CHAPTER 1

Introduction

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This chapter describes the Cisco 3G wireless WAN services, the types of 3G wireless broadband networks, and other characteristics for the 3G High-Speed WAN Interface Card.

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Overview

This guide provides deployment, debugging, and troubleshooting information for the 3G High-Speed WAN Interface Card (HWIC). 3G HWIC provides wireless 3G networking capability on the second generation Integrated Services Routers (ISR-G2).

This guide is intended for use by system integrators, sales engineers, customer support engineers, and those responsible for the design and implementation of 3G wireless services in a network environment. This guide bridges the gap for those who have a strong background in the 3G environment or in data and voice networking.

For specific information about the HWIC hardware, see http://www.cisco.com/go/3g.

Some basic knowledge is required to understand each element in the 3G services. Additional knowledge may be required depending on the specific service being implemented. A successful implementation will require knowledge in the following areas:

- Operational knowledge of the 3G services to be networked, including wired interface characteristics
- Provisioning data services on Cisco IOS software-based routers

Installations may also require skills in configuring the Cisco Dialer and Tunnel interfaces.

Background Information

This section describes the Cisco 3G wireless WAN services and various attributes for 3G wireless broadband networks.

Cisco 3G Wireless WAN Services

The 3G High-Speed WAN Interface Cards, or the HWIC-3G-CDMA and HWIC-3G-GSM, enable new enterprise and small-to-medium business (SMB) services based on high-speed mobile broadband. These services include:

- Remote Branch Primary/Backup WAN connection—Target service is remote branch backup because many enterprises and SMBs choose to replace ISDN with alternative technologies. The Wireless WAN can also act as a primary access for non-real-time, low-to-medium speed applications such as bank automated teller machines (ATM), or any serial encapsulated technology running at 9600 Bps.
- Rapid, Nomadic Deployment—Wireless WAN service enabled by the 3G HWIC is beneficial for nomadic connectivity, such as workgroups and temporary connectivity from trade shows and construction sites.
- Mobile Disaster Recovery Solution—This service is important when there are major outages with whirling facilities. Cellular service can remain functional because it can take alternative paths through different central offices.

Types of 3G Wireless Broadband Networks

3G wireless data networks are defined as broadband wireless public networks, supporting at least 2 Mbit/sec access speeds (not necessarily average sustained throughput). These networks are based on Code Division Multiple Access (CDMA) radio access technology, which provides concurrent multiple accesses. The available access bandwidth on these networks is shared among concurrent *active* users; therefore, the total available bandwidth is shared amongst these users.

These wireless broadband networks have evolved from the existing cellular networks, which were primarily and originally designed for circuit-switched voice. With the growth of IP-based networks and IP data connectivity, broadband service was introduced on these networks. Because the original network was primarily designed for circuit-switched voice, this network path was not suitable for the support of broadband IP data. An overlay network was created to provide support for this capability.

There are two types of cellular wireless data networks deployed today:

- GSM/UMTS—The architecture for GSM/UMTS is defined by the 3GPP standards organization. This set of standards includes GPRS, EDGE, HSPA, and HSPA+ air interfaces.
- CDMA2000 technology—The architecture for CDMA2000 technology is defined by the 3GPP2 standards organization. This set of standards includes 1xRTT, EvDO-Rev0, and EvDO-RevA air interfaces.

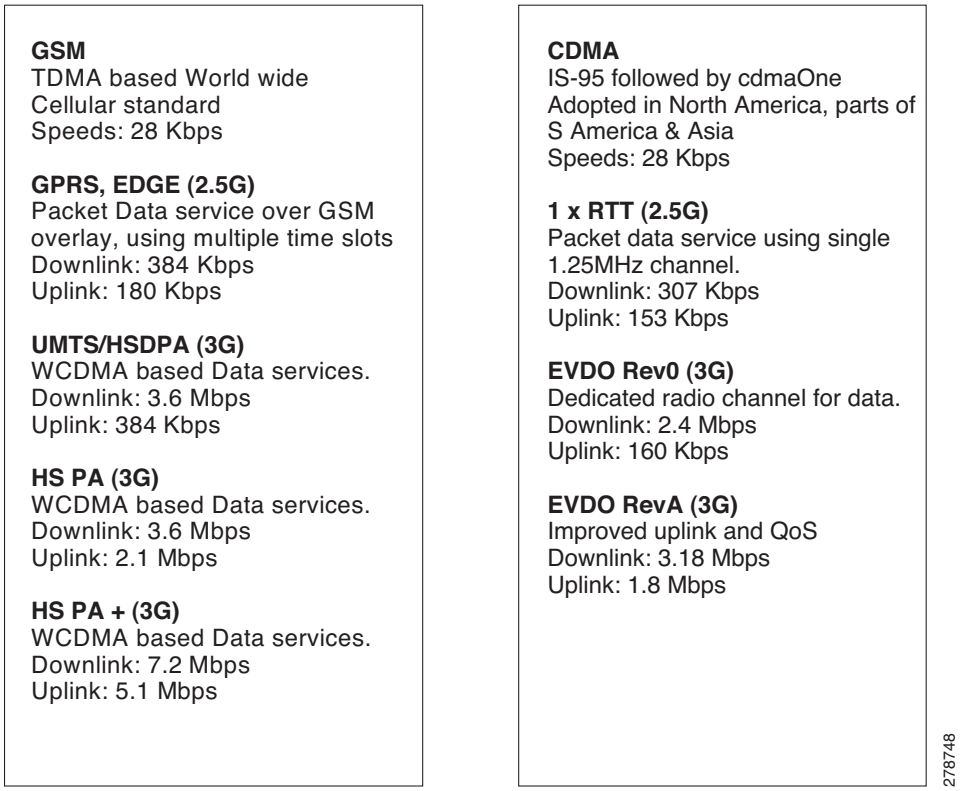
In this document, the term *GSM* is used to describe any of the radio transmission technologies covered by the 3GPP standards. The term *CDMA* is used to describe any of the radio transmission technologies covered by the 3GPP2 standards. Both UMTS and CDMA2000 use CDMA modulation technology, but UMTS uses a wider bandwidth as compared to CDMA, thus known as W-CDMA. CDMA2000 operates at 1.25-MHz bandwidth, instead of the 5.0-MHz bandwidth used by UMTS.

The CDMA broadband wireless network is based on the Qualcomm CDMA-2000 technology. This network architecture is IETF-centric because it makes use of the existing IETF protocols as much as possible. The GSM broadband architecture is not as IETF-centric; it uses some of its own protocols instead of using any of the existing protocols.

Performance Characteristics

3G HWIC supports HSDPA and EV-DO Rev A. Figure 1-1 shows the CDMA2000 technologies and the GSM/UMTS technologies.

Figure 1-1 CMDA2000, GSM, and CDMA Technology Performance Characteristics



Throughput

Throughput is shared per cell sector and per carrier frequency. The values for total theoretical throughput per sector downlink and uplink for EVDO Rev A, HSDPA, and HSPA are shown in Table 1-1.

Table 1-1 Total Theoretical Throughput Per Sector for the 3G HWIC Chipset

Technology/Service	Uplink (Mbps)	Downlink (Mbps)
EVDO Rev A	1.8	3.1
HSDPA	384 (Kbps)	3.6
HSPA	5.1	7.2

Actual throughput depends on network conditions at the time, the Received Signal Strength Indicator (RSSI), and the cellular backhaul facilities on the ISP network.

Latency

Latency in the 3G cellular network is higher than that in wire-line networks. It is dependent on network conditions and may be up to 100 ms on the air-link and Radio Access Network (RAN). Table 1-2 depicts the observed end-to-end throughput and latency during beta.

Table 1-2 End-to-end Latency and Throughput Observed During Beta

Technology/Service	Uplink (Kbps)	Downlink (Kbps)	One way Latency (ms)
EDGE	80	140	250-300
UMTS	250	400	150-200
HSDPA	300	700	100-125
1xRTT	80	150	250
EVDO Rel 0	140	500	125
EVDO Rev A	500	800	75-100

Shared Access

Wi-Fi, Ethernet, DSL, and 3G cellular all display shared access technology. Other data subscribers, including PC card users and other 3G HWICs who are using radio resources in the same cell and sector, can impact the performance of the 3G HWIC.

RSSI and Carrier-to-Interference Ratio

RSSI is a circuit to measure the strength of an incoming signal. The basic circuit is designed to pick RF signals and generate an output equivalent to the signal strength. The ability of the receiver to pick the weakest signal is referred to as receiver sensitivity. The higher the receiver sensitivity, the better the performance. There are circuits that measure the signal strength based on the output voltage. If the signal strength is good, the output voltage is higher and the output voltage is poor if the signal strength is low.

A mobile handset which is moving in a cell will record a signal strength that varies. Signal strength is subject to slow fading, fast fading and interference from other signals, resulting in degradation of the carrier-to-interference (C/I) ratio. A high C/I ratio yields quality communication. A high C/I ratio is achieved in cellular systems by using optimum power levels through the power control of most links. When carrier power is too high, excessive interference is created, degrading the C/I ratio for other traffic and reducing the traffic capacity of the radio subsystem. When carrier power is too low, C/I is too low and quality of service (QoS) targets are not met. Ideally, the C/I ratio should be as high as possible, and the ratio of received pilot energy (Ec) to total received energy or total power spectral density (Io) value (Ec/Io) should be as low as possible. Cisco does not determine any acceptable values. These values are determined by the cellular carriers. In situations in which high Ec/Io values are observed and a low Received Signal Strength Indicator (RSSI) value, a site survey is necessary to determine how to achieve better characteristics of the signal.

Because of these performance characteristics, the sweet spot for the 3G HWIC is non-real time, sub-512Kbps applications. As networks evolve, latencies decrease and QoS becomes available, real-time applications such as VoIP become viable.

Quality of Service

Currently, air-link and Radio Access Network (RAN) QoS are not available on production cellular networks. Therefore, while the traditional IP QoS are available on the ISRs and on the 3G HWIC interface, there is no mapping to the air-link. The Cisco IOS QoS capabilities may be leveraged to improve the application experience. Techniques such as congestion management, congestion avoidance, policing and shaping, and MQC (Modular QoS CLI) are all useful. For more information, see:

http://www.cisco.com/en/US/partner/docs/ios-xml/ios/isg/configuration/12-2sr/isg-12-2sr-book.html

Since 3G uses shared access, the output field of BandWidth (BW) from **show interface** reflects the theoretical bandwidth available (such as 1.8 Mbps for EV-DO Rev A) and not the actual bandwidth. Instantaneous downlink network speeds may be 2 Mbps or 300 Kbps.