

eRelay3.0 RRN3301 Product Description

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Contents

1 Product Positioning	1
1.1 Positioning	1
1.2 Benefits	2
2 Product Architecture	4
2.1 Overview.....	4
2.2 Exterior	4
2.3 Ports	5
3 Application Scenarios	6
4 OM	8
4.1 Overview.....	8
4.2 OM Structure.....	8
5 Specifications	10
5.1 Capacity Specifications	10
5.2 Device-Related Specifications	10
5.3 Reliability Specifications	11

1 Product Positioning

eRelay is a wireless transport networking solution, used on the higher band of TDD spectrum (<6GHz). As a network element (NE) in the eRelay system, eRelay remote node(RRN) works together with eRelay BS to perform wireless backhaul.

1.1 Positioning

With the expansion of mobile broadband users (MBB), network capacity is insufficient in some outdoor hot spot areas, affecting user experience. Operators use compact devices such as AP, Micro, and Pico eNodeBs to cover hot spots. In the preceding scenarios, if access devices for fixed networks, such as optical fibers, are used for backhaul, deployment costs are high and fixed network resources are difficult to obtain. Therefore, wireless backhaul is required to solve the problem.

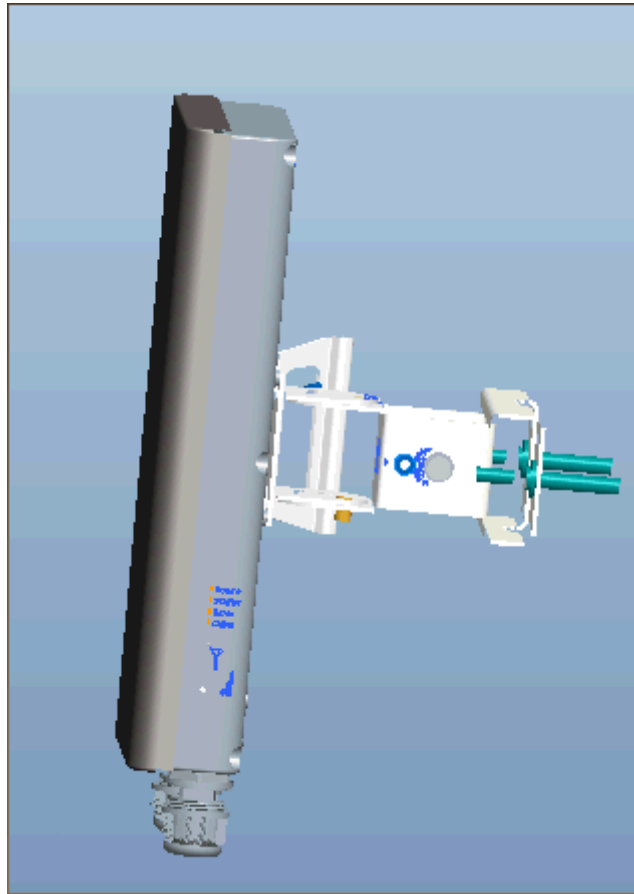
As a wireless backhaul solution, eRelay adopts TDD technologies and provides high throughput with short delay. Compared with backhaul in fixed networks, deployment costs for eRelay are low and frequency resources are accessible. Compared with micro waves, eRelay has advantages in transmission in non line of sight (NLOS) scenarios.

In the eRelay solution, the eRelay RRN provides wireless backhaul channels for Served Equipments such as Macro, Micro, Pico, video surveillance, AP and fixed network equipment. RRN access eRelay BS through air interfaces.

RRN3301 is one of the Huawei eRelay module.

Figure 1-1 shows an eRelay RRN3301.

Figure 1-1 eRelay RRN3301



1.2 Benefits

Larger Capacity and Throughput with Flexible Transmit Power

- A single eRelay RRN3301 can be connected to a maximum of two Served Equipments.
- A single eRelay RRN3301 supports the maximum uplink and downlink rate of 28 Mbit/s and 80Mbit/s, respectively.

Optimized Transmission Mode with Low Costs

- eRelay RRN3301 support layer 2 switching.

Flexible Installation for Fast Network Deployment with Low CAPEX

- The eRelay RRN3301 has a highly integrated structure with a small size and light weight, facilitating installation and maintenance and reducing the capital expenditure (CAPEX).
- eRelay RRN3301 can be mounted onto a pole, and equipment rooms are not required. eRelay RRN3301 can be flexibly installed on different places and

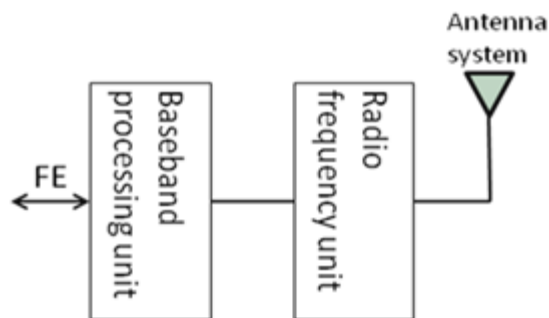
require small space. Therefore, sites are easily obtained, network deployment flexibility is enhanced, and site lease costs are reduced.

2 Product Architecture

2.1 Overview

An eRelay RRN3301 consists of a modem, and panel antenna. Figure 2-1 shows the eRelay RRN3301 architecture.

Figure 2-1 eRelay RRN3301 architecture



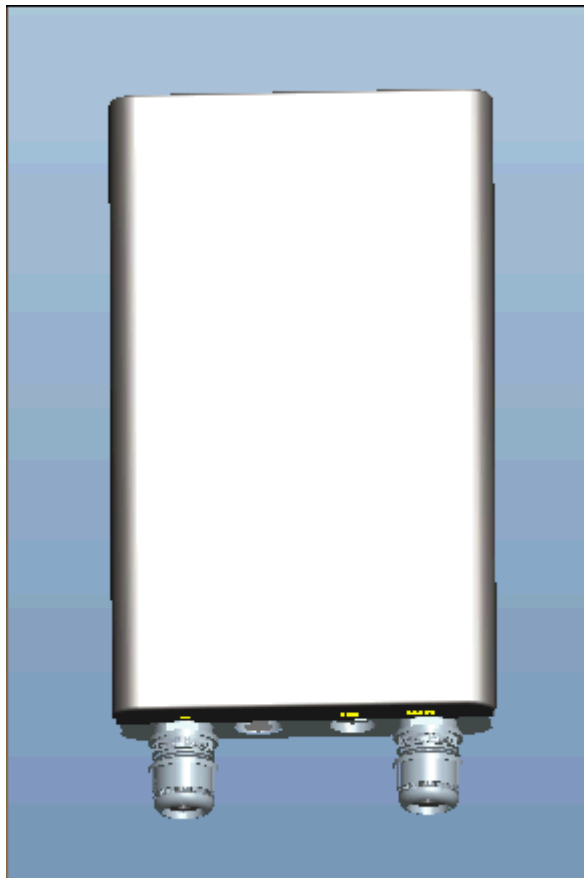
Modules in eRelay RRN3301 have following functions:

- The modem enables the connection between the RRN and eRelay BS over air interfaces.
- The panel antenna provides directional transmission and receipt of LTE signals with high gains. The specifications are as follows:
Gain: 17 ± 1 dBi for 3.5G.
Horizontal 3dB beamwidth: 40°
Vertical 3 dB beamwidth: 20°

2.2 Exterior

Figure 2-2 shows the eRelay RRN3301 exterior.

Figure 2-2 eRelay RRN3301 exterior



2.3 Ports

The eRelay RRN3301 provides ports on its bottom panel and indicator panel, as described in Table 2-1.

Table 2-1 Ports on the eRelay RRN3301

Module	Port	Number	Connector	Description
Bottom panel	PoE/FE0	1	RJ45	Power over Ethernet (PoE) or service Ethernet port 1
	DBG	1	USB	Combined virtual commissioning serial and Ethernet port
	FE1	1	RJ45	Service Ethernet port 2
Indicator panel	/	/	/	PWR, FE1, FE2, RUN, and SIG indicators

3 Application Scenarios

Working together with auxiliary devices, eRelay RRN3301 can be installed indoors and outdoors based on operator requirements.

An eRelay RRN3301 can be mounted onto a pole or on the wall, as shown in Figure 3-1 and Figure 3-2.

Figure 3-1 eRelay RRN3301 mounted onto the pole

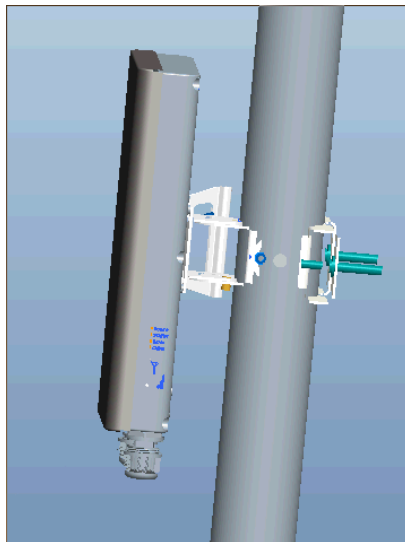
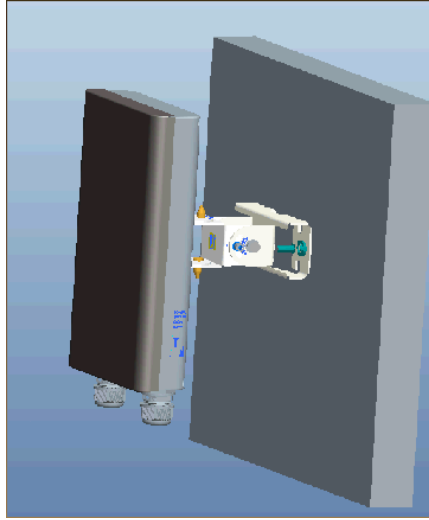


Figure 3-2 eRelay RRN3301 installed on the wall



4 OM

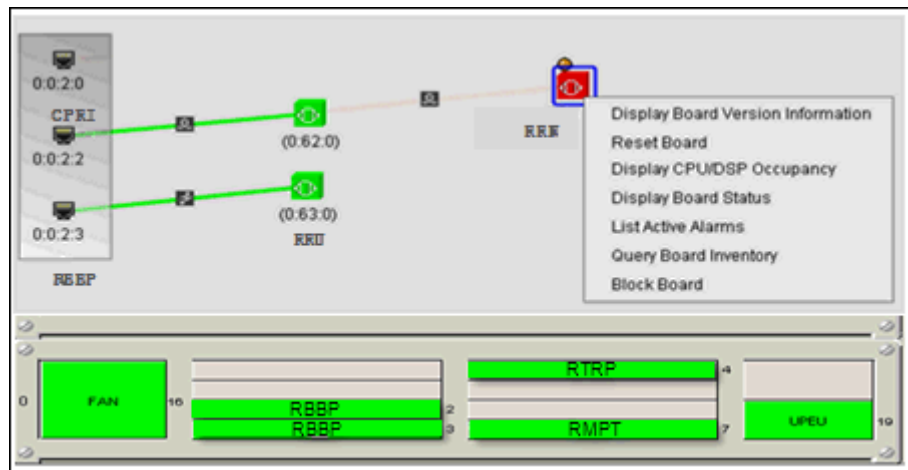
4.1 Overview

The eRelay RRN3301 will be managed as a board of BS by operation and maintenance system.

4.2 OM Structure

Figure 4-1 shows the operation and maintenance system of the eRelay RRN3301.

Figure 4-1 OM system of the eRelay RRN3301



The OM system consists of the LMT and the M2000.

The LMT is used to maintain a single eRelay RRN3301.

- To maintain the eRelay RRN3301 remotely, connect the LMT to the eRelay RRN3301 through the Internet Protocol (IP) network.

The M2000, a mobile element management system provided by Huawei, is used to remotely maintain multiple eRelay RRN3301s of different types or software versions.

The OM system provides the following functions:

- The LMT performs functions such as data configuration, alarm monitoring, commissioning, and software upgrade.

- The M2000 performs functions such as data configuration, alarm monitoring, performance monitoring, and software upgrade.
Both the LMT and the M2000 support MML and GUI modes.

5 Specifications

eRelay RRN3301 specifications include capacity specifications, device-related specifications, and reliability specifications.

5.1 Capacity Specifications

Table 5-1 describes the capacity specifications for an eRelay RRN3301.

Table 5-1 Capacity specifications for an eRelay RRN3301

Item	Specifications
Maximum throughput of a single eRelay RRN	Downlink throughput: 80 Mbit/s Uplink throughput: 28 Mbit/s
Maximum number of Served Equipments connected to a single eRelay RRN	2

5.2 Device-Related Specifications

Table 5-2 describes the device specifications for an eRelay RRN3301.

Table 5-2 Device specifications for an eRelay RRN3301

Item	Specifications			
eRelay RRN3301	Mode	TDD		
	Frequency band	RX band (MHz)	TX band (MHz)	Bandwidth (MHz)
	3.5GHz (Band 43)	3650MHz -3675MHz	3650MHz -3675MHz	10M/20M

Table 5-3 describes mechanical and electrical specifications for an eRelay RRN3301.

Table 5-3 Mechanical and electrical specifications for an eRelay RRN3301

Item	Specifications
Dimensions (H x W x D)	200 mm × 340 mm × 60 mm
Weight	≤3.5 kg
Power supply	PoE input: -48 V DC, 0.6 A

Table 5-4 describes the specifications for ports on the eRelay RRN3301.

Table 5-4 Specifications for ports on the eRelay RRN3301

Item	Specifications
Transmission ports	Two fast Ethernet (FE) electrical ports, one of which supports PoE power input.
Maintenance port	One DBG port

Table 5-5 describes the environment and clock specifications for an eRelay RRN3301.

Table 5-5 Environment and clock specifications for an eRelay RRN3301

Item	Specifications
Operating temperature	• -40 °C to +50 °C
Relative humidity	5% RH to 95% RH
Protection class	IP65

5.3 Reliability Specifications

Reliability specifications include system availability, mean time between failures (MTBF), mean time to repair (MTTR), and system restarting time. Table 5-6 describes the reliability for an eRelay RRN3301.

Table 5-6 Reliability specifications for an eRelay RRN3301

Item	Specifications
System availability	≥ 99.999%
System restarting time(soft-reset)	60s



A Acronyms and Abbreviations

C

CAPEX capital expenditure

D

DHCP Dynamic Host Configuration Protocol

F

FE fast Ethernet

I

IP Internet Protocol

L

L Long Term Evolution

M

MBB mobile broadband

MTBF mean time between failures

MTTR mean time to repair

N

NE network element

O

O&M operation and maintenance

P

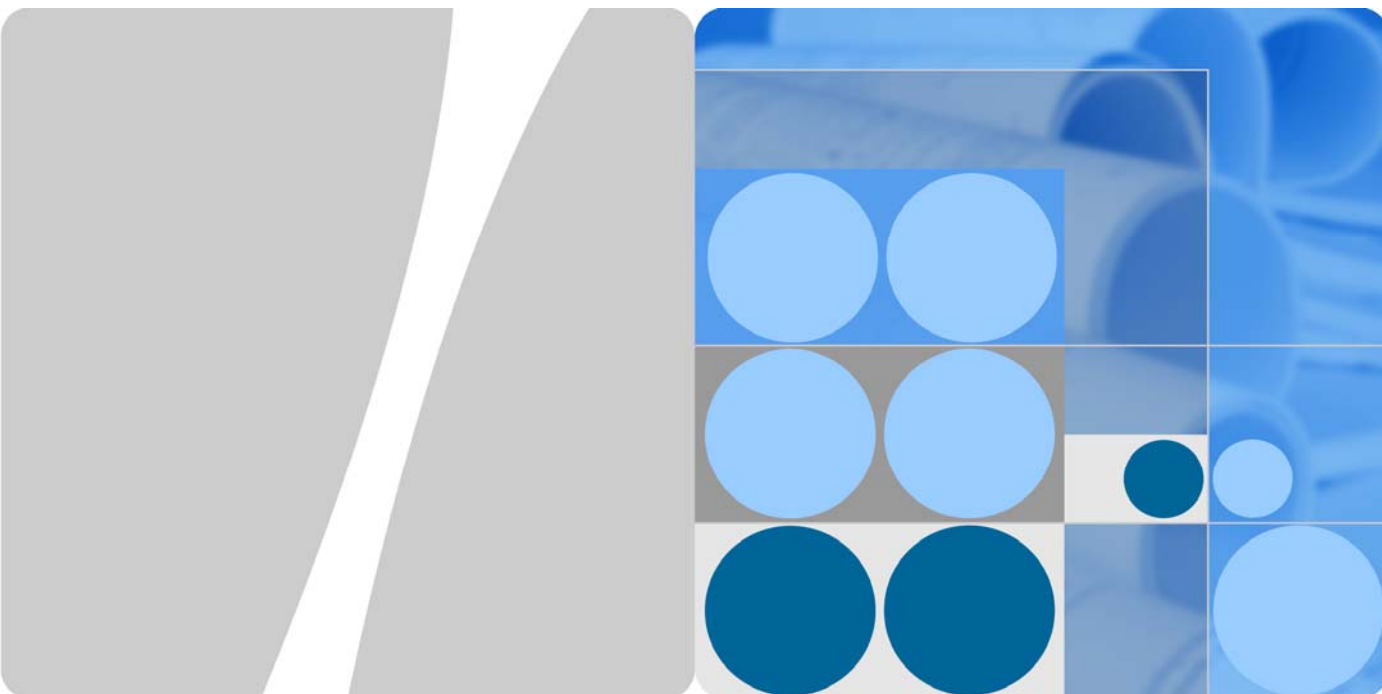
PoE power over Ethernet

R

RRN eRelay Remote Node

T

TDD time division duplex



Regulatory Compliance Statement

RRN3301

CE 0168

Issue 02
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1 Regulatory Compliance Statement

About This Chapter

1.1 Declaration of Conformity to European Directives

Declaration of Conformity to European Directives

Figure 1-1 Declaration of Conformity to European Directives

Doc NO.: CE-00918517	
Declaration of Conformity For EU Directives and Regulations	
For the following equipment	
Product	: <u>eRelay Remote Node</u>
Model/Trademark	: <u>RRN3301 / HUAWEI</u>
Manufacturer's Name	: <u>Huawei Technologies Co., Ltd.</u>
Manufacturer's Address	: <u>Administration Building, Headquarters of</u> <u>Huawei Technologies Co., Ltd., Bantian,</u> <u>Longgang District, Shenzhen, 518129, P.R.C</u>
<p>is herewith confirmed to comply with the requirements which are set out in 1999/5/EC(R&TTE Directive), 2002/95/EC & 2011/65/EU (RoHS Directive), 2002/96/EC&2012/19/EU (WEEE Directive) and 2006/1907/EC(REACH Regulation). For the evaluation of the compliance with these Directives and Regulations, the following standards/requirements were applied:</p>	
Safety	EN 60950-1:2006+A11:2009+A1:2010+A12:2011 EN 60950-22:2006+A11:2008 IEC/EN 60215(1989) ed3 +A1:1992+A2:1994
EMC	ETSI EN 301 489-01 V1.9.2 ETSI EN 301 489-24 V1.5.1 EN 55022:2010 CISPR 22:2008 EN 55024:2010 CISPR 24:2010
Radio & Health	ETSI EN 301 908-1 V5.2.1 ETSI EN 301 908-13 V5.2.1 Council Recommendation 1999/519/EC EN 50385:2002
RoHS	2002/95/EC, 2011/65/EU, EN 50581: 2012
REACH	EC NO. 1907/2006
WEEE	2002/96/EC, 2012/19/EU
Responsible for making this declaration is the:	
<input checked="" type="checkbox"/> Manufacturer <input type="checkbox"/> Authorised representative established within the EU	
Person responsible for making this declaration	
Name/Title:	<u>Zhang Xing Wei</u> Regulation Compliance Manager
Place/Date	<u>Shenzhen, China</u> <u>Apr 26, 2013</u>

2 Regulatory Compliance Information

About This Chapter

- 2.1 Regulatory Compliance Standards
- 2.2 European Regulatory Compliance
- 2.3 U.S.A Regulatory Compliance
- 2.4 Japanese Regulatory Compliance
- 2.5 CISPR 22 Compliance

2.1 Regulatory Compliance Standards

The Product complies with the standards listed in Table 2-1.

Table 2-1 Regulatory compliance standards

Discipline	Standards
EMC	<ul style="list-style-type: none"> • CISPR22 Class B • CISPR24 • EN55022 Class B • EN50024 • ETSI EN 301 489 Class B • CFR 47 FCC Part 15 Class B • FCC Part 90z • RSS-192 • RSS-197 • RSS-102 • ICES 003 Class B • AS/NZS CISPR22 Class B • GB9254 Class B • VCCI Class B • CNS 13438 Class B • IEC/EN 61000-6-1 • IEC/EN 61000-6-3

Discipline	Standards
Safety	<ul style="list-style-type: none">• IEC 60950-1• IEC/EN60215• IEC/EN41003• EN 60950-1• UL 60950-1• UL 60950-22• CSA C22.2 No 60950-1• AS/NZS 60950.1• BS EN 60950-1• IS 13252• GB4943• GB8898
RF	<ul style="list-style-type: none">• ETSI EN 301 908-1• ETSI EN 301 908-13
Health	<ul style="list-style-type: none">• ICNIRP Guideline• 1999-519-EC• EN 50385• OET Bulletin 65• IEEE Std C95.1• EN 60215
Environmental protection	<ul style="list-style-type: none">• 2002/95/EC & 2011/65/EU (RoHS)• EC NO. 1907/2006 (REACH)• 2002/96/EC&2012/19/EU(WEEE)
Grounding	<ul style="list-style-type: none">• ITU-T K.27• ETSI EN 300 253

Discipline	Standards
<p>Note:</p> <p>EMC: electromagnetic compatibility</p> <p>NEBS: Network Equipment Build Standard</p> <p>RF: radio frequency</p> <p>CISPR: International Special Committee on Radio Interference</p> <p>EN: European Standard</p> <p>ETSI: European Telecommunications Standards Institute</p> <p>CFR: Code of Federal Regulations</p> <p>FCC: Federal Communication Commission</p> <p>IEC: International Electrotechnical Commission</p> <p>AS/NZS: Australian/New Zealand Standard</p> <p>VCCI: Voluntary Control Council for Interference</p> <p>CNS: Chinese National Standard</p> <p>UL: Underwriters Laboratories</p> <p>CSA: Canadian Standards Association</p> <p>BS: British Standard</p> <p>IS: Indian Standard</p> <p>GR: general requirement</p> <p>FDA: Food and Drug Administration</p> <p>BTS: base transceiver station</p> <p>GSM: Global System for Mobile communications</p> <p>WLAN: wireless local area network</p> <p>ICNIRP: International Commission on Non-Ionizing Radiation Protection</p> <p>OET: Office of Engineering Technology</p> <p>IEEE: Institute of Electrical and Electronics Engineers</p> <p>RoHS: restriction of the use of certain hazardous substances</p>	

2.2 European Regulatory Compliance

The Product complies with the following European directives and regulations.

- 2004/108/EC (EMC)
- 2006/95/EC (low voltage)
- 1999/5/EC (R&TTE)
- 2002/95/EC & 2011/65/EU (RoHS)
- EC NO. 1907/2006 (REACH)
- 2002/96/EC&2012/19/EU (WEEE)

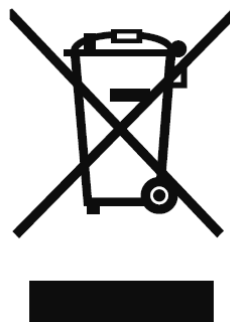
The Product complies with Directive 2002/95/EC, 2011/65/EU and other similar regulations from the countries outside the European Union, on the RoHS in electrical and electronic

equipment. The device does not contain lead, mercury, cadmium, and hexavalent chromium and brominated flame retardants (Polybrominated Biphenyls (PBB) or Polybrominated Diphenyl Ethers (PBDE)) except for those exempted applications allowed by RoHS directive for technical reasons.

Product complies with Regulation EC NO. 1907/2006 (REACH) and other similar regulations from the countries outside the European Union. Huawei will notify to the European Chemical Agency (ECHA) or the customer when necessary and regulation requires.

Product complies with Directive 2002/96/EC&2012/19/EU on waste electrical and electronic equipment (WEEE). Huawei is responsible for recycling its end-of-life devices, and please contact Huawei local service center when recycling is required. Huawei strictly complies with the EU Waste Electrical and Electronic Equipment Directive (WEEE Directive) and electronic waste management regulations enacted by different countries worldwide. In addition, Huawei has established a system for recycling and reuse of electronic wastes, and it can provide service of dismantling and recycling for WEEE. By Huawei recycling system, the waste can be handled environmentally and the resource can be recycled and reused fully, which is also Huawei WEEE stratagem in the word. Most of the materials in product are recyclable, and our packaging is designed to be recycled and should be handled in accordance with your local recycling policies.

In accordance with Article 11(2) in Directive 2002/96/EC&2012/19/EU (WEEE), products were marked with the following symbol: a cross-out wheeled waste bin with a bar beneath as below:



2.3 U.S.A Regulatory Compliance

2.3.1 FCC Part 15

2.3.1 FCC Part 15

The Product complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- This device does not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

If this device is modified without authorization from Huawei, the device may no longer comply with FCC requirements for Class B digital devices. In that a case, your right to use the device may be limited by FCC regulations. Moreover, you may be required to correct any interference to radio or television communications at your own expense.

This device has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This device generates, uses and radiates radio frequency energy. If it is not installed and used in accordance with the instructions, it may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this device does cause harmful interference to radio or television reception, which can be determined by turning the device off and on, the user may take one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Reinforce the separation between the device and receiver.
- Connect the device into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio or TV technician for assistance.

2.4 Japanese Regulatory Compliance

2.4.1 VCCI

The Product complies with VCCI Class B by Information Technology Equipment (ITE).

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取扱説明書に従って正しい取り扱いをして下さい。 VCCI-B

The preceding translates as follows:

This is a Class B product based on the standard of the Voluntary Control Council for Interference by Information Technology Equipment (VCCI). If this product is used near a radio or television receiver in a domestic environment, it may cause radio interference. Install and use the equipment according to the instruction manual.

2.5 CISPR 22 Compliance

The Product complies with CISPR 22 for Class B by the ITE.

2.6 China RoHS hazardous substance table

This product described in this guide complies with the Chinese RoHS

部件名称	产品中有害物质或元素的名称及含量					
	镉	铅	汞	六价铬	多溴联苯	多溴联苯醚
Frame	○	×	○	○	○	○
Alloy Parts	○	×	○	○	○	○
Power Adapter	○	×	○	○	○	○
Metal Fittings	○	○	○	○	○	○
PCBA	○	×	○	○	○	○
Capacitor	○	×	○	○	○	○
Other electronics	○	×	○	○	○	○
Screen	○	○	○	○	○	○
Solder	○	×	○	○	○	○
Cable	×	×	○	○	○	○
Plastic and Polymer	○	×	○	○	○	×
Label	○	○	○	○	○	○
Battery	○	○	○	○	○	○

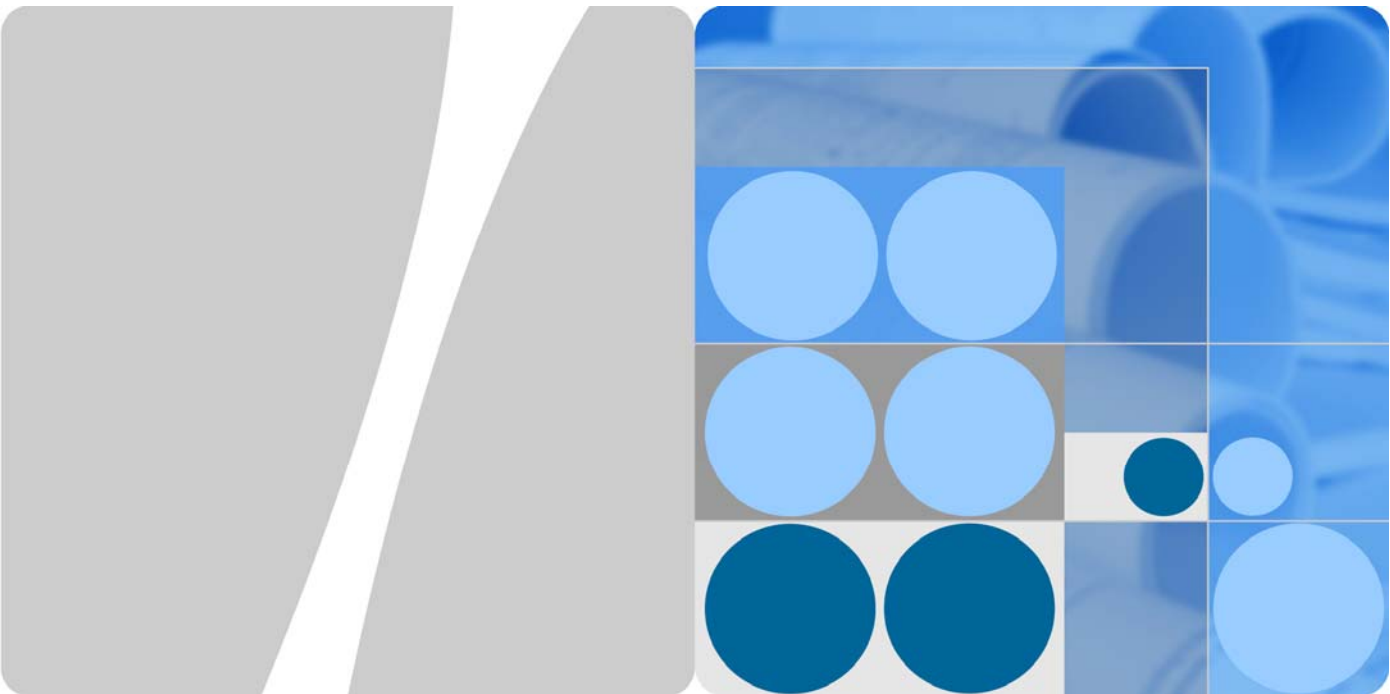
2.7 India RoHS hazardous substance table

The Product described in this guide complies with the Chinese RoHS

Part Descriptions	Restricted Substances in Product					
	Cd	Pb	Hg	Cr(VI)	PBBs	PBDEs
Frame	○	×	○	○	○	○
Alloy Parts	○	×	○	○	○	○
Power Adapter	○	×	○	○	○	○
Metal Fittings	○	○	○	○	○	○
PCBA	○	×	○	○	○	○
Capacitor	○	×	○	○	○	○
Other electronics	○	×	○	○	○	○
Screen	○	○	○	○	○	○
Solder	○	×	○	○	○	○
Cable	×	×	○	○	○	○
Plastic and Polymer	○	×	○	○	○	×
Label	○	○	○	○	○	○
Battery	○	○	○	○	○	○

2.8 Other Markets

For relevant compliance information/documentation for markets not mentioned above, please contact Huawei representative



Compliance and Safety Manual RRN3301

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1 Safety

About This Chapter

- 1.1 Health and Safety
- 1.2 Equipment Safety
- 1.3 Electromagnetic Field Exposure

1.1 Health and Safety

- 1.1.1 Overview
- 1.1.2 Electrical Safety
- 1.1.3 Inflammable Environment
- 1.1.4 Radiation
- 1.1.5 Working at Heights
- 1.1.6 Mechanical Safety
- 1.1.7 Bundling Signal Cables

1.1.1 Overview

Introduction

This section describes the safety precautions you must take before installing or maintaining Huawei equipment.

- To ensure safety of humans and the equipment, pay attention to the safety symbols on the equipment and all the safety instructions in this document.
- The "NOTE", "CAUTION", and "WARNING" marks in other documents do not represent all the safety instructions. They are only supplements to the safety instructions.
- Installation and maintenance personnel must understand basic safety precautions to avoid hazards.
- When operating Huawei equipment, in addition to following the general precautions in this document, follow the specific safety instructions given by Huawei.

- Only trained and qualified personnel are allowed to install, operate, and maintain Huawei equipment.
- To assure continued compliance, any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

Local Safety Regulations

When operating Huawei equipment, you must follow the local laws and regulations. The safety instructions in this document are only supplements to the local laws and regulations.

General Requirements

To minimize risk of personal injury and damage to equipment, read and follow all the precautions in this document before performing any installation or maintenance.

Ensure that the instructions provided in this document are followed completely. This section also provides guidelines for selecting the measuring and testing devices.

Installation

- The device (or system) must be installed in an access-controlled location.
- Tighten the thumbscrews by using a tool after initial installation and subsequent access to the panel.

Ground

- Do not damage the ground conductor or operate the device in the absence of a properly installed ground conductor. Conduct the electrical inspection carefully.
- The device (or system) must be connected permanently to the protection ground before an operation. The cross-sectional area of the protective ground conductor must be at least 6 mm².
- The device must be fixed securely on the floor or other reliable objects, such as the walls and the mounting racks before operation.
- When installing the unit, always make the ground connection first and disconnect it last

Power Supply

- For DC-supplied model: The device applies to DC power source that complies with the Safety Extra-Low Voltage (SELV) requirements in IEC 60950-1 based safety standards.
- Prepared conductors are connected to the terminal block, and only the appropriate AWG/Type of wire is secured with the lug terminals.
- This device relies on the building's installation for short-circuit (overcurrent) protection. Ensure that a fuse or circuit breaker no larger than 80 VDC, 25A for DC supplied model is used on the phase conductors (all current-carrying conductors).
- For this device, a readily accessible disconnect device shall be incorporated external to the equipment

- To minimize the risk of fire, use only No. 26 AWG or larger telecommunication line cord.

Human Safety

- Do not operate the device or cables during lightning strikes.
- To avoid electric shock, do not connect safety extra-low voltage (SELV) circuits to telecommunication network voltage (TNV) circuits.
- Move or lift the chassis by holding its lower edge. Do not hold the handles on certain modules such as power supply, fans, and boards because they cannot support the weight of the device.
- Do not look into the optical port without eye protection.
- Do not wear jewelry or watches when you operate the device.
- Reinforced insulation or double insulation must be provided to isolate DC source from AC mains supply.

Operator

- Only qualified professional personnel are allowed to install, configure, operate, and disassemble the device.
- Only the personnel authenticated or authorized by Huawei are allowed to replace or change the device or the parts of the device (including the software).
- Any fault or error that might cause safety problems must be reported immediately to a supervisor.
- Only qualified personnel are allowed to remove or disable the safety facilities and to troubleshoot and maintain the device.
- Ensure that the instructions provided in this document are followed completely. The document also provides guidelines in selecting the measuring and testing device.

1.1.2 Electrical Safety

High Voltage



DANGER

The high voltage power supply provides power for the device operation. Direct or indirect contact (through damp objects) with high voltage and AC mains supply may result in fatal danger.

- During the installation of the AC power supply facility, follow the local safety regulations. The personnel who install the AC facility must be qualified to perform high voltage and AC operations.
- Do not wear conductive articles, such as watches, hand chains, bracelets, and rings during the operation.
- When water is found in the rack or the rack is damp, switch off the power supply immediately.
- When the operation is performed in a damp environment, make sure that the device is dry.



WARNING

Non-standard and improper high voltage operations may result in fire and electric shock. Therefore, you must abide by the local rules and regulations when bridging and wiring AC cables. Only qualified personnel are allowed to perform high voltage and AC operations.



WARNING

Before powering on a device, ground the device. Otherwise, personal injury or device damage may be caused by high leakage current.

Thunderstorm



DANGER

Do not perform any operation, including high voltage and AC operations, on a steel tower or mast during a thunderstorm.

Tools



WARNING

Dedicated tools must be used during high voltage and AC operations. Avoid using ordinary tools.

High Electrical Leakage



WARNING

Ground the device before powering it on. Otherwise, personal injury or device damage may be caused by high leakage current.

If a "high electrical leakage" tag is present on the power terminal of the device, you must ground the device before powering it on.

Power Cable

**WARNING**

Do not install or remove power cables when the device is on. Transient contact between the core of the power cable and the conductor may generate electric arcs or sparks, which may cause fire or hurt human eyes.

- Before installing or removing the power cable, turn off the power switch.
- Before connecting a power cable, check that the label on the power cable is correct.

**CAUTION**

- If the device is connected with the DC power supply, use 0.75 mm² or 18 AWG minimum power supply cord.
- Use type H03VV-F or light PVC-sheathed flexible cord according to IEC 60227.

1.1.3 Inflammable Environment

Operating the electrical device in an inflammable environment can be fatal.

**DANGER**

Do not place the device in an environment that has inflammable and explosive air or gas. Do not perform any operation in this environment.

1.1.4 Radiation

Electromagnetic Field Exposure

**WARNING**

Radio-frequency signals with high intensity are harmful to human body.

Before installing or maintaining an antenna on a steel tower or a mast with a large number of transmitter antennas, coordinate with the parties concerned to shut down the transmitter antennas.

**WARNING**

When handling optical fibers, do not stand close to or look at the optical fiber outlet directly with unprotected eyes.

General Laser Information

Laser transceivers or transmitters are used in optical transmission systems and associated test tools. The wavelength of the laser is between 780 nm and 1600 nm. The laser transmitted through optical fibers has very high power density and is invisible to human eyes. A beam of light causes damage to the retina.

Laser of wavelengths used in telecommunications causes thermal damage to the retina.

Lasers used in lightwave systems have a larger beam divergence, typically 10 to 20 degrees. Looking at an un-terminated fiber or damaged fiber with unprotected eyes at a distance greater than 150 mm (6 inches) does not cause eye injury. Eye injury, however, may be caused if an optical tool such as a microscope, magnifying glass, or eye loupe is used to view the energized fiber end.

A lightwave system in normal operating mode is totally enclosed and presents no risk of eye injury. The automatic laser shutdown (ALS) feature of the lightwave system also ensures safety. The ALS, however, can be applied to bi-directional transmission only. If the receiver side does not detect the laser from the transmitter side, it sends the transmitter side a signal. Upon receiving the signal, the ALS shuts down the laser emission within 100 ms.

Safety Guidelines

Follow the following guidelines to avoid laser radiation:

- Read the instructions before installing, operating, and maintaining the device. Ignoring the instructions can cause exposure to dangerous laser radiation.
- Wear a pair of eye-protective glasses when you are handling lasers or fibers.
- Only qualified personnel are allowed to perform laser-related operations.
- Make sure that the optical source is switched off before disconnecting optical fiber connectors.
- Before opening the front door of an optical transmission system, make sure that you are not exposed to laser radiation.
- Do not look at the end of an exposed fiber or an open connector when you are not sure whether the optical source is switched off or not.
- Use an optical power meter to check that the optical source is switched off and verify that it is off by measuring the optical power.
- Do not use an optical tool such as a microscope, a magnifying glass, or an eye loupe to view the optical connector or fiber.

Handling Fibers

Read the instructions before handling fibers:

- Only trained and qualified personnel can cut or splice fibers.
- Before cutting or splicing a fiber, ensure that the fiber is disconnected from the optical source. After disconnecting the fiber, use protecting caps to protect all the optical connectors.

1.1.5 Working at Heights

**WARNING**

Avoid object falling when you work at heights.

When working at heights, fulfill the following requirements:

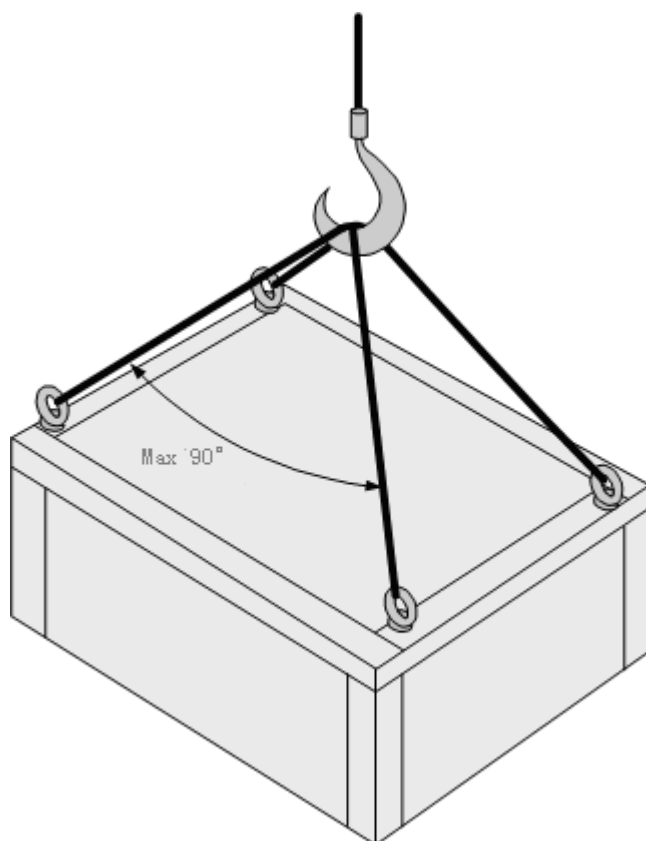
- Only trained personnel can work at heights.
- Prevent the devices and tools that you carry from falling down.
- Take safety and protection measures, for example, wear a helm and safety belt.
- Wear warm clothes when working at heights in a cold region.
- Before working at heights, check that all the lifting facilities are in good condition.

Hoisting Heavy Objects

**WARNING**

Do not walk below the cantilever or hoisted objects when heavy objects are being hoisted.

- Only trained and qualified personnel can perform hoisting operations.
- Before hoisting heavy objects, check that the hoisting tools are complete and in good condition.
- Before hoisting heavy objects, ensure that the hoisting tools are fixed to a secure object or wall with good weight capacity.
- Issue orders with short and explicit words to avoid misoperations.
- Ensure that the angle formed by two cables is not larger than 90 degrees. See Figure 1-1.

Figure 1-1 Hoisting heavy objects

Using Ladders

Checking a Ladder

- Before using a ladder, check whether the ladder is damaged. Only the ladder in good condition can be used.
- Before using a ladder, you should know the maximum weight capacity of the ladder. Avoid overweighing the ladder.

Placing a Ladder

The recommended gradient of ladders is 75 degrees. You can measure the gradient of the ladder with an angle square or your arms. When using a ladder, ensure that the wider feet of the ladder are downward, or take protection measures for the ladder feet to prevent the ladder from sliding. Ensure that the ladder is placed securely.

Climbing Up a Ladder

When climbing up a ladder, note the following:

- Ensure that the center of gravity of your body does not deviate from the edges of the two long sides.
- To minimize the risk of falling, hold your balance on the ladder before any operation.

- Do not climb higher than the fourth rung of the ladder (counted from up to down).
- If you want to climb up a roof, ensure that the ladder top is at least one meter higher than the roof.

1.1.6 Mechanical Safety

Drilling Holes



WARNING

Do not drill the cabinet at will. Drilling holes without complying with the requirements affects the electromagnetic shielding performance of the cabinet and damages the cables inside the cabinet. In addition, if the scraps caused by drilling enter the cabinet, the printed circuit boards (PCBs) may be short circuited.

- Before you drill a hole in the cabinet, wear insulated gloves and remove the internal cables from the cabinet.
- Wear an eye protector when drilling holes. This is to prevent your eyes from being injured by the splashing metal scraps.
- Ensure that the scraps caused by drilling do not enter the cabinet.
- Drilling holes without complying with the requirements affects the electromagnetic shielding performance of the cabinet.
- After drilling, clean the metal scraps immediately.

Sharp Objects



WARNING

Before you hold or carry a device, wear protective gloves to avoid getting injured by sharp edges of the device.

Lifting Heavy Objects



WARNING

When heavy objects are being lifted, do not stand or walk under the cantilever or the lifted object.

1.1.7 Bundling Signal Cables



CAUTION

- Do not bundle signal cables with high current cables or high voltage cables.
 - Maintain a minimum space of 150 mm between adjacent ties.
-

1.2 Equipment Safety

[1.2.1 Electricity Safety](#)

[1.2.2 Electrostatic Discharge](#)

[1.2.3 Installing and Removing a Board](#)

[1.2.4 Laying Cables](#)

1.2.1 Electricity Safety

Thunderstorm



CAUTION

During thunderstorms, the electromagnetic field generated in the thunderstorm area may damage the electronic parts. To prevent damage to the device during lightning, ground the device properly.

High Electrical Leakage



CAUTION

If the "high electrical leakage" tag is present on the power terminal of the device, you must ground the device before powering it on.

Fuse



WARNING

If a fuse is to be replaced, the new fuse must be of the same type and specifications.

1.2.2 Electrostatic Discharge

CAUTION

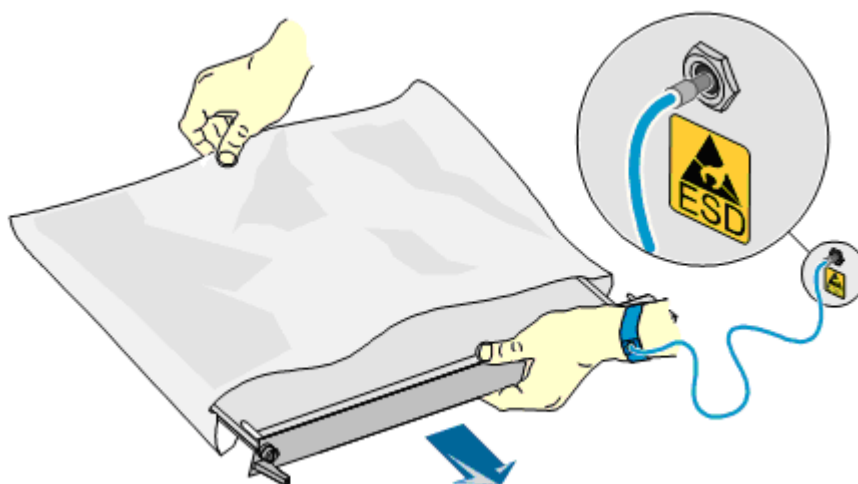
The static electricity generated by human bodies may damage the electrostatic-sensitive components on boards, for example, the large-scale integrated (LSI) circuits.

Human body movement, friction between human bodies and clothes, friction between shoes and floors, or handling of plastic articles causes static electromagnetic fields on human bodies. These static electromagnetic fields cannot be eliminated until the static is discharged.

To prevent electrostatic-sensitive components from being damaged by the static on human bodies, you must wear a well-grounded ESD wrist strap when touching the device or handling boards or application-specific integrated circuits (ASICs).

Figure 1-2 shows how to wear an ESD wrist strap.

Figure 1-2 Wearing an ESD wrist strap



1.2.3 Installing and Removing a Board

CAUTION

When installing a board, use proper force to prevent the pins on the backplane from being leaned.

When installing or removing a board, note the following:

- Insert the board along the guide rails.
- Prevent the surface of a board from contacting the surface of another board. This is to prevent the boards from being short-circuited or scratched.

- To prevent electrostatic-sensitive devices from being damaged by the ESD, do not touch the circuits, components, connectors, or connection slots on boards.

1.2.4 Laying Cables

When the temperature is very low, violent strike or vibration may damage the cable sheathing. To ensure safety, comply with the following requirements:

- Cables can be laid or installed only when the temperature is higher than 0°C.
- Before laying cables which have been stored in a temperature lower than 0°C, move the cables to an environment of the ambient temperature and store them at the ambient temperature for at least 24 hours.
- Handle cables with caution, especially at a low temperature. Do not drop the cables directly from the vehicle.

1.3 Electromagnetic Field Exposure

Introduction

The Base Transceiver Station (BTS) emits Radio Frequency (RF) radiation. Follow the local safety regulations when installing and operating the BTS to avoid radiation hazard.

Guidelines on Limiting Exposure to Electromagnetic Fields

There are a number of international regulations, standards, and guidelines for exposure to electromagnetic fields. Some European countries have adopted the recommendation of the council of the European Union (1999/519/EC), released on July 12, 1999, focusing on the hazards of exposure to electromagnetic fields. The recommendation is based on the guideline published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP).

Location of Base Station Antennas

Base station antennas, the source of the radiation, are usually mounted:

- On freestanding towers, with a height up to 30 m
- On a tower on the top of buildings
- To the side of buildings, on rare occasions

Generally, the antenna cannot be located in a position lower than 10 m. The energy usually forms a horizontal main beam and is slightly tilted downwards. The remaining energy forms into weaker beams on both sides of the main beam. The main beam, however, does not reach the ground if the antenna is around 50–200 m away from the ground.

The highest level of emission would be expected in close vicinity of the antenna and in line of sight to the antenna.

Exclusion Zones

The requirements for exclusion zones are as follows:

- The antenna should be properly located to prevent the public from accessing the area where the RF radiation exceeds the previously mentioned limits.

- If areas with excessive RF radiation are accessible to the operation and maintenance (O&M) personnel, ensure that they know the source of radiation and can power off or shut down the transmitters before entering high radiation areas. In addition, such areas must be confined within a distance of 10 m from the antennas.
- Each exclusion zone should be defined by a physical barrier and by a recognizable sign warning the public or O&M personnel.

Guidelines on Choosing Antenna Sites

The guidelines on choosing the antenna sites are as follows:

- For roof-mounted antennas, raise the antennas above the height of the personnel who may have to work on the rooftop.
- For roof-mounted antennas, keep the transmitter antennas away from the areas accessible to the public, such as roof access points, telephone service points, and HVAC devices.
- For roof-mounted directional antennas, place the antennas near the periphery, and do not make the antennas face the building.
- Consider the trade-off between large aperture antennas (lower maximum RF) and small aperture antennas (lower visual impact).
- Keep higher-power antennas away from accessible areas.
- Keep the antennas in a site that is far away from urban areas, though this may contradict the coverage area requirements.
- Exercise extra caution when designing co-location sites, that is, antennas owned by different companies are located in the same site or are co-sited. This applies particularly to sites that include high-power broadcast (FM/TV) antennas. Local zone often favors co-location, but co-location may cause safety problems.
- Take special precautions for antenna sites near hospital and schools.

Location of BTS

The product is shielded from RF radiation hazards. The device has been tested to comply with the radioactive spurious emission requirements of international standards or local regulations. Therefore, the BTS under normal operating conditions does not cause danger to the public and O&M engineers. However, the limits for RF radiation might be exceeded due to faulty antenna cables or for other causes.

- BTS sites shall not be accessible to the public. Only authorized and trained personnel can access BTS sites or equipment rooms.
- A sign of excessive RF radiation must be present on the doors of the sites or equipment rooms to warn the personnel inside the site or equipment room of excessive RF radiation.
- BTS sites must be regularly monitored and inspected after installation.

Prediction of the Exposure to Electromagnetic Fields

This section provides a theoretical approach to calculate possible exposure to electromagnetic radiation around a BTS antenna. Precise statements are possible either with measurements or complex calculations considering the complexity of the environment, such as soil conditions, nearby buildings and other obstacles. The complexity may cause reflection, deflection, and scattering of electromagnetic fields.

The maximum output power (given in EIRP) of a product is usually limited by license conditions of the network operator.

A rough estimation of the expected exposure in power flux density on a given point can be made with the following equation:

$$S = (P(W) \times G_{\text{numeric}}) / (4 \times r^2(\text{m}) \times \pi)$$

Where,

P = Maximum output power at antenna port of the BTS in W

G_{numeric} = Numeric gain (see below)

r = Distance between the antenna and the point of exposure in meters

For the calculation of the G_{numeric} ,

$$G_{\text{numeric}} = 10^{\text{GdB}/10}$$

$$\text{GdB} = G_{\text{antenna}}(\text{dB}) - B_{\text{cable}}(\text{dB}) - B_{\text{vertical-attenuation}}(\text{dB}) - B_{\text{horizontal-attenuation}}(\text{dB})$$

B = attenuation in dB

FCC Radiation Exposure Statement To comply with FCC RF exposure requirements in section 1.1307, a minimum separation distance of 20 cm is required between the antenna and all public persons.