4 Antenna Subsystem of the BTS

About This Chapter

The antenna subsystem of the BTS receives and transmits signals, and it consists of the RF antenna subsystem and the satellite synchronization antenna subsystem.

4.1 RF Antenna Subsystem
This topic describes the functional structure of the RF antenna subsystem and the basic concepts about the RF antenna, for example, antenna gains, polarization, and receiver diversity.

4.2 Satellite Synchronization Antenna Subsystem of the BTS
This topic describes the functional structure of the satellite synchronization antenna subsystem of the BTS, the functions of the global position system (GPS) and the global navigation satellite system (GLONASS), and the hardware configuration of the satellite synchronization antenna.

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4.1.1 Functional Structure of the RF Antenna Subsystem
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4.1.2 RF Antenna
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4.1.1 Functional Structure of the RF Antenna Subsystem

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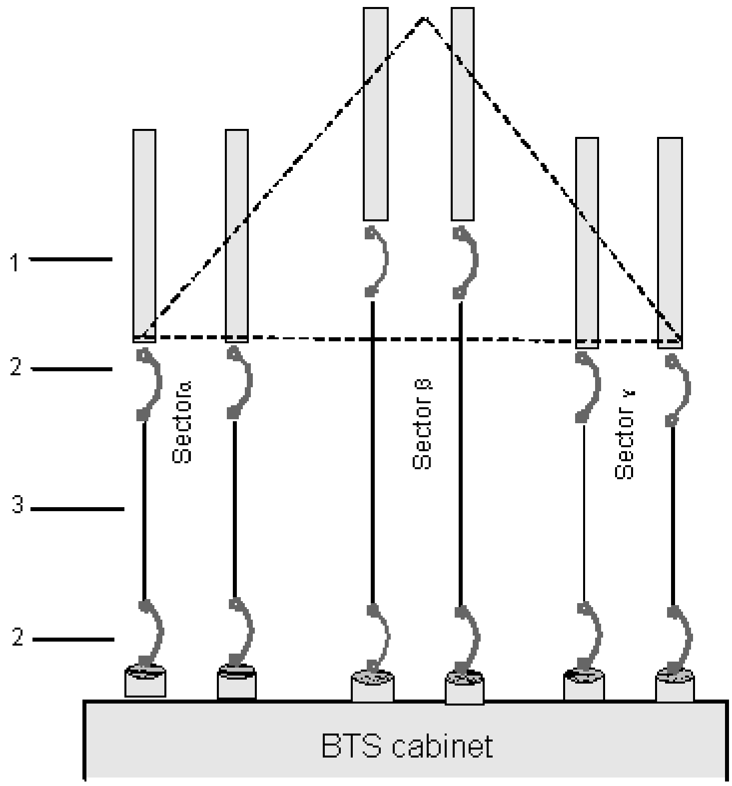
The RF antenna subsystem consists of the RF antenna, the jumper between the RF antenna and the feeder, the feeder, and the jumper between the feeder and the outlet of the RF cable. **Figure 4-1** shows the structure of the RF antenna subsystem.

Figure 4-1 Structure of the RF antenna subsystem



(1) RF antenna (2) Jumper (3) Feeder

NOTE

Figure 4-1 shows only the basic composition of the RF antenna subsystem. For details on the installation position and method, refer to the *BTS3606C RF Antenna System Installation Guide*.

4.1.2 RF Antenna

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Antenna Gain

The antenna gain is the capability of an antenna to radiate the input power in specific directions. Generally, a great amount of antenna gain results in a strong field intensity and large coverage in the direction where the antenna has the strongest radiation intensity. In such cases, however, dead zones may exist near the antenna.

Antenna Pattern

An antenna pattern describes the radiation intensity of the antenna in all directions. The horizontal antenna pattern is commonly used and considered as a standard for classifying antennas.

Generally, BTS antennas are classified into two types, namely, omni-directional antennas and directional antennas. Directional antennas are further classified into several types, for example, 120°directional antennas, 90°directional antennas, 65°directional antennas, and 33°directional antennas.

Polarization

Polarization describes the path of direction change of electrical fields.

Mobile communication systems often use uni-polarization antennas. A bi-polarization antenna has two internal antennas whose polarization directions are +45° and –45° respectively. The isolation between the two internal antennas is over 30 dB. Instead of using two independent uni-polarization antennas, you can use a bi-polarization antenna to reduce the number of required antennas.

When choosing antennas, adhere to the following principles:

- Use omni-directional antennas for omni-directional cells.
- Use directional antennas for directional cells. Two types of directional antennas, namely, bi-polarization directional antennas and uni-polarization directional antennas, are available. Choose one type according to the actual situation.

Receiver Diversity

The propagation of radio waves in urban areas has the following features:

- The medium value of field intensity gradually varies with the place and time, and the variation follows the logarithmic normal distribution. This is known as slow fading.
- The instantaneous value of field intensity selectively fades along multiple transmission paths, and the fading follows the Rayleigh distribution. This is known as fast fading.

The fast fading, slow fading, multi-path effect, and shadow effect undermine the quality of communication or even interrupt communication.

Diversity technologies are an effective solution to the fading problem. When the correlation between two fading signals is very low, appropriate diversity receiving and combining technologies effectively reduce the fading effect during the transmission of signals.

Diversity technologies include the polarization diversity technology and the space diversity technology. Both these technologies can be used in current mobile communication systems.

- The space diversity technology is highly effective when the distance between two antennas exceeds 10 wavelengths.
- The polarization diversity technology is more and more widely used because it facilitates the installation of antennas and saves space.

Isolation Between the Transmitting and Receiving Antennas

The transmitting and receiving antennas must be sufficiently isolated to minimize interference to the receiver. The degree of isolation depends on the spurious emission from the transmitter and the features of the receiver.

4.2 Satellite Synchronization Antenna Subsystem of the BTS

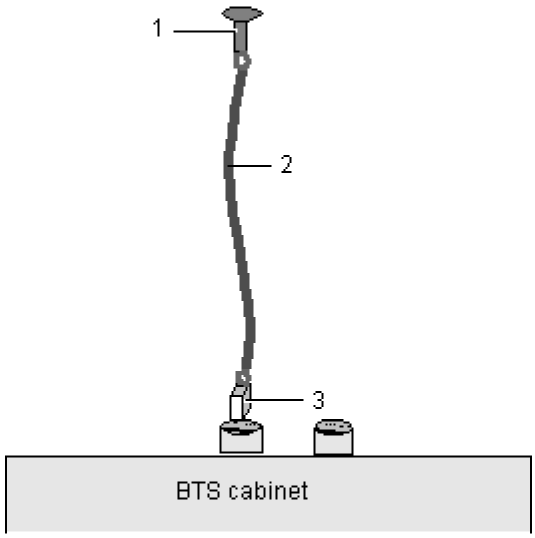
This topic describes the functional structure of the satellite synchronization antenna subsystem of the BTS, the functions of the global position system (GPS) and the global navigation satellite system (GLONASS), and the hardware configuration of the satellite synchronization antenna.

4.2.1 Functional Structure of the Satellite Synchronization Antenna Subsystem

This topic describes the functional structure of the satellite synchronization antenna subsystem. For system security and reliability, the BTS receives signals from the GPS or GLONASS through a satellite synchronization antenna to implement radio synchronization.

The satellite synchronization antenna subsystem consists of an antenna, two feeders, and a lightning arrester, as shown in **Figure 4-2**.

Figure 4-2 Functional structure of the satellite synchronization antenna subsystem



(1) GPS antenna (2) Feeder (3) Lightning arrester

NOTE

The 1/2 in. feeder and the RG8 feeder are used.

Figure 4-2 shows only the basic composition of the satellite antenna subsystem. For details on the installation position and method, refer to the *BTS3606C GPS Antenna System Installation Guide*.

4.2.2 Introduction to the GPS and the GLONASS

This topic describes the GPS and the GLONASS and their use in the BTS.

Introduction to the GPS

The GPS is an all-weather satellite navigation system based on radio communication. The GPS enables you to precisely determine three-dimension positions, speeds, and time around the globe. The precision of three-dimension position information provided by the GPS is better than 10 yards (approximately 9.1 m), and the precision of the time signals provided by BTS is better than 100 ns. After being processed, the GPS time signals can be used as the reference frequency.

The GPS consists of the following three parts:

- Space part: is a satellite constellation that comprises 24 satellites orbiting the earth once every 12 hours at a height of 20,183 km [12,541.13 mi.].
- Terrestrial controlling part: consists of a main controlling center and some widely distributed tuning stations.
- User part: consists of GPS receivers and their supporting devices.

Introduction to the GLONASS

The GLONASS is a global satellite navigation system developed by the former Soviet Union. Russia further develops the GLONASS, which is similar to the US-developed GPS but has less coverage.

Use of the GPS and the GLONASS in the BTS

The BTS provides the GPS synchronization mode and the GPS/GLONASS synchronization mode to cater to different requirements of users.

In the CDMA system, the BTS is equivalent to a GPS or GLONASS user taking advantage of the timing function of the GPS or GLONASS. The BTS uses intelligent software phase-locking and holdover technologies to minimize interference, such as signal drifts and jitters caused by errors of the GPS or GLONASS satellite that occur at the ionosphere or the troposphere.

The timing signals from the GPS or the GLONASS have high reliability and long-term frequency stability. The BTS is configured with a highly stable oscillation clock. The short-term stability of this oscillation clock and the long-term stability of the GPS or GLONASS guarantee the reliability and stability of the CDMA system clock.

4.2.3 Hardware Configuration of the Satellite Synchronization Antenna

This topic describes the GPS antenna, the GPS/GLONASS antenna, the antenna lightning arrester, the GPS receiver, and the GPS/GLONASS receiver.

GPS Antenna

The GPS antenna is an active antenna. It receives L1 band (1,565 MHz to 1,585 MHz) signals from GPS satellites. The signals are processed by a narrowband filter and amplified by a preamplifier and then sent to a GPS receiver built in the BCKM.

The CSGPS-38BH GPS antenna, CCAH22ST11 GPS antenna, and AT1675-0 GPS antenna are commonly used.

Figure 4-3 shows the CSGPS-38BH GPS antenna.

Figure 4-3 CSGPS-38BH GPS antenna

(1) GPS antenna (2) Fixing and connecting plate at the bottom of the antenna

(3) Screw assembly (4) N-shaped connector and its jacket

GPS/GLONASS Antenna

The GPS/GLONASS antenna is an active antenna. It can receive both L1 band signals from GPS antennas and signals (1602 MHz to 1611 MHz) from GLONASS satellites.

Figure 4-4 shows the AT1675-0 GPS/GLONASS antenna.

Figure 4-4 AT1675-0 GPS/GLONASS antenna

Antenna Lightning Arrester

The antenna lightning arrester used by the satellite synchronization antenna protects the equipment from the inductive lightning current in the feeder. One lightning arrester is configured on the equipment side for each feeder.

GPS Receiver

There are many types of GPS receivers. This document takes the GPS receiver with eight parallel channels as an example.

This type of GPS receiver can track eight satellites simultaneously. Also, it receives L1 band GPS signals to track C/A codes.

In the receiver, the RF signal processor performs down-conversion for GPS signals received by the GPS antenna to obtain intermediate frequency (IF) signals. Then, the RF signal processor converts the IF signals into digital signals and sends them to the eight-channel code correlator and the eight-channel carrier correlator, which perform signal detection, code correlation, carrier tracking, and carrier filtering.

The processed signals are simultaneously sent to the micro processing unit (MPU). The MPU calculates the position, speed, and time by controlling the working mode and decoding process of the GPS receiver, processing satellite data, and measuring the pseudo distance and the pseudo distance increment.

GPS/GLONASS Receiver

The GPS/GLONASS receiver has 20 receiving channels and works in much the same way as the GPS receiver does. You can use a specific cipher code to upgrade a GPS L1 receiver to a GPS/GLONASS L1+L2 receiver or upgrade in other ways.