CHAPTER 1

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 software.

This chapter includes the following sections:

Overview

GPRS and UMTS are evolutions of the global system for mobile communication (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 packet-based data services over GSM networks. Common applications of GPRS include the following: Internet access, intranet/corporate access, instant messaging, and mutlimedia 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 wideband code division multiple access (CDMA) radio technology. The CDMA technology offers higher throughput, real-time services, and end-to-end quality of service (QoS), and delivers pictures, graphics, video communications, and other multimedia information as well as voice and data to mobile wireless subscribers. UMTS is standardized by the 3GPP.

The GPRS/UMTS packet core comprises 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 via Cisco IOS software on the Cisco 7200 series router or on the Cisco Multi-Processor WAN Application Module (MWAM) installed in a Catalyst 6500 series switch or Cisco 7600 series Internet router. Cisco IOS GGSN Release 4.0 and later 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 1-1 shows the basic GPRS/UMTS network components with GGSNs implemented on Cisco 7200 series routers.

Figure 1-1 GPRS/UMTS Network Components with GGSNs Implemented on Cisco 7200 Routers

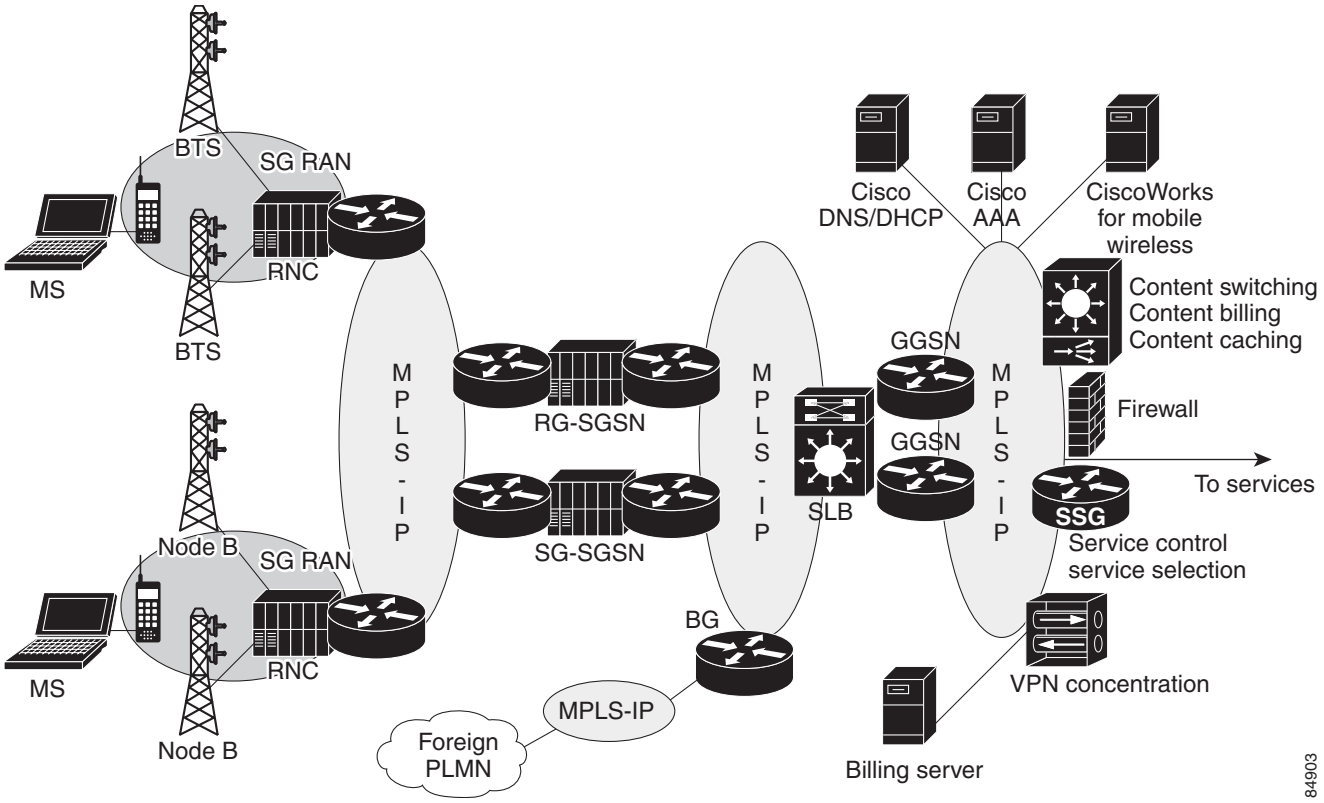
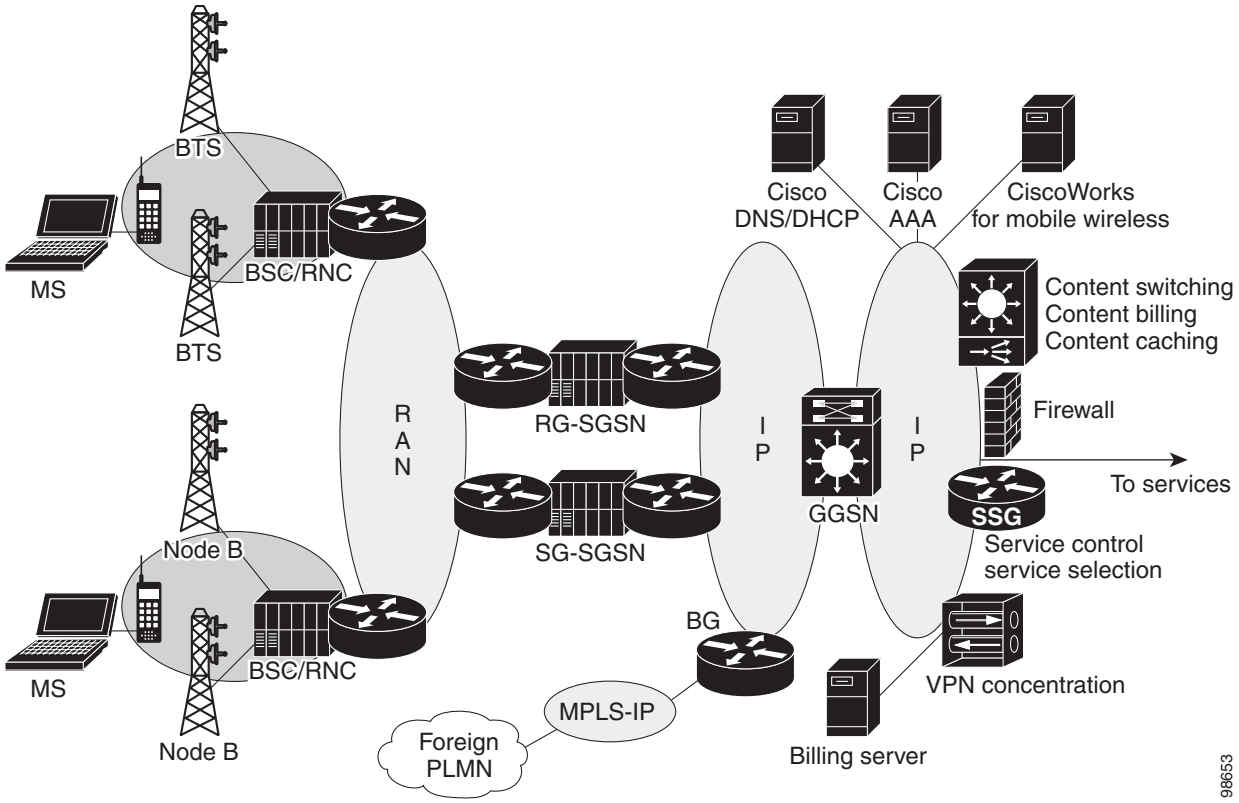


Figure 1-2 shows the network components with the GGSNs implemented on the Cisco MWAM in the Catalyst 6500/Cisco 7600 platform.

Figure 1-2 GPRS/UMTS Network Components with GGSNs Implemented on the Cisco MWAM in the Catalyst 6500 / Cisco 7600 Platform



Note that, as Figure 1-1 and Figure 1-2 show, the RAN is made up of different components for 2.5G and 3G.

In a 2.5G environment, the RAN is composed 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 NodeB, which connects to a radio network controller (RNC).

The RAN connects to the GPRS/UMTS core through an SGSN, which tunnels user sessions to a GGSN that acts 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, the GPRS/UMTS core, and the services networks can be made up of IP or Multiprotocol Label Switching (MPLS) networks.

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

In Cisco IOS Release 12.1(5)T and later, the GGSN on the Cisco 7200 series router (with an Integrated Services Adapter [ISA] card) supports IP Security (IPSec) protocol to provide data confidentiality, data integrity, and data authentication between participating peers.

On the Cisco MWAM installed in a Catalyst 6500 series switch / Cisco 7600 series Internet router platform, IPSec encryption is performed on the IPSec Virtual Private Network (VPN) Acceleration Services Module.

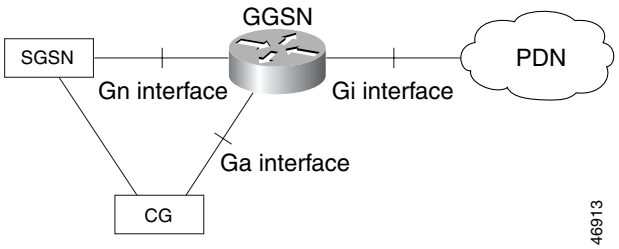
GPRS Interface Reference Model

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 in descriptions of GPRS/UMTS networks.

Figure 1-3 shows the interfaces that are implemented in the Cisco IOS GGSN feature:

- Gn interface—Interface between GSNs within the same public land mobile network (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.

Figure 1-3 GPRS Interfaces Configured in the Cisco IOS GGSN Feature Implemented on the Cisco 7200 Series Router



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 that is not tied directly to a specific interface, but that can be associated dynamically with a interface.

As with a physical interface on a 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 for communicating 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 can connect 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 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 7-10.

Benefits

The 2.5G 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 network service providers who want to add GPRS services on top of GSM, which is currently widely deployed
- Supports enhanced data rates in comparison to the traditional circuit-switched GSM data service
- Supports larger message lengths than Short Message Service (SMS)
- Supports a wide range of access to data networks and services, including VPN/Internet service provider (ISP) corporate site access and Wireless Application Protocol (WAP).

In addition to the above, the 3G UMTS technology includes the following:

- 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

GGSN Release 5.0 and later is a fully-compliant 2.5G and 3G GGSN that provides the following features:

- Release 99 (R99), Release 98 (R98) and Release 97 (R97) support and compliance
- GTPv0 and GTPv1 messaging
- IP Packet Data Protocol (PDP) and PPP PDP types
- Cisco Express Forwarding (CEF) switching for GTPv0 and GTPv1, and for IP and PPP PDP types
- Support of secondary PDP contexts for GTPv1 (up to 11)
- Virtual APN
- VRF support per APN
- Multiple APNs per VRF
- VPN support
  - Generic routing encapsulation (GRE) tunneling
  - Layer 2 Tunneling Protocol (L2TP) extension for PPP PDP type
  - PPP Regeneration for IP PDP type
  - 802.1Q virtual LANs (VLANs)
- Security features
  - Duplicate IP address protection
  - PLMN range checking
  - Blocking of Foreign Mobiles
  - Anti-spoofing
  - Mobile-to-mobile redirection
- Quality of service (QoS)
  - Support of UMTS classes and interworking with differentiated services (DiffServ)
  - Delay QoS
  - Canonical QoS
  - GPRS QoS (R97/R98) conversion to UMTS QoS (R99) and the reverse
  - Call Admission Control
  - Per-PDP policing
- Dynamic address allocation
  - External DHCP server
  - External RADIUS server
  - Local pools
- Per-APN statistics
- Anonymous access
- RADIUS authentication and accounting
- Accounting
  - Wait accounting
  - Per-PDP accounting

  - Authentication and accounting using RADIUS server groups mapped to APNs
  - 3GPP vendor-specific attributes (VSAs) for IP PDP type
  - Transparent mode accounting
  - Class attribute
  - Interim updates
  - Session idle timer
  - Packet of Disconnect (PoD)
- Dynamic Echo Timer
- GGSN interworking between 2.5G and 3G SGSNs with registration authority (RA) update from
  - 2.5G to 2.5G SGSN
  - 2.5G to 3G SGSN
  - 3G to 3G SGSN
  - 3G to 2.5G SGSN
- Charging
  - Time trigger
  - Charging profiles
  - Tertiary charging gateway
  - Switchback to primary charging gateway
- Maintenance mode
- Multiple trusted PLMN IDs
- GGSN-IOS SLB messaging
- Session timeout

New Features in Cisco IOS Release 12.4(2)XB

This release of the GGSN software provides the following new GGSN features:

- Auto-retrieval of charging data records (CDRs) from a Cisco Persistent Storage Device (PSD) (Catalyst 6500/Cisco 7600 platform only)
- High Speed Downlink Data Packet Access (HSDPA) support and associated 3GPP R5 (as required).
- Enhanced Virtual APN
- Support for new information elements (IEs) sent from the SGSN (user location, radio access technology [RAT], MS time zone, Customized Application for Mobile Enhanced Logic [CAMEL] charging information, and user location information IEs)
- NPE-G1 support (Cisco GGSN Release 5.0 and later, Cisco 7200 platform)
- GTP SLB Stickiness
- P-CSCF Discovery
- Enhanced MIB Support - Cisco Content Services Gateway (CSG), Diameter Credit Control Application (DCCA), Persitent Storage Device (PSD) Client