QAM	1024QAM	512QAM

NOTE

The channel spacings supported by the OptiX RTN 980 comply with ETSI standards. Channel spacings 14/28/56 MHz apply to most frequency bands; but channel spacings 13.75/27.5/55 MHz apply to the 18 GHz frequency band.

SDH microwave work mode (IS6-mode)

Table 6-23 SDH microwave work mode (IS6-mode)

Service Capacity	Modulation Scheme	Channel Spacing (MHz)
STM-1	128QAM	28 (27.5)
2xSTM-1	128QAM	56 (55)
NOTE In IS6 running mode and SDH service mode, the microwave work modes are the same regardless of whether the XPIC function is enabled or disabled.		

Integrated IP microwave work mode (IS6-mode, E1+Ethernet)

Table 6-24 Integrated IP microwave work mode (IS6 mode, E1 + Ethernet, non-XPIC)

Channel Spacing (MHz)	Modulation Scheme	Maximum Number of E1s in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Native Ethernet Throughput (Mbit/s)	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
7	QPSK Strong	4	8 to 10	8 to 12	8 to 19	8 to 25
7	QPSK	5	10 to 13	10 to 16	10 to 25	10 to 32
7	16QAM Strong	8	17 to 21	17 to 26	17 to 41	18 to 53
7	16QAM	10	20 to 26	20 to 32	21 to 49	21 to 63
7	32QAM	12	25 to 32	25 to 39	26 to 61	26 to 78
7	64QAM	15	32 to 40	32 to 50	33 to 77	33 to 98
7	128QAM	18	37 to 47	38 to 58	38 to 90	39 to 116
7	256QAM	20	43 to 54	43 to 66	43 to 102	44 to 131
7	512QAM	22	47 to 60	47 to 73	48 to 113	49 to 145
7	1024QAM	25	51 to 65	52 to 80	52 to 123	53 to 158

Channel Spacing (MHz)	Modulation Scheme	Maximum Number of E1s in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Native Ethernet Throughput (Mbit/s)	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
14 (13.75)	QPSK Strong	27	17 to 21	17 to 26	17 to 41	18 to 53
14 (13.75)	QPSK	28	20 to 26	21 to 32	21 to 49	21 to 64
14 (13.75)	16QAM Strong	8	35 to 44	35 to 54	36 to 84	36 to 108
14 (13.75)	16QAM	10	41 to 52	42 to 64	42 to 99	43 to 127
14 (13.75)	32QAM	16	52 to 66	52 to 80	53 to 124	54 to 159
14 (13.75)	64QAM	19	65 to 83	66 to 101	66 to 156	68 to 200
14 (13.75)	128QAM	25	77 to 98	78 to 120	79 to 185	80 to 237
14 (13.75)	256QAM	31	89 to 113	90 to 138	91 to 214	93 to 274
14 (13.75)	512QAM	37	99 to 125	99 to 153	101 to 236	103 to 303
14 (13.75)	1024QAM	43	104 to 132	105 to 162	106 to 250	109 to 321
14 (13.75)	2048QAM	47	115 to 146	116 to 179	118 to 276	120 to 354
28 (27.5)	QPSK Strong	50	36 to 46	36 to 56	37 to 86	37 to 111
28 (27.5)	QPSK	55	42 to 54	42 to 66	43 to 101	44 to 130
28 (27.5)	16QAM Strong	57	73 to 93	74 to 114	75 to 175	76 to 225
28 (27.5)	16QAM	17	86 to 109	86 to 133	87 to 205	89 to 263
28 (27.5)	32QAM	20	109 to 139	110 to 170	112 to 262	114 to 337
28 (27.5)	64QAM	35	135 to 172	136 to 210	138 to 324	141 to 416
28 (27.5)	128QAM	41	160 to 203	161 to 248	163 to 383	167 to 492
28 (27.5)	256QAM	52	185 to 234	186 to 287	189 to 443	192 to 568
28 (27.5)	512QAM	65	207 to 262	208 to 320	211 to 494	215 to 635
28 (27.5)	1024QAM	75	219 to 277	220 to 339	223 to 523	228 to 672
28 (27.5)	2048QAM	75	242 to 306	244 to 374	247 to 578	251 to 742
28 (27.5)	4096QAM	75	258 to 327	260 to 400	263 to 617	268 to 792
56 (55)	QPSK Strong	75	73 to 93	74 to 114	75 to 176	76 to 226
56 (55)	QPSK	75	86 to 109	87 to 133	88 to 206	89 to 264

Channel Spacing (MHz)	Modulation Scheme	Maximum Number of E1s in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Native Ethernet Throughput (Mbit/s)	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
56 (55)	16QAM Strong	75	148 to 188	149 to 230	151 to 355	154 to 456
56 (55)	16QAM	35	173 to 220	175 to 268	177 to 414	180 to 532
56 (55)	32QAM	41	217 to 275	219 to 336	221 to 519	226 to 666
56 (55)	64QAM	71	273 to 346	275 to 423	279 to 653	284 to 838
56 (55)	128QAM	75	323 to 409	326 to 500	330 to 772	336 to 991
56 (55)	256QAM	75	373 to 473	376 to 578	381 to 891	388 to 1145
56 (55)	512QAM	75	417 to 528	420 to 645	425 to 996	433 to 1278
56 (55)	1024QAM	75	450 to 571	454 to 698	460 to 1076	468 to 1382
56 (55)	2048QAM	75	502 to 636	506 to 777	512 to 1199	522 to 1539
56 (55)	4096QAM	75	535 to 678	540 to 829	546 to 1280	557 to 1643
40	QPSK Strong	75	49 to 63	50 to 77	51 to 119	51 to 153
40	QPSK	75	58 to 74	58 to 90	59 to 139	60 to 179
40	16QAM Strong	75	100 to 127	101 to 156	102 to 240	104 to 309
40	16QAM	24	117 to 149	118 to 182	120 to 281	122 to 360
40	32QAM	28	150 to 190	151 to 232	153 to 359	156 to 460
40	64QAM	48	185 to 235	187 to 287	189 to 443	192 to 568
40	128QAM	56	219 to 277	221 to 339	223 to 524	228 to 672
40	256QAM	72	253 to 320	255 to 392	258 to 605	263 to 776
40	512QAM	75	282 to 358	285 to 438	288 to 675	294 to 867
40	1024QAM	75	304 to 386	307 to 472	311 to 728	317 to 934
40	2048QAM	75	330 to 418	332 to 511	337 to 788	343 to 1012
40	4096QAM	75	344 to 436	347 to 533	351 to 823	358 to 1056
112	QPSK Strong	75	148 to 188	149 to 229	151 to 354	154 to 455
112	QPSK	75	173 to 219	174 to 268	177 to 414	180 to 531

Channel Spacing (MHz)	Modulation Scheme	Maximum Number of E1s in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Native Ethernet Throughput (Mbit/s)	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
112	16QAM Strong	75	298 to 377	300 to 461	304 to 712	310 to 914
112	16QAM	70	348 to 441	351 to 539	355 to 831	362 to 1067
112	32QAM	75	435 to 551	439 to 674	444 to 1040	453 to 1336
112	64QAM	75	548 to 694	552 to 848	559 to 1309	570 to 1680
112	128QAM	75	647 to 820	653 to 1003	661 to 1547	673 to 1987
112	256QAM	75	747 to 947	753 to 1158	763 to 1786	777 to 2293
112	512QAM	75	835 to 1058	841 to 1293	852 to 1995	868 to 2415

Table 6-25 Integrated IP microwave work mode (IS6 mode, E1 + Ethernet, XPIC)

Channel Spacing (MHz)	Modulation Scheme	Maximum Number of E1s in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Native Ethernet Throughput (Mbit/s)	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
7	QPSK Strong	3	8 to 10	8 to 12	8 to 19	8 to 24
7	QPSK	4	10 to 12	10 to 15	10 to 24	10 to 31
7	16QAM Strong	8	16 to 21	17 to 26	17 to 40	17 to 51
7	16QAM	9	20 to 25	20 to 31	20 to 48	20 to 61
7	32QAM	11	24 to 31	25 to 38	25 to 59	25 to 76
7	64QAM	15	31 to 39	31 to 48	32 to 74	32 to 96
7	128QAM	17	36 to 46	37 to 56	37 to 87	38 to 112
7	256QAM	20	42 to 53	42 to 65	43 to 101	44 to 130
7	512QAM	22	47 to 60	47 to 73	48 to 113	49 to 145
14 (13.75)	QPSK Strong	25	16 to 21	16 to 26	17 to 40	17 to 51
14 (13.75)	QPSK	8	20 to 25	20 to 31	20 to 48	21 to 62

Channel Spacing (MHz)	Modulation Scheme	Maximum Number of E1s in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Native Ethernet Throughput (Mbit/s)	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
14 (13.75)	16QAM Strong	9	34 to 43	34 to 53	35 to 82	35 to 105
14 (13.75)	16QAM	16	40 to 51	40 to 62	41 to 96	42 to 124
14 (13.75)	32QAM	19	50 to 64	51 to 78	51 to 120	52 to 155
14 (13.75)	64QAM	24	63 to 80	64 to 98	64 to 152	66 to 195
14 (13.75)	128QAM	30	75 to 95	75 to 116	76 to 179	78 to 231
14 (13.75)	256QAM	36	86 to 109	86 to 133	87 to 205	89 to 263
14 (13.75)	512QAM	41	96 to 121	96 to 148	98 to 229	100 to 294
14 (13.75)	1024QAM	46	104 to 132	105 to 162	106 to 250	109 to 321
28 (27.5)	QPSK Strong	50	36 to 46	36 to 56	37 to 86	37 to 111
28 (27.5)	QPSK	17	42 to 54	42 to 66	43 to 101	44 to 130
28 (27.5)	16QAM Strong	20	73 to 93	74 to 114	75 to 175	76 to 225
28 (27.5)	16QAM	35	86 to 109	86 to 133	87 to 205	89 to 263
28 (27.5)	32QAM	41	109 to 139	110 to 170	112 to 262	114 to 337
28 (27.5)	64QAM	52	135 to 172	136 to 210	138 to 324	141 to 416
28 (27.5)	128QAM	65	160 to 203	161 to 248	163 to 383	167 to 492
28 (27.5)	256QAM	75	184 to 233	185 to 284	187 to 439	191 to 564
28 (27.5)	512QAM	75	198 to 251	200 to 307	202 to 474	206 to 609
28 (27.5)	1024QAM	75	216 to 274	218 to 335	221 to 517	225 to 664
28 (27.5)	2048QAM	75	227 to 287	228 to 351	231 to 542	236 to 696
56 (55)	QPSK Strong	75	73 to 93	74 to 114	75 to 176	76 to 226
56 (55)	QPSK	35	86 to 109	87 to 133	88 to 206	89 to 264
56 (55)	16QAM Strong	41	148 to 188	149 to 230	151 to 355	154 to 456
56 (55)	16QAM	71	173 to 220	175 to 268	177 to 414	180 to 532
56 (55)	32QAM	75	217 to 275	219 to 336	221 to 519	226 to 666

Channel Spacing (MHz)	Modulation Scheme	Maximum Number of E1s in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Native Ethernet Throughput (Mbit/s)	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
56 (55)	64QAM	75	273 to 346	275 to 423	279 to 653	284 to 838
56 (55)	128QAM	75	323 to 409	326 to 500	330 to 772	336 to 991
56 (55)	256QAM	75	369 to 467	372 to 571	376 to 882	384 to 1132
56 (55)	512QAM	75	400 to 507	403 to 619	408 to 956	416 to 1227
56 (55)	1024QAM	75	436 to 552	439 to 675	445 to 1041	453 to 1337
56 (55)	2048QAM	75	456 to 578	460 to 707	466 to 1091	475 to 1401
40	QPSK Strong	75	49 to 63	50 to 77	51 to 119	51 to 153
40	QPSK	24	58 to 74	58 to 90	59 to 139	60 to 179
40	16QAM Strong	28	100 to 127	101 to 156	102 to 240	104 to 309
40	16QAM	48	117 to 149	118 to 182	120 to 281	122 to 360
40	32QAM	56	150 to 190	151 to 232	153 to 359	156 to 460
40	64QAM	72	185 to 235	187 to 287	189 to 443	192 to 568
40	128QAM	75	219 to 277	221 to 339	223 to 524	228 to 672
40	256QAM	75	251 to 318	253 to 389	256 to 600	261 to 770
40	512QAM	75	271 to 344	273 to 420	277 to 648	282 to 832
40	1024QAM	75	295 to 374	298 to 458	302 to 706	307 to 907
40	2048QAM	75	326 to 413	328 to 505	333 to 779	339 to 1000
112	QPSK Strong	75	147 to 188	149 to 229	150 to 354	152 to 455
112	QPSK	70	172 to 219	174 to 268	175 to 414	178 to 531
112	16QAM Strong	75	297 to 377	300 to 461	302 to 712	306 to 914
112	16QAM	75	347 to 441	351 to 539	352 to 831	357 to 1067
112	32QAM	75	434 to 551	439 to 674	441 to 1040	447 to 1336
112	64QAM	75	546 to 694	552 to 848	554 to 1309	562 to 1680
112	128QAM	75	646 to 820	653 to 1003	656 to 1547	665 to 1987
112	256QAM	75	745 to 947	753 to 1158	757 to 1786	768 to 2293

Channel Spacing (MHz)	Modulation Scheme	Maximum Number of E1s in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Native Ethernet Throughput (Mbit/s)	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
112	512QAM	75	832 to 1058	841 to 1293	845 to 1995	857 to 2415

Integrated IP microwave work mode (IS6-mode, STM-1+Ethernet)

Table 6-26 Integrated IP microwave work mode (IS6 mode, STM-1 + Ethernet, non-XPIC)

Channel Spacing (MHz)	Modulation Scheme	Number of STM-1 Services in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Native Ethernet Throughput (Mbit/s)	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
28 (27.5)	128QAM	1	160 to 203	161 to 248	163 to 383	167 to 492
28 (27.5)	256QAM	1	185 to 234	186 to 287	189 to 443	192 to 568
28 (27.5)	512QAM	1	207 to 262	208 to 320	211 to 494	215 to 635
28 (27.5)	1024QAM	1	219 to 277	220 to 339	223 to 523	228 to 672
28 (27.5)	2048QAM	1	242 to 306	244 to 374	247 to 578	251 to 742
28 (27.5)	4096QAM	1	258 to 327	260 to 400	263 to 617	268 to 792
56 (55)	16QAM	1	173 to 220	175 to 268	177 to 414	180 to 532
56 (55)	32QAM	1	217 to 275	219 to 336	221 to 519	226 to 666
56 (55)	64QAM	1	273 to 346	275 to 423	279 to 653	284 to 838
56 (55)	128QAM	1	323 to 409	326 to 500	330 to 772	336 to 991
56 (55)	256QAM	1	373 to 473	376 to 578	381 to 891	388 to 1145
56 (55)	512QAM	1	417 to 528	420 to 645	425 to 996	433 to 1278
56 (55)	1024QAM	1	450 to 571	454 to 698	460 to 1076	468 to 1382
56 (55)	2048QAM	1	502 to 636	506 to 777	512 to 1199	522 to 1539
56 (55)	4096QAM	1	535 to 678	540 to 829	546 to 1280	557 to 1643
40	64QAM	1	185 to 235	187 to 287	189 to 443	192 to 568
40	128QAM	1	219 to 277	221 to 339	223 to 524	228 to 672

Channel Spacing (MHz)	Modulation Scheme	Number of STM-1 Services in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Native Ethernet Throughput (Mbit/s)	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
40	256QAM	1	253 to 320	255 to 392	258 to 605	263 to 776
40	512QAM	1	282 to 358	285 to 438	288 to 675	294 to 867
40	1024QAM	1	304 to 386	307 to 472	311 to 728	317 to 934
40	2048QAM	1	330 to 418	332 to 511	337 to 788	343 to 1012
40	4096QAM	1	344 to 436	347 to 533	351 to 823	358 to 1056
112	QPSK	1	173 to 219	174 to 268	177 to 414	180 to 531
112	16QAM Strong	1	298 to 377	300 to 461	304 to 712	310 to 914
112	16QAM	1	348 to 441	351 to 539	355 to 831	362 to 1067
112	32QAM	1	435 to 551	439 to 674	444 to 1040	453 to 1336
112	64QAM	1	548 to 694	552 to 848	559 to 1309	570 to 1680
112	128QAM	1	647 to 820	653 to 1003	661 to 1547	673 to 1987
112	256QAM	1	747 to 947	753 to 1158	763 to 1786	777 to 2293
112	512QAM	1	835 to 1058	841 to 1293	852 to 1995	868 to 2415

Table 6-27 Integrated IP microwave work mode (IS6 mode, STM-1 + Ethernet, XPIC)

Channel Spacing (MHz)	Modulation Scheme	Number of STM-1 Services in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Native Ethernet Throughput (Mbit/s)	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
28 (27.5)	128QAM	1	160 to 203	161 to 248	163 to 383	167 to 492
28 (27.5)	256QAM	1	184 to 233	185 to 284	187 to 439	191 to 564
28 (27.5)	512QAM	1	198 to 251	200 to 307	202 to 474	206 to 609
28 (27.5)	1024QAM	1	216 to 274	218 to 335	221 to 517	225 to 664
28 (27.5)	2048QAM	1	227 to 287	228 to 351	231 to 542	236 to 696

Channel Spacing (MHz)	Modulation Scheme	Number of STM-1 Services in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)			
			Native Ethernet Throughput (Mbit/s)	With L2 Frame Header Compression	With L2+L3 Frame Header Compression (IPv4)	With L2+L3 Frame Header Compression (IPv6)
56 (55)	16QAM	1	173 to 220	175 to 268	177 to 414	180 to 532
56 (55)	32QAM	1	217 to 275	219 to 336	221 to 519	226 to 666
56 (55)	64QAM	1	273 to 346	275 to 423	279 to 653	284 to 838
56 (55)	128QAM	1	323 to 409	326 to 500	330 to 772	336 to 991
56 (55)	256QAM	1	369 to 467	372 to 571	376 to 882	384 to 1132
56 (55)	512QAM	1	400 to 507	403 to 619	408 to 956	416 to 1227
56 (55)	1024QAM	1	436 to 552	439 to 675	445 to 1041	453 to 1337
56 (55)	2048QAM	1	456 to 578	460 to 707	466 to 1091	475 to 1401
40	64QAM	1	185 to 235	187 to 287	189 to 443	192 to 568
40	128QAM	1	219 to 277	221 to 339	223 to 524	228 to 672
40	256QAM	1	251 to 318	253 to 389	256 to 600	261 to 770
40	512QAM	1	271 to 344	273 to 420	277 to 648	282 to 832
40	1024QAM	1	295 to 374	298 to 458	302 to 706	307 to 907
40	2048QAM	1	326 to 413	328 to 505	333 to 779	339 to 1000
112	QPSK	1	172 to 219	174 to 268	175 to 414	178 to 531
112	16QAM Strong	1	297 to 377	300 to 461	302 to 712	306 to 914
112	16QAM	1	347 to 441	351 to 539	352 to 831	357 to 1067
112	32QAM	1	434 to 551	439 to 674	441 to 1040	447 to 1336
112	64QAM	1	546 to 694	552 to 848	554 to 1309	562 to 1680
112	128QAM	1	646 to 820	653 to 1003	656 to 1547	665 to 1987
112	256QAM	1	745 to 947	753 to 1158	757 to 1786	768 to 2293
112	512QAM	1	832 to 1058	841 to 1293	845 to 1995	857 to 2415

NOTE

- The throughput specifications listed in the tables are based on the following conditions.
  - Without compression: untagged Ethernet frames with a length ranging from 64 bytes to 1518 bytes
  - With L2 frame header compression: untagged Ethernet frames with a length ranging from 64 bytes to 1518 bytes
  - With L2+L3 frame header compression (IPv4): UDP messages, C-tagged Ethernet frames with a length ranging from 70 bytes to 1518 bytes
  - With L2+L3 frame header compression (IPv6): UDP messages, S-tagged Ethernet frames with a length ranging from 94 bytes to 1518 bytes
- E1/STM-1 services need to occupy the corresponding bandwidth of the air interface capacity. The bandwidth remaining after the E1/STM-1 service capacity is subtracted from the air interface capacity can be provided for Ethernet services.

6.1.1.8 Throughput of an EPLA Group

This section describes air-interface throughput of an enhanced physical link aggregation (EPLA) group between two sites.

Throughput data in tables listing microwave work modes is measured based on 1+0 microwave links, throughput of an EPLA group is not equal to the total throughput of its member 1+0 microwave links.

In the EPLA group shown in **Figure 6-1**, ISV3 boards work in IS3 mode and the four microwave links are configured consistently. **Table 6-28** lists the throughput of the EPLA group. When more than 1 Gbit/s services are received from the client side, load-sharing LAG must be configured, or a 10GE port must be used for service access.

Table 6-29 lists the throughput of a 4+0 EPLA group on ISM6 boards that work in IS6 mode.

Figure 6-1 An EPLA group consisting of four microwave links

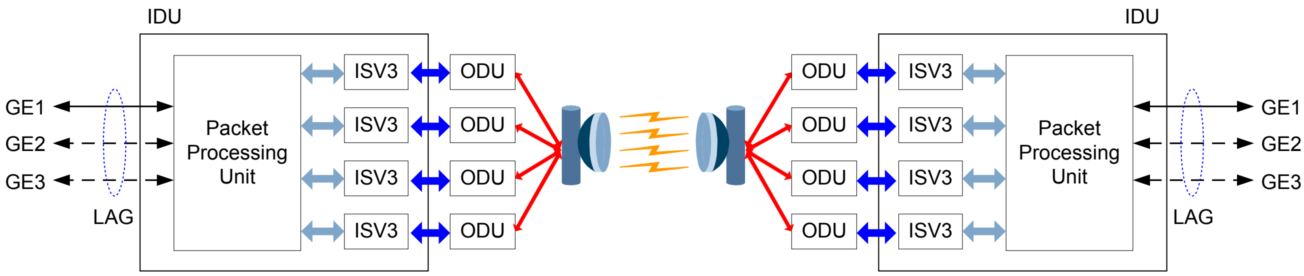


Table 6-28 Throughput of the EPLA group consisting of four microwave links (ISV3 board, IS3 mode, non-XPIC)

Modulation Scheme	Native Ethernet Service Throughput (Mbit/s)				
	7 MHz	14 MHz	28 MHz	40 MHz	56 MHz
QPSK Strong	30 to 37	64 to 78	136 to 164	186 to 225	276 to 333
QPSK	38 to 46	78 to 94	159 to 192	218 to 263	322 to 390
16QAM Strong	64 to 77	132 to 159	275 to 332	376 to 455	555 to 671

Modulation Scheme	Native Ethernet Service Throughput (Mbit/s)				
	7 MHz	14 MHz	28 MHz	40 MHz	56 MHz
16QAM	77 to 93	155 to 188	321 to 388	439 to 531	649 to 784
32QAM	95 to 115	194 to 235	410 to 496	561 to 679	812 to 982
64QAM	120 to 145	244 to 295	507 to 613	693 to 838	1022 to 1236
128QAM	141 to 170	289 to 350	600 to 725	820 to 991	1209 to 1461
256QAM	158 to 191	331 to 400	685 to 828	946 to 1144	1379 to 1668
512QAM	168 to 203	350 to 423	734 to 888	1000 to 1212	1479 to 1788
512QAM Light	179 to 216	374 to 454	786 to 950	1072 to 1297	1582 to 1913
1024QAM	191 to 231	388 to 469	813 to 983	1129 to 1367	1654 to 2022
1024QAM Light	N/A	407 to 492	853 to 1032	1183 to 1434	1799 to 2175

NOTE
Throughput data in this table is calculated based on the scenario in which microwave links transmit Ethernet frames with a length ranging from 64 bytes to 1518 bytes.

Table 6-29 Throughput of the EPLA group consisting of four microwave links (ISM6 board, IS6 mode, non-XPIC)

Modulation Scheme	Native Ethernet Service Throughput (Mbit/s)					
	7 MHz	14 MHz	28 MHz	40 MHz	56 MHz	112 MHz
QPSK Strong	31 to 37	64 to 78	136 to 164	186 to 225	275 to 333	554 to 670
QPSK	39 to 47	78 to 94	159 to 192	218 to 263	322 to 389	648 to 783
16QAM Strong	64 to 78	132 to 159	275 to 332	376 to 455	555 to 671	1115 to 1347
16QAM	77 to 93	155 to 188	321 to 388	440 to 531	649 to 784	1301 to 1573
32QAM	95 to 115	194 to 235	410 to 496	561 to 679	812 to 982	1628 to 1969
64QAM	120 to 145	244 to 296	507 to 613	693 to 838	1022 to 1236	2048 to 2476
128QAM	141 to 170	289 to 350	600 to 725	820 to 991	1209 to 1461	2422 to 2928
256QAM	160 to 194	335 to 404	693 to 838	946 to 1144	1395 to 1687	2795 to 3380
512QAM	177 to 214	370 to 447	774 to 936	1057 to 1278	1558 to 1884	3122 to 3774
1024QAM	193 to 233	391 to 473	819 to 990	1139 to 1377	1685 to 2037	N/A
2048QAM	N/A	432 to 522	905 to 1094	1234 to 1492	1876 to 2269	N/A
4096QAM	N/A	N/A	966 to 1167	1288 to 1557	2003 to 2421	N/A

Modulation Scheme	Native Ethernet Service Throughput (Mbit/s)					
	7 MHz	14 MHz	28 MHz	40 MHz	56 MHz	112 MHz
NOTE Throughput data in this table is calculated based on the scenario in which microwave links transmit Ethernet frames with a length ranging from 64 bytes to 1518 bytes.						

6.1.2 Frequency Band

The ODUs of different series and different types support a variety of operating frequency bands.

NOTE

Each frequency range in the following tables refers to the range that the corresponding frequency band covers. For the operating frequency range that each T/R spacing supports, see the corresponding *ODU Hardware Description*.

Frequency Bands (High Power ODU)

Table 6-30 Frequency band (XMC-2 ODU)

Frequency Band	Frequency Range (GHz)	T/R Spacing (MHz)
6 GHz	5.925 to 7.125	252.04, 160/170, 340/350
7 GHz	7.093 to 7.897	154, 161, 168, 196, 245
8 GHz	7.731 to 8.497	119/126, 151.614, 208, 266, 310, 311.32
10 GHz	10.130 to 10.650	350
	10.500 to 10.678	91
11 GHz	10.675 to 11.745	500/490, 530/520
13 GHz	12.751 to 13.248	266
15 GHz	14.400 to 15.358	315/322, 420, 490, 644, 728
18 GHz	17.685 to 19.710	1010/1008, 1092.5, 1560
23 GHz	21.200 to 23.618	1008, 1200, 1232
26 GHz	24.250 to 26.453	1008
28 GHz	27.520 to 29.481	1008
32 GHz	31.815 to 33.383	812
38 GHz	37.044 to 40.105	1260
42 GHz	40.522 to 43.464	1500

NOTE

In a description of models of XMC-2 ODUs, the frequency band 10 GHz is used to represent the 10 GHz and 10.5 GHz frequency bands.

7/8 GHz XMC-2 ODUs are available in two versions: normal and XMC-2E. Only 8 GHz XMC-2 ODUs of the XMC-2E version support the T/R spacing 310 MHz.

Table 6-31 Frequency band (XMC-2H ODU)

Frequency Band	Frequency Range (GHz)	T/R Spacing (MHz)
6 GHz	5.925 to 6.425 (L6) 6.425 to 7.125 (U6)	252.04 (L6) 340/350 (U6)
7 GHz	7.093 to 7.897	154, 161, 168, 196, 245, 160
8 GHz	7.731 to 8.497	119/126, 151.614, 208, 266, 310, 311.32
11 GHz	10.675 to 11.745	500/490, 530/520

Table 6-32 Frequency band (XMC-3 ODU)

Frequency Band	Frequency Range (GHz)	T/R Spacing (MHz)
13 GHz	12.751 to 13.248	266
15 GHz	14.400 to 15.358	315/322, 420, 490, 644, 728
18 GHz	17.685 to 19.710	1010/1008, 1092.5, 1560
23 GHz	21.200 to 23.618	1008, 1050, 1200, 1232
26 GHz	24.250 to 26.453	1008
28 GHz	27.520 to 29.481	1008
32 GHz	31.815 to 33.383	812
38 GHz	37.044 to 40.105	1260

Table 6-33 Frequency band (HP ODU)

Frequency Band	Frequency Range (GHz)	T/R Spacing (MHz)
6 GHz	5.925 to 6.425 (L6) 6.430 to 7.120 (U6)	252.04 (L6) 340 (U6)
7 GHz	7.093 to 7.897	154, 161, 168, 196, 245

Frequency Band	Frequency Range (GHz)	T/R Spacing (MHz)
8 GHz	7.731 to 8.497	119, 126, 151.614, 208, 266, 311.32
10 GHz	10.150 to 10.650	350
10.5 GHz	10.500 to 10.678	91
11 GHz	10.675 to 11.745	490, 500, 530
13 GHz	12.751 to 13.248	266
15 GHz	14.400 to 15.353	315, 322, 420, 490, 644, 728
18 GHz	17.685 to 19.710	1008, 1010, 1560
23 GHz	21.200 to 23.618	1008, 1200, 1232
26 GHz	24.549 to 26.453	1008
28 GHz	27.520 to 29.481	1008
32 GHz	31.815 to 33.383	812
38 GHz	37.044 to 40.105	700, 1260

Table 6-34 Frequency Band (HPA ODU)

Frequency Band	Frequency Range (GHz)	T/R Spacing (MHz)
6 GHz	5.915-7.125	160, 170, 252.04,340, 350
7 GHz	7.093-7.897	154, 161, 168, 196, 245
8 GHz	7.731-8.496	119, 126, 266, 311.32
11 GHz	10.675-11.745	490, 500, 530
13 GHz	12.751-13.248	266
15 GHz	14.400-15.353	420, 490, 644, 728
18 GHz	17.685-19.710	1008, 1010, 1560
23 GHz	21.200-23.618	1008, 1200, 1232

Frequency Bands (Standard Power ODU)

Table 6-35 Frequency Band (SP ODU)

Frequency Band	Frequency Range (GHz)	T/R Spacing (MHz)
7 GHz	7.093 to 7.897	154, 161, 168, 196, 245
8 GHz	7.731 to 8.496	119, 126, 266, 311.32
11 GHz	10.675 to 11.745	490, 500, 530
13 GHz	12.751 to 13.248	266
15 GHz	14.400 to 15.353	315, 322, 420, 490, 644, 728
18 GHz	17.685 to 19.710	1008, 1010, 1560
23 GHz	21.200 to 23.618	1008, 1200, 1232
26 GHz	24.549 to 26.453	1008
38 GHz	37.044 to 40,105	700, 1260

Table 6-36 Frequency band (SPA ODU)

Frequency Band	Frequency Range (GHz)	T/R Spacing (MHz)
6 GHz	5.915 to 6.425 (L6) 6.425 to 7.125 (U6)	252.04 (L6) 340 (U6)
7 GHz	7.093 to 7.897	154, 161, 168, 196, 245
8 GHz	7.731 to 8.496	119, 126, 266, 311.32
11 GHz	10.675 to 11.745	490, 500, 530
13 GHz	12.751 to 13.248	266
15 GHz	14.403 to 15.348	420, 490
18 GHz	17.685 to 19.710	1008, 1010
23 GHz	21.200 to 23.618	1008, 1232

Frequency Bands (Low Capacity ODU)

Table 6-37 Frequency band (LP ODU)

Frequency Band	Frequency Range (GHz)	T/R Spacing (MHz)
7 GHz	7.093 to 7.897	154, 161, 168, 196, 245
8 GHz	7.718 to 8.496	119, 126, 266, 311.32
11 GHz	10.675 to 11.745	490, 500, 530
13 GHz	12.751 to 13.248	266
15 GHz	14.403 to 15.348	420, 490
18 GHz	17.685 to 19.710	1008, 1010
23 GHz	21.200 to 23.618	1008, 1232

6.1.3 Receiver Sensitivity

The receiver sensitivity reflects the anti-fading capability of the microwave equipment.

NOTE

For a guaranteed value, remove 3 dB from the typical value.

6.1.3.1 Receiver Sensitivity (IF1 Board)

The IF1 board supports SDH/PDH microwave work modes.

NOTE

For an XMC-1 ODU or XMC-2 ODU at the 18 GHz frequency band, remove 2 dB from the sensitivity values specified in the table.

Table 6-38 Typical receiver sensitivity of the SDH/PDH microwave (i, IF1 board)

Item	Performance					
	4xE1		8xE1		16xE1	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
RSL@ BER = 10^{-6} (dBm)						
@6 GHz	-91.5	-87.5	-88.5	-84.5	-85.5	-81.5
@7 GHz	-91.5	-87.5	-88.5	-84.5	-85.5	-81.5
@8 GHz	-91.5	-87.5	-88.5	-84.5	-85.5	-81.5
@10 GHz	-91.0	-87.0	-88.0	-84.0	-85.0	-81.0

Item	Performance					
	4xE1		8xE1		16xE1	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
@10.5 GHz	-89.0	-85.0	-86.0	-82.0	-83.0	-79.0
@11 GHz	-91.0	-87.0	-88.0	-84.0	-85.0	-81.0
@13 GHz	-91.0	-87.0	-88.0	-84.0	-85.0	-81.0
@15 GHz	-91.0	-87.0	-88.0	-84.0	-85.0	-81.0
@18 GHz	-91.0	-87.0	-88.0	-84.0	-85.0	-81.0
@23 GHz	-90.5	-86.5	-87.5	-83.5	-84.5	-80.5
@26 GHz	-90.0	-86.0	-87.0	-83.0	-84.0	-80.0
@32 GHz	-89.0	-85.0	-86.0	-82.0	-83.0	-79.0
@38 GHz	-88.5	-84.5	-85.5	-81.5	-82.5	-78.5

Table 6-39 Typical receiver sensitivity of the SDH/PDH microwave (ii, IF1 board)

Item	Performance					
	22xE1	26xE1	35xE1	44xE1	53xE1	STM-1
	32QAM	64QAM	16QAM	32QAM	64QAM	128QAM
RSL@ BER = 10^{-6} (dBm)						
@6 GHz	-80.5	-76.5	-79.0	-77.5	-73.5	-70.5
@7 GHz	-80.5	-76.5	-79.0	-77.5	-73.5	-70.5
@8 GHz	-80.5	-76.5	-79.0	-77.5	-73.5	-70.5
@10 GHz	-80.0	-76.0	-78.5	-77.0	-73.0	-70.0
@10.5 GHz	-78.0	-74.0	-76.5	-75.0	-71.0	-68.0
@11 GHz	-80.0	-76.0	-78.5	-77.0	-73.0	-70.0
@13 GHz	-80.0	-76.0	-78.5	-77.0	-73.0	-70.0
@15 GHz	-80.0	-76.0	-78.5	-77.0	-73.0	-70.0
@18 GHz	-80.0	-76.0	-78.5	-77.0	-73.0	-70.0
@23 GHz	-79.5	-75.5	-78.0	-76.5	-72.5	-69.5
@26 GHz	-79.0	-75.0	-77.5	-76.0	-72.0	-69.0
@32 GHz	-78.0	-74.0	-76.5	-75.0	-71.0	-68.0

Item	Performance					
	22xE1	26xE1	35xE1	44xE1	53xE1	STM-1
	32QAM	64QAM	16QAM	32QAM	64QAM	128QAM
@38 GHz	-77.5	-73.5	-76.0	-74.5	-70.5	-67.5

6.1.3.2 Receiver Sensitivity (IFU2 board)

The IFU2 board supports Integrated IP microwave work modes.

NOTE

- For an XMC-2 ODU at the 18 GHz frequency band, remove 2 dB from the sensitivity values specified in the table.
- The 10.5 GHz ODU with the T/R spacing of 91 MHz does not support the channel spacing of 56 MHz. The receiver sensitivity is not available (N/A).

Table 6-40 Typical receiver sensitivity of the Integrated IP microwave (i, IFU2 board)

Item	Performance (Channel Spacing: 7 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6}(dBm)						
@6 GHz	-92.5	-86.5	-82.5	-79.5	-76.5	-73.5
@7 GHz	-92.5	-86.5	-82.5	-79.5	-76.5	-73.5
@8 GHz	-92.5	-86.5	-82.5	-79.5	-76.5	-73.5
@10 GHz	-92	-86	-82	-79	-76	-73
@10.5 GHz	-90	-84	-80	-77	-74	-71
@11 GHz	-92	-86	-82	-79	-76	-73
@13 GHz	-92	-86	-82	-79	-76	-73
@15 GHz	-92	-86	-82	-79	-76	-73
@18 GHz	-92	-86	-82	-79	-76	-73
@23 GHz	-91.5	-85.5	-81.5	-78.5	-75.5	-72.5
@26 GHz	-91	-85	-81	-78	-75	-72
@28 GHz	-90.5	-84.5	-80.5	-77.5	-74.5	-71.5
@32 GHz	-90	-84	-80	-77	-74	-71
@38 GHz	-89.5	-83.5	-79.5	-76.5	-73.5	-70.5

Item	Performance (Channel Spacing: 7 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
@42 GHz	-88	-82	-78	-75	-72	-69

Table 6-41 Typical receiver sensitivity of the Integrated IP microwave (ii, IFU2 board)

Item	Performance (Channel Spacing: 14 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-90.5	-83.5	-79.5	-76.5	-73.5	-70.5
@7 GHz	-90.5	-83.5	-79.5	-76.5	-73.5	-70.5
@8 GHz	-90.5	-83.5	-79.5	-76.5	-73.5	-70.5
@10 GHz	-90	-83	-79	-76	-73	-70
@10.5 GHz	-88	-81	-77	-74	-71	-68
@11 GHz	-90	-83	-79	-76	-73	-70
@13 GHz	-90	-83	-79	-76	-73	-70
@15 GHz	-90	-83	-79	-76	-73	-70
@18 GHz	-90	-83	-79	-76	-73	-70
@23 GHz	-89.5	-82.5	-78.5	-75.5	-72.5	-69.5
@26 GHz	-89	-82	-78	-75	-72	-69
@28 GHz	-88.5	-81.5	-77.5	-74.5	-71.5	-68.5
@32 GHz	-88	-81	-77	-74	-71	-68
@38 GHz	-87.5	-80.5	-76.5	-73.5	-70.5	-67.5
@42 GHz	-86	-79	-75	-72	-69	-66

Table 6-42 Typical receiver sensitivity of the Integrated IP microwave (iii, IFU2 board)

Item	Performance (Channel Spacing: 28 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-87.5	-80.5	-76.5	-73.5	-70.5	-67.5

Item	Performance (Channel Spacing: 28 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
@7 GHz	-87.5	-80.5	-76.5	-73.5	-70.5	-67.5
@8 GHz	-87.5	-80.5	-76.5	-73.5	-70.5	-67.5
@10 GHz	-87	-80	-76	-73	-70	-67
@10.5 GHz	-85	-78	-74	-71	-68	-65
@11 GHz	-87	-80	-76	-73	-70	-67
@13 GHz	-87	-80	-76	-73	-70	-67
@15 GHz	-87	-80	-76	-73	-70	-67
@18 GHz	-87	-80	-76	-73	-70	-67
@23 GHz	-86.5	-79.5	-75.5	-72.5	-69.5	-66.5
@26 GHz	-86	-79	-75	-72	-69	-66
@28 GHz	-85.5	-78.5	-74.5	-71.5	-68.5	-65.5
@32 GHz	-85	-78	-74	-71	-68	-65
@38 GHz	-84.5	-77.5	-73.5	-70.5	-67.5	-64.5
@42 GHz	-83	-76	-72	-69	-66	-63

Table 6-43 Typical receiver sensitivity of the Integrated IP microwave (iv, IFU2 board)

Item	Performance (Channel Spacing: 56 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-84.5	-77.5	-73.5	-70.5	-67.5	-64.5
@7 GHz	-84.5	-77.5	-73.5	-70.5	-67.5	-64.5
@8 GHz	-84.5	-77.5	-73.5	-70.5	-67.5	-64.5
@10 GHz	-84	-77	-73	-70	-67	-64
@10.5 GHz	N/A	N/A	N/A	N/A	N/A	N/A
@11 GHz	-84	-77	-73	-70	-67	-64
@13 GHz	-84	-77	-73	-70	-67	-64
@15 GHz	-84	-77	-73	-70	-67	-64

Item	Performance (Channel Spacing: 56 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
@18 GHz	-84	-77	-73	-70	-67	-64
@23 GHz	-83.5	-76.5	-72.5	-69.5	-66.5	-63.5
@26 GHz	-83	-76	-72	-69	-66	-63
@28 GHz	-82.5	-75.5	-71.5	-68.5	-65.5	-62.5
@32 GHz	-82	-75	-71	-68	-65	-62
@38 GHz	-81.5	-74.5	-70.5	-67.5	-64.5	-61.5
@42 GHz	-80	-73	-69	-66	-63	-60

6.1.3.3 Receiver Sensitivity (IFX2 board)

The IFX2 board supports Integrated IP microwave work modes.

NOTE

- For an XMC-2 ODU at the 18 GHz frequency band, remove 2 dB from the sensitivity values specified in the table.
- The IFX2 board does not support the 7MHz/128QAM, 7MHz/256QAM, and 14MHz/256QAM working modes at frequency bands from 6 GHz to 23 GHz. The receiver sensitivity is not available (N/A).
- The IFX2 board does not support the 7MHz/64QAM, 7MHz/128QAM, 7MHz/256QAM, 14MHz/128QAM, and 14MHz/256QAM working modes at frequency bands from 26 GHz to 42 GHz. The receiver sensitivity is not available (N/A).
- The 10.5 GHz XMC-2 ODU with the T/R spacing of 91 MHz does not support the channel spacing of 56 MHz. The receiver sensitivity is not available (N/A).

Table 6-44 Typical receiver sensitivity of the Integrated IP microwave (i, IFX2 board)

Item	Performance (Channel Spacing: 7 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-92.5	-86.5	-82.5	-79.5	N/A	N/A
@7 GHz	-92.5	-86.5	-82.5	-79.5	N/A	N/A
@8 GHz	-92.5	-86.5	-82.5	-79.5	N/A	N/A
@10 GHz	-92	-86	-82	-79	N/A	N/A
@10.5 GHz	-90	-84	-80	-77	N/A	N/A
@11 GHz	-92	-86	-82	-79	N/A	N/A

Item	Performance (Channel Spacing: 7 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
@13 GHz	-92	-86	-82	-79	N/A	N/A
@15 GHz	-92	-86	-82	-79	N/A	N/A
@18 GHz	-92	-86	-82	-79	N/A	N/A
@23 GHz	-91.5	-85.5	-81.5	-78.5	N/A	N/A
@26 GHz	-91	-85	-81	N/A	N/A	N/A
@28 GHz	-90.5	-84.5	-80.5	N/A	N/A	N/A
@32 GHz	-90	-84	-80	N/A	N/A	N/A
@38 GHz	-89.5	-83.5	-79.5	N/A	N/A	N/A
@42 GHz	-88	-82	-78	N/A	N/A	N/A

Table 6-45 Typical receiver sensitivity of the Integrated IP microwave (ii, IFX2 board)

Item	Performance (Channel Spacing: 14 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-90.5	-83.5	-79.5	-76.5	-73.5	N/A
@7 GHz	-90.5	-83.5	-79.5	-76.5	-73.5	N/A
@8 GHz	-90.5	-83.5	-79.5	-76.5	-73.5	N/A
@10 GHz	-90	-83	-79	-76	-73	N/A
@10.5 GHz	-88	-81	-77	-74	-71	N/A
@11 GHz	-90	-83	-79	-76	-73	N/A
@13 GHz	-90	-83	-79	-76	-73	N/A
@15 GHz	-90	-83	-79	-76	-73	N/A
@18 GHz	-90	-83	-79	-76	-73	N/A
@23 GHz	-89.5	-82.5	-78.5	-75.5	-72.5	N/A
@26 GHz	-89	-82	-78	-75	N/A	N/A
@28 GHz	-88.5	-81.5	-77.5	-74.5	N/A	N/A
@32 GHz	-88	-81	-77	-74	N/A	N/A

Item	Performance (Channel Spacing: 14 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
@38 GHz	-87.5	-80.5	-76.5	-73.5	N/A	N/A
@42 GHz	-86	-79	-75	-72	N/A	N/A

Table 6-46 Typical receiver sensitivity of the Integrated IP microwave (iii, IFX2 board)

Item	Performance (Channel Spacing: 28 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-87.5	-80.5	-76.5	-73.5	-70.5	-67.5
@7 GHz	-87.5	-80.5	-76.5	-73.5	-70.5	-67.5
@8 GHz	-87.5	-80.5	-76.5	-73.5	-70.5	-67.5
@10 GHz	-87	-80	-76	-73	-70	-67
@10.5 GHz	-85	-78	-74	-71	-68	-65
@11 GHz	-87	-80	-76	-73	-70	-67
@13 GHz	-87	-80	-76	-73	-70	-67
@15 GHz	-87	-80	-76	-73	-70	-67
@18 GHz	-87	-80	-76	-73	-70	-67
@23 GHz	-86.5	-79.5	-75.5	-72.5	-69.5	-66.5
@26 GHz	-86	-79	-75	-72	-69	-66
@28 GHz	-85.5	-78.5	-74.5	-71.5	-68.5	-65.5
@32 GHz	-85	-78	-74	-71	-68	-65
@38 GHz	-84.5	-77.5	-73.5	-70.5	-67.5	-64.5
@42 GHz	-83	-76	-72	-69	-66	-63

Table 6-47 Typical receiver sensitivity of the Integrated IP microwave (iv, IFX2 board)

Item	Performance (Channel Spacing: 56 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6} (dBm)						

Item	Performance (Channel Spacing: 56 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
@6 GHz	-84.5	-77.5	-73.5	-70.5	-67.5	-64.5
@7 GHz	-84.5	-77.5	-73.5	-70.5	-67.5	-64.5
@8 GHz	-84.5	-77.5	-73.5	-70.5	-67.5	-64.5
@10 GHz	-84	-77	-73	-70	-67	-64
@10.5 GHz	N/A	N/A	N/A	N/A	N/A	N/A
@11 GHz	-84	-77	-73	-70	-67	-64
@13 GHz	-84	-77	-73	-70	-67	-64
@15 GHz	-84	-77	-73	-70	-67	-64
@18 GHz	-84	-77	-73	-70	-67	-64
@23 GHz	-83.5	-76.5	-72.5	-69.5	-66.5	-63.5
@26 GHz	-83	-76	-72	-69	-66	-63
@28 GHz	-82.5	-75.5	-71.5	-68.5	-65.5	-62.5
@32 GHz	-82	-75	-71	-68	-65	-62
@38 GHz	-81.5	-74.5	-70.5	-67.5	-64.5	-61.5
@42 GHz	-80	-73	-69	-66	-63	-60

6.1.3.4 Receiver Sensitivity (ISU2 board)

The ISU2 board supports SDH microwave work modes and Integrated IP microwave work modes.

NOTE

- For an XMC-2 ODU at the 18 GHz frequency band, remove 2 dB from the values specified in the table to obtain the values of receiver sensitivity.
- The 10.5 GHz ODU with the T/R spacing of 91 MHz does not support the channel spacing of 40/56 MHz. The receiver sensitivity is not available (N/A).
- Currently the 42 GHz ODU does not support the channel spacing of 3.5 MHz. The receiver sensitivity is not available (N/A).

SDH Microwave (ISU2 Board)

Table 6-48 Typical receiver sensitivity of the SDH microwave (ISU2)

Item	Performance	
	1xSTM-1	2xSTM-1
	128QAM/28 MHz	128QAM/56 MHz
RSL@ BER = 10^{-6} (dBm)		
@6 GHz	-71	-68
@7 GHz	-71	-68
@8 GHz	-71	-68
@10 GHz	-70.5	-67.5
@10.5 GHz	-68.5	N/A
@11 GHz	-70.5	-67.5
@13 GHz	-70.5	-67.5
@15 GHz	-70.5	-67.5
@18 GHz	-70.5	-67.5
@23 GHz	-70	-67
@26 GHz	-69.5	-66.5
@28 GHz	-69	-66
@32 GHz	-68.5	-65.5
@38 GHz	-68	-65
@42 GHz	-66.5	-63.5

Integrated IP Microwave (ISU2 Board)

Table 6-49 Typical receiver sensitivity of the Integrated IP microwave I (ISU2)

Item	Performance (Channel Spacing: 7 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-92.5	-86.5	-82.5	-80	-77	-74
@7 GHz	-92.5	-86.5	-82.5	-80	-77	-74

Item	Performance (Channel Spacing: 7 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
@8 GHz	-92.5	-86.5	-82.5	-80	-77	-74
@10 GHz	-92	-86	-82	-79.5	-76.5	-73.5
@10.5 GHz	-90	-84	-80	-77.5	-74.5	-71.5
@11 GHz	-92	-86	-82	-79.5	-76.5	-73.5
@13 GHz	-92	-86	-82	-79.5	-76.5	-73.5
@15 GHz	-92	-86	-82	-79.5	-76.5	-73.5
@18 GHz	-92	-86	-82	-79.5	-76.5	-73.5
@23 GHz	-91.5	-85.5	-81.5	-79	-76	-73
@26 GHz	-91	-85	-81	-78.5	-75.5	-72.5
@28 GHz	-90.5	-84.5	-80.5	-78	-75	-72
@32 GHz	-90	-84	-80	-77.5	-74.5	-71.5
@38 GHz	-89.5	-83.5	-79.5	-77	-74	-71
@42 GHz	-88	-82	-78	-75.5	-72.5	-69.5

Table 6-50 Typical receiver sensitivity of the Integrated IP microwave II (ISU2)

Item	Performance (Channel Spacing: 14 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-90.5	-83.5	-79.5	-77	-74	-71
@7 GHz	-90.5	-83.5	-79.5	-77	-74	-71
@8 GHz	-90.5	-83.5	-79.5	-77	-74	-71
@10 GHz	-90	-83	-79	-76.5	-73.5	-70.5
@10.5 GHz	-88	-81	-77	-74.5	-71.5	-68.5
@11 GHz	-90	-83	-79	-76.5	-73.5	-70.5
@13 GHz	-90	-83	-79	-76.5	-73.5	-70.5
@15 GHz	-90	-83	-79	-76.5	-73.5	-70.5
@18 GHz	-90	-83	-79	-76.5	-73.5	-70.5

Item	Performance (Channel Spacing: 14 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
@23 GHz	-89.5	-82.5	-78.5	-76	-73	-70
@26 GHz	-89	-82	-78	-75.5	-72.5	-69.5
@28 GHz	-88.5	-81.5	-77.5	-75	-72	-69
@32 GHz	-88	-81	-77	-74.5	-71.5	-68.5
@38 GHz	-87.5	-80.5	-76.5	-74	-71	-68
@42 GHz	-86	-79	-75	-72.5	-69.5	-66.5

Table 6-51 Typical receiver sensitivity of the Integrated IP microwave III (ISU2)

Item	Performance (Channel Spacing: 28 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-87.5	-80.5	-76.5	-74	-71	-68
@7 GHz	-87.5	-80.5	-76.5	-74	-71	-68
@8 GHz	-87.5	-80.5	-76.5	-74	-71	-68
@10 GHz	-87	-80	-76	-73.5	-70.5	-67.5
@10.5 GHz	-85	-78	-74	-71.5	-68.5	-65.5
@11 GHz	-87	-80	-76	-73.5	-70.5	-67.5
@13 GHz	-87	-80	-76	-73.5	-70.5	-67.5
@15 GHz	-87	-80	-76	-73.5	-70.5	-67.5
@18 GHz	-87	-80	-76	-73.5	-70.5	-67.5
@23 GHz	-86.5	-79.5	-75.5	-73	-70	-67
@26 GHz	-86	-79	-75	-72.5	-69.5	-66.5
@28 GHz	-85.5	-78.5	-74.5	-72	-69	-66
@32 GHz	-85	-78	-74	-71.5	-68.5	-65.5
@38 GHz	-84.5	-77.5	-73.5	-71	-68	-65
@42 GHz	-83	-76	-72	-69.5	-66.5	-63.5

Table 6-52 Typical receiver sensitivity of the Integrated IP microwave IV (ISU2)

Item	Performance (Channel Spacing: 56 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-84.5	-77.5	-73.5	-71	-68	-65
@7 GHz	-84.5	-77.5	-73.5	-71	-68	-65
@8 GHz	-84.5	-77.5	-73.5	-71	-68	-65
@10 GHz	-84	-77	-73	-70.5	-67.5	-64.5
@10.5 GHz	N/A	N/A	N/A	N/A	N/A	N/A
@11 GHz	-84	-77	-73	-70.5	-67.5	-64.5
@13 GHz	-84	-77	-73	-70.5	-67.5	-64.5
@15 GHz	-84	-77	-73	-70.5	-67.5	-64.5
@18 GHz	-84	-77	-73	-70.5	-67.5	-64.5
@23 GHz	-83.5	-76.5	-72.5	-70	-67	-64
@26 GHz	-83	-76	-72	-69.5	-66.5	-63.5
@28 GHz	-82.5	-75.5	-71.5	-69	-66	-63
@32 GHz	-82	-75	-71	-68.5	-65.5	-62.5
@38 GHz	-81.5	-74.5	-70.5	-68	-65	-62
@42 GHz	-80	-73	-69	-66.5	-63.5	-60.5

Table 6-53 Typical receiver sensitivity of the Integrated IP microwave V (ISU2)

Item	Performance (Channel Spacing: 40 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-86	-79	-75	-72.5	-69.5	-66.5
@7 GHz	-86	-79	-75	-72.5	-69.5	-66.5
@8 GHz	-86	-79	-75	-72.5	-69.5	-66.5
@10 GHz	-85.5	-78.5	-74.5	-72	-69	-66
@10.5 GHz	N/A	N/A	N/A	N/A	N/A	N/A

Item	Performance (Channel Spacing: 40 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
@11 GHz	-85.5	-78.5	-74.5	-72	-69	-66
@13 GHz	-85.5	-78.5	-74.5	-72	-69	-66
@15 GHz	-85.5	-78.5	-74.5	-72	-69	-66
@18 GHz	-85.5	-78.5	-74.5	-72	-69	-66
@23 GHz	-85	-78	-74	-71.5	-68.5	-65.5
@26 GHz	-84.5	-77.5	-73.5	-71	-68	-65
@28 GHz	-84	-77	-73	-70.5	-67.5	-64.5
@32 GHz	-83.5	-76.5	-72.5	-70	-67	-64
@38 GHz	-83	-76	-72	-69.5	-66.5	-63.5
@42 GHz	-81.5	-74.5	-70.5	-68	-65	-62

Table 6-54 Typical receiver sensitivity of the Integrated IP microwave VI (ISU2)

Item	Performance (Channel Spacing: 3.5 MHz)	
	QPSK	16QAM
RSL@ BER=10^{-6} (dBm)		
@6 GHz	-95.5	-89.5
@7 GHz	-95.5	-89.5
@8 GHz	-95.5	-89.5
@10.5 GHz	-95	-89
@11 GHz	-93	-87
@11 GHz	-95	-89
@13 GHz	-95	-89
@15 GHz	-95	-89
@18 GHz	-95	-89
@23 GHz	-94.5	-88.5
@26 GHz	-94	-88
@28 GHz	-93.5	-87.5
@32 GHz	-91.5	-86

Item	Performance (Channel Spacing: 3.5 MHz)	
	QPSK	16QAM
@38 GHz	-91	-85.5
@42 GHz	-89.5	-84

Table 6-55 Typical receiver sensitivity of the Integrated IP microwave VII (ISU2)

Item	Performance (Channel Spacing: 50 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6} (dBm)						
@18 GHz	-85	-77	-73.5	-71	-68	-65
@23 GHz	-86	-78	-74.5	-72	-69	-66

6.1.3.5 Receiver Sensitivity (ISX2 board)

The ISX2 board supports SDH microwave work modes and Integrated IP microwave work modes.

NOTE

- For an XMC-2 ODU at the 18 GHz frequency band, remove 2 dB from the sensitivity values specified in the table.
- The 10.5 GHz ODU with the T/R spacing of 91 MHz does not support the channel spacing of 40/56 MHz. The receiver sensitivity is not available (N/A).
- When the XPIC function is enabled, the ISX2 board does not support the 7MHz/128QAM, 7MHz/256QAM, and 14MHz/256QAM working modes at frequency bands from 7 GHz to 23 GHz. The receiver sensitivity is not available (N/A).
- When the XPIC function is enabled, the ISX2 board does not support the 7MHz/64QAM, 7MHz/128QAM, 7MHz/256QAM, 14MHz/128QAM, and 14MHz/256QAM working modes at frequency bands from 26 GHz to 42 GHz. The receiver sensitivity is not available (N/A).
- For an XMC-2 ODU at the 38 GHz frequency band, when the XPIC function is enabled, remove 2 dB from the sensitivity value specified in the table when the ISX2 board is at 28MHz/256QAM working mode.

SDH Microwave (ISX2 Board)

Table 6-56 Typical receiver sensitivity of the SDH microwave (ISX2 Board, XPIC disabled)

Item	Performance	
	1xSTM-1	2xSTM-1
	128QAM/28 MHz	128QAM/56 MHz
RSL@ BER = 10^{-6} (dBm)		
@6 GHz	-71	-68
@7 GHz	-71	-68
@8 GHz	-71	-68
@10 GHz	-70.5	-67.5
@10.5 GHz	-68.5	N/A
@11 GHz	-70.5	-67.5
@13 GHz	-70.5	-67.5
@15 GHz	-70.5	-67.5
@18 GHz	-70.5	-67.5
@23 GHz	-70	-67
@26 GHz	-69.5	-66.5
@28 GHz	-69	-66
@32 GHz	-68.5	-65.5
@38 GHz	-68	-65
@42 GHz	-66.5	-63.5

Table 6-57 Typical receiver sensitivity of the SDH microwave (ISX2 Board, XPIC enabled)

Item	Performance	
	1xSTM-1	2xSTM-1
	128QAM/28 MHz	128QAM/56 MHz
RSL@ BER = 10^{-6} (dBm)		
@6 GHz	-71	-68
@7 GHz	-71	-68

Item	Performance	
	1xSTM-1	2xSTM-1
	128QAM/28 MHz	128QAM/56 MHz
@8 GHz	-71	-68
@11 GHz	-70.5	-67.5
@13 GHz	-70.5	-67.5
@15 GHz	-70.5	-67.5
@18 GHz	-70.5	-67.5
@23 GHz	-70	-67
@26 GHz	-69.5	-66.5
@28 GHz	-69	-66
@32 GHz	-68.5	-65.5
@38 GHz	-68	-65
@42 GHz	-66.5	-63.5

Integrated IP Microwave (ISX2 Board)

Table 6-58 Typical receiver sensitivity of the Integrated IP microwave I (ISX2 Board, XPIC disabled)

Item	Performance (Channel Spacing: 7 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-92.5	-86.5	-82.5	-80	-77	-74
@7 GHz	-92.5	-86.5	-82.5	-80	-77	-74
@8 GHz	-92.5	-86.5	-82.5	-80	-77	-74
@10 GHz	-92	-86	-82	-79.5	-76.5	-73.5
@10.5 GHz	-90	-84	-80	-77.5	-74.5	-71.5
@11 GHz	-92	-86	-82	-79.5	-76.5	-73.5
@13 GHz	-92	-86	-82	-79.5	-76.5	-73.5
@15 GHz	-92	-86	-82	-79.5	-76.5	-73.5

Item	Performance (Channel Spacing: 7 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
@18 GHz	-92	-86	-82	-79.5	-76.5	-73.5
@23 GHz	-91.5	-85.5	-81.5	-79	-76	-73
@26 GHz	-91	-85	-81	-78.5	-75.5	-72.5
@28 GHz	-90.5	-84.5	-80.5	-78	-75	-72
@32 GHz	-90	-84	-80	-77.5	-74.5	-71.5
@38 GHz	-89.5	-83.5	-79.5	-77	-74	-71
@42 GHz	-88	-82	-78	-75.5	-72.5	-69.5

Table 6-59 Typical receiver sensitivity of the Integrated IP microwave II (ISX2 Board, XPIC disabled)

Item	Performance (Channel Spacing: 14 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-90.5	-83.5	-79.5	-77	-74	-71
@7 GHz	-90.5	-83.5	-79.5	-77	-74	-71
@8 GHz	-90.5	-83.5	-79.5	-77	-74	-71
@10 GHz	-90	-83	-79	-76.5	-73.5	-70.5
@10.5 GHz	-88	-81	-77	-74.5	-71.5	-68.5
@11 GHz	-90	-83	-79	-76.5	-73.5	-70.5
@13 GHz	-90	-83	-79	-76.5	-73.5	-70.5
@15 GHz	-90	-83	-79	-76.5	-73.5	-70.5
@18 GHz	-90	-83	-79	-76.5	-73.5	-70.5
@23 GHz	-89.5	-82.5	-78.5	-76	-73	-70
@26 GHz	-89	-82	-78	-75.5	-72.5	-69.5
@28 GHz	-88.5	-81.5	-77.5	-75	-72	-69
@32 GHz	-88	-81	-77	-74.5	-71.5	-68.5
@38 GHz	-87.5	-80.5	-76.5	-74	-71	-68
@42 GHz	-86	-79	-75	-72.5	-69.5	-66.5

Table 6-60 Typical receiver sensitivity of the Integrated IP microwave III (ISX2 Board, XPIC disabled)

Item	Performance (Channel Spacing: 28 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-87.5	-80.5	-76.5	-74	-71	-68
@7 GHz	-87.5	-80.5	-76.5	-74	-71	-68
@8 GHz	-87.5	-80.5	-76.5	-74	-71	-68
@10 GHz	-87	-80	-76	-73.5	-70.5	-67.5
@10.5 GHz	-85	-78	-74	-71.5	-68.5	-65.5
@11 GHz	-87	-80	-76	-73.5	-70.5	-67.5
@13 GHz	-87	-80	-76	-73.5	-70.5	-67.5
@15 GHz	-87	-80	-76	-73.5	-70.5	-67.5
@18 GHz	-87	-80	-76	-73.5	-70.5	-67.5
@23 GHz	-86.5	-79.5	-75.5	-73	-70	-67
@26 GHz	-86	-79	-75	-72.5	-69.5	-66.5
@28 GHz	-85.5	-78.5	-74.5	-72	-69	-66
@32 GHz	-85	-78	-74	-71.5	-68.5	-65.5
@38 GHz	-84.5	-77.5	-73.5	-71	-68	-65
@42 GHz	-83	-76	-72	-69.5	-66.5	-63.5

Table 6-61 Typical receiver sensitivity of the Integrated IP microwave IV (ISX2 Board, XPIC disabled)

Item	Performance (Channel Spacing: 56 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-84.5	-77.5	-73.5	-71	-68	-65
@7 GHz	-84.5	-77.5	-73.5	-71	-68	-65
@8 GHz	-84.5	-77.5	-73.5	-71	-68	-65

Item	Performance (Channel Spacing: 56 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
@10 GHz	-84	-77	-73	-70.5	-67.5	-64.5
@10.5 GHz	N/A	N/A	N/A	N/A	N/A	N/A
@11 GHz	-84	-77	-73	-70.5	-67.5	-64.5
@13 GHz	-84	-77	-73	-70.5	-67.5	-64.5
@15 GHz	-84	-77	-73	-70.5	-67.5	-64.5
@18 GHz	-84	-77	-73	-70.5	-67.5	-64.5
@23 GHz	-83.5	-76.5	-72.5	-70	-67	-64
@26 GHz	-83	-76	-72	-69.5	-66.5	-63.5
@28 GHz	-82.5	-75.5	-71.5	-69	-66	-63
@32 GHz	-82	-75	-71	-68.5	-65.5	-62.5
@38 GHz	-81.5	-74.5	-70.5	-68	-65	-62
@42 GHz	-80	-73	-69	-66.5	-63.5	-60.5

Table 6-62 Typical receiver sensitivity of the Integrated IP microwave V (ISX2 Board, XPIC disabled)

Item	Performance (Channel Spacing: 40 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-86	-79	-75	-72.5	-69.5	-66.5
@7 GHz	-86	-79	-75	-72.5	-69.5	-66.5
@8 GHz	-86	-79	-75	-72.5	-69.5	-66.5
@10 GHz	-85.5	-78.5	-74.5	-72	-69	-66
@10.5 GHz	N/A	N/A	N/A	N/A	N/A	N/A
@11 GHz	-85.5	-78.5	-74.5	-72	-69	-66
@13 GHz	-85.5	-78.5	-74.5	-72	-69	-66
@15 GHz	-85.5	-78.5	-74.5	-72	-69	-66
@18 GHz	-85.5	-78.5	-74.5	-72	-69	-66

Item	Performance (Channel Spacing: 40 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
@23 GHz	-85	-78	-74	-71.5	-68.5	-65.5
@26 GHz	-84.5	-77.5	-73.5	-71	-68	-65
@28 GHz	-84	-77	-73	-70.5	-67.5	-64.5
@32 GHz	-83.5	-76.5	-72.5	-70	-67	-64
@38 GHz	-83	-76	-72	-69.5	-66.5	-63.5
@42 GHz	-81.5	-74.5	-70.5	-68	-65	-62

Table 6-63 Typical receiver sensitivity of the Integrated IP microwave VI (ISX2 Board, XPIC disabled)

Item	Performance (Channel Spacing: 50 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6} (dBm)						
@18 GHz	-85	-77	-73.5	-71	-68	-65
@23 GHz	-86	-78	-74.5	-72	-69	-66

Table 6-64 Typical receiver sensitivity of the Integrated IP microwaveI (ISX2 board, XPIC enabled)

Item	Performance (Channel Spacing: 7 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-92.5	-86.5	-82.5	-79.5	N/A	N/A
@7 GHz	-92.5	-86.5	-82.5	-79.5	N/A	N/A
@8 GHz	-92.5	-86.5	-82.5	-79.5	N/A	N/A
@10 GHz	-92	-86	-82	-79	N/A	N/A
@10.5 GHz	-90	-84	-80	-77	N/A	N/A
@11 GHz	-92	-86	-82	-79	N/A	N/A
@13 GHz	-92	-86	-82	-79	N/A	N/A

Item	Performance (Channel Spacing: 7 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
@15 GHz	-92	-86	-82	-79	N/A	N/A
@18 GHz	-92	-86	-82	-79	N/A	N/A
@23 GHz	-91.5	-85.5	-81.5	-78.5	N/A	N/A
@26 GHz	-91	-85	-81	N/A	N/A	N/A
@28 GHz	-90.5	-84.5	-80.5	N/A	N/A	N/A
@32 GHz	-90	-84	-80	N/A	N/A	N/A
@38 GHz	-89.5	-83.5	-79.5	N/A	N/A	N/A
@42 GHz	-88	-82	-78	N/A	N/A	N/A

Table 6-65 Typical receiver sensitivity of the Integrated IP microwave II (ISX2 board, XPIC enabled)

Item	Performance (Channel Spacing: 14 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-90.5	-83.5	-79.5	-76.5	-73.5	N/A
@7 GHz	-90.5	-83.5	-79.5	-76.5	-73.5	N/A
@8 GHz	-90.5	-83.5	-79.5	-76.5	-73.5	N/A
@10 GHz	-90	-83	-79	-76	-73	N/A
@10.5 GHz	-88	-81	-77	-74	-71	N/A
@11 GHz	-90	-83	-79	-76	-73	N/A
@13 GHz	-90	-83	-79	-76	-73	N/A
@15 GHz	-90	-83	-79	-76	-73	N/A
@18 GHz	-90	-83	-79	-76	-73	N/A
@23 GHz	-89.5	-82.5	-78.5	-75.5	-72.5	N/A
@26 GHz	-89	-82	-78	-75	N/A	N/A
@28 GHz	-88.5	-81.5	-77.5	-74.5	N/A	N/A
@32 GHz	-88	-81	-77	-74	N/A	N/A
@38 GHz	-87.5	-80.5	-76.5	-73.5	N/A	N/A

Item	Performance (Channel Spacing: 14 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
@42 GHz	-86	-79	-75	-72	N/A	N/A

Table 6-66 Typical receiver sensitivity of the Integrated IP microwave III (ISX2 board, XPIC enabled)

Item	Performance (Channel Spacing: 28 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-87.5	-80.5	-76.5	-74	-71	-68
@7 GHz	-87.5	-80.5	-76.5	-74	-71	-68
@8 GHz	-87.5	-80.5	-76.5	-74	-71	-68
@10 GHz	-87	-80	-76	-73.5	-70.5	-67.5
@10.5 GHz	-85	-78	-74	-71.5	-68.5	-65.5
@11 GHz	-87	-80	-76	-73.5	-70.5	-67.5
@13 GHz	-87	-80	-76	-73.5	-70.5	-67.5
@15 GHz	-87	-80	-76	-73.5	-70.5	-67.5
@18 GHz	-87	-80	-76	-73.5	-70.5	-67.5
@23 GHz	-86.5	-79.5	-75.5	-73	-70	-67
@26 GHz	-86	-79	-75	-72.5	-69.5	-66.5
@28 GHz	-85.5	-78.5	-74.5	-72	-69	-66
@32 GHz	-85	-78	-74	-71.5	-68.5	-65.5
@38 GHz	-84.5	-77.5	-73.5	-71	-68	-65
@42 GHz	-83	-76	-72	-69.5	-66.5	-63.5

Table 6-67 Typical receiver sensitivity of the Integrated IP microwave IV (ISX2 board, XPIC enabled)

Item	Performance (Channel Spacing: 56 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-84.5	-77.5	-73.5	-71	-68	-65
@7 GHz	-84.5	-77.5	-73.5	-71	-68	-65
@8 GHz	-84.5	-77.5	-73.5	-71	-68	-65
@10 GHz	-84	-77	-73	-70.5	-67.5	-64.5
@10.5 GHz	N/A	N/A	N/A	N/A	N/A	N/A
@11 GHz	-84	-77	-73	-70.5	-67.5	-64.5
@13 GHz	-84	-77	-73	-70.5	-67.5	-64.5
@15 GHz	-84	-77	-73	-70.5	-67.5	-64.5
@18 GHz	-84	-77	-73	-70.5	-67.5	-64.5
@23 GHz	-83.5	-76.5	-72.5	-70	-67	-64
@26 GHz	-83	-76	-72	-69.5	-66.5	-63.5
@28 GHz	-82.5	-75.5	-71.5	-69	-66	-63
@32 GHz	-82	-75	-71	-68.5	-65.5	-62.5
@38 GHz	-81.5	-74.5	-70.5	-68	-65	-62
@42 GHz	-80	-73	-69	-66.5	-63.5	-60.5

Table 6-68 Typical receiver sensitivity of the Integrated IP microwave V (ISX2 board, XPIC enabled)

Item	Performance (Channel Spacing: 40 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-86	-79	-75	-72.5	-69.5	-66.5
@7 GHz	-86	-79	-75	-72.5	-69.5	-66.5
@8 GHz	-86	-79	-75	-72.5	-69.5	-66.5
@10 GHz	-85.5	-78.5	-74.5	-72	-69	-66

Item	Performance (Channel Spacing: 40 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
@10.5 GHz	N/A	N/A	N/A	N/A	N/A	N/A
@11 GHz	-85.5	-78.5	-74.5	-72	-69	-66
@13 GHz	-85.5	-78.5	-74.5	-72	-69	-66
@15 GHz	-85.5	-78.5	-74.5	-72	-69	-66
@18 GHz	-85.5	-78.5	-74.5	-72	-69	-66
@23 GHz	-85	-78	-74	-71.5	-68.5	-65.5
@26 GHz	-84.5	-77.5	-73.5	-71	-68	-65
@28 GHz	-84	-77	-73	-70.5	-67.5	-64.5
@32 GHz	-83.5	-76.5	-72.5	-70	-67	-64
@38 GHz	-83	-76	-72	-69.5	-66.5	-63.5
@42 GHz	-81.5	-74.5	-70.5	-68	-65	-62

Table 6-69 Typical receiver sensitivity of the Integrated IP microwave VI (ISX2 board, XPIC enabled)

Item	Performance (Channel Spacing: 50 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6} (dBm)						
@18 GHz	-85	-77	-73.5	-71	-68	-65
@23 GHz	-86	-78	-74.5	-72	-69	-66

6.1.3.6 Receiver Sensitivity (ISV3 board)

The ISV3 board supports SDH microwave work modes and Integrated IP microwave work modes.

The ISV3 board supports two running modes: IS3 and IS2.

- This section provides the receiver sensitivity when the ISV3 runs in the IS3 mode.
- When the ISV3 board runs in the IS2 mode and XPIC is disabled, the radio work mode and receiver sensitivity for the ISV3 board are the same as those for the ISU2 board. For details, see **6.1.3.4 Receiver Sensitivity (ISU2 board)**.

- When the ISV3 board runs in the IS2 mode and XPIC is enabled, the radio work mode and receiver sensitivity for the ISV3 board are the same as those for the ISX2 board. For details, see **6.1.3.5 Receiver Sensitivity (ISX2 board)**.

NOTE

Unless otherwise specified, the receiver sensitivity values in the table are valid when different types of ODUs are used. However, the frequency bands and modulation schemes supported by different types of ODUs are different.

N/A means that microwave working mode is not supported.

SDH Microwave (IS3-Mode)

Table 6-70 Typical receiver sensitivity of the SDH microwave (ISV3 @IS3-mode)

Item	Performance	
	1xSTM-1	2xSTM-1
	28MHz/128QAM	56MHz/128QAM
RSL@ BER=10^{-6} (dBm)		
@6 GHz	-72.5	-69.5
@7 GHz	-72.5	-69.5
@8 GHz	-72.5	-69.5
@10 GHz	-72	-69
@10.5 GHz	-70	N/A
@11 GHz	-72	-69
@13 GHz	-72	-69
@15 GHz	-72	-69
@18 GHz	-71.5	-68.5
@23 GHz	-71.5	-68.5
@26 GHz	-71	-68
@28 GHz	-70.5	-67.5
@32 GHz	-70	-67
@38 GHz	-69.5	-66.5
@42 GHz	-68	-65
NOTE For the ISV3 board in SDH service mode, receiver sensitivities are the same regardless of whether the XPIC function is enabled or disabled.		

Integrated IP Microwave (IS3-mode)

Table 6-71 Typical receiver sensitivity of the Integrated IP microwave I (ISV3 @IS3-mode, XPIC disabled)

Item	Performance (Channel Spacing: 7 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-96	-94	-89.5	-87.5	-84.5	-81.5
@7 GHz	-96	-94	-89.5	-87.5	-84.5	-81.5
@8 GHz	-96	-94	-89.5	-87.5	-84.5	-81.5
@10 GHz	-95.5	-93.5	-89	-87	-84	-81
@10.5 GHz	-93.5	-91.5	-87	-85	-82	-79
@11 GHz	-95.5	-93.5	-89	-87	-84	-81
@13 GHz	-95.5	-93.5	-89	-87	-84	-81
@15 GHz	-95.5	-93.5	-89	-87	-84	-81
@18 GHz	-95	-93	-88.5	-86.5	-83.5	-80.5
@23 GHz	-95	-93	-88.5	-86.5	-83.5	-80.5
@26 GHz	-94.5	-92.5	-88	-86	-83	-80
@28 GHz	-94	-92	-87.5	-85.5	-82.5	-79.5
@32 GHz	-93.5	-91.5	-87	-85	-82	-79
@38 GHz	-93	-91	-86.5	-84.5	-81.5	-78.5
@42 GHz	-91.5	-89.5	-85	-83	-80	-77

Table 6-72 Typical receiver sensitivity of the Integrated IP microwave II (ISV3 @IS3-mode, XPIC disabled)

Item	Performance (Channel Spacing: 7 MHz)				
	128QAM	256QAM	512QAM	512QAM Light	1024QAM
RSL@ BER=10^{-6} (dBm)					
@6 GHz	-78.5	-75.5	-73.5	-72	-70
@7 GHz	-78.5	-75.5	-73.5	-72	-70
@8 GHz	-78.5	-75.5	73.5	-72	-70

Item	Performance (Channel Spacing: 7 MHz)				
	128QAM	256QAM	512QAM	512QAM Light	1024QAM
@10 GHz	-78	-75	-73	-71.5	-69.5
@10.5 GHz	-76	-73	-71	-69.5	-67.5
@11 GHz	-78	-75	-73	-71.5	-69.5
@13 GHz	-78	-75	-73	-71.5	-69.5
@15 GHz	-78	-75	-73	-71.5	-69.5
@18 GHz	-77.5	-74.5	-72.5	-71	-69
@23 GHz	-77.5	-74.5	-72.5	-71	-69
@26 GHz	-77	-74	-72	-70.5	-68.5
@28 GHz	-76.5	-73.5	-71.5	N/A	N/A
@32 GHz	-76	-73	-71	-69.5	N/A
@38 GHz	-75.5	-72.5	-70.5	-69	N/A
@42 GHz	-74	-71	-69	-67.5	N/A

Table 6-73 Typical receiver sensitivity of the Integrated IP microwave III (ISV3 @IS3-mode, XPIC disabled)

Item	Performance (Channel Spacing: 14 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-94	-92	-86.5	-84.5	-81.5	-78.5
@7 GHz	-94	-92	-86.5	-84.5	-81.5	-78.5
@8 GHz	-94	-92	-86.5	-84.5	-81.5	-78.5
@10 GHz	-93.5	-91.5	-86	-84	-81	-78
@10.5 GHz	-91.5	-89.5	-84	-82	-79	-76
@11 GHz	-93.5	-91.5	-86	-84	-81	-78
@13 GHz	-93.5	-91.5	-86	-84	-81	-78
@15 GHz	-93.5	-91.5	-86	-84	-81	-78
@18 GHz	-93	-91	-85.5	-83.5	-80.5	-77.5
@23 GHz	-93	-91	-85.5	-83.5	-80.5	-77.5

Item	Performance (Channel Spacing: 14 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
@26 GHz	-92.5	-90.5	-85	-83	-80	-77
@28 GHz	-92	-90	-84.5	-82.5	-79.5	-76.5
@32 GHz	-91.5	-89.5	-84	-82	-79	-76
@38 GHz	-91	-89	-83.5	-81.5	-78.5	-75.5
@42 GHz	-89.5	-87.5	-82	-80	-77	-74

Table 6-74 Typical receiver sensitivity of the Integrated IP microwave IV (ISV3 @IS3-mode, XPIC disabled)

Item	Performance (Channel Spacing: 14 MHz)					
	128QAM	256QAM	512QAM	512QAM Light	1024QAM	1024QAM Light
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-75.5	-72.5	-70.5	-69	-67	-65.5
@7 GHz	-75.5	-72.5	-70.5	-69	-67	-65.5
@8 GHz	-75.5	-72.5	-70.5	-69	-67	-65.5
@10 GHz	-75	-72	-70	-68.5	-66.5	-65
@10.5 GHz	-73	-70	-68	-66.5	-64.5	-63
@11 GHz	-75	-72	-70	-68.5	-66.5	-65
@13 GHz	-75	-72	-70	-68.5	-66.5	-65
@15 GHz	-75	-72	-70	-68.5	-66.5	-65
@18 GHz	-74.5	-71.5	-69.5	-68	-66	-64.5
@23 GHz	-74.5	-71.5	-69.5	-68	-66	-64.5
@26 GHz	-74	-71	-69	-67.5	-65.5	-64
@28 GHz	-73.5	-70.5	-68.5	-67	-65	N/A
@32 GHz	-73	-70	-68	-66.5	-64.5	N/A
@38 GHz	-72.5	-69.5	-67.5	-66	-64	N/A
@42 GHz	-71	-68	-66	-64.5	-62.5	N/A

Table 6-75 Typical receiver sensitivity of the Integrated IP microwave V (ISV3 @IS3-mode, XPIC disabled)

Item	Performance (Channel Spacing: 28 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-90.5	-89	-83.5	-82	-79	-75.5
@7 GHz	-90.5	-89	-83.5	-82	-79	-75.5
@8 GHz	-90.5	-89	-83.5	-82	-79	-75.5
@10 GHz	-90	-88.5	-83	-81.5	-78.5	-75
@10.5 GHz	-88	-86.5	-81	-79.5	-76.5	-73
@11 GHz	-90	-88.5	-83	-81.5	-78.5	-75
@13 GHz	-90	-88.5	-83	-81.5	-78.5	-75
@15 GHz	-90	-88.5	-83	-81.5	-78.5	-75
@18 GHz	-89.5	-88	-82.5	-81	-78	-74.5
@23 GHz	-89.5	-88	-82.5	-81	-78	-74.5
@26 GHz	-89	-87.5	-82	-80.5	-77.5	-74
@28 GHz	-88.5	-87	-81.5	-80	-77	-73.5
@32 GHz	-88	-86.5	-81	-79.5	-76.5	-73
@38 GHz	-87.5	-86	-80.5	-79	-76	-72.5
@42 GHz	-86	-84.5	-79	-77.5	-74.5	-71

Table 6-76 Typical receiver sensitivity of the Integrated IP microwave VI (ISV3 @IS3-mode, XPIC disabled)

Item	Performance (Channel Spacing: 28 MHz)						
	128QAM	256QAM	512QAM	512QAM Light	1024QAM	1024QAM Light	2048QAM
RSL@ BER=10^{-6} (dBm)							
@6 GHz	-72.5	-69.5	-67.5	-66	-64	-62.5	-61
@7 GHz	-72.5	-69.5	-67.5	-66	-64	-62.5	-61
@8 GHz	-72.5	-69.5	-67.5	-66	-64	-62.5	-61
@10 GHz	-72	-69	-67	-65.5	-63.5	-62	N/A
@10.5 GHz	-70	-67	-65	-63.5	-61.5	-60	N/A

Item	Performance (Channel Spacing: 28 MHz)						
	128QAM	256QAM	512QAM	512QAM Light	1024QAM	1024QAM Light	2048QAM
@11 GHz	-72	-69	-67	-65.5	-63.5	-62	-60.5
@13 GHz	-72	-69	-67	-65.5	-63.5	-62	-60.5
@15 GHz	-72	-69	-67	-65.5	-63.5	-62	-60.5
@18 GHz	-71.5	-68.5	-66.5	-65	-63	-61.5	-60
@23 GHz	-71.5	-68.5	-66.5	-65	-63	-61.5	-60
@26 GHz	-71	-68	-66	-64.5	-62.5	-61	-59.5
@28 GHz	-70.5	-67.5	-65.5	-64	-62	-60.5	-59
@32 GHz	-70	-67	-65	-63.5	-61.5	-60	-58.5
@38 GHz	-69.5	-66.5	-64.5	-63	-61	-59.5	-58
@42 GHz	-68	-65	-63	-61.5	-59.5	-58	N/A

Table 6-77 Typical receiver sensitivity of the Integrated IP microwave VII (ISV3 @IS3-mode, XPIC disabled)

Item	Performance (Channel Spacing: 56 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-87.5	-86	-80.5	-79	-76	-72.5
@7 GHz	-87.5	-86	-80.5	-79	-76	-72.5
@8 GHz	-87.5	-86	-80.5	-79	-76	-72.5
@10 GHz	-87	-85.5	-80	-78.5	-75.5	-72
@10.5 GHz	N/A	N/A	N/A	N/A	N/A	N/A
@11 GHz	-87	-85.5	-80	-78.5	-75.5	-72
@13 GHz	-87	-85.5	-80	-78.5	-75.5	-72
@15 GHz	-87	-85.5	-80	-78.5	-75.5	-72
@18 GHz	-86.5	-85	-79.5	-78	-75	-71.5
@23 GHz	-86.5	-85	-79.5	-78	-75	-71.5
@26 GHz	-86	-84.5	-79	-77.5	-74.5	-71
@28 GHz	-85.5	-84	-78.5	-77	-74	-70.5

Item	Performance (Channel Spacing: 56 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
@32 GHz	-85	-83.5	-78	-76.5	-73.5	-70
@38 GHz	-84.5	-83	-77.5	-76	-73	-69.5
@42 GHz	-83	-81.5	-76	-74.5	-71.5	-68

Table 6-78 Typical receiver sensitivity of the Integrated IP microwave VIII (ISV3 @IS3-mode, XPIC disabled)

Item	Performance (Channel Spacing: 56 MHz)						
	128QAM	256QAM	512QAM	512QAM Light	1024QAM	1024QAM Light	2048QAM
RSL@ BER=10^{-6} (dBm)							
@6 GHz	-69.5	-66.5	-64.5	-63	-61	-59.5	-58
@7 GHz	-69.5	-66.5	-64.5	-63	-61	-59.5	-58
@8 GHz	-69.5	-66.5	-64.5	-63	-61	-59.5	-58
@10 GHz	-69	-66	-64	-62.5	-60.5	-59	N/A
@10.5 GHz	N/A	N/A	N/A	N/A	N/A	N/A	N/A
@11 GHz	-69	-66	-64	-62.5	-60.5	-59	-57.5
@13 GHz	-69	-66	-64	-62.5	-60.5	-59	-57.5
@15 GHz	-69	-66	-64	-62.5	-60.5	-59	-57.5
@18 GHz	-68.5	-65.5	-63.5	-62	-60	-58.5	-57
@23 GHz	-68.5	-65.5	-63.5	-62	-60	-58.5	-57
@26 GHz	-68	-65	-63	-61.5	-59.5	-58	-56.5
@28 GHz	-67.5	-64.5	-62.5	-61	-59	-57.5	-56
@32 GHz	-67	-64	-62	-60.5	-58.5	-57	-55.5
@38 GHz	-66.5	-63.5	-61.5	-60	-58	-56.5	-55
@42 GHz	-65	-62	-60	-58.5	-56.5	-55	N/A

Table 6-79 Typical receiver sensitivity of the Integrated IP microwave IX (ISV3 @IS3-mode, XPIC disabled)

Item	Performance (Channel Spacing: 40 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-89	-87.5	-82	-80.5	-77.5	-74
@7 GHz	-89	-87.5	-82	-80.5	-77.5	-74
@8 GHz	-89	-87.5	-82	-80.5	-77.5	-74
@10 GHz	-88.5	-87	-81.5	-80	-77	-73.5
@10.5 GHz	N/A	N/A	N/A	N/A	N/A	N/A
@11 GHz	-88.5	-87	-81.5	-80	-77	-73.5
@13 GHz	-88.5	-87	-81.5	-80	-77	-73.5
@15 GHz	-88.5	-87	-81.5	-80	-77	-73.5
@18 GHz	-88	-86.5	-81	-79.5	-76.5	-73
@23 GHz	-88	-86.5	-81	-79.5	-76.5	-73
@26 GHz	-87.5	-86	-80.5	-79	-76	-72.5
@28 GHz	-87	-85.5	-80	-78.5	-75.5	-72
@32 GHz	-86.5	-85	-79.5	-78	-75	-71.5
@38 GHz	-86	-84.5	-79	-77.5	-74.5	-71
@42 GHz	-84.5	-83	-77.5	-76	-73	-69.5

Table 6-80 Typical receiver sensitivity of the Integrated IP microwave X (ISV3 @IS3-mode, XPIC disabled)

Item	Performance (Channel Spacing: 40 MHz)						
	128QAM	256QAM	512QAM	512QAM Light	1024QAM	1024QAM Light	2048QAM
RSL@ BER=10^{-6} (dBm)							
@6 GHz	-71	-68	-66	-64.5	-62.5	-61	-59.5
@7 GHz	-71	-68	-66	-64.5	-62.5	-61	-59.5
@8 GHz	-71	-68	-66	-64.5	-62.5	-61	-59.5
@10 GHz	-70.5	-67.5	-65.5	-64	-62	-60.5	N/A
@10.5 GHz	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Item	Performance (Channel Spacing: 40 MHz)						
	128QAM	256QAM	512QAM	512QAM Light	1024QAM	1024QAM Light	2048QAM
@11 GHz	-70.5	-67.5	-65.5	-64	-62	-60.5	-59
@13 GHz	-70.5	-67.5	-65.5	-64	-62	-60.5	-59
@15 GHz	-70.5	-67.5	-65.5	-64	-62	-60.5	-59
@18 GHz	-70	-67	-65	-63.5	-61.5	-60	-58.5
@23 GHz	-70	-67	-65	-63.5	-61.5	-60	-58.5
@26 GHz	-69.5	-66.5	-64.5	-63	-61	-59.5	-58
@28 GHz	-69	-66	-64	-62.5	-60.5	-59	-57.5
@32 GHz	-68.5	-65.5	-63.5	-62	-60	-58.5	-57
@38 GHz	-68	-65	-63	-61.5	-59.5	-58	-56.5
@42 GHz	-66.5	-63.5	-61.5	-60	-58	-56.5	N/A

Table 6-81 Typical receiver sensitivity of the Integrated IP microwave XI (ISV3 @IS3-mode, XPIC enabled)

Item	Performance (Channel Spacing: 7 MHz)						
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM	128QAM
RSL@ BER=10^{-6} (dBm)							
@6 GHz	-96	-94	-89.5	-87.5	-84.5	-81.5	-78.5
@7 GHz	-96	-94	-89.5	-87.5	-84.5	-81.5	-78.5
@8 GHz	-96	-94	-89.5	-87.5	-84.5	-81.5	-78.5
@10 GHz	-95.5	-93.5	-89	-87	-84	-81	-78
@10.5 GHz	-93.5	-91.5	-87	-85	-82	-79	-76
@11 GHz	-95.5	-93.5	-89	-87	-84	-81	-78
@13 GHz	-95.5	-93.5	-89	-87	-84	-81	-78
@15 GHz	-95.5	-93.5	-89	-87	-84	-81	-78
@18 GHz	-95	-93	-88.5	-86.5	-83.5	-80.5	-77.5
@23 GHz	-95	-93	-88.5	-86.5	-83.5	-80.5	-77.5
@26 GHz	-94.5	-92.5	-88	-86	-83	-80	-77
@28 GHz	-94	-92	-87.5	-85.5	-82.5	-79.5	-76.5

Item	Performance (Channel Spacing: 7 MHz)						
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM	128QAM
@32 GHz	-93.5	-91.5	-87	-85	-82	-79	-76
@38 GHz	-93	-91	-86.5	-84.5	-81.5	-78.5	-75.5
@42 GHz	-91.5	-89.5	-85	-83	-80	-77	-74

Table 6-82 Typical receiver sensitivity of the Integrated IP microwave XII (ISV3 @IS3-mode, XPIC enabled)

Item	Performance (Channel Spacing: 14 MHz)							
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10^{-6} (dBm)								
@6 GHz	-94	-92	-86.5	-84.5	-81.5	-78.5	-75.5	-72.5
@7 GHz	-94	-92	-86.5	-84.5	-81.5	-78.5	-75.5	-72.5
@8 GHz	-94	-92	-86.5	-84.5	-81.5	-78.5	-75.5	-72.5
@10 GHz	-93.5	-91.5	-86	-84	-81	-78	-75	-72
@10.5 GHz	-91.5	-89.5	-84	-82	-79	-76	-73	-70
@11 GHz	-93.5	-91.5	-86	-84	-81	-78	-75	-72
@13 GHz	-93.5	-91.5	-86	-84	-81	-78	-75	-72
@15 GHz	-93.5	-91.5	-86	-84	-81	-78	-75	-72
@18 GHz	-93	-91	-85.5	-83.5	-80.5	-77.5	-74.5	-71.5
@23 GHz	-93	-91	-85.5	-83.5	-80.5	-77.5	-74.5	-71.5
@26 GHz	-92.5	-90.5	-85	-83	-80	-77	-74	-71
@28 GHz	-92	-90	-84.5	-82.5	-79.5	-76.5	-73.5	-70.5
@32 GHz	-91.5	-89.5	-84	-82	-79	-76	-73	-70
@38 GHz	-91	-89	-83.5	-81.5	-78.5	-75.5	-72.5	-69.5
@42 GHz	-89.5	-87.5	-82	-80	-77	-74	-71	-68

Table 6-83 Typical receiver sensitivity of the Integrated IP microwave XIII (ISV3 @IS3-mode, XPIC enabled)

Item	Performance (Channel Spacing: 28 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-90.5	-89	-83.5	-82	-79	-75.5
@7 GHz	-90.5	-89	-83.5	-82	-79	-75.5
@8 GHz	-90.5	-89	-83.5	-82	-79	-75.5
@10 GHz	-90	-88.5	-83	-81.5	-78.5	-75
@10.5 GHz	-88	-86.5	-81	-79.5	-76.5	-73
@11 GHz	-90	-88.5	-83	-81.5	-78.5	-75
@13 GHz	-90	-88.5	-83	-81.5	-78.5	-75
@15 GHz	-90	-88.5	-83	-81.5	-78.5	-75
@18 GHz	-89.5	-88	-82.5	-81	-78	-74.5
@23 GHz	-89.5	-88	-82.5	-81	-78	-74.5
@26 GHz	-89	-87.5	-82	-80.5	-77.5	-74
@28 GHz	-88.5	-87	-81.5	-80	-77	-73.5
@32 GHz	-88	-86.5	-81	-79.5	-76.5	-73
@38 GHz	-87.5	-86	-80.5	-79	-76	-72.5
@42 GHz	-86	-84.5	-79	-77.5	-74.5	-71

Table 6-84 Typical receiver sensitivity of the Integrated IP microwave XIV (ISV3 @IS3-mode, XPIC enabled)

Item	Performance (Channel Spacing: 28 MHz)				
	128QAM	256QAM	512QAM	512QAM Light	1024QAM
RSL@ BER=10^{-6} (dBm)					
@6 GHz	-72.5	-69.5	-67.5	-66	-64
@7 GHz	-72.5	-69.5	-67.5	-66	-64
@8 GHz	-72.5	-69.5	-67.5	-66	-64
@10 GHz	-72	-69	-67	-65.5	N/A
@10.5 GHz	-70	-67	-65	-63.5	N/A

Item	Performance (Channel Spacing: 28 MHz)				
	128QAM	256QAM	512QAM	512QAM Light	1024QAM
@11 GHz	-72	-69	-67	-65.5	-63.5
@13 GHz	-72	-69	-67	-65.5	-63.5
@15 GHz	-72	-69	-67	-65.5	-63.5
@18 GHz	-71.5	-68.5	-66.5	-65	-63
@23 GHz	-71.5	-68.5	-66.5	-65	-63
@26 GHz	-71	-68	-66	-64.5	N/A
@28 GHz	-70.5	-67.5	N/A	N/A	N/A
@32 GHz	-70	-67	N/A	N/A	N/A
@38 GHz	-69.5	-66.5	-64.5	N/A	N/A
@42 GHz	-68	-65	-63	N/A	N/A

Table 6-85 Typical receiver sensitivity of the Integrated IP microwave XV (ISV3 @IS3-mode, XPIC enabled)

Item	Performance (Channel Spacing: 56 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-87.5	-86	-80.5	-79	-76	-72.5
@7 GHz	-87.5	-86	-80.5	-79	-76	-72.5
@8 GHz	-87.5	-86	-80.5	-79	-76	-72.5
@10 GHz	-87	-85.5	-80	-78.5	-75.5	-72
@10.5 GHz	N/A	N/A	N/A	N/A	N/A	N/A
@11 GHz	-87	-85.5	-80	-78.5	-75.5	-72
@13 GHz	-87	-85.5	-80	-78.5	-75.5	-72
@15 GHz	-87	-85.5	-80	-78.5	-75.5	-72
@18 GHz	-86.5	-85	-79.5	-78	-75	-71.5
@23 GHz	-86.5	-85	-79.5	-78	-75	-71.5
@26 GHz	-86	-84.5	-79	-77.5	-74.5	-71
@28 GHz	-85.5	-84	-78.5	-77	-74	-70.5

Item	Performance (Channel Spacing: 56 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
@32 GHz	-85	-83.5	-78	-76.5	-73.5	-70
@38 GHz	-84.5	-83	-77.5	-76	-73	-69.5
@42 GHz	-83	-81.5	-76	-74.5	-71.5	-68

Table 6-86 Typical receiver sensitivity of the Integrated IP microwave XVI (ISV3 @IS3-mode, XPIC enabled)

Item	Performance (Channel Spacing: 56 MHz)					
	128QAM	256QAM	512QAM	512QAM Light	1024QAM	1024QAM Light
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-69.5	-66.5	-64.5	-63	-61	-59.5
@7 GHz	-69.5	-66.5	-64.5	-63	-61	-59.5
@8 GHz	-69.5	-66.5	-64.5	-63	-61	-59.5
@10 GHz	-69	-66	-64	-62.5	-60.5	-59
@10.5 GHz	N/A	N/A	N/A	N/A	N/A	N/A
@11 GHz	-69	-66	-64	-62.5	-60.5	-59
@13 GHz	-69	-66	-64	-62.5	-60.5	-59
@15 GHz	-69	-66	-64	-62.5	-60.5	-59
@18 GHz	-68.5	-65.5	-63.5	-62	-60	-58.5
@23 GHz	-68.5	-65.5	-63.5	-62	-60	-58.5
@26 GHz	-68	-65	-63	-61.5	-59.5	-58
@28 GHz	-67.5	-64.5	-62.5	N/A	N/A	N/A
@32 GHz	-67	-64	-62	N/A	N/A	N/A
@38 GHz	-66.5	-63.5	-61.5	-60	N/A	N/A
@42 GHz	-65	-62	-60	-58.5	N/A	N/A

Table 6-87 Typical receiver sensitivity of the Integrated IP microwave XVII (ISV3 @IS3-mode, XPIC enabled)

Item	Performance (Channel Spacing: 40 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
RSL@ BER=10^{-6} (dBm)						
@6 GHz	-89	-87.5	-82	-80.5	-77.5	-74
@7 GHz	-89	-87.5	-82	-80.5	-77.5	-74
@8 GHz	-89	-87.5	-82	-80.5	-77.5	-74
@10 GHz	-88.5	-87	-81.5	-80	-77	-73.5
@10.5 GHz	N/A	N/A	N/A	N/A	N/A	N/A
@11 GHz	-88.5	-87	-81.5	-80	-77	-73.5
@13 GHz	-88.5	-87	-81.5	-80	-77	-73.5
@15 GHz	-88.5	-87	-81.5	-80	-77	-73.5
@18 GHz	-88	-86.5	-81	-79.5	-76.5	-73
@23 GHz	-88	-86.5	-81	-79.5	-76.5	-73
@26 GHz	-87.5	-86	-80.5	-79	-76	-72.5
@28 GHz	-87	-85.5	-80	-78.5	-75.5	-72
@32 GHz	-86.5	-85	-79.5	-78	-75	-71.5
@38 GHz	-86	-84.5	-79	-77.5	-74.5	-71
@42 GHz	-84.5	-83	-77.5	-76	-73	-69.5

Table 6-88 Typical receiver sensitivity of the Integrated IP microwave XVIII (ISV3 @IS3-mode, XPIC enabled)

Item	Performance (Channel Spacing: 40 MHz)				
	128QAM	256QAM	512QAM	512QAM Light	1024QAM
RSL@ BER=10^{-6} (dBm)					
@6 GHz	-71	-68	-66	-64.5	-62.5
@7 GHz	-71	-68	-66	-64.5	-62.5
@8 GHz	-71	-68	-66	-64.5	-62.5
@10 GHz	-70.5	-67.5	-65.5	-64	-62
@10.5 GHz	N/A	N/A	N/A	N/A	N/A

Item	Performance (Channel Spacing: 40 MHz)				
	128QAM	256QAM	512QAM	512QAM Light	1024QAM
@11 GHz	-70.5	-67.5	-65.5	-64	-62
@13 GHz	-70.5	-67.5	-65.5	-64	-62
@15 GHz	-70.5	-67.5	-65.5	-64	-62
@18 GHz	-70	-67	-65	-63.5	-61.5
@23 GHz	-70	-67	-65	-63.5	-61.5
@26 GHz	-69.5	-66.5	-64.5	-63	-61
@28 GHz	-69	-66	-64	-62.5	N/A
@32 GHz	-68.5	-65.5	-63.5	-62	N/A
@38 GHz	-68	-65	-63	-61.5	N/A
@42 GHz	-66.5	-63.5	-61.5	-60	N/A

6.1.3.7 Receiver Sensitivity (ISM6 board)

The ISM6 board supports the SDH microwave work mode and the Integrated IP microwave work mode.

The ISM6 board supports three IF running modes: IS6, IS3 and IS2

- This section provides the receiver sensitivity when the ISM6 runs in the IS6 mode.
- When the ISM6 board runs in the IS3 mode, it supports a channel spacing from 7 MHz to 56 MHz. The radio work mode and receiver sensitivity for the ISM6 board are the same as those for the ISV3 board. For details, see **6.1.3.6 Receiver Sensitivity (ISV3 board)**.
- When the ISM6 board runs in the IS2 mode and XPIC is disabled, the radio work mode and receiver sensitivity for the ISM6 board are the same as those for the ISU2 board. For details, see **6.1.3.4 Receiver Sensitivity (ISU2 board)**.
- When the ISM6 board runs in the IS2 mode and XPIC is enabled, the radio work mode and receiver sensitivity for the ISM6 board are the same as those for the ISX2 board. For details, see **6.1.3.5 Receiver Sensitivity (ISX2 board)**.

NOTE

N/A means that microwave working mode is not supported.

SDH Microwave (IS6-Mode)

Table 6-89 Typical receiver sensitivity of the SDH microwave (IS6-mode)

Item	Performance	
	1×STM-1	2×STM-1
	28 MHz/128QAM	56 MHz/128QAM
RSL@ BER = 10^{-6} (dBm)		
@13 GHz	-72	-69
@15 GHz	-72	-69
@18 GHz	-71.5	-68.5
@23 GHz	-71.5	-68.5
@26 GHz	-71	-68
@28 GHz	-70.5	-67.5
@32 GHz	-70	-67
@38 GHz	-69.5	-66.5

NOTE
For the ISM6 board in SDH service mode, receiver sensitivities are the same regardless of whether the XPIC function is enabled or disabled.

Integrated IP Microwave

Table 6-90 Typical receiver sensitivity of the Integrated IP microwave I (IS6-mode, XPIC disabled)

Item	Performance (Channel Spacing: 7 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
RSL@ BER = 10^{-6} (dBm)						
@13 GHz	-95.5	-93.5	-89	-87	-84	-81
@15 GHz	-95.5	-93.5	-89	-87	-84	-81
@18 GHz	-95	-93	-88.5	-86.5	-83.5	-80.5
@23 GHz	-95	-93	-88.5	-86.5	-83.5	-80.5
@26 GHz	-94.5	-92.5	-88	-86	-83	-80
@28 GHz	-94	-92	-87.5	-85.5	-82.5	-79.5

Item	Performance (Channel Spacing: 7 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
@32 GHz	-93.5	-91.5	-87	-85	-82	-79
@38 GHz	-93	-91	-86.5	-84.5	-81.5	-78.5

Table 6-91 Typical receiver sensitivity of the Integrated IP microwave II (IS6-mode, XPIC disabled)

Item	Performance (Channel Spacing: 7 MHz)			
	128QAM	256QAM	512QAM	1024QAM
RSL@ BER = 10^{-6} (dBm)				
@13 GHz	-78	-75	-72	-69
@15 GHz	-78	-75	-72	-69
@18 GHz	-77.5	-74.5	-71.5	-68.5
@23 GHz	-77.5	-74.5	-71.5	-68.5
@26 GHz	-77	-74	-71	-68
@28 GHz	-76.5	-73.5	-70.5	-67.5
@32 GHz	-76	-73	-70	-67
@38 GHz	-75.5	-72.5	-69.5	-66.5

Table 6-92 Typical receiver sensitivity of the Integrated IP microwave III (IS6-mode, XPIC disabled)

Item	Performance (Channel Spacing: 14 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
RSL@ BER = 10^{-6} (dBm)						
@13 GHz	-93.5	-91.5	-86	-84	-81	-78
@15 GHz	-93.5	-91.5	-86	-84	-81	-78
@18 GHz	-93	-91	-85.5	-83.5	-80.5	-77.5
@23 GHz	-93	-91	-85.5	-83.5	-80.5	-77.5
@26 GHz	-92.5	-90.5	-85	-83	-80	-77
@28 GHz	-92	-90	-84.5	-82.5	-79.5	-76.5

Item	Performance (Channel Spacing: 14 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
@32 GHz	-91.5	-89.5	-84	-82	-79	-76
@38 GHz	-91	-89	-83.5	-81.5	-78.5	-75.5

Table 6-93 Typical receiver sensitivity of the Integrated IP microwave IV (IS6-mode, XPIC disabled)

Item	Performance (Channel Spacing: 14 MHz)				
	128QAM	256QAM	512QAM	1024QAM	2048QAM
RSL@ BER = 10^{-6} (dBm)					
@13 GHz	-75	-72	-69	-66	-63
@15 GHz	-75	-72	-69	-66	-63
@18 GHz	-74.5	-71.5	-68.5	-65.5	-62.5
@23 GHz	-74.5	-71.5	-68.5	-65.5	-62.5
@26 GHz	-74	-71	-68	-65	-62
@28 GHz	-73.5	-70.5	-67.5	-64.5	-61.5
@32 GHz	-73	-70	-67	-64	-61
@38 GHz	-72.5	-69.5	-66.5	-63.5	-60.5

Table 6-94 Typical receiver sensitivity of the Integrated IP microwave V (IS6-mode, XPIC disabled)

Item	Performance (Channel Spacing: 28 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
RSL@ BER = 10^{-6} (dBm)						
@13 GHz	-90	-88.5	-83	-81.5	-78.5	-75
@15 GHz	-90	-88.5	-83	-81.5	-78.5	-75
@18 GHz	-89.5	-88	-82.5	-81	-78	-74.5
@23 GHz	-89.5	-88	-82.5	-81	-78	-74.5
@26 GHz	-89	-87.5	-82	-80.5	-77.5	-74
@28 GHz	-88.5	-87	-81.5	-80	-77	-73.5

Item	Performance (Channel Spacing: 28 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
@32 GHz	-88	-86.5	-81	-79.5	-76.5	-73
@38 GHz	-87.5	-86	-80.5	-79	-76	-72.5

Table 6-95 Typical receiver sensitivity of the Integrated IP microwave VI (IS6-mode, XPIC disabled)

Item	Performance (Channel Spacing: 28 MHz)					
	128QAM	256QAM	512QAM	1024QAM	2048QAM	4096QAM
RSL@ BER = 10^{-6} (dBm)						
@13 GHz	-72	-69	-66	-63	-60	-57
@15 GHz	-72	-69	-66	-63	-60	-57
@18 GHz	-71.5	-68.5	-65.5	-62.5	-59.5	-56.5
@23 GHz	-71.5	-68.5	-65.5	-62.5	-59.5	-56.5
@26 GHz	-71	-68	-65	-62	-59	-56
@28 GHz	-70.5	-67.5	-64.5	-61.5	-58.5	N/A
@32 GHz	-70	-67	-64	-61	-58	N/A
@38 GHz	-69.5	-66.5	-63.5	-60.5	-57.5	N/A

Table 6-96 Typical receiver sensitivity of the Integrated IP microwave VII (IS6-mode, XPIC disabled)

Item	Performance (Channel Spacing: 56 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
RSL@ BER = 10^{-6} (dBm)						
@13 GHz	-87	-85.5	-80	-78.5	-75.5	-72
@15 GHz	-87	-85.5	-80	-78.5	-75.5	-72
@18 GHz	-86.5	-85	-79.5	-78	-75	-71.5
@23 GHz	-86.5	-85	-79.5	-78	-75	-71.5
@26 GHz	-86	-84.5	-79	-77.5	-74.5	-71
@28 GHz	-85.5	-84	-78.5	-77	-74	-70.5

Item	Performance (Channel Spacing: 56 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
@32 GHz	-85	-83.5	-78	-76.5	-73.5	-70
@38 GHz	-84.5	-83	-77.5	-76	-73	-69.5

Table 6-97 Typical receiver sensitivity of the Integrated IP microwave VIII (IS6-mode, XPIC disabled)

Item	Performance (Channel Spacing: 56 MHz)					
	128QAM	256QAM	512QAM	1024QAM	2048QAM	4096QAM
RSL@ BER = 10^{-6} (dBm)						
@13 GHz	-69	-66	-63	-60	-57	-54
@15 GHz	-69	-66	-63	-60	-57	-54
@18 GHz	-68.5	-65.5	-62.5	-59.5	-56.5	-53.5
@23 GHz	-68.5	-65.5	-62.5	-59.5	-56.5	-53.5
@26 GHz	-68	-65	-62	-59	-56	-53
@28 GHz	-67.5	-64.5	-61.5	-58.5	-55.5	N/A
@32 GHz	-67	-64	-61	-58	-55	N/A
@38 GHz	-66.5	-63.5	-60.5	-57.5	-54.5	N/A

Table 6-98 Typical receiver sensitivity of the Integrated IP microwave IX (IS6-mode, XPIC disabled)

Item	Performance (Channel Spacing: 40 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
RSL@ BER = 10^{-6} (dBm)						
@13 GHz	-88.5	-87	-81.5	-80	-77	-73.5
@15 GHz	-88.5	-87	-81.5	-80	-77	-73.5
@18 GHz	-88	-86.5	-81	-79.5	-76.5	-73
@23 GHz	-88	-86.5	-81	-79.5	-76.5	-73
@26 GHz	-87.5	-86	-80.5	-79	-76	-72.5
@28 GHz	-87	-85.5	-80	-78.5	-75.5	-72

Item	Performance (Channel Spacing: 40 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
@32 GHz	-86.5	-85	-79.5	-78	-75	-71.5
@38 GHz	-86	-84.5	-79	-77.5	-74.5	-71

Table 6-99 Typical receiver sensitivity of the Integrated IP microwave X (IS6-mode, XPIC disabled)

Item	Performance (Channel Spacing: 40 MHz)					
	128QAM	256QAM	512QAM	1024QAM	2048QAM	4096QAM
RSL@ BER = 10^{-6} (dBm)						
@13 GHz	-70.5	-67.5	-64.5	-61.5	-58.5	-55.5
@15 GHz	-70.5	-67.5	-64.5	-61.5	-58.5	-55.5
@18 GHz	-70	-67	-64	-61	-58	-55
@23 GHz	-70	-67	-64	-61	-58	-55
@26 GHz	-69.5	-66.5	-63.5	-60.5	-57.5	-54.5
@28 GHz	-69	-66	-63	-60	-57	N/A
@32 GHz	-68.5	-65.5	-62.5	-59.5	-56.5	N/A
@38 GHz	-68	-65	-62	-59	-56	N/A

Table 6-100 Typical receiver sensitivity of the Integrated IP microwave XI (IS6-mode, XPIC disabled)

Item	Performance (Channel Spacing: 112 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
RSL@ BER = 10^{-6} (dBm)						
@32 GHz	-81.5	-80	-74.5	-73	-70	-66.5

Table 6-101 Typical receiver sensitivity of the Integrated IP microwave XII (IS6-mode, XPIC disabled)

Item	Performance (Channel Spacing: 112 MHz)		
	128QAM	256QAM	512QAM
RSL@ BER = 10^{-6} (dBm)			

Item	Performance (Channel Spacing: 112 MHz)		
	128QAM	256QAM	512QAM
@32 GHz	-63.5	-60.5	-57.5

Table 6-102 Typical receiver sensitivity of the Integrated IP microwave XIII (IS6-mode, XPIC enabled)

Item	Performance (Channel Spacing: 7 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
RSL@ BER = 10^{-6} (dBm)						
@13 GHz	-95.5	-93.5	-89	-87	-84	-81
@15 GHz	-95.5	-93.5	-89	-87	-84	-81
@18 GHz	-95	-93	-88.5	-86.5	-83.5	-80.5
@23 GHz	-95	-93	-88.5	-86.5	-83.5	-80.5
@26 GHz	-94.5	-92.5	-88	-86	-83	-80
@28 GHz	-94	-92	-87.5	-85.5	-82.5	-79.5
@32 GHz	-93.5	-91.5	-87	-85	-82	-79
@38 GHz	-93	-91	-86.5	-84.5	-81.5	-78.5

Table 6-103 Typical receiver sensitivity of the Integrated IP microwave XIV (IS6-mode, XPIC enabled)

Item	Performance (Channel Spacing: 7 MHz)		
	128QAM	256QAM	512QAM
RSL@ BER = 10^{-6} (dBm)			
@13 GHz	-78	-75	-72
@15 GHz	-78	-75	-72
@18 GHz	-77.5	-74.5	-71.5
@23 GHz	-77.5	-74.5	-71.5
@26 GHz	-77	-74	-71
@28 GHz	-76.5	-73.5	-70.5
@32 GHz	-76	-73	-70
@38 GHz	-75.5	-72.5	-69.5

Table 6-104 Typical receiver sensitivity of the Integrated IP microwave XV (IS6-mode, XPIC enabled)

Item	Performance (Channel Spacing: 14 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
RSL@ BER = 10^{-6} (dBm)						
@13 GHz	-93.5	-91.5	-86	-84	-81	-78
@15 GHz	-93.5	-91.5	-86	-84	-81	-78
@18 GHz	-93	-91	-85.5	-83.5	-80.5	-77.5
@23 GHz	-93	-91	-85.5	-83.5	-80.5	-77.5
@26 GHz	-92.5	-90.5	-85	-83	-80	-77
@28 GHz	-92	-90	-84.5	-82.5	-79.5	-76.5
@32 GHz	-91.5	-89.5	-84	-82	-79	-76
@38 GHz	-91	-89	-83.5	-81.5	-78.5	-75.5

Table 6-105 Typical receiver sensitivity of the Integrated IP microwave XVI (IS6-mode, XPIC enabled)

Item	Performance (Channel Spacing: 14 MHz)			
	128QAM	256QAM	512QAM	1024QAM
RSL@ BER = 10^{-6} (dBm)				
@13 GHz	-75	-72	-69	-66
@15 GHz	-75	-72	-69	-66
@18 GHz	-74.5	-71.5	-68.5	-65.5
@23 GHz	-74.5	-71.5	-68.5	-65.5
@26 GHz	-74	-71	-68	-65
@28 GHz	-73.5	-70.5	-67.5	-64.5
@32 GHz	-73	-70	-67	-64
@38 GHz	-72.5	-69.5	-66.5	-63.5

Table 6-106 Typical receiver sensitivity of the Integrated IP microwave XVII (IS6-mode, XPIC enabled)

Item	Performance (Channel Spacing: 28 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
RSL@ BER = 10^{-6} (dBm)						
@13 GHz	-90	-88.5	-83	-81.5	-78.5	-75
@15 GHz	-90	-88.5	-83	-81.5	-78.5	-75
@18 GHz	-89.5	-88	-82.5	-81	-78	-74.5
@23 GHz	-89.5	-88	-82.5	-81	-78	-74.5
@26 GHz	-89	-87.5	-82	-80.5	-77.5	-74
@28 GHz	-88.5	-87	-81.5	-80	-77	-73.5
@32 GHz	-88	-86.5	-81	-79.5	-76.5	-73
@38 GHz	-87.5	-86	-80.5	-79	-76	-72.5

Table 6-107 Typical receiver sensitivity of the Integrated IP microwave XVIII (IS6-mode, XPIC enabled)

Item	Performance (Channel Spacing: 28 MHz)				
	128QAM	256QAM	512QAM	1024QAM	2048QAM
RSL@ BER = 10^{-6} (dBm)					
@13 GHz	-72	-69	-66	-63	-60
@15 GHz	-72	-69	-66	-63	-60
@18 GHz	-71.5	-68.5	-65.5	-62.5	-59.5
@23 GHz	-71.5	-68.5	-65.5	-62.5	-59.5
@26 GHz	-71	-68	-65	-62	-59
@28 GHz	-70.5	-67.5	-64.5	-61.5	N/A
@32 GHz	-70	-67	-64	-61	N/A
@38 GHz	-69.5	-66.5	-63.5	-60.5	N/A

Table 6-108 Typical receiver sensitivity of the Integrated IP microwave XIX (IS6-mode, XPIC enabled)

Item	Performance (Channel Spacing: 56 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
RSL@ BER = 10^{-6} (dBm)						
@13 GHz	-87	-85.5	-80	-78.5	-75.5	-72
@15 GHz	-87	-85.5	-80	-78.5	-75.5	-72
@18 GHz	-86.5	-85	-79.5	-78	-75	-71.5
@23 GHz	-86.5	-85	-79.5	-78	-75	-71.5
@26 GHz	-86	-84.5	-79	-77.5	-74.5	-71
@28 GHz	-85.5	-84	-78.5	-77	-74	-70.5
@32 GHz	-85	-83.5	-78	-76.5	-73.5	-70
@38 GHz	-84.5	-83	-77.5	-76	-73	-69.5

Table 6-109 Typical receiver sensitivity of the Integrated IP microwave XX (IS6-mode, XPIC enabled)

Item	Performance (Channel Spacing: 56 MHz)				
	128QAM	256QAM	512QAM	1024QAM	2048QAM
RSL@ BER = 10^{-6} (dBm)					
@13 GHz	-69	-66	-63	-60	-57
@15 GHz	-69	-66	-63	-60	-57
@18 GHz	-68.5	-65.5	-62.5	-59.5	-56.5
@23 GHz	-68.5	-65.5	-62.5	-59.5	-56.5
@26 GHz	-68	-65	-62	-59	-56
@28 GHz	-67.5	-64.5	-61.5	-58.5	N/A
@32 GHz	-67	-64	-61	-58	N/A
@38 GHz	-66.5	-63.5	-60.5	-57.5	N/A

Table 6-110 Typical receiver sensitivity of the Integrated IP microwave XXI (IS6-mode, XPIC enabled)

Item	Performance (Channel Spacing: 40 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
RSL@ BER = 10^{-6} (dBm)						
@13 GHz	-88.5	-87	-81.5	-80	-77	-73.5
@15 GHz	-88.5	-87	-81.5	-80	-77	-73.5
@18 GHz	-88	-86.5	-81	-79.5	-76.5	-73
@23 GHz	-88	-86.5	-81	-79.5	-76.5	-73
@26 GHz	-87.5	-86	-80.5	-79	-76	-72.5
@28 GHz	-87	-85.5	-80	-78.5	-75.5	-72
@32 GHz	-86.5	-85	-79.5	-78	-75	-71.5
@38 GHz	-86	-84.5	-79	-77.5	-74.5	-71

Table 6-111 Typical receiver sensitivity of the Integrated IP microwave XXII (IS6-mode, XPIC enabled)

Item	Performance (Channel Spacing: 40 MHz)				
	128QAM	256QAM	512QAM	1024QAM	2048QAM
RSL@ BER = 10^{-6} (dBm)					
@13 GHz	-70.5	-67.5	-64.5	-61.5	-58.5
@15 GHz	-70.5	-67.5	-64.5	-61.5	-58.5
@18 GHz	-70	-67	-64	-61	-58
@23 GHz	-70	-67	-64	-61	-58
@26 GHz	-69.5	-66.5	-63.5	-60.5	-57.5
@28 GHz	-69	-66	-63	-60	N/A
@32 GHz	-68.5	-65.5	-62.5	-59.5	N/A
@38 GHz	-68	-65	-62	-59	N/A

Table 6-112 Typical receiver sensitivity of the Integrated IP microwave XXIII (IS6-mode, XPIC enabled)

Item	Performance (Channel Spacing: 112 MHz)					
	QPSK Strong	QPSK	16QAM Strong	16QAM	32QAM	64QAM
RSL@ BER = 10^{-6} (dBm)						
@32 GHz	-81.5	-80	-74.5	-73	-70	-66.5

Table 6-113 Typical receiver sensitivity of the Integrated IP microwave XXIV (IS6-mode, XPIC enabled)

Item	Performance (Channel Spacing: 112 MHz)		
	128QAM	256QAM	512QAM
RSL@ BER = 10^{-6} (dBm)			
@32 GHz	-63.5	-60.5	-57.5

6.1.4 Distortion Sensitivity

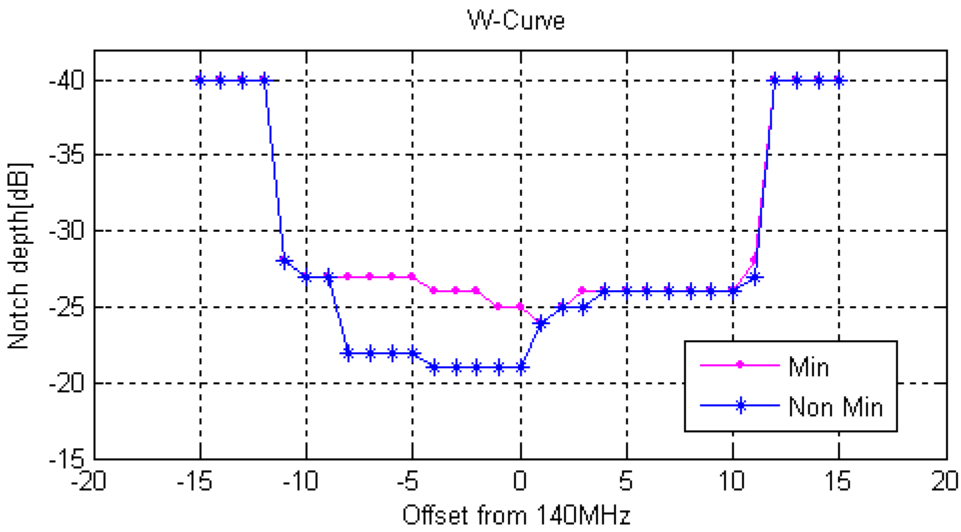
The distortion sensitivity reflects the anti-multipath fading capability of the OptiX RTN 980.

The notch depth of the OptiX RTN 980 meets the requirements described in ETSI EN 302217-2-1. **Table 6-114** describes the anti-multipath fading capability of the OptiX RTN 980 in STM-1/128QAM microwave working modes.

Table 6-114 Anti-multipath fading capability

Item	Performance
STM-1/128QAM W-curve	See **Figure 6-2**
STM-1/128QAM dispersion fading margin	51 dB

Figure 6-2 W-curve



6.1.5 Transceiver Performance

The performance of the transceiver includes the nominal maximum/minimum transmit power, nominal maximum receive power, and frequency stability.

NOTE

When cooperated with ISV3/ISM6 boards, ODUs may support QPSK Strong, 16QAM Strong, 512QAM Light, and 1024QAM Light working modes. Strong and light indicate FEC coding strength. Strong FEC improves receiver sensitivity by increasing error-correcting codes. Light FEC expands service capacity by reducing error-correcting codes. For detail, refer to **6.1.1.6 Microwave Work Modes (ISV3 board)**.

Transceiver Performance (High Power ODU)

NOTE

- In normal mode, XMC ODUs work with IF1, IFU2, IFX2, ISU2, or ISX2 boards, or ISV3 boards that work in IS2 mode.
- In IS3 mode, XMC ODUs work with ISV3/ISM6 boards that work in IS3 mode.
- In IS6 mode, XMC ODUs work with ISM6 boards that work in IS6 mode.

Table 6-115 Transceiver performance (XMC-2 ODU in normal mode)

Item	Performance					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
Nominal maximum transmit power (dBm) **NOTE** For 7/8 GHz XMC-2 ODUs, when the channel spacing is 40 MHz or 56 MHz and the same modulation scheme is applied, the nominal maximum transmit power of an XMC-2 ODU of the normal version is less than the value in the table by 3 dB, whereas that of an XMC-2 ODU of the XMC-2E version is the same as the value in the table.						
6 GHz	30	28	26.5	25	25	23
7 GHz (Normal)	26.5	25.5	25.5	25	25	23
8 GHz (Normal)	26.5	25.5	25.5	25	25	23
7 GHz (XMC-2E)	30	26	26	25	25	23
8 GHz (XMC-2E)	30	26	26	25	25	23
10 GHz	26.5	23.5	23.5	21.5	21.5	19.5
10.5 GHz	24.5	22.5	22.5	20.5	20.5	18.5
11 GHz	26	24	24	22	22	20
13 GHz	25	22	22	20.5	20.5	17.5

Item	Performance					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
15 GHz	25	22	22	20.5	20.5	18.5
18 GHz	24	21	21	19.5	19.5	16.5
23 GHz	24	21	21	19.5	19.5	17.5
26 GHz	22	20	20	18	18	16
28 GHz	25	22	21.5	19	19	17
32 GHz	23	21	19.5	17	17	15
38 GHz	20	17	17	16	16	14
42 GHz	16	12	12	11	11	9
Nominal minimum transmit power (dBm)						
6 GHz	0					
7 GHz (Normal)	6.5					
8 GHz (Normal)	6.5					
7 GHz (XMC-2E)	6.5					
8 GHz (XMC-2E)	6.5					
10 GHz	0					
10.5 GHz	0					
11 GHz	0					
13 GHz	5					
15 GHz	5					
18 GHz	4					
23 GHz	4					
26 GHz	0					
28 GHz	-5					
32 GHz	-5					
38 GHz	0					

Item	Performance					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
42 GHz	-5					
Nominal maximum receive power (dBm)	-20				-20 (6 GHz to 38 GHz) -23 (42 GHz)	-20 (6 GHz to 38 GHz) -25 (42 GHz)
Frequency stability (ppm)	±5 ppm					

Table 6-116 Transceiver performance (XMC-2 ODU in IS3 mode)

Item	Performance								
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM	512QAM	1024QAM	2048QAM
Nominal maximum transmit power (dBm) **NOTE** For 7/8 GHz XMC-2 ODUs, when the channel spacing is 40 MHz or 56 MHz and the same modulation scheme is applied, the nominal maximum transmit power of an XMC-2 ODU of the normal version is less than the value in the table by 3 dB, whereas that of an XMC-2 ODU of the XMC-2E version is the same as the value in the table.									
6 GHz	30	28	26.5	25	25	23	21	19	-
7 GHz (Normal)	26.5	25.5	25.5	25	25	23	-	-	-
8 GHz (Normal)	26.5	25.5	25.5	25	25	23	-	-	-
7 GHz (XMC-2E)	30	28	28	26	26	24	24	23	21
8 GHz (XMC-2E)	30	28	28	26	26	24	24	23	21
10 GHz	26.5	24.5	24.5	23.5	23.5	21.5	21.5	19.5	-
10.5 GHz	24.5	23.5	23.5	22.5	22.5	20.5	20.5	18.5	-

Item	Performance								
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM	512QAM	1024QAM	2048QAM
11 GHz	26	25	25	24	24	22	22	20	-
13 GHz	25	24	24	23	23	21	20	18	16
15 GHz	25	24	24	23	23	21	21	19	17
18 GHz	24	23	23	22	22	20	19	17	15
23 GHz	24	23	23	22	22	19.5	19.5	18	16
26 GHz	22	21	21	20	20	17	17	15	-
28 GHz	25	22	21.5	19	19	17	15	13	-
32 GHz	23	21	19.5	17	17	15	13	11	-
38 GHz	20	18	18	17	17	16	15	13	11
42 GHz	16	14	14	13	13	11	10	8	-
Nominal minimum transmit power (dBm)									
6 GHz	0								-
7 GHz (Normal)	6.5						-		
8 GHz (Normal)	6.5						-		
7 GHz (XMC-2E)	6.5								
8 GHz (XMC-2E)	6.5								
10 GHz	0								-
10.5 GHz	0								-
11 GHz	0								-
13 GHz	5								
15 GHz	5								
18 GHz	4								

Item	Performance								
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM	512QAM	1024QAM	2048QAM
23 GHz	4								
26 GHz	0								-
28 GHz	-5								-
32 GHz	-5								-
38 GHz	0								
42 GHz	-5								-
Nominal maximum receive power (dBm)	-20			-20 (6 GHz to 38 GHz) -23 (42 GHz)		-20 (6 GHz to 38 GHz) -25 (42 GHz)	-25		-28
Frequency stability (ppm)	±5 ppm								

NOTE

For 13/15/18/23/38 GHz XMC-2 ODUs, only those manufactured since November 2014 support 2048QAM. A 38 GHz XMC-2 ODU supports 2048QAM only when it operates at the normal temperature and when the matching IF cable is longer than 60 m.

Table 6-117 Transceiver performance (XMC-2H ODU in IS3 mode)

Item	Performance								
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM	512QAM	1024QAM	2048QAM
Nominal maximum transmit power (dBm)									
6 GHz	30.5	30.5	30.5	30.5	30.5	28.5	28.5	27.5	25.5
7 GHz	30.5	30.5	30.5	30.5	30.5	28.5	28.5	27.5	25.5
8 GHz	30.5	30.5	30.5	30.5	30.5	28.5	28.5	27.5	25.5
11 GHz	28.5	28.5	28.5	28.5	28.5	26.5	26.5	25.5	23.5
Nominal minimum transmit power (dBm)									

Item	Performance								
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM	512QAM	1024QAM	2048QAM
6 GHz	5								
7 GHz	5								
8 GHz	5								
11 GHz	5								
Nominal maximum receive power (dBm)	-20						-25		-28
Frequency stability (ppm)	±5ppm								

Table 6-118 Transceiver performance (XMC-3 ODU in IS3 mode)

Item	Performance								
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM	512QAM	1024QAM	2048QAM
Nominal maximum transmit power (dBm)									
13GHz	25	24	24	23	23	21	20	18	18
15GHz	25	24	24	23	23	21	21	19	19
18GHz	24	23	23	22	22	20	19	17	17
23GHz	24	23	23	22	22	19.5	19.5	18	18
26GHz	22	21	21	19	19	17	17	15	15
28GHz	22	20	20	19	19	17	16	15	15
32GHz	22	20	20	19	19	17	16	15	15
38GHz	20	18	18	17	17	16	15	13	13
Nominal minimum transmit power (dBm)									
13GHz	-5								

Item	Performance								
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM	512QAM	1024QAM	2048QAM
15GHz	-5								
18GHz	-7								
23GHz	-7								
26GHz	-10								
28GHz	-6								
32GHz	-10								3
38GHz	-6								0
Nominal maximum receive power (dBm)	-20						-25		-30
Frequency stability (ppm)	±5ppm								

Table 6-119 Transceiver performance (XMC-3 ODU in IS6 mode)

Item	Performance									
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM	512QAM	1024QAM	2048QAM	4096QAM
Nominal maximum transmit power (dBm)										
13GHz	25	24	24	23	23	21	20	18	18	17
15GHz	25	24	24	23	23	21	21	19	19	18
18GHz	24	23	23	22	22	20	19	17	17	16
23GHz	24	23	23	22	22	19.5	19.5	18	18	17
26GHz	22	21	21	19	19	17	17	15	15	14
28GHz	22	20	20	19	19	17	16	15	15	-
32GHz	22	20	20	19	19	17	16	15	15	-

<table>
<tr><th rowspan="2">Item</th><th colspan="10">Performance</th></tr>
<tr><th>QPSK</th><th>16QAM</th><th>32QAM</th><th>64QAM</th><th>128QAM</th><th>256QAM</th><th>512QAM</th><th>1024QAM</th><th>2048QAM</th><th>4096QAM</th></tr>
<tr><td>32GHz (112MHz)</td><td>22</td><td>18</td><td>18</td><td>17</td><td>17</td><td>16</td><td>14</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>38GHz</td><td>20</td><td>18</td><td>18</td><td>17</td><td>17</td><td>16</td><td>15</td><td>13</td><td>13</td><td>-</td></tr>
<tr><td colspan="11">Nominal minimum transmit power (dBm)</td></tr>
<tr><td>13GHz</td><td colspan="10">-5</td></tr>
<tr><td>15GHz</td><td colspan="10">-5</td></tr>
<tr><td>18GHz</td><td colspan="10">-7</td></tr>
<tr><td>23GHz</td><td colspan="10">-7</td></tr>
<tr><td>26GHz</td><td colspan="10">-10</td></tr>
<tr><td>28GHz</td><td colspan="9">-6</td><td>-</td></tr>
<tr><td>32GHz</td><td colspan="8">-10</td><td>3</td><td>-</td></tr>
<tr><td>32GHz (112MHz)</td><td colspan="7">-2</td><td colspan="3">-</td></tr>
<tr><td>38GHz</td><td colspan="8">-6</td><td>0</td><td>-</td></tr>
<tr><td>Nominal maximum receive power (dBm)</td><td colspan="6">-20</td><td colspan="2">-25</td><td>-30</td><td>-35 (13GHz to 26GHz)</td></tr>
<tr><td>Frequency stability (ppm)</td><td colspan="10">±5ppm</td></tr>
</table>

Table 6-120 Transceiver performance (HP ODU)

Item	Performance			
	QPSK	16QAM/ 32QAM	64QAM/ 128QAM	256QAM
Nominal maximum transmit power (dBm)				
@6 GHz	30	26	24	22
@7 GHz	30	28	25	23
@8 GHz	30	28	25	23
@10 GHz	26.5	22.5	20.5	18.5
@10.5 GHz	24	20.5	18	16
@11 GHz	28	26	22	20
@13 GHz	26	24	20	18
@15 GHz	26	24	20	18
@18 GHz	25.5	23	19	17
@23 GHz	25	23	19	17
@26 GHz	25	22	19	17
@28GHz	25	22	17	15
@32 GHz	23	21	17	15
@38 GHz	23	20	17	15
Nominal minimum transmit power (dBm)				
@6 GHz	9			
@7 GHz	9			
@8 GHz	9			
@10 GHz	2			
@10.5 GHz	0			
@11 GHz	6			
@13 GHz	3			
@15 GHz	3			
@18 GHz	2			
@23 GHz	2			
@26 GHz	2			

Item	Performance			
	QPSK	16QAM/ 32QAM	64QAM/ 128QAM	256QAM
@28GHz	2			
@32 GHz	1			
@38 GHz	1			
Nominal maximum receive power (dBm)	-20			-25
Frequency stability (ppm)	±5			

Table 6-121 Transceiver Performance (HPA ODU)

Item	Performance			
	QPSK	16QAM/ 32QAM	64QAM/ 128QAM	256QAM
Nominal maximum transmit power (dBm)				
@6 GHz	30	28 (16QAM) 26.5 (32QAM)	25	23
@7 GHz	30	28	25	23
@8 GHz	30	28	25	23
@11 GHz	28	26	22	20
@13 GHz	26	24	20	18
@15 GHz	26	24	20	18
@18 GHz	25.5	23	19	17
@23 GHz	25	23	19	17
Nominal minimum transmit power (dBm)				
@6 GHz	9			
@7 GHz	9			
@8 GHz	9			
@11 GHz	6			

Item	Performance			
	QPSK	16QAM/ 32QAM	64QAM/ 128QAM	256QAM
@13 GHz	3			
@15 GHz	3			
@18 GHz	2			
@23 GHz	2			
Nominal maximum receive power (dBm)	-20			-25
Frequency stability (ppm)	±5			

Transceiver Performance (Standard Power ODU)

Table 6-122 Transceiver Performance (SP ODU)

Item	Performance			
	QPSK	16QAM/ 32QAM	64QAM/ 128QAM	256QAM
Nominal maximum transmit power (dBm)				
@7 GHz	27	22.5	18.5	16.5
@8 GHz	27	22.5	18.5	16.5
@11 GHz	26	21.5	17.5	15.5
@13 GHz	26	21.5	17.5	15.5
@15 GHz	26	21.5	17.5	15.5
@18 GHz	25.5	21.5	17.5	15.5
@23 GHz	24	20.5	16.5	14.5
@26 GHz	23.5	19.5	15.5	13.5
@38 GHz	22	17.5	13.5	11.5
Nominal minimum transmit power (dBm)	-6			

Item	Performance			
	QPSK	16QAM/ 32QAM	64QAM/ 128QAM	256QAM
Nominal maximum receive power (dBm)	-20			-25
Frequency stability (ppm)	±5			

Table 6-123 Transceiver performance (SPA ODU)

Item	Performance			
	QPSK	16QAM/ 32QAM	64QAM/ 128QAM	256QAM
Nominal maximum transmit power (dBm)				
@6 GHz	26.5	24	23	21
@7 GHz	25.5	21.5	20	18
@8 GHz	25.5	21.5	20	18
@11 GHz	24.5	20.5	18	16
@13 GHz	24.5	20	18	16
@15 GHz	24.5	20	18	16
@18 GHz	22.5	19	17	15
@23 GHz	22.5	19	16	14
Nominal minimum transmit power (dBm)	0			
Nominal maximum receive power (dBm)	-20			-25
Frequency stability (ppm)	±5			

Transceiver Performance (Low Capacity ODU)

Table 6-124 Transceiver performance (LP ODU)

Item	Performance	
	QPSK	16QAM
Nominal maximum transmit power (dBm)		
@7 GHz	27	21
@8 GHz	27	21
@11 GHz	25	19
@13 GHz	25	19
@15 GHz	23.5	17.5
@18 GHz	23	17
@23 GHz	23	17
Nominal minimum transmit power (dBm)	0	
Nominal maximum receive power (dBm)	-20	
Frequency stability (ppm)	±5	

NOTE

For ODUs operating at a T/R spacing that is not an integer, for example, 311.32 MHz, 151.614 MHz, or 252.04 MHz, the frequency stability is not ±5 ppm but still meets requirements specified by the ETSI.

6.1.6 IF Performance

The IF performance includes the performance of the IF signal and the performance of the ODU O&M signal.

Table 6-125 IF performance

Item		Performance
IF signal	Transmit frequency of the IF board (MHz)	350
	Receive frequency of the IF board (MHz)	140
ODU O&M signal	Modulation scheme	ASK
	Transmit frequency of the IF board (MHz)	5.5
	Receive frequency of the IF board (MHz)	10

Item	Performance
Interface impedance (ohm)	50

6.1.7 Baseband Signal Processing Performance of the Modem

The baseband signal processing performance of the modem indicates the FEC coding scheme and the performance of the baseband time domain adaptive equalizer.

Table 6-126 Baseband signal processing performance of the modem

Item	Performance
Encoding mode	● IF1 – Reed-Solomon (RS) encoding for PDH signals – Trellis-coded modulation (TCM) and RS two-level encoding for SDH signals ● IFU2/IFX2/ISU2/ISX2/ISV3/ISM6 Low-density parity check code (LDPC) encoding.
Adaptive time-domain equalizer for baseband signals	Supported.

6.2 Predicted Equipment Reliability

Equipment reliability is measured by mean time between failures (MTBF), and predicated equipment reliability complies with the Telcordia SR-332 standard.

6.2.1 Predicted Component Reliability

The component reliability reflects the reliability of a single component.

Table 6-127 provides the predicted component reliability for the Integrated IP radio equipment with typical configuration.

Table 6-127 Predicted component reliability

Item	Performance		
	IDU		ODU
	1+0 Non-Protection Configuration	1+1 Protection Configuration	
MTBF (hour)	43.83×10^4	69.21×10^4	$\geqslant 48.18 \times 10^4$

Item	Performance		
	IDU		ODU
	1+0 Non-Protection Configuration	1+1 Protection Configuration	
MTBF (year)	50.04	79.01	≥55
MTTR (hour)	1	1	1
Availability	99.99977%	99.99986%	≥99.99979%

6.2.2 Predicted Link Reliability

The link reliability reflects the equipment reliability of a microwave hop and reflects the reliability of all the involved components.

Table 6-128 provides the predicted equipment reliability for a single Integrated IP radio hop with typical configuration.

Table 6-128 Predicted equipment reliability for a single hop of link

Item	Performance	
	1+0 Non-Protection Configuration	1+1 Protection Configuration
MTBF (hour)	$14.61x10^4$	$32.07x10^4$
MTBF (year)	16.67	36.61
MTTR (hour)	1	1
Availability	99.99932%	99.99969%

6.3 Interface Performance

This section describes the technical specifications of services and auxiliary interfaces.

6.3.1 SDH Interface Performance

The performance of the SDH optical interface is compliant with ITU-T G.957/G.825, and the performance of the electrical interface is compliant with ITU-T G.703.

STM-4 Optical Interface Performance

The performance of the STM-4 optical interface is compliant with ITU-T G.957. The following table provides the typical performance of the interface.

Table 6-129 STM-4 optical interface performance

Item	Performance		
Nominal bit rate (kbit/s)	622080		
Classification code	S-4.1	L-4.1	L-4.2
Fiber type	Single-mode fiber	Single-mode fiber	Single-mode fiber
Transmission distance (km)	15	40	80
Operating wavelength (nm)	1274 to 1356	1280 to 1335	1480 to 1580
Mean launched power (dBm)	-15 to -8	-3 to +2	-3 to +2
Minimum receiver sensitivity (dBm)	-28	-28	-28
Minimum overload (dBm)	-8	-8	-8
Minimum extinction ratio (dB)	8.2	10	10

NOTE

The OptiX RTN 980 uses SFP optical modules for providing optical interfaces. You can use different types of SFP optical modules to provide optical interfaces with different classification codes and transmission distances.

STM-1 Optical Interface Performance

The performance of the STM-1 optical interface is compliant with ITU-T G.957/G.825. The following table provides the typical performance of the interface.

Table 6-130 STM-1 optical interface performance (two-fiber bidirectional)

Item	Performance			
Nominal bit rate (kbit/s)	155520			
Classification code	Ie-1	S-1.1	L-1.1	L-1.2
Fiber type	Multi-mode fiber	Single-mode fiber	Single-mode fiber	Single-mode fiber
Transmission distance (km)	2	15	40	80
Operating wavelength (nm)	1270 to 1380	1261 to 1360	1263 to 1360	1480 to 1580
Mean launched power (dBm)	-19 to -14	-15 to -8	-5 to 0	-5 to 0

Item	Performance			
Receiver minimum sensitivity (dBm)	-30	-28	-34	-34
Minimum overload (dBm)	-14	-8	-10	-10
Minimum extinction ratio (dB)	10	8.2	10	10

NOTE

The OptiX RTN 980 uses SFP optical modules for providing optical interfaces. You can use different types of SFP optical modules to provide optical interfaces with different classification codes and transmission distances.

Table 6-131 STM-1 optical interface performance (single-fiber bidirectional)

Item	Performance			
Nominal bit rate (kbit/s)	155520			
Classification code	S-1.1-BX-D	S-1.1-BX-U	L-1.1-BX-D	L-1.1-BX-U
Fiber type	Single-mode fiber	Single-mode fiber	Single-mode fiber	Single-mode fiber
Transmission distance (km)	15	15	40	40
Nominal wavelength (nm)	Tx: 1550 Rx: 1310	Tx: 1310 Rx: 1550	Tx: 1550 Rx: 1310	Tx: 1310 Rx: 1550
Operating wavelength (nm)	Tx: 1480 to 1580 Rx: 1260 to 1360	Tx: 1260 to 1360 Rx: 1480 to 1580	Tx: 1480 to 1580 Rx: 1260 to 1360	Tx: 1260 to 1360 Rx: 1480 to 1580
Mean launched power (dBm)	-15 to -8	-15 to -8	-5 to 0	-5 to 0
Receiver minimum sensitivity (dBm)	-32	-32	-32	-32
Minimum overload (dBm)	-8	-8	-10	-10
Minimum extinction ratio (dB)	8.5	8.5	10	10

NOTE

The OptiX RTN 980 uses SFP optical modules for providing optical interfaces. You can use different types of SFP optical modules to provide optical interfaces with different classification codes and transmission distances.

STM-1 Electrical Interface Performance

The performance of the STM-1 electrical interface is compliant with ITU-T G.703. The following table provides the typical performance of the interface.

Table 6-132 STM-1 electrical interface performance

Item	Performance
Nominal bit rate (kbit/s)	155520
Code type	CMI
Wire pair in each transmission direction	One coaxial wire pair
Impedance (ohm)	75

NOTE

The OptiX RTN 980 uses SFP electrical modules to provide electrical interfaces.

6.3.2 E1 Interface Performance

The performance of the E1 interface is compliant with ITU-T G.703/G.823.

E1 Interface Performance

Table 6-133 E1 interface performance

Item	Performance	
Nominal bit rate (kbit/s)	2048	
Code pattern	HDB3	
Impedance (ohm)	75	120
Wire pair in each transmission direction	One coaxial wire pair	One symmetrical wire pair

6.3.3 Ethernet Interface Performance

Ethernet interface performance complies with IEEE 802.3.

GE Optical Interface Performance

The characteristics of GE optical interfaces comply with IEEE 802.3. **Table 6-134** to **Table 6-136** provide GE optical interface performance.

Table 6-134 GE optical interface performance(two-fiber bidirectional, short-distance transmission)

Item	Performance	
Classification code	**1000BASE-SX (0.5 km)**	**1000BASE-LX (10 km)**
Nominal wavelength (nm)	850	1310
Nominal bit rate (Mbit/s)	1000	
Fiber type	Multi-mode	Single-mode
Transmission distance (km)	0.5	10
Operating wavelength (nm)	770 to 860	1270 to 1355
Average optical output power (dBm)	-9 to -3	-9 to -3
Receiver sensitivity (dBm)	-17	-20
Overload (dBm)	0	-3
Extinction ratio (dB)	9.5	9.5

Table 6-135 GE optical interface performance (two-fiber bidirectional, long-haul transmission)

Item	Performance		
Classification code	**1000BASE-VX (40 km)**	**1000BASE-VX (40 km)**	**1000BASE-ZX (80 km)**
Nominal wavelength (nm)	1310	1550	1550
Nominal bit rate (Mbit/s)	1000	1000	1000
Fiber type	Single-mode	Single-mode	Single-mode
Transmission distance (km)	40	40	80
Operating wavelength (nm)	1270 to 1350	1480 to 1580	1500 to 1580
Average optical output power (dBm)	-5 to 0	-5 to 0	-2 to +5
Receiver sensitivity (dBm)	-23	-22	-22
Overload (dBm)	-3	-3	-3
Extinction ratio (dB)	9	9	9

Table 6-136 GE optical interface performance (single-fiber bidirectional)

Item	Performance			
	1000BASE-BX-D (10 km)	**1000BASE-BX-U (10km)**	**1000BASE-BX-D (40 km)**	**1000BASE-BX-U (40km)**
Nominal wavelength (nm)	Tx: 1490 Rx: 1310	Tx: 1310 Rx: 1490	Tx: 1490 Rx: 1310	Tx: 1310 Rx: 1490
Nominal bit rate (Mbit/s)	1000	1000	1000	1000
Fiber type	Single-mode	Single-mode	Single-mode	Single-mode
Transmission distance (km)	10	10	40	40
Operating wavelength (nm)	Tx: 1480 to 1500 Rx: 1260 to 1360	Tx: 1260 to 1360 Rx: 1480 to 1500	Tx: 1260 to 1360 Rx: 1480 to 1500	Tx: 1480 to 1500 Rx: 1260 to 1360
Average optical output power (dBm)	-9 to -3	-9 to -3	-3 to +3	-3 to +3
Receiver sensitivity (dBm)	-19.5	-19.5	-23	-23
Overload (dBm)	-3	-3	-3	-3
Extinction ratio (dB)	6	6	6	6

NOTE

The OptiX RTN 980 uses SFP modules to provide GE optical interfaces. Users can use different types of SFP modules to provide GE optical interfaces with different classification codes and transmission distances.

GE Electrical Interface Performance

The characteristics of GE electrical interfaces comply with IEEE 802.3. The following table provides GE electrical interface performance.

Table 6-137 GE electrical interface performance

Item	Performance
Nominal bit rate (Mbit/s)	10 (10BASE-T) 100 (100BASE-TX) 1000 (1000BASE-T)
Code pattern	Manchester encoding signal (10BASE-T) MLT-3 encoding signal (100BASE-TX) 4D-PAM5 encoding signal (1000BASE-T)

Item	Performance
Interface type	RJ45

10GE optical interface performance

The characteristics of 10GE optical interfaces comply with IEEE 802.3. **Table 6-138** to **Table 6-139** provide 10GE optical interface performance.

Table 6-138 10GE optical interface performance(two-fiber bidirectional)

Item	Performance			
Classification code	**10GBASE-SW** **10GBASE-SR**	**10GBASE-LW** **10GBASE-LR**	**10GBASE-EW** **10GBASE-ER**	**10GBASE-ZW** **10GBASE-ZR**
Nominal wavelength (nm)	850	1310	1550	1550
Fiber type	Multi-mode	Single-mode	Single-mode	Single-mode
Transmission distance (km)	0.3	10	40	80
Operating wavelength (nm)	840 to 860	1260 to 1355	1530 to 1565	1530 to 1565
Average optical output power (dBm)	–1.3 to -7.3	-8.2 to 0.5	-4.7 to 4	0 to 4
Receiver sensitivity (dBm)	–7.5	-12.6	-14.1	-21
Overload (dBm)	–1	0.5	-1	-7
Extinction ratio (dB)	3	3.5	3	3

Table 6-139 10GE optical interface performance (single-fiber bidirectional)

Item	Performance			
Classification code	**10GBASE-LW-D** **10GBASE-LR-D**	**10GBASE-LW-U** **10GBASE-LR-U**	**10GBASE-EW-D** **10GBASE-ER-D**	**10GBASE-EW-U** **10GBASE-ER-U**
Nominal wavelength (nm)	Tx: 1330 Rx: 1270	Tx: 1270 Rx: 1330	Tx: 1330 Rx: 1270	Tx: 1270 Rx: 1330
Fiber type	Single-mode	Single-mode	Single-mode	Single-mode
Transmission distance (km)	10	10	40	40
Operating wavelength (nm)	Tx: 1320 to 1340 Rx: 1260 to 1280	Tx: 1260 to 1360 Rx: 1480 to 1500	Tx: 1320 to 1340 Rx: 1260 to 1280	Tx: 1260 to 1360 Rx: 1480 to 1500
Average optical output power (dBm)	-5 to 0	-5 to 0	1 to 5	1 to 5
Receiver sensitivity (dBm)	-14	-14	-15	-15
Overload (dBm)	0.5	0.5	–3	–3
Extinction ratio (dB)	3.5	3.5	3.5	3.5

NOTE

The OptiX RTN 980 uses XFP modules to provide 10GE optical interfaces. Users can use different types of XFP modules to provide 10GE optical interfaces with different classification codes and transmission distances.

FE Optical Interface Performance

The characteristics of FE optical interfaces comply with IEEE 802.3. **Table 6-140** to **Table 6-141** provide FE optical interface performance.

Table 6-140 FE optical interface performance (two-fiber bidirectional)

Item	Performance			
	100BASE-FX (2 km)	**100BASE-LX (15 km)**	**100BASE-VX (40 km)**	**100BASE-ZX (80 km)**
Nominal wavelength (nm)	1310	1310	1310	1550
Nominal bit rate (Mbit/s)	100	100	100	100
Fiber type	Multi-mode	Single-mode	Single-mode	Single-mode
Transmission distance (km)	2	15	40	80
Operating wavelength (nm)	1270 to 1380	1261 to 1360	1263 to 1360	1480 to 1580

Item	Performance			
	100BASE-FX (2 km)	**100BASE-LX (15 km)**	**100BASE-VX (40 km)**	**100BASE-ZX (80 km)**
Average optical output power (dBm)	-19 to -14	-15 to -8	-5 to 0	-5 to 0
Receiver sensitivity (dBm)	-30	-28	-34	-34
Overload (dBm)	-14	-8	-10	-10
Extinction ratio (dB)	10	8.2	10	10.5

Table 6-141 FE optical interface performance (single-fiber bidirectional)

Item	Performance			
Classification code	**100BASE-BX-D (15 km)**	**100BASE-BX-U (15 km)**	**100BASE-BX-D (40 km)**	**100BASE-BX-U (40 km)**
Nominal wavelength (nm)	Tx: 1550 Rx: 1310	Tx: 1310 Rx: 1550	Tx: 1550 Rx: 1310	Tx: 1310 Rx: 1550
Nominal bit rate (Mbit/s)	100	100	100	100
Fiber type	Single-mode	Single-mode	Single-mode	Single-mode
Transmission distance (km)	15	15	40	40
Operating wavelength (nm)	Tx: 1480 to 1580 Rx: 1260 to 1360	Tx: 1260 to 1360 Rx: 1480 to 1580	Tx: 1480 to 1580 Rx: 1260 to 1360	Tx: 1260 to 1360 Rx: 1480 to 1580
Average optical output power (dBm)	-15 to -8	-15 to -8	-5 to 0	-5 to 0
Receiver sensitivity (dBm)	-32	-32	-32	-32
Overload (dBm)	-8	-8	-10	-10
Extinction ratio (dB)	8.5	8.5	10	10

NOTE

The OptiX RTN 980 uses SFP modules to provide FE optical interfaces. Users can use different types of SFP modules to provide FE optical interfaces with different classification codes and transmission distances.

FE Electrical Interface Performance

The characteristics of FE interfaces comply with IEEE 802.3. The following table provides FE electrical interface performance.

Table 6-142 FE electrical interface performance

Item	Performance
Nominal bit rate (Mbit/s)	10 (10BASE-T) 100 (100BASE-TX)
Code pattern	Manchester encoding signal (10BASE-T) MLT-3 encoding signal (100BASE-TX)
Interface type	RJ45

6.3.4 Auxiliary Interface Performance

The auxiliary interface performance includes the performance of the orderwire interface, synchronous data interface, asynchronous data interface, and wayside service interface.

Orderwire Interface Performance

Table 6-143 Orderwire interface performance

Item	Performance
Transmission path	Uses the E1 and E2 bytes in the SDH overhead or the Huawei-defined byte in the overhead of the microwave frame.
Orderwire type	Addressing call
Wire pair in each transmission direction	One symmetrical wire pair
Impedance (ohm)	600

NOTE

The OptiX RTN equipment also supports the orderwire group call function. For example, when OptiX RTN equipment calls 888, the orderwire group call number, all the OptiX RTN equipment orderwire phones in the orderwire subnet ring until a phone is answered. Then, a point-to-point orderwire phone call is established.

Synchronous Data Interface Performance

Table 6-144 Synchronous data interface performance

Item	Performance
Transmission path	Uses the F1 byte in the SDH overhead or the Huawei-defined byte in the overhead of the microwave frame.
Nominal bit rate (kbit/s)	64

Item	Performance
Interface type	Codirectional
Interface characteristics	Meets the ITU-T G.703 standard.

Asynchronous Data Interface

Table 6-145 Asynchronous data interface performance

Item	Performance
Transmission path	Uses the user-defined byte of the SDH overhead or the Huawei-defined byte in the overhead of the microwave frame.
Nominal bit rate (kbit/s)	≤ 19.2
Interface characteristics	Meets the RS-232 standard.

Wayside Service Interface Performance

Table 6-146 Wayside service interface performance

Item	Performance
Transmission path	Uses the Huawei-defined bytes in the overhead of the microwave frame.
Nominal bit rate (kbit/s)	2048
Impedance (ohm)	120
Interface characteristics	Meets the ITU-T G.703 standard.

6.4 Clock Timing and Synchronization Performance

The clock timing performance and synchronization performance of the product meet relevant ITU-T recommendations.

Table 6-147 Clock timing and synchronization performance

Item	Performance
External synchronization source	2048 kbit/s (compliant with ITU-T G.703 §9), or 2048 kHz (compliant with ITU-T G.703 §13)
Frequency accuracy	Compliant with ITU-T G.813

Item	Performance
Pull-in and pull-out ranges	
Noise generation	
Noise tolerance	
Noise transfer	
Transient response and holdover performance	

6.5 Integrated System Performance

Integrated system performance includes the dimensions, weight, power consumption, power supply, EMC, surge protection, safety, and environment.

Dimensions

Table 6-148 Dimensions

Component	Dimensions (W x H x D)
IDU	442 mm x 225 mm x 220 mm
ODU	< 280 mm x 280 mm x 92 mm

Weight

Table 6-149 Typical weight

Component	Typical Weight
IDU	19.7 kg (8×[1+0] configuration)
ODU	< 4.6 kg

Power Consumption

Table 6-150 Typical power consumption

Radio Link Form	Service Interface and RF Configuration	Typical Power Consumption (IDU+ODU)
Intergrade IP radio link	4xSTM-1/4 + 6xGE + 4xFE + 32xE1, 8×[1+0] configuration (2xCSHN + 8xISU2 + 1xEM6T + 1xSP3D + 1xFAN + 2xPIU + 8xXMC-2 ODU)	470 W

Power Supply

Table 6-151 Power Supply

Component	Performance
IDU	● Compliant with ETSI EN300 132-2 ● Supports two -48 V/-60 V (-38.4 V to -72 V) DC power inputs (mutual backup) ● Supports the 1+1 backup of the 3.3 V power units.
ODU	● Compliant with ETSI EN300 132-2 ● Supports one -48 V DC power input that is provided by the IDU

Electromagnetic Compatibility

- Passes CE authentication.
- Compliant with ETSI EN 301 489-1.
- Compliant with ETSI EN 301 489-4.
- Compliant with CISPR 22.
- Compliant with EN 55022.

Lightning Protection

- Compliant with ITU-T K.27.
- Compliant with ETSI EN 300 253.

Safety

- Passes CE authentication.
- Compliant with ETSI EN 60215.
- Compliant with ETSI EN 60950.

- Compliant with IEC 60825.

Environment

The IDU is used in a place that has weather protection and where the temperature can be controlled. The ODU is an outdoor unit.

Table 6-152 Environment performance

Item		Component	
		IDU	ODU
Major reference standards	Operation	Compliant with ETSI EN 300 019-1-3 class 3.2	Compliant with ETSI EN 300 019-1-4 class 4.1
	Transportation	Compliant with ETSI EN 300 019-1-2 class 2.3	
	Storage	Compliant with ETSI EN 300 019-1-1 class 1.2	
Air temperature	Operation	Long-term: -5°C to +60°C Short-term: -20°C to +65°C	-35°C to +55°C
	Transportation and storage	-40°C to +70°C	
Relative humidity		5% to 95%	5% to 100%
Noise		< 7.2 bel, compliant with ETSI EN 300 753 class 3.2 attended	-
Earthquake		Compliant with Bellcore GR-63-CORE ZONE 4	
Mechanical stress		Compliant with ETSI EN 300 019	

A Typical Configuration

This topic introduces equipment configuration in typical scenarios.

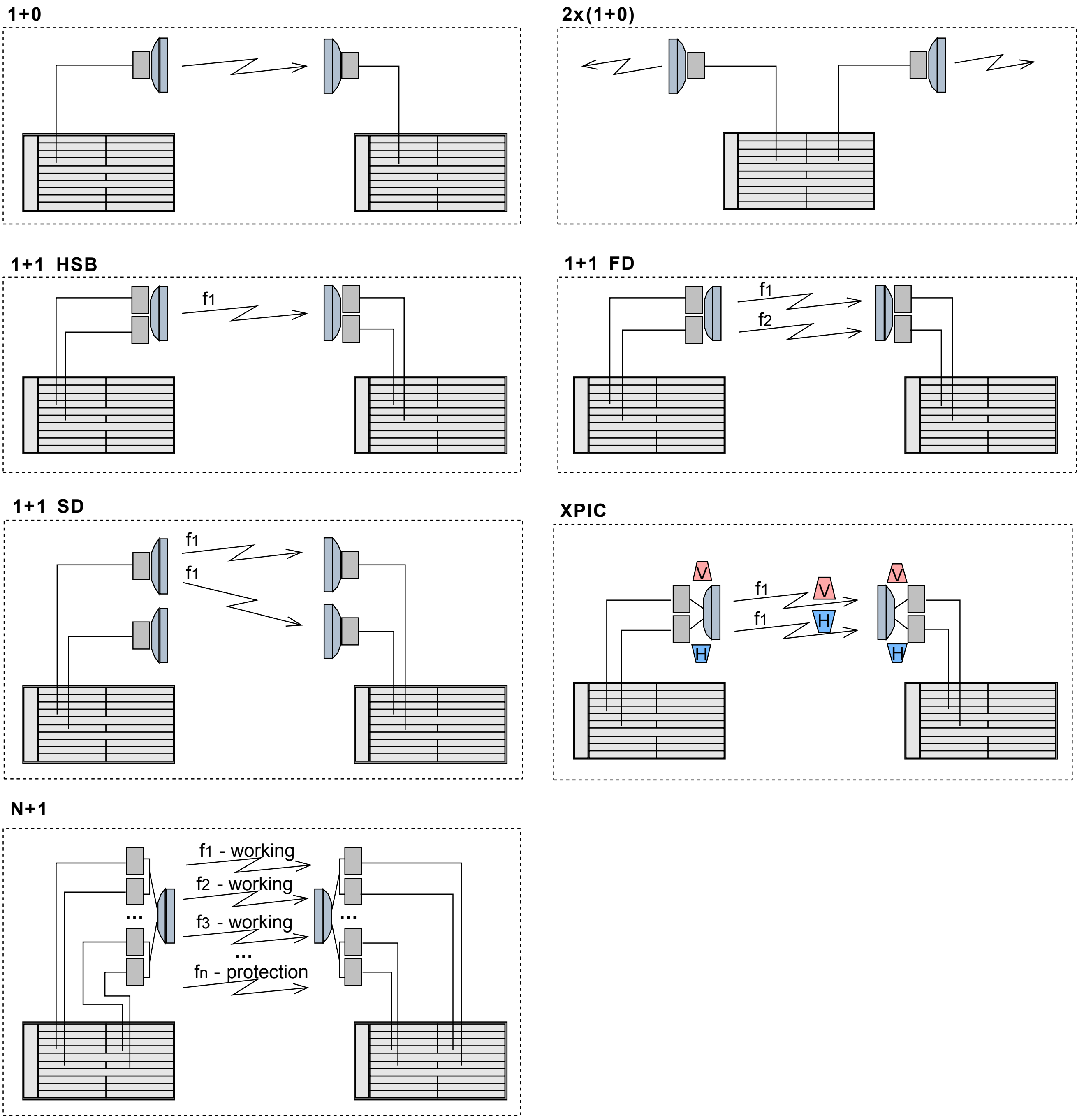
A.1 Typical RF Configuration Modes
This topic provides an overview of the typical configuration modes of RF links of the OptiX RTN 980.

A.1 Typical RF Configuration Modes

This topic provides an overview of the typical configuration modes of RF links of the OptiX RTN 980.

Figure A-1 shows typical RF configuration modes. In practice, configurations are flexible.

Figure A-1 Typical RF configuration modes



B Compliance Standards

B.1 ITU-R Standards

The OptiX RTN 980 complies with the ITU-R standards designed for microwave equipment.

Table B-1 ITU-R standard

Standard	Description
ITU-R F.383-8	Radio-frequency channel arrangements for high capacity radio-relay systems operating in the lower 6 GHz band
ITU-R F.384-10	Radio-frequency channel arrangements for medium and high capacity analogue or digital radio-relay systems operating in the upper 6 GHz band
ITU-R F.385-9	Radio-frequency channel arrangements for fixed wireless systems operating in the 7 GHz band
ITU-R F.386-8	Radio-frequency channel arrangements for medium and high capacity analogue or digital radio-relay systems operating in the 8 GHz band
ITU-R F.387-10	Radio-frequency channel arrangements for radio-relay systems operating in the 11 GHz band
ITU-R F.497-7	Radio-frequency channel arrangements for radio-relay systems operating in the 13 GHz frequency band
ITU-R F.595-9	Radio-frequency channel arrangements for fixed wireless systems operating in the 18 GHz frequency band
ITU-R F.636-3	Radio-frequency channel arrangements for radio-relay systems operating in the 15 GHz band
ITU-R F.637-3	Radio-frequency channel arrangements for radio-relay systems operating in the 23 GHz band
ITU-R F.747	Radio-frequency channel arrangements for fixed wireless systems operating in the 10 GHz band
ITU-R F.748-4	Radio-frequency channel arrangements for radio-relay systems operating in the 25, 26 and 28 GHz bands
ITU-R F.749-2	Radio-frequency arrangements for systems of the fixed service operating in the 38 GHz band
ITU-R F.1191-1-2	Bandwidths and unwanted emissions of digital radio-relay systems
ITU-R F.1520-2	Radio-frequency channel arrangements for systems in the fixed service operating in the band 31.8-33.4 GHz
ITU-R P.530-12	Propagation data and prediction methods required for the design of terrestrial line-of-sight systems
ITU-R P.453-9	The radio refractive index: its formula and refractivity data

Standard	Description
ITU-R P.525-2	Calculation of free-space attenuation
ITU-R P.837-5	Characteristics of precipitation for propagation modelling
ITU-R P.838-3	Specific attenuation model for rain for use in prediction methods
ITU-R F.1093	Effects of multipath propagation on the design and operation of line-of-sight digital fixed wireless systems
ITU-R F.1101	Characteristics of digital fixed wireless systems below about 17 GHz
ITU-R F.1102	Characteristics of fixed wireless systems operating in frequency bands above about 17 GHz
ITU-R F.1330	Performance limits for bringing into service the parts of international plesiochronous digital hierarchy and synchronous digital hierarchy paths and sections implemented by digital fixed wireless systems
ITU-R F.1605	Error performance and availability estimation for synchronous digital hierarchy terrestrial fixed wireless systems
ITU-R F.1668	Error performance objectives for real digital fixed wireless links used in 27 500 km hypothetical reference paths and connections
ITU-R F.1703	Availability objectives for real digital fixed wireless links used in 27 500 km hypothetical reference paths and connections
ITU-R F.592	Vocabulary of terms for the fixed service
ITU-R F.746	Radio-frequency arrangements for fixed service systems
ITU-R F.750	Architectures and functional aspects of radio-relay systems for synchronous digital hierarchy (SDH)-based network
ITU-R F.751	Transmission characteristics and performance requirements of radio-relay systems for SDH-based networks
ITU-R F.556	Hypothetical reference digital path for radio-relay systems which may form part of an integrated services digital network with a capacity above the second hierarchical level
ITU-R SM.329-10	Unwanted emissions in the spurious domain

B.2 ETSI Standards

The OptiX RTN 980 complies with the ETSI standards designed for microwave equipment.

Table B-2 ETSI standard

Standard	Description
ETSI EN 302 217-1 V1.3.1	Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 1: Overview and system-independent common characteristics
ETSI EN 302 217-2-1 V1.3.1	Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 2-1: System-dependent requirements for digital systems operating in frequency bands where frequency co-ordination is applied
ETSI EN 302 217-2-2 V1.3.1	Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 2-2: Harmonized EN covering essential requirements of Article 3.2 of R&TTE Directive for digital systems operating in frequency bands where frequency co-ordination is applied
ETSI EN 302 217-3 V1.2.1	Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 3: Harmonized EN covering essential requirements of Article 3.2 of R&TTE Directive for equipment operating in frequency bands where no frequency co-ordination is applied
ETSI EN 302 217-4-1 V1.4.1	Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 4-1: System-dependent requirements for antennas
ETSI EN 302 217-4-2 V1.5.1	Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 4-2: Harmonized EN covering essential requirements of Article 3.2 of R&TTE Directive for antennas
ETSI EN 301 126-1 V1.1.2	Fixed Radio Systems; Conformance testing; Part 1: Point-to-Point equipment - Definitions, general requirements and test procedures
ETSI EN 301 126-3-1 V1.1.2	Fixed Radio Systems; Conformance testing; Part 3-1: Point-to-Point antennas; Definitions, general requirements and test procedures
ETSI EN 301 390 V1.2.1	Fixed Radio Systems; Point-to-point and Multipoint Systems; Spurious emissions and receiver immunity limits at equipment/ antenna port of Digital Fixed Radio Systems

B.3 IEC Standards

The OptiX RTN 980 is compliant with the IEC standards related to the waveguide.

Table B-3 Relevant IEC standards

Standard	Description
IEC 60154-1	Flanges for waveguides. Part 1: General requirements
IEC 60154-2	Flanges for waveguides. Part 2: Relevant specifications for flanges for ordinary rectangular waveguides
IEC 60154-3	Flanges for waveguides. Part 3: Relevant specifications for flanges for flat rectangular waveguides
IEC 60154-4	Flanges for waveguides. Part 4: Relevant specifications for flanges for circular waveguides
IEC 60154-6	Flanges for waveguides. Part 6: Relevant specifications for flanges for medium flat rectangular waveguides
IEC 60154-7	Flanges for waveguides - Part 7: Relevant specifications for flanges for square waveguides
IEC 60153-1	Hollow metallic waveguides. Part 1: General requirements and measuring methods
IEC 60153-2	Hollow metallic waveguides. Part 2: Relevant specifications for ordinary rectangular waveguides
IEC 60153-3	Hollow metallic waveguides. Part 3: Relevant specifications for flat rectangular waveguides
IEC 60153-4	Hollow metallic waveguides. Part 4: Relevant specifications for circular waveguides
IEC 60153-6	Hollow metallic waveguides. Part 6: Relevant specifications for medium flat rectangular waveguides
IEC 60153-7	Hollow metallic waveguides. Part 7: Relevant specifications for square waveguides

B.4 ITU-T Standards

The OptiX RTN 980 complies with the ITU-T standards designed for SDH/PDH equipment.

Table B-4 ITU-T standard

Standard	Description
ITU-T G.664	Optical safety procedures and requirements for optical transport systems
ITU-T G.702	Digital hierarchy bit rates
ITU-T G.703	Physical/electrical characteristics of hierarchical digital interfaces

Standard	Description
ITU-T G.704	Synchronous frame structures used at 1544, 6312, 2048, 8448 and 44,736 kbit/s hierarchical levels
ITU-T G.706	Frame alignment and cyclic redundancy check (CRC) procedures relating to basic frame structures defined in Recommendation G.704
ITU-T G.707	Network node interface for the synchronous digital hierarchy (SDH)
ITU-T G.773	Protocol suites for Q-interfaces for management of transmission systems
ITU-T G.774	Synchronous digital hierarchy (SDH) management information model for the network element view
ITU-T G.774.1	Synchronous Digital Hierarch y(SDH) performance monitoring for the network element view
ITU-T G.774.2	Synchronous digital hierarchy (SDH) configuration of the payload structure for the network element view
ITU-T G.774.3	Synchronous digital hierarchy (SDH) management of multiplex-section protection for the network element view
ITU-T G.774.4	Synchronous digital hierarchy (SDH) management of the sub-network connection protection for the network element view
ITU-T G.774.5	Synchronous digital hierarchy (SDH) management of connection supervision functionality(HCS/LCS) for the network element view
ITU-T G.774.6	Synchronous digital hierarchy (SDH) unidirectional performance monitoring for the network element view
ITU-T G.774.7	Synchronous digital hierarchy (SDH) management of lower order path trace and interface labeling for the network element view
ITU-T G.774.9	Synchronous digital hierarchy (SDH) configuration of linear multiplex section protection for the network element view
ITU-T G.774.10	Synchronous digital hierarchy (SDH) configuration of linear multiplex section protection for the network element view
ITU-T G.775	Loss of Signal (LOS), Alarm Indication Signal (AIS) and Remote Defect Indication (RDI) defect detection and clearance criteria for PDH signals
ITU-T G.7710	Common equipment management function requirements
ITU-T G.780	Vocabulary of terms for synchronous digital hierarchy (SDH) networks and equipment
ITU-T G.781	Synchronization layer functions
ITU-T G.783	Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks

Standard	Description
ITU-T G.784	Synchronous digital hierarchy (SDH) management
ITU-T G.803	Architecture of transport networks based on the synchronous digital hierarchy (SDH)
ITU-T G.805	Generic functional architecture of transport networks
ITU-T G.806	Characteristics of transport equipment - Description methodology and generic functionality
ITU-T G.808.1	Generic protection switching - Linear trail and sub-network protection
ITU-T G.810	Definitions and terminology for synchronization networks
ITU-T G.811	Timing characteristics of primary reference clocks
ITU-T G.812	Timing requirements of slave clocks suitable for use as node clocks in synchronization networks
ITU-T G.813	Timing characteristics of SDH equipment slave clocks (SEC)
ITU-T G.821	Error performance of an international digital connection operating at a bit rate below the primary rate and forming part of an integrated services digital network
ITU-T G.822	Controlled slip rate objectives on an international digital connection
ITU-T G.823	The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy
ITU-T G.825	The control of jitter and wander within digital networks which are based on the synchronous digital hierarchy (SDH)
ITU-T G.826	Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate
ITU-T G.828	Error performance parameters and objectives for international, constant bit rate synchronous digital paths
ITU-T G.829	Error performance events for SDH multiplex and regenerator sections
ITU-T G.831	Management capabilities of transport networks based on the synchronous digital hierarchy (SDH)
ITU-T G.832	Transport of SDH elements on PDH networks - Frame and multiplexing structures
ITU-T G.841	Types and characteristics of SDH network protection architectures
ITU-T G.842	Inter-working of SDH network protection architectures
ITU-T G.957	Optical interfaces for equipments and systems relating to the synchronous digital hierarchy

Standard	Description
ITU-T G.958	Digital line systems based on the synchronous digital hierarchy for use on optical fiber cables.
ITU-T G.7043/Y. 1343	Virtual concatenation of Plesiochronous Digital Hierarchy (PDH) signals
ITU-T G.8010	Architecture of Ethernet layer networks
ITU-T G.8011	Ethernet over Transport - Ethernet services framework
ITU-T G.8011.1	Ethernet private line service
ITU-T G.8011.2	Ethernet virtual private line service
ITU-T G.8012	Ethernet UNI and Ethernet over transport NNI
ITU-T G.8021	Characteristics of Ethernet transport network equipment functional blocks
ITU-T G.8110	MPLS layer network architecture
ITU-T G.8110.1	Application of MPLS in the transport network
ITU-T G.8121	Characteristics of transport MPLS equipment functional blocks
ITU-T G.8112	Interfaces for the transport MPLS (T-MPLS) hierarchy
ITU-T G.8113.1	Operations, Administration and Maintenance mechanism for MPLS-TP networks
ITU-T G.8131	Protection switching for transport MPLS (T-MPLS) networks
ITU-T G.8261/Y. 1361	Timing and synchronization aspects in packet networks
ITU-T G.8262/Y. 1362	Timing characteristics of synchronous Ethernet equipment slave clock (EEC)
ITU-T G.8264	Timing distribution through packet networks
ITU-T Y.1541	Network performance objectives for IP-based services
ITU-T Y.1710	Requirements for OAM functionality for MPLS networks
ITU-T Y.1730	Requirements for OAM functions in Ethernet based networks and Ethernet services
ITU-T Y.1731	OAM functions and mechanisms for Ethernet based networks
ITU-T G.8032/Y. 1344	Ethernet Ring Protection Switching
ITU-T Y.1711	Operation & Maintenance mechanism for MPLS networks
ITU-T Y.1720	Protection switching for MPLS networks
ITU-T I.610	B-ISDN operation and maintenance principles and functions

Standard	Description
ITU-T Y.1291	An architectural framework for support of quality of service (QoS) in packet networks

B.5 IETF Standards

The OptiX RTN 980 complies with IETF standards.

Table B-5 IETF standard

Standard	Description
RFC 2819	Remote Network Monitoring Management Information Base
RFC 4664	Framework for layer 2 virtual private networks (L2VPNs)
RFC 3031	MPLS architecture
RFC 3469	Framework for multi-protocol label switching (MPLS)-based recovery
RFC 3811	Definitions of textual conventions for multiprotocol label switching (MPLS) management
RFC 3813	Multiprotocol label switching (MPLS) label switching router (LSR) management information base
RFC 3814	Multiprotocol label switching (MPLS) forwarding equivalence class to next hop label forwarding entry (FEC-To-NHLFE) management information base
RFC 4221	Multiprotocol label switching (MPLS) management overview
RFC 4377	Operations and management (OAM) requirements for multi-protocol label switched (MPLS) networks
RFC 4378	A framework for multi-protocol label switching (MPLS) operations and management (OAM)
RFC 3032	MPLS label stack encoding
RFC 3443	Time to live (TTL) processing in multi-protocol label switching (MPLS) networks
RFC 3916	Requirements for pseudo-wire emulation edge-to-edge (PWE3)
RFC 3985	Pseudo wire emulation edge-to-edge (PWE3) architecture
RFC 4197	Requirements for edge-to-edge emulation of time division multiplexed (TDM) circuits over packet switching networks
RFC 4385	Pseudowire emulation edge-to-edge (PWE3) control word for use over an MPLS PSN

Standard	Description
RFC 4446	IANA allocations for pseudowire edge to edge emulation (PWE3)
RFC 0826	Ethernet address resolution protocol
RFC 3270	Multi-protocol label switching (MPLS) support of differentiated services
RFC 4448	Encapsulation methods for transport of Ethernet over MPLS networks
RFC 4553	Structure-agnostic time division multiplexing (TDM) over packet (SAToP)
RFC 5085	Pseudo wire virtual circuit connectivity verification (VCCV)
RFC 5086	Structure-Aware Time Division Multiplexed (TDM) Circuit Emulation Service over Packet Switched Network (CESoPSN)
RFC 4717	Encapsulation Methods for Transport of Asynchronous Transfer Mode (ATM) over MPLS Networks
RFC 4816	Pseudowire Emulation Edge-to-Edge (PWE3) Asynchronous Transfer Mode (ATM) Transparent Cell Transport Service
RFC 4385	Pseudowire emulation edge-to-edge (PWE3) control word for use over an MPLS PSN
RFC 5254	Requirements for Multi-Segment Pseudowire Emulation Edge-to-Edge (PWE3)
RFC 3644	Policy quality of service (QoS) Information model
RFC 2212	Specification of guaranteed quality of service
RFC 2474	Definition of the differentiated services field (DS Field) in the IPv4 and IPv6 headers
RFC 2475	An architecture for differentiated services
RFC 2597	Assured forwarding PHB group
RFC 2698	A two rate three color marker
RFC 3246	An expedited forwarding PHB (Per-hop behavior)
RFC 3270	Multi-protocol label switching (MPLS) support of differentiated services
draft-ietf-l2vpn-oam-req-frmk-05	L2VPN OAM requirements and framework
draft-ietf-pwe3-segmented-pw-03	Segmented pseudo wire
draft-ietf-pwe3-ms-pw-requirements-03	Requirements for inter domain pseudo-wires

Standard	Description
draft-ietf-pwe3-ms-pw-arch-02	An architecture for multi-segment pseudo wire emulation edge-to-edge
RFC1661	The Point-to-Point Protocol (PPP)
RFC1662	PPP in HDLC-like Framing
RFC1990	The PPP Multilink Protocol (MP)
RFC2686	The Multi-Class Extension to Multi-Link PPP
RFC5317	Joint Working Team (JWT) Report on MPLS Architectural Considerations for a Transport Profile
RFC5586	MPLS Generic Associated Channel
RFC5654	Requirements of an MPLS Transport Profile
RFC5921	A Framework for MPLS in Transport Networks
RFC5860	Requirements for Operations, Administration, and Maintenance (OAM) in MPLS Transport Networks

B.6 IEEE Standards

The OptiX RTN 980 complies with the IEEE standards designed for Ethernet networks.

Table B-6 IEEE standard

Standard	Description
IEEE 802.3	Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specification
IEEE 802.3u	Media Access Control (MAC) parameters, physical Layer, medium attachment units, and repeater for 100 Mb/s operation, type 100BASE-T
IEEE 802.3x	Full Duplex Operation and Type 100BASE-T2
IEEE 802.3z	Media Access Control (MAC) parameters, physical Layer, repeater and management parameters for 1000 Mb/s operation
IEEE 802.3ah	Media Access Control Parameters, Physical Layers, and Management Parameters for Subscriber Access Networks
IEEE 802.1d	Media Access Control (MAC) Bridges
IEEE 802.1q	Virtual bridged local area networks
IEEE 802.1ad	Virtual Bridged Local Area Networks Amendment 4: Provider Bridges

Standard	Description
IEEE 802.1ag	Virtual Bridged Local Area Networks — Amendment 5: Connectivity Fault Management
IEEE 1588v2	IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems
IEEE 802.3af	Data Terminal Equipment (DTE) Power Via Media Dependent Interface (MDI)
IEEE 802.3at	Data Terminal Equipment (DTE) Power via the Media Dependent Interface (MDI) Enhancements

B.7 MEF Standards

The OptiX RTN 980 complies with MEF standards.

Table B-7 MEF standard

Standard	Description
MEF 2	Requirements and framework for Ethernet service protection in metro Ethernet networks
MEF 4	Metro Ethernet network architecture framework - Part 1: generic framework
MEF 9	Abstract Test Suite for Ethernet Services at the UNI
MEF 10	Ethernet services attributes phase 1
MEF 14	Abstract Test Suite for Traffic Management Phase 1
MEF 17	Service OAM Framework and Requirements
MEF 18	Abstract Test Suite for Circuit Emulation Services
MEF 21	Abstract Test Suite for UNI Type 2 Part 1: Link OAM
MEF 22	Mobile Backhaul Implementation Agreement Phase 1

B.8 AF Standards

The OptiX RTN 980 complies with AF standards.

Table B-8 AF standard

Standard	Description
AF-PHY-0086.001	Inverse Multiplexing for ATM Specification Version 1.1
AF-TM-0121.000	Traffic Management Specification

B.9 Environmental Standards

The OptiX RTN 980 complies with the environmental standards designed for split-mount microwave equipment.

Table B-9 environmental standard

Standard	Description
EN 55022	Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipment
CISPR 22	Limits and methods of measurement of radio disturbance characteristics of information
ETSI EN 301 489-1	Electromagnetic compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements
ETSI EN 301 489-4	Electromagnetic compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 4: Specific conditions for fixed radio links and ancillary equipment and services
EN 60950-1	Information technology equipment-Safety-Part 1: General requirements
UL 60950-1	Information technology equipment-Safety-Part 1: General requirements
IEC 60825-1	Safety of laser products-Part 1: Equipment classification, requirements and user's guide
IEC 60825-2	Safety of laser products-Part 2: Safety of optical fiber communication systems (OFCS)
IEC 60950-1	Information technology equipment-Safety-Part 1: General requirements
IEC 60950-22 (Outdoor Unit)	Information technology equipment-Safety-Part 22: Equipment to be installed outdoors
IEC 61000-4-2	Electromagnetic compatibility (EMC) Part 2: Testing and measurement techniques Section 2: Electrostatic discharge immunity test Basic EMC Publication

Standard	Description
IEC 61000-4-3	Electromagnetic compatibility; Part 3: Testing and measurement techniques Section 3 radio frequency electromagnetic fields; immunity test.
IEC 61000-4-4	Electromagnetic compatibility (EMC) Part 4: Testing and measurement techniques Section 4: Electrical fast transient/burst immunity test Basic EMC publication
IEC 61000-4-5	Electromagnetic compatibility (EMC) Part 5: Testing and measurement techniques Section 5: Surge immunity test
IEC 61000-4-6	Electromagnetic compatibility: Part 6: Testing and measurement techniques: Section 6 conducted disturbances induced by radio-frequency fields; immunity test
IEC 721-3-1 Classes 1K4/1Z2/1Z3/1Z5/1B2/1C2/1S3/1M2	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 1: Storage Classes 1K4/1Z2/1Z3/1Z5/1B2/1C2/1S3/1M2
IEC 721-3-2 Classes 2K4/2B2/2C2/2S2/2M2	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 2: Transportation Classes 2K4/2B2/2C2/2S2/2M2
IEC 721-3-3 Classes 3K5/3Z2/3Z4/3B2/3C2(3C1)/3S2/3M2 (Indoor Unit)	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 3: Stationary use at weather protected locations Classes 3K5/3Z2/3Z4/3B2/3C2(3C1)/3S2/3M2
IEC 721-3-4 Classes 4K2/4Z5/4Z7/4B1/4C2(4C3)/4S2/4M5 (Outdoor Unit)	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 4: Stationary use at non-weather protected locations. Classes 4K2/4Z5/4Z7/4B1/4C2(4C3)/4S2/4M5
ETSI EN 300 019-1-1 Class 1.2	Environmental conditions and environmental tests for telecommunications equipment; Part 1-1: Classification of environmental conditions; Storage Class 1.2
ETSI EN 300 019-1-2 Class 2.3	Environmental conditions and environmental tests for telecommunications equipment; Part 1-2: Classification of environmental conditions; Transportation Class 2.3
ETSI EN 300 019-1-3 Class 3.2 (Indoor Unit)	Environmental conditions and environmental tests for telecommunications equipment; Part 1-3: Classification of environmental conditions; Stationary use at weather-protected locations; Class 3.2
ETSI EN 300 019-1-4 Class 4.1 (Outdoor Unit)	Environmental conditions and environmental tests for telecommunications equipment; Part 1-4: Classification of environmental conditions; Stationary use at non-weather-protected locations Class 4.1

Standard	Description
EN 300 132-2	Environmental Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 2: Operated by direct current (dc)
EN 300 119	Environmental Engineering (EE); European telecommunication standard for equipment practice;
TR 102 489 V1.1.1	Thermal Management Guidance for equipment and its deployment
ETS 300 753	Equipment Engineering (EE); Acoustic noise emitted by telecommunications equipment
IEC 60215	Safety requirements for radio transmitting equipment
IEC 60825	Safety of laser products
IEC 60657	Non-ionizing radiation hazards in the frequency range from 10 MHz to 300 000 MHz
IEC 60297	Dimensions of mechanical structures of the 482.6 mm (19 in) series
IEC 60529	Degrees of protection provided by enclosures
IEC 60068	Environmental Testing
EN 61000-3-2	Electromagnetic compatibility (EMC) -Part 3-2: Limits -Limits for harmonic current emissions (equipment input current< 16 A per phase)
EN 61000-3-3	Electromagnetic compatibility (EMC) -Part 3-3: Limits -Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current < - 16 A per phase and not subject to conditional connection
EN 50383	Basic standard for the calculation and measurement of electromagnetic field strength and SAR related to human exposure from radio base stations and fixed terminal stations for wireless telecommunications system (110 MHz - 40 GHz)
EN 50385	Product standard to demonstrate the compliances of radio base stations and fixed terminal stations for wireless telecommunication systems with the basic restrictions or the reference levels related to human exposure to ratio frequency electromagnetic fields (110MHz-40GHz) -General public
IEC 68-2-2	Environmental testing: Dry heat.
IEC 68-2-14	Environmental testing: Change of temperature.
IEC 68-2-30	Environmental testing: Damp heat, cyclic: (12 + 12 hour cycle).

C Glossary

Numerics

3G	See **3rd Generation.**
3GPP	3rd Generation Partnership Project
3rd Generation (3G)	The third generation of digital wireless technology, as defined by the International Telecommunications Union (ITU). Third generation technology is expected to deliver data transmission speeds between 144 kbit/s and 2 Mbit/s, compared to the 9.6 kbit/s to 19.2 kbit/s offered by second generation technology.
802.1Q in 802.1Q (QinQ)	A VLAN feature that allows the equipment to add a VLAN tag to a tagged frame. The implementation of QinQ is to add a public VLAN tag to a frame with a private VLAN tag to allow the frame with double VLAN tags to be transmitted over the service provider's backbone network based on the public VLAN tag. This provides a layer 2 VPN tunnel for customers and enables transparent transmission of packets over private VLANs.

A

A/D	analog/digit
ABR	See **available bit rate.**
ACAP	See **adjacent channel alternate polarization.**
ACL	See **access control list.**
ADC	analog to digital converter
ADM	add/drop multiplexer
AF	See **assured forwarding.**
AIS	alarm indication signal
ALS	See **automatic laser shutdown.**
AM	See **adaptive modulation.**
APS	automatic protection switching
ARP	See **Address Resolution Protocol.**

ASBR	See **autonomous system boundary router.**
ASIC	See **application-specific integrated circuit.**
ATM	asynchronous transfer mode
ATPC	See **automatic transmit power control.**
AU	See **administrative unit.**
Address Resolution Protocol (ARP)	An Internet Protocol used to map IP addresses to MAC addresses. The ARP protocol enables hosts and routers to determine link layer addresses through ARP requests and responses. The address resolution is a process by which the host converts the target IP address into a target MAC address before transmitting a frame. The basic function of ARP is to use the target equipment's IP address to query its MAC address.
access control list (ACL)	A list of entities, together with their access rights, which are authorized to access a resource.
adaptive modulation (AM)	A technology that is used to automatically adjust the modulation mode according to the channel quality. When the channel quality is favorable, the equipment uses a high-efficiency modulation mode to improve the transmission efficiency and the spectrum utilization of the system. When the channel quality is degraded, the equipment uses the low-efficiency modulation mode to improve the anti-interference capability of the link that carries high-priority services.
adjacent channel alternate polarization (ACAP)	A channel configuration method, which uses two adjacent channels (a horizontal polarization wave and a vertical polarization wave) to transmit two signals.
administrative unit (AU)	The information structure that enables adaptation between the higher order path layer and the multiplex section layer. The administrative unit consists of an information payload (the higher order VC) and an AU pointer, which indicates the offset of the payload frame start relative to the multiplex section frame start.
alarm suppression	A method to suppress alarms for the alarm management purpose. Alarms that are suppressed are no longer reported from NEs.
analog signal	A signal in which information is represented with a continuously variable physical quantity, such as voltage. Because of this constant changing of the wave shape with regard to its passing a given point in time or space, an analog signal might have a virtually indefinite number of states or values. This contrasts with a digital signal that is expressed as a square wave and therefore has a very limited number of discrete states. Analog signals, with complicated structures and narrow bandwidth, are vulnerable to external interference.
application-specific integrated circuit (ASIC)	A special type of chip that starts out as a nonspecific collection of logic gates. Late in the manufacturing process, a layer is added to connect the gates for a specific function. By changing the pattern of connections, the manufacturer can make the chip suitable for many needs.
assured forwarding (AF)	One of the four per-hop behaviors (PHB) defined by the Diff-Serv workgroup of IETF. It is suitable for certain key data services that require assured bandwidth and short delay. For traffic within the bandwidth limit, AF assures quality in forwarding. For traffic that exceeds the bandwidth limit, AF degrades the service class and continues to forward the traffic instead of discarding the packets.

attenuator	A device used to increase the attenuation of an Optical Fiber Link. Generally used to ensure that the signal at the receive end is not too strong.
automatic laser shutdown (ALS)	A technique (procedure) to automatically shutdown the output power of laser transmitters and optical amplifiers to avoid exposure to hazardous levels.
automatic transmit power control (ATPC)	A method of adjusting the transmit power based on fading of the transmit signal detected at the receiver
autonomous system boundary router (ASBR)	A router that exchanges routing information with other ASs.
available bit rate (ABR)	A kind of service categories defined by the ATM forum. ABR only provides possible forwarding service and applies to the connections that does not require the real-time quality. It does not provide any guarantee in terms of cell loss or delay.

B

B-ISDN	See **broadband integrated services digital network.**
BDI	See **backward defect indication.**
BE	See **best effort.**
BER	bit error rate
BFD	See **Bidirectional Forwarding Detection.**
BGP	Border Gateway Protocol
BIOS	See **basic input/output system.**
BIP	See **bit interleaved parity.**
BPDU	See **bridge protocol data unit.**
BSC	See **base station controller.**
BTS	base transceiver station
Bidirectional Forwarding Detection (BFD)	A fast and independent hello protocol that delivers millisecond-level link failure detection and provides carrier-class availability. After sessions are established between neighboring systems, the systems can periodically send BFD packets to each other. If one system fails to receive a BFD packet within the negotiated period, the system regards that the bidirectional link fails and instructs the upper layer protocol to take actions to recover the faulty link.
backbone network	A network that forms the central interconnection for a connected network. The communication backbone for a country is WAN. The backbone network is an important architectural element for building enterprise networks. It provides a path for the exchange of information between different LANs or subnetworks. A backbone can tie together diverse networks in the same building, in different buildings in a campus environment, or over wide areas. Generally, the backbone network's capacity is greater than the networks connected to it.
backward defect indication (BDI)	A function that the sink node of a LSP, when detecting a defect, uses to inform the upstream end of the LSP of a downstream defect along the return path.

base station controller (BSC)	A logical entity that connects the BTS with the MSC in a GSM/CDMA network. It interworks with the BTS through the Abis interface, the MSC through the A interface. It provides the following functions: radio resource management, base station management, power control, handover control, and traffic measurement. One BSC controls and manages one or more BTSs in an actual network.
basic input/output system (BIOS)	Firmware stored on the computer motherboard that contains basic input/output control programs, power-on self test (POST) programs, bootstraps, and system setting information. The BIOS provides hardware setting and control functions for the computer.
baud rate	The number of times per second the signal can change on a transmission line. Commonly, the transmission line uses only two signal states, making the baud rate equal to the number of bits per second that can be transferred. The underlying transmission technique may use some of the bandwidth, so it may not be the case that user data transfers at the line's specified bit rate.
best effort (BE)	A traditional IP packet transport service. In this service, the diagrams are forwarded following the sequence of the time they reach. All diagrams share the bandwidth of the network and routers. The amount of resource that a diagram can use depends of the time it reaches. BE service does not ensure any improvement in delay time, jitter, packet loss ratio, and high reliability.
bit interleaved parity (BIP)	A method of error monitoring. With even parity, the transmitting equipment generates an X-bit code over a specified portion of the signal in such a manner that the first bit of the code provides even parity over the first bit of all X-bit sequences in the covered portion of the signal, the second bit provides even parity over the second bit of all X-bit sequences within the specified portion, and so forth. Even parity is generated by setting the BIP-X bits so that an even number of 1s exist in each monitored partition of the signal. A monitored partition comprises all bits in the same bit position within the X-bit sequences in the covered portion of the signal. The covered portion includes the BIP-X.
bridge	A device that connects two or more networks and forwards packets among them. Bridges operate at the physical network level. Bridges differ from repeaters because bridges store and forward complete packets, while repeaters forward all electrical signals. Bridges differ from routers because bridges use physical addresses, while routers use IP addresses.
bridge protocol data unit (BPDU)	Data messages exchanged across switches within an extended LAN that uses a spanning tree protocol (STP) topology. BPDU packets contain information on ports, addresses, priorities, and costs, and they ensure that the data reaches its intended destination. BPDU messages are exchanged across bridges to detect loops in a network topology. These loops are then removed by shutting down selected bridge interfaces and placing redundant switch ports in a backup, or blocked, state.
broadband integrated services digital network (B-ISDN)	A standard defined by the ITU-T to handle high-bandwidth applications, such as voice. It currently uses the ATM technology to transmit data over SONNET-based circuits at 155 to 622 Mbit/s or higher speed.
broadcast	A means of delivering information to all members in a network. The broadcast range is determined by the broadcast address.
broadcast domain	A group of network stations that receives broadcast packets originating from any device within the group. The broadcast domain also refers to the set of ports between which a device forwards a multicast, broadcast, or unknown destination frame.

C

CAR	committed access rate
CBR	See **constant bit rate.**
CBS	See **committed burst size.**
CC	See **continuity check.**
CCDP	See **co-channel dual polarization.**
CDMA	See **Code Division Multiple Access.**
CE	See **customer edge.**
CES	See **circuit emulation service.**
CGMP	Cisco Group Management Protocol
CIST	See **Common and Internal Spanning Tree.**
CLNP	connectionless network protocol
CM	connection management
CORBA	See **Common Object Request Broker Architecture.**
CPU	See **central processing unit.**
CRC	See **cyclic redundancy check.**
CSES	consecutive severely errored second
CSMA/CD	See **carrier sense multiple access with collision detection.**
CTC	common transmit clock
CW	control word
Code Division Multiple Access (CDMA)	A communication scheme that uses frequency expansion technology to form different code sequences. When the CDMA scheme is used, subscribers with different addresses can use different code sequences for multi-address connection.
Common Object Request Broker Architecture (CORBA)	A specification developed by the Object Management Group in 1992 in which pieces of programs (objects) communicate with other objects in other programs, even if the two programs are written in different programming languages and are running on different platforms. A program makes its request for objects through an object request broker, or ORB, and therefore does not need to know the structure of the program from which the object comes. CORBA is designed to work in object-oriented environments.
Common and Internal Spanning Tree (CIST)	The single spanning tree jointly calculated by STP and RSTP, the logical connectivity using MST bridges and regions, and MSTP. The CIST ensures that all LANs in the bridged local area network are simply and fully connected.
cable tie	A tie used to bind cables.

carrier sense multiple access with collision detection (CSMA/CD)

Carrier sense multiple access with collision detection (CSMA/CD) is a computer networking access method in which:

- A carrier sensing scheme is used.
- A transmitting data station that detects another signal while transmitting a frame, stops transmitting that frame, transmits a jam signal, and then waits for a random time interval before trying to send that frame again.

central processing unit (CPU)

The computational and control unit of a computer. The CPU is the device that interprets and executes instructions. The CPU has the ability to fetch, decode, and execute instructions and to transfer information to and from other resources over the computer's main data-transfer path, the bus.

channel

A telecommunication path of a specific capacity and/or speed between two or more locations in a network. The channel can be established through wire, radio (microwave), fiber, or any combination of the three. The amount of information transmitted per second in a channel is the information transmission speed, expressed in bits per second. For example, b/s (100 bit/s), kb/s (103 bit/s), Mb/s (106 bit/s), Gb/s (109 bit/s), and Tb/s (1012 bit/s).

circuit emulation service (CES)

A function with which the E1/T1 data can be transmitted through ATM networks. At the transmission end, the interface module packs timeslot data into ATM cells. These ATM cells are sent to the reception end through the ATM network. At the reception end, the interface module re-assigns the data in these ATM cells to E1/T1 timeslots. The CES technology guarantees that the data in E1/T1 timeslots can be recovered to the original sequence at the reception end.

clock tracing

The method of keeping the time on each node synchronized with a clock source in the network.

co-channel dual polarization (CCDP)

A channel configuration method, which uses a horizontal polarization wave and a vertical polarization wave to transmit two signals. The Co-Channel Dual Polarization has twice the transmission capacity of the single polarization.

committed burst size (CBS)

A parameter used to define the capacity of token bucket C, that is, the maximum burst IP packet size when information is transferred at the committed information rate. This parameter must be greater than 0 but should be not less than the maximum length of an IP packet to be forwarded.

constant bit rate (CBR)

A kind of service categories defined by the ATM forum. CBR transfers cells based on the constant bandwidth. It is applicable to service connections that depend on precise clocking to ensure undistorted transmission.

continuity check (CC)

An Ethernet connectivity fault management (CFM) method used to detect the connectivity between MEPs by having each MEP periodically transmit a Continuity Check Message (CCM).

cross polarization interference cancellation (XPIC)

A technology used in the case of the Co-Channel Dual Polarization (CCDP) to eliminate the cross-connect interference between two polarization waves in the CCDP.

customer edge (CE)

A part of the BGP/MPLS IP VPN model that provides interfaces for directly connecting to the Service Provider (SP) network. A CE can be a router, switch, or host.

cyclic redundancy check (CRC)	A procedure used to check for errors in data transmission. CRC error checking uses a complex calculation to generate a number based on the data transmitted. The sending device performs the calculation before performing the transmission and includes the generated number in the packet it sends to the receiving device. The receiving device then repeats the same calculation. If both devices obtain the same result, the transmission is considered to be error free. This procedure is known as a redundancy check because each transmission includes not only data but extra (redundant) error-checking values.

D

DC	direct current
DC-C	See **DC-return common (with ground).**
DC-I	See **DC-return isolate (with ground).**
DC-return common (with ground) (DC-C)	A power system, in which the BGND of the DC return conductor is short-circuited with the PGND on the output side of the power supply cabinet and also on the line between the output of the power supply cabinet and the electric equipment.
DC-return isolate (with ground) (DC-I)	A power system, in which the BGND of the DC return conductor is short-circuited with the PGND on the output side of the power supply cabinet and is isolated from the PGND on the line between the output of the power supply cabinet and the electric equipment.
DCC	See **data communications channel.**
DCN	See **data communication network.**
DDF	digital distribution frame
DDN	See **digital data network.**
DE	discard eligible
DM	See **delay measurement.**
DS boundary node	A DS node that connects one DS domain to a node either in another DS domain or in a domain that is not DS-capable.
DS interior node	A DS node located at the center of a DS domain. It is a non-DS boundary node.
DS node	A DS-compliant node, which is subdivided into DS boundary node and ID interior node.
DSCP	See **differentiated services code point.**
DVMRP	See **Distance Vector Multicast Routing Protocol.**
DiffServ	See **Differentiated Services.**
Differentiated Services (DiffServ)	An IETF standard that defines a mechanism for controlling and forwarding traffic in a differentiated manner based on CoS settings to handle network congestion.
Distance Vector Multicast Routing Protocol (DVMRP)	An Internet gateway protocol based primarily on the RIP. The DVMRP protocol implements a typical dense mode IP multicast solution and uses IGMP to exchange routing datagrams with its neighbors.
data communication network (DCN)	A communication network used in a TMN or between TMNs to support the data communication function.

data communications channel (DCC)	The data channel that uses the D1-D12 bytes in the overhead of an STM-N signal to transmit information on the operation, management, maintenance, and provisioning (OAM&P) between NEs. The DCC channel composed of bytes D1-D3 is referred to as the 192 kbit/s DCC-R channel. The other DCC channel composed of bytes D4-D12 is referred to as the 576 kbit/s DCC-M channel.
delay measurement (DM)	The time elapsed since the start of transmission of the first bit of the frame by a source node until the reception of the last bit of the loopbacked frame by the same source node, when the loopback is performed at the frame's destination node.
differentiated services code point (DSCP)	According to the QoS classification standard of the Differentiated Service (Diff-Serv), the type of services (ToS) field in the IP header consists of six most significant bits and two currently unused bits, which are used to form codes for priority marking. Differentiated services code point (DSCP) is the six most important bits in the ToS. It is the combination of IP precedence and types of service. The DSCP value is used to ensure that routers supporting only IP precedence can be used because the DSCP value is compatible with IP precedence. Each DSCP maps a per-hop behavior (PHB). Therefore, terminal devices can identify traffic using the DSCP value.
digital data network (DDN)	A data transmission network that is designed to transmit data on digital channels (such as the fiber channel, digital microwave channel, or satellite channel).
digital modulation	A method that controls the changes in amplitude, phase, and frequency of the carrier based on the changes in the baseband digital signal. In this manner, the information can be transmitted by the carrier.
dual-polarized antenna	An antenna intended to simultaneously radiate or receive two independent radio waves orthogonally polarized.

E

E-Aggr	See **Ethernet aggregation.**
E-LAN	See **Ethernet local area network.**
E-Line	See **Ethernet line.**
ECC	See **embedded control channel.**
EMC	See **electromagnetic compatibility.**
EMI	See **electromagnetic interference.**
EPL	See **Ethernet private line.**
EPLAN	See **Ethernet private LAN service.**
EPLD	See **erasable programmable logic device.**
ERPS	Ethernet ring protection switching
ESD	electrostatic discharge
ETS	European Telecommunication Standards
ETSI	See **European Telecommunications Standards Institute.**
EVPL	See **Ethernet virtual private line.**
EVPLAN	See **Ethernet virtual private LAN service.**

Ethernet	A LAN technology that uses the carrier sense multiple access with collision detection (CSMA/CD) media access control method. The Ethernet network is highly reliable and easy to maintain. The speed of an Ethernet interface can be 10 Mbit/s, 100 Mbit/s, 1000 Mbit/s, or 10,000 Mbit/s.
Ethernet aggregation (E-Aggr)	A type of Ethernet service that is based on a multipoint-to-point EVC (Ethernet virtual connection).
Ethernet line (E-Line)	A type of Ethernet service that is based on a point-to-point EVC (Ethernet virtual connection).
Ethernet local area network (E-LAN)	A type of Ethernet service that is based on a multipoint-to-multipoint EVC (Ethernet virtual connection).
Ethernet private LAN service (EPLAN)	A type of Ethernet service provided by SDH, PDH, ATM, or MPLS server layer networks. This service is carried over dedicated bandwidth between multipoint-to-multipoint connections.
Ethernet private line (EPL)	A type of Ethernet service provided by SDH, PDH, ATM, or MPLS server layer networks. This service is carried over dedicated bandwidth between point-to-point connections.
Ethernet virtual private LAN service (EVPLAN)	A type of Ethernet service provided by SDH, PDH, ATM, or MPLS server layer networks. This service is carried over shared bandwidth between multipoint-to-multipoint connections.
Ethernet virtual private line (EVPL)	A type of Ethernet service provided by SDH, PDH, ATM, or MPLS server layer networks. This service is carried over shared bandwidth between point-to-point connections.
European Telecommunications Standards Institute (ETSI)	A standards-setting body in Europe. Also the standards body responsible for GSM.
electromagnetic compatibility (EMC)	A condition which prevails when telecommunications equipment is performing its individually designed function in a common electromagnetic environment without causing or suffering unacceptable degradation due to unintentional electromagnetic interference to or from other equipment in the same environment.
electromagnetic interference (EMI)	Any electromagnetic disturbance that interrupts, obstructs, or otherwise degrades or limits the performance of electronics/electrical equipment.
embedded control channel (ECC)	A logical channel that uses a data communications channel (DCC) as its physical layer to enable the transmission of operation, administration, and maintenance (OAM) information between NEs.
engineering label	A mark on a cable, a subrack, or a cabinet for identification.
erasable programmable logic device (EPLD)	A logic array device which can be used to implement the required functions by programming the array. In addition, a user can modify and program the array repeatedly until the program meets the requirement.

F

FD	See **frequency diversity.**
FDDI	See **fiber distributed data interface.**

FDI	See **forward defect indication.**
FEC	See **forward error correction.**
FFD	fast failure detection
FFD packet	A path failure detection method independent from CV. Different from a CV packet, the frequency for generating FFD packets is configurable to satisfy different service requirements. By default, the frequency is 20/s. An FFD packet contains information the same as that in a CV packet. The destination end LSR processes FFD packets in the same way for processing CV packets.
FIFO	See **first in first out.**
FPGA	See **field programmable gate array.**
FTP	File Transfer Protocol
fiber distributed data interface (FDDI)	A standard developed by the American National Standards Institute (ANSI) for high-speed fiber-optic LANs. FDDI provides specifications for transmission rates of 100 megabits per second on token ring networks.
field programmable gate array (FPGA)	A semi-customized circuit that is used in the Application Specific Integrated Circuit (ASIC) field and developed based on programmable components. FPGA remedies many of the deficiencies of customized circuits, and allows the use of many more gate arrays.
first in first out (FIFO)	A stack management method in which data that is stored first in a queue is also read and invoked first.
forward defect indication (FDI)	A packet generated and traced forward to the sink node of the LSP by the node that first detects defects. It includes fields to indicate the nature of the defect and its location. Its primary purpose is to suppress alarms being raised at affected higher level client LSPs and (in turn) their client layers.
forward error correction (FEC)	A bit error correction technology that adds correction information to the payload at the transmit end. Based on the correction information, the bit errors generated during transmission can be corrected at the receive end.
fragmentation	A process of breaking a packet into smaller units when transmitting over a network node that does not support the original size of the packet.
frequency diversity (FD)	A diversity scheme in which two or more microwave frequencies with a certain frequency interval are used to transmit/receive the same signal and selection is then performed between the two signals to ease the impact of fading.

G

GCRA	generic cell rate algorithm
GFC	generic flow control
GFP	See **Generic Framing Procedure.**
GNE	See **gateway network element.**
GPS	See **Global Positioning System.**
GTS	See **generic traffic shaping.**
GUI	graphical user interface

Generic Framing Procedure (GFP)	A framing and encapsulated method that can be applied to any data type. GFP is defined by ITU-T G.7041.
Global Positioning System (GPS)	A global navigation satellite system that provides reliable positioning, navigation, and timing services to users worldwide.
gateway	A device that connects two network segments using different protocols. It is used to translate the data in the two network segments.
gateway network element (GNE)	An NE that serves as a gateway for other NEs to communicate with a network management system.
generic traffic shaping (GTS)	A traffic control measure that proactively adjusts the output speed of the traffic. This is to adapt the traffic to network resources that can be provided by the downstream router to avoid packet discarding and congestion.

H

HDLC	High-Level Data Link Control
HQoS	See **hierarchical quality of service.**
HSDPA	See **High Speed Downlink Packet Access.**
HSM	hitless switch mode
High Speed Downlink Packet Access (HSDPA)	A modulating-demodulating algorithm put forward in 3GPP R5 to meet the requirement for asymmetric uplink and downlink transmission of data services. It enables the maximum downlink data service rate to reach 14.4 Mbit/s without changing the WCDMA network topology.
hierarchical quality of service (HQoS)	A type of QoS that controls the traffic of users and performs the scheduling according to the priority of user services. HQoS has an advanced traffic statistics function, and the administrator can monitor the usage of bandwidth of each service. Hence, the bandwidth can be allocated reasonably through traffic analysis.
hybrid radio	The hybrid transmission of Native E1 and Native Ethernet signals. Hybrid radio supports the AM function.

I

I/O	input/output
ICMP	See **Internet Control Message Protocol.**
IDU	See **indoor unit.**
IEEE	See **Institute of Electrical and Electronics Engineers.**
IF	See **intermediate frequency.**
IGMP	See **Internet Group Management Protocol.**
IGMP snooping	A multicast constraint mechanism running on a layer 2 device. This protocol manages and controls the multicast group by listening to and analyzing Internet Group Management Protocol (IGMP) packets between hosts and Layer 3 devices. In this manner, the spread of the multicast data on layer 2 network can be prevented efficiently.
IGP	See **Interior Gateway Protocol.**

IMA	See **inverse multiplexing over ATM.**
IP	Internet Protocol
IPv4	See **Internet Protocol version 4.**
IPv6	See **Internet Protocol version 6.**
IS-IS	See **Intermediate System to Intermediate System.**
ISDN	integrated services digital network
ISO	International Organization for Standardization
IST	internal spanning tree
ITU	See **International Telecommunication Union.**
Institute of Electrical and Electronics Engineers (IEEE)	A professional association of electrical and electronics engineers based in the United States, but with membership from numerous other countries. The IEEE focuses on electrical, electronics, and computer engineering, and produces many important technology standards.
Interior Gateway Protocol (IGP)	A routing protocol that is used within an autonomous system. The IGP runs in small-sized and medium-sized networks. The commonly used IGPs are the routing information protocol (RIP), the interior gateway routing protocol (IGRP), the enhanced IGRP (EIGRP), and the open shortest path first (OSPF).
Intermediate System to Intermediate System (IS-IS)	A protocol used by network devices (routers) to determine the best way to forward datagram or packets through a packet-based network.
International Telecommunication Union (ITU)	A United Nations agency, one of the most important and influential recommendation bodies, responsible for recommending standards for telecommunication (ITU-T) and radio networks (ITU-R).
Internet Control Message Protocol (ICMP)	A network layer protocol that provides message control and error reporting between a host server and an Internet gateway.
Internet Group Management Protocol (IGMP)	One of the TCP/IP protocols for managing the membership of Internet Protocol multicast groups. It is used by IP hosts and adjacent multicast routers to establish and maintain multicast group memberships.
Internet Protocol version 4 (IPv4)	The current version of the Internet Protocol (IP). IPv4 utilizes a 32bit address which is assigned to hosts. An address belongs to one of five classes (A, B, C, D, or E) and is written as 4 octets separated by periods and may range from 0.0.0.0 through to 255.255.255.255. Each IPv4 address consists of a network number, an optional subnetwork number, and a host number. The network and subnetwork numbers together are used for routing, and the host number is used to address an individual host within the network or subnetwork.
Internet Protocol version 6 (IPv6)	An update version of IPv4, which is designed by the Internet Engineering Task Force (IETF) and is also called IP Next Generation (IPng). It is a new version of the Internet Protocol. The difference between IPv6 and IPv4 is that an IPv4 address has 32 bits while an IPv6 address has 128 bits.
indoor unit (IDU)	The indoor unit of the split-structured radio equipment. It implements accessing, multiplexing/demultiplexing, and intermediate frequency (IF) processing for services.

intermediate frequency (IF)	The transitional frequency between the frequencies of a modulated signal and an RF signal.
inverse multiplexing over ATM (IMA)	A technique that involves inverse multiplexing and de-multiplexing of ATM cells in a cyclical fashion among links grouped to form a higher bandwidth logical link whose rate is approximately the sum of the link rates.

L

L2VPN	Layer 2 virtual private network
LACP	See **Link Aggregation Control Protocol.**
LAG	See **link aggregation group.**
LAN	See **local area network.**
LAPS	Link Access Protocol-SDH
LB	See **loopback.**
LCAS	See **link capacity adjustment scheme.**
LM	See **loss measurement.**
LOS	See **loss of signal.**
LPT	link-state pass through
LSDB	link state database
LSP	See **label switched path.**
LSP tunnel	An LSP over which traffic is transmitted based on labels that are assigned to FECs on the ingress. The traffic is transparent to the intermediate nodes
LSR	See **label switching router.**
LTE	Long Term Evolution
Layer 2 switching	A data forwarding method. In a LAN, a network bridge or 802.3 Ethernet switch transmits and distributes packet data based on the MAC address. Since the MAC address is at the second layer of the OSI model, this data forwarding method is called Layer 2 switching.
Link Aggregation Control Protocol (LACP)	A dynamic link aggregation protocol that improves the transmission speed and reliability. The two ends of the link send LACP packets to inform each other of their parameters and form a logical aggregation link. After the aggregation link is formed, LACP maintains the link status in real time and dynamically adjusts the ports on the aggregation link upon detecting the failure of a physical port.
label switched path (LSP)	A sequence of hops (R0...Rn) in which a packet travels from R0 to Rn through label switching mechanisms. A label-switched path can be chosen dynamically, based on common routing mechanisms or through configuration.
label switching router (LSR)	Basic element of an MPLS network. All LSRs support the MPLS protocol. The LSR is composed of two parts: control unit and forwarding unit. The former is responsible for allocating the label, selecting the route, creating the label forwarding table, creating and removing the label switch path; the latter forwards the labels according to groups received in the label forwarding table.

laser	A component that generates directional optical waves of narrow wavelengths. The laser light has better coherence than ordinary light. Semi-conductor lasers provide the light used in a fiber system.
line rate	The maximum packet forwarding capacity on a cable. The value of line rate equals the maximum transmission rate capable on a given type of media.
link aggregation group (LAG)	An aggregation that allows one or more links to be aggregated together to form a link aggregation group so that a MAC client can treat the link aggregation group as if it were a single link.
link capacity adjustment scheme (LCAS)	LCAS in the virtual concatenation source and sink adaptation functions provides a control mechanism to hitless increase or decrease the capacity of a link to meet the bandwidth needs of the application. It also provides a means of removing member links that have experienced failure. The LCAS assumes that in cases of capacity initiation, increases or decreases, the construction or destruction of the end-to-end path is the responsibility of the network and element management systems.
local area network (LAN)	A network formed by the computers and workstations within the coverage of a few square kilometers or within a single building, featuring high speed and low error rate. Current LANs are generally based on switched Ethernet or Wi-Fi technology and run at 1,000 Mbit/s (that is, 1 Gbit/s).
loopback (LB)	A troubleshooting technique that returns a transmitted signal to its source so that the signal or message can be analyzed for errors. The loopback can be a inloop or outloop.
loss measurement (LM)	A method used to collect counter values applicable for ingress and egress service frames where the counters maintain a count of transmitted and received data frames between a pair of MEPs.
loss of signal (LOS)	No transitions occurring in the received signal.

M

MA	maintenance association
MAC	See **Media Access Control.**
MADM	multiple add/drop multiplexer
MBS	maximum burst size
MD	See **maintenance domain.**
MD5	See **message digest algorithm 5.**
MDI	medium dependent interface
MEP	maintenance association end point
MIB	See **management information base.**
MLPPP	Multi-Link Point-to-Point Protocol
MP	maintenance point
MPLS	See **Multiprotocol Label Switching.**
MPLS L2VPN	A network that provides the Layer 2 VPN service based on an MPLS network. In this case, on a uniform MPLS network, the carrier is able to provide Layer 2 VPNs of different media types, such as ATM, FR, VLAN, Ethernet, and PPP.

MPLS TE	multiprotocol label switching traffic engineering
MPLS VPN	See **multiprotocol label switching virtual private network.**
MPLS-TP	See **MultiProtocol Label Switching Transport Profile.**
MS	multiplex section
MSP	See **multiplex section protection.**
MST region	See **Multiple Spanning Tree region.**
MSTI	See **multiple spanning tree instance.**
MSTP	See **Multiple Spanning Tree Protocol.**
MTBF	See **mean time between failures.**
MTTR	See **mean time to repair.**
MTU	See **maximum transmission unit.**
Media Access Control (MAC)	A protocol at the media access control sublayer. The protocol is at the lower part of the data link layer in the OSI model and is mainly responsible for controlling and connecting the physical media at the physical layer. When transmitting data, the MAC protocol checks whether to be able to transmit data. If the data can be transmitted, certain control information is added to the data, and then the data and the control information are transmitted in a specified format to the physical layer. When receiving data, the MAC protocol checks whether the information is correct and whether the data is transmitted correctly. If the information is correct and the data is transmitted correctly, the control information is removed from the data and then the data is transmitted to the LLC layer.
MultiProtocol Label Switching Transport Profile (MPLS-TP)	A packet transport technology proposed by IETF that combines the packet experience of MPLS with the operational experience of transport networks.
Multiple Spanning Tree Protocol (MSTP)	A protocol that can be used in a loop network. Using an algorithm, the MSTP blocks redundant paths so that the loop network can be trimmed as a tree network. In this case, the proliferation and endless cycling of packets is avoided in the loop network. The protocol that introduces the mapping between VLANs and multiple spanning trees. This solves the problem that data cannot be normally forwarded in a VLAN because in STP/RSTP, only one spanning tree corresponds to all the VLANs.
Multiple Spanning Tree region (MST region)	A region that consists of switches that support the MSTP in the LAN and links among them. Switches physically and directly connected and configured with the same MST region attributes belong to the same MST region.
Multiprotocol Label Switching (MPLS)	A technology that uses short tags of fixed length to encapsulate packets in different link layers, and provides connection-oriented switching for the network layer on the basis of IP routing and control protocols.
maintenance domain (MD)	The network or the part of the network for which connectivity is managed by connectivity fault management (CFM). The devices in a maintenance domain are managed by a single Internet service provider (ISP).
management information base (MIB)	A type of database used for managing the devices in a communications network. It comprises a collection of objects in a (virtual) database used to manage entities (such as routers and switches) in a network.

maximum transmission unit (MTU)	The largest packet of data that can be transmitted on a network. MTU size varies, depending on the network—576 bytes on X.25 networks, for example, 1500 bytes on Ethernet, and 17,914 bytes on 16 Mbit/s token ring. Responsibility for determining the size of the MTU lies with the link layer of the network. When packets are transmitted across networks, the path MTU, or PMTU, represents the smallest packet size (the one that all networks can transmit without breaking up the packet) among the networks involved.
mean time between failures (MTBF)	The average time between consecutive failures of a piece of equipment. It is a measure of the reliability of the system.
mean time to repair (MTTR)	The average time that a device will take to recover from a failure.
message digest algorithm 5 (MD5)	A hash function that is used in a variety of security applications to check message integrity. MD5 processes a variable-length message into a fixed-length output of 128 bits. It breaks up an input message into 512-bit blocks (sixteen 32-bit little-endian integers). After a series of processing, the output consists of four 32-bit words, which are then cascaded into a 128-bit hash number.
multicast	A process of transmitting data packets from one source to many destinations. The destination address of the multicast packet uses Class D address, that is, the IP address ranges from 224.0.0.0 to 239.255.255.255. Each multicast address represents a multicast group rather than a host.
multiple spanning tree instance (MSTI)	A type of spanning trees calculated by MSTP within an MST Region, to provide a simply and fully connected active topology for frames classified as belonging to a VLAN that is mapped to the MSTI by the MST Configuration. A VLAN cannot be assigned to multiple MSTIs.
multiplex section protection (MSP)	A function, which is performed to provide capability for switching a signal between and including two multiplex section termination (MST) functions, from a "working" to a "protection" channel.
multiprotocol label switching virtual private network (MPLS VPN)	An Internet Protocol (IP) virtual private network (VPN) based on the multiprotocol label switching (MPLS) technology. It applies the MPLS technology for network routers and switches, simplifies the routing mode of core routers, and combines traditional routing technology and label switching technology. It can be used to construct the broadband Intranet and Extranet to meet various service requirements.

N

N+1 protection	A radio link protection system composed of N working channels and one protection channel.
NE	network element
NE Explorer	The main operation interface of the NMS, which is used to manage the telecommunication equipment. In the NE Explorer, a user can query, manage, and maintain NEs, boards, and ports.
NNI	network-to-network interface
NPE	network provider edge
NSAP	See **network service access point.**
NSF	non-stop forwarding

network service access point (NSAP)	A network address defined by ISO, at which the OSI Network Service is made available to a Network service user by the Network service provider.
network storm	A phenomenon that occurs during data communication. To be specific, mass broadcast packets are transmitted in a short time; the network is congested; transmission quality and availability of the network decrease rapidly. The network storm is caused by network connection or configuration problems.
node	A managed device in the network. For a device with a single frame, one node stands for one device. For a device with multiple frames, one node stands for one frame of the device.
non-GNE	See **non-gateway network element.**
non-gateway network element (non-GNE)	A network element that communicates with the NM application layer through the gateway NE application layer.

O

O&M	operation and maintenance
OAM	See **operation, administration and maintenance.**
OAMPDU	operation, administration and maintenance protocol data unit
ODF	optical distribution frame
ODU	See **outdoor unit.**
OSPF	See **Open Shortest Path First.**
Open Shortest Path First (OSPF)	A link-state, hierarchical interior gateway protocol (IGP) for network routing that uses cost as its routing metric. A link state database is constructed of the network topology, which is identical on all routers in the area.
operation, administration and maintenance (OAM)	A set of network management functions that cover fault detection, notification, location, and repair.
orderwire	A channel that provides voice communication between operation engineers or maintenance engineers of different stations.
outdoor unit (ODU)	The outdoor unit of the split-structured radio equipment. It implements frequency conversion and amplification for radio frequency (RF) signals.

P

P2P	See **point-to-point service.**
PBS	See **peak burst size.**
PCB	See **printed circuit board.**
PDH	See **plesiochronous digital hierarchy.**
PDU	protocol data unit
PE	See **provider edge.**
PHB	See **per-hop behavior.**

PIR	peak information rate
PLA	See **physical link aggregation.**
PLL	See **phase-locked loop.**
PPP	Point-to-Point Protocol
PRBS	See **pseudo random binary sequence.**
PRI	primary rate interface
PSN	See **packet switched network.**
PSTN	See **public switched telephone network.**
PTN	packet transport network
PTP	Precision Time Protocol
PTP clock	See **Precision Time Protocol clock.**
PVP	See **permanent virtual path.**
PW	See **pseudo wire.**
PWE3	See **pseudo wire emulation edge-to-edge.**
Precision Time Protocol clock (PTP clock)	A type of high-decision clock defined by the IEEE 1588 V2 standard. The IEEE 1588 V2 standard specifies the precision time protocol (PTP) in a measurement and control system. The PTP protocol ensures clock synchronization precise to sub-microseconds.
packet switched network (PSN)	A telecommunications network that works in packet switching mode.
paired slots	Two slots of which the overheads can be passed through by using the bus on the backplane.
peak burst size (PBS)	A parameter that defines the capacity of token bucket P, that is, the maximum burst IP packet size when the information is transferred at the peak information rate.
per-hop behavior (PHB)	IETF Diff-Serv workgroup defines forwarding behaviors of network nodes as per-hop behaviors (PHB), such as, traffic scheduling and policing. A device in the network should select the proper PHB behaviors, based on the value of DSCP. At present, the IETF defines four types of PHB. They are class selector (CS), expedited forwarding (EF), assured forwarding (AF), and best-effort (BE).
permanent virtual path (PVP)	Virtual path that consists of PVCs.
phase-locked loop (PLL)	A circuit that consists essentially of a phase detector that compares the frequency of a voltage-controlled oscillator with that of an incoming carrier signal or reference-frequency generator. The output of the phase detector, after passing through a loop filter, is fed back to the voltage-controlled oscillator to keep it exactly in phase with the incoming or reference frequency.
physical link aggregation (PLA)	Being a technology providing load balancing based on physical layer bandwidths, physical link aggregation (PLA) combines Ethernet transmission paths in several Integrated IP radio links into a logical Ethernet link for higher Ethernet bandwidth and Ethernet transmission reliability.

plesiochronous digital hierarchy (PDH)	A multiplexing scheme of bit stuffing and byte interleaving. It multiplexes the minimum rate 64 kit/s into rates of 2 Mbit/s, 34 Mbit/s, 140 Mbit/s, and 565 Mbit/s.
point-to-point service (P2P)	A service between two terminal users. In P2P services, senders and recipients are terminal users.
polarization	A kind of electromagnetic wave, the direction of whose electric field vector is fixed or rotates regularly. Specifically, if the electric field vector of the electromagnetic wave is perpendicular to the plane of horizon, this electromagnetic wave is called vertically polarized wave; if the electric field vector of the electromagnetic wave is parallel to the plane of horizon, this electromagnetic wave is called horizontal polarized wave; if the tip of the electric field vector, at a fixed point in space, describes a circle, this electromagnetic wave is called circularly polarized wave.
printed circuit board (PCB)	A board used to mechanically support and electrically connect electronic components using conductive pathways, tracks, or traces, etched from copper sheets laminated onto a non-conductive substrate.
provider edge (PE)	A device that is located in the backbone network of the MPLS VPN structure. A PE is responsible for managing VPN users, establishing LSPs between PEs, and exchanging routing information between sites of the same VPN. A PE performs the mapping and forwarding of packets between the private network and the public channel. A PE can be a UPE, an SPE, or an NPE.
pseudo random binary sequence (PRBS)	A sequence that is random in the sense that the value of each element is independent of the values of any of the other elements, similar to a real random sequence.
pseudo wire (PW)	An emulated connection between two PEs for transmitting frames. The PW is established and maintained by PEs through signaling protocols. The status information of a PW is maintained by the two end PEs of a PW.
pseudo wire emulation edge-to-edge (PWE3)	An end-to-end Layer 2 transmission technology. It emulates the essential attributes of a telecommunication service such as ATM, FR or Ethernet in a packet switched network (PSN). PWE3 also emulates the essential attributes of low speed time division multiplexing (TDM) circuit and SONET/SDH. The simulation approximates to the real situation.
public switched telephone network (PSTN)	A telecommunications network established to perform telephone services for the public subscribers. Sometimes it is called POTS.

Q

QPSK	See **quadrature phase shift keying.**
QinQ	See **802.1Q in 802.1Q.**
QoS	See **quality of service.**
quadrature phase shift keying (QPSK)	A modulation method of data transmission through the conversion or modulation and the phase determination of the reference signals (carrier). It is also called the fourth period or 4-phase PSK or 4-PSK. QPSK uses four dots in the star diagram. The four dots are evenly distributed on a circle. On these phases, each QPSK character can perform two-bit coding and display the codes in Gray code on graph with the minimum BER.

quality of service (QoS) A commonly-used performance indicator of a telecommunication system or channel. Depending on the specific system and service, it may relate to jitter, delay, packet loss ratio, bit error ratio, and signal-to-noise ratio. It functions to measure the quality of the transmission system and the effectiveness of the services, as well as the capability of a service provider to meet the demands of users.

R

RADIUS See **Remote Authentication Dial In User Service.**

RADIUS accounting An accounting mode in which the BRAS sends the accounting packets to the RADIUS server. Then the RADIUS server performs accounting.

RDI remote defect indication

RED See **random early detection.**

REI remote error indication

RF See **radio frequency.**

RFC See **Request For Comments.**

RMEP remote maintenance association end point

RMON remote network monitoring

RNC See **radio network controller.**

RSL See **received signal level.**

RSSI See **received signal strength indicator.**

RSTP See **Rapid Spanning Tree Protocol.**

RSVP See **Resource Reservation Protocol.**

RTN radio transmission node

RTSP Real-Time Streaming Protocol

Rapid Spanning Tree Protocol (RSTP) An evolution of the Spanning Tree Protocol (STP) that provides faster spanning tree convergence after a topology change. The RSTP protocol is backward compatible with the STP protocol.

Remote Authentication Dial In User Service (RADIUS) A security service that authenticates and authorizes dial-up users and is a centralized access control mechanism. RADIUS uses the User Datagram Protocol (UDP) as its transmission protocol to ensure real-time quality. RADIUS also supports the retransmission and multi-server mechanisms to ensure good reliability.

Request For Comments (RFC) A document in which a standard, a protocol, or other information pertaining to the operation of the Internet is published. The RFC is actually issued, under the control of the IAB, after discussion and serves as the standard. RFCs can be obtained from sources such as InterNIC.

Resource Reservation Protocol (RSVP) A protocol that reserves resources on every node along a path. RSVP is designed for an integrated services Internet.

RoHS restriction of the use of certain hazardous substances

radio frequency (RF)	A type of electric current in the wireless network using AC antennas to create an electromagnetic field. It is the abbreviation of high-frequency AC electromagnetic wave. The AC with the frequency lower than 1 kHz is called low-frequency current. The AC with frequency higher than 10 kHz is called high-frequency current. RF can be classified into such high-frequency current.
radio network controller (RNC)	A device in a radio network subsystem that is in charge of controlling the usage and integrity of radio resources.
random early detection (RED)	A packet loss algorithm used in congestion avoidance. It discards the packet according to the specified higher limit and lower limit of a queue so that global TCP synchronization resulting from traditional tail drop can be prevented.
real-time variable bit rate (rt-VBR)	A parameter intended for real-time applications, such as compressed voice over IP (VoIP) and video conferencing. The rt-VBR is characterized by a peak cell rate (PCR), sustained cell rate (SCR), and maximum burst size (MBS). You can expect the source device to transmit in bursts and at a rate that varies with time.
received signal level (RSL)	The signal level at a receiver input terminal.
received signal strength indicator (RSSI)	The received wide band power, including thermal noise and noise generated in the receiver, within the bandwidth defined by the receiver pulse shaping filter, for TDD within a specified timeslot. The reference point for the measurement shall be the antenna
receiver sensitivity	The minimum acceptable value of mean received power at point Rn (a reference point at an input to a receiver optical connector) to achieve a 1x10-12 BER when the FEC is enabled.
regeneration	The process of receiving and reconstructing a digital signal so that the amplitudes, waveforms and timing of its signal elements are constrained within specified limits.
route	The path that network traffic takes from its source to its destination. Routes can change dynamically.
router	A device on the network layer that selects routes in the network. The router selects the optimal route according to the destination address of the received packet through a network and forwards the packet to the next router. The last router is responsible for sending the packet to the destination host. Can be used to connect a LAN to a LAN, a WAN to a WAN, or a LAN to the Internet.
rt-VBR	See **real-time variable bit rate.**

S

SAI	service area identifier
SAToP	Structure-Agnostic Time Division Multiplexing over Packet
SCSI	Small Computer System Interface
SD	See **space diversity.**
SDH	See **synchronous digital hierarchy.**
SEC	security screening
SES	severely errored second
SETS	SDH equipment timing source

SF	See **signal fail.**
SFP	small form-factor pluggable
SLA	See **service level agreement.**
SNCP	subnetwork connection protection
SNMP	See **Simple Network Management Protocol.**
SNR	See **signal-to-noise ratio.**
SSL	See **Secure Sockets Layer.**
SSM	See **Synchronization Status Message.**
STM	See **synchronous transport module.**
STM-1	See **Synchronous Transport Module level 1.**
STM-4	Synchronous Transport Module level 4
STM-N	Synchronous Transport Module level N
STP	Spanning Tree Protocol
Secure Sockets Layer (SSL)	A security protocol that works at a socket level. This layer exists between the TCP layer and the application layer to encrypt/decode data and authenticate concerned entities.
Simple Network Management Protocol (SNMP)	A network management protocol of TCP/IP. It enables remote users to view and modify the management information of a network element. This protocol ensures the transmission of management information between any two points. The polling mechanism is adopted to provide basic function sets. According to SNMP, agents, which can be hardware as well as software, can monitor the activities of various devices on the network and report these activities to the network console workstation. Control information about each device is maintained by a management information block.
Synchronization Status Message (SSM)	A message that carries the quality levels of timing signals on a synchronous timing link. SSM messages provide upstream clock information to nodes on an SDH network or synchronization network.
Synchronous Transport Module level 1 (STM-1)	Synchronous transfer mode at 155 Mbit/s.
service level agreement (SLA)	A service agreement between a customer and a service provider. SLA specifies the service level for a customer. The customer can be a user organization (source domain) or another differentiated services domain (upstream domain). An SLA may include traffic conditioning rules which constitute a traffic conditioning agreement as a whole or partially.
signal fail (SF)	A signal indicating that associated data has failed in the sense that a near-end defect condition (non-degrade defect) is active.
signal-to-noise ratio (SNR)	The ratio of the amplitude of the desired signal to the amplitude of noise signals at a given point in time. SNR is expressed as 10 times the logarithm of the power ratio and is usually expressed in dB.
single-ended switching	A protection mechanism that takes switching action only at the affected end of the protected entity in the case of a unidirectional failure.

single-polarized antenna	An antenna intended to radiate or receive radio waves with only one specified polarization.
space diversity (SD)	A diversity scheme that enables two or more antennas separated by a specific distance to transmit/receive the same signal and selection is then performed between the two signals to ease the impact of fading. Currently, only receive SD is used.
subnet mask	The technique used by the IP protocol to determine which network segment packets are destined for. The subnet mask is a binary pattern that is stored in the device and is matched with the IP address.
synchronous digital hierarchy (SDH)	A transmission scheme that follows ITU-T G.707, G.708, and G.709. SDH defines the transmission features of digital signals, such as frame structure, multiplexing mode, transmission rate level, and interface code. SDH is an important part of ISDN and B-ISDN.
synchronous transport module (STM)	An 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. 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 kbit/s. This is termed STM-1. Higher capacity STMs are formed at rates equivalent to N times this basic rate. STM capacities for N = 4, N = 16 and N = 64 are defined; higher values are under consideration.

T

T1	A North American standard for high-speed data transmission at 1.544Mbps. It provides 24 x 64 kbit/s channels.
TCI	tag control information
TCP	See **Transmission Control Protocol.**
TCP/IP	Transmission Control Protocol/Internet Protocol
TD-SCDMA	See **Time Division-Synchronous Code Division Multiple Access.**
TDD	time division duplex
TDM	See **time division multiplexing.**
TDMA	See **Time Division Multiple Access.**
TE	See **traffic engineering.**
TEDB	See **traffic engineering database.**
TIM	trace identifier mismatch
TMN	See **telecommunications management network.**
TOS	test operation system
TTL	See **time to live.**
TUG	tributary unit group
Telnet	A standard terminal emulation protocol in the TCP/IP protocol stack. Telnet allows users to log in to remote systems and use resources as if they were connected to a local system. Telnet is defined in RFC 854.

Time Division Multiple Access (TDMA)	An approach used for allocating a single channel among many users, by dividing the channel into different timeslots during which each user has access to the medium.
Time Division-Synchronous Code Division Multiple Access (TD-SCDMA)	A 3G mobile communications standard found in UMTS mobile telecommunications networks in China as an alternative to W-CDMA. TD-SCDMA integrates technologies of CDMA, TDMA, and FDMA, and makes use of technologies including intelligent antenna, joint detection, low chip rate (LCR), and adaptive power control. With the flexibility of service processing, a TD-SCDMA network can connect to other networks through the RNC.
Transmission Control Protocol (TCP)	The protocol within TCP/IP that governs the breakup of data messages into packets to be sent using Internet Protocol (IP), and the reassembly and verification of the complete messages from packets received by IP. A connection-oriented, reliable protocol (reliable in the sense of ensuring error-free delivery), TCP corresponds to the transport layer in the ISO/OSI reference model.
tail drop	A congestion management mechanism, in which packets arrive later are discarded when the queue is full. This policy of discarding packets may result in network-wide synchronization due to the TCP slow startup mechanism.
tangent ring	A concept borrowed from geometry. Two tangent rings have a common node between them. The common node often leads to single-point failures.
telecommunications management network (TMN)	A protocol model defined by ITU-T for managing open systems in a communications network. TMN manages the planning, provisioning, installation, and OAM of equipment, networks, and services.
time division multiplexing (TDM)	A multiplexing technology. TDM divides the sampling cycle of a channel into time slots (TSn, n=0, 1, 2, 3…), and the sampling value codes of multiple signals engross time slots in a certain order, forming multiple multiplexing digital signals to be transmitted over one channel.
time to live (TTL)	A specified period of time for best-effort delivery systems to prevent packets from looping endlessly.
trTCM	See **two rate three color marker.**
traffic engineering (TE)	A technology that is used to dynamically monitor the traffic of the network and the load of the network elements, to adjust in real time the parameters such as traffic management parameters, route parameters and resource restriction parameters, and to optimize the utilization of network resources. The purpose is to prevent the congestion caused by unbalanced loads.
traffic engineering database (TEDB)	A type of database that every router generates after collecting the information about TE of every links in its area. TEDB is the base of forming the dynamic TE path in the MPLS TE network.
tributary loopback	A fault can be located for each service path by performing loopback to each path of the tributary board. There are three kinds of loopback modes: no loopback, outloop, and inloop.
tunnel	A channel on the packet switching network that transmits service traffic between PEs. In VPN, a tunnel is an information transmission channel between two entities. The tunnel ensures secure and transparent transmission of VPN information. In most cases, a tunnel is an MPLS tunnel.

two rate three color marker (trTCM) An algorithm that meters an IP packet stream and marks its packets based on two rates, Peak Information Rate (PIR) and Committed Information Rate (CIR), and their associated burst sizes to be either green, yellow, or red. A packet is marked red if it exceeds the PIR. Otherwise it is marked either yellow or green depending on whether it exceeds or does not exceed the CIR.

U

UART universal asynchronous receiver/transmitter

UAS unavailable second

UBR unspecified bit rate

UBR+ Unspecified Bit Rate Plus

UDP See **User Datagram Protocol.**

UI user interface

UNI See **user-to-network interface.**

UPC See **usage parameter control.**

User Datagram Protocol (UDP) A TCP/IP standard protocol that allows an application program on one device to send a datagram to an application program on another. UDP uses IP to deliver datagrams. UDP provides application programs with the unreliable connectionless packet delivery service. That is, UDP messages may be lost, duplicated, delayed, or delivered out of order. The destination device does not actively confirm whether the correct data packet is received.

unicast The process of sending data from a source to a single recipient.

usage parameter control (UPC) During communications, UPC is implemented to monitor the actual traffic on each virtual circuit that is input to the network. Once the specified parameter is exceeded, measures will be taken to control. NPC is similar to UPC in function. The difference is that the incoming traffic monitoring function is divided into UPC and NPC according to their positions. UPC locates at the user/network interface, while NPC at the network interface.

user-to-network interface (UNI) The interface between user equipment and private or public network equipment (for example, ATM switches).

V

V-NNI virtual network-network interface

V-UNI See **virtual user-network interface.**

VB virtual bridge

VBR See **variable bit rate.**

VC See **virtual container.**

VCC See **virtual channel connection.**

VCCV virtual circuit connectivity verification

VCG See **virtual concatenation group.**

VCI virtual channel identifier

VCTRUNK	A virtual concatenation group applied in data service mapping, also called the internal port of a data service processing board.
VLAN	virtual local area network
VPI	See **virtual path identifier.**
VPLS	virtual private LAN segment
VPN	virtual private network
VSWR	voltage standing wave ratio
variable bit rate (VBR)	One of the traffic classes used by ATM (Asynchronous Transfer Mode). Unlike a permanent CBR (Constant Bit Rate) channel, a VBR data stream varies in bandwidth and is better suited to non real time transfers than to real-time streams such as voice calls.
virtual channel connection (VCC)	A VC logical trail that carries data between two end points in an ATM network. A point-to-multipoint VCC is a set of ATM virtual connections between two or multiple end points.
virtual circuit	A channel or circuit established between two points on a data communications network with packet switching. Virtual circuits can be permanent virtual circuits (PVCs) or switched virtual circuits (SVCs) .
virtual concatenation group (VCG)	A group of co-located member trail termination functions that are connected to the same virtual concatenation link.
virtual container (VC)	An information structure used to support path layer connections in the SDH. A VC consists of a payload and path overhead (POH), which are organized in a block frame structure that repeats every 125 μs or 500 μs.
virtual path identifier (VPI)	The field in the Asynchronous Transfer Mode (ATM) cell header that identifies to which virtual path the cell belongs.
virtual user-network interface (V-UNI)	A virtual user-network interface, works as an action point to perform service classification and traffic control in HQoS.

W

WCDMA	See **Wideband Code Division Multiple Access.**
WDM	wavelength division multiplexing
WEEE	waste electrical and electronic equipment
WFQ	See **weighted fair queuing.**
WRED	See **weighted random early detection.**
WRR	weighted round robin
WTR	See **wait to restore.**
Web LCT	The local maintenance terminal of a transport network, which is located at the NE management layer of the transport network.
Wi-Fi	See **Wireless Fidelity.**
Wideband Code Division Multiple Access (WCDMA)	A standard defined by the ITU-T for the third-generation wireless technology derived from the Code Division Multiple Access (CDMA) technology.

Wireless Fidelity (Wi-Fi)	A short-distant wireless transmission technology. It enables wireless access to the Internet within a range of hundreds of feet wide.
wait to restore (WTR)	The number of minutes to wait before services are switched back to the working line.
weighted fair queuing (WFQ)	A fair queue scheduling algorithm based on bandwidth allocation weights. This scheduling algorithm allocates the total bandwidth of an interface to queues, according to their weights and schedules the queues cyclically. In this manner, packets of all priority queues can be scheduled.
weighted random early detection (WRED)	A packet loss algorithm used for congestion avoidance. It can prevent the global TCP synchronization caused by traditional tail-drop. WRED is favorable for the high-priority packet when calculating the packet loss ratio.
winding pipe	A tool for fiber routing, which acts as the corrugated pipe.

X

XPIC	See **cross polarization interference cancellation.**