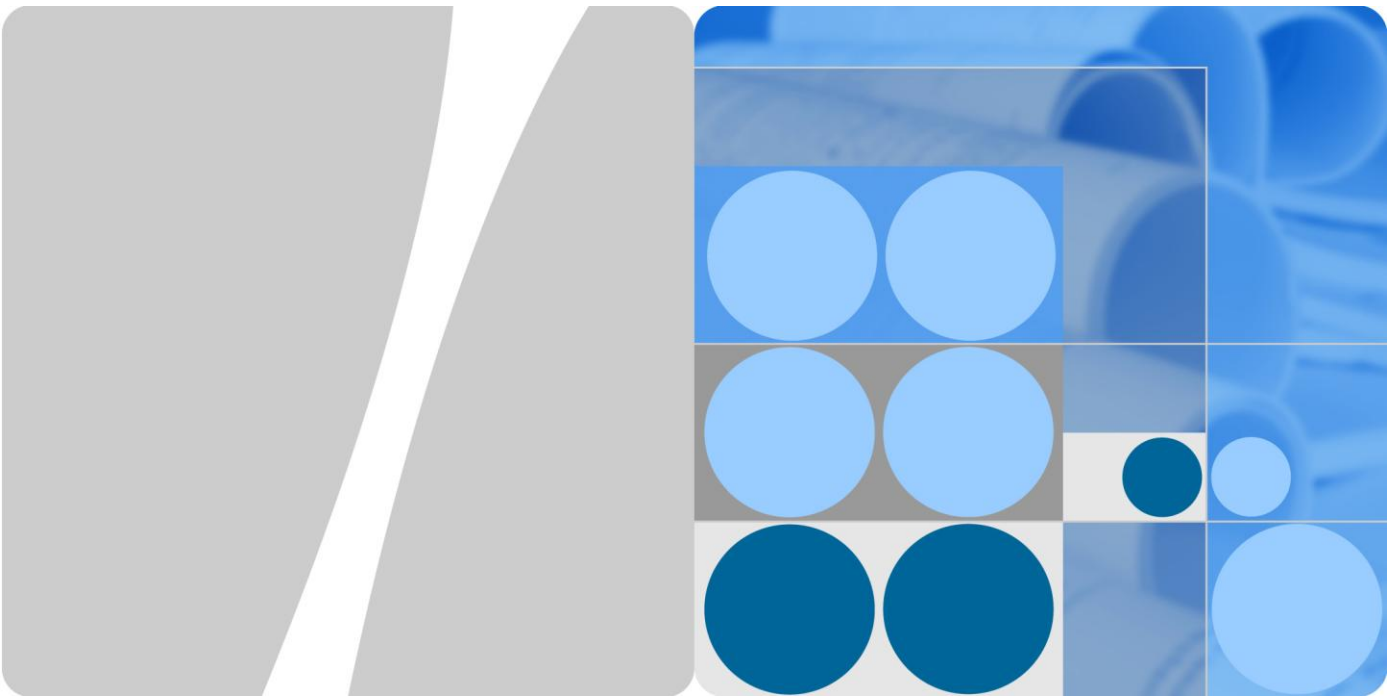

OptiX RTN 360 Radio Transmission V100R001C00

Product Description

Issue 02

Date 2014-08-30

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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 360	V100R001C00
iManager U2000–T	V200R014C50
iManager U2000–M	V200R014C00

Intended Audience

This document is intended for:

- Network planning engineer
- Hardware installation engineer
- Installation and commissioning engineer
- Field maintenance engineer
- Data configuration engineer
- System maintenance engineer

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.

Symbol	Description
 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.
 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`.

Change History

Changes between document issues are cumulative. The latest document issue contains all the changes made in earlier issues.

Updates in Issue 02 (2014-08-30) Based on Product Version V100R001C00

This issue is the second release for the product version V100R001C00.

Updates are as follows.

Update	Description
1.2 Product Specifications	Optimized the table containing product specifications.
3.4 Indicators	Added an explanation for the link status of the STAT indicator.
5.1 Ethernet Service Specifications	Optimized the table containing Ethernet service throughput specifications.
A.2 Component Photos	Added section "Component Photos."
A.3 Compliance Standards	Added section "Compliance Standards."
Entire document	Fixed known defects.

Issue 01 (2014-04-30)

This issue is the first release for the product version V100R001C00.

Contents

1 Product Introduction

About This Chapter

The OptiX RTN 360 radio transmission system (RTN 360 for short) is a full-outdoor radio transmission product that operates at the V-band (a frequency band ranging from 59 GHz to 64 GHz).

RTN 360 is tailored for service backhaul for small cell base stations that are deployed on buildings or at the street level. RTN 360 plays an important role in the Huawei radio backhaul solution for small cell base stations.

RTN 360's specifications meet the requirements of service backhaul for small cell base stations. In addition, RTN 360 features excellent immunity to interference, and is easy to install and maintain.

RTN 360s are usually powered by Docks or other standard power sourcing equipment (PSE). RTN 360s can form sites providing one-direction, two-direction, or multi-direction microwave links.

1.1 Network Application

RTN 360 is tailored for service backhaul for small cell base stations that are deployed on buildings or at the street level. RTN 360 plays an important role in the Huawei radio backhaul solution for small cell base stations.

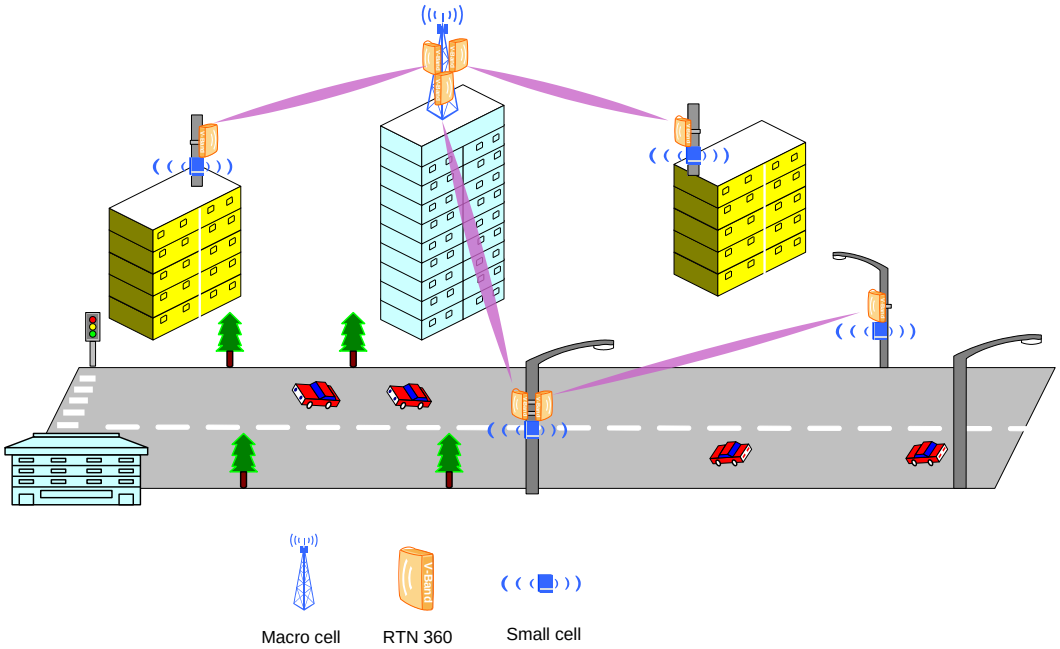
As V-band full-outdoor radio equipment, RTN 360 has the following characteristics:

- RTN 360 operates at the frequency band ranging from 59 GH to 64 GHz. It requires unobstructed line of sight (LOS) and features low inter-site interference and rich idle frequency spectrum resources. A V-band link can span a maximum distance of 300 m, meeting the requirements of service backhaul for small cell base stations. RTN 360 can provide large-capacity microwave links for small cell base stations densely deployed in downtown areas.

- RTN 360 is a highly integrated full-outdoor radio transmission product. Its antenna, RF unit, and baseband unit are integrated into an outdoor unit that supports zero-footprint installation, providing carriers with cost-effective full-outdoor radio solutions.

RTN 360 provides backhaul links for small cell base stations on buildings or at the street level in downtown areas. See Figure 1-1.

Figure 1-1 RTN 360 backhaul link solution for small cell base stations



1.2 Product Specifications

RTN 360's specifications meet the requirements of service backhaul for small cell base stations. In addition, RTN 360 features excellent immunity to interference, and is easy to install and maintain.

Table 1-1 Product Specifications

Product Specifications	
Appearance	
Dimensions (H x W x D)/Weight	192.5 mm x 192.5 mm x 70 mm/2.5 kg

Product Specifications	
Antenna	Built-in panel antenna
Operating frequency band	59 GHz to 64 GHz
Duplex mode	TDD
Radio working mode (modulation scheme/channel spacing)	16QAM/200 MHz
Air-interface throughput	≥ 480 Mbit/s
Maximum transmission distance	300 m
Service port	Two GE electrical service ports
RF configuration mode	1+0 configuration
Power supply mode	Power over Ethernet (PoE), supplied by the DC power injector (PI), Dock, and other standard power sourcing equipment (PSE)
Basic Ethernet features	• E-Line/E-LAN • QinQ • QoS • Synchronous Ethernet

1.3 Site Configurations

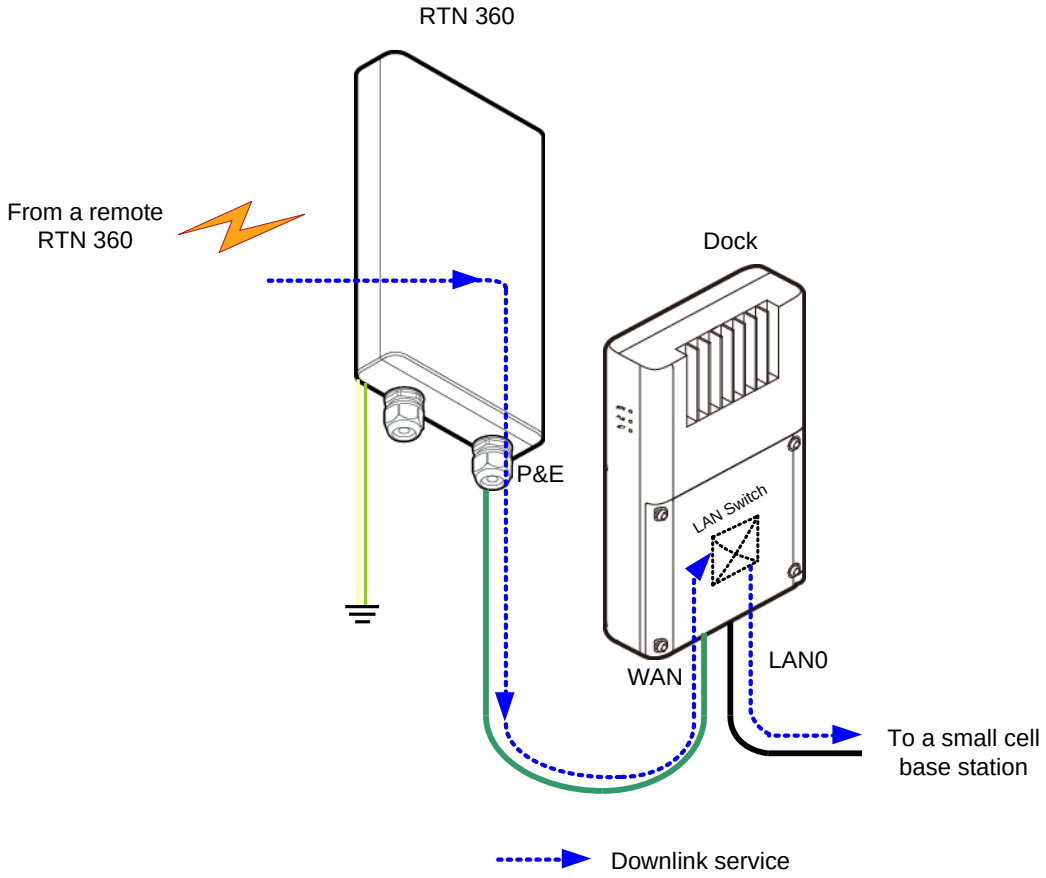
RTN 360s are usually powered by Docks or other standard power sourcing equipment (PSE). RTN 360s can form sites providing one-direction, two-direction, or multi-direction microwave links.

1.3.1 Sites Providing One-Direction Microwave Links

If a small cell base station is located at the end of a transmission link, an RTN 360 is required to provide a 1+0 unprotected microwave link. The RTN 360 receives power signals and service signals from the Dock of the small cell base station.

Figure 1-2 illustrates configurations of a site providing a one-direction microwave link.

Figure 1-2 Site providing a one-direction microwave link



NOTE

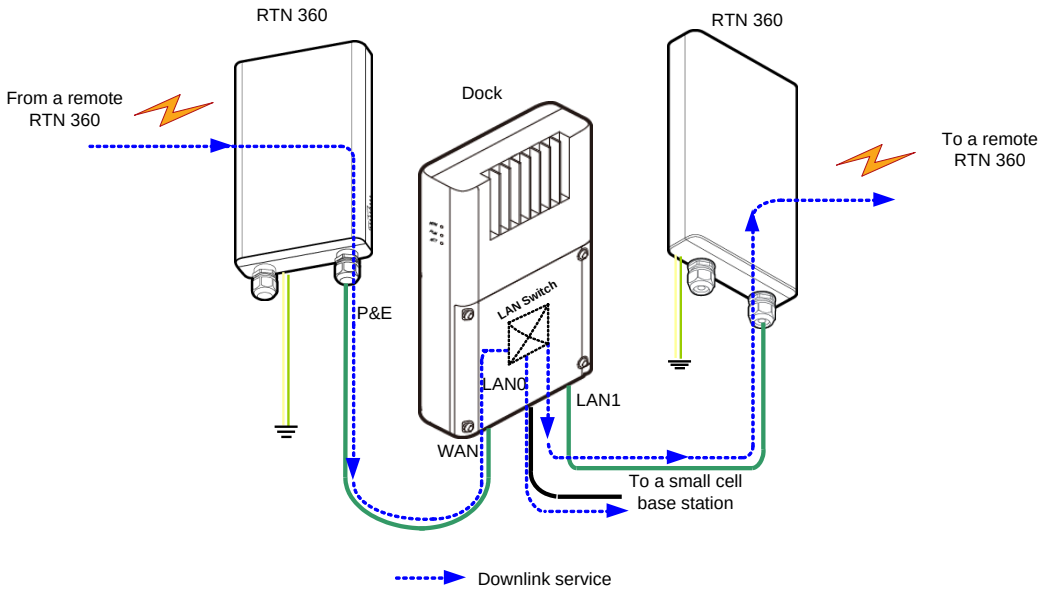
If a small cell base station can serve as standard PSE, RTN 360s can directly receive power signals and service signals from the small cell base station.

1.3.2 Sites Providing Two-Direction Microwave Links

If a small cell base station is an intermediate node on a transmission link, two RTN 360s are required to provide two 1+0 unprotected microwave links in different directions. RTN 360s receive power signals and service signals from the Dock of the small cell base station.

Figure 1-3 illustrates configurations of a site providing two microwave links in different directions.

Figure 1-3 Site providing two microwave links in different directions

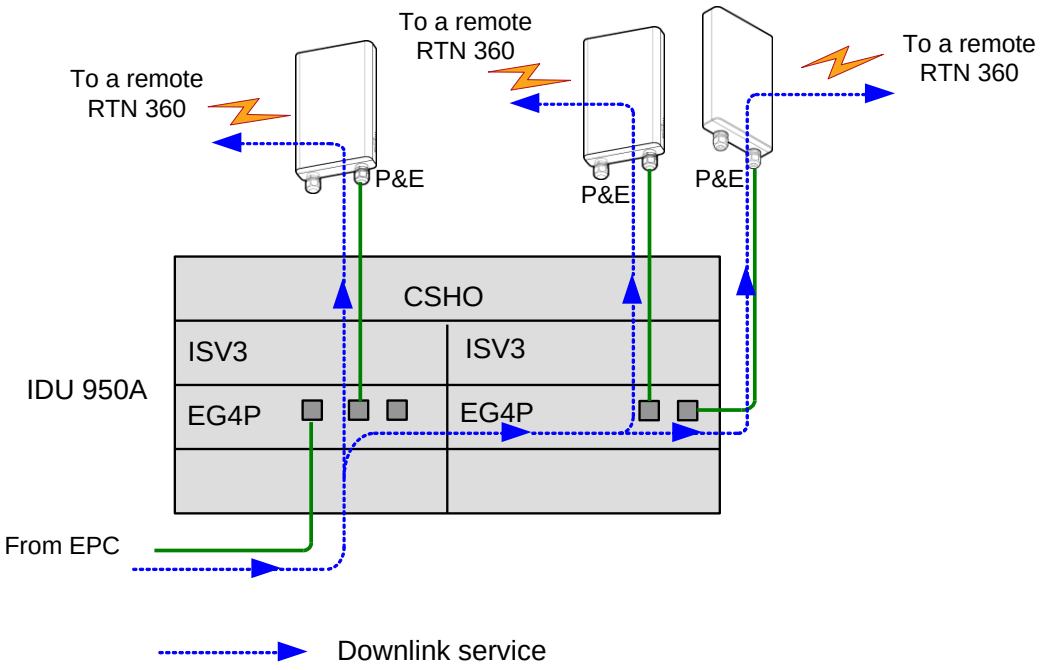


1.3.3 Sites Providing Multi-direction Microwave Links

If a macro base station connects to multiple small cell base stations in a star topology, in addition to multiple RTN 360s, an OptiX RTN 900 (IDU) (for example, an IDU 950A) or other power sourcing equipment (PSE) is required. The IDU supplies power to the RTN 360s through a PoE board (for example, an EG4P board) and aggregates services.

Figure 1-4 illustrates configurations of a site providing multi-direction microwave links.

Figure 1-4 Site providing multi-direction microwave links



NOTE

In addition to RTN 360s, the OptiX RTN 900 IDU may connect to FOs or ODUs operating at other frequency bands to implement backhaul.

2 Functions and Features

About This Chapter

RTN 360 provides a variety of functions and features.

A variety of technologies are used to simplify RTN 360 installation so that wireless installation personnel can deploy an RTN 360 within 30 minutes.

2.10 Easy Maintenance

RTN 360 supports contact-free maintenance, powerful equipment-level OAM functions, and end-to-end TP-Assist.

2.11 Security Management

RTN 360 works with its network management system (NMS) to prevent unauthorized logins and operations, ensuring equipment management security.

2.12 Energy Saving

RTN 360 consumes less energy by using:

2.13 Environmental Protection

RTN 360 is designed to meet environmental protection requirements. The product complies with restriction of hazardous substances (RoHS) directives.

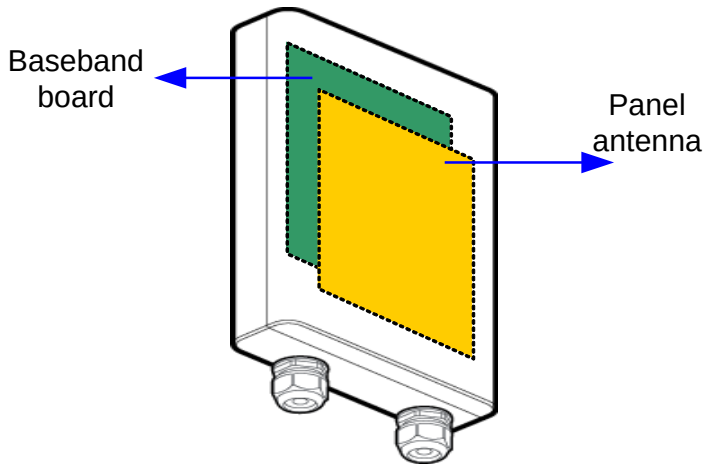
2.1 Integration

RTN 360 integrates a built-in antenna and uses a wide frequency band design, which allows a single chassis to cover the entire V-band.

Built-in Antenna

RTN 360 integrates its system control unit, clock unit, power unit, baseband unit, RF unit, and antenna into a single chassis. See Figure 2-1.

Figure 2-1 Integrated chassis with a built-in antenna



Such a highly integrated design facilitates quick and flexible installation of RTN 360s in full-outdoor scenarios.

Wide Frequency Band

RTN 360 uses a wide frequency band design, which enables a single chassis to cover the entire V-band from 59 GHz to 64 GHz. This eliminates the need to distinguish TX high and low sites, which means that spare parts need to be prepared for only one equipment model.

Both RTN 360 and Huawei small cell base stations can be installed on walls and poles. They are similar in appearance and look harmonious when installed together.

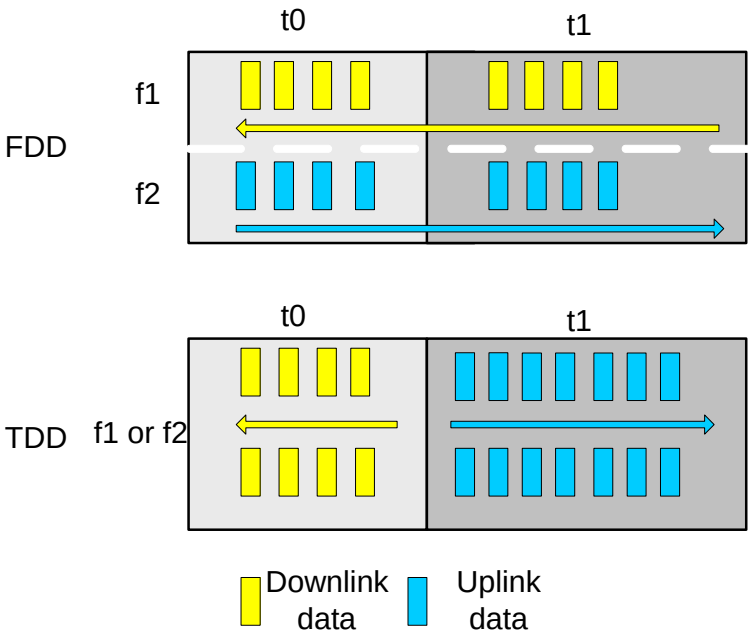
2.2 TDD

Time division duplex (TDD) has unique advantages over frequency division duplex (FDD) in asymmetric transmission and high frequency spectrum resource utilization.

In FDD mode, symmetric frequencies are required to function as the uplink and downlink channels. The V-band is license-free in most areas and may be used by multiple users, and it is difficult to obtain interference-free symmetric frequencies. Therefore, RTN 360 uses TDD mode.

In TDD mode, asymmetric frequencies are used. Uplink and downlink data is transmitted in different time periods. The ratio of timeslots for uplink data to those for downlink data can be configured based on service requirements, flexibly using frequency resources.

Figure 2-2 Comparison between FDD and TDD modes



Using TDD mode, RTN 360 has the following advantages:

- One RTN 360 can cover the operating frequency band (59 GHz to 64 GHz), eliminating the need to distinguish TX high and low sites.
- Timeslots for uplink and downlink data can be flexibly adjusted based on actual traffic. The ratio of timeslots for uplink data to those for downlink data can be configured to 3:1, 2:1, 1:1, 1:2, or 1:3.

2.3 Automatic Frequency Selection

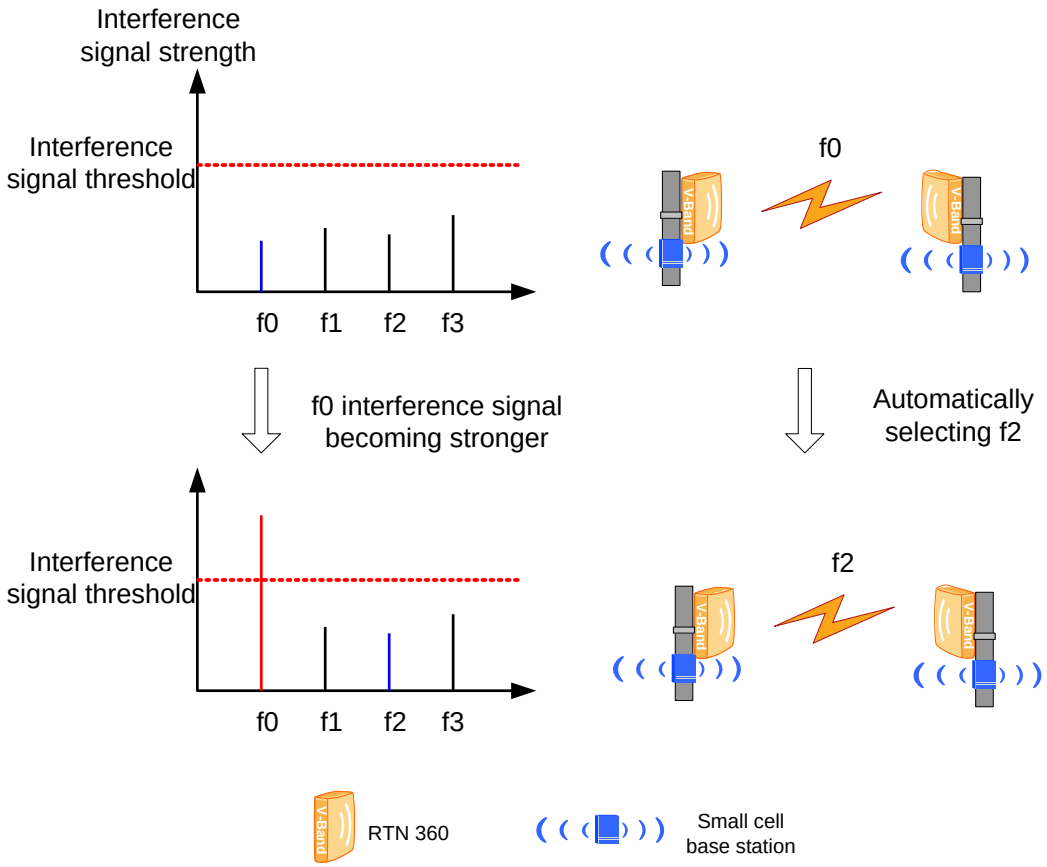
RTN 360 supports automatic frequency selection, which enables it to automatically select an interference-free channel as the working channel.

RTN 360 scans frequencies within a specified range to select interference-free channels. See Figure 2-3.

Automatic frequency selection applies to the following two scenarios:

- During commissioning in site deployment, this function is used to obtain interference-free channels, releasing engineers from planning microwave link frequencies.
- For an in-service RTN 360, this function is used to reselect and switch to an interference-free channel if the current microwave link is interrupted or fails due to interference on the working channel, improving microwave links' immunity to interference.

Figure 2-3 Automatic frequency selection diagram



2.4 Power over Ethernet

RTN 360 provides a P&E port through which it supports power over Ethernet (PoE) as a powered device (PD).

In PoE mode, an outdoor network cable carries Ethernet service signals along with DC power signals. PoE has the following advantages:

- Reduces the number of power cables and simplifies installation.
- Enables RTN 360 to share power supplies with small cell base stations.
- Enables RTN 360 to work with the power injector (PI) or other power sourcing equipment (PSE) such as an RTN 900 IDU or a Dock so that RTN 360 is connected to the network while being supplied with power.

2.5 Ethernet Service Processing Capability

RTN 360 can process native Ethernet services.

Table 2-1 Ethernet service processing capability

Item	Description
Service ports	Two GE service ports • The first GE port is a P&E port. • The second GE port is a fixed electrical port.
Port attributes	The GE electrical port supports 10M full-duplex, 100M full-duplex, 1000M full-duplex, and auto-negotiation.
Ethernet service types	• E-Line • E-LAN
Range of maximum frame length	1518 bytes to 9600 bytes
VLAN	• Adds, deletes, and swaps 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.
QinQ	• Adds, deletes, and swaps S-TAG tags, and forwards packets based on S-VLAN tags. • The S-VLAN ID ranges from 1 to 4094. • The QinQ type domain is configurable. The default value is 88A8.
MAC address management	• Supports MAC address self-learning for E-LAN services in two learning modes: SVL and IVL. • Filters blacklisted MAC addresses. • Sets static MAC address entries. • Supports a MAC address table with a maximum of 16K capacity (including static and blacklist entries).

Item	Description
Link-state pass through (LPT)	Supports simple LPT. When a microwave link is faulty, the related RTN 360 automatically disables the remote Ethernet port that is connected to a user-to-network interface (UNI) device.
Quality of service (QoS)	Supports QoS. For details, see 2.6 QoS.
Traffic control	Supports IEEE 802.3x-compliant traffic control.
ETH OAM	• Supports IEEE 802.1ag- and IEEE 802.3ah-compliant ETH OAM. • Supports ITU-T Y.1731-compliant packet loss measurement, delay measurement, and delay variation measurement.
Ethernet performance monitoring	• Supports IETF RFC 2819-compliant remote network monitoring (RMON). • Supports measurement of real-time and historical traffic, bandwidth utilization, and packet loss for ports.
Synchronous Ethernet	Supported
Link Layer Discovery Protocol (LLDP)	Supported

NOTE

- RTN 360 supports a maximum of 64 E-Line services. The supported E-Line services fall into the following types:
- Port-based E-Line services
- Port+VLAN-based E-Line services
- Port+QinQ-based E-Line services
- RTN 360 supports only one E-LAN service. The supported E-LAN services fall into the following types:
- IEEE 802.1d bridge-based E-LAN services
- IEEE 802.1Q bridge-based E-LAN services
- IEEE 802.1ad bridge-based E-LAN services

2.6 QoS

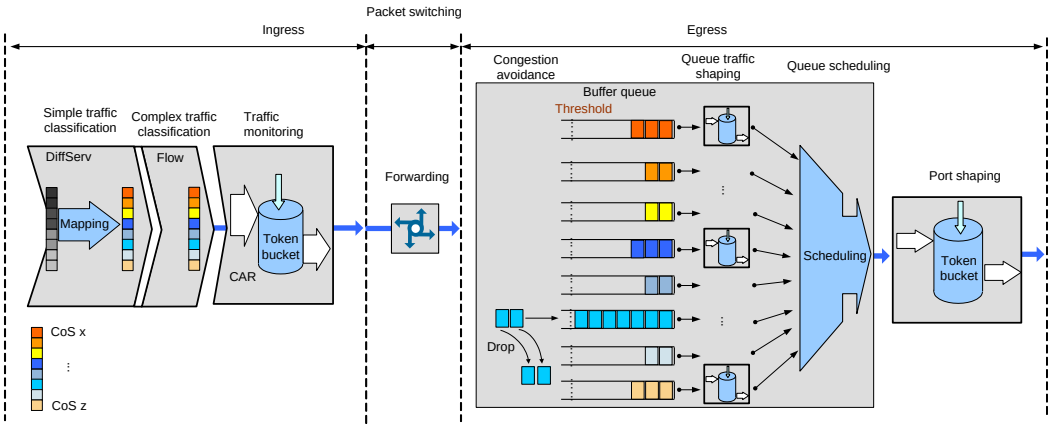
RTN 360 supports quality of service (QoS) functions, including traffic classification, traffic policing, congestion avoidance, queue scheduling, and traffic shaping.

QoS Processing Flow

QoS provides different levels of service quality in certain aspects of services as required, such as bandwidth, delay, jitter, and packet loss ratio. This ensures that the request and response of a user or application reaches an expected quality level.

Figure 2-4 shows how RTN 360 performs QoS processing for Ethernet services.

Figure 2-4 QoS processing



QoS Functions

Table 2-2 QoS functions

Function	Description
Simple traffic classification (DiffServ)	• Supports one DiffServ (DS) domain. • Maps Ethernet services into different per-hop behaviors (PHBs) based on C-VLAN priorities, S-VLAN priorities, IP differentiated services code point (DSCP) values, or MPLS experimental bits (EXP) values. • Supports enabling/disabling of DSCP demapping at egress ports.
Complex traffic classification	Supports traffic classification by MAC address, VLAN ID, VLAN priority, IP address, DSCP value, protocol type, port ID, or Internet Control Message Protocol (ICMP) type at ports.
ACL	Supports ACL based on complex traffic classification.
Traffic policing	Supports committed access rate (CAR) based on complex traffic classification at ports and supports the setting of the committed information rate (CIR), peak information rate (PIR), committed burst size (CBS), and peak burst size (PBS).
Congestion avoidance	• Supports tail drop at both microwave ports and Ethernet ports. • Supports weighted random early detection (WRED) at both microwave ports and

Function	Description
	Ethernet ports.
Queue scheduling	• Supports eight levels of priority scheduling at both Ethernet ports and microwave ports. • Flexibly sets the queue scheduling scheme for each Ethernet port and microwave port. The queue scheduling schemes include strict priority (SP), weighted round robin (WRR), and SP+WRR.
Traffic shaping	• Supports traffic shaping for egress queues and egress ports. • Supports the setting of PIR in increments of 64 kbit/s and the setting of PBS.

2.7 Clock Features

RTN 360's clock features meet clock transmission requirements of mobile communications networks and offer a wide selection of clock protection mechanisms.

Item	Description
Clock working mode	• Tracing • Holdover • Free-run
Clock source	• Microwave link clock • Synchronous Ethernet clock **NOTE** When two RTN 360s form a hop of microwave link, one is the master NE tracing the Synchronous Ethernet clock, and the other is the slave NE tracing the microwave link clock.
Synchronization Status Message (SSM) protocol or extended SSM protocol	Supported. SSM information can be transmitted in the following modes: • Microwave link • Synchronous Ethernet

2.8 Network Management

RTN 360 supports multiple network management modes and provides comprehensive management information exchange solutions.

Network Management Modes

RTN 360 supports the following network management modes:

- Uses the iManager U2000 Web LCT to manage local and remote NEs on a per-NE basis.
- Uses the Mobile LCT to manage local NEs on a per-NE basis through Wi-Fi.
- Uses the iManager U2000-T to manage Huawei OptiX RTN NEs and Huawei optical transmission products in a unified manner. The iManager U2000-T is also able to manage transport networks in a unified manner.
- Uses the iManager U2000-M, which manages Huawei mobile communications network products in a unified manner, to manage RTN 360 using its NE Explore.
- Uses SNMP Get to query alarms, performance events, and RMON performance.

Network Management Information Exchange Solutions

Table 2-3 DCN information exchange solutions

Item			Specifications
DCN channel	Data communications channel (DCC) bytes		Three Huawei-defined DCC bytes in a microwave frame
	Network management system (NMS) port		One NMS port
	In-band DCN	Microwave link	All in-band DCN channels are marked by one VLAN ID. The bandwidth of an in-band DCN channel is configurable.
		GE port	All in-band DCN channels are marked by one VLAN ID. The bandwidth of an in-band DCN channel is configurable.
Network management protocol	HWECC protocol		Supported
	IP protocol		Supported
	L2DCN		Supported

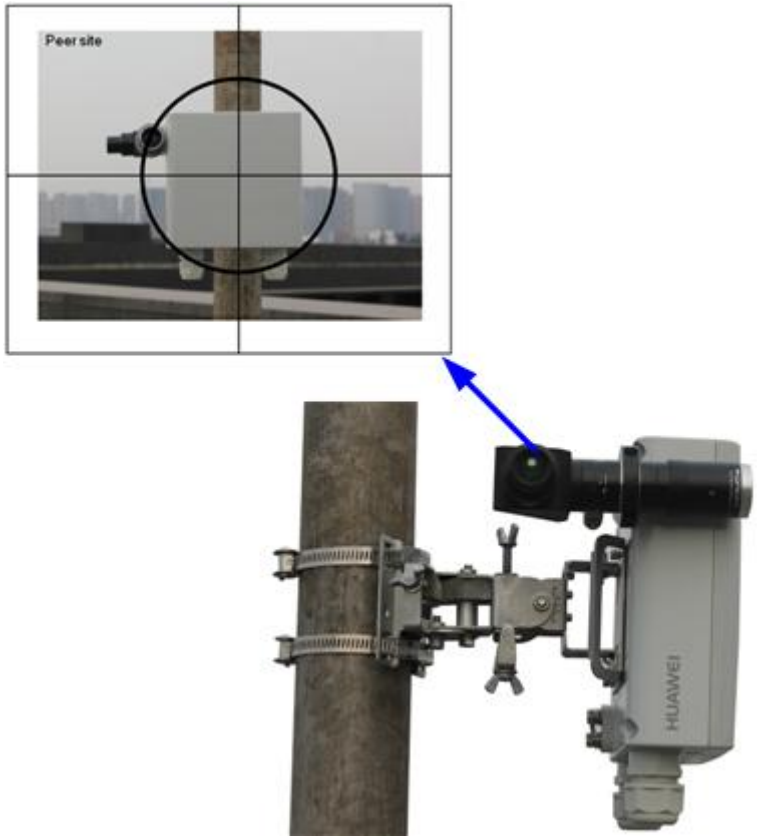
2.9 Rapid Deployment

A variety of technologies are used to simplify RTN 360 installation so that wireless installation personnel can deploy an RTN 360 within 30 minutes.

So that it can be deployed rapidly, RTN 360:

- Uses TDD mode, in which signals are transmitted and received over the same frequency, eliminating the need to distinguish TX high and low sites and requiring spare parts for only one equipment model.
- Supports automatic frequency selection, simplifying microwave link frequency planning.
- Integrates panel antennas, simplifying installation.
- Uses an alignment scope to facilitate antenna alignment, improving installation efficiency.

Figure 2-5 Aligning antennas using an alignment scope



- Supports power over Ethernet. RTN 360 can work with a Dock, power injector (PI), or other power sourcing equipment (PSE) to receive service signals and power signals, facilitating deployment.
- Supports configuration-free commissioning using a USB flash drive.
- Manages NEs on a per-NE basis using a Wi-Fi module.

2.10 Easy Maintenance

RTN 360 supports contact-free maintenance, powerful equipment-level OAM functions, and end-to-end TP-Assist.

2.10.1 Contact-Free Maintenance

RTN 360 supports contact-free maintenance with its Wi-Fi module.

The Mobile LCT or Web LCT can use Wi-Fi to connect to a local RTN 360 with a Wi-Fi module.

Figure 2-6 Contact-free maintenance

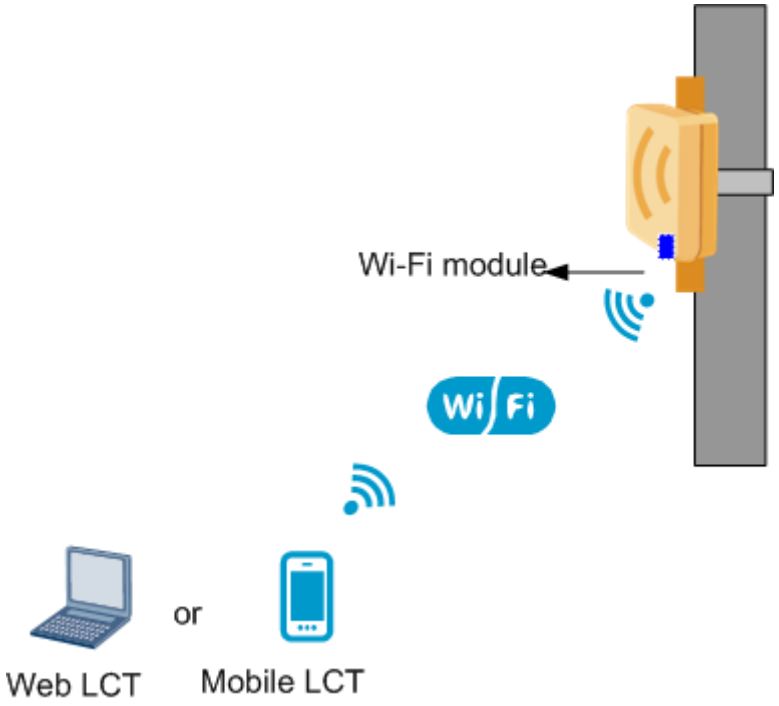
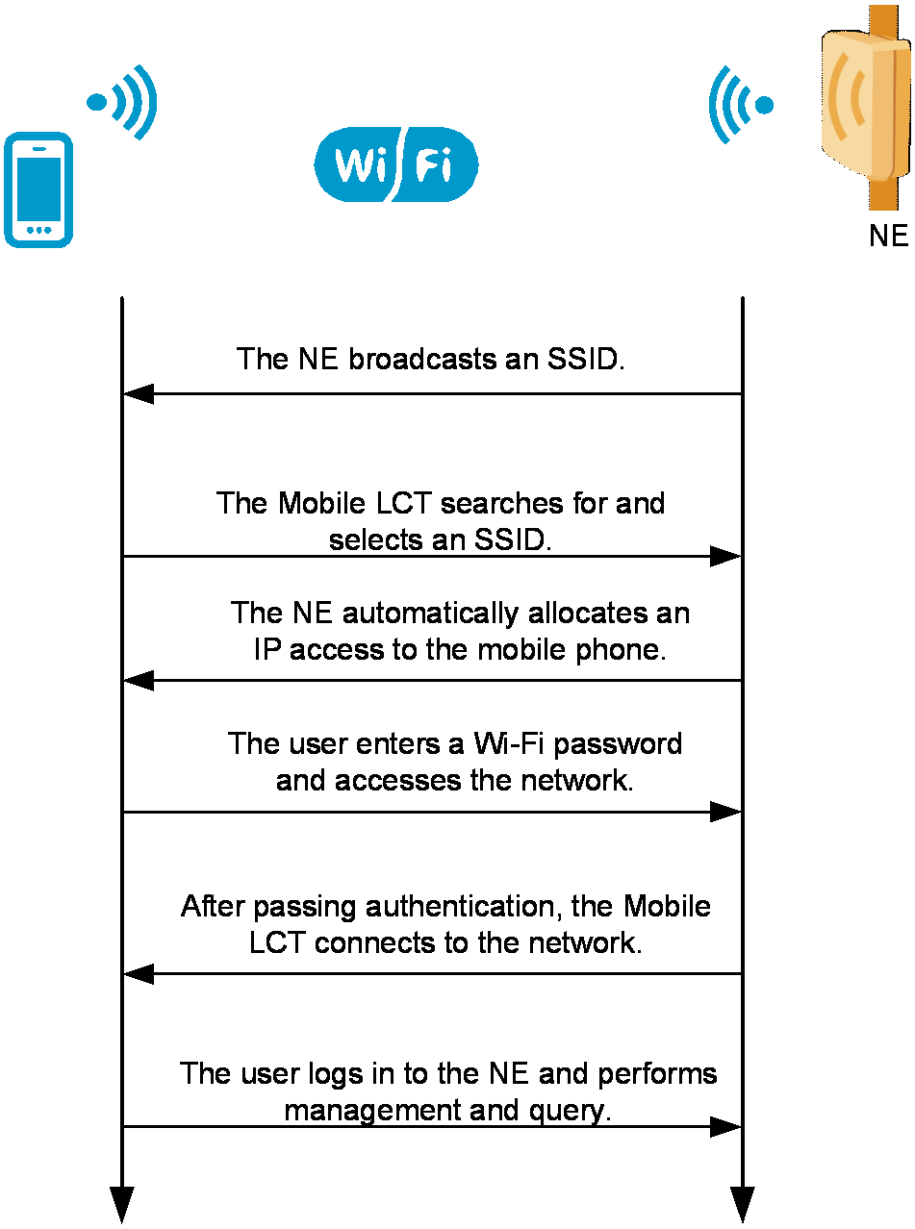


Figure 2-7 Access process through Wi-Fi



After connecting to a local NE through Wi-Fi, the Mobile LCT or Web LCT can be used to configure the NE, and query NE alarms, and the Web LCT can also be used to query performance and logs, facilitating commissioning and maintenance.

2.10.2 Equipment-Level OAM

RTN 360 provides a variety of operation, administration and maintenance (OAM) functions that effectively reduce equipment maintenance costs.

Table 2-4 describes the OAM functions supported by RTN 360.

Table 2-4 Equipment-level OAM functions

Function	Description
Management and monitoring	• Supports unified management of microwave transmission networks and optical transmission networks, and end-to-end service creation and management using the iManager U2000-T. • Supports creation, configuration, and operation management of an RTN 360 using the iManager U2000-M. • Reports a variety of alarms and performance events. • Supports RMON performance events. • Measures real-time and historical traffic and bandwidth utilization for ports. • Measures congestion-caused packet loss information by traffic class and egress queue for ports. • Queries equipment temperatures. • Monitors key radio transmission performance indicators, such as the microwave transmit power, receive power, signal-to-noise ratio (SNR), and air-interface bit error rate (BER), and displays them graphically. • Supports frequency scanning to help identify co-channel interference and adjacent-channel interference. • Collects one-click fault diagnosis information. • Supports the connection of the Mobile LCT or Web LCT to the equipment using Wi-Fi during equipment commissioning or maintenance.
Diagnosis tests	• Supports pseudo random binary sequence (PRBS) tests at microwave ports. • Simulates Ethernet meters to test the packet loss ratio, delay, and throughput. • Supports various loopback functions at service ports and microwave ports.
ETH OAM	• Supports IEEE 802.1ag- and IEEE 802.3ah-compliant ETH OAM. • Supports ITU-T Y.1731-compliant packet loss measurement, delay measurement, and delay variation measurement. • Supports loopback tests for Ethernet services.
Database management	• Backs up and restores NE databases remotely using the iManager U2000-T. • Backs up and restores NE data using USB flash drives. • Backs up and restores databases of peer NEs on microwave links.
Software management	• Supports remote loading of NE software and data using the iManager U2000-T and provides a complete NE upgrade solution, allowing rapid upgrades of the entire network. • Upgrades NE software using USB flash drives. • Supports the not-stop forwarding (NSF) function, which prevents Ethernet services from being interrupted by warm NE software resets. • Supports hot patches so that you can upgrade software without interrupting services. • Supports software version rollback so that original system services are restored in case of software upgrade failures.

2.10.3 Packet OAM (TP-Assist)

In compliance with the network-centered, service-centered, and intelligent packet network O&M trend, Huawei promotes a brand new O&M system based on the TP-Assist solution. The O&M system covers the entire O&M process from network planning to fault diagnosis.

Table 2-5 describes the packet OAM functions supported by RTN 360.

Table 2-5 Functions of the TP-Assist O&M system

Function		Description	Purpose
Professional planning service and planning tools		Experienced planning expert teams provide professional planning service. Planning tool UniSTAR Designer, embedded with the common network HLD/LLD design templates and device/board/interface capacity parameter templates, is used. This tool is applicable to various network planning scenarios including new network construction, network expansion, network migration, and service adjustment.	Improves planning efficiency. Improves planning accuracy.
End-to-end service deployment		Deploys Native Ethernet (E-Line and E-LAN) services and hybrid services in an end-to-end manner. Deploys services across microwave and optical fibers in an end-to-end manner.	Quick service configuration Improves configuration accuracy.
Automatic deployment of alarm management with service deployment		Deploying ETH-OAM or MPLS-TP OAM when deploying Ethernet services and MPLS tunnels in an end-to-end manner.	Avoids extra OAM deployment operations. Allows the NE to automatically report alarms when a service fault occurs.
One-click service connectivity test		Supports one-click service connectivity test for Ethernet services and MPLS tunnels that are deployed in an end-to-end manner.	Quick commissioning Lowers project acceptance costs.
One-click service performance test		Supports one-click packet loss, delay, and delay jitter tests for Ethernet services and MPLS tunnels that are deployed in an end-to-end manner.	
Automatic tests with no need for any instrument		Simulating the Smartbits function, supports delay, throughput, short-term packet loss ratio, and long-term packet loss ratio tests for VLAN-based E-Line services.	
Performance monitoring and	Network-level performance	The PMS embedded in the U2000 supports unified monitoring and measurement of	Optimized monitoring points,

Function		Description	Purpose
measurement	monitoring and measurement system	any measurement object and performance indicator in the network. It supports 24-hour service status pre-warning and monitoring, and provides equipment performance threshold-crossing alarms and network performance threshold-crossing alarms.	rich service monitoring methods Visualized monitoring; network-level and service-centered monitoring
	360-degree traffic statistics and monitoring based on service paths	Allows all-service-layer (port, MPLS tunnel, PW, and VLAN) traffic statistics and monitoring in a service view. Supports QoS packet loss detection.	
Visualized O&M	Queries and display of service paths based on VLANs	For E-Line services, allows users to find the service working path and protection path views based VLANs. For E-LAN services, allows users to find the VLAN domain views based on VLANs.	Service visualization
	Queries and display of service paths based on MAC addresses	For E-LAN services, allows users to find the actual MAC address forwarding path views based on MAC addresses.	
Intelligent fault diagnosis		Performs automatic fault diagnosis for Ethernet services by layer (service/PW/tunnel/port) and by level (connectivity/performance/configuration). Quickly outputs fault diagnosis reports on a one-click operation GUI.	Intelligent fault diagnosis Cross-product fault diagnosis
IP ping		Responds to IP ping packets sent from client equipment and then quickly narrows down the fault location to the client equipment or the transport network. Support near-end or far-end IP ping responding. Supports initiating an IP ping test to the near-end or far-end.	
Network-level E-LAN service loop detection		Quickly detects an E-LAN loop (if any) in the service view. Automatically shuts down a looped service. Displays the loopback path.	

2.11 Security Management

RTN 360 works with its network management system (NMS) to prevent unauthorized logins and operations, ensuring equipment management security.

Overview of Hardware Security

RTN 360 uses the following hardware security measures:

- Microwave ports: The forward error correction (FEC) encoding mode is adopted and the adaptive time-domain equalizer for baseband signals is used. This enables the microwave ports to withstand strong interference. An interceptor cannot restore the content 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 isolated, minimizing the impact of the fault on other units in the system.
- CPU flow control: The data flow sent to the CPU for processing is classified and controlled to prevent CPU resources from being exhausted by a large number of packets. This ensures that the CPU operates properly under attacks.
- Management port control: The protective cover for the maintenance compartment is kept closed when the management port is not being used, preventing unauthorized access.

Overview of Software Security

RTN 360 processes two types of data: O&M data and service data. The two types of data are transmitted over independent paths and do not affect each other. This enables services running on an RTN 360 to be 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. Security features on the management plane implement secure access, integrated security management, and all-round security audits.
- Data plane

  The data plane processes the service data flow entering the equipment and forwards service packets according to the forwarding table. Security features on the data plane ensure confidentiality and integration of user data by preventing malicious theft, modification, and removal of user service packets. These features ensure reliable data forwarding by protecting forwarding entries against malicious attacks and falsification.

Table 2-6 describes security functions provided by RTN 360.

Table 2-6 Security functions

Plane	Function	Description
Management plane	Account and password management	Manages and stores maintenance accounts and passwords.
	Local authentication and authorization	Authenticates and authorizes accounts.
	RADIUS authentication and	Authenticates and authorizes

Plane	Function	Description
	authorization	remote accounts in a centralized manner to reduce maintenance costs.
	Security log	Records events related to account management.
	Operation log	Records non-query operations.
	Syslog management	Provides a standard solution to offline storage of logs, addressing insufficient storage space.
	TCP/IP attack defense	Provides defense against TCP/IP attacks, such as error IP packet attacks, Internet Control Message Protocol (ICMP) ping and Jolt attacks, and DoS attacks.
	Access control list	Provides access control lists based on IP addresses and port IDs.
	SSL/TLS encryption communication (SSL is the abbreviated form of Secure Sockets Layer, and TLS is the abbreviated form of Transport Layer Security.)	Uses the SSL3.0 and TLS1.0 protocols to establish an encryption channel based on a security certificate.
	Secure File Transfer Protocol (SFTP)	Provides SFTP services.
	Open Shortest Path First (OSPF)	Uses the OSPFv2 protocol for standard MD5 authentication.
	Network Time Protocol (NTP)	Uses the NTPv3 protocol for MD5 authentication and permission control.
	Simple Network Management Protocol (SNMP)	Uses the SNMPv3 protocol for authentication and data encryption.
	USB flash drive connection control	Supports connection of only authorized USB flash drives based on a certificate file.
	Wi-Fi connection control	Supports Wi-Fi connection with correct passwords.

Plane	Function	Description
Data plane	Flow control	Controls traffic at ports. Broadcast packets are suppressed. Unknown unicast packets and multicast packets are discarded. QoS is used to control service traffic.
	Discarding of incorrect packets	Discards incorrect packets, such as an Ethernet packet shorter than 64 bytes.
	Loop prevention	Detects self-loops at service ports and blocks self-looped ports.
	Access control of Layer 2 services	Filters static MAC addresses in the static MAC address table, provides a blacklist, enables and disables the MAC address learning function, and filters packets based on traffic classification.
	Service separation	Includes Layer 2 logical separation, split horizon, and physical path separation.

2.12 Energy Saving

RTN 360 consumes less energy by using:

- Streamlined design with minimum components
- High-efficient power modules
- Low-power components

2.13 Environmental Protection

RTN 360 is designed to meet environmental protection requirements. The product complies with restriction of hazardous substances (RoHS) directives.

- The product complies with RoHS, waste from electrical and electronic equipment (WEEE), and Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) directives.
- The product complies with compulsory packing restrictions that limit the size of the package containing the equipment and accessories to three times that of the equipment dimensions.

- All hazardous substances contained in the package can degrade quickly.
- Every plastic component that weighs over 25 g is labeled according to the ISO 11469 and ISO 1043-1 to ISO 1043-4 standards. All components and packaging come with standard recycling labels.
- Plugs and connectors are easy to find and are compatible with standard tools.
- All the attached materials, such as labels, are easy to remove. Certain types of identifying information, such as silkscreens, are printed on the chassis.

3 Product Structure

About This Chapter

This chapter describes RTN 360's system architecture, service signal processing flow, external ports, indicators, and labels.

3.1 System Architecture

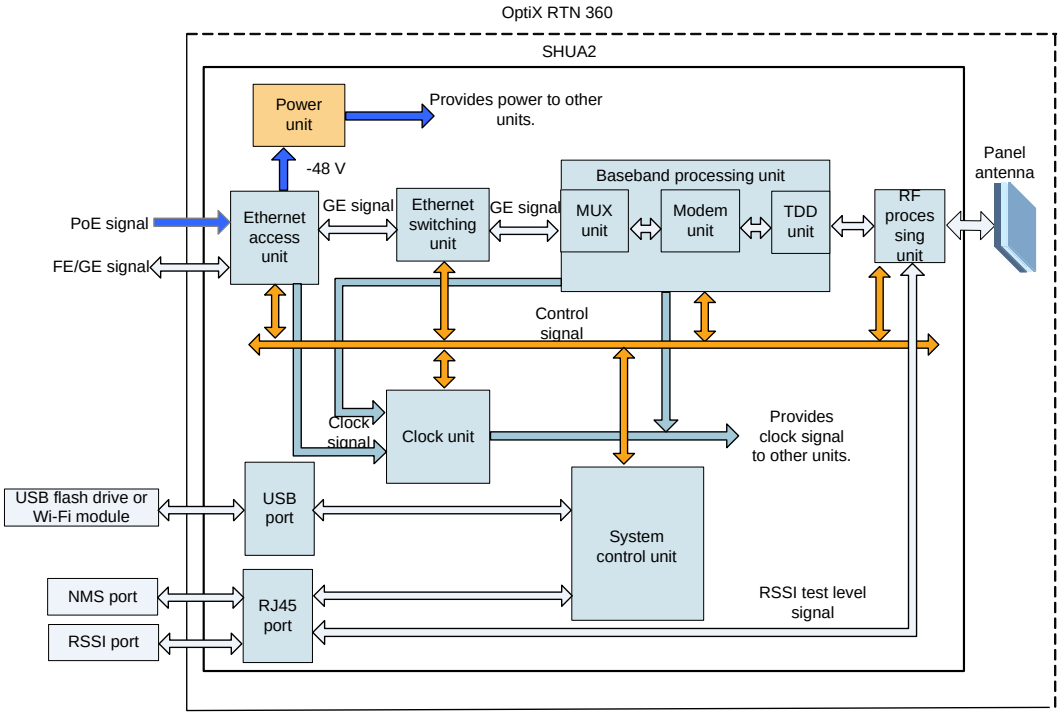
RTN 360 integrates its functional units into a single chassis.

An RTN 360 has a panel antenna and one physical board, the SLV1SHUA2 board. The SLV1SHUA2 board is displayed as SHUA2 on the network management system (NMS) and occupies logical slot 1.

The SHUA2 board is physically divided into multiple functional units based on logical functions.

Block Diagram

Figure 3-1 Block diagram of RTN 360



Functional Units

Table 3-1 Functional units

Functional Unit	Description
Ethernet access unit	• Receives/Transmits one channel of Ethernet service signals and one channel of PoE signals. • Splits PoE signals into -48 V power signals and FE/GE signals. • Transmits the power signals to the power unit. • Converts serial Ethernet signals into parallel Ethernet signals. • Performs frame delimitation, preamble stripping, and cyclic redundancy checks (CRCs).
Ethernet switching unit	• Processes VLAN tags in Ethernet service signals. • Performs quality of service (QoS) processing for Ethernet frames. • Grooms services and processes

Functional Unit	Description
	protocols.
Baseband processing unit	• Maps and demaps service signals to/from microwave frame signals. • Processes overhead bytes in microwave frames. • Performs forward error correction (FEC) coding and decoding. • Modulates and demodulates digital signals. • Converts between analog and digital signals. • Uses the TDD unit to control signal receiving/transmitting according to the specified ratio of receive/transmit timeslots.
RF processing unit	• Performs frequency conversion and power amplification, and sends RF signals to antennas in the transmit direction. • Performs isolation, filtering, down-conversion, and power amplification for RF signals, and converts RF signals into low-frequency analog signals in the receive direction.
Antenna	Performs conversion between RF signals and electromagnetic waves.
System control unit	• Configures and manages the system. • Collects alarms and monitors performance. • Processes signals to and from the USB port. • Processes Wi-Fi connection signals.
Clock unit	• Traces the specified clock source signals. • Provides clock signals required by the system.
Power unit	• Processes power over Ethernet signals. • Performs DC/DC conversion and provides power signals to other units.

3.2 Service Signal Processing Flow

This section describes how the functional units of RTN 360 process power over Ethernet (PoE) signals.

Figure 3-2 Signal processing flow

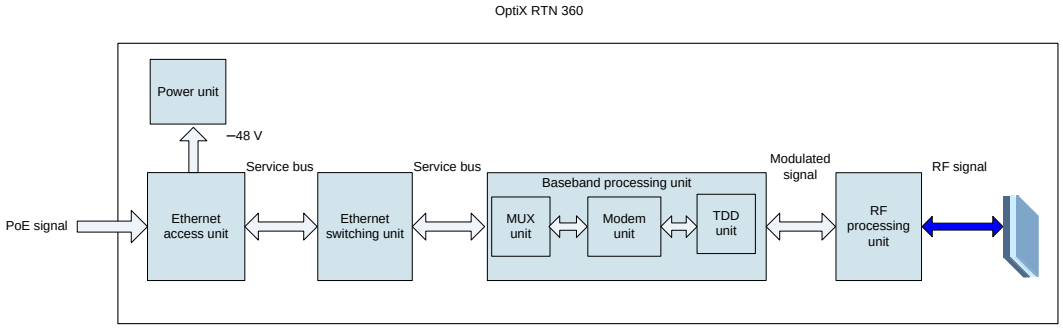


Table 3-2 Signal processing in the transmit direction

Step	Functional Unit	Processing Flow
1	Ethernet access unit	• Receives PoE signals. • Splits PoE signals into Ethernet service signals and -48 V power signals. • Transmits the power signals to the power unit. • Extracts Ethernet frames from Ethernet service signals.
2	Ethernet switching unit	• Performs Layer 2 protocol processing and quality of service (QoS) processing for the Ethernet frames. • Transmits processed Ethernet service signals to the baseband processing unit.
3	Baseband processing unit	• Receives Ethernet service signals from the Ethernet switching unit. • Combines Ethernet service signals and microwave frame overheads into microwave frames. • Performs forward error correction (FEC) coding. • Selects a proper modulation scheme based on the current channel quality. • Performs modulation and converts digital signals to analog signals. • Transmits the modulated signals to the RF processing unit using the transmit timeslot specified by the TDD electronic switch.
4	RF processing unit	• Performs up-conversion and power amplification to convert the modulated signals into RF signals. • Transmits the RF signals to the antenna through a

Step	Functional Unit	Processing Flow
		flexible waveguide.

Table 3-3 Signal processing in the receive direction

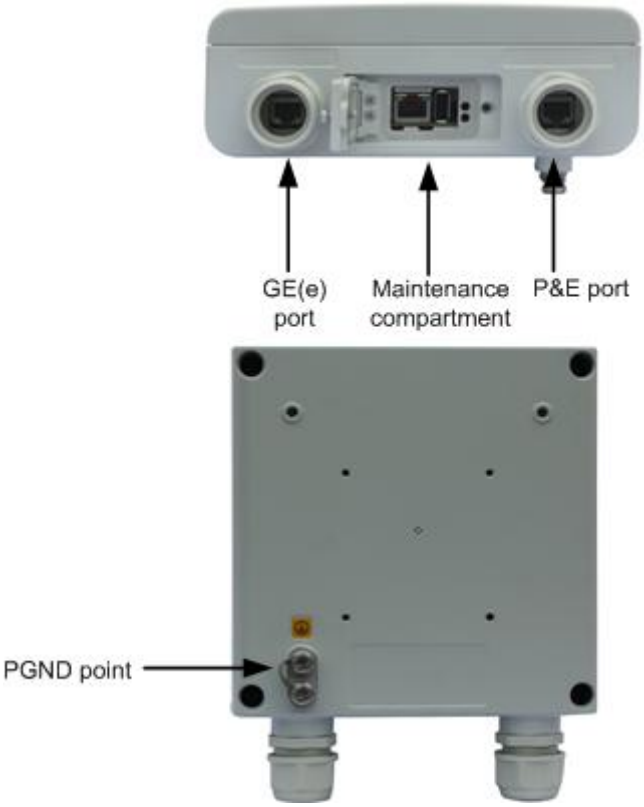
Step	Functional Unit	Processing Flow
1	RF processing unit	• Isolates and filters RF signals. • Performs down-conversion and power amplification. • Transmits the modulated signals to the baseband processing unit.
2	Baseband processing unit	• Receives modulated signals from the RF processing unit using the receive timeslot specified by the TDD electronic switch. • Converts analog signals to digital signals. • Demodulates signals. • Performs FEC decoding. • Extracts overhead signals and Ethernet frames from microwave frames. • Transmits the Ethernet frames to the Ethernet switching unit.
3	Ethernet switching unit	• Receives Ethernet frames from the baseband processing unit. • Processes the Ethernet frames based on service configurations and Layer 2 protocols. • Transmits the Ethernet frames to the Ethernet access unit.
4	Ethernet access unit	Converts parallel Ethernet signals to serial Ethernet signals and transmits them.

3.3 Ports

An RTN 360 has one GE port, one P&E port, and one maintenance compartment.

Port Positions

Figure 3-3 Port positions



The maintenance compartment contains a USB port, RSSI port, and an NMS port. See Figure 3-4. When RTN 360 is running, the protective cover of the maintenance compartment must be closed.

Figure 3-4 Front view of the management ports

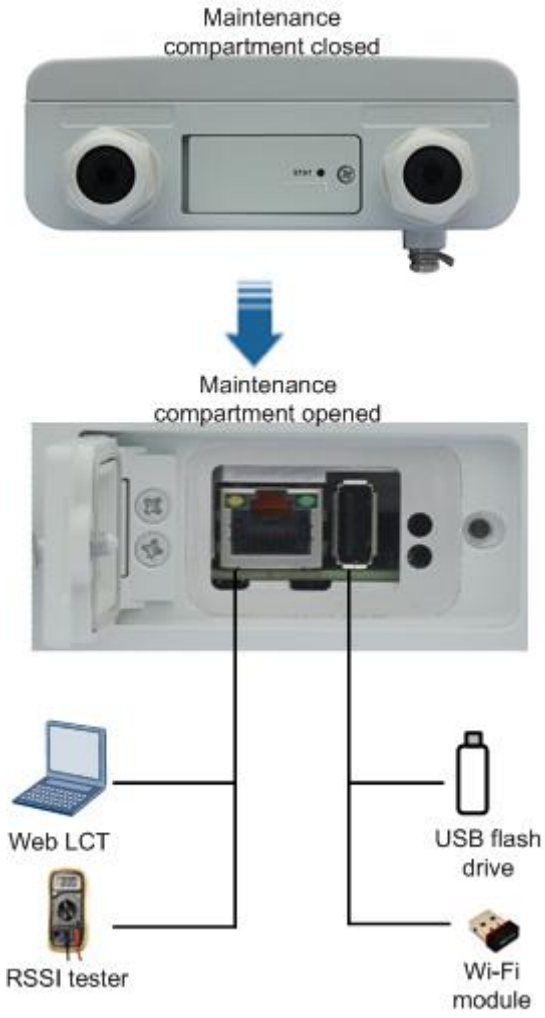


Table 3-4 Ports

No.	Port	Description	Connector Type
1	GE(e)	GE electrical port **NOTE** Do not remove the protective connector of a vacant GE electrical port.	RJ45 connector
2	P&E	Power over Ethernet port, which can concurrently receive FE/GE electrical signals and -48 V power signals	RJ45 connector
3	USB port	• A USB flash drive can connect to the USB port to import initial configuration data, back up NE data, or upgrade software. • A Wi-Fi module can connect to the USB port to enable connection of the Mobile	USB connector

No.	Port	Description	Connector Type
		LCT or Web LCT to the equipment.	
4	RSSI port	You can obtain the received signal level (RSL) of an RTN 360 by testing the voltage at the RSSI port using a multimeter.	RJ45 connector **NOTE** RSSI port and NMS port share an RJ45 connector.
5	NMS port	The NMS port transmits network management signals.	
6	PGND point	-	M5 screw

P&E Port and GE(e) Port

The P&E port can simultaneously receive GE electrical signals and -48 V power signals. It connects to a power injector (PI), a Dock, or power sourcing equipment (PSE).

The GE(e) port is a common GE electrical port.

NOTE
On the NMS, the P&E port is displayed as GE1 and the GE(e) port is displayed as GE2.

Both the P&E and GE(e) ports use RJ45 connectors.

Figure 3-5 Front view of an RJ45 connector

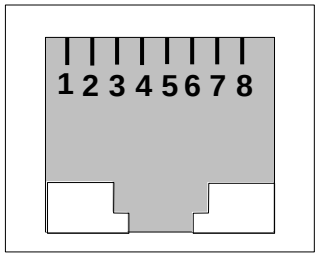


Table 3-5 Pin assignments for RJ45 connectors of the P&E and GE(e) ports

Pin No.	P&E Port		GE(e) Port	
	Signal	Function	Signal	Function
1	BIDA+/BGND	Bidirectional data wire A (+)/BGND	BIDA+	Bidirectional data wire A (+)
2	BIDA-/BGND	Bidirectional data wire A (-)/BGND	BIDA-	Bidirectional data wire A (-)
3	BIDB+/-48 V	Bidirectional data wire B (+)/-48 V	BIDB+	Bidirectional data wire B (+)

Pin No.	P&E Port		GE(e) Port	
	Signal	Function	Signal	Function
4	BIDB-/BGND	Bidirectional data wire B (-)/BGND	BIDB-	Bidirectional data wire B (-)
5	BIDC+/BGND	Bidirectional data wire C (+)/BGND	BIDC+	Bidirectional data wire C (+)
6	BIDC-/-48 V	Bidirectional data wire C (-)/-48 V	BIDC-	Bidirectional data wire C (-)
7	BIDD+/-48 V	Bidirectional data wire D (+)/-48 V	BIDD+	Bidirectional data wire D (+)
8	BIDD-/-48 V	Bidirectional data wire D (-)/-48 V	BIDD-	Bidirectional data wire D (-)

USB Port

The USB port can either connect to a USB flash drive for importing configurations, upgrading software, or backing up data or to a Wi-Fi module for enabling connection of the Mobile LCT or Web LCT to the equipment.

RSSI Port/NMS Port

Table 3-6 provides the pin assignments for the RJ45 connector of the RSSI port/NMS port.

Table 3-6 Pin assignments for the RJ45 connector of the RSSI port/NMS port

Pin No.	Signal
1	Signal output (+)
2	Signal output (-)
3	Signal input (+)
4	Ground
5	Reserved
6	Signal input (-)
7	RSSI test level signal
8	Reserved

The RJ45 connector has two indicators that indicate the NMS port connection status. Table 3-7 describes what the indicator statuses mean.

Table 3-7 Indicator status explanation

Indicator	Status	Meaning
LINK (yellow)	On	The NMS port connection is normal.
	Off	The NMS port connection is interrupted.
ACT (green)	On or blinks	The NMS port is receiving or transmitting data.
	Off	The NMS port is not receiving or transmitting data.

3.4 Indicators

RTN 360 has an STAT indicator and a USB port indicator.

The two indicators are in the maintenance compartment. You can observe the STAT indicator even when the protective cover of the maintenance compartment is closed, but you can observe the USB port indicator only if the protective cover of the maintenance compartment is open.

Figure 3-6 Indicator positions

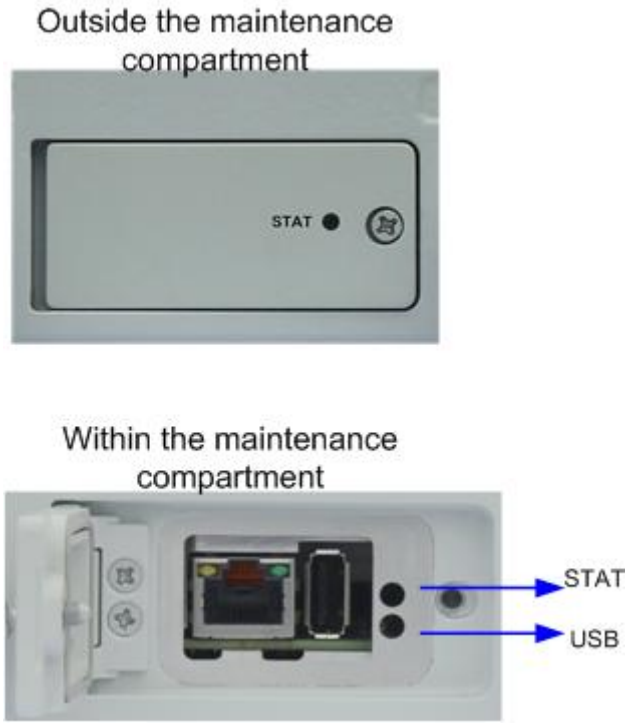


Table 3-8 Indicator status explanation

Indicator		Status	Meaning
Indicator that indicates system operating status and link status (STAT)	Operating status	Steady green	The equipment is working properly and services at the air interface are normal.
		Steady red	The hardware is faulty (for example, the equipment fails to start, or a HARD_BAD alarm is reported).
		Off	The equipment is not powered on.
	Link status	Blinks red	The equipment is working properly but services at the air interface are interrupted.
		Steady green	• The microwave link is available. No expected receive power is set according to the network plan. • The microwave link is available. The expected receive power is set according to the network plan. The difference between the actual receive power and the expected receive power is less than 3 dB.
		Blinks green	The microwave link is available. The

Indicator		Status	Meaning
			difference between the actual receive power and the expected receive power is greater than 3 dB.
USB port indicator	Wi-Fi module	Steady green	The Wi-Fi module has been identified and is working properly.
		Steady red	The Wi-Fi module is faulty.
		Off	• No Wi-Fi module is connected to the USB port. • The Wi-Fi module connected to the USB port cannot be identified.
	USB flash drive	Steady green	Backing up or restoring data is complete.
		Blinks green	Data is being backed up or restored.
		Steady red	• The USB flash drive is faulty. • Backing up or restoring data fails.
		Blinks red	The hardware is faulty and fails to initialize the USB flash drive.
		Off	• No USB flash drive is connected to the USB port. • The USB flash drive connected to the USB port cannot be identified.

NOTE

After you load data to an RTN 360 using a USB flash drive, the RTN 360 automatically resets. All the indicators are off during the reset. After the reset is complete, observe the STAT indicator to learn about the status of the RTN 360.

3.5 Labels

A product nameplate label, electrostatic discharge (ESD) warning label, radiation warning label, grounding label, and high temperature warning label are affixed on a chassis. Adhere to any warnings on the labels when performing tasks to avoid personal injury and damage to equipment.

Label Positions

Figure 3-7 Label positions

NOTE

High temperature warning label: Indicates that the equipment surface temperature may exceed 70 ℃ when the ambient temperature is higher than 55 ℃. Wear protective gloves to handle the equipment.

Product Nameplate Label

Figure 3-8 Product nameplate label

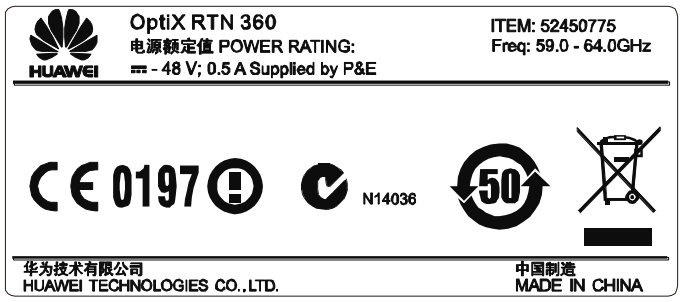


Table 3-9 Product nameplate label description

Label Information	Description
OptiX RTN 360	Indicates the product name.
ITEM: 52450775	Indicates the product item for identifying the product model.
-48V; 0.5A	Indicates the power supply rated value.
Supplied by P&E	Indicates that PoE is used.
Freq: 59.0–64.0 GHz	Indicates the frequency range.

4 Network Management System

About This Chapter

This chapter describes network management solutions and the network management system (NMS) software used in these solutions.

4.1 Network Management Solutions

Huawei provides complete transport network management solutions that satisfy the telecommunications management network (TMN) requirements for various function domains and customer groups of telecommunications networks.

The following network management solutions are available:

- iManager U2000 Web LCT local maintenance terminal

  The Web LCT, a web-based local maintenance terminal, manages local and remote NEs on a per-NE/hop basis.
- iManager U2000 Mobile LCT local maintenance terminal

The Mobile LCT, a local maintenance terminal running on a smartphone, manages local and remote NEs on a per-NE/hop basis through Wi-Fi.

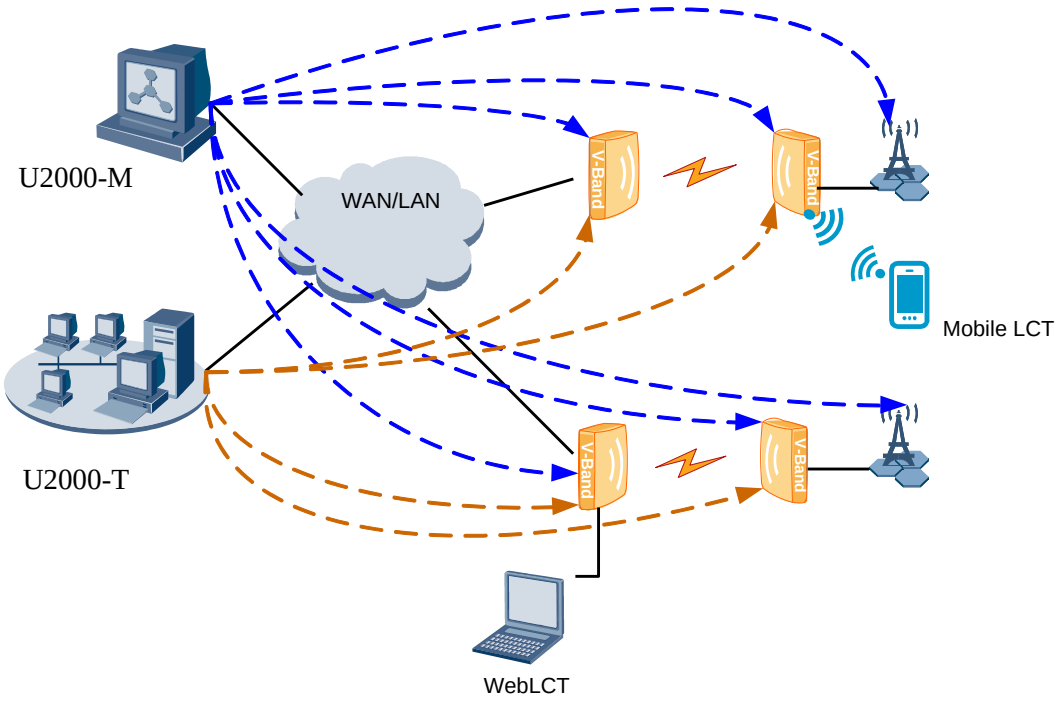
- iManager U2000-T unified network management system

  The iManager U2000-T, a network-level management system, manages Huawei RTN, PTN, MSTP, and WDM products on transport networks in a unified manner.

- iManager U2000-M unified network management system

  The iManager U2000-M, a network-level management system, manages Huawei mobile communications products in a unified manner.

Figure 4-1 Network management solutions for transport networks



4.2 Web LCT

The Web LCT is a local maintenance terminal running on a PC.

The Web LCT provides the following management functions at the NE layer: NE management, alarm management, performance management, configuration management, communication management, and security management.

The Web LCT also provides hop management, which displays the information about the two ends of a microwave link hop graphically and enables a microwave link hop to be managed easily.

Figure 4-2 NE management window

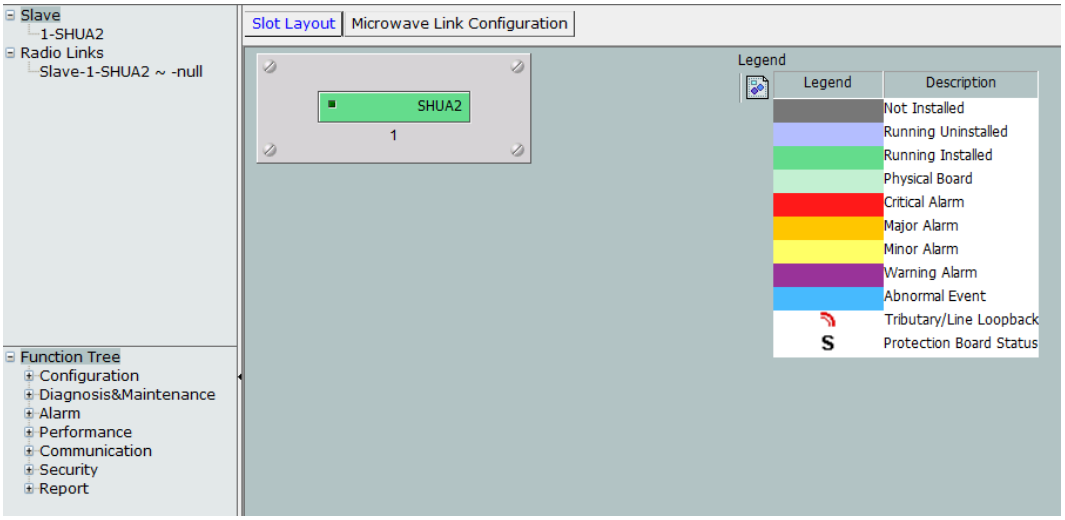
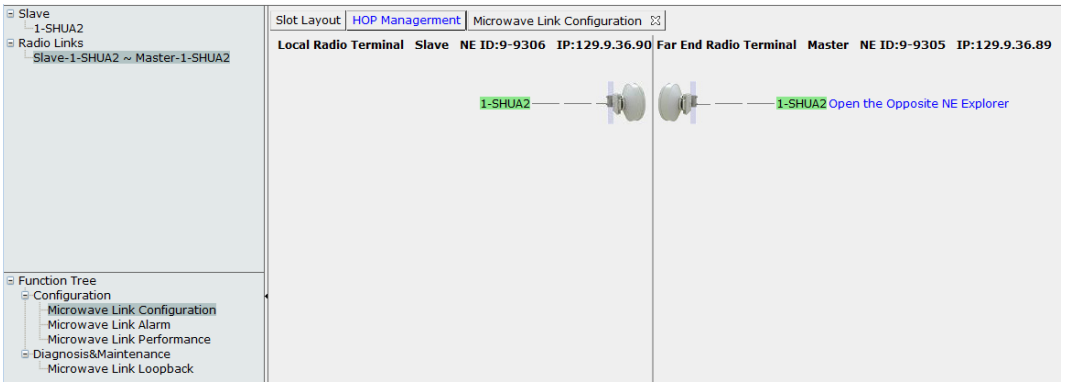


Figure 4-3 HOP management window

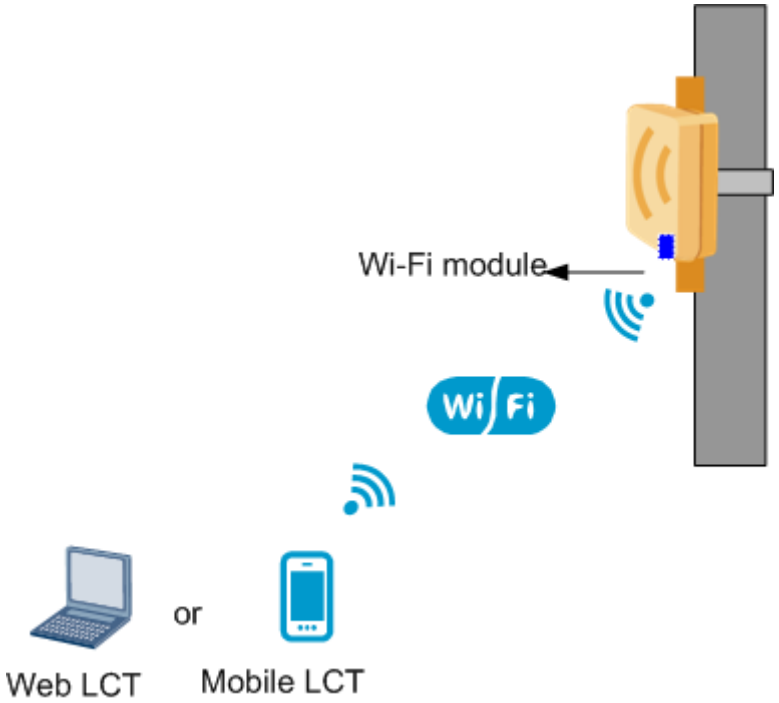


4.3 Mobile LCT

The Mobile LCT is a local maintenance terminal running on a smartphone.

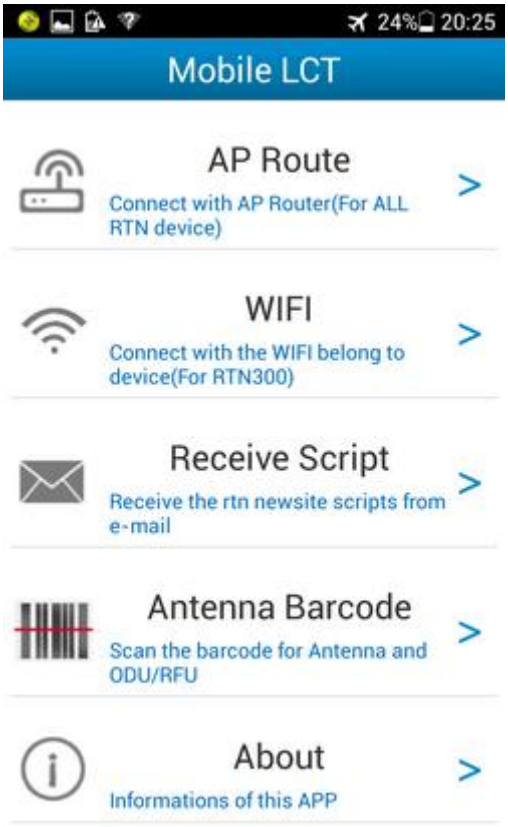
The Mobile LCT manages an NE after connecting to the NE using Wi-Fi. Figure 4-4 shows a typical application scenario.

Figure 4-4 Mobile LCT application scenario



The Mobile LCT can create NEs by searching NEs, configure NE attributes, microwave links, and DCN, and query alarms.

Figure 4-5 Workbench of the Mobile LCT



4.4 U2000-T

The iManager U2000-T is a network-level management system (NMS) that manages Huawei fixed-line network products in a unified manner.

The U2000-T provides topology management, which displays NE positions and connections between NEs. See Figure 4-6.

The U2000-T manages network-level alarms, performance, inventory, and security, and end-to-end service configurations. See Figure 4-7.

The U2000-T provides a built-in NE Explorer to manage all NEs on the topology. See Figure 4-8.

Figure 4-6 Topology management interface of the U2000-T

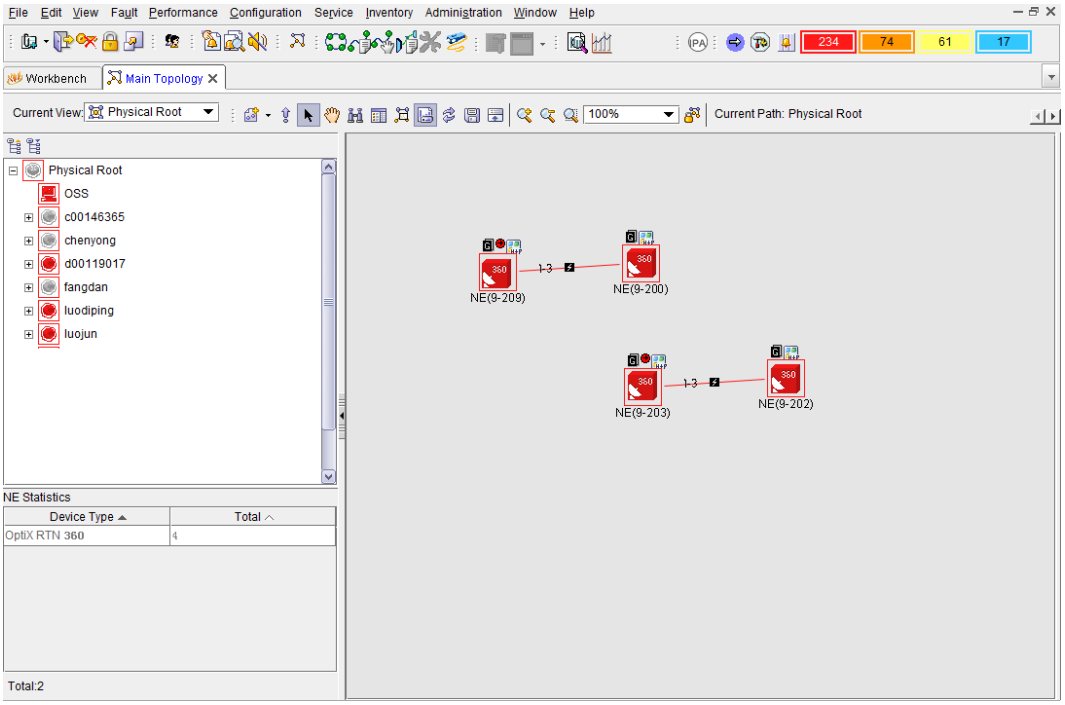


Figure 4-7 End-to-end service configuration interface of the U2000-T

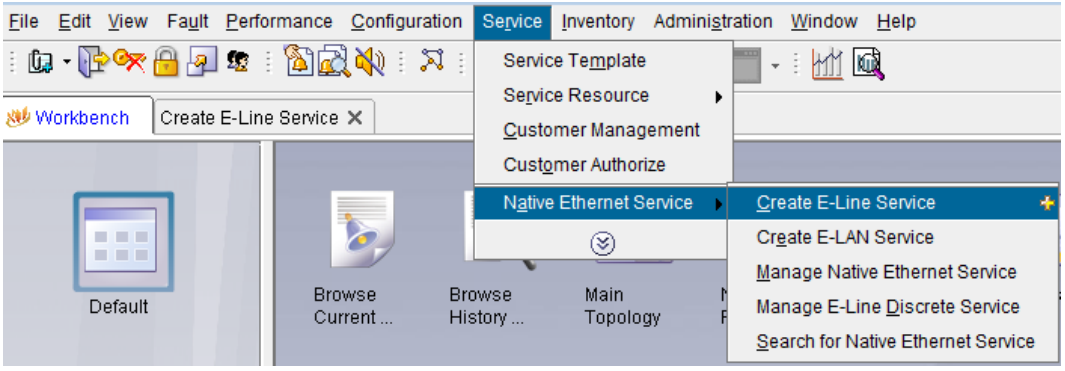
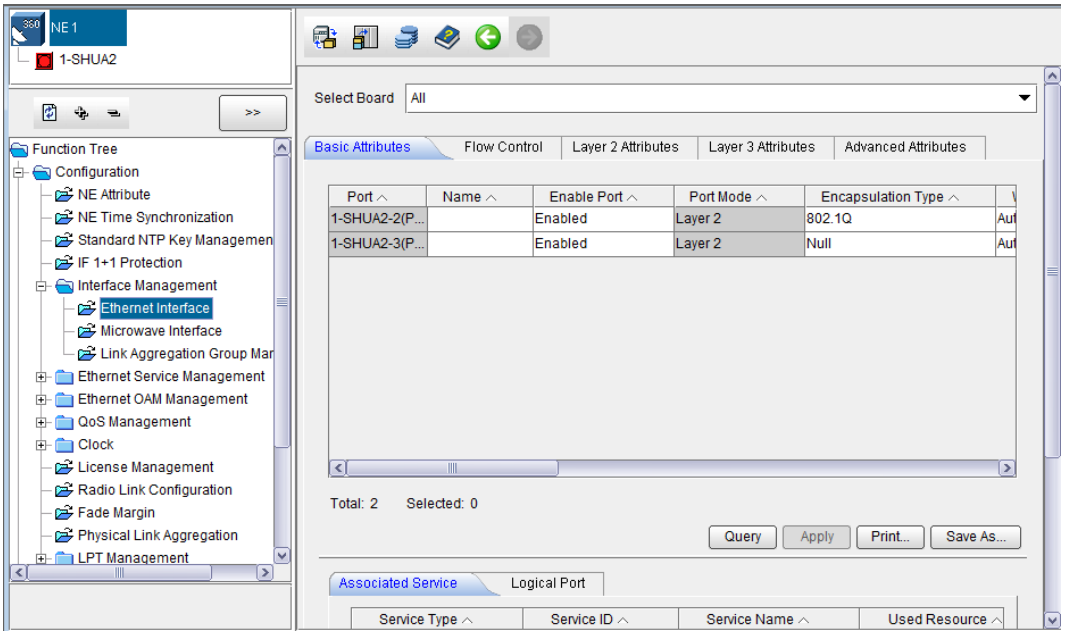


Figure 4-8 NE Explorer interface of the U2000-T



4.5 U2000-M

The U2000-M is a network-level management system that manages Huawei mobile communications products in a unified manner.

The U2000-M displays connections between RTN 360s and base stations.

The U2000-M can manage RTN 360s using its built-in NE Explorer.

5 Technical Specifications

About This Chapter

This chapter describes the technical specifications of OptiX RTN 360.

5.1 Ethernet Service Specifications

This section describes the service throughput for Native Ethernet services on a hop of microwave link.

5.2 RF Performance

This section describes major RF performance of RTN 360, including the frequency band, transmit power, and receiver sensitivity.

5.3 Antenna Performance

This section describes the major antenna performance of RTN 360, including the antenna gain, standing wave ratio (SWR), and cross polarization discrimination (XPD).

5.4 Predicted Reliability

This section describes the predicted equipment reliability of a single RTN 360 and the predicted link reliability of a hop of microwave link forming by two RTN 360s.

5.5 Integrated System Performance

Integrated system performance includes the dimensions, weight, power consumption, and power supply.

5.1 Ethernet Service Specifications

This section describes the service throughput for Native Ethernet services on a hop of microwave link.

The bit error performance of Ethernet services on RTN 360 complies with IETF RFC2544.

Throughput of Ethernet Services

Ratio of Timeslots for Uplink Data to Those for Downlink Data (Uplink:Downlink)	Uplink Throughput (Mbit/s)	Downlink Throughput (Mbit/s)
1:1	244 to 313	244 to 313
1:2	161 to 206	328 to 419
2:1	328 to 419	161 to 206
1:3	118 to 152	372 to 476
3:1	372 to 476	118 to 152

NOTE
The throughput is measured assuming that untagged Ethernet frames with length ranging from 64 bytes to 9600 bytes are transmitted.

5.2 RF Performance

This section describes major RF performance of RTN 360, including the frequency band, transmit power, and receiver sensitivity.

Table 5-1 RF performance

Item	Performance
Working mode	200 MHz/16QAM
Operating frequency band	59 GHz to 64 GHz
Transmit power	3 dBm
Receive power	• Maximum receive power: -23 dBm • Minimum receive power: -70 dBm
Receiver Sensitivity (BER = 10-6)	-60 dBm
Ratio of timeslots for uplink data to those for downlink data	3:1, 2:1, 1:1, 1:2, and 1:3

5.3 Antenna Performance

This section describes the major antenna performance of RTN 360, including the antenna gain, standing wave ratio (SWR), and cross polarization discrimination (XPD).

Table 5-2 Antenna performance

Item	Performance
Antenna gain	34.5 dBi
SWR	10 dB
3 dB beamwidth	1.9 º
XPD	21 dB
Front-to-back ratio (FBR)	> 48 dB
Regulatory compliance	ETSI class 2

5.4 Predicted Reliability

This section describes the predicted equipment reliability of a single RTN 360 and the predicted link reliability of a hop of microwave link forming by two RTN 360s.

Predicted Equipment Reliability

The equipment reliability shows the reliability of a single piece of equipment.

Table 5-3 Predicted equipment reliability

Item	Performance
MTBF (hour)	66.22×10^4
MTBF (year)	75.59
MTTR (hour)	0.79
Availability	99.99985%

Predicted Link Reliability

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

Table 5-4 Predicted link reliability

Item	Performance
MTBF (hour)	33.11×10^4
MTBF (year)	37.79
Availability	99.99970%

5.5 Integrated System Performance

Integrated system performance includes the dimensions, weight, power consumption, and power supply.

Mechanical Performance and Power Consumption

Item	Performance
Dimensions (H x W x D)	192.5 mm x 192.5 mm x 70 mm
Weight	2.5 kg
Typical power consumption	20 W
Power supply	• Supports power over Ethernet. • The input PoE voltage ranges from –38.4 V to –57.6 V.

Electromagnetic Compatibility

- Passed CE authentication
- Compliant with ETSI EN 301 489-1
- Compliant with ETSI EN 301 489-4
- Compliant with EN 55022 class B

Lightning Protection

- Compliant with ITU-T K.20
- Compliant with ITU-T K.21
- Compliant with ITU-T K.27
- Compliant with ETSI EN 300 253.

Safety

- Passed CE authentication
- Compliant with IEC 60825
- Compliant with IEC 60215
- Compliant with IEC 60950-1
- Compliant with IEC 60950-22
- Compliant with K.20
- Compliant with K.21
- Compliant with GB 12638-1990
- Compliant with EN 41003

Environment

RTN 360 is used outdoors.

Table 5-5 Environment performance

Item		Performance
Major reference standards	Operating	Compliant with EN 300 019-2-4
	Transportation	Compliant with EN 300 019-2-3 class 2.3
	Storage	Compliant with EN 300 019-2-4
Temperature	Operating	-33℃ to +55℃
	Transportation and storage	-40℃ to +70℃
Protection class		IP65
Relative humidity		5% to 100%
Earthquake resistant design		Compliant with ETSI 300 019-2-4
Mechanical stress		Compliant with ETSI EN 300 019-2-1

6 Accessories

About This Chapter

RTN 360 describes all the accessories.

6.1 Power Injector

A power injector (PI) transmits GE signals together with -48 V power signals to an RTN 360 through a network cable.

NOTE

Huawei provides various types of PIs with similar functions and working principles. PIs will be detailed latter by taking OptiX RTN PI-DC A11 as an example.

Table 6-1 Differences between PIs

Type	OptiX RTN PI-DC A10	OptiX RTN PI-DC B10	OptiX RTN PI-DC A11
Appearance			
Application scenario	Indoor equipment room and outdoor cabinet	Outdoor (not on a tower)	Indoor equipment room and outdoor cabinet
Dimensions	38.6 mm x 145.6 mm x 185 mm	43.6 mm x 164 mm x 226 mm	36.0 mm x 145.6 mm x 84 mm
Weight	0.8 kg	1.3 kg	0.5 kg
Input power supply	–38.4 V to –57.6 V	–38.4 V to –57.6 V	–38.4 V to –57.6 V
Number of P&E ports, Mode	One, Forced power mode	One, Forced power mode	One, Standard PSE or forced power mode

6.1.1 Appearance, Functions, and Features

A power injector (PI) transmits GE electrical signals, -48 V power signals, and network management signals to an RTN 360 through an outdoor network cable.

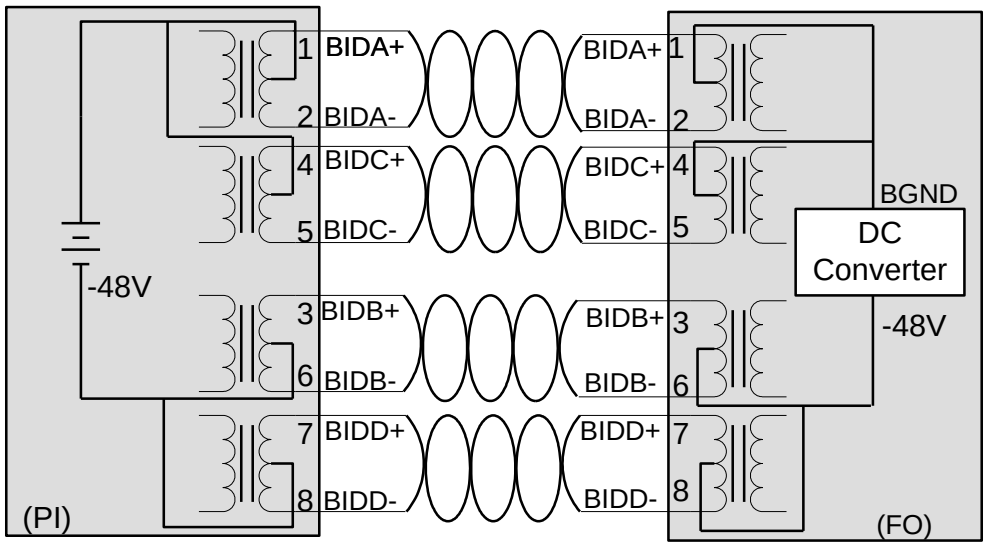
Appearance

Figure 6-1 Appearance

Features and Functions

- Switches between the standard PSE power mode or forced power mode through a dual in-line package (DIP) switch.
- Receives/Transmits a channel of electrical GE service signals.
- Receives a channel of -48 V DC power signals.
- Couples -48 V power signals to eight pins of the GE electrical port and transmits them to an RTN 360 through an outdoor network cable. See Figure 6-2.

Figure 6-2 -48 V power signal coupling



There is no interference between DC power signals and Ethernet service signals, which can be transmitted over the same twisted pair.

Installation Modes

An indoor PI can be installed:

- In a 300 mm deep European Telecommunications Standards Institute (ETSI) cabinet
- In a 600 mm deep ETSI cabinet
- In a 450 mm deep 19-inch cabinet
- In a 600 mm deep 19-inch cabinet
- In a 19-inch open rack
- In an outdoor cabinet for wireless equipment
- On an indoor wall

6.1.2 Ports and Indicators

A power injector (PI) has one GE service port, one network management system (NMS) port, one P&E port, one power input port, indicators, and labels on its front panel.

Ports

Figure 6-3 and Figure 6-4 show the ports on a PI.

Figure 6-3 Ports on the front panel of a PI

Figure 6-4 Port on the rear side of a PI

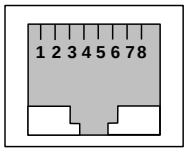
Table 6-2 Ports on a PI

Port	Description	Connector Type	Required Cable
RTN (+)	BGND	2-pin terminal block	7.3 Power Cables
NEG (-)	-48 V		
GE	GE electrical port	RJ45	Ordinary network cable
NMS	NMS port (reserved)		
MGMT	NMS port (reserved)	RJ45	7.1 Outdoor Network Cables
P&E	Ethernet service and -48 V power port		
Power Output Mode	Power output mode switch: • If the DIP switch is on the PSE-PD side, the standard PSE power mode, which applies to standard PoE equipment such as RTN 360 is	DIP switch	-

Port	Description	Connector Type	Required Cable
	used. • If the DIP switch is on the FORCE side, the forced power mode is used.RTN 360 does not use the forced power mode. **NOTE** The switch should be set to the planned value before the PI is powered on. After the PI is powered on, the mode cannot be changed.		

The GE service port, NMS port, and P&E port use RJ45 connectors. Figure 6-5 shows the front view of an RJ45 connector.

Figure 6-5 Front view of an RJ45 connector



The GE electrical port is compatible with an FE electrical port and supports the MDI, MDI-X, and auto-MDI/MDI-X modes. Table 6-3 and Table 6-4 provide the pin assignments for an RJ45 port in different modes.

Table 6-3 Pin assignments for an RJ45 connector in MDI mode (Ethernet service signals)

Pin	10/100BASE-T(X)		1000BASE-T	
	Signal	Function	Signal	Function
1	TX+	Transmitting data (+)	BIDA+	Bidirectional data wire A (+)
2	TX-	Transmitting data (-)	BIDA-	Bidirectional data wire A (-)
3	RX+	Receiving data (+)	BIDB+	Bidirectional data wire B (+)
4	Reserved	-	BIDC+	Bidirectional data wire C (+)
5	Reserved	-	BIDC-	Bidirectional data wire C

Pin	10/100BASE-T(X)		1000BASE-T	
	Signal	Function	Signal	Function
				(-)
6	RX-	Receiving data (-)	BIDB-	Bidirectional data wire B (-)
7	Reserved	-	BIDD+	Bidirectional data wire D (+)
8	Reserved	-	BIDD-	Bidirectional data wire D (-)

Table 6-4 Pin assignments for an RJ45 connector in MDI-X mode (Ethernet service signals)

Pin	10/100BASE-T(X)		1000BASE-T	
	Signal	Function	Signal	Function
1	RX+	Receiving data (+)	BIDB+	Bidirectional data wire B (+)
2	RX-	Receiving data (-)	BIDB-	Bidirectional data wire B (-)
3	TX+	Transmitting data (+)	BIDA+	Bidirectional data wire A (+)
4	Reserved	-	BIDD+	Bidirectional data wire D (+)
5	Reserved	-	BIDD-	Bidirectional data wire D (-)
6	TX-	Transmitting data (-)	BIDA-	Bidirectional data wire A (-)
7	Reserved	-	BIDC+	Bidirectional data wire C (+)
8	Reserved	-	BIDC-	Bidirectional data wire C (-)

The P&E port couples Ethernet service signals and power signals and transmits them. Whether the port uses MDI or MDI-X mode to transmit Ethernet service signals does not affect the pin assignments for the power signals.

Table 6-5 Pin assignments for an RJ45 connector (power signals)

Pin	Signal
1	BGND

Pin	Signal
2	BGND
3	Power signal (-48 V)
4	BGND
5	BGND
6	Power signal (-48 V)
7	Power signal (-48 V)
8	Power signal (-48 V)

The NMS and MGMT ports transmit network management signals. Table 6-6 lists their pin assignments.

Table 6-6 Pin assignments for the NMS and MGMT ports

Pin	Signal	Function
1	TX+	Transmitting data (+)
2	TX-	Transmitting data (-)
3	RX+	Receiving data (+)
4	Reserved	-
5	Reserved	-
6	RX-	Receiving data (-)
7	Reserved	-
8	Reserved	-

Indicators

Table 6-7 Indicator status explanation

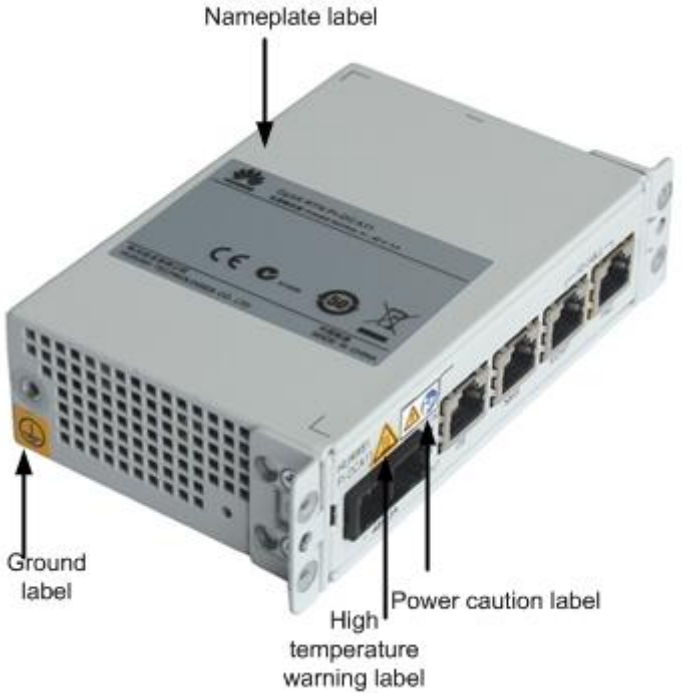
Indicator	Status	Meaning
DC IN	Steady green	Power is supplied.
	Off	Power is not supplied.
P&E OUT	Steady green	P&E is being output normally.
	Blinks green	In PSE-PD mode, the equipment is in handshake status.

Indicator	Status	Meaning
	Off	P&E is not being output.

6.1.3 PI Labels

This section lists the labels that are attached to a power injector (PI). Adhere to any warnings or instructions on the labels when performing various tasks to avoid any personal injury or damage to equipment.

Figure 6-6 Label positions on an indoor PI



NOTE

High temperature warning label: Indicates that the equipment surface temperature may exceed 70 ℃ when the ambient temperature is higher than 55 ℃. Wear protective gloves to handle the equipment.

Table 6-8 Product nameplate label description

Example of the Label Content	Parameter	Parameter Description
OptiX RTN PI – DC A 11 1 2 3 4 5	1: Product name	-
	2: Power supply mode	DC: direct current
	3: Application environment	• A: indoor • B:

Example of the Label Content	Parameter	Parameter Description
		outdoor
	4: Number of channels	1: one power-over-Ethernet channel
	5: Version number	-
电源额定值 POWER RATING : ⎓ -48V; 2.6A	-	PI power supply rated value

6.1.4 Technical Specifications

The technical specifications of power injectors (PIs) include electromagnetic compatibility, anti-interference capability, safety, and environmental standards.

Power Supply

Item	Specifications
Input voltage range	-38.4 V to -57.6 V
Number of PoE outputs	One
PoE mode	Standard PSE power mode and forced power mode

Dimensions and Weight

Item	Specifications
Dimensions (H x W x D)	36 mm x 145.6 mm x 84 mm
Weight	0.5 kg

Electromagnetic Compatibility

- Passed CE authentication
- Compliant with ETSI EN 301 489-1
- Compliant with ETSI EN 301 489-4
- Compliant with ETSI EN 300 386

Safety

- Passed CE authentication
- Compliant with EN60950-22
- Compliant with IEC60950-22
- Compliant with IEC60950-1
- Compliant with EN60950-1

Environment

Table 6-9 Environment performance

Item		Specifications
Major reference standards	Operating	Compliant with 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
Operating temperature		-33℃ to +55℃
Relative humidity		5% to 100%
Earthquake resistant design		Compliant with GR3108 Zone 4 and ETSI 300 019-2-4/YD5083

6.2 Dock

Dock is a type of outdoor power sourcing equipment (PSE) with the built-in Layer 2 switching function. It often provides power to both RTN 360 and Huawei small cell base stations.

NOTE
Huawei provides various types of Docks with similar functions and working principles. The following details Docks by taking Dock V318R001C00 working with Huawei small cell base stations as an example.

6.2.1 Appearance, Functions, and Features

A Dock switches Ethernet services between equipment and provides power to other equipment. It transmits DC power signals which are converted from AC power signals together with Ethernet signals.

Appearance

Figure 6-7 Appearance

Features and Functions

- Power supply functions
  - Receives 220 V AC power and converts it to -57 V DC power.
  - Outputs -57 V DC power signals coupled with Ethernet service signals through the LAN0, LAN1, and WAN ports, implementing power over Ethernet (PoE).
  - Supports the standard PSE power mode and forced power mode (PSE stands for power sourcing equipment). By default, a Dock uses the standard PSE power mode.
- Ethernet service functions
  - Provides one FE/GE optical port (OPT). The port supports 100M full-duplex (FE optical module), 1000M full-duplex (GE optical module), and autonegotiation. The port works in autonegotiation mode by default.
  - Provides three PoE ports including LAN0, LAN1, and WAN. These ports support 100M full-duplex, 1000M full-duplex, and autonegotiation. These ports work in autonegotiation mode by default.
  - Switches Ethernet service packets among four Ethernet ports based on the IEEE 802.1ad bridge.
- Clock functions
  - Supports synchronous Ethernet clocks.
  - Supports the configuration of clock sources. By default, a Dock traces synchronous Ethernet clocks of optical ports or WAN ports. Optical ports have a higher priority than the WAN ports.

- Supports configuration management, security management, and system management.

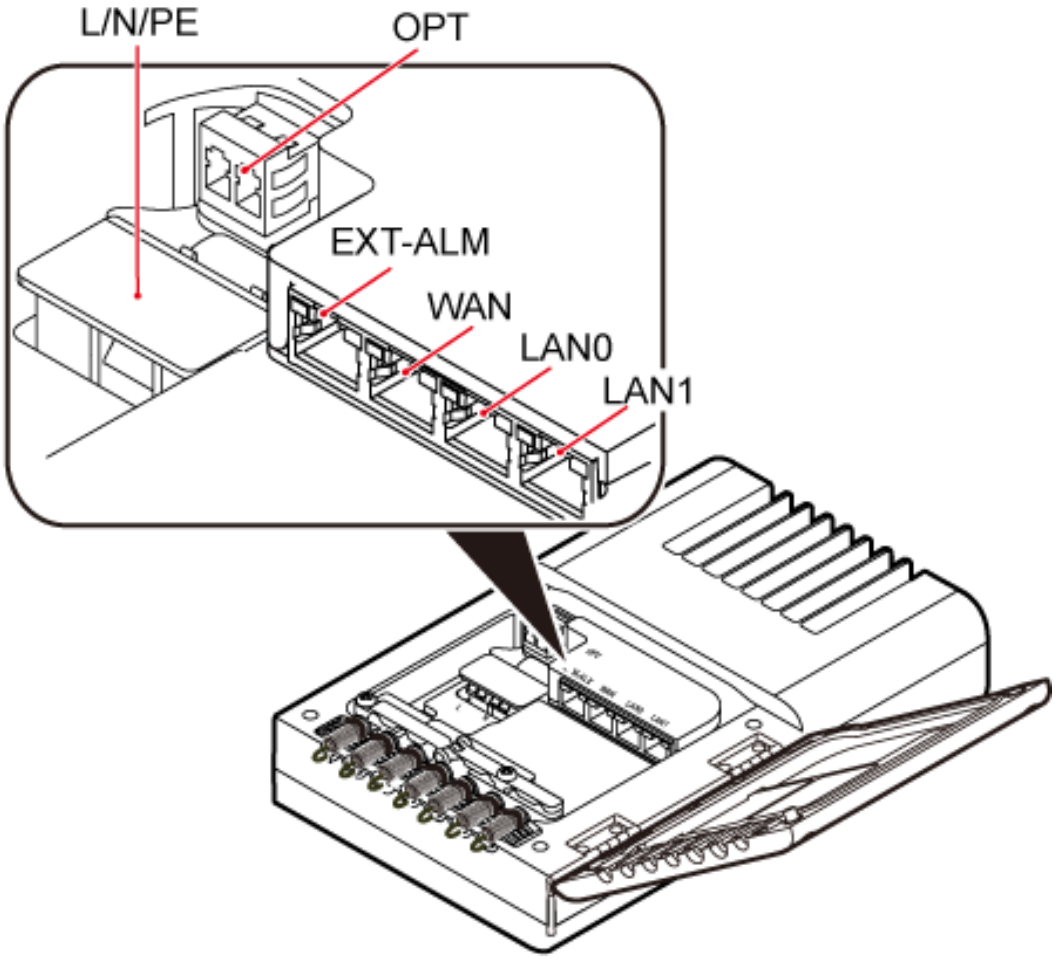
For more details, see related documents of Huawei Atomcell.

6.2.2 Ports and Indicators

Ports are inside a Dock, and indicators are outside a Dock.

Ports

Figure 6-8 Ports



The following describes ports of a Dock.

Table 6-10 Ports

Port	Description
OPT	FE/GE optical port that connects to external transmission equipment

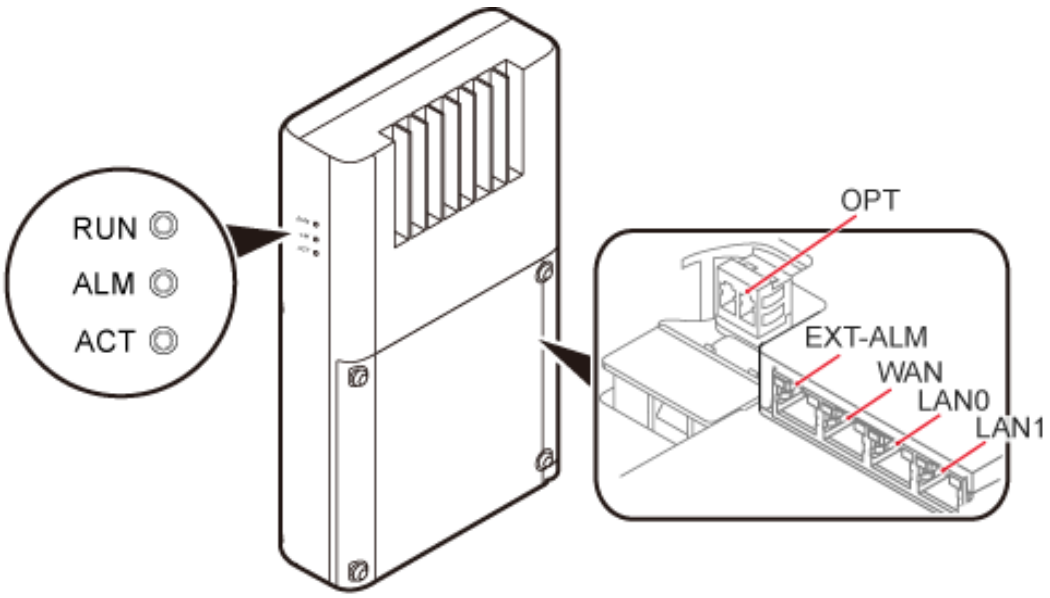
Port	Description
L/N/PE	Port that connects to external power equipment through a live wire, neutral wire, or PE cable
EXT-ALM	Environment monitoring port that provides four-line dry contacts to connect external devices and monitor alarms
WAN	PoE port that connects to external transmission equipment
LAN0	PoE port that connects to a small cell base station
LAN1	PoE port that connects to commissioning equipment or lower-level cascade equipment

NOTE
WAN and LAN1 ports can provide power to standard PoE equipment.

Indicators

A Dock has three external indicators RUN, ALM, and ACT to indicate the equipment running status. Each internal RJ45 connector has two indicators for indicating the connection status and data transmission status. The connector of the OPT port has one indicator for indicating both the connection status and data transmission status.

Figure 6-9 Indicators of a Dock



The following table describes indicators of a Dock.

Table 6-11 External indicators

Indicator	Meaning	Status	Description
RUN	Running status	Steady green	Power supply is available, but the Dock is faulty or has just been powered on.
		Off	No power supply is available, or the Dock is faulty.
		Blinks green (on for 1s and off for 1s)	The Dock is running properly.
		Blinks green (on for 0.125s and off for 0.125s)	Software is being loaded to the Dock, or the Dock is not started.
ALM	Alarm status	Steady red	An alarm is generated, and the Dock must be replaced. Or, the Dock has just been powered on.
		Blinks red	An alarm is generated. The alarm is caused by a fault on the Dock.
		Off	No alarm
ACT	Service status	Steady green	The Dock is receiving or transmitting data.
		Off	The Dock is not receiving or transmitting data, or has just been powered on.

Table 6-12 Internal indicators

Indicator	Meaning	Status	Description
EXTALM/WAN/LAN0/LAN1	Green indicator: connection status	Steady green	The port is connected correctly.
		Off	No connection is set

Indicator	Meaning	Status	Description
			up on the port.
	Orange indicator: data transmission	Blinks orange	The port is receiving or transmitting data.
		Off	The port is not receiving or transmitting data.
OPT	Optical port status	Steady green	The port connection status is normal, and the port is not receiving or transmitting data.
		Blinks green	The port is receiving or transmitting data.
		Off	No connection is set up on the port.

6.2.3 Technical Specifications

The technical specifications of Docks include dimensions and weight, power supplies, and power consumption.

Dimensions and Weight

Item	Specifications
Dimensions (H x W x D)	52 mm x 160 mm x 250 mm
Weight	2.8 kg

Power Supply

Item	Specifications
Input voltage range	90 V AC to 290 V AC, frequency being 45 Hz to 65 Hz
Output PoE voltage	-57 V DC
Number of PoE outputs	Three
Output power of PoE ports	• Output power of the LAN0 port: 150 W • Total output power of WAN and LAN1 ports: 60 W

Power Consumption

Power consumption ≤ 35 W

6.3 USB Flash Drives

Configuring, replacing, and upgrading RTN 360s is simple with USB flash drives, which store NE data and new software to be installed and are also used to back up configuration data.

Functions and Features

USB flash drives prepared for RTN 360s store NE software and configuration data (including databases, system parameters, and scripts).

- Equipment software and scripts stored in USB flash drives are installed on RTN 360s for deployment and commissioning. With this system, users do not need to configure data onsite.
- Software, patch packages, NE databases, and system parameters are backed up to USB flash drives. This avoids the need to reconfigure data when replacing a RTN 360.
- Software of target versions stored in USB flash drives are imported to RTN 360s.

Application Scenario

- For deployment and commissioning of an RTN 360, scripts, and software are stored on a USB flash drive. After the USB flash drive is plugged in and functioning, the RTN 360 downloads software, and scripts in sequence.
- For an upgrade or downgrade of an RTN 360, only the software of the target version is stored on a USB flash drive. After the USB flash drive is plugged in and functioning, the RTN 360 compares the versions of the running software and the software stored on the USB flash drive. If the versions are not the same, the RTN 360 automatically downloads the software from the USB flash drive for an upgrade or downgrade.
- During RTN 360 replacement, an empty USB flash drive is inserted into a faulty device, which automatically backs up its data to the drive. After the faulty device is replaced, the drive holding the backup data is inserted into the new device, which automatically downloads the backed up NE data, software, and system parameters and restores the NE data.

Data uploading

A USB flash drive contains the following folders:

NOTE
The USB flash drive partition format is FAT32.

- The root directory stores a **RTN.CER** file.

NOTE
The **RTN.CER** file, which stores administrator-level account and password information (with password information encrypted), is used for authenticating the USB flash drive. The file is generated by a system administrator at the network management center (NMC) using a dedicated tool.

- pkg: stores the NE software.

CAUTION

Data is saved in the \pkg folder only when the NE software is upgraded. Otherwise, keep the folder empty.

- patch: stores the patch software.
- sysdata: stores system parameters.
- script: stores scripts.
- db: stores NE databases.
- license: stores a license.

NOTE

The license directory cannot be backed up or restored. It is usually empty.

- devicetype: stores device type parameters.

When a USB flash drive is connected to an RTN 360, the RTN 360 checks the folders on the USB flash drive in the following order:

1. Checks for the **RTN.CER** file in the root directory. If the file exists, the USB flash drive is authenticated. Otherwise, the USB flash drive fails to be identified.
2. Checks the NE software folder **pkg**. If the NE software version is different from that of the local RTN 360, the RTN 360 upgrades its software.
3. Checks the patch software folder **patch**. If the patch software version is different from that of the local RTN 360, the RTN 360 loads the patch software from the folder.
4. Checks the system parameter folder **sysdata**. If the folder contains data, the RTN 360 imports system parameters from the folder.
5. Checks the script folder **script**. If the folder contains data, the RTN 360 imports script data from the folder.
6. Checks the database folder **db**. If the folder contains data and the device type under **\Devicetype** is the same as the NE device type, the RTN 360 loads the database from the folder.
7. If any of the preceding folders contains no data or does not exist, the RTN 360 checks the next folder. If the RTN 360 finds none of the preceding folders, it exports its data to the USB flash drive.

Ensure that USB flash drives have only the preceding folders, as extra folders may lead to malfunctions.

NOTE

A device reads data from a USB flash drive at different rates in different scenarios. The user can check whether the device is reading data from a USB flash drive by observing the USB port or USB flash drive indicator.

Types of USB Flash Drives

Table 6-13 lists the types of USB flash drives supported by RTN 360. Not all USB flash drives are supported by RTN 360. If a USB flash drive of another model or capacity is required, confirm with the local Huawei office that the USB flash drive is supported by RTN 360.

Table 6-13 Types of USB flash drives

No.	Manufacturer	Model	Capacity
1	Netac	U208	4 GB

6.4 Wi-Fi Module

A Wi-Fi module for an RTN 360 enables the Mobile LCT or Web LCT to connect to the RTN 360 using Wi-Fi, implementing contact-free configuration and maintenance.

Appearance

Figure 6-10 Wi-Fi module

Specifications

Table 6-14 Wi-Fi module specifications

Item	Specifications
Port	USB2.0 high-speed connector
Dimensions (H x W x D)	20 mm x 14 mm x 6 mm
Wireless mode	Compatible with IEEE 802.11b/g/n
Maximum wireless rate	• IEEE 802.11n: 150 Mbit/s • IEEE 802.11g: 54 Mbit/s • IEEE 802.11b: 11 Mbit/s
Frequency range	2.4 GHz to 2.4835 GHz
Wireless transmit power	Maximum power: 20 dBm • IEEE 802.11b: 18±1 dBm • IEEE 802.11g: 15±1 dBm • IEEE 802.11n: 12±1 dBm
Receiver sensitivity	• 130 Mbit/s: -68 dBm@10% PER • 108 Mbit/s: -68 dBm@10% PER

Item	Specifications
	• 54 Mbit/s: -68 dBm@10% PER • 11 Mbit/s: -85 dBm@8% PER • 6 Mbit/s: -88 dBm@10% PER • 1 Mbit/s: -90 dBm@8% PER
Wi-Fi encryption mode	WPA2-PSK
Setting of the service set identifier (SSID)	Supported
Setting whether to enable Wi-Fi	Supported
Setting of Wi-Fi passwords	Supported
Maximum transmission distance	• 30 m (laptop/mobile phone) • 70 m (laptop + external Wi-Fi network adapter) **NOTE** 30 m is obtained based on tests in which a laptop (such as Lenovo Thinkpad X230) or mobile phone (such as Huawei 8815) is used and there is no obstacle between the laptop/mobile phone and NE. The actual transmission distance may vary according to performance of the laptop or mobile phone used. 70 m is obtained based on tests in which a laptop works with an external Wi-Fi network adapter (such as Tenda W311U+) and there is no obstacle between the laptop and NE. It is recommended that an external Wi-Fi network adapter with 18 dBm transmit power, -86 dBm receiver sensitivity, and an antenna of more than 4.2 dBi gain be used or an external Wi-Fi network adapter with better performance be used.

7 Cables

About This Chapter

This chapter describes the purpose, physical appearance, and connections of various cables used with OptiX RTN 360s.

7.1 Outdoor Network Cables

Fitted with RJ45 connectors at both ends, outdoor network cables connect Ethernet ports.

The GE electrical ports of PIs support the medium dependent interface (MDI), MDI crossover (MDI-X), and auto-MDI/MDI-X modes. Straight-through cables and crossover cables can be used to connect the NMS ports and GE electrical ports to MDIs or MDI-Xs. Straight-through cables are recommended if network cables are made onsite.

Cable Diagram

Figure 7-1 Network cable

Pin Assignments

Table 7-1 Pin assignments for straight-through cables

Connector X1	Connector X2	Color	Relationship
X1.1	X2.1	White/Orange	Twisted pair
X1.2	X2.2	Orange	
X1.3	X2.3	White/Green	Twisted pair
X1.6	X2.6	Green	
X1.4	X2.4	Blue	Twisted pair
X1.5	X2.5	White/Blue	
X1.7	X2.7	White/Brown	Twisted pair
X1.8	X2.8	Brown	
Braided shield			

Table 7-2 Pin assignments for crossover cables

Connector X1	Connector X2	Color	Relationship
X1.1	X2.3	White/Green	Twisted pair
X1.2	X2.6	Green	
X1.3	X2.1	White/Orange	Twisted pair
X1.6	X2.2	Orange	
X1.4	X2.4	Blue	Twisted pair
X1.5	X2.5	White/Blue	
X1.7	X2.7	White/Brown	Twisted pair
X1.8	X2.8	Brown	
Braided shield			

NOTE

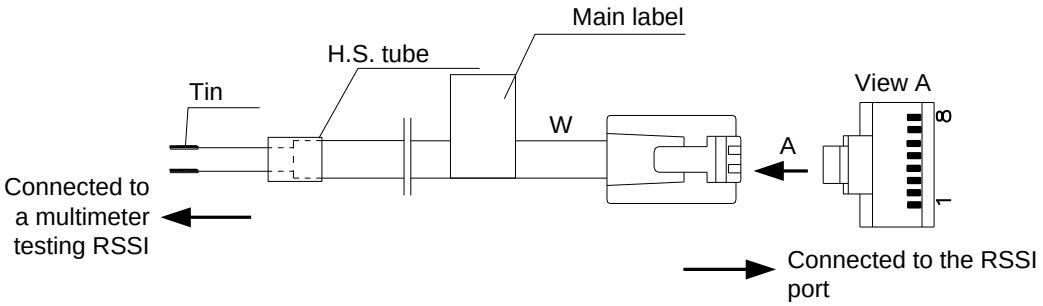
- Straight-through cables are used between MDIs and MDI-Xs, and crossover cables are used between MDIs or between MDI-Xs. The only difference between straight-through cables and crossover cables is with regard to their pin assignments.
- Either straight-through cables or crossover cables can be used to connect RTN 360 to common Ethernet equipment since Ethernet electrical ports support the MDI, MDI-X, and auto-MDI/MDI-X modes. If RTN 360 connects to power sourcing equipment (PSE) through a P&E port, pin assignments for power signals output from the PSE determines whether to use straight-through cables or crossover cables.
- A network cable transmits power signals and Ethernet signals simultaneously. Therefore, the impedance difference between cores of a network cable must be less than 5%; otherwise, Ethernet service packets may be lost.

7.2 RSSI Cables

Received signal strength indicator (RSSI) cables connect RSSI ports of RTN 360s to multimeters.

Cable Diagram

Figure 7-2 RSSI cable



Pin Assignments

An RSSI cable uses two cores to detect level signals.

Table 7-3 Pin assignments for RSSI cables

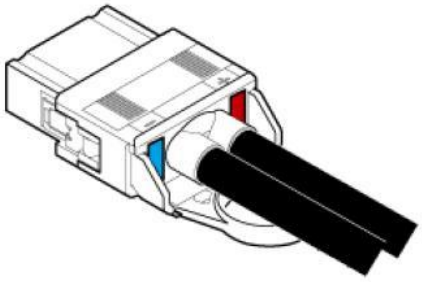
Pin	Signal
4	Ground signal
7	RSSI test level signal

7.3 Power Cables

Power cables connect PIs to power supply devices and supply them with -48 V power.

Cable Diagram

Figure 7-3 PI power cable



Cable Parameters

Table 7-4 Cable parameters

Cable	Cable Parameter	Terminal Parameter
Indoor-PI power cable	Power cable, 600 V, UL3386, 1.5 mm^2, 16 AWG, blue/black, XLPE	Common connector, 2-pin, single row, 5.08 mm (pitch)

7.4 RTN 360 PGND Cables

PGND cables are connected to ground screws and outdoor ground points (such as ground points on towers) so that RTN 360 is connected to the outdoor ground grid.

Cable Diagram

Figure 7-4 RTN 360 PGND cable

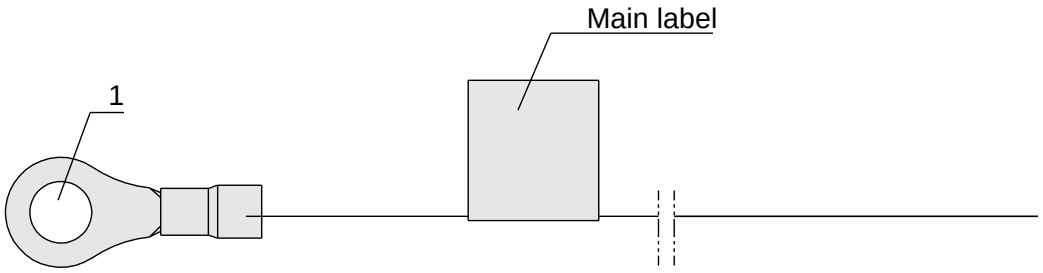
1. Bare crimp terminal, OT

7.5 PI PGND Cables

Power injector (PI) PGND cables connect the ground points on the left of indoor PIs to external equipment's ground points (for example, cabinets' ground columns), so indoor PIs and external equipment share the same ground.

Cable Diagram

Figure 7-5 Indoor-PI PGND cable



1. Bare crimp terminal, OT

A Appendix

A.1 Port Loopbacks

The loopback capabilities of ports on RTN 360 differ based on the port type.

Table A-1 Port loopbacks

Port Type	Loopback Capability
Microwave port	• Inloops at the IF port • Inloops at the composite port
GE port	• Inloops at the MAC layer • Inloops at the PHY layer

A.2 Component Photos

This section provides photos of major components of an RTN 360.

RTN 360

Figure A-1 Front view

Figure A-2 Rear view

Figure A-3 Ports

PI

Figure A-4 OptiX RTN PI-DC A10

Figure A-5 OptiX RTN PI-DC B10

Figure A-6 OptiX RTN PI-DC B10 (interior)

Figure A-7 OptiX RTN PI-DC A11

Dock

Figure A-8 Dock

A.3 Compliance Standards

A.3.1 ITU-R Standards

OptiX RTN 360 complies with the ITU-R standards designed for radio equipment.

Table A-2 ITU-R standard

Standard	Description
ITU-R F.1093	Effects of multipath propagation on the design and operation of line-of-sight digital fixed wireless systems
ITU-R F.1094	Maximum allowable error performance and availability degradations to digital fixed wireless systems arising from radio interference from emissions and radiations from other sources
ITU-R F.1102	Characteristics of fixed wireless systems operating in frequency bands above about 17 GHz
ITU-R F.1191	Bandwidths and unwanted emissions of digital fixed service systems
ITU-R F.1565	Performance degradation due to interference from other services sharing the same frequency bands on a co-primary basis with real digital fixed wireless systems used in the international and national portions of a 27 500 km hypothetical reference path at or above the primary rate
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.752	Diversity techniques for point-to-point fixed wireless systems
ITU-R F.758	Considerations in the development of criteria for sharing between the terrestrial fixed service and other services
ITU-R SM.329	Unwanted emissions in the spurious domain
ITU-R P.525	Calculation of free-space attenuation
ITU-R P.530	Propagation data and prediction methods required for the design of terrestrial line-of-sight systems
ITU-R P.676	Attenuation by atmospheric gases
ITU-R P.837	Characteristics of precipitation for propagation modelling
ITU-R P.838	Specific attenuation model for rain for use in prediction methods

Standard	Description
ITU-R P.836	Information on water vapour density
ITU-R F.2107	characteristics and applications of fixed wireless systems operating in frequency ranges between 57 GHz and 134 GHz
ITU-R SM.328	Spectra and bandwidth of emissions
ITU-R SM.1045	Frequency tolerance of transmitters
ITU-R SM.1539-1	Variation of the boundary between the out-of-band and spurious domains required for the application of Recommendations ITU-R SM.1541 and ITU-R SM.329
ITU-R SM.1541	Unwanted emissions in the out-of-band domain
ITU-R F.1519	Guidance on frequency arrangements based on frequency blocks for systems in the fixed service

A.3.2 ITU-T Standards

OptiX RTN 360 complies with the ITU-T standards.

Table A-3 ITU-T standard

Standard	Description
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.8261	Timing and synchronization aspects in packet networks
ITU-T G.8262	Timing characteristics of synchronous ethernet equipment slave clock (EEC)
ITU-T G.8264	Timing distribution through packet networks
ITU-T G.8032	Ethernet ring protection switching
ITU-T G.8012	Ethernet UNI and Ethernet over transport NNI
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.8031	Ethernet protection switching

Standard	Description
ITU-T G.8010	Architecture of Ethernet layer networks
ITU-T G.8021	Characteristics of Ethernet transport network equipment functional blocks
ITU-T Y.1291	An architectural framework for support of quality of service (QoS) in packet networks
ITU-T K.20	Resistibility of telecommunication equipment installed in a telecommunications centre to overvoltages and overcurrents
ITU-T K.21	Resistibility of telecommunication equipment installed in customer premises to overvoltages and overcurrents
ITU-T K.27	Bonding configurations and earthing inside a telecommunication building
ITU-T K.41	Resistibility of internal interfaces of telecommunication centres to surge overvoltages
ITU-T K.45	Resistibility of telecommunication equipment installed in the access and trunk networks to overvoltages and overcurrents

A.3.3 ETSI Standards

OptiX RTN 360 complies with the ETSI standards designed for radio equipment.

Table A-4 ETSI standard

Standard	Description
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
ETSI EN 301 390	Fixed Radio Systems; Point-to-point and Multipoint Systems; Spurious emissions and receiver immunity limits at equipment/antenna port of Digital Fixed Radio Systems
ETSI TR 102 457	Transmission and Multiplexing (TM);Study on the electromagnetic radiated field in fixed radio systems for environmental issuesStudy on the electromagnetic radiated field in fixed radio systems for environmental issues
ETSI EN 300 132-2	Environmental Engineering (EE); Power supply interface at the

Standard	Description
	input to telecommunications equipment; Part 2: Operated by direct current (dc)
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 (Indoor Unit Class 3.2)	Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-3: Classification of environmental conditions; Stationary use at weatherprotected locations
ETSI EN 300 019-1-4 (Outdoor Unit Class 4.1)	Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-4: Classification of environmental conditions; Stationary use at non-weather protected locations
ETSI EN 300 019-2-1	Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-1: Specification of environmental tests; Storage
ETSI EN 300 019-2-2	Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-2: Specification of environmental tests; Transportation
ETSI EN 300 019-2-4	Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-4: Specification of environmental tests; Stationary use at non-weatherprotected locations
ETSI TR 102 489	Thermal Management Guidance for equipment and its deployment
ETSI EN 301 126-1	Fixed Radio Systems; Conformance testing;Part 1: Point-to-point equipment - Definitions, general requirements and test procedures
ETSI EN 301 126-3-1	Fixed Radio Systems; Conformance testing;Part 3-1: Point-to-Point antennas; Definitions, general requirements and test procedures
ETSI EN 302 217-1	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	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 302 217-3	Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 3: Equipment operating in frequency bands where both frequency coordinated or uncoordinated deployment might be applied; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE

Standard	Description
	Directive
ETSI EN 302 217-4-1	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	Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 4-2: Antennas; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive
ETSI TR 102 565	Fixed Radio Systems (FRS); Point-to-point systems; Requirements and bit rates of PtP Fixed Radio Systems with packet data interfaces, effects of flexible system parameters, use of mixed interfaces and implications on IP/ATM networksReq.s and bit rates of systems wit packet data interfaces applying RIC-rates not covered by PDH/SDH.
ETSI EN 300 253	Environmental Engineering (EE); Earthing and bonding of telecommunication equipment in telecommunication centres
ETSI EN 300 119	Environmental Engineering (EE); European telecommunication standard for equipment practice;
ETSI ES 201 468 Ver. 1.3.1	Electromagnetic compatibility and Radio spectrum Matters (ERM); Additional ElectroMagnetic Compatibility (EMC) requirements and resistibility requirements for telecommunications equipment for enhanced availability of service in specific applications
ETSI TR 103 820	Fixed Radio Systems;Energy efficiency metrics and test procedures for Point-to-point fixed radio systems
ETSI TR 103 053	Access, Terminals, Transmission and Multiplexing (ATTM)Fixed Radio Systems;Parameters affecting the Signal-to-Noise Ratio (SNR) and the Receiver Signal Level (RSL) threshold in point-to-point receivers; Theory and practice
ETSI TR 102 243-1	Fixed Radio Systems; Representative values for transmitter power and antenna gain to support inter- and intra-compatibility and sharing analysis; Part 1: Digital point-to-point systems

A.3.4 CEPT Standards

OptiX RTN 360 complies with the CEPT standards.

Table A-5 CEPT Standards

Standard	Description
ERC/REC 74-01	Unwanted Emissions in the Spurious Domain
ECC/REC/(02)05	Use of the 64-66 GHz frequency band for Fixed Service

A.3.5 IEC Standards

OptiX RTN 360 complies with the IEC standards related to the waveguide.

Table A-6 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
IEC 60215	Safety requirements for radio transmitting equipment
IEC 60529	Degrees of protection provided by enclosures
IEC 60825	Safety of laser products
IEC 60950-1	Information technology equipment — Safety — Part 1 General requirements
IEC 60950-22	Information technology equipment — Safety — Part 22 Equipment installed outdoors
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

Standard	Description
IEC 60529	Degrees of protection provided by enclosures
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
IEC 61000-4-2	Electromagnetic compatibility(EMC) Part 2:Testing and measurement techniques Section 2:Electrostatic discharge immunity test Basic EMC Publication
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:Sruge 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 61000-4-29	Electromagnetic compatibility:Part 29:Testing and measurement techniques -Voltage dips,short interruptinns and voltage variations on DC input power port immunity tests

A.3.6 IETF Standards

OptiX RTN 360 complies with IETF standards.

Table A-7 IETF standards

Standard	Description
RFC 791	Internet Protocol
RFC 2819	Remote Network Monitoring Management Information Base
RFC 1661	The Point-to-Point Protocol(PPP)
RFC 1662	PPP in HDLC-like Framing
RFC 2615	PPP over SONET/SDH
draft-ietf-l2vpn-oam-req-frmk-05	L2VPN OAM requirements and framework
draft-ietf-l2vpn-signaling-08	Provisioning, autodiscovery, and signaling in L2VPNs

Standard	Description
RFC 4664	Framework for layer 2 virtual private networks (L2VPNs)
RFC 3289	Management information base for the differentiated services architecture
RFC 3644	Policy quality of service (QoS) Information model
RFC 3670	Information model for describing network device QoS datapath mechanisms
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 3140	Per hop behavior identification codes
RFC 3246	An expedited forwarding PHB (Per-hop behavior)
STD 0062	An Architecture for Describing Simple Network Management Protocol (SNMP) Management Frameworks

A.3.7 IEEE Standards

OptiX RTN 360 complies with the IEEE standards designed for Ethernet networks.

Table A-8 IEEE standards

Standard	Description
IEEE 802.1D	Media Access Control (MAC) Bridges
IEEE 802.3	Carrier Sense Multiple Access with Collision Detection (CSMA/CD) access method and physical layer specifications
IEEE 802.1Q	Virtual Bridged Local Area Networks
IEEE 802.1ag	Virtual Bridged Local Area Networks — Amendment 5: Connectivity Fault Management
IEEE 802.3ah	Media Access Control Parameters, Physical Layers, and Management Parameters for Subscriber Access Networks
IEEE 802.3x	Supplements to Carrier Sense Multiple Access With Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications

A.3.8 Other Standards

This section describes other standards with which OptiX RTN 360 complies.

Table A-9 Other standards

Standard	Description
EN 50289	Communication cables - Specifications for test methods
EN 50392	Generic standard to demonstrate the compliance of electronic and electrical apparatus with the basic restrictions related to human exposure to electromagnetic fields (0 Hz - 300 GHz)
EN 62311	Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz – 300 GHz)
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
EN 55022	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement (IEC/CISPR 22:1997, modified + A1:2000); German version EN 55022:1998 + Corrigendum:2001 + A1:2000
EN 55024	Information technology equipment - Immunity characteristics - Limits and methods of measurement
EN 41003	Particular safety requirements for equipment to be connected to telecommunication networks;
EN 60215	safty requirements for radio transmitting equipment
EN 60950-1	Information technology equipment — Safety — Part 1 General requirements
EN 60950-22	Information technology equipment — Safety — Part 22 Equipment installed outdoors
EN 60529	Degrees of protection provided by enclosures (IP code) (IEC 60529:1989 + A1:1999); German version EN 60529:1991 + A1:2000
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

Standard	Description
	< – 16 A per phase and not subject toconditional connection
EN 61000-4-2	CENELEC. EMC Part 4: Testing and measurement techniques - Section 2: Electrostatic discharge immunity test
EN 61000-4-3	CENELEC. EMC Part 4: Testing and measurement techniques - Section 3: Radiated, radio-frequency, electromagnetic field immunity test.
EN 61000-4-4	CENELEC. EMC Part 4: Testing and measurement techniques - Section 4: Electrical fast transient/burst immunity test.
EN 61000-4-5	CENELEC. EMC Part 4: Testing and measurement techniques - Section 5: Surge Immunity test.
EN 61000-4-6	CENELEC. EMC Part 4: Testing and measurement techniques - Section 6: Immunity to conducted disturbances induced by radio frequency field.
AF-PHY-0086.001	AF-PHY-0086.001 Inverse Multiplexing for ATM Specification Version 1.1
AF-TM-0121.000	Traffic Management Specification
MEF2	Requirements and Framework for Ethernet Service Protection in Metro Ethernet Networks
MEF4	Metro Ethernet network architecture framework - Part 1: generic framework
MEF10	Ethernet services attributes phase 1
MEF9	Abstract Test Suite for Ethernet Services at the UNI
MEF14	Abstract Test Suite for Traffic Management Phase 1
CISPR 22(2010)	limits and methods of measurement of radio disturbance characteristics of information
CISPR 24(2010)	Information Technology Equipment -Immunity characteristics -Limits and methods measurement