RTN 600 Product Description

OptiX RTN 600 Radio Transmission System
Product Description

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Chapter 1 Overview

1.1 Network Application

The OptiX RTN 600 radio transmission system is a short haul digital microwave transmission system developed by Huawei Technologies Co., Ltd.

Each radio frequency (RF) carrier of the RTN 600 system can transmit 4/8/16xE1 or 1xSTM-1.

The RTN 600 can provide back haul links in a private network or a mobile telecommunication network, and can also network with optical transmission systems.

1.2 Components

The OptiX RTN 600 adopts a split structure. The system consists of the indoor unit (IDU) and the outdoor unit (ODU). An ODU is connected to an IDU through a coaxial cable.

I. IDU

The IDU has two types as follows:

- IDU 610: 1U; one IF board; supporting 1+0 non-protection configuration.
- IDU 620: 2U; one to four IF boards; supporting 1+0 non-protection configuration and 1+1 configuration.
-

Figure 1-1 IDU 610

Figure 1-2 IDU 620

II. ODU

There are two types of antenna configurations as follows:

- One ODU using one antenna

  The ODU is installed on the back of the antenna, using direct mount or separate mount.

- Two ODUs sharing one antenna

  An RF signal combiner and divider (hereinafter referred to as hybrid coupler) is used between the antenna and the two ODUs. The hybrid coupler can be directly or separately mounted onto the antenna.

Figure 1-3 One ODU and one antenna configuration (direct mount)

Figure 1-4 Two ODUs and one antenna configuration (direct mount)

Figure 1-5 One ODU and one antenna configuration (separate mount)

Figure 1-6 Two ODUs and one antenna configuration (separate mount)

Chapter 2 Features

2.1 Advanced Physical Structure

- The IDU is independent of frequency.
- The ODU is independent of capacity.
- The interfaces between the IDU and the ODU, or the interfaces between the ODU and the antenna, are independent of their respective types.
- The system adopts a uniform SDH and PDH transmission platform. The system can transmit PDH or SDH services.
- The IDU adopts the design of the ADM, which makes it groom services fast.
- The IDU adopts the design of plug-in boards. The two types of IDUs can share boards.

2.2 High Integration

- IDU 610 dimensions: 442 mm x 44 mm x 215 mm (width x height x depth) two-layer structure
- IDU 620 dimensions: 442 mm x 87 mm x 215 mm (width x height x depth) four-layer structure
- ODU dimensions: < 260 mm x 260 mm x 92 mm (width x height x depth)
- The power unit, cross-connect unit, and clock unit are all integrated into one board.
- The control unit, auxiliary interface unit, and standby power unit are all integrated into one board.

2.3 Multiple RF Configurations

The IDU 610 supports 1+0 non-protection configuration.

The IDU 620 supports the following configurations:

Configuration Mode		Maximum Number of Directions
1+0 non-protection		4
1+1 protection	1+1 HSB (Hot Standby)	2
	1+1 FD (Frequency Diversity)	
	1+1 SD (Space Diversity)	

2.4 Rich Interfaces

For the types and the maximum capacity of the OptiX RTN 600 interfaces, refer to Table 2-1. Later versions will add more interfaces to meet the market demand.

Table 2-1 Interface types and maximum interface capacity

Interface Type	Specifications	IDU 610	IDU 620
PDH interface	75/120-ohm E1 interface	16	64
SDH interface	STM-1 optical interface: Ie-1, S-1.1, L-1.1, L-1.2	2[a]	8[b]
	75-ohm STM-1 electrical interface	2[a]	8[b]
Ethernet service interface	10M/100M BASE-T(x) interface	4	16
External clock interface	75-ohm 2048 kHz/ or 2048 kbit/s external clock interface	1	2
Auxiliary interface	Orderwire interface	1	1
	Wayside (WS) interface (the external clock interface)	1	2
	RS232 asynchronous data interface	1	1
Management interface	10/100BASE-T(x) NM interface	1	1
	10/100BASE-T(x) NE cascade interface	1	1
	Management serial port	1	1
Alarm interface	Alarm input/out interface	6 inputs + 2 outputs	6 inputs + 2 outputs

a: IDU 610 supports four STM-1 interfaces when acting as a pure optical transmission system.

b: IDU 620 supports 10 STM-1 interfaces when acting as a pure optical transmission system.

2.5 Flexible Modulation

The modem of the OptiX RTN 600 supports QPSK, 16QAM, and 128QAM. You can select the modulation mode as required.

2.6 Automatic Transmit Power Control

The OptiX RTN 600 supports the automatic transmit power control (ATPC) function. The ATPC function enables the output power of the transmitter to trace the level fluctuation at the receive end automatically. This reduces interference against neighboring systems and residual BER.

2.7 Flexible System Configuration and Easy Expansion

- Grooming services as the ADM
- Software selectable microwave capacity and modulation
- Extended slots compatible with various service boards and IF boards
- Hot swappable service boards, IF boards, and SCC boards
- Upgrade from 1+0 non-protection configuration to 1+1 protection configuration or establishing new microwave links by adding IF boards and ODUs to the system with IDU 620

2.8 Complete Protection Schemes

- The IDU 610 supports 1+1 backup of internal power modules.
- The IDU 620 supports 1+1 backup of input power and 2+1 backup of internal power modules.
- The IDU 620 supports 1+1 backup of the cross-connect unit and the timing unit.
- The IDU 620 supports three 1+1 protection configurations, that is, 1+1 FD, 1+1 SD, and 1+1 HSB.
- Both the IDU 610 and IDU 620 support the sub-network connection protection (SNCP) between optical transmission links, between radio links, or between transmission links and radio links.
- Both the IDU 610 and IDU 620 support linear MSP of optical transmission links.

2.9 Powerful Clock Processing Capability

- Extracts the clock source from the line, tributary, microwave, and external clock signal.
- Supports the synchronization status message (SSM) protocol and the extended SSM protocol.
- Supports the tributary retiming function.

2.10 Multiple Network Management Modes

- Directly connect an iManager T2000 Web Local Draft Terminal (Web LCT) to the OptiX RTN 600 to manage the NE.
- Connect a Web LCT to an NE in the network to manage any OptiX RTN 600.
- Use the iManager T2000 to manage all the OptiX RTN 600 and other Huawei optical transmission systems in the network.
- Use the simple network management protocol (SNMP) agent to query alarms and performance events.

2.11 Complete Network Management Information Interworking Schemes

The OptiX RTN 600 supports the interworking of NM information in both the physical layer and the network layer.

In the physical layer, the OptiX RTN 600 uses:

- A self-defined DCC byte in the PDH microwave frame to carry the NM information.
- The D1 to D3 bytes in the SDH microwave frame and the SDH frame to carry the NM information.
- The D4 to D12 bytes in the SDH microwave frame and the SDH frame to carry the NM information.
- The D1 to D12 bytes in the SDH microwave frame and the SDH frame to carry the NM information.

In the network layer, the OptiX RTN 600 uses:

- HWECC (Huawei's private protocol) to carry the NM information.
- IP over DCC to carry the NM information.
- OSI over DCC to carry the NM information.

2.12 Easy Installation

- The IDU supports various mounting methods. It can be installed in:
  - A 300 mm ETSI cabinet.
  - A 600 mm ETSI cabinet.
  - A 450 mm 19-inch cabinet.
  - A 600 mm 19-inch cabinet.
  - An open cabinet.
  - On the wall.
  - On a table.

- The ODU supports flexible mounting modes.
  - Direct mount
  - Separate mount

2.13 Easy Commissioning and Maintenance

- SDH alarms and performance events compliant with ITU-T G.783.
- Various loopback functions at the service port and the IF port.
- Integrated test system. You can perform the following tests when no special test tools are at hand:
  - PRBS BER test at the E1 port.
  - Transmitting/Receiving of Ethernet GFP test frames.
- The monitoring of important radio transmission performance indexes, such as the microwave launch power, and received signal strength indicator (RSSI).
- Removable storage card. The storage card is used to store the data configuration files. You can restore the data of the SCC board by replacing the storage card.
- Hot patch function. In-service upgrade of the equipment software is supported without interrupting services.
- Software version rollback function. When the software upgrade fails, the services can be recovered.

Chapter 3 Structure

3.1 System Architecture

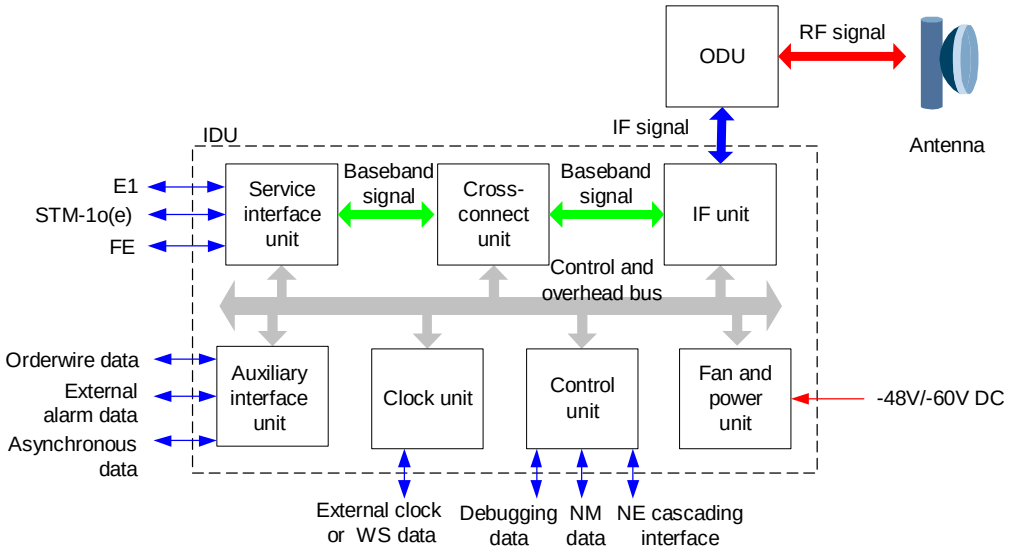

Figure 3-1 System architecture

Table 3-1 Functional modules

Functional Module	Corresponding Component	Function Description
Service interface unit	SL1, SD1, SLE, SDE, PH1, PO1, EFT4	• Accesses E1/STM-1o/STM-1e/FE signals.
Cross-connect unit	PXC (XC)	• Cross-connects and grooms services. • Supports 1+1 standby.
IF unit	IF1A (IF), IF1B (IF)	• Converts signals between service signals and IF analog signals. • Supports hitless switching for 1+1 FD/SD configuration. • Supports FEC. • Supports ATPC.
Control unit	SCC (SCC)	• System communications and control. • System configuration and management. • Collects alarms and monitors performance.
Clock unit	PXC (CLK)	• Traces the clock source signal and provides various clock signals for the system.
Auxiliary interface unit	SCC (EOW)	• Provides the orderwire interface. • Provides the asynchronous data interface. • Provides the external alarm input/output interface.
Fan and power unit	PXC (PWR), SCC (PWR), IF1A (PWR), IF1B (PWR), FAN	• Provides –48 V/+3.3 V power for the IDU. • Supports the backup function of the input power supply and the internal power supply. • Provides –48 V power for the ODU. • Provides air cooling for the IDU 620.
ODU	ODU	• Converts signals between IF signals and RF analog signals. • Provides the operations and maintenance (O&M) channel to the IDU.

3.2 Hardware Structure

The OptiX RTN 600 hardware consists of IDU and ODU. The ODU is connected to the IDU through a coaxial cable. The cable is used to transmit IF signals, O&M signals, and –48 V DC power.

3.2.1 IDU

The IDU is the indoor unit of an OptiX RTN 600 system. It accesses services, and performs multiplexing/demultiplexing and IF processing for the services.

The IDU is designed with slots. You can install different types of boards into the slots to realize different functions.

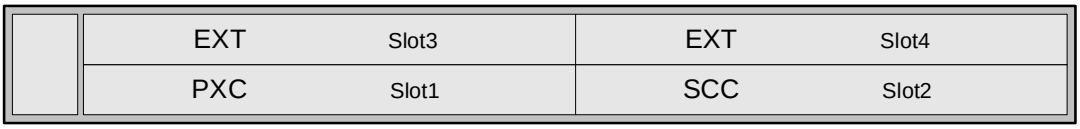

Figure 3-2 IDU 610 configuration

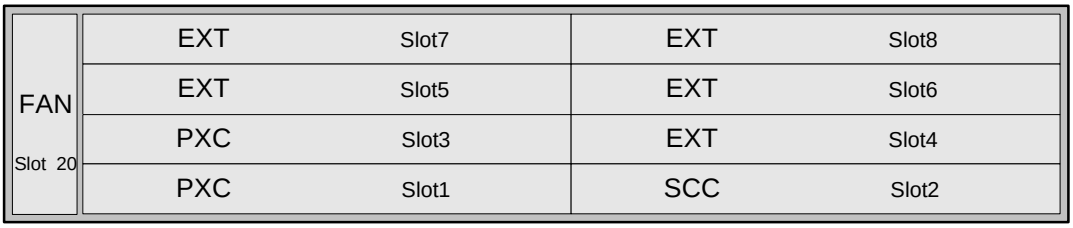

Figure 3-3 IDU 620 configuration

Note:

EXT refers to the extended slot. The slots of the IF board and the service board are called extended slots.

Table 3-2 List of IDU boards

Board Name	Full Name	Available Slot		Description
		IDU 610	IDU 620	
PXC	Integrated power cross-connect clock board	Slot 1	Slot 1/3	• Accesses one –48 V/–60 V DC power signal. • Provides full timeslot cross-connection for VC-12/VC-3/VC-4 services equivalent to 16x16 VC-4.
SCC	System control and communication board	Slot 2		• Integrates an EOW subboard, occupying the logical slot 21.

Board Name	Full Name	Available Slot		Description
		IDU 610	IDU 620	
IF1A	Isolated intermediate frequency board	Slot 4	Slot 5/6/7/8	• Provides one IF interface. The logical slot number of the ODU connected is the slot number of the IF board plus 10. • At most one IF board can be configured for the IDU 610 and four IF boards for the IDU 620. • The IF1A supports the DC-I and DC-C power distribution modes. The IF1B only supports DC-C.
IF1B	Non-isolated intermediate frequency board			
SL1	SDH single STM-1 port board	Slot 3/4	Slot 4/5/6/7/8	• Uses the SFP optical module to provide one STM-1 optical interface.
SD1	SDH dual STM-1 port board			• Uses the SFP optical module to provide two STM-1 optical interfaces.
SLE	SDH single STM-1 electrical port board			• Provides one 75-ohm STM-1 electrical interface.
SDE	SDH dual STM-1 electrical port board			• Provides two 75-ohm STM-1 electrical interfaces.
PO1	8xE1 tributary board			• Provides eight 75/120-ohm E1 interfaces.
PH1	16xE1 tributary board			• Provides 16 75/120-ohm E1 interfaces.
EFT4	4-port 10M/100M Ethernet transparent transmission processing board			• Provides a 4x10M/100M BASE-T(x) interface for processing Ethernet transparent transmission services. The uplink bandwidth of the board is 2xVC-4.
FAN	Fan board	-	Slot 20	Provides air cooling for the IDU 620.

3.2.2 ODU

The ODU is the outdoor part of the OptiX RTN 600 system. It performs frequency conversion and amplification for RF signals.

The ODU is an integrated system and has various types. Different types of ODUs have the same structure and conform to the same working principle. They only differ in the operating frequency band, sub-band, T/R spacing, and higher/lower station.

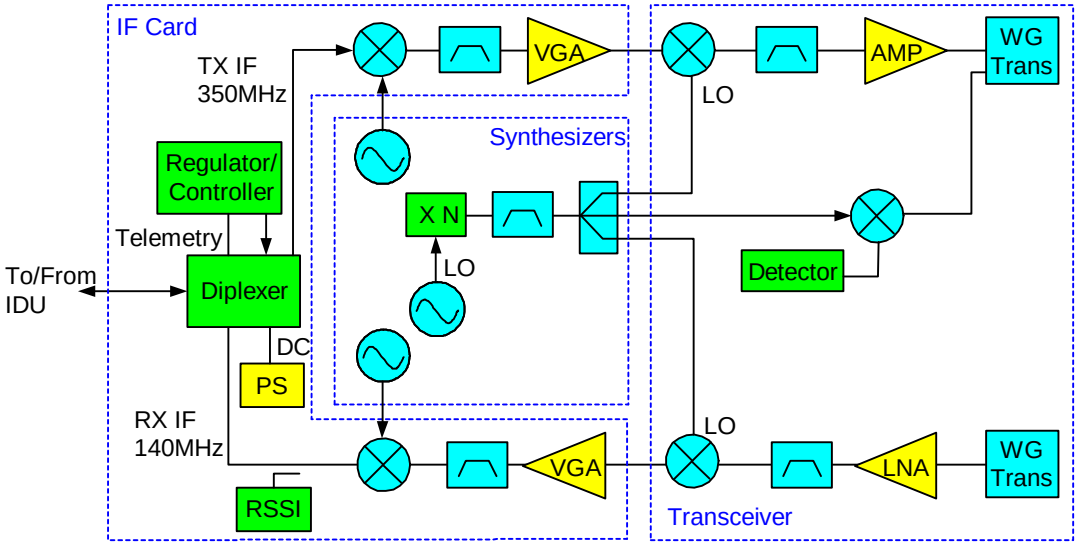

Figure 3-4 Block diagram of an ODU

3.3 Software Architecture

The software package of the OptiX RTN 600 contains the network management system (NMS) software, NE software, and board software.

3.3.1 NMS software

Refer to Chapter 6 "Network Management System."

3.3.2 NE Software

The NE software runs in the SCC board. It monitors, manages, and controls the running status of the IDU. Through the NE software, the NMS communicates with the boards, controls and manages the NE.

3.3.3 Board Software

The board software manages and controls the running status of the ODU and all the boards except for the SCC of the IDU. Integrated with the NE software, all board software runs in the SCC board.

Note:

In the software architecture, the ODU is considered as a logical board. The ODU board software in the SCC board manages and controls the ODU hardware through the management channel between the IDU and the ODU.

3.4 Service Signal Processing Flow

The following describes the flow that the OptiX RTN 600 processes service signals through the example of STM-1 optical signals.

Table 3-3 Transmit direction

No.	Component	Signal Processing Description
1	SL1/SD1 (IDU)	• Converts the STM-1 optical signals into STM-1 electrical signals. • Synchronizes and descrambles the frames. • Extracts the overheads from the STM-1 frames. • Transmits the VC-4 signals in the STM-1 frames to the cross-connect unit through the service bus.
2	PXC (IDU)	• Cross-connects the VC-4 signals to the service bus of the IF1A/IF1B board.
3	IF1A/IF1B (IDU)	• Multiplexes the VC-4 signals, microwave frame overheads, and pointers to be STM-1 microwave frames. • Scrambling. • FEC coding. • Digital modulation. • D/A conversion. • Analog modulation. • Combines the analog IF signals and ODU O&M signals. The ODU O&M signals have been modulated by the auxiliary MODEM. • Transmits the combined signals and –48 V power to the ODU through the coaxial cable.
4	ODU	• Divides the analog IF signals, ODU O&M signals, and –48 V power. • Converts the analog IF signals into RF signals through up conversions and amplifications. • Transmits the RF signals to the antenna through the waveguide.

Table 3-4 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 amplifications. • Controls the level of the signals through the automatic gain control (AGC) circuit. • Combines the IF signals and the ODU O&M signals. The O&M signals have been modulated by an auxiliary modem. • Transmits the combined signals to the IF1A/IF1B.
2	IF1A/IF1B (IDU)	• Divides the received analog IF signals and ODU O&M signals. • Controls the level of the analog IF signals through the AGC circuit. • Performs A/D conversion for the IF signals. • Digital demodulation. • Time domain adaptive equalization. • FEC decoding. • Frame synchronization and descrambling. • Extracts overheads from microwave frames. • Extracts VC-4 signals from microwave frames, and transmits the VC-4 signals to the cross-connect unit.
3	PXC (IDU)	• Cross-connects the VC-4 signals to the service bus of the SL1/SD1 board.
4	SL1/SD1 (IDU)	• Multiplexes the VC-4 signals, overheads, and pointers to be STM-1 signals. • Scrambles the signals. • Converts the signals to be STM-1 optical signals.

Chapter 4 RF Configuration

4.1 1+0 Non-Protection Configuration

The microwave link configured with 1+0 non-protection has one working channel only. There is no standby channel.

This section describes the configuration requirements and system block diagram of 1+0 non-protection configuration of the OptiX RTN 600 through an example.

4.1.1 Configuration Requirements

Table 4-1 Requirements for 1+0 non-protection configuration

Component	Configuration Requirement
IF1A/IF1B	1 PCS
ODU	1 PCS
Antenna	1 PCS

4.1.2 System Block Diagram

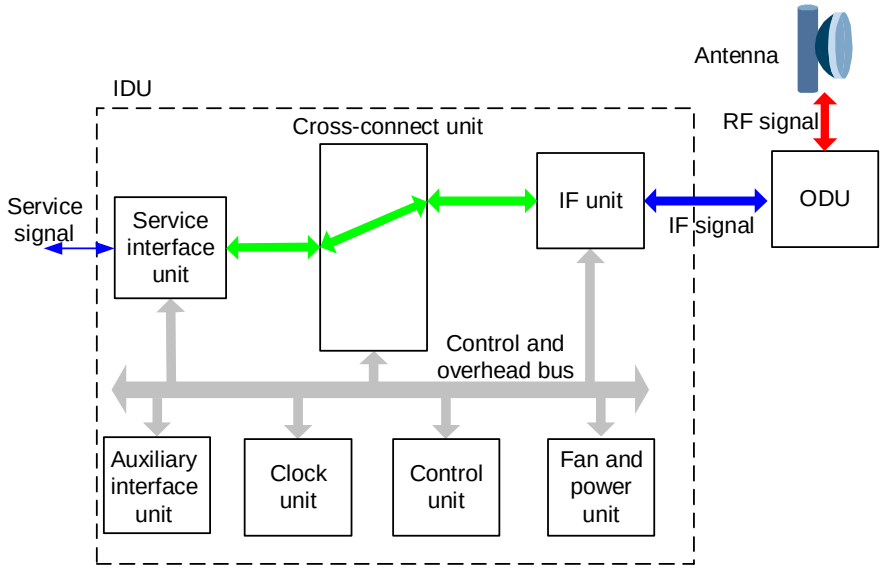

Figure 4-1 Block diagram of a 1+0 non-protection microwave transmission system

4.2 1+1 Protection Configuration

For each hop of 1+1 protection microwave transmission link, there is one main channel and one standby channel. 1+1 protection has three types, 1+1 HSB, 1+1 FD, and 1+1 SD.

This section describes the configuration requirements and system block diagram of 1+1 protection configuration through the example of the OptiX RTN 600 with 1+1 protection configuration in one direction.

4.2.1 1+1 HSB Configuration

In a 1+1 hot standby (HSB) system, each of the IF unit and the ODU has a hot standby.

During 1+1 HSB switching, transient interruption will occur to services.

I. Configuration Requirements

Table 4-2 Requirements for 1+1 HSB configuration (one direction)

Component	Configuration Requirement
IF1A/IF1B	2 PCS
ODU	2 PCS
Antenna	1 PCS (with 1 PCS hybrid coupler)

II. System Block Diagram

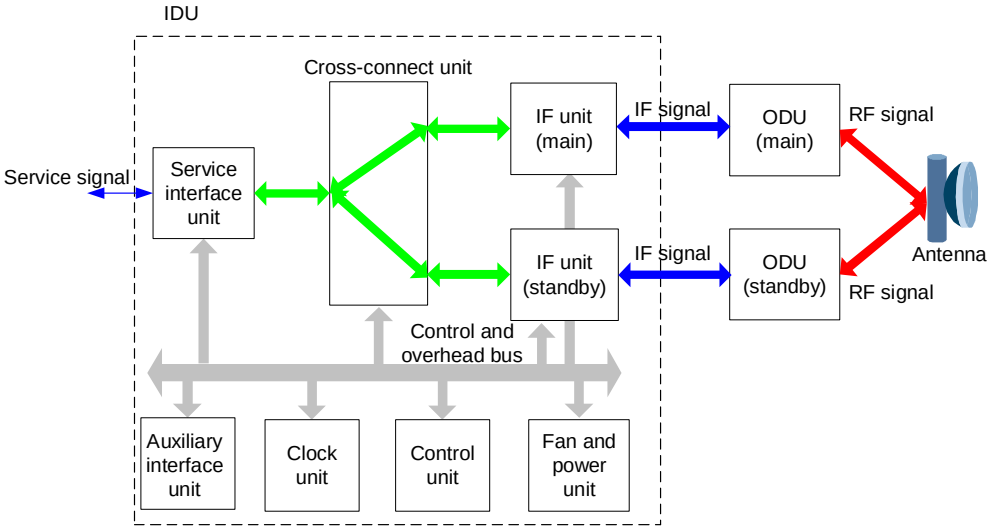

Figure 4-2 Block diagram of a 1+1 HSB microwave transmission system (one direction)

III. Switching Principle

- Transmit direction

The cross-connect unit transmits two service signals to the main and the standby IF units. Normally, only the main ODU transmits the RF signals to the antenna. When the main IF unit or the main ODU becomes faulty, the standby ODU takes over and starts to transmit signals to the antenna.

- Receive direction

The antenna transmits two RF signals to the main and the standby ODUs. Normally, the cross-connect unit selects the service signal coming from the main IF unit. When the main IF unit or the main ODU becomes faulty, the cross-connect unit selects the service signal coming from the standby IF unit.

Note:

The 1+1 HSB switching can also be triggered when the local NE receives the RDI signal coming from the remote NE.

4.2.2 1+1 FD Configuration

1+1 frequency diversity (FD) is one of the methods for channel backup. The OptiX RTN 600, configured with 1+1 FD, employs two channels that have certain frequency spacing to transmit and receive the same signal. Thus the fading in the signal transmission is reduced.

In a 1+1 FD OptiX RTN 600 system, the frequency correlation of two channels is required to be small enough. Otherwise, severe fading may occur to the receive signals of the two diversities.

The 1+1 FD switching does not affect services.

I. Configuration Requirements

Table 4-3 Requirements for 1+1 HSB configuration (one direction)

Component	Configuration Requirement
IF1A/IF1B	2 PCS (paired in slot 5 and slot 7, or in slot 6 and slot 8)
ODU	2 PCS
Antenna	1 PCS (with one balanced hybrid coupler), or 2 PCS

II. System Block Diagram

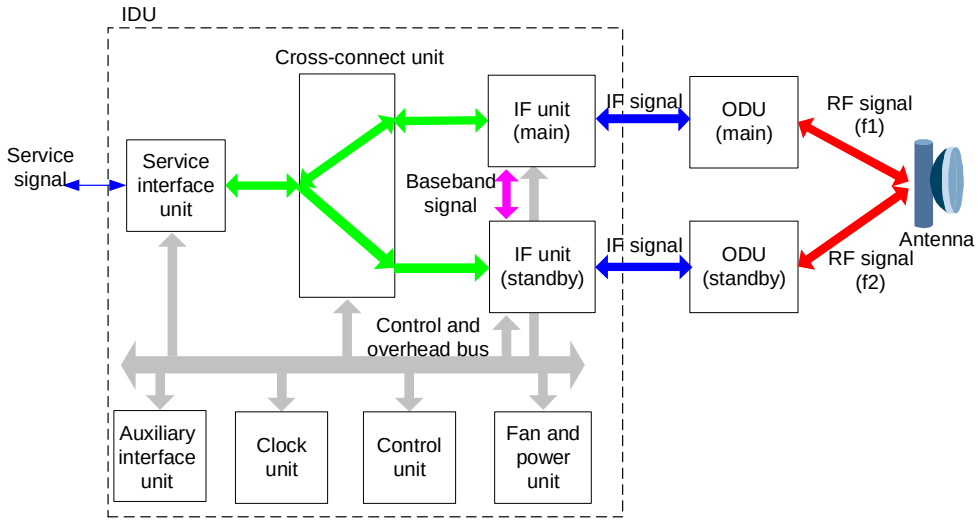

Figure 4-3 Block diagram of a 1+1 FD microwave transmission system (one antenna in one direction)

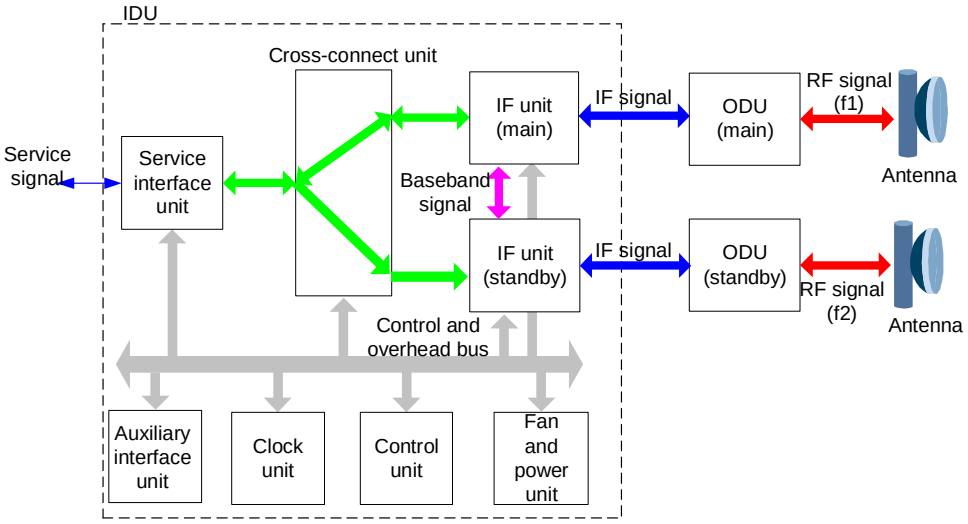

Figure 4-4 Block diagram of a 1+1 FD microwave transmission system (two antennas in one direction)

III. Switching Principle

- Transmit direction

The cross-connect unit transmits two service signals to the main and the standby IF units. The main ODU transmits an RF signal with a frequency of f1 to the antenna.

The standby ODU transmits an RF signal with a frequency of f2 to the antenna. Frequencies f1 and f2 has little correlation.

- Receive direction

The main and standby ODUs extract the RF signals at the frequencies of f1 and f2 respectively received from the antenna. When the main channel becomes faulty or the BER crosses the threshold, the standby IF unit transmits the standby baseband signal to the main IF unit, and the main IF unit transmits the main baseband signal to the standby IF unit. The cross-connect unit selects the service signal from the main IF unit only.

Note:

1+1 FD is compatible with HSB. When the main IF unit or the main ODU becomes faulty, the cross-connect unit selects the service signal from the standby IF unit. This is the HSB switching. During 1+1 HSB switching, transient interruption will occur to services.

4.2.3 1+1 SD Configuration

1+1 space diversity (SD) is one of the methods for channel backup. The OptiX RTN 600, configured with 1+1 SD, employs two antennas that have certain space to receive the same signal. Thus the fading in the signal transmission is reduced.

In a 1+1 SD OptiX RTN 600 system, choose proper height difference for two antennas to reduce space correlation. Otherwise, severe fading may occur to the receive signals of the two diversities.

The 1+1 SD switching does not affect services.

I. Configuration Requirements

Table 4-4 Requirements for 1+1 SD configuration

Component	Configuration Requirement
IF1A/IF1B	2 PCS (paired in slot 5 and slot 7, in slot 6 and slot 8)
ODU	2 PCS
Antenna	2 PCS

II. System Block Diagram

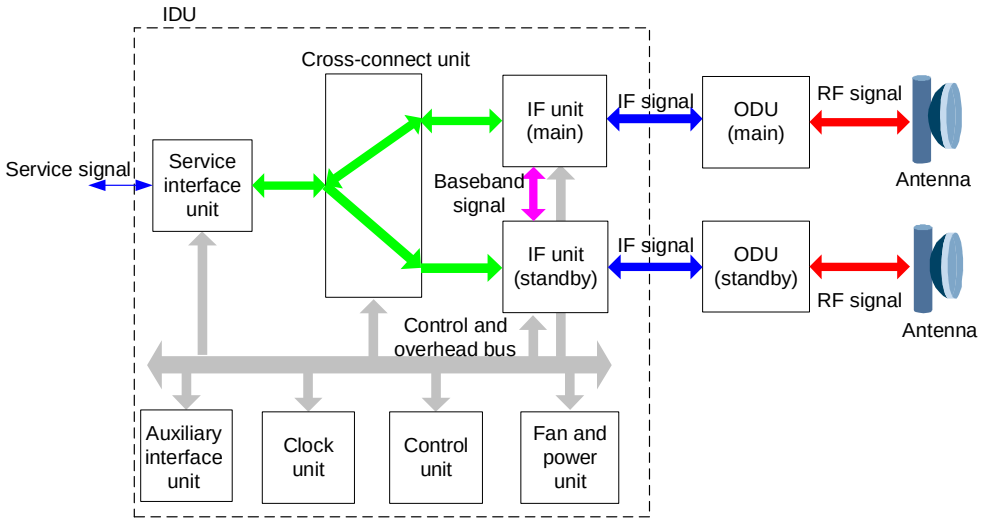

Figure 4-5 Block diagram of a 1+1 SD microwave transmission system

III. Switching Principle

- Transmit direction

The cross-connect unit transmits two service signals to the main and the standby IF units. Normally, only the main ODU transmits the RF signals to the antenna. When the main IF unit or the main ODU becomes faulty, the standby ODU takes over and starts to transmit signals to the antenna.

- Receive direction

The two antennas transmit the received RF signals to the main and the standby ODUs. When the main channel becomes faulty or the BER crosses the threshold, the standby IF unit transmits the standby baseband signal to the main IF unit, and the main IF unit transmits the main baseband signal to the standby IF unit. The cross-connect unit selects the service signal from the main IF unit only.

Note:

- 1+1 SD is compatible with HSB. When the main IF unit or the main ODU becomes faulty, the cross-connect unit selects the service signal from the standby IF unit. During 1+1 HSB switching, transient interruption will occur to services.
- 1+1 SD also supports reverse switching. The HSB can be triggered when the local NE receives the RDI signal coming from the remote NE.

Chapter 5 Networking

5.1 Point-to-Point

Under this networking mode, the services between two nodes are transported over microwave.

In this case, the OptiX RTN 600 usually adopts 1+0 non-protection configuration. For key services, 1+1 protection configuration is also used.

Figure 5-1 Point-to-point networking

5.2 Chain Networking

Under this networking mode, all the microwave transmission nodes are connected in series, and the head and tail nodes are not connected.

Figure 5-2 shows a chain network without protection to its microwave links. In this example, the terminal nodes adopt 1+0 non-protection configuration, and the intermediate one adopts 1+0 non-protection configuration in two directions.

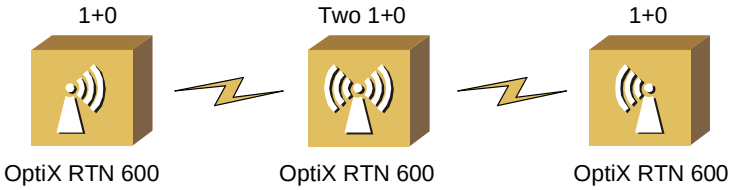

Figure 5-2 Chain networking (without protection)

Figure 5-3 shows a chain network that offers protection to its microwave links. In this example, the terminal nodes adopt 1+1 configuration, and the intermediate one adopts 1+1 protection configuration in two directions.

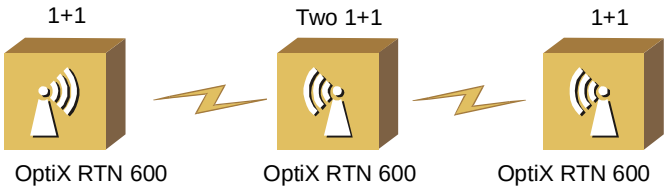

Figure 5-3 Chain networking (with protection)

5.3 Tree Networking

Under this networking mode, several chains are connected at one or more nodes and the nodes do not form a ring.

Figure 5-4 describes an application example of tree networking in mobile network back transmission. The link near the BSC side adopts 1+1 protection configuration and the microwave capacity is 16xE1 or 1xSTM-1. The link at the network edge adopts 1+0 non-protection configuration and the microwave capacity is 4xE1.

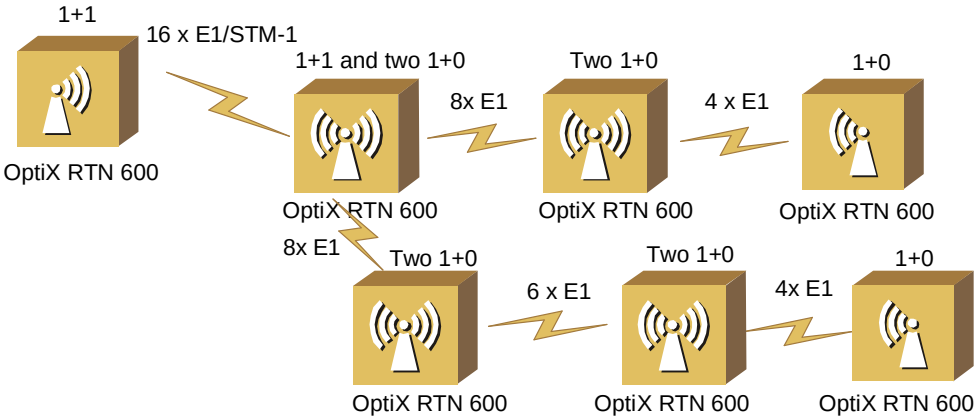

Figure 5-4 Tree networking

5.4 Fiber Ring Networking

Under this networking mode, optical transmission systems form a ring through fiber connection, and microwave transmission systems are directly connected to the ring or indirectly connected to the ring through STM-1o or STM-1e.

Figure 5-5 shows a network with a fiber ring and a microwave link directly connected to the ring. In this example, the optical transmission systems and the OptiX RTN 600 systems form an STM-1 ring. The ring adopts the SNCP protection mechanism.

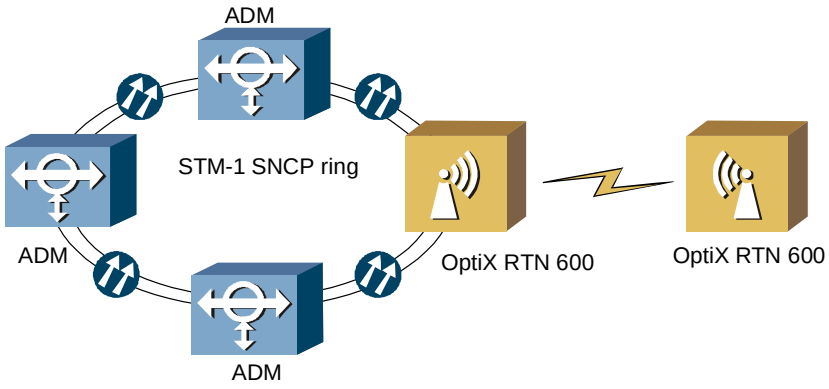

Figure 5-5 Fiber ring networking (microwave services directly accessed)

Figure 5-6 shows a network with a fiber ring and a microwave link indirectly connected to the ring. In this example, optical transmission systems form an STM-4 ring. The ring adopts the protection mechanism of two fiber bidirectional multiplex section shared protection ring. The microwave link is connected to the ring through an STM-1 optical interface. If the microwave transmission services are important, configure linear MSP for the fiber link between the ring and the microwave link.

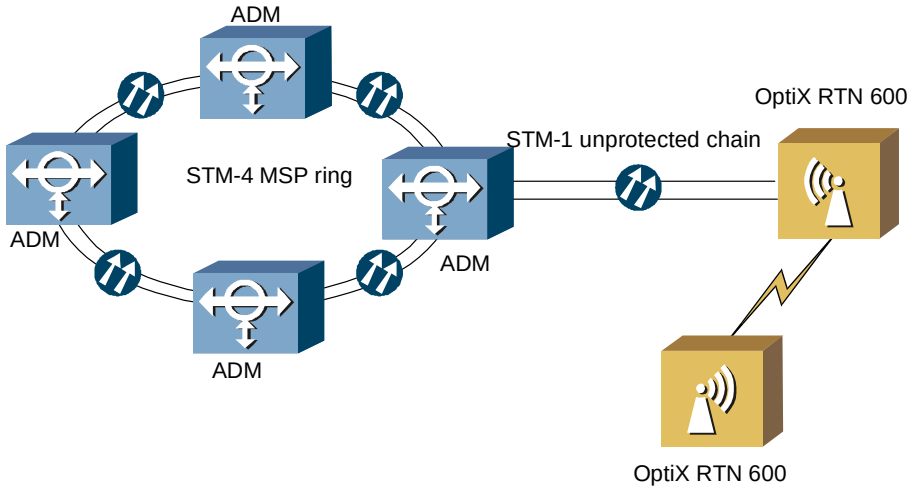

Figure 5-6 Fiber ring networking (microwave services indirectly accessed)

5.5 Microwave Ring Networking

Under this networking mode, the OptiX RTN 600 forms a microwave ring network.

Figure 5-7 shows an STM-1 microwave ring network. The ring adopts the SNCP protection mechanism. The OptiX RTN 600 adopts 1+0 non-protection configuration in two directions.

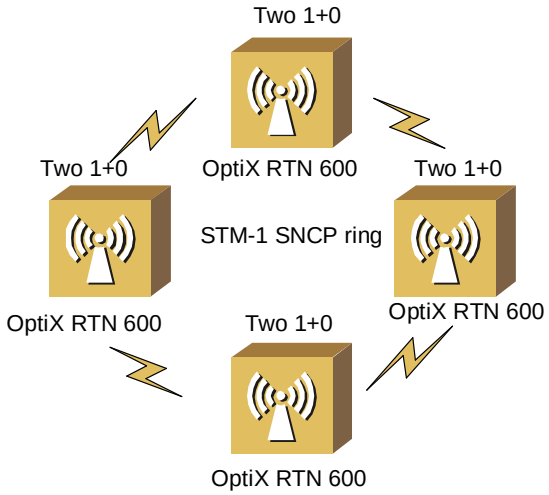

Figure 5-7 Microwave ring networking

Note:

The OptiX RTN 600 also supports PDH microwave networking. In this case, the SNCP protection mechanism can also be applied.

5.6 Hybrid Networking

Under this networking mode, the OptiX RTN 600 and optical transmission systems form a ring network.

Figure 5-8 shows an STM-1 hybrid network. The ring adopts the SNCP protection mechanism. The OptiX RTN 600 adopts 1+0 non-protection configuration.

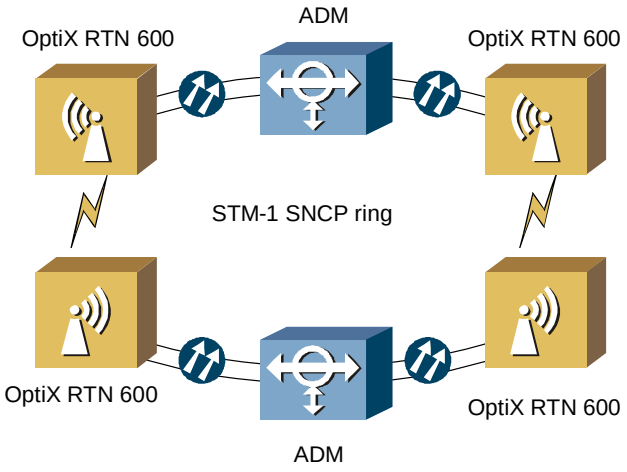

Figure 5-8 Hybrid networking

Chapter 6 Network Management System

6.1 NM Solution

Huawei provides a complete transport network management solution compliant with telecommunication management network (TMN) for different function domains and customers in telecommunication networks.

The NM solutions include:

- iManager T2000 web local craft terminal
- iManager T2000 subnetwork level management system
- iManager T2100 network level management system

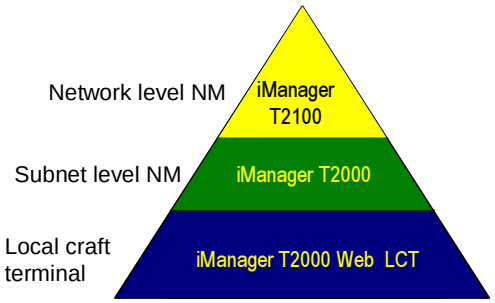

Figure 6-1 NM solution of a transport network

6.2 Web LCT

The Web LCT is a local craft terminal. Users can access the Web LCT terminal through the Internet Explorer and thus achieve the management over a single OptiX RTN 600 NE.

6.2.1 Functionality

- Object NE management
- NE level alarm management
- NE level security management
- NE level communication management
- NE level configuration management

6.2.2 Networking

A Web LCT server can be accessed to a network in two modes: near end mode and gateway mode.

I. Near End Mode

In this mode, the Web LCT server is connected to the NM interface of the target NE directly or through a data communication network (DCN) and performs management.

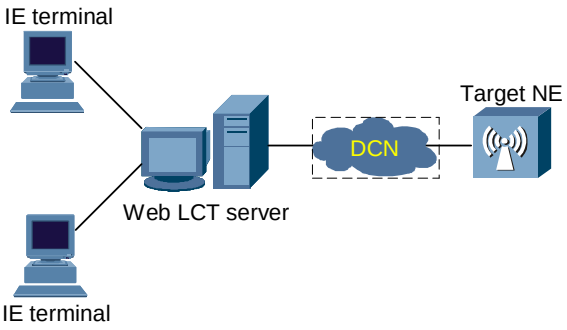

Figure 6-2 Web LCT networking mode (near end)

Note:

The Web LCT server can access the management serial port of the NE to perform NE management through a serial port cable.

The OptiX RTN 600 also supports one upper NE managing a lower NE. The upper NE acts as a hub and a part of the DCN network. This still belongs to the near end mode.

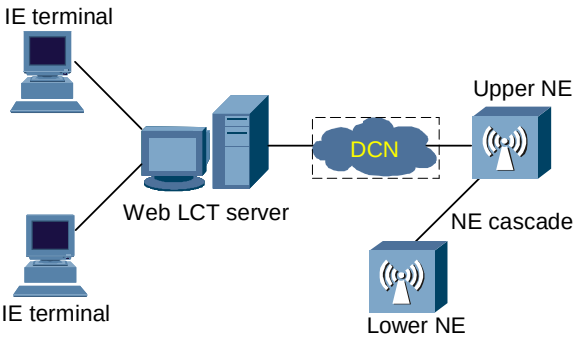

Figure 6-3 Web LCT networking mode (near end)

Note:

- DCN communications use the TCP/IP or TP4 protocol.
- To cascade NEs, use a network cable or DCN to connect the NE cascade interface of the upper NE with the NM interface of the lower NE.

II. Gateway Mode

In this mode, there is a gateway NE (GNE), and the Web LCT server is connected to the NM interface of the GNE directly or through a DCN network. The GNE communicates with the target NE using embedded control channel (ECC). The GNE interfaces between the Web LCT server and the target NE to forward messages.

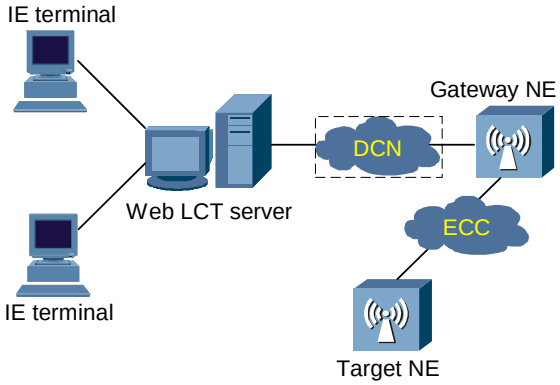

Figure 6-4 Web LCT networking mode (gateway mode)

Note:

- The GNE can be any of Huawei OptiX series of transmission products.
- ECC employs either the SDH DCC or the microwave DCC for transmission. When the extended ECC function is enabled, ECC can also be transmitted over DCN. Figure 6-5 shows a network where there is no DCC channel between the GNE and the target NE, and a network cable or a DCN network is used to transmit ECC.

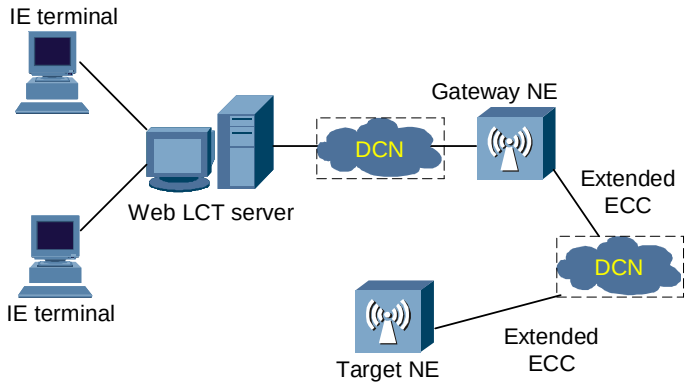

Figure 6-5 Web LCT networking mode (extended ECC)

6.3 T2000

The T2000 is a subnetwork level management system. Users can access the T2000 server through a T2000 client and thus achieve uniform management over a transmission network composed of Huawei's OptiX series of transmission products.

6.3.1 Functionality

I. NE Layer Management

- Object NE management
- NE level alarm management
- NE level security management
- NE level communication management
- NE level configuration management

II. Network Layer Management

- Topology management
- Network level alarm management
- Network level security management
- Network level communication management
- Network-wide clock management

III. Others

- Report function
- Man-Machine Language (MML) or northbound CORBA interface

6.3.2 Networking

The T2000 provides users with single layer management network solutions for small and medium transmission networks. Together with the upper level network management system (through the standard external interfaces), the T2000 can assist the network layer management system and the service layer management system in managing large transmission networks.

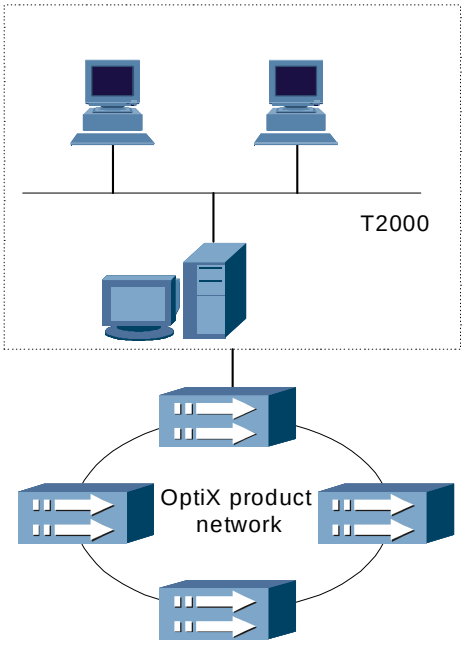

Figure 6-6 Single layer management network

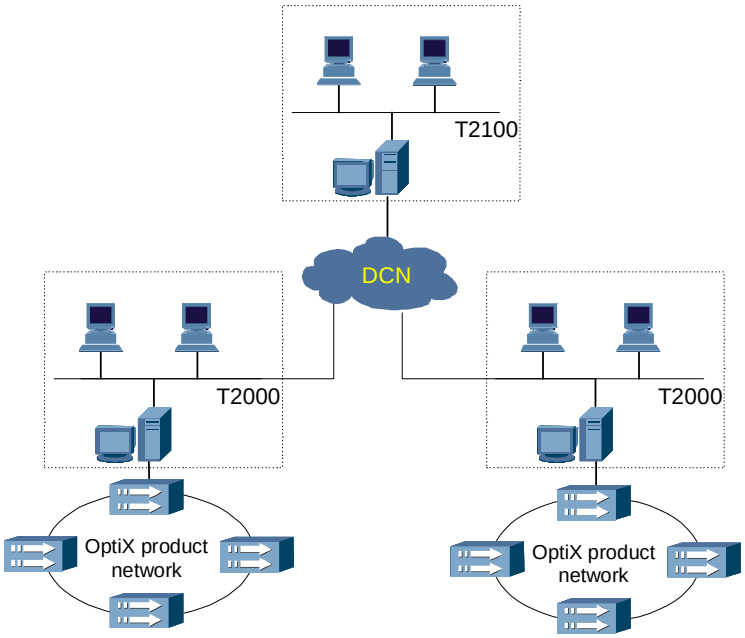

Figure 6-7 Hierarchical management network

6.4 T2100

The T2100 is a network level management system. Users can access the T2100 server through a special T2100 client and thus achieve uniform management over multiple transmission networks composed of Huawei's OptiX series of transmission products.

The T2100 and the T2000 form a hierarchical management network to manage large transmission networks. The hierarchical management system can:

- Strengthen the network management ability.
- Realize uniform network management.
- Separate NE management from network management.
- Meet the requirements for the O&M mechanism of operators.

Chapter 7 Performance

7.1 Radio Performance

7.1.1 Frequency Band

Table 7-1 Frequency band

Frequency Band	Frequency Range (GHz)	T/R spacing (MHz)
7GHz	7.093 to 7.897	154, 160, 161, 168, 196, 245
8GHz	7.731 to 8.497	119, 126, 151.614, 208, 266, 311.32
11GHz	10.675 to 11.745	490, 530
13GHz	12.751 to 13.248	266
15GHz	14.400 to 15.358	315, 420, 475, 490, 640, 644, 728
18GHz	17.685 to 19.710	1010, 1008, 1560
23GHz	21.200 to 23.618	1008, 1200, 1232
26GHz	24.250 to 26.453	800, 1008
38GHz	37.044 to 40.105	700, 1260

Note: For detailed frequency information, refer to Appendix A “Frequency Information.”

7.1.2 Receiver Sensitivity

Table 7-2 Receiver sensitivity

Item	Performance						
	4xE1		8xE1		16xE1		STM-1
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	128QAM
RSL@ BER=10^{-6} (dBm)							
@ 7GHz	–91.5	–87.5	–88.5	–84.5	–85.5	–81.5	–69.5
@ 8GHz	–91.5	–87.5	–88.5	–84.5	–85.5	–81.5	–69.5
@ 11GHz	–91.0	–87.0	–88.0	–84.0	–85.0	–81.0	–69.0
@ 13GHz	–91.0	–87.0	–88.0	–84.0	–85.0	–81.0	–69.0
@ 15GHz	–91.0	–87.0	–88.0	–84.0	–85.0	–81.0	–69.0
@ 18GHz	–91.0	–87.0	–88.0	–84.0	–85.0	–81.0	–69.0
@ 23GHz	–90.5	–86.5	–87.5	–83.5	–84.5	–80.5	–68.5
@ 26GHz	–90.0	–86.0	–87.0	–83.0	–84.0	–80.0	–68.0
@ 38GHz	–88.5	–84.5	–85.5	–81.5	–82.5	–78.5	–66.5

Note: For guaranteed value, remove 3 dB from the typical value.

7.1.3 Modem Performance

Table 7-3 Modem performance

Item	Performance						
	4xE1		8xE1		16xE1		STM-1
Modulation scheme	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	128QAM
Channel spacing (MHz)[a]	7	3.5	13.75/14[b]	7	27.5/28[c]	13.75/14[b]	27.5/28[c]
Encoding mode	Reed-Solomon (R-S) encoding for PDH signals Trellis-coded modulation (TCM) and the R-S two-level encoding for SDH signals						
Adaptive time-domain equalizer for baseband signals	Consisting of the 24-tap feed forward equalizer filter and the 3-tap decision feedback equalizer						

a: The channel spacing described in the table is the minimum channel spacing supported by the equipment. The channel spacing bigger than this value is all supported.

b: At 18 GHz, the channel spacing is 13.75 MHz. At other frequency bands, the channel spacing is 14 MHz.

c: At 18 GHz, the channel spacing is 27.5 MHz. At other frequency bands, the channel spacing is 28 MHz.

7.1.4 IF Performance

Table 7-4 IF performance

Item	Performance
IF signal	
Transmit frequency (MHz)	350
Receive frequency (MHz)	140
Impedance (ohm)	50
ODU management signal	
Modulation scheme	ASK
Transmit frequency (MHz)	5.5
Receive frequency (MHz)	10

7.1.5 Transceiver Performance

Table 7-5 Transceiver performance

Item	Performance								
	7GHz	8GHz	11GHz	13GHz	15GHz	18GHz	23GHz	26GHz	38GHz
Nominal maximum transmit power (dBm)									
QPSK	25.5/30.0[a]	25.5/30.0[a]	24.5	24.5	24.5	24	22.5	22	20.5
16QAM	21.0/28.0[a]	21.0/28.0[a]	20	20	20	20	19	18	16
128QAM	15.0/24.5[a]	15.0/24.5[a]	14	14	14	14	13	12	10
Nominal minimum transmit power (dBm)	–4								
Stability of the frequency (ppm)	±5								

a: The number before the solidus refers to the nominal maximum transmit power of a standard power ODU, and the number after the solidus refers to the nominal maximum transmit power of a high power ODU.

7.1.6 Multipath Immunity

Table 7-6 Multipath immunity

Item	Performance
STM-1/128QAM W-curve	See Figure 7-1.
STM-1/128QAM dispersion fading margin	51 dB

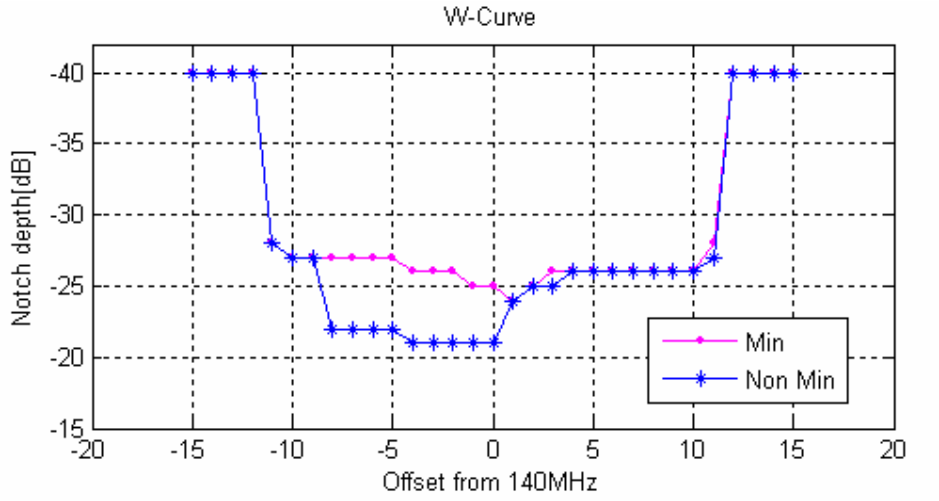

Figure 7-1 W-curve

7.2 Reliability

Table 7-7 Component reliability

Item	Performance		
	IDU 610	IDU 620	ODU
MTBF (h)	45.7×10^4	93.5×10^4	48.18×10^4
MTTR (h)	1	1	1
Availability	99.99978%	99.99989%	99.99979%

Table 7-8 Link reliability (per HOP)

Item	Performance	
	1+0 Non-Protection Configuration	1+1 Protection Configuration
MTBF (h)	23.5×10^4	78.3×10^4
MTTR (h)	1	1
Availability	99.99957%	99.99987%

7.3 Interface Performance

7.3.1 STM-1 Optical Interface

The performances of the STM-1 optical interface meet ITU-T G.957. The following table provides the primary performances.

Table 7-9 STM-1 optical interface performance

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	G.652 fiber	G.652 fiber	G.652 fiber
Transmission distance (km)	0.5	15	40	80/100
Operating wavelength (nm)	1270 to 1380	1261 to 1360	1280 to 1335	1480 to 1580
Mean launched power (dBm)	–19 to –14	–15 to –8	–5 to 0	–5 to 0
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:

All optical interface boards use the small form-factor pluggable (SFP) optical modules to provide optical interfaces. To provide optical interfaces with different classification codes or transmission distances, use the SFP optical modules of different types.

7.3.2 STM-1 Electrical Interface

The performances of the STM-1 electrical interface meet ITU-T G.703. The following table provides the primary performances.

Table 7-10 STM-1 electrical interface performance

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

7.3.3 E1 Interface

The performances of the E1 interface meet ITU-T G.703. The following table provides the primary performances.

Table 7-11 E1 interface performance

Item	Performance	
Nominal bit rate (kbit/s)	2048	
Code pattern	HDB3 (High Density Bipolar of order 3)	
Wire pair in each transmission direction	One coaxial wire pair	One symmetrical wire pair
Impedance (ohm)	75	120

7.3.4 10/100Base-T(x) Interface

The 10/100Base-T(x) interface conforms to IEEE 802.3u. The following table provides the primary performances.

Table 7-12 10/100Base-T (x) interface

Item	Performance
Nominal bit rate (Mbit/s)	10(10Base-T), 100(100Base-TX)
Code Pattern	Manchester encoding signal (10Base-T) or MLT-3 encoding signal (100Base-TX)
Interface type	RJ-45

7.3.5 Orderwire Interface

Table 7-13 Orderwire interface performance

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

7.3.6 Wayside Service Interface

Table 7-14 Wayside service interface performance

Item	Performance
Transmission path	Uses the user-defined byte in the overhead of the microwave frame.
Nominal bit rate (kbit/s)	2048
Wire pair in each transmission direction	One coaxial wire pair
Impedance (ohm)	75

7.3.7 Asynchronous Data Interface

Table 7-15 Asynchronous data interface performance

Item	Performance
Transmission path	Uses any byte in the serial 1 to serial 4 in the SDH overhead or the user-defined byte in the overhead of the microwave frame.
Nominal bit rate (kbit/s)	≤ 19.2
Interface characteristics	Meets RS232 standard.

7.4 Jitter Performance

Table 7-16 Jitter performance

Item	Performance
Output jitter at SDH interface	Compliant with ITU-T G.813/ITU-T G.825.
Output jitter at PDH interface	Compliant with ITU-T G.823/ITU-T G.783.

7.5 Clock Timing and Synchronization Performance

Table 7-17 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/ITU-T G.783.
Pull-in, hold-in, and pull-out ranges	
Noise generation	
Noise tolerance	
Noise transfer	
Transient response and holdover performance	

7.6 Integrated System Performance

7.6.1 Dimensions

Table 7-18 Dimensions of the OptiX RTN 600

Component	Dimensions
IDU 610	442 mm x 44 mm x 215 mm (width x height x depth)
IDU 620	442 mm x 87 mm x 215 mm (width x height x depth)
ODU	< 260 mm x 260 mm x 92 mm (width x height x depth)

7.6.2 Weight

Table 7-19 Weight of the OptiX RTN 600

Component	Weight (kg)
IDU 610	< 4
IDU 620	< 8
ODU	< 5

7.6.3 Power Supply

Table 7-20 Power supply of the OptiX RTN 600

Component	Performance
IDU 610	• Compliant with ETSI EN300 132-2. • Supports one –48 V/–60 V (–38.4 V to –72 V) DC power input. • Supports 1+1 standby of a 3.3 V power unit.
IDU 620	• Compliant with ETSI EN300 132-2. • Supports two –48 V/–60 V (–38.4 V to –72 V) DC power inputs (mutual backup). • Supports 2+1 standby of a 3.3 V power unit.
ODU	• Compliant with ETSI EN300 132-2. • The IDU provides one –48 V (–38.4 V to –72 V) DC power input.

7.6.4 Power Consumption

Table 7-21 Power consumption

Component	Power Consumption (W)
IDU 610	< 41
IDU 620	< 87.5
ODU	< 40 (standard) < 52 (high)

7.6.5 EMC

- Passes CE authentication.
- Compliant with ETSI EN 301 489-1.
- Compliant with ETSI EN 301 489-4.
- Compliant with EN55022 CLASS B.
- Compliant with CISPR 22.
- Compliant with EN 61000-4-2.
- Compliant with EN 61000-4-3.
- Compliant with EN 61000-4-4.
- Compliant with EN 61000-4-5.
- Compliant with EN 61000-4-6.

7.6.6 Lightning Protection

- Compliant with ITU-T K.11 standard.
- Compliant with ITU-T K.20 standard.
- Compliant with ITU-T K.27 standard.
- Compliant with ETSI EN 300 253 standard

7.6.7 Security

- Passes CE authentication.
- Compliant with ETSI EN 60215.
- Compliant with ETSI EN 60950.
- Compliant with IEC 60825.

7.6.8 Environment

The IDU is a unit used in a place with weather protection and controllable temperature. The ODU is an outdoor unit.

Table 7-22 Environment of the OptiX RTN 600

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	–5°C to +50°C	–35°C to +55°C
	Transportation and storage	–40°C to +70°C	–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.	

Appendix A Frequency Information

Table A-1 7 GHz frequency band

T/R Spacing (MHz)	Sub-band	Transmit Frequency of Non-Primary Station (MHz)		Transmit Frequency of Primary Station (MHz)	
		Lower Limit	Upper Limit	Lower Limit	Upper Limit
154	A	7,428.00	7,484.00	7,582.00	7,638.00
154	B	7,470.00	7,526.00	7,624.00	7,680.00
154	C	7,512.00	7,568.00	7,666.00	7,722.00
160	A	7,433.50	7,496.50	7,539.50	7,656.50
160	B	7,478.50	7,541.50	7,638.50	7,701.50
160	C	7,526.00	7,589.00	7,686.00	7,749.00
161	A	7,114.00	7,177.00	7,275.00	7,338.00
161	B	7,149.00	7,212.00	7,310.00	7,373.00
161	C	7,184.00	7,247.00	7,345.00	7,408.00
161	D	7,219.00	7,282.00	7,380.00	7,443.00
161	E	7,239.00	7,302.00	7,400.00	7,463.00
161	F	7,274.00	7,337.00	7,435.00	7,498.00
161	G	7,309.00	7,372.00	7,470.00	7,533.00
161	H	7,344.00	7,407.00	7,505.00	7,568.00
161	I	7,414.00	7,477.00	7,575.00	7,638.00
161	J	7,449.00	7,512.00	7,610.00	7,673.00
161	K	7,484.00	7,547.00	7,645.00	7,708.00
161	L	7,519.00	7,582.00	7,680.00	7,743.00
161	M	7,539.00	7,602.00	7,700.00	7,763.00
161	N	7,574.00	7,637.00	7,735.00	7,798.00
161	O	7,609.00	7,672.00	7,770.00	7,833.00
161	P	7,644.00	7,707.00	7,805.00	7,868.00
168	A	7,443.00	7,499.00	7,611.00	7,667.00
168	B	7,485.00	7,541.00	7,653.00	7,709.00
168	C	7,527.00	7,583.00	7,695.00	7,751.00

T/R Spacing (MHz)	Sub-band	Transmit Frequency of Non-Primary Station (MHz)		Transmit Frequency of Primary Station (MHz)	
		Lower Limit	Upper Limit	Lower Limit	Upper Limit
196	A	7,093.00	7,149.00	7,289.00	7,345.00
196	B	7,121.00	7,177.00	7,317.00	7,373.00
196	C	7,149.00	7,205.00	7,345.00	7,401.00
196	D	7,177.00	7,233.00	7,373.00	7,429.00
196	E	7,205.00	7,261.00	7,401.00	7,457.00
245	A	7,400.00	7,484.00	7,645.00	7,729.00
245	B	7,484.00	7,568.00	7,729.00	7,813.00
245	C	7,568.00	7,652.00	7,813.00	7,897.00

Table A-2 8 GHz frequency band

T/R Spacing (MHz)	Sub-band	Transmit Frequency of Non-Primary Station (MHz)		Transmit Frequency of Primary Station (MHz)	
		Lower Limit	Upper Limit	Lower Limit	Upper Limit
119.0/ 126.0	A	8,279.00	8,307.00	8,398.00	8,426.00
119.0/ 126.0	B	8,293.00	8,321.00	8,412.00	8,440.00
119.0/ 126.0	C	8,307.00	8,335.00	8,426.00	8,454.00
119.0/ 126.0	D	8,321.00	8,349.00	8,440.00	8,468.00
119.0/ 126.0	E	8,335.00	8,363.00	8,454.00	8,482.00
119.0/ 126.0	F	8,349.00	8,377.00	8,468.00	8,496.00
151.614	A	8,203.00	8,271.00	8,355.00	8,423.00
151.614	B	8,240.00	8,308.00	8,392.00	8,460.00
151.614	C	8,277.00	8,345.00	8,429.00	8,497.00
208	A	8,043.00	8,113.00	8,251.00	8,321.00
208	B	8,099.00	8,169.00	8,307.00	8,377.00
208	C	8,155.00	8,225.00	8,363.00	8,433.00

T/R Spacing (MHz)	Sub-band	Transmit Frequency of Non-Primary Station (MHz)		Transmit Frequency of Primary Station (MHz)	
		Lower Limit	Upper Limit	Lower Limit	Upper Limit
208	D	8,211.00	8,281.00	8,419.00	8,489.00
266	A	7,905.00	8,024.00	8,171.00	8,290.00
266	B	8,017.00	8,136.00	8,283.00	8,402.00
311.32	A	7,731.00	7,867.00	8,042.00	8,178.00
311.32	B	7,835.00	7,971.00	8,146.00	8,282.00

Table A-3 11 GHz frequency band

T/R Spacing (MHz)	Sub-band	Transmit Frequency of Non-Primary Station (MHz)		Transmit Frequency of Primary Station (MHz)	
		Lower Limit	Upper Limit	Lower Limit	Upper Limit
490	A	10,675.00	10,855.00	11,165.00	11,345.00
490	B	10,795.00	10,975.00	11,285.00	11,465.00
490	C	10,915.00	11,095.00	11,405.00	11,585.00
490	D	11,035.00	11,215.00	11,525.00	11,705.00
530	A	10,675.00	10,855.00	11,205.00	11,385.00
530	B	10,795.00	10,975.00	11,325.00	11,505.00
530	C	10,915.00	11,135.00	11,445.00	11,665.00
530	D	11,035.00	11,215.00	11,565.00	11,745.00

Table A-4 13 GHz frequency band

T/R Spacing (MHz)	Sub-band	Transmit Frequency of Non-Primary Station (MHz)		Transmit Frequency of Primary Station (MHz)	
		Lower Limit	Upper Limit	Lower Limit	Upper Limit
266	A	12,751.00	12,814.00	13,017.00	13,080.00
266	B	12,807.00	12,870.00	13,073.00	13,136.00
266	C	12,863.00	12,926.00	13,129.00	13,192.00
266	D	12,919.00	12,982.00	13,185.00	13,248.00

Table A-5 15 GHz frequency band

T/R Spacing (MHz)	Sub-band	Transmit Frequency of Non-Primary Station (MHz)		Transmit Frequency of Primary Station (MHz)	
		Lower Limit	Upper Limit	Lower Limit	Upper Limit
315	A	14,627.00	14,732.00	14,942.00	15,047.00
315	B	14,725.00	14,844.00	15,040.00	15,159.00
315	C	14,823.00	14,928.00	15,138.00	15,243.00
420	A	14,501.00	14,613.00	14,921.00	15,033.00
420	B	14,606.00	14,725.00	15,026.00	15,145.00
420	C	14,718.00	14,837.00	15,138.00	15,257.00
420	D	14,816.00	14,928.00	15,236.00	15,348.00
475	A	14,500.00	14,668.00	14,975.00	15,143.00
475	B	14,660.00	14,828.00	15,135.00	15,303.00
475	C	14,783.00	14,883.00	15,258.00	15,358.00
490	A	14,403.00	14,522.00	14,893.00	15,012.00
490	B	14,515.00	14,634.00	15,005.00	15,124.00
490	C	14,627.00	14,746.00	15,117.00	15,236.00
490	D	14,739.00	14,858.00	15,229.00	15,348.00
640	A	14,500.00	14,610.00	15,140.00	15,250.00
640	B	14,605.00	14,715.00	15,245.00	15,355.00
644	A	14,400.00	14,512.00	15,044.00	15,156.00
644	B	14,498.00	14,610.00	15,142.00	15,254.00
644	C	14,596.00	14,708.00	15,240.00	15,352.00
728	A	14,500.00	14,615.00	15,228.00	15,343.00

Table A-6 18 GHz frequency band

T/R Spacing (MHz)	Sub-band	Transmit Frequency of Non-Primary Station (MHz)		Transmit Frequency of Primary Station (MHz)	
		Lower Limit	Upper Limit	Lower Limit	Upper Limit
1010.00/ 1008.0	A	17,685.00	17,985.00	18,695.00	18,995.00

T/R Spacing (MHz)	Sub-band	Transmit Frequency of Non-Primary Station (MHz)		Transmit Frequency of Primary Station (MHz)	
		Lower Limit	Upper Limit	Lower Limit	Upper Limit
1010.0/ 1008.0	B	17,930.00	18,230.00	18,940.00	19,240.00
1010.0/ 1008.0	C	18,180.00	18,480.00	19,190.00	19,490.00
1010.0/ 1008.0	D	18,400.00	18,700.00	19,410.00	19,710.00
1560.00	A	17,700.00	18,000.00	19,260.00	19,560.00
1560.00	B	17,840.00	18,140.00	19,400.00	19,700.00
1560.00	C	17,700.00	18,140.00	19,260.00	19,700.00

Table A-7 23 GHz frequency band

T/R Spacing (MHz)	Sub-band	Transmit Frequency of Non-Primary Station (MHz)		Transmit Frequency of Primary Station (MHz)	
		Lower Limit	Upper Limit	Lower Limit	Upper Limit
1,008.00	A	21,994.00	22,330.00	23,002.00	23,338.00
1,008.00	B	22,274.00	22,610.00	23,282.00	23,618.00
1,200.00	A	21,200.00	21,530.00	22,400.00	22,730.00
1,200.00	B	21,490.00	21,820.00	22,690.00	23,020.00
1,200.00	C	21,780.00	22,110.00	22,980.00	23,310.00
1,200.00	D	22,070.00	22,400.00	23,270.00	23,600.00
1,232.00	A	21,200.00	21,500.00	22,432.00	22,732.00
1,232.00	B	21,472.00	21,786.00	22,704.00	23,018.00
1,232.00	C	21,779.00	22,093.00	23,011.00	23,325.00
1,232.00	D	22,086.00	22,386.00	23,318.00	23,618.00

Table A-8 26 GHz frequency band

T/R Spacing (MHz)	Sub-band	Transmit Frequency of Non-Primary Station (MHz)		Transmit Frequency of Primary Station (MHz)	
		Lower Limit	Upper Limit	Lower Limit	Upper Limit
800	A	24,250.00	24,450.00	25,050.00	25,250.00
1008	A	24,549.00	24,885.00	25,557.00	25,893.00
1008	B	24,829.00	25,165.00	25,837.00	26,173.00
1008	C	25,109.00	25,445.00	26,117.00	26,453.00

Table A-9 38 GHz frequency band

T/R Spacing (MHz)	Sub-band	Transmit Frequency of Non-Primary Station (MHz)		Transmit Frequency of Primary Station (MHz)	
		Lower Limit	Upper Limit	Lower Limit	Upper Limit
700	A	38,595.00	38,805.00	39,295.00	39,505.00
700	B	38,795.00	39,005.00	39,495.00	39,705.00
700	C	38,995.00	39,205.00	39,695.00	39,905.00
700	D	39,195.00	39,405.00	39,895.00	40,105.00
1260	A	37,044.00	37,632.00	38,304.00	38,892.00
1260	B	37,604.00	38,192.00	38,864.00	39,452.00

Appendix B Acronyms and Abbreviations

A	
ADM	add/drop multiplexer
AGC	Automatic Gain Control
ASK	Amplitude Shift Keying
ATPC	Automatic Transmit Power Control
B	
BER	Bit Error Rate
BSC	Base Station Controller
C	
CMI	Coded Mark Inversion
CORBA	Common Object Request Broker Architecture
D	
DC	Direct Current
DCC	Data Communications Channel
DCN	Data Communication Network
DFE	Decision Feedback Equalizer
E	
ECC	Embedded Control Channel
ETSI	European Telecommunications Standards Institute
F	
FD	Frequency Diversity
FEC	Forward Error Correction
FFF	Feed Forward Equalizer Filter
H	
HDB3	High Density Bipolar Code 3
HSB	Hot Standby
I	
IDU	Indoor Unit
IE	Internet Explorer
IEC	International Electrotechnical Commission

IF	Intermediate Frequency
IP	Internet Protocol
ITU-T	International Telecommunication Union - Telecommunication Standardization Sector
L	
LCS	Leased Circuit Service
LCT	Local Craft Terminal
M	
MML	Human-Machine Language (formerly Man-Machine Language)
MODEM	MOdulator-DEModulator
MTBF	Mean Time Between Failure
MTTR	Mean Time To Repair
N	
NMS	Network Management System
O	
ODU	Outdoor Unit
OSI	open systems interconnection
P	
PDH	Plesiochronous Digital Hierarchy
Q	
QPSK	Quadrature Phase Shift Keying
R	
RF	Radio Frequency
RSL	Received Signal Level
RSSI	Received Signal Strength Indicator
RTN	Radio Transmission Node
S	
SD	Space Diversity
SDH	Synchronous Digital Hierarchy
SFP	Small Form-Factor Pluggable
SNCP	Sub-Network Connection Protection
SNMP	Simple Network Management Protocol
SOH	SDH Overhead
SSM	Synchronization Status Message

STM-1	SDH Transport Module -1
STM-1e	STM-1 Electrical Interface
STM-1o	STM-1 Optical Interface
STM-4	SDH Transport Module -4
T	
TCM	Trellis Coded Modulation schemes
TCP	Transfer Control Protocol
TMN	Telecommunication Management Network
V	
VC-12	Virtual Container -12
VC-3	Virtual Container -3
VC-4	Virtual Container -4
VIP	Very Important Person
VPN	Virtual Private Network
VSM	VIP Service Management
W	
WS	Wayside