Overview of GPRS and UMTS

This chapter provides a brief introduction to the 2.5G General Packet Radio Service (GPRS) and the 3G Universal Mobile Telecommunication System (UMTS) technologies and their implementation in Cisco IOS GGSN Release 4.0 software.

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Overview

GPRS and UMTS are evolutions of the Global System for Mobile Communications (GSM) networks. GSM is a digital cellular technology that is used worldwide, predominantly in Europe and Asia. GSM is the world’s leading standard in digital wireless communications.

GPRS is a 2.5G mobile communications technology that enables mobile wireless service providers to offer their mobile subscribers with packet-based data services over GSM networks. Common applications of GPRS include the following: Internet access, intranet/corporate access, instant messaging, and multimedia messaging. GPRS was standardized by the European Telecommunications Standards Institute (ETSI), but today is standardized by the Third Generation Partnership Program (3GPP).

UMTS is a 3G mobile communications technology that provides Wide-band Code Division Multiple Access (CDMA) radio technology. The CDMA technology offers higher throughput, real-time services, and end-to-end QoS, and is designed to deliver pictures, graphics, video communications, and other multimedia information as well as voice and data to mobile wireless subscribers. UMTS is standardized by the Third Generation Partnership Program (3GPP).

The GPRS/UMTS packet core is primarily composed of two major network elements:

- Gateway GPRS Support Node (GGSN)—A gateway that provides mobile cell phone users access to a public data network (PDN) or specified private IP networks. The GGSN function is implemented on the Cisco Systems’ router via Cisco IOS software. The Cisco IOS GGSN 4.0 feature provides both the 2.5G GPRS and 3G UMTS GGSN functions.
- Serving GPRS Support Node (SGSN)—Connects the Radio Access Network (RAN) to the GPRS/UMTS core and tunnels user sessions to the GGSN. The SGSN sends data to and receives data from mobile stations, and maintains information about the location of a mobile station (MS). The SGSN communicates directly with the MS and the GGSN. SGSN support is available from Cisco partners or other vendors.
Figure 2-1 provides a view of the basic GPRS/UMTS network components.

Note that, as illustrated in Figure 2-1, the Radio Access Network (RAN) is made up of different components for 2.5G and 3G.

In a 2.5G environment, the RAN is comprised of mobile stations that connect to a Base Transceiver Station (BTS) that connects to a Base Station Controller (BSC). In a 3G environment, the RAN is made up of mobile stations that connect to a NodeB that connects to a Radio Network Controller (RNC).

The RAN then connects to the GPRS/UMTS core through an SGSN, which tunnels user sessions to a GGSN that act as a gateway to the services networks (for example, the Internet and intranet). The connection between the SGSN and the GGSN is enabled through a tunneling protocol called the GPRS Tunneling Protocol (GTP); GTP Version 0 (GTP V0) for 2.5G applications and GTP Version 1 (GTP V1) for 3G applications. GTP is carried over IP. Multiple SGSNs and GGSNs within a network are referred to collectively as GPRS Support Nodes (GSNs).

Note
Depending on the specific operator configuration, the RAN, GPRS/UMTS core, and the services networks can be made up of IP or MPLS networks.

To assign mobile sessions an IP address, the GGSN uses the Dynamic Host Configuration Protocol (DHCP). The GGSN can use a Remote Authentication Dial-In User Service (RADIUS) server to authorize and authenticate the remote users. DHCP and RADIUS services can be specified at the global configuration level (using GPRS DHCP and RADIUS commands), or for each access point configured on the GGSN.
Overview

In Cisco IOS Release 12.1(5)T and later, the GGSN (with an Industry-Standard Architecture [ISA] card), supports the IP security protocol (IPSec) to provide data confidentiality, data integrity, and data authentication between participating peers.

GPRS Interface Reference Model

The 2.5G GPRS and 3G UMTS standards use the term interface to label (or identify) the communication path between different network elements. The GPRS/UMTS standards define the requirements and characteristics of communication between different GPRS/UMTS network elements over these interfaces. These interfaces are commonly referred to when describing aspects of a GPRS/UMTS network.

Figure 2-2 shows the interfaces that are implemented in the Cisco IOS GGSN Release 4.0 feature:

- Gn interface—Interface between GSNs within the same PLMN in a GPRS/UMTS network. GTP is a protocol defined on the Gn interface between GSNs in a GPRS/UMTS network.
- Gi interface—Reference point between a GPRS/UMTS network and an external packet data network.
- Ga interface—Interface between a GGSN and charging gateway (CG) in a GPRS/UMTS network.

Virtual Template Interface

To facilitate configuration of connections between the GGSN and SGSN, and the GGSN and PDNs, the Cisco IOS GGSN software uses an internal interface called a virtual template interface. A virtual template is a logical interface on the router. A logical interface configuration on the router is not tied directly to a specific physical interface, but it can be associated dynamically with a physical interface.

As with a physical interface on the router, you can assign an IP address to the virtual template interface. You can also configure IP routing characteristics on the virtual template interface. You are required to configure certain GPRS/UMTS-specific elements on the virtual template interface, such as GTP encapsulation (which is necessary to communicate with the SGSN) and the access list that the GGSN uses to determine which PDNs are accessible on the network.

Access Points

The GPRS/UMTS standards define a network identity called an access point name (APN). An APN identifies the service or network to which a user a user can connect to from a GGSN in a GPRS/UMTS network.
To configure APNs, the Cisco IOS GGSN software uses the following configuration elements:

- Access point—Defines an APN and its associated access characteristics, including security and method of dynamic addressing.
- Access point list—Logical interface that is associated with the virtual template of the GGSN. The access-point list contains one or more access points.
- Access group—An additional level of security on the router that is configured at an access point to control access to and from a PDN. When an MS is permitted access to the GGSN as defined by a traditional IP access list, the IP access group further defines whether access is permitted to the PDN (at the access point). The IP access group configuration can also define whether access from a PDN to an MS is permitted.

For more detailed information on access-point configuration, refer to the “Configuring Access Points on the GGSN” section on page 6-6 in the “Configuring Network Access to the GGSN” chapter.

**Benefits**

The 2.5 G GPRS technology provides the following benefits:

- Enables the use of a packet-based air interface over the existing circuit-switched GSM network, which allows greater efficiency in the radio spectrum because the radio bandwidth is used only when packets are sent or received.
- Supports minimal upgrades to the existing GSM network infrastructure for those network service providers who want to add GPRS services on top of GSM, which is currently widely deployed.
- Supports enhanced data rates compared to the traditional circuit-switched GSM data service.
- Supports larger message lengths than Short Message Services (SMS).
- Supports a wide range of access to data networks and services, including virtual private network (VPN)/Internet service provider (ISP) corporate site access and Wireless Application Protocol (WAP).

In addition to the above, the 3G UMTS technology extends these benefits to include:

- Enhanced data rates of approximately:
  - 144 kbps—Satellite and rural outdoor
  - 384 kbps—Urban outdoor
  - 2048 kbps—Indoor and low range outdoor.
- Supports connection-oriented Radio Access Bearers with specified QoS, enabling end-to-end QoS.

The Cisco IOS GGSN 4.0 feature is a fully-compliant 2.5G and 3G GGSN that provides the following:

- Release 99 (R99), Release 98 (R98), and Release 97 (R97) support and compliance
- GTP v0 and GTP v1 messaging
- UMTS QoS support
- GPRS QoS (R97/R98) conversion to UMTS QoS (R99) and the reverse
- R99 charging
- GGSN interworking between 2.5G and 3G SGSNs with RA update from:
  - 2.5G to 2.5G SGSN
  - 2.5G to 3G SGSN
- 3G to 3G SGSN
- 3G to 2.5G SGSN
- R97/R98 Ga support
- R99 Ga support
- 2.5G and 3G MIB support