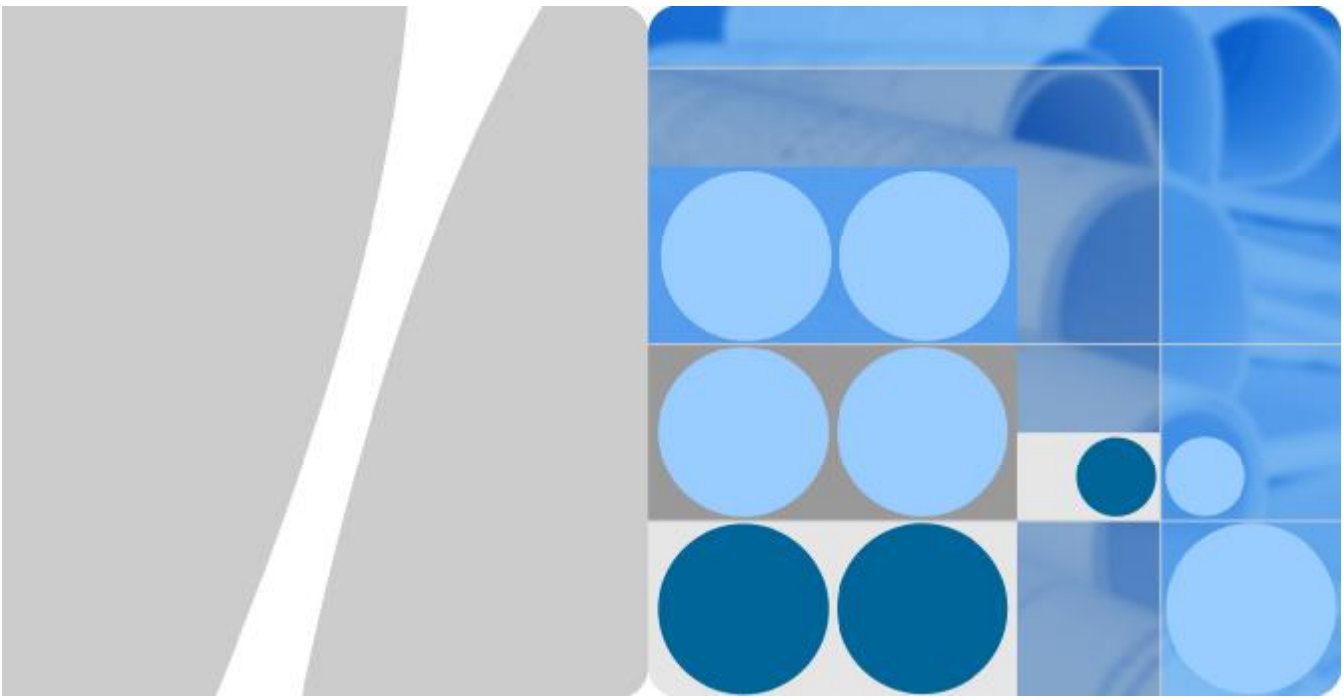

eWBB2.0 USN9810

Product Description

Issue 01

Date 2012-05-30

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Huawei Technologies Co., Ltd.

Address: Huawei Industrial Base
Bantian, Longgang
Shenzhen 518129
People's Republic of China

Website: http://www.huawei.com

Email: support@huawei.com

Contents

About This Document

Overview

This document describes the network position, product architecture and characteristics, and related technical specifications of the USN9810.

Intended Audience

This document is intended for:

- Huawei technical support
- System engineers
- Network planning engineers

Change History

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

Issue 01 (2012-05-30)

This is the first commercial release.

1 Introduction

1.1 Positioning

This document is released with the eWBB2.0 Solution. The version of the product corresponds to USN9810 V900R011C01.

eWBB2.0 USN9810 (USN9810 for short in this document) is a unified service node that is deployed by Huawei and is applied to only evolved packet core (EPC) systems.

The USN9810 can provide the functionalities of the mobility management entity (MME) and provide integrated user authentication management, which is part of System Architecture Evolution-home subscriber server (SAE-HSS)'s functionalities. It is operated and maintained as a single piece of equipment.

1.1.1 3GPP System Evolution

This section describes architectural evolution of the 3rd Generation Partnership Project (3GPP) EPC system.

Introduction to current networks

Wireless technology has undergone a process of development from the Global System for Mobile Communications (GSM, 2G) to the General Packet Radio Service (GPRS, 2.5G) and then to the Universal Mobile Telecommunications System (UMTS, 3G). Currently, mobile communications have achieved almost universal coverage, with high-speed wireless data transmission, and easy access to the Internet. Mobile communications are now providing multimedia services, such as voice, data, and video, enabling people to communicate with each other anywhere anytime.

The structures of current networks, however, cannot keep pace with the rapid development and diversified service requirements. The following issues are major limitations to the current network structure:

- The packet switched (PS) domain only supports non-real-time services and the circuit switched (CS) domain is responsible for implementing voice services. This scheme means that carriers must deploy PS and CS domains separately, which complicates network management and maintenance and increases operational expenditure (OPEX).
- Data routing and forwarding efficiency is low because of multiple network layers.
- Data processing capabilities and radio access technologies (RATs) of mobile stations (MSs) on current networks have been continuously improving, calling for the convergence of existing RATs and support for diverse wireless networks.

Introduction to the EPC network

To strengthen the network competitiveness, 3GPP has been developing enhanced 3G (E3G).

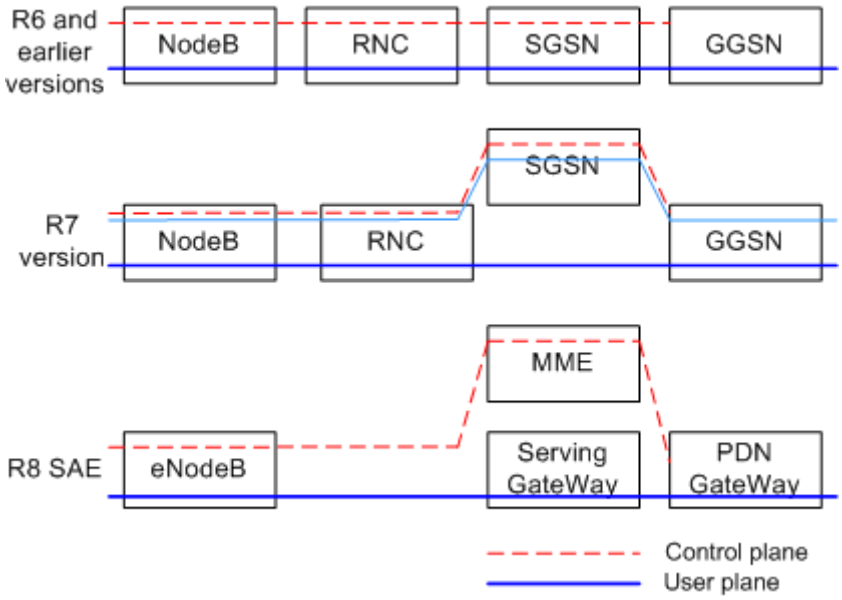
- The E3G air interface technology is Long Term Evolution (LTE).
- The LTE core network is system architecture evolution (SAE), also called EPC.

3GPP EPC aims at exploring key communication technologies in the next 10 years. The 3GPP EPC has the following key features:

- All-IP network: The CS domain no longer exists on EPC networks. Voice services will be provided by PS domains and IP multimedia subsystem (IMS) networks. The all-IP network structure will improve network efficiency and performance.
- Flat network: The optional co-design of serving gateway (S-GW) and PDN gateway (P-GW) is supported, providing simplified network deployment and reduced latency.
- Multiple RATs: The 3GPP EPC system can interwork with existing 3GPP systems. It also supports non-3GPP access, and roaming and handovers between 3GPP systems and non-3GPP systems.
- High data rate: The peak uplink rate is 50 Mbit/s and the peak downlink rate is 100 Mbit/s.
- Fast deployment: The EPC network can be quickly deployed owing to its simple network structure, to meet the increasingly diversified service requirements.
- Enhanced real-time services: The latency in service connection setup is reduced.

Figure 1-1 shows the 3GPP system architecture evolution.

Figure 1-1 3GPP system architecture evolution



NodeB: UMTS base station

RNC: radio network controller

SGSN: serving GPRS support node

GGSN: gateway GPRS support node

eNodeB: evolved NodeB

MME: mobility management entity

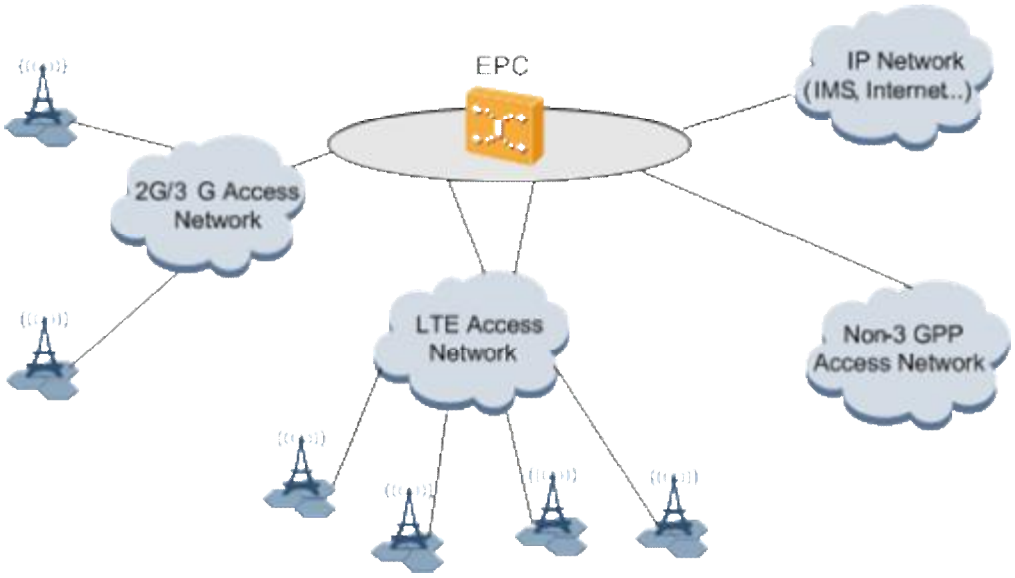
S-GW: serving gateway

P-GW: PDN gateway

The EPC network is intended to provide high-speed packet data services. It has a less complex network structure than current core networks, with the following differences:

- The eNodeB can access the EPC network directly. RNC functions are integrated into the eNodeB.
- The functions of the network elements (NEs) in the PS domain are adjusted as follows:
  - The SGSN signaling plane and forwarding plane are separated. The MME implements the function of the SGSN signaling plane and the S-GW implements the function of the SGSN forwarding plane.
  - The P-GW functions as the GGSN.
  - The optional co-design of S-GW and P-GW is supported.
- The EPC network allows multiple RATs, including non-3GPP access technologies such as CDMA2000 high rate packet data (HRPD). See Figure 1-2.

Figure 1-2 Multiple RATs supported on the ECP network



1.1.2 Huawei EPC Solution

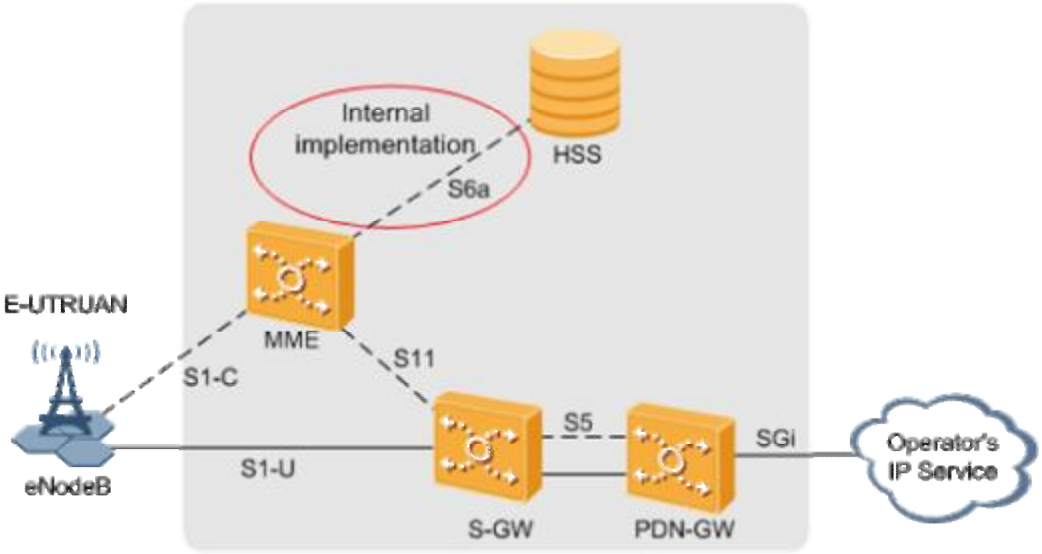
The EPC solution provided by Huawei meets diverse service and access requirements.

UGW9811 located in EPC(Evolved Packet Core) supports the functions and any combination of S-GW and P-GW.

Usage of the UGW9811 in the EPC System

Figure 1-3 shows the network environment for the UGW9811 in Huawei EPC solution.

Figure 1-3 Network environment for the UGW9811 in Huawei EPC solution



eNodeB: evolved NodeB	E-UTRAN: evolved UMTS terrestrial radio access network
MME: mobility management entity	HSS: home subscriber server
S-GW: serving gateway	P-GW: PDN gateway

The EPC network primarily consists of the following elements:

- User equipment (UE): initiates and receives calls over air interfaces.
- Evolved UMTS terrestrial radio access network (E-UTRAN): implements all functions related to the radio access.
- EPC: core of the EPC network, which consists of the MME, S-GW, P-GW, and HSS, and connects the EPC network to external packet data networks (PDNs) such as the Internet.

1.1.3 NE Functions

The functions of the major NEs in the EPC solution are as follows.

E-UTRAN

The E-UTRAN implements all functions related to the radio access to the LTE/EPC network, including:

- Management and establishment of radio resources
- Header compression and user plane ciphering
- MME selection when no route to an MME can be determined from the information provided by the UE
- UL bearer level rate enforcement based on UE-aggregate maximum bit rate (AMBR) by means of uplink scheduling and maximum bit rate (MBR)
- DL bearer level rate enforcement based on UE-AMBR

- UL and DL bearer level admission control
- Transport level packet marking in the uplink, for example, setting the DiffServ Code Point (DSCP), based on the QoS Class Identifier (QCI) of the associated EPS bearer

MME

The MME is responsible for mobility management in the control plane, including management of the user contexts and mobile status, and assignment of temporary identifiers. The functions of the MME include:

- Non-access stratum (NAS) signaling
- NAS signaling security
- UE reachability in ECM-IDLE state (including control and execution of paging retransmission)
- Tracking Area list management
- P-GW and S-GW selection
- MME selection for handovers with MME change
- Authentication
- Bearer management functions including dedicated bearer establishment
- Lawful interception of signaling services

S-GW

The S-GW is the anchor point in the user plane between different access networks. It can shield interfaces within the 3GPP network towards different access networks. The S-GW is the gateway that terminates the interface towards E-UTRAN.

The functions of the S-GW include:

- The local mobility anchor point for inter-eNodeB handover
- Assist the eNodeB reordering function during inter-eNodeB handover by sending one or more **end marker** packets to the source eNodeB immediately after switching the path
- ECM-IDLE mode downlink packet buffering and initiation of network triggered service request procedure
- Lawful interception
- Packet routing and forwarding
- Transport level packet marking in the uplink and the downlink (DSCP)
- Accounting on user and QCI granularity for inter-operator charging

P-GW

The P-GW is the anchor point in the user plane between the 3GPP access networks and non-3GPP access networks. The P-GW is the gateway that terminates the SGi interface towards the PDN.

The functions of the P-GW include:

- Per-user based packet filtering (for example, deep packet inspection)
- Lawful interception
- UE IP address allocation

- Transport level packet marking in the uplink and downlink
- UL and DL service level charging (for example, based on service data flows (SDFs) defined by the PCRF, or based on deep packet inspection defined by local policy)
- UL and DL service level gating control
- UL and DL service level rate enforcement (for example, by rate policing/shaping per SDF)
- UL and DL rate enforcement based on APN-AMBR (for example, by rate policing/shaping per aggregate of traffic of all SDFs of the same UE-APN that are associated with Non-GBR (guaranteed bit rate) QCIs.
- DL rate enforcement based on the accumulated MBRs of the aggregate of SDFs with the same GBR QCI for example, by rate policing/shaping)
- DHCPv4 (server and client) functions
- UL and DL bearer binding
- UL bearer binding verification

DNS

There are two types of domain name server (DNS) on the LTE/EPC network:

- DNS located between the P-GW and the PDN

  It is used to resolve the domain name of the PDN, equivalent to a common DNS on the Internet.
- DNS located on the LTE/EPC core network

  When the UE requests to access an external network for packet services, the MME requests the DNS to resolve the domain name according to the access point name (APN). After the IP address of the corresponding P-GW is obtained, a transmission channel can be set up between the UE and P-GW.

  In mobility management procedures, such as attach and tracking area update (TAU), a DNS is used for selecting the peer MME.

The DNS can also be deployed on other networks in addition to GPRS/UMTS networks.

1.2 Product Features

The USN9810 is a competitive product developed by Huawei. It features multiple access standards and multiple logical product types and has many outstanding features or characteristics.

High Integration

The USN9810 supports a maximum of 20,000 E-UTRAN subscribers attached at the same time. In the case of full configuration, only one cabinet, one Advanced Telecommunications Computing Architecture (ATCA) subrack, and one PGP-X8 subrack are required.

The USN9810 uses a high-speed forwarding processor to forward the data on the user plane, which improves the processing efficiency and integration of the system.

Advanced ATCA Platform

ATCA is a hardware standard. It is the name of the architecture standard for the hardware platform rather than the name of a specific product.

The USN9810 uses the Open Standards Telecom Architecture (OSTA 2.0) platform of Huawei, which is a server system featuring high density and high performance. The USN9810 can provide reliable data processing services for carrier-grade telecommunications applications.

The OSTA 2.0 hardware platform stipulates a series of specifications related to boards, backplanes, and software for the next generation telecom devices. Based on the ATCA standard architecture and conforming to the network equipment building system (NEBS) and European telecommunications standards institute (ETSI) standards, the platform has the following features:

- High rate

  The high-speed serial data link and switched structure are used. Therefore, the data exchange bandwidth intra-subrack can reach 2.5 Tbit/s.
- High reliability

  All boards and subboards are hot swappable. In addition, redundancy is implemented on all key components, such as power supply, fan, management module, and board of each type. Therefore, the reliability of the system reaches 99.999%.
- High scalability

  The USN9810 supports the addition of the interfaces on the ATCA board and cascading between subracks through the interface board within a subrack.
- Easy to upgrade

  Backplane forwarding bandwidth can be smoothly upgraded to 10 GE. The performance of interface boards is easy to upgrade.
- Efficient management

  The standard management bus is used, which can manage any part in the system.

The USN9810 uses the embedded software platform, namely, carrier grade platform (CGP), which is universally used by the core network products of Huawei. The CGP has the features such as cross-hardware platform, cross-operating system, and easy maintenance.

- Cross-hardware platform

  A uniform interface of the hardware platform is provided, which implements the operation of upper-layer applications on different hardware platforms. Therefore, the hardware management is independent of the hardware platform.
- Cross-operating system

  Different interfaces of the operating system at the lower layer are shielded. Instead, a uniform virtual operating system application programming interface (VOS API) is provided for upper-layer applications.
- Easy maintenance

  The implementation mechanisms of the functions such as operation and maintenance, alarm management, performance measurement, call and signaling tracing, data backup, board switchover, and online loading are provided for upper-layer applications.

Easy Operation and Maintenance

When the STM-1 or STM-4 optical interface is used for the USN9810 to interconnect with another device, you need to configure the clock synchronization system. The clock

synchronization system of the USN9810 uses the advanced digital phase-locked loop (DPLL) and reliable software phase-locking technique, and has the following features:

- Clocks of multiple stratums such as stratum 2 (class A and class B) and stratum 3 clocks are available.
- Stratum 2 and stratum 3 clocks can be flexibly selected for configuration through a terminal.
- The input primary source signals 2.048 MHz and 2.048 Mbit/s are available.
- Powerful software functions are available. Operators can easily control the reference source and phase-lock mode of the clock through the LMT. In addition, the LMT provides complete display, alarm, and OM functions.

The USN9810 has powerful phase-locking capabilities, and therefore is applicable to various clock transmission situations. When the reference source of the clock works improperly, the clock synchronization system of the USN9810 can work in free-run mode and maintains clock synchronization in a certain period.

High Reliability

The USN9810 is highly reliable because of the following features:

- Backup of important data

  The USN9810 automatically backs up important data, such as the configuration data, performance data, and operation logs.
- Operation security management

  Different management privileges are assigned to different users. During the user login, the USN9810 checks the user identity. After the user login, the USN9810 maintains the complete operation to ensure system security.
- Hardware redundancy design

  All critical boards are configured in the 1+1 backup to ensure the high reliability of the system.
- Fault prevention

  The USN9810 provides protection mechanisms to avoid the following system faults:
  - System power off
  - Misoperation on the system power switch
  - Lightning surge on the system power
  - High voltage and low voltage
  - Short circuit of power supply
  - Current surge and high voltage on the power supply and interfaces
- System overload control

  In the case of center processing unit (CPU) overload or resource congestion, the USN9810 adjusts the traffic smoothly to avoid system down.
- Board lock and unlock, process lock and unlock

  The board and process lock function stops access to new services as required and gradually removes the existing services within a certain period. The board and process unlock function, however, provides access to new services.

2 Product Architecture

2.1 Overview

The system structure of the USN9810 includes hardware structure and software structure.

2.2 Hardware Architecture

The USN9810 uses the Huawei OSTA 2.0 hardware platform, which is based on ATCA. The physical structure of the platform consists of cabinets, subracks, and boards.

2.2.1 Introduction to the Cabinet

As a cabinet-type device, the USN9810 uses the Huawei N68E-22 cabinet. The available space of the cabinet is 46 U (1 U = 44.45 mm = 1.75 inch). The cabinet, composed of the power distribution frame (PDF), OSTA 2.0 subrack, cable tray, filler panel, rack, and guide rail, enables the internal modules to be flexibly configured.

Figure 2-1 shows the appearance of the N68E-22 cabinet.

Figure 2-1 Appearance of the N68E-22 cabinet

The N68E-22 cabinet is a 19-inch cabinet of the standard industrial structure. It conforms to the following international standards:

- IEC60297-1, Dimensions of mechanical structures of the 482.6 mm (19 in) series Part 1: Panels and racks
- IEC60297-2, Dimensions of mechanical structures of the 482.6 mm (19 in) series Part 2: Cabinets and pitches of rack structures
- IEC60297-3, Dimensions of mechanical structures of the 482.6 mm (19 in) series Part 3: Subracks and associated plug-in units

2.2.2 Introduction to Subracks

The USN9810 subracks are classified into the basic subrack and the service subrack.

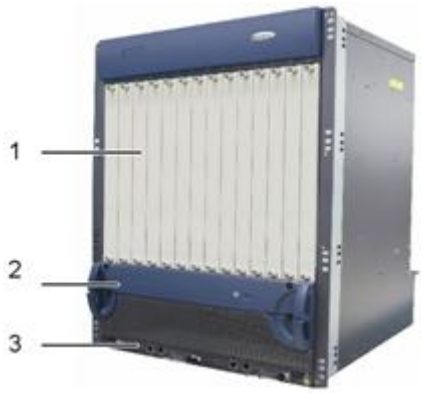
The ATCA subrack is the basic subrack. In the basic subrack, the rear board of the switching unit (SWU) board is the time master interface (TMI) board.

The board area of a subrack has 14 slots at the front and rear sides respectively. Boards can be inserted from both the front side and the rear side of the subrack. The front board, SWU, and the corresponding rear board, TMI, occupy slots 6 and 7. Other slots, namely, slots 0 to 5 and slots 8 to 13 are the slots for universal services.

Two subrack management unit (SMU) boards and two subrack data manage (SDM) boards exist at the bottom of the subrack. The SMU board and the SDM board are inserted from the front side and the rear side. The SMU board is located at the front side of the subrack and the SDM board is located at the rear side of the subrack.

Figure 2-2 shows the front view of the OSTA 2.0 subrack. Figure 2-3 shows the rear view of the OSTA 2.0 subrack.

Figure 2-2 Front view of the OSTA 2.0 subrack



1 Board slot 2 Fan frame (with an air intake vent) 3 SMU board slot

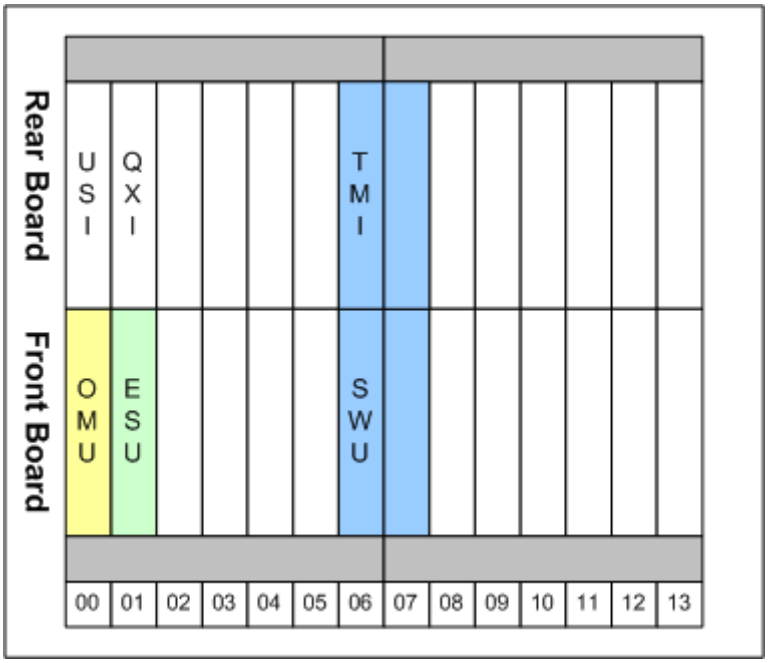
Figure 2-3 Rear view of the OSTA 2.0 subrack

1 Air exhaust vent 2 Interface board slot 3 Cable trough

4 Power distribution module 5 SDM board slot

Figure 2-4 show the typical configurations of the basic subrack.

Figure 2-4 Typical configuration of the basic subrack



2.2.3 Introduction to Boards

Table 2-1 lists the boards of different types.

Table 2-1 Boards of different types

Physical Board	Position	Function
Operation and Maintenance Unit (OMU)	Front board	Responsible for operation and maintenance
QXI (Quad-port 10GE Rear Interface Unit A)	Rear board	Implementing the access of the broadband ports such as 10GE and GE. This rear board does not have a subboard and supports four 10GE ports and four GE ports.
Switch Unit (SWU)	Front board	Providing the basic function such as layer 2 switching for the GE interfaces of the Base plane and Fabric plane inside a subrack and between subracks
Time Master Interface (TMI)	Rear board	Rear board of the SWU board, which is used for cascading between subracks and distributing clocks
Subrack Management Unit(SMU)	Front board	Used to manage and maintain the devices inside the subrack
Subrack Data Management (SDM)	Rear board	Rear board of the SUM board, which is used to store device archives

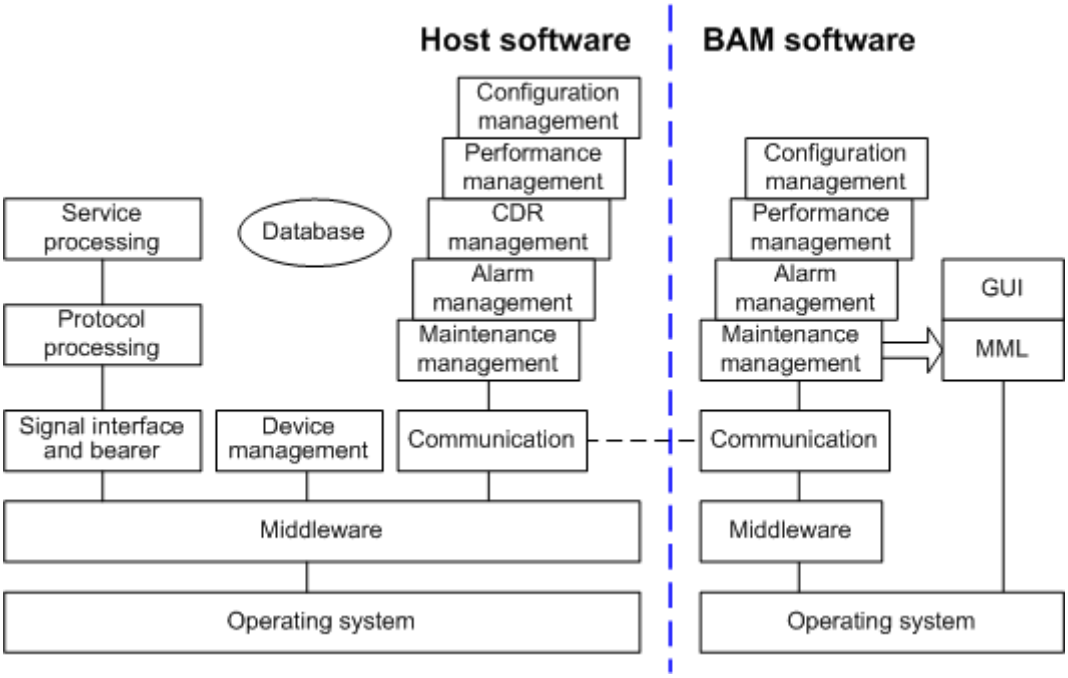
Physical Board	Position	Function
Enhanced Service Unit (ESU)	Front board	Responsible for processing the services on the control plane and user plane
Universal Service Interface (USI)	Rear board	Rear board of the OMU board, which provides precise time and maintenance for the GE interface

2.3 Software Architecture

The USN9810 uses a distributed software structure. The functional modules of the software are distributed in different types of boards and can be flexibly configured to meet the requirements of network application.

Based on the software location, the USN9810 software consists of the host software and the background administration module (BAM) software. Figure 2-5 shows the software structure of the USN9810.

Figure 2-5 Software structure of the USN9810



2.3.1 Host Software

The host software runs on different boards in the OSTA subrack. It implements functions such as signaling access and processing, service control, resource management, and charging information generation. In response to specific commands, the host software also performs the

following operations such as data management, device management, alarm management, performance statistics, and signaling trace on the host in cooperation with the BAM software.

The host software adopts a hierarchical and modular design. From bottom to top, its components are the operating system, middleware, and various applications.

Operating System

The operating system of the host software is Linux + Vxworks, which is a real-time operating system.

Middleware

The middleware technology (DOPRA) is applied to the operating system and applications of the USN9810. Therefore, the upper-layer service software is irrelevant to the lower-layer operating system.

The middleware facilitates the migration of software functions between different platforms. Therefore, new and stable product versions are released quickly as the service software is rarely changed.

Applications

The application is the functional part of the USN9810 software. Loaded with different applications, boards can provide different functions. The USN9810 applications can be classified into the following types:

- Signaling bearer software: Implements the access of broadband and narrowband signaling and processing of the lower-layer protocols.
- Service processing software: Performs signaling processing, session management, mobility management, and resource management.
- Database software: Manages device data and dynamic subscriber data.
- System support software: Implements system management and device interconnection.
- OM software: Receives the operation commands from the OMU and reports the command results to the OMU.

2.3.2 BAM Software

The BAM software runs on the OMU, LMT, and Web UI. Along with the host software, it provides the man-machine interface, which enables the maintenance personnel to implement the following functions: data management, device management, alarm management, performance statistics, signaling trace, and CDR management.

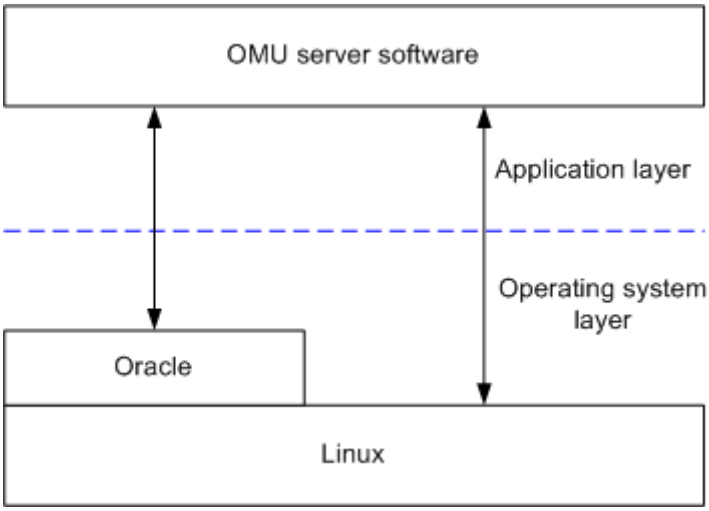
The BAM software adopts the client/server model. It consists of the OMU server software, LMT software, and Web UI software. The OMU server software is installed on the OMU. The LMT software and Web UI software is installed on the client, namely, a PC.

OMU server software

The OMU server software runs on the OMU board. As a combination of the communication server and the database server, the OMU server software forwards OM commands from different workstations to the host and sends responses or command results to the corresponding workstations. The OMU server software serves as the essential unit of the operation, administration and maintenance (OAM) software.

The OMU server software runs on the Linux operating system and uses the Oracle as the database platform. It provides functions of the terminal OAM software through multiple parallel service processes, such as maintenance process, data management process, alarm process, and performance statistical process. Figure 2-6 shows the relationship between the OMU server software, operating system, and database platform.

Figure 2-6 Relationships between the OMU server software, operating system, and database platform



LMT software

The LMT software runs on a workstation. Serving as a client, the LMT software is connected to the OMU, serving as a server, in client/server mode. The LMT software provides MML-based graphical terminals. A workstation can be located locally or remotely. For example, a remote workstation can be connected to the OMU server through a wide area network (WAN) in dial-up mode.

In addition, you can perform the following maintenance functions on a workstation: data maintenance, device management, alarm management, performance statistics, call trace, and signaling trace.

Web UI software

The Web UI software is namely the Web client. You can use the Web browser, such as IE browser, to perform performance management and traffic statistics. In addition, the Web browser can also be used during upgrade.

3 Configurations

The USN9810 has two typical configurations: single-subrack minimum configuration and 1+1 mode configuration.

Single-Subrack Minimum Configuration

The USN9810 with single-subrack minimum configuration supports 20,000 attached subscribers, 40,000 active Packet Data Protocol (PDP) contexts, and 40,000 MME bearers. Table 3-1 lists the board name and quantity for the single-subrack minimum configuration.

Table 3-1 Board name and quantity for the single-subrack minimum configuration

Board Name	Board Quantity
SMU	1
SDM	1
OMU	1
USI	1
ESU	1
SWU	1
TMI	1
QXI	1

1+1 Mode Configuration

The USN9810 with the 1+1 mode configuration supports 20,000 attached subscribers, 40,000 active PDP contexts, and 40,000 MME bearers. Table 3-2 lists the board name and quantity for the 1+1 mode configuration.

Table 3-2 Board name and quantity for the 1+1 mode configuration

Board Name	Board Quantity
SMU	1
SDM	1
OMU	2
USI	1
ESU	2
SWU	2
TMI	1
QXI	1

4 Operation and Maintenance

The USN9810 offers abundant services and functions, and meets the requirements of multiple networks and operations.

Flexible OM methods

The OM system can be flexibly built according to the network structure and customer requirements. Multiple maintenance interfaces are supported, including the interfaces to the local maintenance terminal (LMT), the Huawei centralized network management system iManager M2000. Through the Common Object Request Broker Architecture (CORBA) interface provided by the iManager M2000, more network management requirements can be fulfilled.

Friendly user interfaces

The USN9810 provides OM interfaces that combine the merits of both man-machine language (MML) and graphic user interface (GUI).

Web UI-based maintenance operation and performance browse

The Web UI-based maintenance operation and performance browse are added. That is, certain maintenance operations and performance browse are implemented on the Web.

Powerful signaling tracing

The USN9810 provides interface tracing, subscriber tracing, and entire-process tracing. It is a powerful tool for equipment maintenance.

Interface tracing tasks can be performed on interfaces such as the S1-MME and S11 interface or performed for the protocols such as SCCP and S1AP.

The subscriber tracing traces the messages of the specified IMSI or mobile station international ISDN number (MSISDN).

The entire-process tracing traces how the packets with specified characteristics are transmitted between modules and calculate the number of packets of the same characteristics processed in each module. This is used to locate the problems during packet transmission such as protocol handling errors, packet loss, delay, packet fault, or sequence disorder.

Operators can save the trace results to handle any queries in the future.

Configuration rollback

The configuration rollback in batches is supported. Only one rollback point can be set.

One-key upgrade and installation and Online software patching

Through online software patching, software errors can be solved without interrupting services. The USN9810 also supports remote patching and version fallback.

5 Technical Specifications

5.1 Performance Specifications

Table 5-1 lists the performance specifications of the USN9810.

Table 5-1 Performance specifications of the USN9810

Parameter	Value
Number of subscribers supported by the system	20,000
Number of bearers supported by the system	40,000
Number of bearers activated by a UE at the same time	11
Number of eNodeBs supported by the system	500
Number of S-GWs and P-GWs supported by the system at the same time	1

5.2 Physical Interfaces

Table 5-2 lists the types and numbers of external physical interfaces provided by the USN9810.

Table 5-2 Physical interfaces provided by the USN9810

Interfaces	Physical Characteristics	Protocol	Maximum ports
S1-MME/S11	GE (Gigabit Ethernet)	IP/MAC	8
	FE (Fast Ethernet)	IP/MAC	8

Interfaces	Physical Characteristics	Protocol	Maximum ports
O&M	FE	IP	2

NOTE
The USN9810 supports a maximum sum of eight FE and GE interfaces.

5.3 Clock Indexes

Table 5-3 lists the primary technical parameters of the clock system in the USN9810.

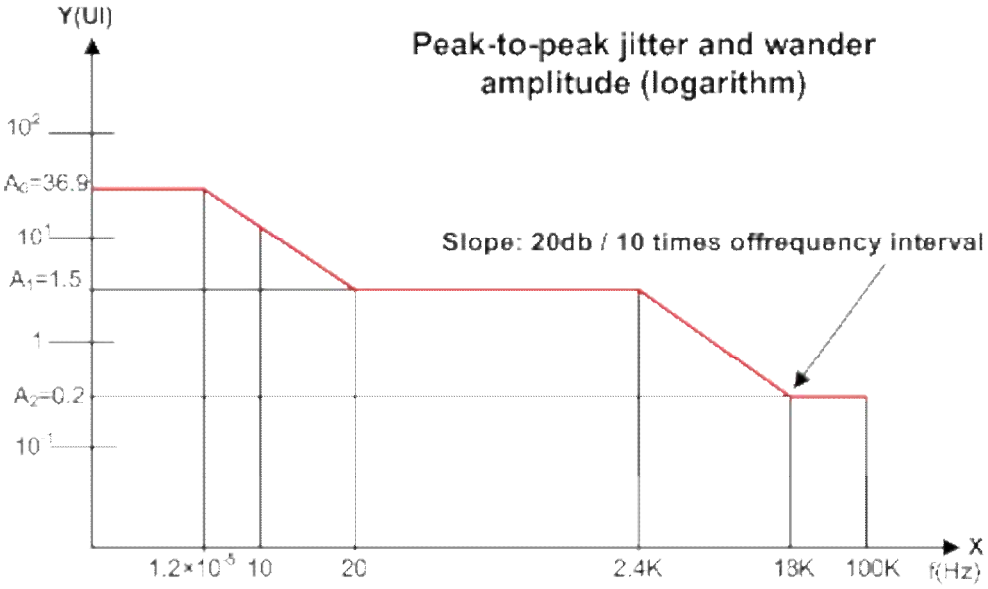
Table 5-3 Technical parameters of the clock system in the USN9810

Name	Index and Function	
Clock network-entry parameters	Minimum accuracy	Stratum-2: ± 4 x 10^{-7} Stratum-3: ± 4.6 x 10^{-6}
	Pull-in range	Stratum-2: ± 4 x 10^{-7} Stratum-3: ± 4.6 x 10^{-6}
	Maximum frequency deviation	Stratum-2: 5 x 10^{-10} per day Stratum-3: 2 x 10^{-8} per day
	Initial maximum frequency deviation	Stratum-2: less than 5 x 10^{-10} per day Stratum-3: less than 1 x 10^{-8} per day
Long-term phase variation	Ideal working state	MRTIE ≤ 1 ms
	Hold-in working state	MRTIE (ns) ≤ a x s + (1/2) x b x s2 + c Where s refers to the time whose units is second, and the unit of MRTIE is ns. Stratum-2: a=0.5, b=1.16 x 10-5, c=1000 Stratum-3: a=10, b=2.3 x 10-4, c=1000
Working modes of the clock	Fast tracking, Tracing, Retaining, Free running	
Input jitter tolerance	For details, see Figure 5-1.	

NOTE

- Minimum accuracy: maximum deviation value of nominal frequency in a long period (20 years) without external frequency benchmark, that is, the clock is in free running state.
- Maximum frequency deviation: a maximum value of the clock's relative frequency change in a UI during a consecutive operation process.
- Pull-in range: maximum frequency bandwidth of the input signal locked by a clock.
- MRTIE: The MRTIE extracts the offset that appears in measurements performed with local reference clocks.

Figure 5-1 Maximum permissible lower limit of input jitter and wander



When the jitter frequency of an input frequency is 1 kHz and the amplitude is more than 1.5 UI, you can infer that the input signal meets the requirements if the system operates normally.

NOTE

UI refers to the unit of time interval. One UI equals the reciprocal of the frequency of the digital signal. For example, the UI of the 2.048 Mbit/s signal is 488 ns.

5.4 Engineering Parameters

Power Input and Typical Power Consumption

Table 5-4 lists the power input and typical power consumption of the USN9810.

Table 5-4 Power input and typical power consumption of the USN9810

Parameter	Value
Power Input	-40 V to -57 V DC
Power consumption for a single board configuration of one subrack	750 W

Parameter	Value
Power consumption for a single board configuration of two subrack	950 W

Dimensions and Weight of a Cabinet

Table 5-5 lists the dimensions and weight of a USN9810 cabinet.

Table 5-5 Dimensions and weight of a USN9810 cabinet

Parameter	Value
Cabinet dimensions (H x W x D)	2200 mm x 600 mm x 800 mm
Cabinet weight	100 kg (with empty cabinet) < 400 kg (with full configuration)

Noise

Table 5-6 lists the noise of a USN9810.

Table 5-6 Noise of a USN9810

Parameter	Value
Noise (acoustic power)	≤ 72 dBA at 23°C (with full configuration)

NOTE
The noise varies with the ambient temperature.

5.5 EMC Specifications

The USN9810 complies with the following electromagnetic compatibility (EMC) specifications:

- ETSI EN 300 386V1.3.3: 2005
- AS/NZS CISPR 22: 2004
- CISPR 22: 2002 CLASSA
- EN 55022: 1998 + A1: 2000 + A2: 2003 CLASSA
- EN 55024: 1998 + A1: 2001 + A2: 2003
- FCC part 15: 2006
- VCCI V-3: 2006
- CISPR 24: 1997

5.6 Environment Requirements

This section describes environment specifications of the USN9810. The environment specifications consist of the storage, transportation, and operating specifications.

The USN9810 complies with the following standards:

- ETSI EN 300019 environmental conditions and environmental tests for telecommunications devices
- IEC 60721 classification of environmental conditions

5.6.1 Storage Environment Requirements

The storage environment requirements consist of the climate requirements, waterproofing requirements, biological requirements, air cleanliness requirements, and mechanical stress requirements.

Climate Requirements

Table 5-7 Climate requirements

Item	Range
Altitude	≤ 5000 m
Atmospheric pressure	70 kPa to 106 kPa
Temperature	-40℃ to +70℃
Temperature change rate	≤ 1℃/min
Relative humidity	10% to 100%
Solar radiation	≤ 1120 W/s²
Heat radiation	≤ 600 W/s²
Wind speed	≤ 30 m/s

Biological Requirements

- There is no propagation of fungus, mildew, or other microorganisms.
- There are no rodents, such as mice, in the equipment room.

Air Cleanliness Requirements

- The air must be free from explosive, conductive, magnetic-conductive, or corrosive dust.
- The density of mechanically active substances must comply with the requirements listed in Table 5-8.

Table 5-8 Requirements for the density of physically active materials

Mechanically Active Substance	Unit	Density
Suspended dust	mg/m³	≤ 5.00
Falling dust	mg/m²•h	≤ 20.0
Sand	mg/m³	≤ 300
NOTE l Suspended dust: diameter ≤ 75 μm l Falling dust: 75 μm ≤ diameter ≤ 150 μm l Sand: 150 μm ≤ diameter ≤ 1000 μm		

l The density of chemically active substances must comply with the requirements listed in Table 5-9.

Table 5-9 Requirements for the density of chemically active substances

Chemically Active Substance	Unit	Density
SO_2	mg/m³	0.30 to 1.00
H_2S	mg/m³	0.10 to 0.50
NO_2	mg/m³	0.50 to 1.00
NH_3	mg/m³	1.00 to 3.00
Cl_2	mg/m³	0.10 to 0.30
HCl	mg/m³	0.10 to 0.50
HF	mg/m³	0.01 to 0.03
O_3	mg/m³	0.05 to 0.10

Mechanical Stress Requirements

Table 5-10 Mechanical stress requirements

Item	Sub-item	Range	
Sinusoidal vibration	Offset	≤ 7.0 mm	-
	Accelerated speed	-	≤ 20.0 m/s²
	Frequency	2 Hz to 9 Hz	9 Hz to 200 Hz
Non-stable impulse	Impulse response spectrum II	≤ 250 m/s²	

Item	Sub-item	Range
	Static payload	≤ 5 kPa

NOTE

- Impulse response spectrum indicates the maximum response curve of the accelerated speed generated by the equipment under the specified impulse excitation. Impulse response spectrum II means that the duration of half-sine impulse response spectrum is 6 ms.
- Static payload indicates the capability of the equipment in package to bear the pressure from the top in normal pile-up method.

Waterproof Requirements

Table 5-11 lists the waterproof requirements.

Table 5-11 Waterproof requirements

Item	Requirement
Being stored indoors (recommended)	- Water should not accumulate on the ground or fall on the package. - The equipment should be located away from water sources such as hydrant and air-conditioner.
Being stored outdoors	- The package is intact. - Waterproof measures are taken to prevent water penetration. - Measures are taken to prevent exposure to sunlight from damaging the package. - Water should not accumulate on the ground or fall on the package.

5.6.2 Transportation Environment

The transportation environment requirements consist of the climate requirements, waterproofing requirements, biological requirements, air cleanliness requirements, and mechanical stress requirements.

Climate Requirements

Table 5-12 Climate requirements

Item	Range
Altitude	≤ 5,000 m
Atmospheric pressure	70 kPa to 106 kPa
Temperature	-40°C to +70°C

Item	Range
Temperature change rate	≤1 °C /min
Relative humidity	5% to 100%
Solar radiation	≤ 1120 W/s²
Heat radiation	≤ 600 W/s²
Wind speed	≤ 30 m/s
Rainfall	≤ 6 mm/min

Biological Requirements

- There is no propagation of fungus, mildew, or other microorganisms.
- There are no rodents, such as mice, in the vehicle.

Air Cleanliness Requirements

- The air must be free from explosive, conductive, magnetic-conductive, or corrosive dust.
- The density of mechanically active substances must comply with the requirements listed in Table 5-13.

Table 5-13 Requirements for the density of mechanically active substances

Mechanically Active Substance	Unit	Density
Suspended dust	mg/m³	No requirement
Falling dust	mg/m²•h	≤ 3.0
Sand	mg/m³	≤ 100
NOTE - Suspended dust: diameter ≤ 75 μm - Falling dust: 75 μm ≤ diameter ≤ 150 μm - Sand: 150 μm ≤ diameter ≤ 1000 μm		

- The density of chemically active substances must comply with the requirements listed in Table 5-14.

Table 5-14 Requirements for the density of chemically active substances

Chemically Active Substance	Unit	Density
SO_2	mg/m³	≤ 1.00
H_2S	mg/m³	≤ 0.50

Chemically Active Substance	Unit	Density
NO_2	mg/m³	≤ 1.00
NH_3	mg/m³	≤ 3.00
Cl_2	mg/m³	≤ 0.30
HCl	mg/m³	≤ 0.50
HF	mg/m³	≤ 0.03
O_3	mg/m³	≤ 0.10

Mechanical Stress Requirements

Table 5-15 Mechanical stress requirements

Item	Sub-item	Range		
Sinusoidal vibration	Offset	≤ 7.5 mm	-	-
	Accelerated speed	-	≤ 20.0 m/s²	≤ 40.0 m/s²
	Frequency	2 Hz to 9 Hz	9 Hz to 200 Hz	200 Hz to 500 Hz
Random oscillation	Acceleration spectrum density (ASD)	10 m²/s³	3 m²/s³	1 m²/s³
	Frequency	2 Hz to 9 Hz	9 Hz to 200 Hz	200 Hz to 500 Hz
Non-stable impulse	Impulse response spectrum II	≤ 300 m/s²		
	Static payload	≤ 10 kPa		

NOTE

- Impulse response spectrum indicates the maximum response curve of the accelerated speed generated by the equipment under the specified impulse excitation. Impulse response spectrum II means that the duration of half-sine impulse response spectrum is 6 ms.
- Static payload indicates the capability of the equipment in package to bear the pressure from the top in normal pile-up method.

Waterproof Requirements

The waterproof requirements for transporting the UGW9811 are as follows:

- The package is intact.

- Waterproofing measures are taken to prevent rainwater from leaking into the package.
- There is no water on the floor of the transportation vehicle.

5.6.3 Operating Environment Requirements

The operating environment requirements consist of the climate requirements, waterproofing requirements, biological requirements, air cleanliness requirements, and mechanical stress requirements.

Climate Requirements

Table 5-16 Requirements for temperature and humidity

Temperature		Relative Humidity	
Long-term	Short-term	Long-term	Short-term
0℃ to +45℃	-5℃ to +55℃	5% to 85%	5% to 95%

NOTE

- The values are measured 1.5 m above the floor and 0.4 m in front of the equipment, without protective panels in front of or behind the cabinet.
- Short term refers to continuous operating for no more than 48 hours or accumulated operating of no more than 15 days in a year.

Table 5-17 Other climate requirements

Item	Range
Altitude	≤ 4000 m
Atmospheric pressure	70 kPa to 106 kPa
Temperature change rate	≤ 5℃/h
Solar radiation	≤ 700 W/m²
Heat radiation	≤ 600 W/m²
Wind speed	≤ 1 m/s
IP grade	IP50

Biological Requirements

- There is no propagation of fungus, mildew, or other microorganisms.
- There are no rodents, such as mice, in the equipment room.

Air Cleanliness Requirements

- The air must be free from explosive, conductive, magnetic-conductive, or corrosive dust.

- The density of mechanically active substances must comply with the requirements listed in Table 5-18.

Table 5-18 Requirements for the density of mechanically active substances

Mechanically Active Substance	Unit	Density
Dust particle	Particle/m³	≤ 3×10^5
Suspended dust	mg/m³	≤ 0.2
Falling dust	mg/m²•h	≤ 1.5
Sand	mg/m³	≤ 30
NOTE - Dust particles: diameter ≥ 5 μm - Suspended dust: diameter ≤ 75 μm - Falling dust: 75 μm ≤ diameter ≤ 150 μm - Sand: 150 μm ≤ diameter ≤ 1,000 μm		

- The density of chemically active substances must comply with the requirements listed in Table 5-19.

Table 5-19 Requirements for the density of chemically active substances

Chemically Active Substance	Unit	Density
SO_2	mg/m³	0.30 to 1.00
H_2S	mg/m³	0.10 to 0.50
NO_2	mg/m³	0.50 to 1.00
NH_3	mg/m³	1.00 to 3.00
Cl_2	mg/m³	0.10 to 0.30
HCl	mg/m³	0.10 to 0.50
HF	mg/m³	0.01 to 0.03
O_3	mg/m³	0.05 to 0.10
CO	mg/m³	≤ 5.0

Mechanical Stress Requirements

Table 5-20 Mechanical stress requirements

Item	Sub-item	Range	
Sinusoidal vibration	Offset	≤ 5.0 mm	-
	Accelerated speed	-	≤ 2.0 m/s²
	Frequency	5 Hz to 62 Hz	62 Hz to 200 Hz
Non-stable impulse	Impulse response spectrum II	≤ 50 m/s²	
	Static payload	0	

NOTE

- Impulse response spectrum indicates the maximum response curve of the accelerated speed generated by the equipment under the specified impulse excitation. Impulse response spectrum II means that the duration of half-sine impulse response spectrum is 6 ms.
- Static payload indicates the capability of the equipment in package to bear the pressure from the top in normal pile-up method.

5.7 Reliability Parameters

Table 5-21 lists the reliability parameters of the USN9810.

Table 5-21 Reliability parameters of the USN9810

Name	Value
System availability in typical configuration	≥ 99.999%
Mean time between failures (MTBF)	≥ 300000 hours
Mean time to repair (MTTR)	≤ 60 minutes
Redundancy backup mechanism	1+1 backup

6 Acronyms and Abbreviations

Table 6-1 List of acronyms and abbreviations

Acronym/Abbreviation	Full Name
3GPP	3rd Generation Partnership Project
APN	Access Point Name
ATCA	Advanced Telecommunications Computing Architecture
CORBA	Common Object Request Broker Architecture
CPU	Center Processing Unit
DOPRA	Distributed Object-oriented Programmable Realtime Architecture
DSCP	Differentiated Services Code Point
ECM	EPS Connection Management
eNodeB	Evolved NodeB
EPC	Evolved Packet Core
EPS	Evolved Packet System
ETSI	European Telecommunications Standards Institute
E-UTRAN	Evolved UMTS Terrestrial Radio Access Network
FE	Fast Ethernet
GE	Gigabit Ethernet
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
GUI	Graphic User Interface
HSS	Home Subscriber Server
IMS	IP Multimedia Subsystem

Acronym/Abbreviation	Full Name
IMSI	International Mobile Subscriber Identity
LMT	Local Maintenance Terminal
LTE	Long Term Evolution
MBR	Mobility Binding Record
MME	Mobility Management Entity
MML	Man-Machine Language
MRTIE	Maximum Relative Time Interval Error
MSISDN	Mobile Station International ISDN Number
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
NAS	Non-Access Stratum
NEBS	Network Equipment Building System
OAM	Operations, Administration and Maintenance
OM	Operation Maintenance
OMU	Operation & Maintenance Unit
PCRF	Policy and Charging Rules Function
PDN	Public Data Network
PDP	Packet Data Protocol
P-GW	PDN Gateway
QCI	QoS Class Identifier
QoS	Quality of Service
QXI	Quad-port 10GE Rear Interface Unit A
SAE	System Architecture Evolution
SDF	Service Data Flow
SDH	Synchronous Digital Hierarchy
SGSN	Serving GPRS Support Node
S-GW	Serving Gateway
UE	User Equipment
UI	Unit Interval
UMTS	Universal Mobile Telecommunications System
USI	Universal Service Interface

Acronym/Abbreviation	Full Name
UTRAN	UMTS Terrestrial radio access network
WebUI	Web User Interface