devCentral

UMTS Capabilities, Technology, and Applications

devCentral White Paper

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AT&T Wireless Developer Program

AT&T Wireless

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Revision History

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04/21/04	1.0	Initial Release

Table of Contents

Figures

Table of Contents

Tables

1. Introduction

AT&T Wireless is the first carrier in North America to deploy Universal Mobile Telecommunications System (UMTS), a pioneering wireless technology that is being adopted by operators globally. This technology promises to be the dominant cellular technology by the end of the decade. As with its national deployment of EDGE technology, AT&T Wireless Services is demonstrating its leadership in the mobile market by creating new customer experiences, content, and economic opportunities for the future. During 2004, AT&T Wireless Services will deploy UMTS in four cities in the United States.

UMTS uses radio technology called Wideband Code Division Multiple Access (WCDMA). UMTS/WCDMA is not a replacement for GSM. Rather it is a complementary technology that allows the two network technologies to coexist, and allows devices to access either network. It provides a seamless upgrade for GSM networks, increasing voice capacity and significantly enhancing data capabilities through higher speeds and lower latency. Customers can keep using existing GSM/GPRS/EDGE devices, or can purchase new UMTS devices that operate on the UMTS network and that operate on the AT&T Wireless Services GSM/GPRS network (the ability to work on both networks is device-dependent). These same devices can also roam globally on GSM/GPRS networks.

This white paper includes a discussion of UMTS capabilities; a comparison of UMTS with GPRS/EDGE; an explanation of how the AT&T Wireless UMTS Network functions; and guidelines for developing and deploying UMTS applications.

1.1 Audience

The paper has been developed for corporate developers, Independent Software Vendors (ISVs), system integrators, and AT&T Wireless sales organizations. This paper assumes some knowledge of data communications and assumes a partial understanding of GPRS and EDGE. For those who are not familiar with GPRS and EDGE, please refer to the companion white paper, *EDGE: Capabilities, Technology and Applications*.

1.2 Contact Information

E-mail comments or questions regarding this document to developer.program@attws.com. Please reference the title of this document in your e-mail.

Peter Rysavy, Author, http://www.rysavy.com

1.3 Resources

1.3.1 AT&T Wireless Resources

Details of services provided specifically by AT&T Wireless were obtained through interviews with AT&T Wireless personnel and from private internal documents.

Secure Application Deployment with GPRS/EDGE document number 12792
http://www.attws.com/developer/network/

IP and APN Management in the AT&T Wireless Services GPRS/EDGE Network, document number 12495
http://www.attws.com/developer/network/

EDGE Capabilities, Technology, and Applications, document number 13218
http://www.attwireless.com/developer/network/edge/

1.3.2 Other Resources

3G Americas white paper: *Data Capabilities for GSM Evolution to UMTS* (November 19, 2002), Peter Rysavy, Rysavy Research
http://www.3gamericas.com/PDFs/rysavy_paper_nov19.pdf

3GPP TS 23.060 V3.16.0 (2003-12), 3rd Generation Partnership Project; General Packet Radio Service (GPRS); Service description; Stage 2 (Release 1999)
http://www.3gpp.org/ftp/Specs/archive/23_series/23.060/23060-3g0.zip

3GPP TS 27.007 V3.13.0 (2003-03), 3rd Generation Partnership Project; AT command set for User Equipment (UE), (Release 1999)
http://www.3gpp.org/ftp/Specs/2003-12/R1999/27_series/27007-3d0.zip

3G Wireless Demystified, Lawrence Harte, Richard Levine, Roman Kikta. McGraw Hill 2002
http://books.mcgraw-hill.com/cgi-bin/pbg/0071363017.html

1.4 Terms and Acronyms

Table 1 defines terms and acronyms used in this document.

Table 1: Terms and Acronyms

Term or Acronym	Definition
3GPP	Third Generation Partnership Project
AAC	Advanced Audio Coding
AMR	Adaptive multi-rate
API	Application Programming Interface
APN	Access Point Name
BSC	Base Station Controller
BTS	Base Transceiver Subsystem
CDMA	Code Division Multiple Access
CDPD	Cellular Digital Packet Data
Communication Manager	A program that provides a friendly user interface and AT&T Wireless Services branding for a connectivity package where the functionality (configuring/creating a connection and data transmission optimization) is provided.
CSS	Cascading Style Sheets
EDGE	Enhanced Data Rates for Global Evolution or Enhanced Data Rates for GSM Evolution
e-Wallet	A functionality that allows customers to purchase items and services using mMode and a Personal Web site without having to fill out an e-form every time a purchase is made. The e-Wallet enables customers to store their billing, shipping and credit card information on a secure server so it is readily available from their wireless handset as well as their Personal Web site.
GGSN	Gateway General Packet Radio Service (GPRS) support node
GMSK	Gaussian Minimum Shift Keying
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
HSDPA	High Speed Downlink Packet Access
HSUPA	High Speed Uplink Packet Access
HTML	Hypertext Markup Language
HTTP	Hypertext Transport Protocol

Term or Acronym	Definition
IEEE	Institute of Electrical and Electronics Engineers
IMS	IP-based Multimedia Services
IP	Internet Protocol
IR	Infrared
ISV	Independent Software Vendor
ITU	International Telecommunications Union
J2ME	Java 2 Micro Edition
kbps	Kilobits per second
kHz	Kilohertz
Mbps	Megabits per Second
MHz	Megahertz
mMode	An AWS consumer offer, introduced in April 2002 that provides easy access to a variety of communication, information, and entertainment services from a wireless phone. With mMode the customer can e-mail friends, check news or sports scores, get driving directions, check airline flight times, or play games, among many other possibilities.
MMS	Multimedia Message Service
MP3	Motion Picture Experts Group 1 Layer 3: A method of compressing music files. MP3 files are about one-tenth the size of uncompressed audio files. On a compact disk (CD), each minute of music takes up about 10 megabytes of space. With MP3 compression, the same four-minute song would take up about four megabytes, and would sound almost as good as the original, 40-megabyte file.
MPEG	Motion Pictures Expert Group: Industry organization developing standards and specifications for the encoding and transmission of video information over various media and network technologies.
MS	Mobile Station (mobile computer plus communications device)
MSISDN	Mobile Subscriber Integrated Digital Services Network
MTU	Maximum Transmission Unit
NAT	Network Address Translation
PC	Portable Computer
PCU	Packet Control Unit
PDA	Personal Digital Assistant
PDCP	Packet Data Convergence Protocol
PDP	Packet Data Protocol
PIN	Personal Identification Number
POP3	Post Office Protocol 3

Term or Acronym	Definition
PSK	Phase Shift Keying
RNC	Radio Network Controller
SGSN	Serving GPRS Support Node
SIM	Subscriber Identity Module
SMS	Short Message Service
TCP	Transmission Control Protocol
UE	User Equipment
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial Bus
UTRAN	UMTS Radio Access Network
VPN	Virtual Private Network
WAP	Wireless Application Protocol
WCDMA	Wideband Code Division Multiple Access
WCO	Wireless Connectivity Option
Wi-Fi	Wireless Fidelity
WLAN	Wireless Local Area Network
WMA	Windows Media Audio
XHTML	Extensible Hypertext Markup Language

2. UMTS Capabilities

2.1 Overview

The AT&T Wireless UMTS network offers a number of significant capabilities (especially for data services), and is ideal for both office productivity applications and vertical-market applications. Consumers can enjoy multimedia capabilities enabled by the high data rates of UMTS, previously unavailable using GPRS and EDGE networks. Specifically, the network and associated services and devices offer business users the following advantages:

- Attractive new phones with large color displays
- Simultaneous voice and data operation (may be supported)
- Operation over both UMTS and GSM/GPRS networks
- Voice handover between UMTS and GSM networks (may be supported)
- High speed data services with peak rates of up to 384 kbps and expected typical throughput rates of 200 to 300 kbps
- Network latency that is lower than that of GPRS/EDGE, further improving application performance
- A UMTS modem card for data-intensive applications (may be provided after commercial launch)
- Practical use of notebook computers for general-purpose communications
- Java support on phones
- Multiple tethering options for phones including Bluetooth, IR and USB cable
- A utility called Communication Manager that configures and manages connections and provides connection status (may be provided)
- An optimization client for streamlining POP3 mail and HTTP Web sessions
- Compatibility with major Virtual Private Network (VPN) products

Meanwhile, users can take advantage of the following:

- A more enhanced mMode user interface
- Improved mMode offerings through richer multimedia content, including both streaming media and downloadable content
- Support for traditional file formats such as MPEG, MP3, Windows Media Audio (WMA), iTunes Advanced Audio Coding (AAC), and new wireless-optimized multimedia file formats.

UMTS technology is not standing still. AT&T Wireless Services is deploying a rich set of initial capabilities. However, international standards bodies have already defined new capabilities for successive versions of UMTS, all of which are fully backward compatible. Examples include quality-of-service control, higher speeds and enhanced security options. If you adopt UMTS technology today, you can enjoy its benefits immediately, yet take advantage of its evolving capability and global deployment.

2.2 Supported Data Applications

What are some of the applications that are possible using UMTS? Like EDGE, almost any application that works over the Internet or your private IP network is a good candidate for UMTS.

With UMTS you can use the same applications as with GPRS/EDGE, including e-mail, group collaboration, instant messaging, and SMS. But with UMTS throughput rates are higher, enabling you to transfer larger files, and for applications to be even more responsive. In addition, with UMTS the following types of applications may be feasible:

- E-mail with large attachments
- General-purpose Web browsing
- Virtual private networking
- Complex database transactions
- Multimedia (video/audio streaming and downloading)
- Picture and video messaging
- WAP-based applications with rich content
- Intranet access to enterprise applications

- Web-based enterprise applications including enterprise resource planning, customer relationship management, and sales force automation

2.3 Voice Support

Though this paper emphasizes UMTS data services, some readers may be curious about UMTS voice services. In general, these function just as they do for GSM.

While in a UMTS coverage area, you may be able to maintain simultaneous voice and data sessions (this capability may not be available at service launch). For example, you could be on a voice call while downloading e-mail to your notebook computer over a Bluetooth connection. After you are in a GSM/GPRS coverage area where UMTS is not available, you must choose between voice or GPRS data. SMS, however, is always available at the same time as voice.

AT&T Wireless uses the same voice mail platform for both its GSM and UMTS customers.

2.4 UMTS Compared to EDGE, GPRS, and Wi-Fi

It is important to understand the capabilities of UMTS relative to other wireless technologies so you can determine which network to use for what applications.

The primary way of comparing these technologies is based upon coverage area and throughput performance. Today, more areas in the world are covered by GSM/GPRS than any other wireless technology. With GPRS, users can expect typical data rates of 30 to 40 kbps. Enhanced Data Rates for GSM Evolution (EDGE) is an enhancement to GPRS that triples data throughputs to typical rates of 100 to 130 kbps, and doubles network capacity. Dozens of operators globally have committed to EDGE deployments, including AT&T Wireless Services, which has deployed EDGE nationally throughout its footprint.

UMTS doubles typical data rates over EDGE, reaching up to 200 to 300 kbps (Source: *Data Capabilities for GSM Evolution to UMTS,* referenced in Section 1.3.2). In fact, with UMTS networks, peak rates over two Mbps are possible, though current devices are limited to a peak rate of up to 384 kbps. UMTS in the United States will be available from AT&T Wireless Services in four cities. Meanwhile, operators are bringing UMTS online throughout Asia and Europe. The end of 2004 expects some 50 UMTS networks worldwide.

Wi-Fi technology, including technology based on IEEE 802.11a, b, and g standards offers throughput rates that are even higher, up to 54 Mbps in bursts and 20 to 30 Mbps on average with the newer standards. However, coverage areas are extremely small compared to cellular, with a maximum range of about 100 meters. Operators, including AT&T Wireless, are increasingly offering Wi-Fi in public areas. The broadband nature of Wi-Fi is highly attractive where available, but overall, hotspot coverage areas constitute only a tiny fraction of the coverage offered by cellular networks. Table 2 compares the different wireless data services offered by AT&T Wireless Services.

Table 2: Characteristics of Wireless Networks Offered by AT&T Wireless Services

EDGE	UMTS	Wi-Fi Hotspot
Suitable for most communications-oriented applications Typical throughput rates of 100 to 130 kbps National footprint Consistent service from a single service provider Supports both stationary and mobile users	Suitable for nearly all communications-oriented applications, including multimedia Typical throughput rates of up to 200 to 300 kbps Available in four cities from AT&T Wireless, but expected to be available globally in several years Supports both stationary and mobile users	Well suited for transfer of large amounts of data Typical throughput rates of five Mbps Available in specific hotspot locations such as airports and hotels Supports stationary users only

Another factor to consider is that the different technologies offer different throughput depending on the degree of mobility. For example, you can expect higher throughputs when stationary compared to when driving.

2.5 Device Capabilities

UMTS devices are currently available in two form factors: mobile telephones and PC Card modems. Mobile telephones currently available for use in the United States are all capable of UMTS and GSM/GPRS operation.

UMTS phones are rich with features, and nearly all of them include large color displays, WAP 2.0 browsers, video viewing capability, audio capabilities, Java support, SMS, and MMS. Data applications on the phone can use the phone's micro browser (XHTML plus cascading style sheets), or can execute on the phone's Java platform or any other execution environment that may be available on the device. Alternatively, the application can operate on a notebook computer or PDA, using the phone as a data modem. Attachment options include a USB cable, IR or Bluetooth.

Note: Not all phones have exactly the same capabilities. For example, most, but not all, UMTS phone models support USB, IR, and Bluetooth. Further, while every UMTS phone that AT&T Wireless Services offers supports GSM, not every phone supports voice handover from UMTS to GSM. Other features may vary as well. With this in mind, you should investigate the exact features you will need on a per-device basis.

AT&T Wireless Services also plans to offer a UMTS PC Card modem. This modem will only function on the UMTS network.

2.6 Value-Added Service Offerings

Nearly all of the value-added service offerings available today for GSM/GPRS/EDGE are also available for the UMTS network. This includes: multimedia services over mMode, SMS, MMS, Communication Manager, Optimization Client, and e-Wallet. The only exceptions are custom APNs and the Wireless Connectivity Option (WCO).

3. How the AT&T Wireless UMTS Network Operates

To explain how the AT&T Wireless UMTS network works, this section describes the global phenomenon of GSM to UMTS evolution. It then examines the architecture, the WCDMA radio link, how IP networking functions, IP and APN management, roaming considerations, data throughput and latency, security mechanisms, and finally the evolution of UMTS itself.

3.1 GSM to UMTS Evolution

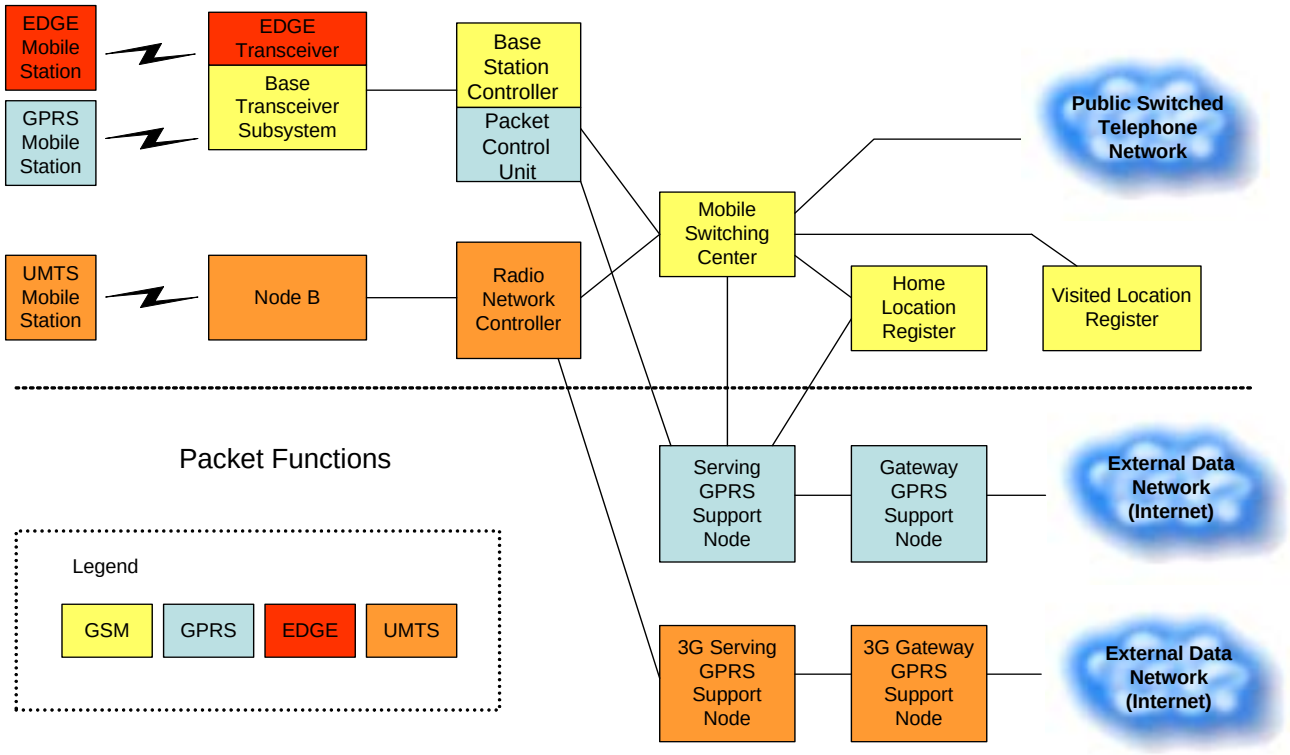
Today, GSM is the most mature and most broadly deployed cellular technology in the world. Data services for GSM include GPRS and EDGE. UMTS is a next-generation cellular technology standardized by international standards organizations that include the Third Generation Partnership Project (3GPP) and International Telecommunications Union (ITU). The ITU classifies UMTS as an official third generation (3G) technology. UMTS has been designed so that it can co-exist with GSM/GPRS/EDGE, which allows operators to gradually deploy it for enhanced services and increased capacity. Globally, UMTS has garnered the overwhelming majority of new 3G spectrum licenses, and over 100 carriers are planning on deploying UMTS networks.

3.2 Architecture

UMTS uses the same fundamental architecture for voice and data services as GSM/GPRS/EDGE. UMTS is divided into the UMTS Terrestrial Radio Access Network (UTRAN) and the UMTS core network. Operators can use the same core network (consisting of the mobile switching centers and packet data nodes) for both the GSM/GPRS/EDGE radio access network and the UTRAN. In its initial deployment, AT&T Wireless is using the same mobile switching centers for both GSM and UMTS, but separate packet data infrastructure, which includes the serving GPRS support node and gateway GPRS support node. See Figure 1.

Note: In UMTS terminology, packet data functions are still referred to as General Packet Radio Service (GPRS).

Figure 1: AT&T Wireless GSM/GPRS/EDGE/UMTS Network



The biggest difference between GSM/GPRS/EDGE networks and UMTS networks is in the radio access network. UMTS uses a wideband CDMA radio interface that is described in the next section. However, the structure of the radio access network is similar to GSM. A UMTS base station, called a Node B, connects to a Radio Network Controller (RNC), which corresponds to the GSM Base Station Controller (BSC). The RNC connects to the core network just like the BSC.

For more details about the UMTS data architecture, refer to the 3GPP specification for data service in UMTS: TS 23.060 V3.16.0 (2003-12), General Packet Radio Service (GPRS); Service description, Stage 2 referenced in Section 1.3.2.

3.3 Wideband CDMA Radio Technology

UMTS uses a radio channel called Wideband CDMA. It is called wideband because the radio channel is 5 MHz wide. Compare this with the 200 kHz radio channels used in GSM, or 1.25 MHz radio channels used in

CDMA2000. The wideband nature provides for both high-speed data channels (eventually as high as 10 Mbps), as well as for flexible real-time allocation of resources between voice and data.

Code Division Multiple Access (CDMA) refers to a process where each bit intended for transmission is spread by a pseudo-random code into a sequence of bits that are referred to as chips. By knowing the code used, the receiver can extract the original signal used. The overall chipping rate of the 5 MHz radio channel is fixed at 3.84 Mchips/sec.

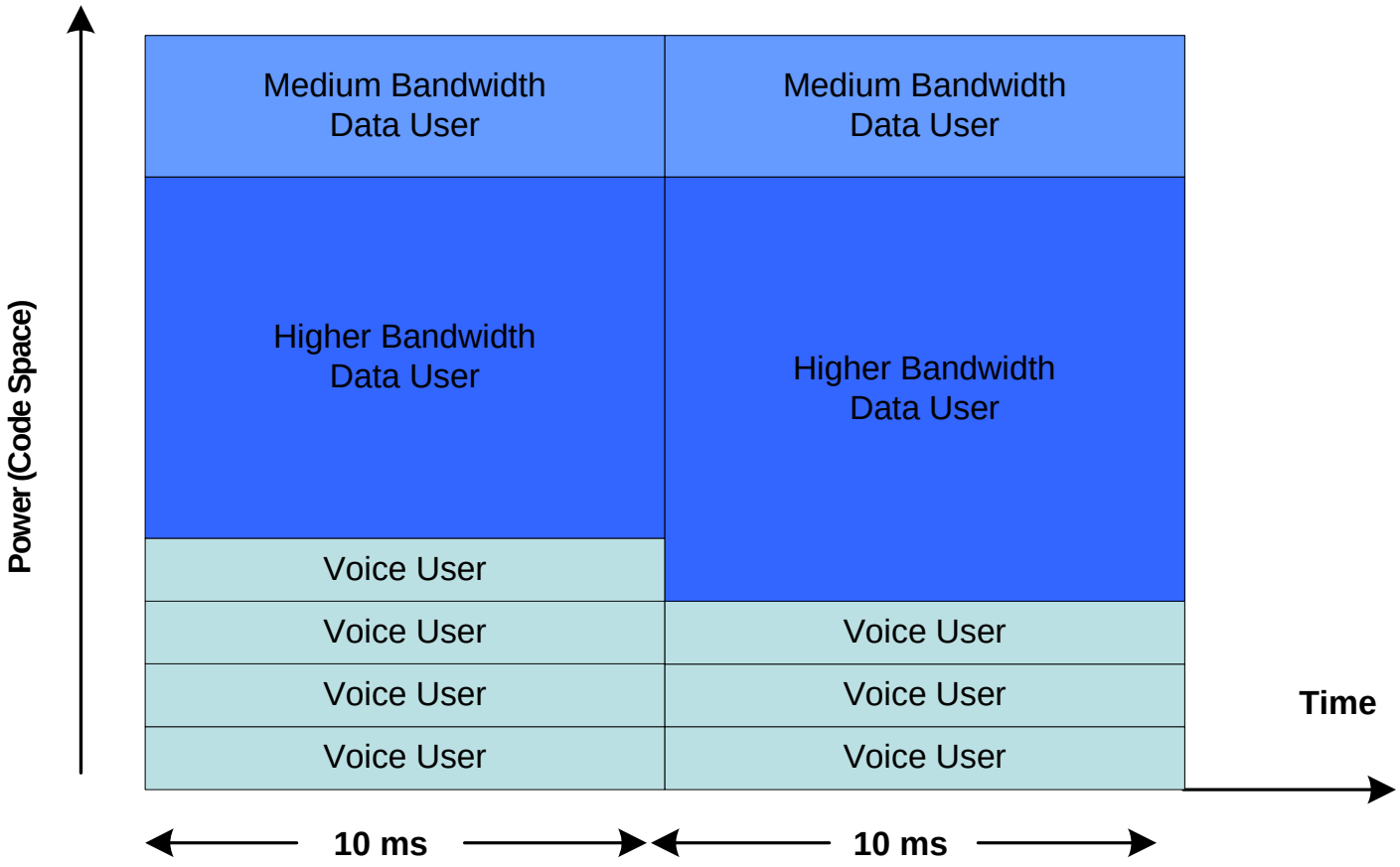
The amount of spreading determines the speed of the channel and how many such channels are available in the cell sector. With greater spreading, such as used for voice, there is greater redundancy in the data stream and more channels can be employed. In contrast, a high-speed data channel has less spreading, and the radio channel can carry only a fewer number of such channels.

Due to the fixed chipping rate, the code space of the channel is finite. In UMTS, voice channels use a spreading factor of 128, whereas a 384 kbps data channel uses a spreading factor of eight. The commonly quoted rate of over two Mbps throughput for UMTS is achieved by combining three data channels each with a spreading factor of four. This capability will be available in future devices.

Through management of the code space, the WDCMA radio channel can support a large number of users, simultaneously carrying voice traffic, narrowband data traffic, broadband data traffic and network signaling information. Because the WCDMA radio channel contains both voice and data transport channels, a UMTS phone can do simultaneous voice and data communications simply by simultaneously employing separate spreading functions for each service.

Relative to GSM, WDCMA is spectrally more efficient, and has greater flexibility and control over the type of data communicated. The WDCMA radio channel can adjust the allocation of code space every 10 ms, allowing the network to dynamically assign the amount of radio resource for different users. Figure 2 is an example of different code space allocations to users. The network can support a far greater number of users than shown in the figure.

Figure 2: Example of Dynamic Allocation of Resources in UMTS



Source: *3G Wireless Demystified* referenced in Section 1.3.2.

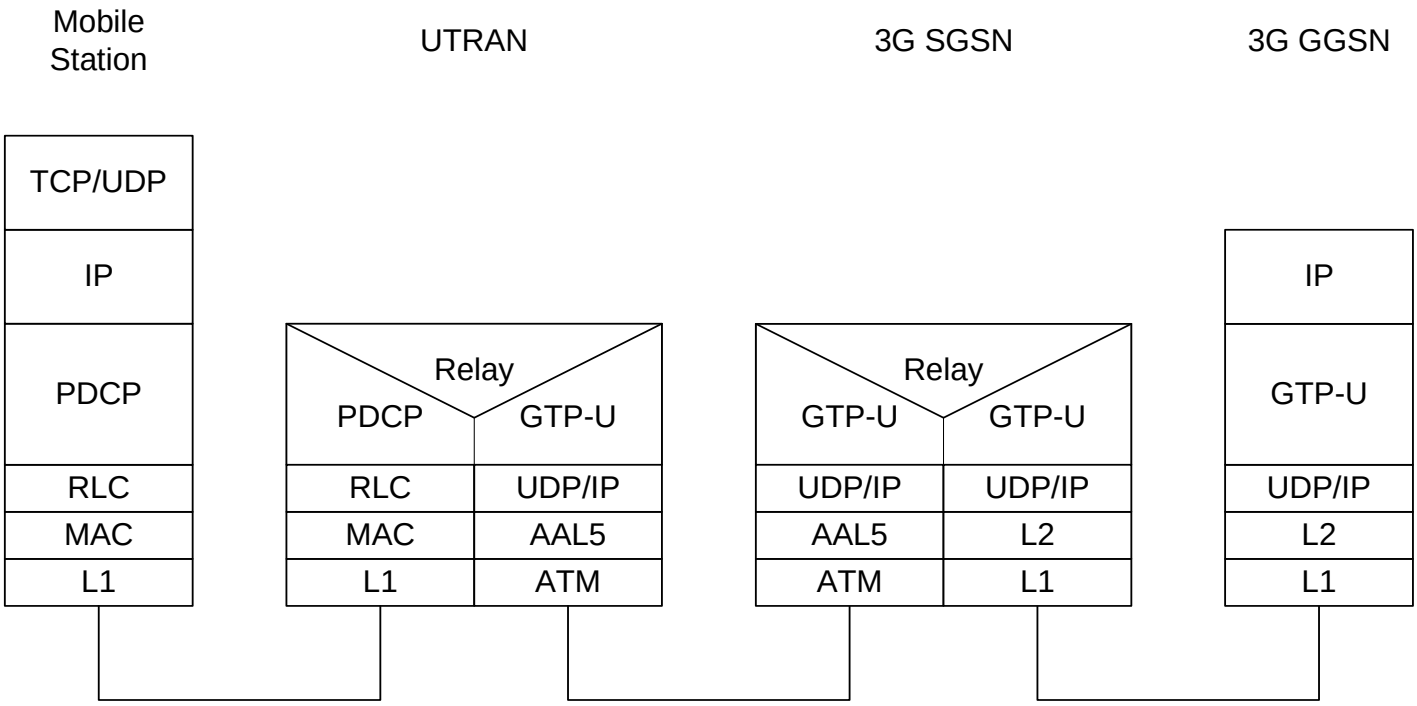
3.4 IP Networking

Like GPRS/EDGE, the UMTS network relays IP packets between mobile stations and external networks. Mobile stations are assigned an IP address when they invoke a data session, called a Packet Data Protocol (PDP) Context. From that point onward, the mobile station can transmit IP packets to external networks and receive IP packets from external networks.

To carry IP packets through the UMTS infrastructure, a variety of other protocols are employed, as shown in Figure 3. These relay the IP packets to the Gateway General Packet Radio Service (GPRS) Support Node (GGSN), a routing node that communicates with external networks. Understanding the UMTS protocols is not necessary for developing

applications. To obtain further details, interested readers can refer to the 3GPP specification for data service in UMTS: TS 23.060 V3.16.0 (2003-12), General Packet Radio Service (GPRS); Service description, referenced in Section 1.3.2.

Figure 3: Data Communication Protocols for UMTS



AAL: ATM Adaptation Layer
ATM: Asynchronous Transfer Mode
GTP-U: GPRS Tunneling Protocol - User Plane
PDCP: Packet Data Convergence Protocol
RLC: Radio Link Control
RLC: Radio Link Control
MAC: Medium Access Control
PPP: Point to Point Protocol
UTRAN: UMTS Terrestrial Radio Access Network

Source: 3GPP 23.060, referenced in Section 1.3.2.

In communications with external networks, the AT&T Wireless UMTS network currently supports communications via the Internet only. The AT&T Wireless Services Wireless Connectivity Option (WCO) is not available, meaning neither frame relay permanent virtual circuits nor the network VPN. Customers wishing to secure communications to their networks are advised to use their own VPNs. The high data throughput capabilities of UMTS make VPNs particularly effective.

3.5 IP Address and APN Management

UMTS uses the same approach to IP packet handling and Access Point Names (APNs) as GPRS/EDGE. The APN specifies the external networks that a mobile station is able to access. It also defines the type of IP address to use, security mechanisms to invoke, available value added services, redundancy, and fixed-end connections.

How IP addresses and APNs are managed is not part of the UMTS specification but is controlled by the operator. In the case of the AT&T Wireless UMTS network, IP address management options and APNs are a subset of what is available for the AT&T Wireless GPRS/EDGE network. IP addresses can either be private or public. With private IP addresses, the network performs Network Address Translation (NAT) between the private IP address assigned to the mobile station and a public IP address used for external communications. With public IP addresses, there is no address translation.

At this time, the UMTS network supports the general-purpose APNs named public and proxy, as detailed in Table 3. Custom APNs are not currently available.

Table 3: APN Support in the AT&T Wireless UMTS Network

APN	proxy	public
Packet Data Protocol (PDP) Name	WAP PDP service	Public IP PDP service
IP Addresses	Private	Public
Who Provides IP Addresses	AT&T Wireless	AT&T Wireless
Static IP Address	No	No
Dynamic DNS	No	No
Allow Mobile Terminated Data	No	No
Access to Web Optimization	Yes	Yes
Access to Dedicated Fixed-End System Connections	No	No
Access to Internet	Yes	Yes
Usage	Most commonly used APN for consumer data plans. Required for mMode	Only used when the customer's application requires a public IP address

For further information about these APNs, refer to *IP and APN Management in the AT&T Wireless Services GPRS/EDGE Network,* referenced in Section 1.3.1.

3.6 Roaming

If you have UMTS service, there may be times you find yourself in the coverage area of another operator. AT&T Wireless has roaming agreements for GSM/GPRS/EDGE with other operators worldwide, allowing you to use the same phone or PC modem card as you use in the United States.

Note: Roaming capabilities are device-dependent.

AT&T Wireless UMTS phones are capable of GSM/GPRS operation in multiple bands, including 850 MHz and 1900 MHz (common in the Americas) and 900 MHz and 1800 MHz (common in Europe). This allows you to use your UMTS phone in other parts of the world.

Currently you will not be able to roam onto any partner UMTS networks because the AT&T Wireless UMTS network operates in the 1900 MHz band, which is a different band from the 2100 MHz band used for UMTS networks in Asia and Europe.

The specific set of supported frequencies varies by phone, so if you wish to use your phone on partner networks you should check to see what frequencies your phone supports.

For the most current details on international roaming options for GSM/GPRS/EDGE, please visit the following AT&T Wireless Web site: http://www.attwireless.com/business/plans/international/disc_roaming.jhtml

When moving from a UMTS coverage area to a GSM coverage area, UMTS phones may be able to maintain a voice call. However a UMTS data connection will terminate and a new data connection must be initiated using GPRS.

3.7 Data Throughput and Latency

The AT&T Wireless UMTS network offers customers data throughput speeds higher than any previous network that AT&T Wireless Services has offered, twice as high as EDGE, more than five times higher than GPRS, and some twenty-five times higher than CDPD. Current devices are designed for peak speeds of 384 kbps. Under typical operating

conditions, user can expect average speeds that range from 200 to 300 kbps for downloads. In comparison, GPRS users can expect 30 to 40 kbps (from a four time-slot device) and EDGE users can expect 100 to 130 kbps (from a four time-slot device). UMTS users can expected data upload rates of approximately 64 kbps.

Note: Actual throughputs depend upon a large number of factors, including network loading, movement speed, and signal quality.

As discussed in Section 3.3 Wideband CDMA Radio Technology, the radio link and network are capable of throughput speeds greater than two Mbps. However, devices that operate at this speed are not yet available. For future networks, 3GPP has also specified an enhanced version of UMTS (available in Release Five) that includes a feature called High Speed Downlink Packet Access (HSDPA). HSDPA will offer peak downlink speeds as high as 10 Mbps, faster than any other cellular technology. AT&T Wireless Services may offer this capability in the future. While the service is not available today, HSDPA illustrates how UMTS provides a compelling roadmap of capabilities to serve future computing needs.

Not only does UMTS provide higher data rates, it also has lower latency (the time it takes packets to traverse the network). For some applications, latency is as important as data throughput, particularly for time sensitive applications such as interactive and streaming multimedia, Web browsing of complex pages with multiple objects, and for applications that send a lot of back and forth traffic (database transactions). The latency of UMTS, as measured by round trip time from the mobile station to a node immediately external to the UMTS network, is expected to be 200 to 250 ms in comparison; GPRS/EDGE latency is about 600 ms.

3.8 Security

The security mechanisms provided by the AT&T Wireless UMTS network are the same as those used in the AT&T Wireless GPRS/EDGE network. These mechanisms include:

- Authentication of the mobile station against credentials stored in the Subscriber Identity Module (SIM) card.

  Note: AT&T Wireless UMTS devices use the same type of SIM card as used in GSM/GPRS/EDGE devices.

- Optional Personal Identification Number (PIN) protection of the user device.
- Encryption of data communications between the mobile station and the SGSN.
- Protection of the AT&T Wireless network infrastructure against intruders through use of private networks and firewalls.
- Compatibility with VPN technology so customers can secure data sessions on an end-to-end basis.

If you are using a VPN, you might want to consider a wireless-specific VPN solution as these offer performance advantages through data compression and mobility management that allows you to maintain sessions even as you change the underlying network, such as moving from a WLAN coverage area to a UMTS coverage area.

UMTS specifications define enhanced security architecture, including mutual authentication of mobile station and network, as well as advanced encryption algorithms. AT&T Wireless may deploy these mechanisms in the future.

For more details, refer to Secure *Application Deployment with GPRS/EDGE*, referenced in Section 1.3.1.

3.9 UMTS Evolution

This paper has mentioned some of the forthcoming capabilities of UMTS, such as High Speed Downlink Packet Access (HSDPA). Technology experts worldwide are continuing to improve UMTS, empowering it with new capabilities that operators can phase in over time. AT&T Wireless has deployed UMTS Release 99, the first deployable version of UMTS. Release 99 contains additional features such as video conferencing over circuit-switched connections that AT&T Wireless Services has not yet implemented. After Release 99, version numbers are by release version rather than by year, and currently include Releases 4, 5, and 6. These successive versions add features such as:

- High Speed Uplink Packet Access (HSUPA)
- Comprehensive multimedia capabilities through a subsystem called IP-based Multimedia Services (IMS)
- Handling of voice functions in the packet domain (voice over IP)
- Integrated support for access networks based on WLAN

- Common radio resource management between GSM, GPRS, EDGE, and UMTS

Note: All successive versions are backward compatible with prior versions, and all integrate support for GSM/GPRS/EDGE. UMTS is not intended to replace GSM/GPRS/EDGE, but rather to augment these technologies. Eventually, UMTS operators may phase out their GSM/GPRS/EDGE networks, but this will not occur for many years.

4. Application Development and Deployment

Compared to GPRS/EDGE applications, the latency and throughput advantages of UMTS enable applications such as multiplayer gaming, streaming audio and video, and latency-sensitive enterprise applications such as complex database transactions.

In developing and deploying wireless applications that take advantage of UMTS you should consider the platform you are using, how wireless applications differ from wire line applications in general, IP addressing options, and other items unique to UMTS.

4.1 Platform Considerations

The type of platform you use determines many of your development options. These are summarized in Table 4.

Table 4: UMTS Development Options for Different Platforms

Platform	Application Development Options
Mobile Telephone	Micro browser using Wireless Application Protocol. Under UMTS coverage, much richer content is feasible Java 2 Micro Edition (J2ME) on mobile phones Short Message Service (SMS) and Multimedia Messaging Service (MMS) available on all phones. Device capability and network interfaces are all comparable to GPRS/EDGE
PDA	Currently, no PDA devices have UMTS capability
Notebooks	Standard IP networking. Extensive development tools for a variety of notebook platforms Applications can be client/server or browser-based UMTS is compatible with nearly all VPNs

4.2 General Wireless Considerations

UMTS provides a high-speed data channel, facilitating the deployment of almost any IP-based communications application. With its high speed and low latency, UMTS improves the user experience for nearly all applications, especially those that demand high networking performance including some database applications, multimedia (e.g., voice over IP), and rich Web content.

UMTS is a wireless technology and there are considerations that apply to wireless connections regardless of their type and speed. First and foremost, connections may not always be reliable, especially if users are moving or have a weak signal. Hence, you should design your applications accordingly. And despite the speeds of UMTS, the application will be the most responsive if it makes efficient use of the network. You may want to consider using wireless middleware solutions which, depending on the vendor, can perform functions such as optimizing network communications, providing security functions, or providing mobile access to specific application servers.

Another decision is whether to use a client/server or browser approach. Finally, your users will be happiest if the user interface gives them control over network activity, including the ability to abort lengthy operations or to see progress indicators. These and other topics are discussed on AT&T Wireless Services devCentral Web site at the following URL: http://www.attwireless.com/developer/network/buildingWireless/

Programming considerations for SMS, MMS, and Java are essentially the same for UMTS as for GPRS/EDGE. For further information, please refer to the AT&T Wireless Services devCentral Web site at the following URL: http://www.attwireless.com/developer/technologies/

4.3 IP Addressing Considerations

Like GPRS/EDGE, the AT&T Wireless UMTS network is IP-based, and acts as a wireless extension of the Internet and private networks. AT&T Wireless provides options for IP address management and how traffic is routed. Unlike GPRS/EDGE, however, no customizable options are available for IP addressing and APN management. Table 5 summarizes the IP addressing options that are available.

Table 5: Summary of IP Addressing Options

IP Address Attribute	Options
Public versus private	The default address is a dynamically assigned, private IP address. However, you can also request a public address for your account.
AT&T Wireless supplied versus customer supplied	All IP addresses used are supplied by AT&T Wireless Services. At this time, there is no option for customer-supplied IP addresses. Private addresses are assigned from the 10.0.0.0 (class A) address space.

IP Address Attribute	Options
Mobile terminated	For security purposes, the network prevents mobile terminated data communications (meaning communications not initiated by a mobile device). Consider alternate mechanisms such as client-based polling, SMS, or WAP push.

4.4 UMTS-Specific Considerations

In addition to general best practices for developing wireless applications as discussed in Section 4.2 General Wireless Considerations, there are some UMTS-specific items your application should address. These include the coverage area, network throughputs, difference in throughput between UMTS and GPRS connections, and knowing what network you are connected to.

The single most important item to know is what coverage area you are in. UMTS is currently only available in a limited number of cities, so if you want UMTS capabilities, you need to verify you are in a UMTS service area. In the markets that support UMTS, the coverage area is concentrated in the central business areas and is not a mirror image of the larger GSM/GPRS/EDGE coverage in that market.

An important application consideration is that many UMTS devices support both UMTS and GPRS modes of operation. This is useful as it greatly extends your data coverage area. However, as described Section 3.7 Data Throughput and Latency, there is a difference in throughput and latency between UMTS and GPRS. Ideally, your application should be able to function satisfactorily over a GPRS connection. However, some applications that demand the capabilities of a UMTS connection will not perform well if connected using GPRS.

If you are developing WAP content, application-programming interfaces are available for determining whether the connection type is UMTS or GPRS/EDGE. These are used when an application detects that the phone is UMTS capable. One API is called the Portal Direct API, a server-to-server interface that does not interact directly with the subscriber. This allows a content provider to query the AT&T Wireless Portal to determine whether the user's connection is UMTS or GPRS/EDGE. The other API, the Redirect API, redirects a user's browser to the AT&T Wireless Portal that returns the connection information to the content provider. -

4.5 Migrating Applications from GPRS/EDGE

From a performance perspective, any application that is suitable for the GPRS/EDGE network will function well on the UMTS network. However, there are additional considerations related to IP addressing and APNs. The AT&T Wireless UMTS network handles IP addressing and APNs in the say way as the GPRS/EDGE network, though currently only a subset of the APNs are available. These are the APNs named public and proxy. For a GPRS/EDGE application to function on the UMTS network, it needs to be able to work in conjunction with one of these APNs.