BTS3900A GSM

V100R012

Technical Description(II)

Issue 08

Date 2011-08-30

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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

About This Document

Purpose

This document describes the BTS3900A GSM in terms of its components, software and hardware structure, logical structure, configuration types, signal flow, clock synchronization modes, and topologies.

Product Version

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

Product Name	Product Version
BTS3900A GSM (hereinafter referred to as BTS3900A)	V100R012

Intended Audience

This document is intended for:

- Network planners
- Field engineers
- System engineers

Organization

1 Changes in the BTS3900A GSM Technical Description(II)

This section describes the changes in the *BTS3900A GSM Technical Description(II)*.

2 Components of the BTS3900A

The BTS3900A consists of the BBU3900, RFUs, APM30H(Ver.B)(hereinafter referred to as APM30H)/TMC11H cabinet, and RFC cabinet. The BBU3900 is installed in the APM30H/TMC11H cabinet, and the RFUs are installed in the RFC cabinet.

3 Logical Structure of the BTS3900A

The BTS3900A mainly consists of the BBU and RFUs. The logical structure of the BTS3900A consists of the RF subsystem, control subsystem, power subsystem, and antenna subsystem.

4 Monitoring System of the BTS3900A

The monitoring system of the BTS3900A implements power monitoring, fan monitoring, and environment monitoring.

5 Reference Clocks of the BTS3900/BTS3900A

The BTS3900/BTS3900A supports four types of reference clocks: IP clock, line clock, free-run clock, and external clock.

6 Signal Flow of the BTS3900/BTS3900A

The signal flow of the BTS3900/BTS3900A consists of the traffic signal flow and the signaling flow of the BTS. The BTS3900/BTS3900A signal flow is classified into the DL traffic signal flow, UL traffic signal flow, and signaling flow. The BTS3900/BTS3900A supports three types of transmission mode: TDM, HDLC, and IP.

7 Topologies of the BTS

The topologies of the BTS include the TDM networking, IP networking, and HDLC networking. In practice, these topologies can be combined. Optimum utilization of the topologies can improve the quality of service and lower the investment on the transmission equipment.

8 Surge Protection Specifications of the BTS3900A

This section describes the surge protection specifications of the BTS3900A. The surge protection specifications of the BTS3900A ports consist of the DC or AC power supply, antenna, signal, and dry contact alarms.

9 Configuration of the BTS3900/BTS3900A

This section describes the configuration principles of the BTS3900/BTS3900A, RF cable connections, and CPRI cable connections.

Conventions

Symbol Conventions

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

Symbol	Description
⚠ DANGER	Indicates a hazard with a high level of risk, which if not avoided, will result in death or serious injury.
⚠ WARNING	Indicates a hazard with a medium or low level of risk, which if not avoided, could result in minor or moderate injury.
⚠ CAUTION	Indicates a potentially hazardous situation, which if not avoided, could result in equipment damage, data loss, performance degradation, or unexpected results.

Symbol	Description
TIP	Indicates a tip that may help you solve a problem or save time.
NOTE	Provides additional information to emphasize or supplement important points of the main text.

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.

Command Conventions

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

<table>
<tr><th>Convention</th><th>Description</th></tr>
<tr><td>Boldface</td><td>The keywords of a command line are in boldface.</td></tr>
<tr><td>Italic</td><td>Command arguments are in italics.</td></tr>
<tr><td>[ ]</td><td>Items (keywords or arguments) in brackets [ ] are optional.</td></tr>
<tr><td>{ x | y | ... }</td><td>Optional items are grouped in braces and separated by vertical bars. One item is selected.</td></tr>
<tr><td>[x | y | ...]</td><td>Optional items are grouped in brackets and separated by vertical bars. One item is selected or no item is selected.</td></tr>
<tr><td>{ x | y | ... }*</td><td>Optional items are grouped in braces and separated by vertical bars. A minimum of one item or a maximum of all items can be selected.</td></tr>
<tr><td>[x | y | ...]*</td><td>Optional items are grouped in brackets and separated by vertical bars. Several items or no item can be selected.</td></tr>
</table>

GUI Conventions

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

Convention	Description
Boldface	Buttons, menus, parameters, tabs, window, and dialog titles are in **boldface**. For example, click **OK**.
>	Multi-level menus are in **boldface** and separated by the ">" signs. For example, choose **File** > **Create** > **Folder**.

Keyboard Operations

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

Format	Description
Key	Press the key. For example, press **Enter** and press **Tab**.
Key 1+**Key 2**	Press the keys concurrently. For example, pressing **Ctrl**+**Alt**+**A** means the three keys should be pressed concurrently.
Key 1, **Key 2**	Press the keys in turn. For example, pressing **Alt**, **A** means the two keys should be pressed in turn.

Mouse Operations

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

Action	Description
Click	Select and release the primary mouse button without moving the pointer.
Double-click	Press the primary mouse button twice continuously and quickly without moving the pointer.
Drag	Press and hold the primary mouse button and move the pointer to a certain position.

Contents

1 Changes in the BTS3900A GSM Technical Description(II)

This section describes the changes in the *BTS3900A GSM Technical Description(II)*.

08 (2011-08-30)

This is the seventh commercial release of V100R012.

Compared with issue 06 (2011-03-30), this issue does not include any new topics.

Compared with issue 06 (2011-03-30), this issue incorporates the following change:

Topic	Change Description
9.2 CPRI Cable Connections of the RFUs	Specifications of CPRI ports on the MRFU V1 and MRFU V2 are added.
9.4 Configurations of the GRFU and MRFU	Configuration of the MRFU is added.

Compared with issue 06 (2011-03-30), this issue does not exclude any topics.

07 (2011-03-30)

This is the sixth commercial release of V100R012.

Compared with issue 06 (2011-01-20), this issue includes the following new topic:

- **9.3 DRFU Configuration**
- GRFU Configuration

Compared with issue 06 (2011-01-20), this issue does not incorporate any changes.

Compared with issue 06 (2011-01-20), this issue excludes the following topics:

- RF Cable Connections of the DRFUs
- RF Cable Connections of the GRFUs

- RF Cable Connections for the Coexistence of the DRFUs and GRFUs

06 (2011-01-20)

This is the fifth commercial release of V100R012.

Compared with issue 05 (2010-11-30), this issue does not include any new topics.

Compared with issue 05 (2010-11-30), this issue incorporates the following change:

Topic	Change Description
CPRI Cable Connections of the RFUs	CPRI cable connections of the GRFUs are modified and specifications of CPRI ports are added.

Compared with issue 05 (2010-11-30), this issue does not exclude any topics.

05 (2010-11-30)

This is the fourth commercial release of V100R012.

Compared with issue 04 (2010-09-27), this issue does not include any new topics.

Compared with issue 04 (2010-09-27), this issue incorporates the following change:

Topic	Description
8 Surge Protection Specifications of the BTS3900A	Surge protection specifications are modified.

Compared with issue 04 (2010-09-27), this issue does not exclude any topics.

04 (2010-09-27)

This is the third commercial release of V100R012.

Compared with issue 03 (2010-07-30), this issue does not include any new topics.

Compared with issue 03 (2010-07-30), this issue incorporates the following change:

Topic	Description
About This Document	The version V300R012 is changed to V100R012.

Compared with issue 03 (2010-07-30), this issue does not exclude any topics.

03 (2010-07-30)

This is the second commercial release of V100R012.

Compared with issue 02 (2010-05-30), this issue does not include any new topics.

Compared with issue 02 (2010-05-30), this issue incorporates the following change:

Topic	Description
2 Components of the BTS3900A	The type of APM30H is specified.

Compared with issue 02 (2010-05-30), this issue does not exclude any topics.

02 (2010-05-30)

This is the first commercial release of V100R012.

Compared with issue 01 (2010-04-10), this issue does not include any new topics.

Compared with issue 01 (2010-04-10), this issue does not incorporate any changes.

Compared with issue 01 (2010-04-10), this issue does not exclude any topics.

01 (2010-04-10)

This is the draft release of V100R012.

Compared with issue 05 (2010-03-15) of the V300R009, this issue does not include any new topics.

Compared with issue 05 (2010-03-15) of the V300R009, this issue does not incorporate any changes.

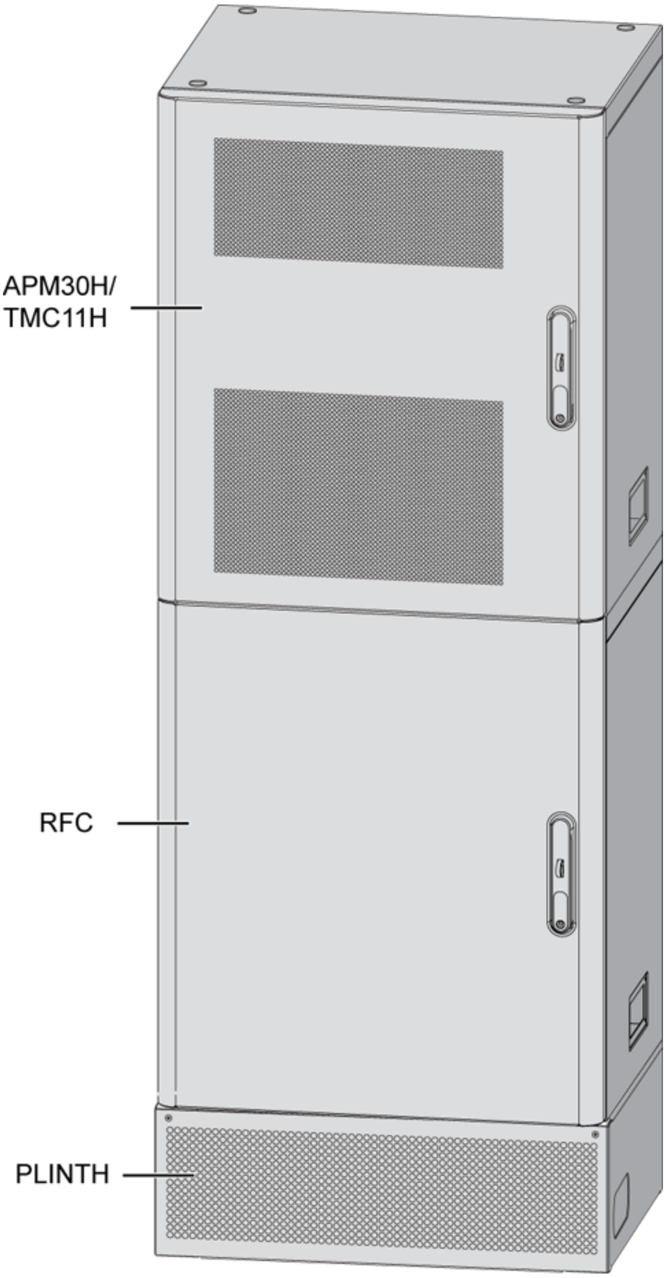
Compared with issue 05 (2010-03-15) of the V300R009, this issue does not exclude any topics.

2 Components of the BTS3900A

The BTS3900A consists of the BBU3900, RFUs, APM30H(Ver.B)(hereinafter referred to as APM30H)/TMC11H cabinet, and RFC cabinet. The BBU3900 is installed in the APM30H/TMC11H cabinet, and the RFUs are installed in the RFC cabinet.

Figure 2-1 shows the BTS3900A.

Figure 2-1 BTS3900A



The function modules of the BTS3900A are described as follows:

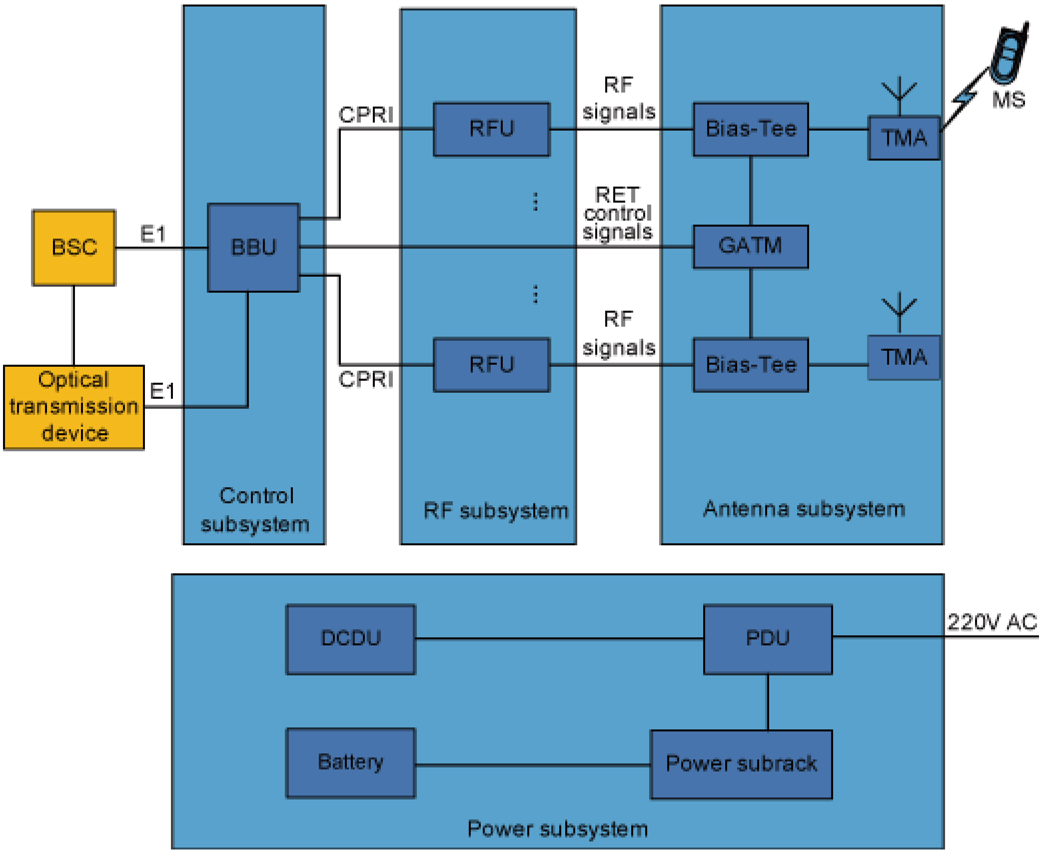
- The BBU3900 is a baseband processing unit that enables interaction between the BTS and the BSC.
- The RFU performs modulation, demodulation, data processing, and combining and dividing for baseband signals and RF signals. The RFU can be a DRFU or a GRFU. The DRFU supports two carriers while the GRFU supports more than two carriers.
- The APM30H/TMC11H cabinet houses the BBU3900 and the RFC cabinet houses the RFUs. In addition, the APM30H/TMC11H cabinet and the RFC cabinet provide functions such as power distribution, heat dissipation, and surge protection.

3 Logical Structure of the BTS3900A

The BTS3900A mainly consists of the BBU and RFUs. The logical structure of the BTS3900A consists of the RF subsystem, control subsystem, power subsystem, and antenna subsystem.

Figure 3-1 shows the logical structure of the BTS3900A.

Figure 3-1 Logical structure of the BTS3900A



The logical subsystems of the BTS3900A are described as follows:

- RF subsystem, implemented by the RFUs

- Control subsystem: implemented by the BBU
- Power subsystem, implemented by the following modules:
  - PDU
  - Power subrack
  - DCDU
  - Battery
- Antenna subsystem, implemented by the following modules:
  - Antenna
  - Bias-Tee
  - GATM
  - TMA

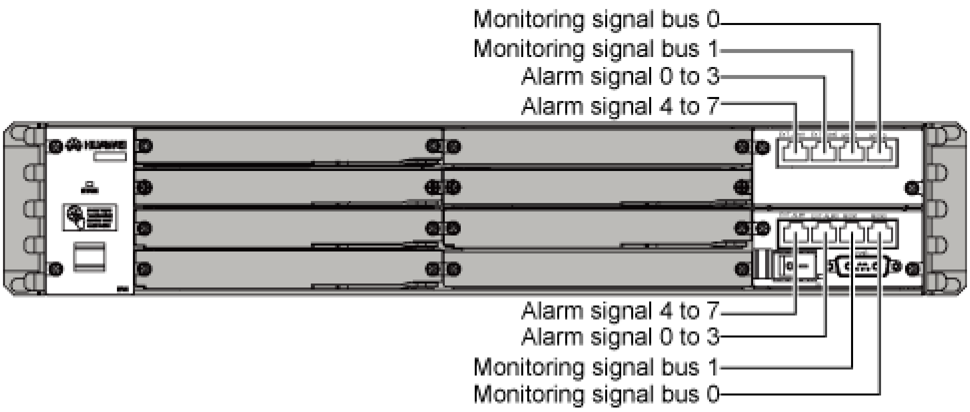
4 Monitoring System of the BTS3900A

The monitoring system of the BTS3900A implements power monitoring, fan monitoring, and environment monitoring.

Monitoring Ports on the BBU

Figure 4-1 shows the monitoring ports on the BBU.

Figure 4-1 Monitoring ports on the BBU

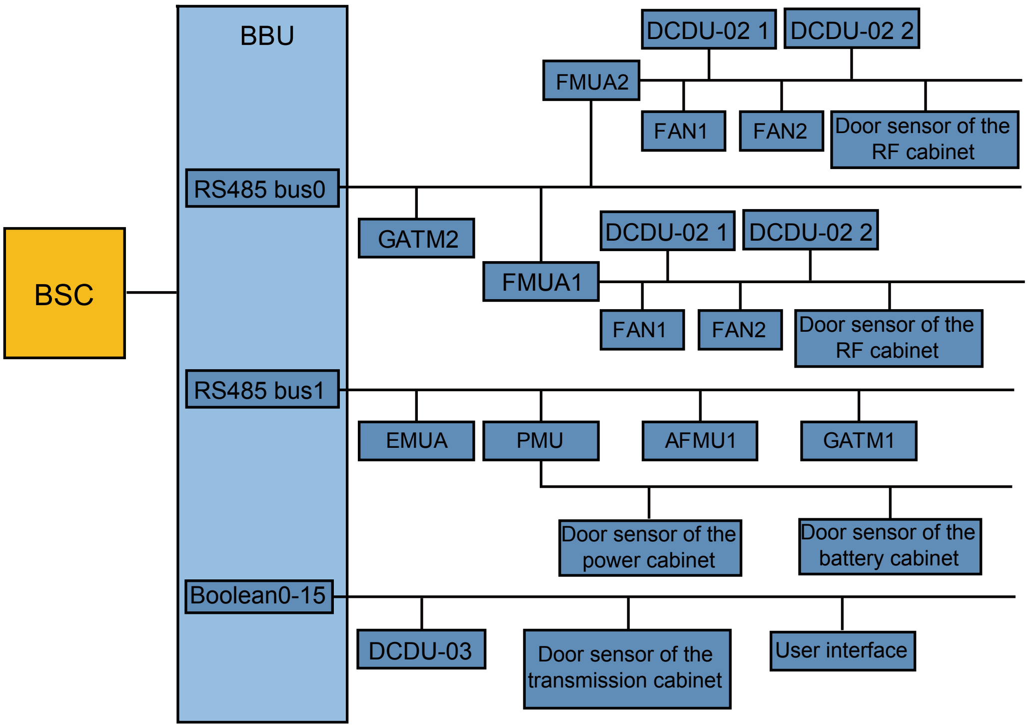


- The BBU can provide a maximum of 2 RS485 buses and 16 Boolean signal inputs.
- The modules connected to RS485 bus 0 cannot be connected to RS485 bus 1, and the modules connected to RS485 bus 1 cannot be connected to RS485 bus 0.
- If two PMUs are configured and the settings of their DIP switches are the same, the two PMUs cannot be connected to the same bus.

Components of the Monitoring System

Figure 4-2 shows the components of the monitoring system.

Figure 4-2 Components of the monitoring system



NOTE

RS485 bus 0 is indicated by bus0. RS485 bus 1 is indicated by bus1.

Table 4-1 describes the relationship between the monitoring modules or boards and the buses.

Table 4-1 Relationship between the monitoring modules or boards and the buses

Module or Board	Bus
FMUA (mandatory)	bus0
GATM2 (optional)	bus0
PMU (mandatory)	bus1
AFMU (mandatory)	bus1
GATM1 (optional)	bus1
EMUA (optional)	bus1

Functions of the Monitoring System

Table 4-2 describes the functions of the monitoring system.

Table 4-2 Functions of the monitoring system

Module or Board	Function
FAN	• Detects fan faults. • Adjusts the fan speed. • Detects the fan speed and temperature of the fans.
GATM	Reports alarms related to RET control signals.
EMUA	• Communicates with the BBU through the RS485 port, through which two RS485 signals are transmitted. • Detects the input voltage. • Provides ports for connections to the humidity and temperature sensor of 12 V DC/24 V DC current type. • Provides ports for detecting the input Boolean signals of dry contact type and of OC type. • Provides ports for six external Boolean outputs of relay node type.
PMU	• Communicates with the BBU through the RS232/RS422 serial port. • Manages the power system and battery charging and discharging. • Reports the detection results about water damage, smoke, door status, and customized Boolean values and also reports the ambient humidity and temperature, battery temperature, and customized analog values. • Detects power distribution and reports related alarms.
DCDU	Monitors the operating status of surge protection.

Module or Board	Function
FMUA	● Collects the alarm information about the intra-cabinet environment on the temperature, humidity, smoke, water damage, and door status. ● Collects the alarm information about the surge protection of the DCDU-02. ● Monitors the operating status of fans and adjusts the fan speed based on the temperature or under the control of the BBU. ● Stops the rotation of the fans when the ambient temperature is low. ● Detects the temperature and reports related alarms. ● Supports the cascading and extension of RS485 ports. ● Supports the cascading of FMUAs.

5 Reference Clocks of the BTS3900/BTS3900A

The BTS3900/BTS3900A supports four types of reference clocks: IP clock, line clock, free-run clock, and external clock.

IP Clock

The IP clock acts as the clock source of the BTS3900/BTS3900A, when the BTS uses the IP over FE transmission mode. The IP clock requires the configuration of the IP clock server in the network. The IP clock server carries the reference clock information in the UDP data packet, and then transmits the clock packets to the BTS. After receiving these clock packets, the BTS uses the clock signals interpreted from the packets.

Line Clock

The BBU3900 directly extracts the clock from the E1/T1 interface. Then, the BBU exports the precise 2 MHz and 8 kHz clocks after frequency division, phase locking, and phase adjustment. The 2 MHz and 8 kHz clocks are used for bit synchronization and frame synchronization in the BTS. The line clock consists of the trace BSC clock and trace transmission clock. The BTS extracts the clock signals from the BSC through the E1/T1 interface and uses them as the reference clock source. When the transmission mode of the BTS is upgraded from E1/T1 mode to IP mode, if there is no IP clock, the BTS extracts the clock signals from the transmission network through the E1/T1 interface and use them as the reference clock source.

Free-Run Clock

In the absence of external clocks, the internal free-run clock ensures that the BTS keeps working properly for at least 90 days.

External Clock

If the BBU3900 is configured with the USCU, the USCU can receive the external clock signals for the GTMU. The USCU supports clock signals including the GPS clock signal, RGPS clock signal, and BITS clock signal.

6 Signal Flow of the BTS3900/BTS3900A

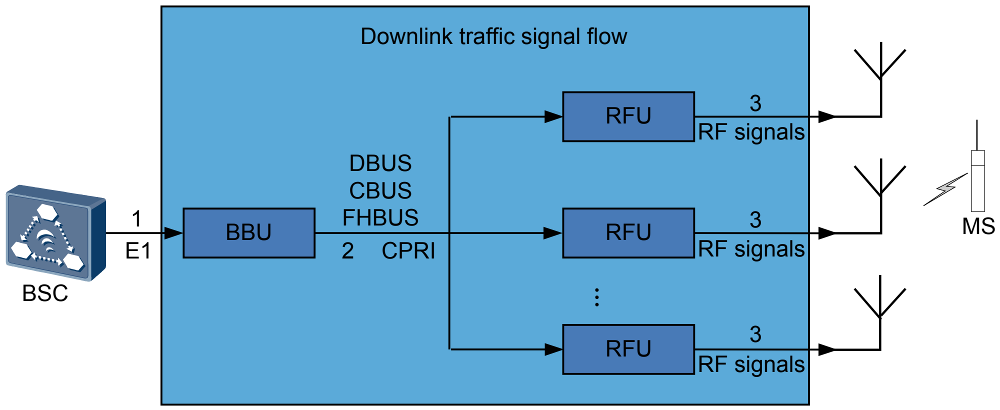
The signal flow of the BTS3900/BTS3900A consists of the traffic signal flow and the signaling flow of the BTS. The BTS3900/BTS3900A signal flow is classified into the DL traffic signal flow, UL traffic signal flow, and signaling flow. The BTS3900/BTS3900A supports three types of transmission mode: TDM, HDLC, and IP.

TDM Transmission

DL Traffic Signal Flow

The DL traffic signal flow is transmitted from the BSC to the MS through the BTS3900/ BTS3900A. In the BTS3900/BTS3900A, the BBU and RFUs work together to process the DL traffic signals. **Figure 6-1** shows the DL traffic signal flow.

Figure 6-1 DL traffic signal flow



The DL traffic signal flow is as follows:

1. The E1 signals from the BSC are transmitted to the BBU through the E1 cable.
2. After receiving the E1 signals, the BBU processes the E1 signals as follows:
   (1) Extracts clock signals from the E1 signals
   (2) Configures the BTS system based on the data configuration on the OML

(3) Encapsulates the E1 data in the format of the CPRI frame, and then transmits the data to the RFU through the CPRI signal cable

3. After receiving the signals, the RFU processes them as follows:

   (1) Decapsulates the high-speed CPRI frames to obtain the baseband signals

   (2) Transmits the baseband signals to the relevant operation units for encryption and interleaving

   (3) Converts the digital signals into the analog signals and modulates the analog signals into RF signals

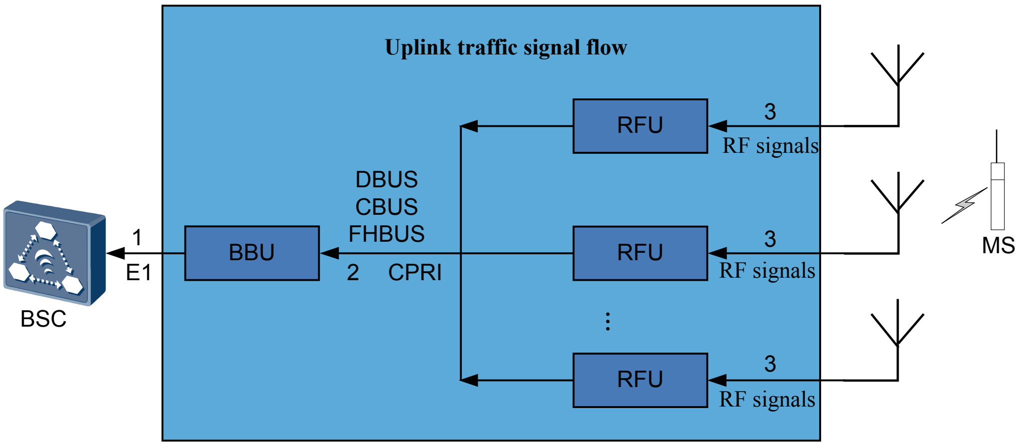
   (4) Combines or divides the RF signals based on its own configuration

   (5) Transmits the combined or divided signals through the feeder and antenna

UL Traffic Signal Flow

Compared to the DL traffic signal flow, the UL traffic signal flow is transmitted from the MS to the BSC through the BTS3900/BTS3900A. In the BTS3900/BTS3900A, the BBU and RFUs work together to process the UL traffic signals. **Figure 6-2** shows the UL traffic signal flow.

Figure 6-2 UL traffic signal flow



The UL traffic signal flow is as follows:

1. The antenna receives the signals sent from the MS. If the TMA is configured, the received signals are amplified by the TMA and then transmitted to the RFU through the feeder.
2. After receiving the UL signals, the RFU processes the signals as follows:

   (1) Divides the UL signals from the antenna or diversity RX port

   (2) Converts the divided analog signals into the digital signals to obtain the baseband signals

   (3) Transmits the baseband signals to the relevant operation units for decryption and de-interleaving

   (4) Encapsulates the processed data in the format of the CPRI frame, and then transmits the data to the BBU through the CPRI signal cable

3. After receiving the signals, the BBU processes the signals as follows:

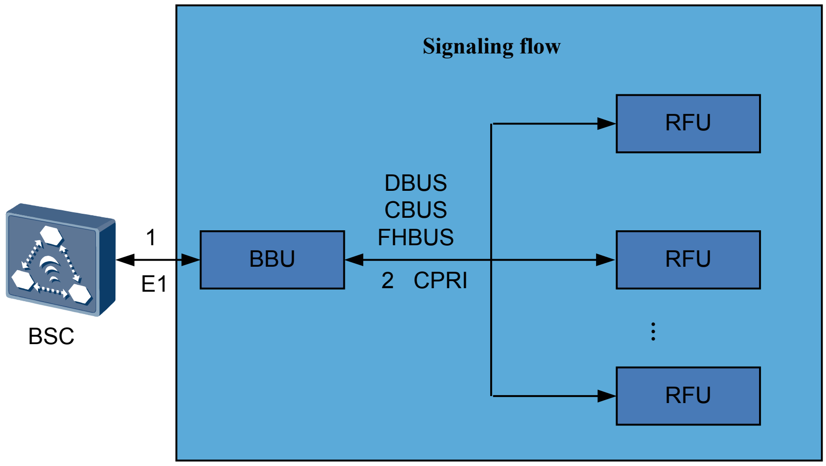
   (1) Decapsulates the high-speed CPRI frames to obtain the baseband signals

(2) Encapsulates the baseband signals in the format of the E1 frame, and then transmits the signals to the BSC through the E1 cable

Signaling Flow

The BTS3900/BTS3900A signaling flow refers to the signaling on the Abis interface. The BBU serves as the control unit and works with the RFUs to process the signaling. **Figure 6-3** shows the signaling flow.

Figure 6-3 Signaling flow



The signaling flow is as follows:

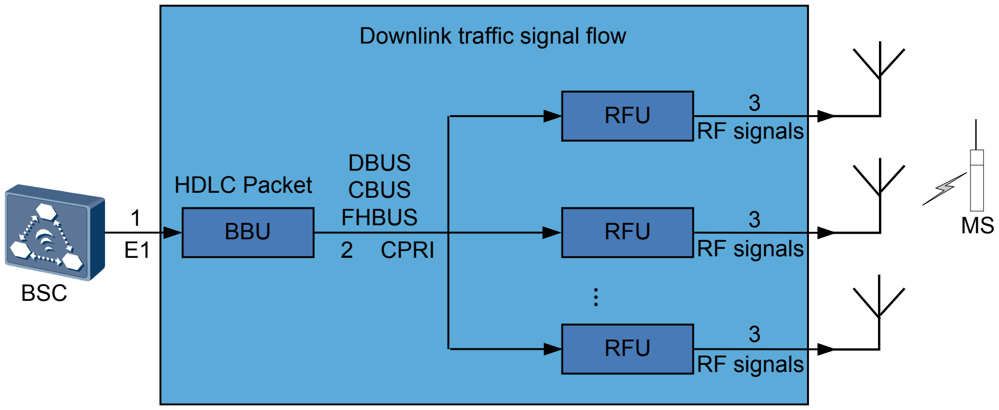
1. The signaling data received from the BSC is transmitted to the BBU through the Abis interface.
2. The BBU encapsulates the signaling data in the format of the CPRI frame, and then transmits the signaling data to the RFU through the CPRI signal cable.
3. The RFU decapsulates the CPRI signals into the baseband signals, and then transmits the baseband signals to the relevant operation units for processing.
4. The RFU encapsulates the data of its own status in the format of the CPRI frame, and then transmits the data to the BBU through the CPRI signal cable.
5. The BBU decapsulates the received CPRI signals to obtain the baseband signals.
6. The BBU analyzes and processes the baseband signals to obtain the BTS status, and then sends the status data to the BSC on the Abis interface.

HDLC Transmission

DL Traffic Signal Flow

The DL traffic signal flow is transmitted from the BSC to the MS through the BTS3900/BTS3900A. In the BTS3900/BTS3900A, the BBU and RFUs work together to process the DL traffic signals. **Figure 6-4** shows the DL traffic signal flow.

Figure 6-4 DL traffic signal flow



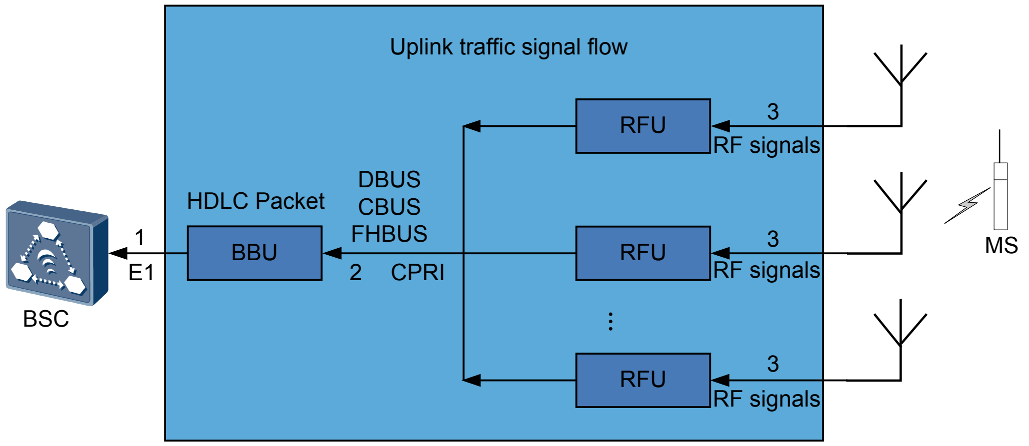
The DL traffic signal flow is as follows:

1. The BSC encapsulates the service data in the format of the HDLC data packet, and then transmits the data to the BBU through the E1 cable.
2. After receiving the E1 signals, the BBU processes the E1 signals as follows:
   (1) Extracts the clock signals from the E1 signal
   (2) Resolves the data packet in the HDLC format from the E1 timeslot signals bound to the HDLC channel, and then configures the BTS system based on the ESL and OML data resolved from the data packet
   (3) Encapsulates the HDLC service data in the format of the CPRI frame, and then transmits the data to the RFU through the CPRI signal cable
3. After receiving the signals, the RFU processes the signals as follows:
   (1) Decapsulates the high-speed CPRI frames and HDLC packets to obtain the baseband signals
   (2) Transmits the baseband signals to the relevant operation units for encryption and interleaving
   (3) Converts the digital signals into the analog signals and modulates the analog signals into RF signals
   (4) Combines or divides the RF signals based on its own configuration
   (5) Transmits the combined or divided signals through the feeder and antenna

UL Traffic Signal Flow

Compared to the DL traffic signal flow, the UL traffic signal flow is transmitted from the MS to the BSC through the BTS3900/BTS3900A. In the BTS3900/BTS3900A, the BBU and RFUs work together to process the UL traffic signals. Figure 6-5 shows the UL traffic signal flow.

Figure 6-5 UL traffic signal flow



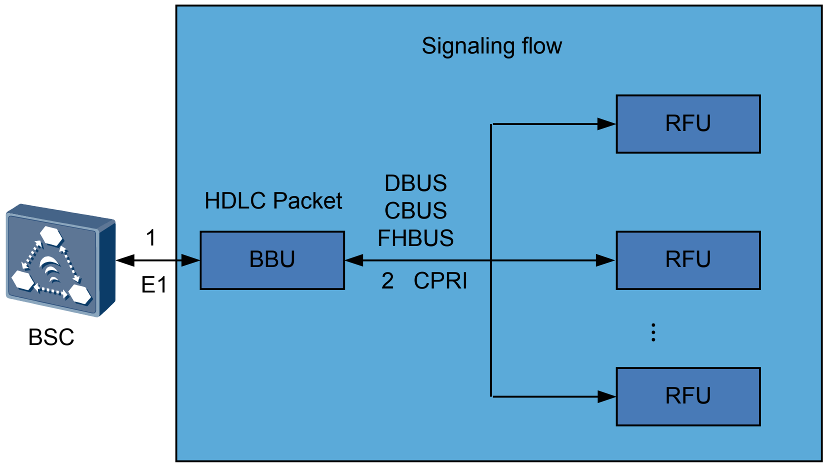
The UL traffic signal flow is as follows:

1. The antenna receives the signals sent from the MS. If the TMA is configured, the received signals are amplified by the TMA and then transmitted to the RFU through the feeder.
2. After receiving the UL signals, the RFU processes the signals as follows:
   (1) Divides the UL signals from the antenna or diversity RX port
   (2) Converts the divided analog signals into the digital signals to obtain the baseband signals
   (3) Transmits the baseband signals to the relevant operation units for decryption and de-interleaving
   (4) Encapsulates the processed signal in the format of the CPRI frame, and then transmits the signal to the BBU through the CPRI signal cable
3. After receiving the signals, the BBU processes the signals as follows:
   (1) Decapsulates the high-speed CPRI frames to obtain the data in the format of the HDLC frame
   (2) Finds the HDLC transmission channel corresponding to this HDLC data packet, and then transmits the data in the format of the E1 frame to the BSC through the E1 cable

Signaling Flow

The BTS3900/BTS3900A signaling flow refers to the signaling on the Abis interface. The BBU serves as the control unit and works with the RFUs to process the signaling. **Figure 6-6** shows the signal flow of signaling processing.

Figure 6-6 Signaling flow of signaling processing



The signaling flow is as follows:

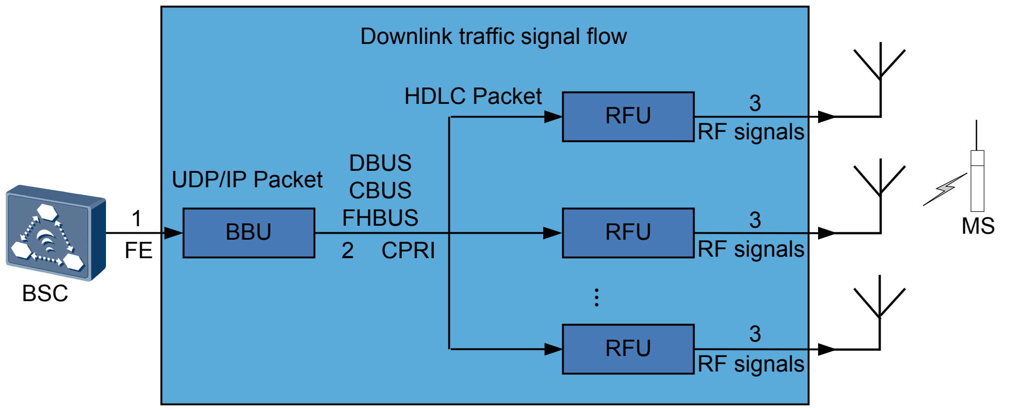
1. The BBU receives the signaling data from the BSC through the E1 cable.
2. The BBU receives the relevant signaling data and processes the signaling data as required.
3. The BBU encapsulates the signaling data to be processed by the RFU in the format of the CPRI frame, and then transmits the signaling data to the RFU through the CPRI signal cable.
4. The RFU decapsulates the received CPRI signals and processes the signals as required.
5. The RFU encapsulates the data of its own status in the format of the CPRI frame, and then transmits the data to the BBU through the CPRI signal cable.
6. The BBU decapsulates the received CPRI signals to obtain the data of the RFU status.
7. The BBU analyzes and processes the baseband signals to obtain the BTS status, and then sends the status data to the BSC on the Abis interface.

IP Transmission

DL Traffic Signal Flow

The DL traffic signal flow is transmitted from the BSC to the MS through the BTS3900/ BTS3900A. In the BTS3900/BTS3900A, the BBU and RFUs work together to process the DL traffic signals. **Figure 6-7** shows the DL traffic signal flow.

Figure 6-7 DL traffic signal flow



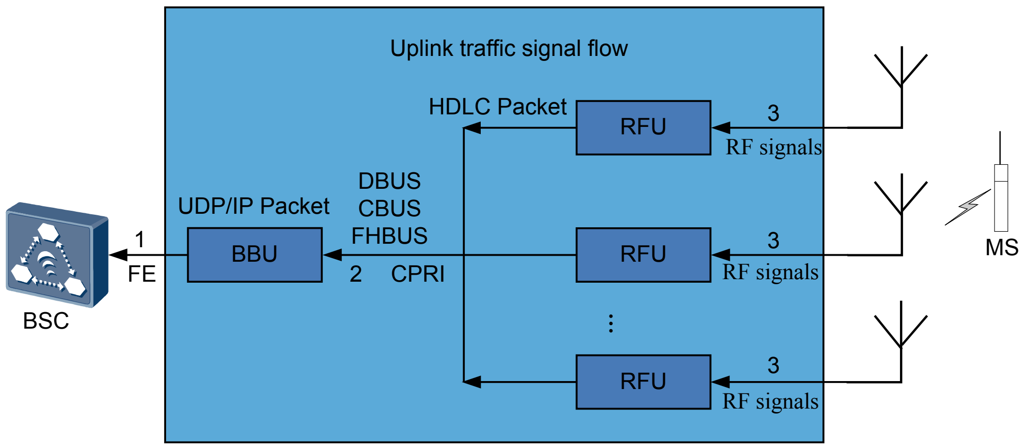
The DL traffic signal flow is as follows:

1. The BSC encapsulates the service data in the UDP payload, and then transmits the IP packet to the BBU through FE transmission.
2. After receiving the IP packet, the BBU processes the packet as follows:
   (1) If the current clock mode is configured to the IP clock, the clock packet is identified from the IP packet. The clock information is resolved from the clock packet for clock synchronization.
   (2) Identifies the packet on the ESL and OML, and configures the BTS system based on the resolved data.
   (3) Identifies the service packet and deletes the UDP/IP header of the service packet. Encapsulates the service data in HDLC format and transmits the data to the RFU in the format of the CPRI frame.
3. After receiving the signals, the RFU processes the signals as follows:
   (1) Decapsulates the high-speed CPRI frames and HDLC packets to obtain the baseband signals
   (2) Transmits the baseband signals to the relevant operation units for encryption and interleaving
   (3) Converts the digital signals into the analog signals and modulates the analog signals into RF signals
   (4) Combines or divides the RF signals based on its own configuration
   (5) Transmits the combined or divided signals through the feeder and antenna

UL Traffic Signal Flow

Compared to the DL traffic signal flow, the UL traffic signal flow is transmitted from the MS to the BSC through the BTS3900/BTS3900A. In the BTS3900/BTS3900A, the BBU and RFUs work together to process the UL traffic signals. **Figure 6-8** shows the UL traffic signal flow.

Figure 6-8 UL traffic signal flow



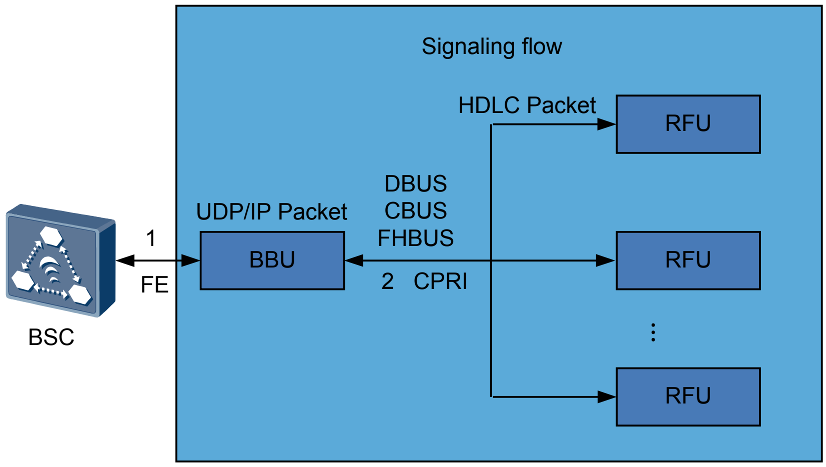
The UL traffic signal flow is as follows:

1. The antenna receives the signals sent from the MS. If the TMA is configured, the received signals are amplified by the TMA and then transmitted to the RFU through the feeder.
2. After receiving the UL signals, the RFU processes the signals as follows:
   (1) Divides the UL signals from the antenna or diversity RX port
   (2) Converts the divided analog signals into the digital signals to obtain the baseband signals
   (3) Transmits the baseband signals to the relevant operation units for decryption and de-interleaving
   (4) Encapsulates the processed signal in the format of the HDLC frame and then in the format of the CPRI frame, and then transmits the signal to the BBU through the CPRI signal cable
3. After receiving the signals, the BBU processes the signals as follows:
   (1) Decapsulates the high-speed CPRI frames to obtain the data in the format of the HDLC frame
   (2) Obtains the UDP/IP header information corresponding to the HDLC data packet in the configuration data, and then encapsulates the HDLC frame payload in the UDP/IP format. Then, the BBU checks the ARP table, finds the destination MAC address, encapsulates the packets in the MAC format, and transmits the packets to the BSC through FE transmission.

Signaling Flow

The BTS3900/BTS3900A signaling flow refers to the signaling on the Abis interface. The BBU serves as the control unit and works with the RFUs to process the signaling. **Figure 6-9** shows the signal flow of signaling processing.

Figure 6-9 Signaling flow of signaling processing



The signaling flow is as follows:

1. The BBU receives the signaling data encapsulated in the UDP/IP format from the BSC through FE transmission.
2. After decapsulating the signaling data, the BBU receives the relevant signaling data and processes the data as required.

3. The BBU encapsulates the signaling data to be processed by the RFU in the format of the CPRI frame, and then transmits the signaling data to the RFU through the CPRI signal cable.
4. The RFU decapsulates the received CPRI signals and processes the signals as required.
5. The RFU encapsulates the data of its own status in the format of the CPRI frame, and then transmits the data to the BBU through the CPRI signal cable.
6. The BBU decapsulates the received CPRI signals to obtain the data of the RFU status.
7. The BBU analyzes and processes the baseband signals to obtain the BTS status, and then sends the status data encapsulated in the UDP/IP format to the BSC through FE transmission.

7 Topologies of the BTS

The topologies of the BTS include the TDM networking, IP networking, and HDLC networking. In practice, these topologies can be combined. Optimum utilization of the topologies can improve the quality of service and lower the investment on the transmission equipment.

TDM Networking

The E1/T1 transmission is used between the BSC and the BTS, and the TDM transmission is used on the Abis interface. The TDM networking can be classified into the star topology, chain topology, tree topology, and ring topology.

Figure 7-1 shows the star topology.

Figure 7-1 Star topology

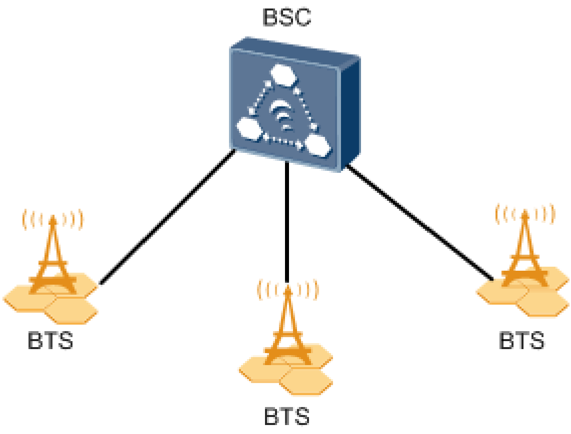


Figure 7-2 shows the chain topology.

Figure 7-2 Chain topology

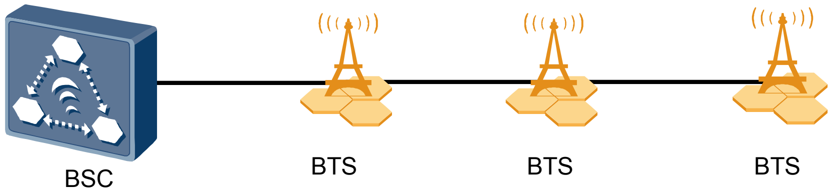


Figure 7-3 shows the tree topology.

Figure 7-3 Tree topology

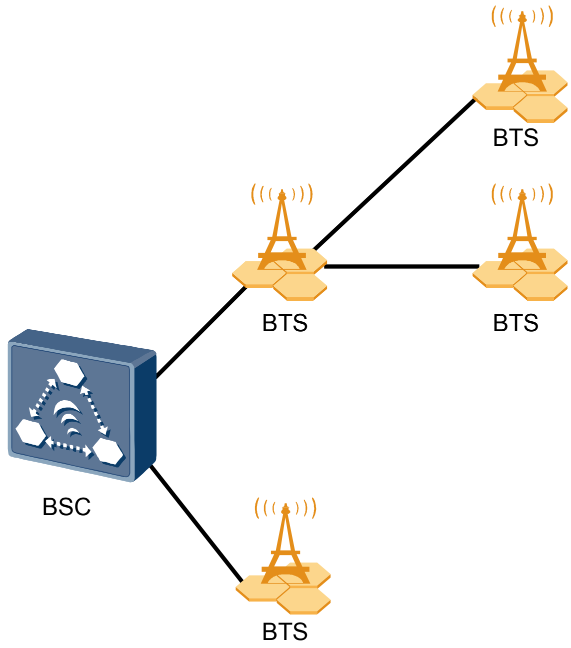


Figure 7-4 shows the ring topology.

Figure 7-4 Ring topology

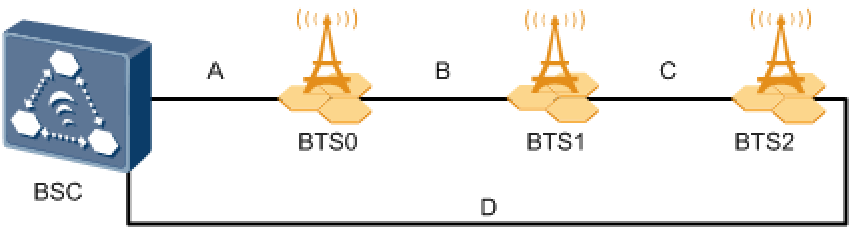
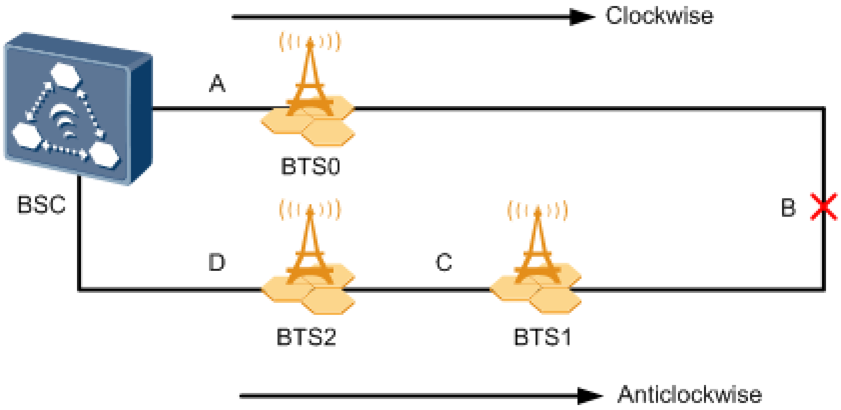


Table 7-1 compares the topology.

Table 7-1 Comparison of topologies

Topology	Application Scenario	Advantage
Star topology	Applies to common areas, especially densely populated areas, such as cities.	● Simple networking ● Easy engineering construction ● Convenient maintenance ● Flexible capacity expansion ● High network reliability
Chain topology	Applies to sparsely populated areas in strip-like terrain, such as areas along highways and railway tracks.	Reduces costs in transmission equipment, construction, and transmission link lease.
Tree topology	Applies to areas where network structures, site distribution, and subscriber distribution are complicated, for example, an area where large-scale coverage overlaps hot spot or small-scale coverage.	Requires fewer transmission cables compared with the star topology.
Ring topology	Applies to common scenarios. Due to its strong self-healing capability, the ring topology is preferred, if permitted by the routing.	If there is a breaking point in the ring, the ring breaks into two chains at the breaking point automatically. In this way, the BTSs preceding and following the breaking point can work normally despite the breaking point, thus improving the robustness of the system. For example, BTS0, BTS1, and BTS2 are sequentially connected to form a ring (clockwise). When a failure occurs at B, BTS0, the BTS topology preceding B, remains unchanged, and BTS2 and BTS1, the BTSs following B form a chain (anticlockwise), as shown in **Figure 7-5**.

Figure 7-5 Regrouping for disconnection in the ring topology



IP Networking

The FE transmission is used between the BSC and the BTS, and the IP transmission is used on the Abis interface. The IP networking consists of the layer-2 networking topology and layer-3 networking topology.

Figure 7-6 shows the layer-2 networking topology.

Figure 7-6 Layer-2 networking topology

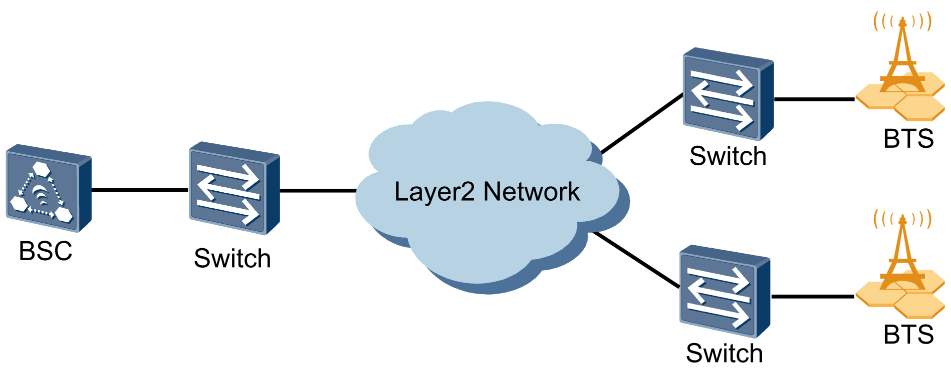
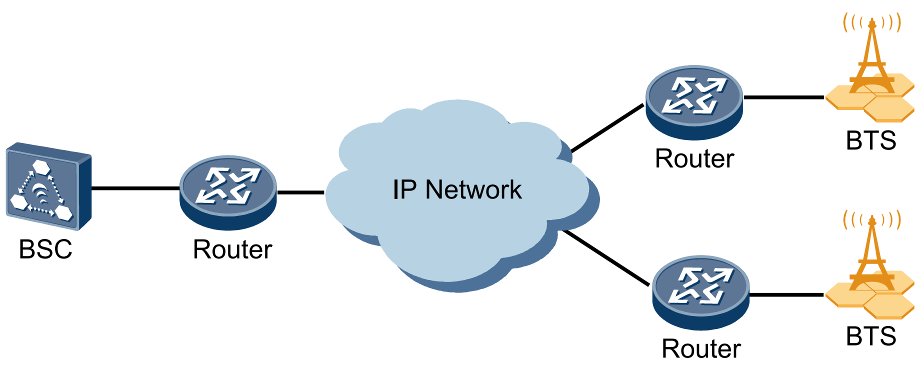


Figure 7-7 shows the layer-3 networking topology.

Figure 7-7 Layer-3 networking topology



HDLC Networking

The E1/T1 transmission is used between the BSC and the BTS, and the HDLC transmission is used on the Abis interface. The HDLC networking can be classified into the star topology, chain topology, and ring topology.

Figure 7-8 shows the star topology.

Figure 7-8 Star topology

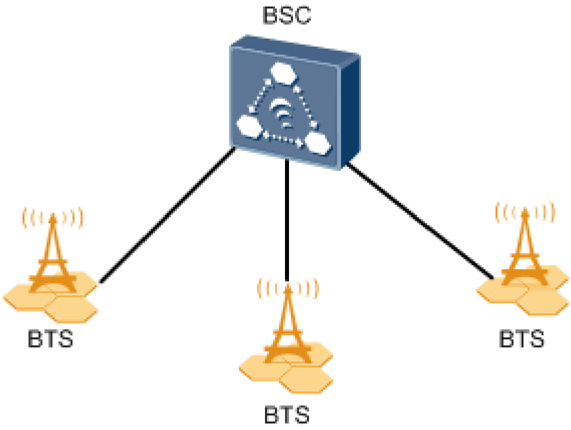


Figure 7-9 shows the chain topology. The upper-level BTS transparently transmits the signals of the lower-level BTS.

Figure 7-9 Chain topology

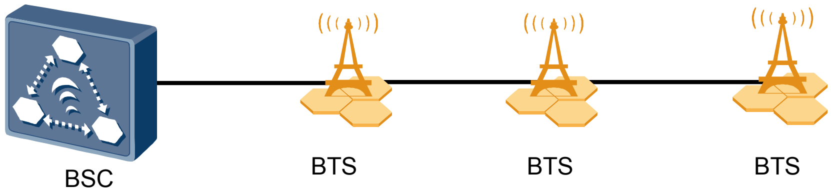
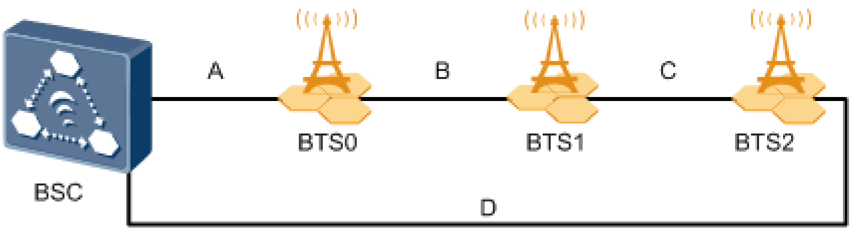


Figure 7-10 shows the ring topology.

Figure 7-10 Ring topology



8 Surge Protection Specifications of the BTS3900A

This section describes the surge protection specifications of the BTS3900A. The surge protection specifications of the BTS3900A ports consist of the DC or AC power supply, antenna, signal, and dry contact alarms.

NOTE

- Unless otherwise specified, the surge protection specifications depend on the surge waveform of 8/20 μs.
- All the discharge current items, unless otherwise specified as maximum discharge current, refer to nominal discharge current.

Table 8-1 Surge protection specifications of the BTS3900A

Port	Surge Protection Mode	Surge Current
DC power port	Differential mode	10 kA
	Common mode	20 kA
AC power port	Differential mode	40 kA
	Common mode	40 kA
Antenna port	Differential mode	8 kA
	Common mode	40 kA
Dry contact port, RS485 port	Differential mode	3 kA
	Common mode	5 kA
E1/T1 port	Differential mode	3 kA
	Common mode	5 kA
RET antenna	Differential mode	3 kA
	Common mode	5 kA

9 Configuration of the BTS3900/BTS3900A

About This Chapter

This section describes the configuration principles of the BTS3900/BTS3900A, RF cable connections, and CPRI cable connections.

9.1 BTS3900/BTS3900A Configuration Principles
The BTS3900/BTS3900A is configured with the antenna system, RFUs, and BBU.

9.2 CPRI Cable Connections of the RFUs
The RFUs support star and chain topologies.

9.3 DRFU Configuration
The DRFU is a double-transceiver module and supports two carriers. Different configurations must be chosen in different topologies.

9.4 Configurations of the GRFU and MRFU
The GRFU and MRFU are multi-carrier radio frequency (RF) modules. Each of them supports six carriers. Different configurations must be chosen in different topologies.

9.1 BTS3900/BTS3900A Configuration Principles

The BTS3900/BTS3900A is configured with the antenna system, RFUs, and BBU.

Basic Configuration Principles

- If multiple hardware configurations meet the requirements for the RNP parameter settings, the configuration mode that supports smooth upgrades is preferred.
- The DRFU is applicable to small- and middle-capacity scenarios; the GRFU is applicable to large-capacity scenarios. The DRFU and GRFU can be configured in the same cabinet or cell to support flexible capacity expansion.
- Wide coverage is preferred. The DRFU supports the PBT, TX diversity, and 4-way RX diversity mode. Therefore, the DRFU can be applied to wide-coverage scenarios.

Antenna Configuration Principles

- One dual-polarized antenna can serve a maximum of two RFUs.
- By default, RX diversity is adopted on the GSM network. That is, two feeders connected to two single-polarized antennas or one dual-polarized antenna must be configured in a cell.
- Each sector of the BTS must be configured with the minimum number of antennas.
- For the 2-way RX diversity, each sector has two antenna channels; for the 4-way RX diversity, each sector has four antenna channels.

RF Configuration Principles

Table 9-1 describes the RF configuration principles of the BTS3900.

Table 9-1 RF configuration principles of the BTS3900

Principle	Description	Example
Configuration principles of the DRFU ports	● ANT1 and ANT2 are the TX ports of the duplexer. They are connected to jumpers. ● Rx1 in, Rx1 out, Rx2 in, and Rx2 out are the ports for signals between interconnected DRFUs. When two carriers provided by a DRFU belong to the same cell, both Rx1 in and Rx2 in can be the input ports for RX diversity of the two carriers. When two carriers provided by a DRFU belong to different cells, Rx1 in is the input port for RX diversity of carrier 1; Rx2 in is the input port for RX diversity of carrier 2. ● CPRI_0 and CPRI_1 are the ports for high-speed electrical cables. The CPRI_1 port is connected to the CPRI port on the BBU or to the upper-level RFU in the case of cascaded RFUs. The CPRI_0 port is connected to the lower-level RFU in the case of cascaded RFUs.	In S3/3 configuration, three DRFUs need to be configured. The carriers provided by the middle DRFU belong to different cells. That is, the Rx1 in port on the middle DRFU is the input port for RX diversity of carrier 1, which belongs to the first cell. The input port for RX main of carrier 1 is ANT1. The Rx2 in port is the input port for RX diversity of carrier 2, which belongs to the second cell. The input port for RX main of carrier 2 is ANT2.

Principle	Description	Example
Configuration principles of the GRFU ports	● The ANT_TX/RXA port supports signal reception and transmission, and the ANT_RXB port supports signal reception. They are connected to jumpers. ● RX_INB and RX_OUTA are the ports for signals between interconnected GRFUs. ● CPRI_0 and CPRI_1 are the ports for high-speed electrical cables. The CPRI_0 port is connected to the CPRI port on the BBU or to the upper-level RFU in the case of cascaded RFUs. The CPRI_1 port is connected to the lower-level RFU in the case of cascaded RFUs.	-
Configuration principles of a single cabinet	● Star topology is adopted between the BBU and RFUs. The RFUs and the high-speed CPRI ports on the BBU have a one-to-one relationship. That is, if slot 1 on the RFU is idle, CPRI port 1 on the BBU is also idle. ● When the DRFU is configured, the maximum cell configuration of a single cabinet is S4/4/4. When the GRFU is configured, the maximum cell configuration of a single cabinet is S12/12/12.	-
Configuration principles of multiple cabinets	When star and chain topology is adopted between the BBU and RFUs, the RFU supports 3 levels of cascading in a chain and thus the BBU supports a maximum of 18 (6 x 3) RFUs.	-

Principle	Description	Example
Two TRXs of one DRFU configured in one sector	● A single DRFU does not support the S1/1 application; however, three DRFUs support the S3/3 application. ● When the DRFU works in TX PBT, TX diversity, or 4-way RX diversity mode, a DRFU provides only one TRX. Therefore, you can configure the DRFU as required.	For example, for a site in S5/4/7 cell configuration, nine DRFUs are installed to meet the requirements of S6/4/8 cell configuration, but data configuration is still performed on the basis of the S5/4/7 cell configuration.
Number of DRFUs	● When the number of TRXs of the site is less than 12, an odd number of TRXs can be configured for a cell. Number of DRFUs = round up [(number of TRXs + number of S1 cells) / 2] ● When the number of TRXs of the site is greater than 12, an even number of TRXs should be configured for a cell. Number of DRFUs = round up (number of TRXs after two TRXs are configured in one sector / 2)	● S3/3/3: Number of DRFUs = round up (9 / 2) = 5; S1/2/3: Number of DRFUs = round up [(6 + 1) / 2] = 4. ● After two TRXs are configured in one sector, the S5/5/5 configuration is S6/6/6. Number of DRFUs = (6 + 6 + 6) / 2 = 9.
Number of GRFUs	● If RAN Sharing is implemented, one GRFU can serve two cells. ● If RAN Sharing is not implemented, one GRFU does not serve two cells. Each cell with a single antenna can be configured with a maximum of two GRFUs.	-

Principle	Description	Example
DRFU TRX allocation in double-antenna-system mode	After TRX allocation, the cells with an odd number of TRXs become neighboring cells of each other. ● S5 = S3 + S2 or S5 = S2 + S3 ● S6 = S4 + S2 or S6 = S3 + S3 ● S7 = S4 + S3 or S7 = S3 + S4 ● S8 = S4 + S4	● In S3/5/4 configuration, S5 can be divided into S3 + S2. Then, the cell configuration becomes S3/(3/2)/4. ● In S2/5/5 configuration, the first S5 is divided into S2 + S3; the second S5 is divided into S3 + S2. Then, the cell configuration becomes S2/(2/3)/(3/2).

Principle	Description	Example
DRFUs at two bands configured in a site	● If the number of DRFUs is not more than 6 in a double-band site, the DRFUs at two bands are configured in the same cabinet. If the RF cabinet is configured with less than three 900 MHz DRFUs and three 1800 MHz DRFUs, the 900 MHz DRFUs are installed in of the three slots on the left of the RF cabinet, and the 1800 MHz DRFUs are installed in the three slots on the right of the RF cabinet. ● When two RF cabinets are configured and the number of DRFUs at each band is not more than six, the 900 MHz DRFUs are installed in the first RF cabinet and the 1800 MHz DRFUs are installed in the second RF cabinet. The DRFUs are installed in the slots according to the typical S4/4/4 configuration. When two RF cabinets are configured and the number of DRFUs at one band (for example, 900 MHz) is greater than six, other DRFUs at this band share the other RF cabinet with the DRFUs at the other band (for example, 1800 MHz). The mixed configuration of DRFUs at two bands is not allowed.	-

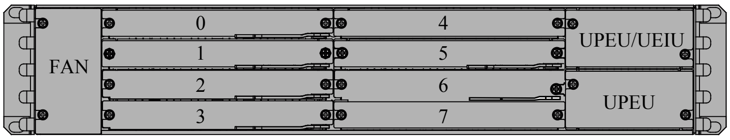
NOTE

In the mode of configuring two TRXs in one sector, a DRFU belongs to only one sector.

BBU Configuration Principles

- A BBU has 6 CPRI ports.
- **Figure 9-1** shows the BBU slots.

Figure 9-1 BBU slots



- **Table 9-2** describes the board configuration principles of the BBU.

Table 9-2 Board configuration principles of the BBU

Module or Board	Description
UBFA	One UBFA must be configured.
UPEU	● One UPEU must be configured. ● A second UPEU can be configured when the backup power is required.
UEIU	The UEIU is optional and a maximum of one UEIU can be configured.
GTMU	● One GTMU must be configured. ● The GTMU is installed in slot 5 and slot 6.
USCU	● The USCU is optional and a maximum of one USCU can be configured. ● The USCU is installed in slot 1 or slot 0.
UTRP	● The UTRP is optional and a maximum of one USCU can be configured. ● The UTRP is installed in slot 0 or 4, preferentially installed in the slot 4.

9.2 CPRI Cable Connections of the RFUs

The RFUs support star and chain topologies.

Figure 9-2 shows the typical topologies of the DRFUs.

NOTE

The DRFU is categorized into the DRFU GSM900 and DRFU GSM1800. The cable connections of the two types are the same. This section takes the DRFU GSM900 as an example.

Figure 9-2 Typical topologies of the DRFUs

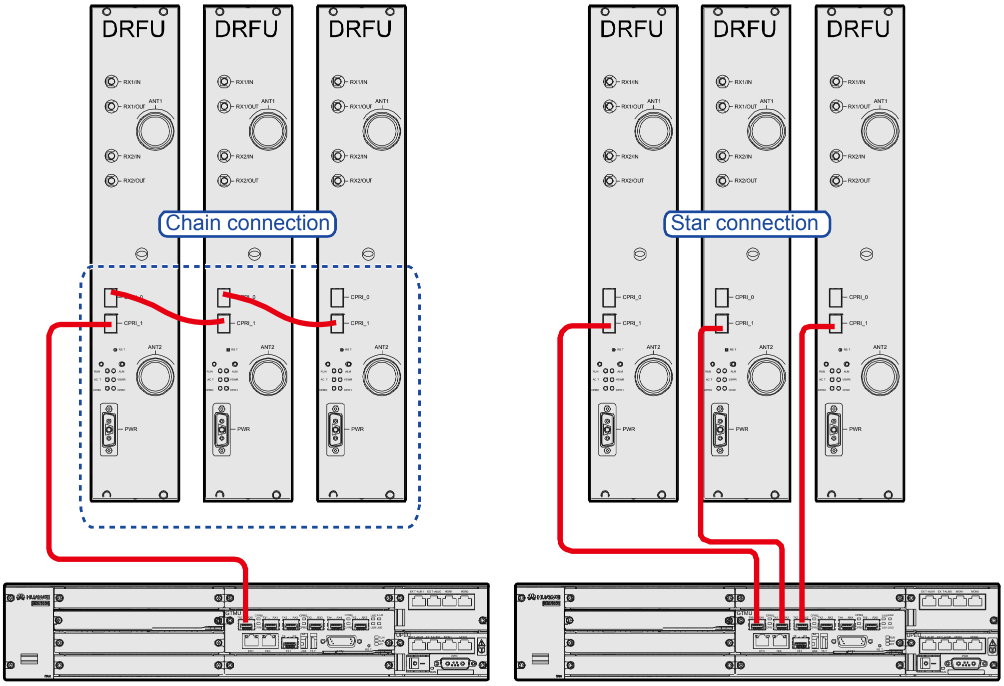


Figure 9-3 shows the typical topologies of the GRFUs.

Figure 9-3 Typical topologies of the GRFUs

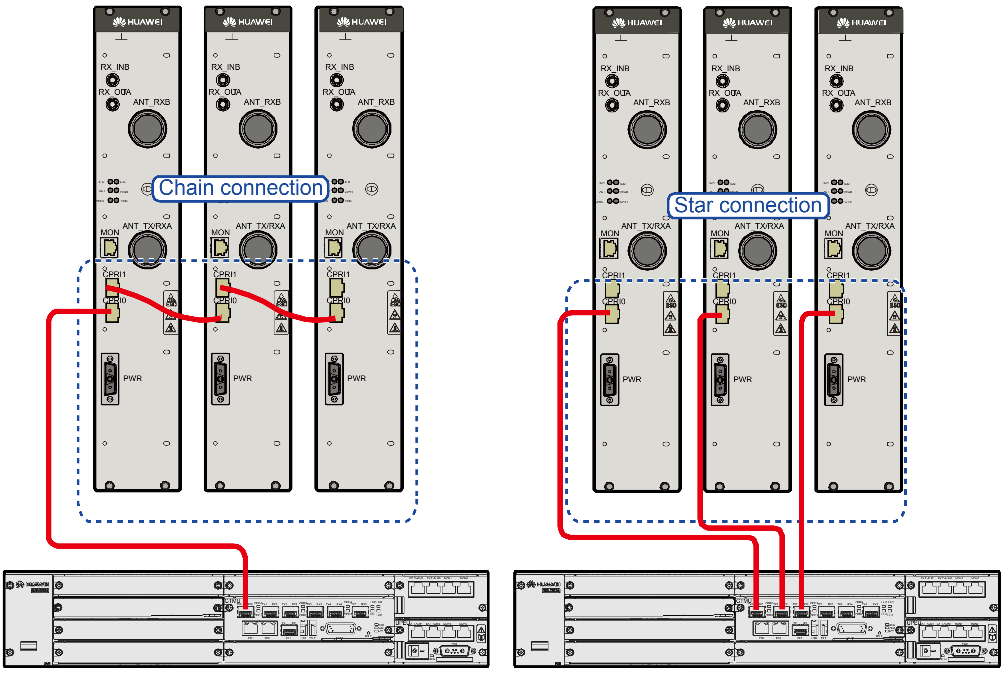


Table 9-3 describes the two typical topologies.

Table 9-3 Two typical topologies

Topology	Application Scenario
Star	Minimum configurations
Chain	Maximum configurations

Table 9-4 provides the specifications of CPRI ports on the GTMU, DRFU, GRFU, MRFU, or MRFUd.

Table 9-4 CPRI port specifications

Board or Module	Number of CPRI Ports	CPRI Data Rate	Topology	Number of Supported TRXs/ Carriers	Cascading Levels
GTMU	6	1.25 Gbit/s	Star, chain, or ring	36 TRXs	-
GTMU b	6	1.25 Gbit/s or 2.5 Gbit/s	Star, chain, or ring	36 TRXs	-
DRFU	2	1.25 Gbit/s	Star or chain	2 carriers	3 levels
GRFU	2	1.25 Gbit/s	Star or chain	6 carriers	2 levels
MRFU V1	2	1.25 Gbit/s	Star	6 carriers	N/A
MRFU V2	2	1.25/2.5 Gbit/s	Star	6 carriers	N/A

9.3 DRFU Configuration

The DRFU is a double-transceiver module and supports two carriers. Different configurations must be chosen in different topologies.

Port

Table 9-5 describes major ports on the DRFU.

Table 9-5 Major ports on the DRFU

Type	Silkscreen	Description
Port for transceiving RF signals	ANT1 and ANT2	The two ports, each of which is used to transmit and receive RF signals, connect to the antenna system through antenna channel 1 and antenna channel 2 respectively.
CPRI port	CPRI0	The port is used to connect to a lower-level DRFU.
	CPRI1	The port is used to connect to the BBU or an upper-level DRFU.
Interconnection port for receiving RF signals	RX1/IN and RX1/OUT	RX1/IN is the diversity receive port for antenna channel 1 while RX1/OUT is the diversity transmit port for antenna channel 1.
	RX2/IN and RX2/OUT	RX2/IN is the diversity receive port for antenna channel 2 while RX2/OUT is the diversity transmit port for antenna channel 2.

Basic Configurations

Table 9-6 lists the basic configurations of a DRFU serving only one sector.

The format of the description of the basic configuration is RF[F][TX][RX]_[C][TYPE]. Where,

- F indicates the number of antenna channels for an RF module.
- TX indicates the number of transmit channels for an RF module.
- RX indicates the number of receive channels for an RF module.
- C indicates the number of CPRI links connecting RF modules with the GTMU board.
- TYPE indicates the CPRI network topologies applied to connect RF modules with the BBU. If the value of TYPE is A, the star topology is applied. If the value of TYPE is B, the chain topology is applied.

Table 9-6 Basic configurations

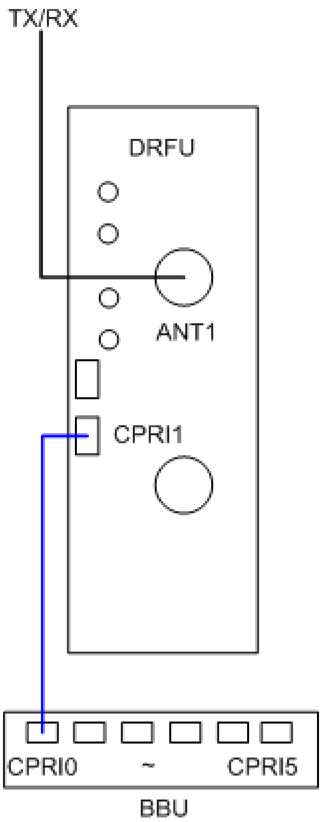
Basic Configuration	Number of Modules	Sending Receiving Mode	Hardware Configuration
RF111_1A	1	Single feeder [1TX 1RX]	**Figure 9-4**
RF211_1A	1	Double feeder [1TX 1RX]	**Figure 9-5**
RF212_1A	1	Double feeder [1TX 2RX]	**Figure 9-6**

Basic Configuration	Number of Modules	Sending Receiving Mode	Hardware Configuration
RF222_1A	1	Double feeder [2TX 2RX]	**Figure 9-7**
RF112_2A	2	Single feeder [1TX 2RX]	**Figure 9-8**
RF224_2A	2	Double feeder [2TX 4RX]	**Figure 9-9**

RF111_1A

A DRFU connects to the antenna system through ANT1. Antenna channel 1 transmits and receives signals.

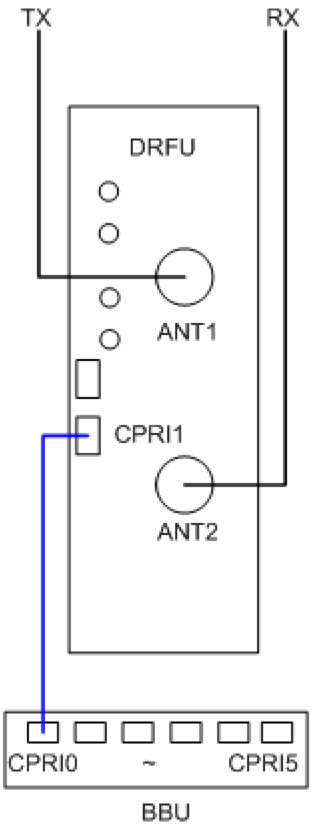
Figure 9-4 RF111_1A



RF211_1A

A DRFU connects to the antenna system through ANT1 and ANT2. Antenna channel 1 transmits signals while antenna channel 2 receives signals.

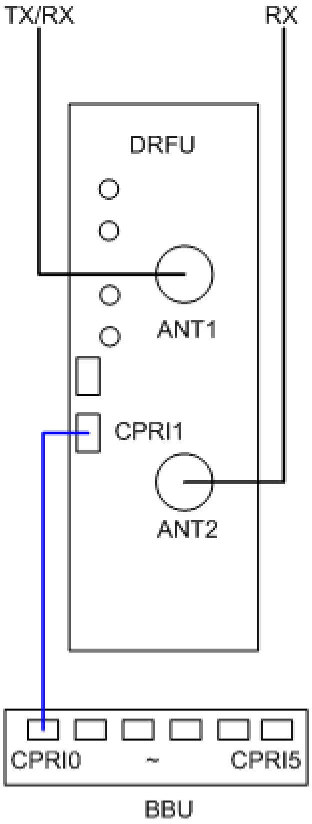
Figure 9-5 RF211_1A



RF212_1A

A DRFU connects to the antenna system through ANT1 and ANT2. Antenna channel 1 transmits and receives signals while antenna channel 2 receives signals only.

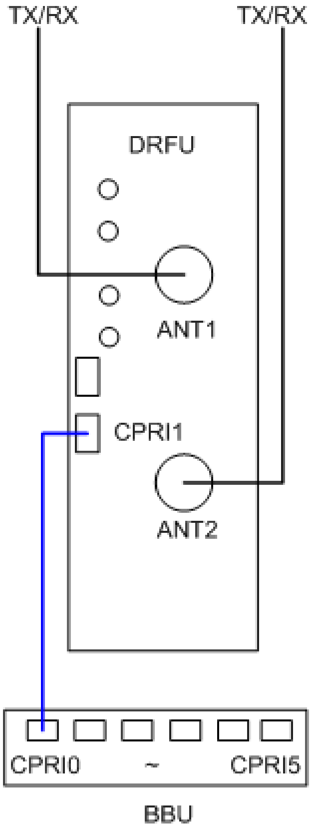
Figure 9-6 RF212_1A



RF222_1A

A DRFU connects to the antenna system through ANT1 and ANT2. Both antenna channel 1 and antenna channel 2 transmit and receive signals.

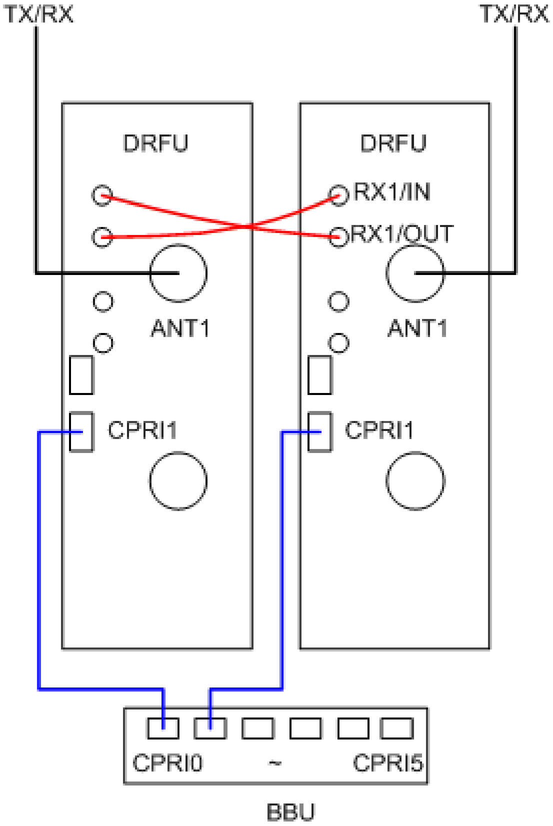
Figure 9-7 RF222_1A



RF112_2A

Two DRFUs connect to the antenna system through ANT1. Antenna channel 1 transmits and receives signals. RX1/IN on one DRFU interconnects with RX1/OUT on the other DRFU to transfer the diversity signals received through antenna channel 1.

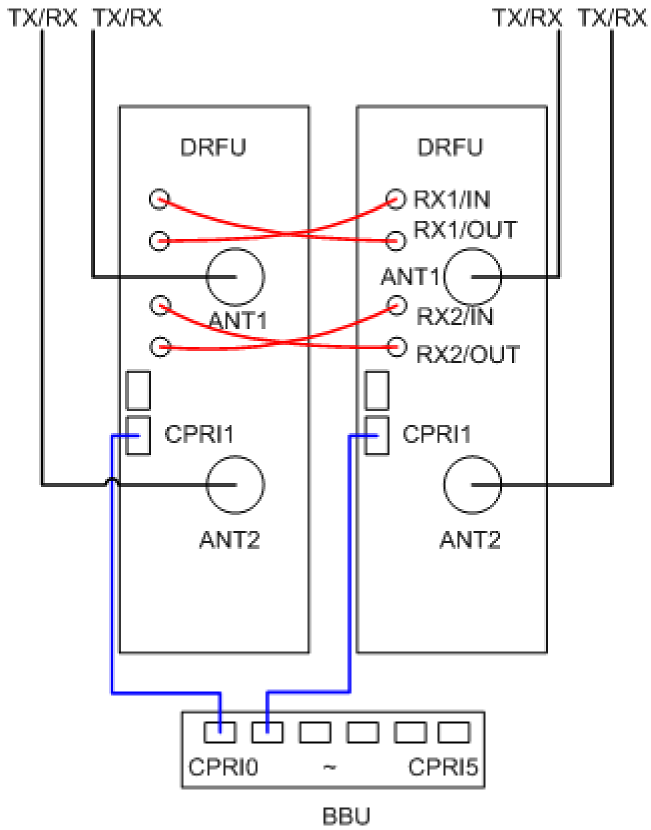
Figure 9-8 RF112_2A



RF224_2A

Two DRFUs connect to the antenna system through their own ports ANT1 and ANT2. Both antenna channel 1 and antenna channel 2 transmit and receive signals. RX1/IN on one DRFU interconnects with RX1/OUT on the other DRFU to transfer the diversity signals received through antenna channel 1. RX2/IN on one DRFU interconnects with RX2/OUT on the other DRFU to transfer the diversity signals received through antenna channel 2.

Figure 9-9 RF224_2A



Typical Configurations

Table 9-7 describes the typical configurations of the DRFU in different scenarios.

Table 9-7 Typical configurations

Scenario	Number of Modules	Send Mode	Typical Configuration
S1	1	Transmit diversity	**RF222_1A**
		Independent transmit or combination	● **RF111_1A** ● **RF212_1A** ● **RF222_1A**
S2	1	Independent transmit or combination	● **RF111_1A** ● **RF212_1A** ● **RF222_1A**
	2	PBT	**RF112_2A**

Scenario	Number of Modules	Send Mode	Typical Configuration
		Transmit diversity	● RF222_1A + RF222_1A ● RF224_2A (the receive mode is four-way receive diversity)
S3	2	Independent transmit or combination	RF112_2A
S4	2	Independent transmit or combination	● RF112_2A ● RF111_1A + RF111_1A ● RF224_2A (the receive mode is four-way receive diversity)

Two carriers of a DRFU can be shared by two cells. That is, a DRFU can serve two cells. Therefore, three DRFUs are used to achieve the configuration S3/3. **Figure 9-10** shows the hardware configuration in the scenario where the configuration S3/3 is applied and **Table 9-8** shows the corresponding data configuration.

Figure 9-10 Hardware configurations in the configuration S3/3

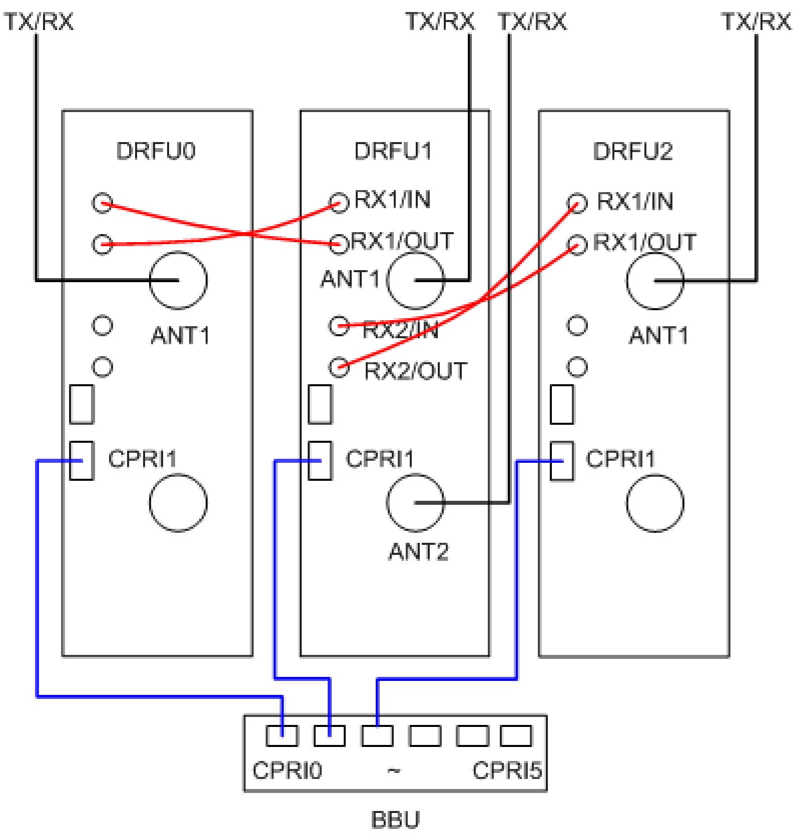


Table 9-8 Data configurations in the configuration S3/3

DRFU	Send Mode	Sending Receiving Mode
DRFU0	Independent transmit or combination	Single feeder [1TX 2RX]
DRFU1		Double feeder [2TX 4RX]
DRFU2		Single feeder [1TX 2RX]

9.4 Configurations of the GRFU and MRFU

The GRFU and MRFU are multi-carrier radio frequency (RF) modules. Each of them supports six carriers. Different configurations must be chosen in different topologies.

Port

Table 9-9 describes major ports on the GRFU and MRFU.

Table 9-9 Major ports on the GRFU and MRFU

Type	Silkscreen	Description
RF port	ANT_TX/RXA	The port, used to transmit and receive RF signals, connects to the antenna system through antenna channel 1.
	ANT_RXB	The port, used to receive RF signals, connects to the antenna system through antenna channel 2.
CPRI port	CPRI0	The port is used to connect to the BBU or an upper-level RFU.
	CPRI1	The port is used to connect to the BBU or a lower-level RFU.
Interconnection port for receiving RF signals	RX_INB and RX_OUTA	RX_INB is the diversity receive port for an antenna channel while RX_OUTA is the diversity transmit port for the antenna channel.

Basic Configurations

The basic configurations of the GRFU and MRFU are the same. The following description takes the GRFU as an example. **Table 9-10** lists the basic configurations of the GRFU serving a single sector mode.

The basic configurations are described in the "RF[F][TX][RX]_[C][TYPE]" format. Where,

- F indicates the number of antenna channels for an RF module.

- TX indicates the number of transmit channels for an RF module.
- RX indicates the number of receive channels for an RF module.
- C indicates the number of CPRI links connecting RF modules with the GTMU board.
- TYPE indicates the CPRI network topologies applied to connect RF modules with the BBU. If the value of TYPE is A, the star topology is applied. If the value of TYPE is B, the chain topology is applied.

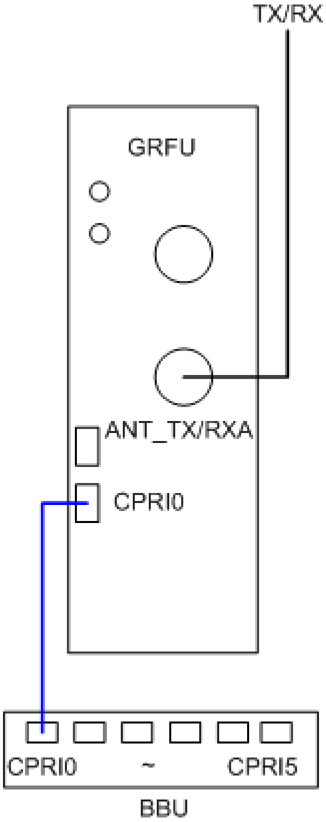
Table 9-10 Basic configurations

Basic Configuration	Number of Modules	Sending Receiving Mode	Hardware Configuration
RF111_1A	1	Single feeder [1TX 1RX]	**Figure 9-11**
RF112_2A	2	Single feeder [1TX 2RX]	**Figure 9-12**
RF211_1A	1	Double feeder [1TX 1RX]	**Figure 9-13**
RF212_1A	1	Double feeder [1TX 2RX]	**Figure 9-14**

RF111_1A

A GRFU connects to the antenna system through ANT_TX/RXA. Antenna channel 1 transmits and receives signals.

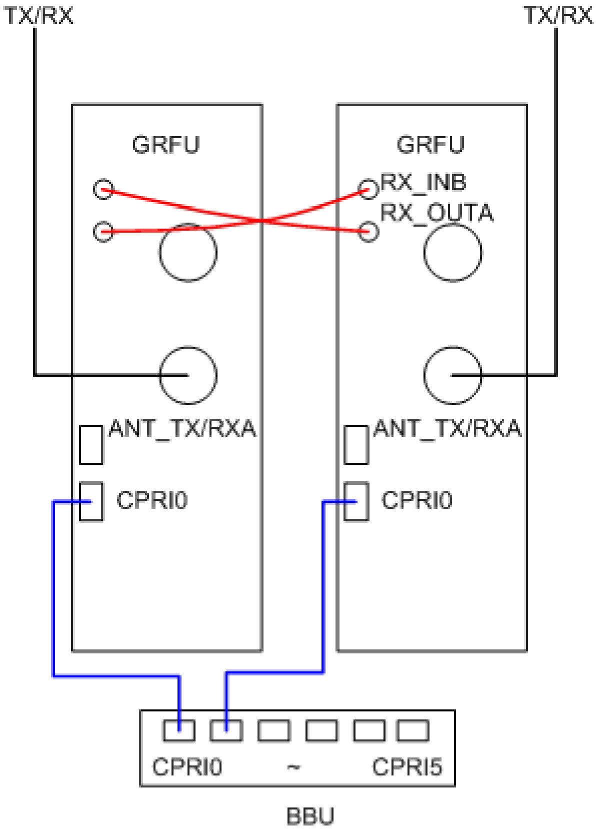
Figure 9-11 RF111_1A



RF112_2A

Two GRFUs connect to the antenna system through ANT_TX/RXA. Each antenna channel 1 transmits and receives signals. RX_INB on one GRFU interconnects with RX_OUTA on the other GRFU to transfer the diversity signals received through an antenna channel.

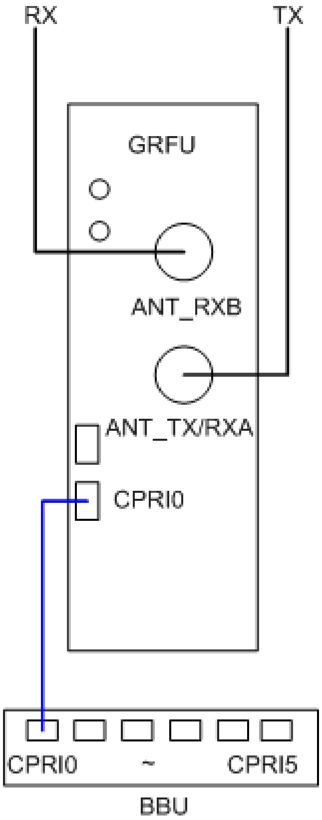
Figure 9-12 RF112_2A



RF211_1A

A GRFU connects to the antenna system through ANT_TX/RXA and ANT_RXB. Antenna channel 1 transmits signals while antenna channel 2 receives signals.

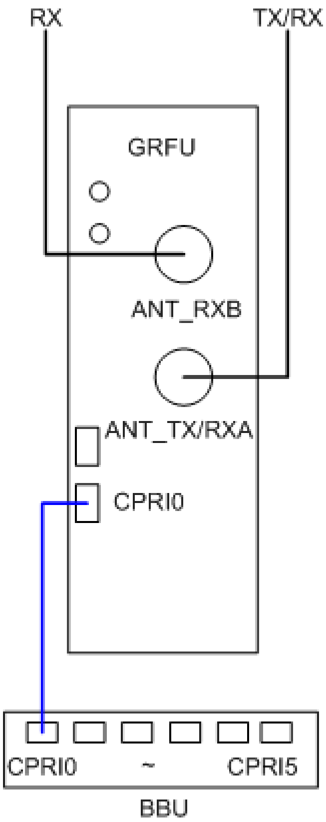
Figure 9-13 RF211_1A



RF212_1A

A GRFU connects to the antenna system through ANT_TX/RXA and ANT_RXB. Antenna channel 1 transmits and receives signals while antenna channel 2 receives signals only.

Figure 9-14 RF212_1A



Typical Configurations

Table 9-11 describes the typical configurations of the GRFU in different scenarios.

Table 9-11 Typical configurations

Scenario	Number of Modules	Typical Configuration
S3-S6	1	**RF212_1A**
S7-S12	2	**RF112_2A**
S13-S18	3	**RF112_2A** + **RF212_1A**
S19-S24	4	**RF112_2A** + **RF112_2A**

NOTE

The configurations of GRFUs serving multiple sectors are the combination of the configurations of several GRFUs serving a single sector.