devCentral

UMTS for the Enterprise

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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1. Introduction

Operators worldwide are deploying Universal Mobile Telecommunications System (UMTS), an advanced and powerful cellular technology capable of supporting a wide range of enterprise applications. UMTS is designed to work seamlessly with GSM networks to provide voice service and enhanced data capability that includes broadband-speed throughput with low latency. The result is an integrated network that can support GSM, GPRS, EDGE, and UMTS.[1] Select new multi-mode devices will work with both GSM and UMTS.

This paper is written for enterprises considering UMTS technology as well as analysts, the media, and others interested in UMTS. It explains how UMTS successfully competes in the global cellular market, its capabilities and workings, how capabilities will dramatically increase over time, and how enterprises can best take advantage of UMTS. This paper also discusses aspect of the AT&T Wireless UMTS network.

Enterprises are increasingly using wireless technology to boost the productivity of their mobile workers as wireless data services become ever more effective. This paper shows that of all the wireless technologies available, UMTS has the most effective combination of capability, wide-area coverage where deployed, and global support from operators and suppliers alike.

AT&T Wireless is deploying UMTS in six cities in 2004. To enhance the effectiveness of UMTS, AT&T Wireless is working with a broad range of companies including those supplying network infrastructure, computer platforms, security software, and enterprise applications whether they be e-mail, database access, or enterprise resource planning.

For workers who are mobile in one of the six initial cities where AT&T Wireless is deploying service, UMTS offers wireless mobility at broadband speed.

[1] UMTS phones offered by AT&T Wireless do not support EDGE, but work on the GPRS network at GPRS speeds. UMTS modem cards offered by AT&T Wireless do not work on the GPRS or EDGE networks.

1.1 Audience

This paper has been written for enterprise managers, enterprise developers, independent developers, analysts, AT&T Wireless Alliances, content developers, and system integrators interested in UMTS. This paper assumes you have some understanding of wireless networking.

1.2 Contact Information

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

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2. Wireless Data Market

Through sheer market momentum and an open standards-based development environment, UMTS in all likelihood will become the dominant cellular technology over the second half of this decade. The reasons are clear. GSM/GPRS/EDGE provides the stable foundation for ubiquitous coverage. UMTS, with its advanced Wideband CDMA (WCDMA) radio interface, provides an overlay that increases voice capacity and provides advanced data services. The intent is not to replace the GSM/GPRS/EDGE foundation, but to augment these technologies. And in the same way that operators significantly enhanced GPRS throughput and capacity with EDGE technology, similar enhancements are planned for UMTS in a forthcoming technology called High Speed Downlink Packet Access (HSDPA).

The history of wireless data is one of constant innovation. The first nationwide wireless IP service was based on Cellular Digital Packet Data (CDPD) technology. Since then, operators worldwide (including AT&T Wireless) have deployed General Packet Radio Service (GPRS) and Enhanced Data Rates for GSM Evolution (EDGE). All these technologies are standards-based, use IP networking, and provide ready integration with enterprise applications connecting via the Internet or private networks. In the case of EDGE, AT&T Wireless was the first operator to deploy a national EDGE network in the United States. The result is the fastest national wireless data network in the U.S. today. The current GSM/GPRS/EDGE network offers interoperability with roaming networks worldwide, and due to the huge scope of global deployments, should be supported for many years by operators and suppliers alike.

AT&T Wireless continues to lead the market by launching UMTS service initially in Seattle, the San Francisco Bay Area, Detroit, Phoenix, and eventually in two other cities. Building on the global success of GSM that now has over a billion subscribers worldwide, UMTS technology has the overwhelming support of GSM operators as well as new 3G operators.[2] There are forty commercial UMTS networks already in operation in twenty-one countries, with sixty-one more in planning or currently being deployed.[3] UMTS is well past the trial stage and deployment is

[2] Current UMTS devices for the AT&T Wireless UMTS network only function on North American radio bands and do not support international UMTS frequencies.

[3] 3G Americas white paper “The Evolution of UMTS”, June 2004, based on the EMC database.

accelerating. The Shosteck Group states, “During 2007, we estimate 70 million new subscribers, bringing the total to 125-150 million...” In addition, the firm predicts that 110 million UMTS handsets will be sold in 2007.[4]

There are a various other broadband[5] wireless technologies available, and enterprises may wonder which to use. Many of these are either proprietary, have limited coverage and no mobility (e.g. Wi-Fi hotspots), or are not yet ready for commercial deployment. The complexity and challenges of wireless technologies cannot be underestimated. UMTS technology benefits from research and development that began in the early 1990s and has since received tremendous analysis, testing, trialing and commitment from many different suppliers including platform suppliers such as Intel, who states:

> *AT&T Wireless' deployment of UMTS networks will help extend the availability of ubiquitous wireless broadband data services. From Intel® Centrino™ Mobile Technology notebooks and tablets to Intel XScale™ technology based cell phones and handhelds, users can experience the benefit of wireless broadband connected anytime, anywhere.*

The only viable alternative to UMTS in the U.S. is a technology called CDMA2000 1xEV-DO. While not without technical merits, 1xEV-DO faces some challenges. One is the split in evolution between 1xEV-DO and 1xEV-DV technologies, which fragments the supplier base. The number of countries where operators are planning DO deployments is small compared to the number for UMTS. Also, by having to dedicate a radio channel for data only, 1xEV-DO operators face spectrum resource management challenges, especially as the amount of data traffic grows. In a scenario where the amount of traffic between voice and data can vary significantly during a day, UMTS offers far greater flexibility as it allows continual readjustment of resources across the whole available spectrum between voice and high-speed data traffic.

Finally, any technical advantage that DO technology may have should be nullified by the introduction of HSDPA. Since UMTS/HSDPA is likely to be deployed in many more markets it is expected to have greater support from device, platform, and application suppliers. The larger base should

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[4] The Shosteck Group (www.shosteck.com): Strategic Wireless Seminar, June 22-27, 2004 Tirennhia, Italy; white paper - “*UMTS - When and Why It Will Happen: Timetables and Forecasts”*, September 2003; The Shosteck Group E-Stats.

[5] Defined by the FCC as greater than 200 Kbps throughput in one direction.

create greater market efficiencies, lower costs, and consequently, the most competitive service.

Of all the available broadband wireless services, UMTS has the clearest evolutionary path and is the best positioned for global deployment and use.

3. UMTS Technology Capabilities

3.1 Benefits

A primary benefit of UMTS is its ability to support many types of communications-oriented applications. This is because of its broadband capability, including high throughput and low latency. AT&T Wireless' UMTS network will offer average download speeds of 220 to 320 Kbps, with bursts up to 384 Kbps. Latency, as measured by round-trip time through the network, is significantly less on the UMTS network than on the GPRS/EDGE network.

UMTS performance capabilities translate to a fundamental benefit, namely network transparency. UMTS does not impose its limitations on the application and can provide speeds comparable to a wireline experience when operating at peak performance.[6] Consequently, UMTS readily supports multiple application architectures whether Web-based or client/server applications that were built for low-latency, high-speed office LANs. Companies can leverage their large investments in application software by extending it wirelessly to their mobile workforces.

Another benefit of UMTS is that it offers wide-area wireless coverage, as compared with Wi-Fi hotspots where coverage is extremely limited. In its initial deployments, one can think of UMTS as offering a metropolitan area hotspot service. Other benefits include multimedia and video capability, devices[7] that can fall back to GSM for voice or GPRS for data when outside of UMTS coverage, video capabilities, and a choice of attractive mobile telephones as well as a PC card modem.

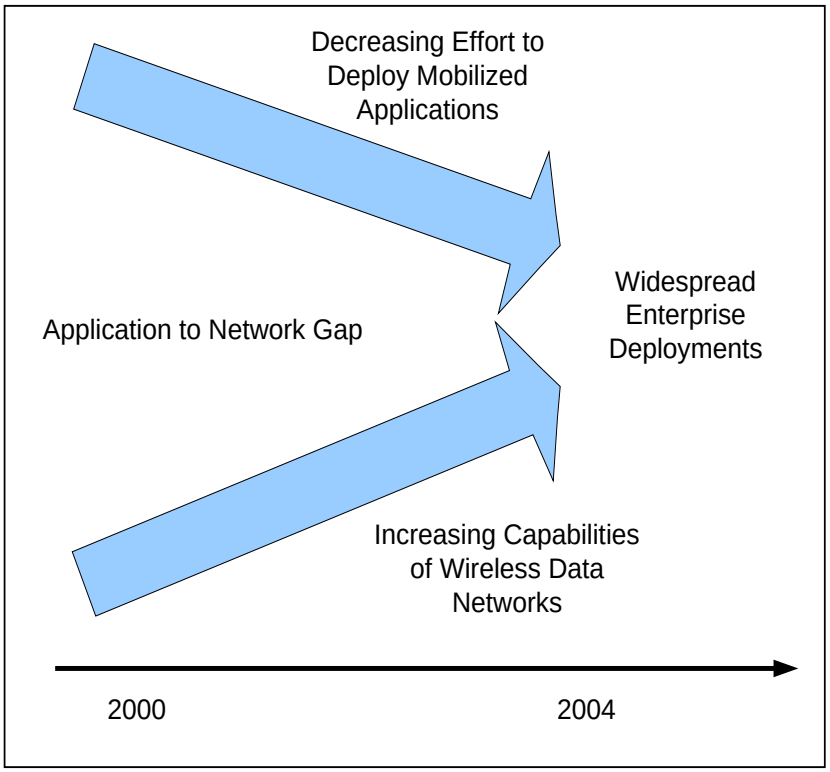
Enterprise customers benefit from another trend: nearly all major enterprise application suppliers are adding features to their programs so they perform better over wireless networks. Examples include Microsoft with Outlook 2003, Oracle with Oracle E-Business Suite 11i.10, and SAP with NetWeaver 2004. These features decrease the effort required to deploy a mobile application. In combination with the higher performance of next-generation networks, wireless-enhanced applications will work even better. As shown in Figure 1, this should result in widespread enterprise

[6] Actual user throughputs depend on many factors, including signal quality and network loading.

[7] Capabilities of devices vary.

deployments as enterprises realize significant productivity gains while minimizing design and implementation costs.

Figure 1: Widespread Enterprise Deployments of UMTS



UMTS also provides extensive security features. Subscriber Identity Module (SIM) cards ensure that only authorized devices can access the network. UMTS protects the radio link with a 128-bit encryption algorithm called Kasumi. In addition, UMTS is compatible with mainstream VPN technologies.

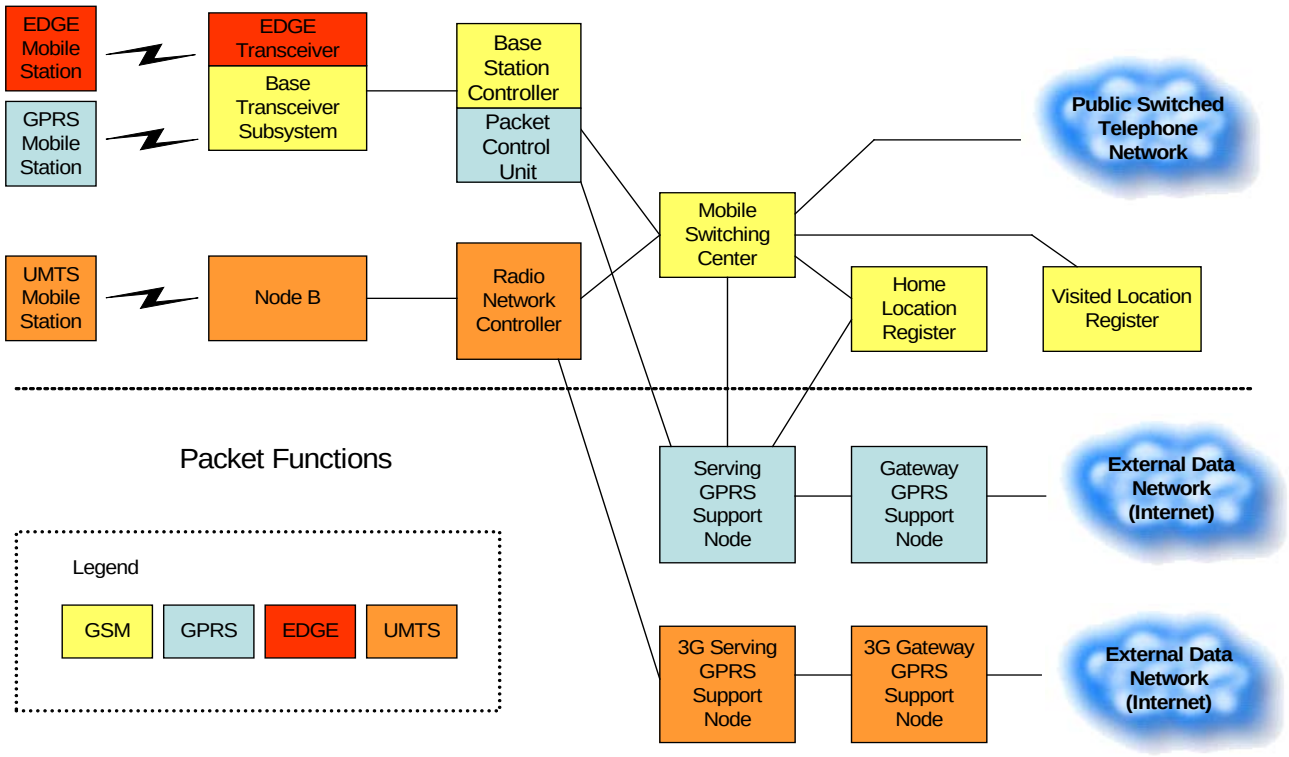
3.2 Architecture

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. This approach allows enterprises to use off-the-shelf IP applications with UMTS.

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.[8] 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 2).

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

Figure 2: 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

[8] 3GPP TS 23.060 V3.16.0 (2003-12), 3rd Generation Partnership Project; General Packet Radio Service (GPRS); Service description; Stage 2 (Release 1999)

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.

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 14 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 more spreading, such as used with voice channels, 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 carries a fewer number of such channels.

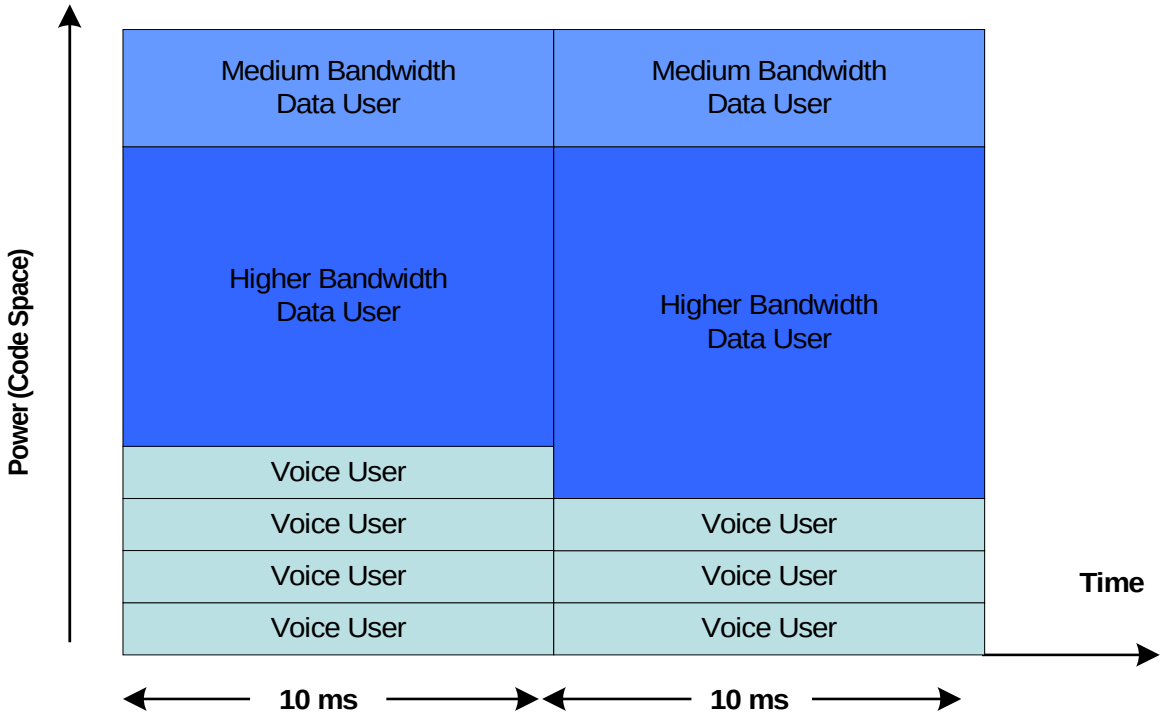
Due to the fixed chipping rate, the code space of the channel is finite. In UMTS, voice channels use a spreading factor of 128, whereas a 384 kbps data channel uses a spreading factor of eight. Though not supported by current devices, UMTS technology can provide peak rates of over 2 Mbps by combining three data channels each with a spreading factor of four.

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 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 3 is an example of different code space allocations to users. A WCDMA radio channel can support a far greater number of actual users than shown in the figure.

Figure 3: Example of Dynamic Allocation of Resources in UMTS



3.4 Evolution of UMTS Capability

Companies worldwide are applying tremendous technical resources to the advancement of UMTS technology, 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 has not yet implemented. After Release 99, the 3GPP standards body simplified its numbering scheme so that the successive release is Release 4, with Releases 5 and 6 to follow. These successive versions add features such as:

- High Speed Downlink Packet Access (HSDPA), discussed in the next section

- High Speed Uplink Packet Access (HSUPA), an enhancement for uplink data speeds currently being researched
- 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

All UMTS specification versions are backward compatible with prior versions, and all include support for GSM/GPRS/EDGE radio access networks. Eventually, UMTS operators could phase out their GSM/GPRS/EDGE networks, but this will not occur for a long time because of the extensive installed base of these networks and the need to provide businesses with a stable platform on which to base their operations.

3.5 High Speed Downlink Packet Access (HSDPA)

Of all the mechanisms that will enhance UMTS, it is HSDPA that will have the greatest impact. Boosting peak data rates to 14 Mbps and increasing network capacity by as much as three times, HSDPA will further broaden the base of applications that can operate wirelessly and will also support more users. Moreover, HSDPA is fully backward compatible with the current WCDMA radio link, meaning that HSDPA devices can work on current UMTS networks and current UMTS devices can work on HSDPA-capable networks.

Like EDGE, which significantly boosted performance over GPRS, HSDPA is based on radio technology advances. One important enhancement is the addition of more powerful radio modulation, namely 16 Quadrature Amplitude Modulation. With 16 QAM, four bits are communicated in each radio symbol, as opposed to two with Quadrature Phase Shift Keying in WCDMA. 16 QAM leverages the greater computing horsepower of new integrated circuits and is the most efficient modulation technique realizable in silicon.

The network chooses between QPSK or 16 QAM based on instantaneous radio conditions. The network also dynamically chooses the type of channel coding, or amount of forward-error correction. The combination of dynamic modulation and channel coding is referred to as link adaptation. Furthermore, in HSDPA, rather than allocating separate data channels to each user based on a spreading code, users share high speed channels in the time domain, which also significantly increases efficiency.

HSDPA further improves performance by creating high speed data channels that are shared by users both in the time domain and in the code domain. This approach allows the network to take advantage of the complete capacity of the cell site.

Also, like EDGE, HSDPA combines retransmitted data in an error situation, which reduces the number of retries required to send data successfully. HSDPA also employs a more efficient scheduling algorithm, which determines which user gets what radio resources at what time. These improvements are summarized in the following table.

Table 1: Similar Radio Methods Used by EDGE and HSDPA

	EDGE	HSDPA
Modulation	Dynamically selected	Dynamically selected
Channel Coding	Dynamic (static in GPRS)	Dynamic (static in WCDMA)
Data Channel	Same time slot approach as GPRS	Shared high speed data channels
Combining of Retransmitted Data	Yes (reduces retries to send data successfully)	Yes (reduces retries to send data successfully)
Scheduling	Same as GPRS	Improved over WCDMA
Throughput Improvement	On average, over three times that of GPRS	On average, expected to be four times that of WCDMA
Network Capacity Gain	Double over GPRS	Two to three times over WCDMA

There are a variety of other techniques employed by HSDPA to maximize performance, but these are beyond the scope of this paper. However, the bottom line is that HSDPA allows more users to obtain higher average throughputs using an even broader range of applications.

HSDPA is part of UMTS Rel'5 specifications. It will see initial deployment in 2005. Just as EDGE was a software upgrade for many GPRS networks, HSDPA will be a software upgrade for WCDMA networks. GSM operators have proven the effectiveness from both a performance and cost point of view of moving from GPRS to EDGE. Similar success is expected in moving from WCDMA to HSPDA.

4. Enterprise Use of UMTS

UMTS, providing an IP data service at broadband speeds with full mobility, allows enterprises to deploy a wide range of applications to mobile workers. These applications include e-mail with large attachments (documents, spreadsheets, and presentations), Web-based enterprise and client/server applications, corporate-network and intranet access, Web conferencing and application sharing, and general Internet access.

Ira Brodsky of Datacomm Research says, "UMTS, with its wide-area broadband capabilities, will be an excellent global network solution for enterprises wishing to extend their applications to mobile workers."

4.1 Application Compatibility

To prove the compatibility and effectiveness of UMTS with enterprise applications, AT&T Wireless is actively engaged with the leaders in the industry to test applications. These companies include IBM, Microsoft, and SAP. Test results have been uniformly positive. IBM states:

> *We have tested with UMTS, have had highly positive test results, and see UMTS as a leading globally available service for delivering high-speed wide-area wireless access to enterprise information, using products such as WebSphere Everyplace Connection Manager and Lotus Workplace.*

As important as compatibility with applications is compatibility with networking infrastructure for safe, secure communications between mobile workers and the enterprise. VPN technology is the leading choice of enterprises today for secure remote access. AT&T Wireless has successfully validated its UMTS network with VPNs from the leading VPN suppliers, including Checkpoint Technologies, Cisco Systems, IBM, and Nortel.

4.2 Types of Enterprises and Job Functions

Any company that has mobile workers who want to access enterprise information in real time is a good candidate for UMTS. This constitutes a broad range of organizations. Some examples include:

- Companies and government agencies with mobile workers who need broadband mobile access to data and travel primarily in the UMTS cities and coverage footprint (locally mobile workers).
- Local field sales and service agents who can get a complete view of the customer before going on call (e.g. status of trouble tickets, outstanding orders, recent shipments, inventory levels).
- Professional services (legal, engineering, construction, management consulting, architecture, environmental) who can download documents, blueprints, reports, and designs remotely.
- Real estate professionals – commercial and residential – who can access the Multiple Listing Service to obtain details about property listings.
- Property appraisers – commercial and residential – who can look up comparables in the area and develop appraisals in the field, helping to speed the closing process.
- Building inspectors who can access municipal building codes and regulations.
- Local couriers/delivery companies that can dispatch couriers more efficiently based on customer demand.
- Utilities/Telecom/Mobile IT support groups that can receive dispatches remotely and access technical documents, troubleshooting guides, and inventory levels, allowing first fixes the first time.

With UMTS, enterprises can:

- Allow their mobile workers to access business systems and applications when they are out of the office at broadband speed.
- Improve mobile worker productivity through more customer visits per day.
- Enhance customer service with real time wireless access to urgent e-mails and attachments.

- Lower costs of conducting business by serving more customers with fewer resources.
- Reduce administrative costs and errors by reducing paperwork and entering orders in the field at the point of contact with the customer.
- Improve business responsiveness and achieve competitive advantage by being more nimble in the marketplace.

4.3 Enterprise Adoption Strategies

Increasingly, enterprises' operations will depend on wireless networks that are run by cellular operators. With multiple available operators and an evolving wireless landscape, enterprises face the question of how to choose an operator partner that will provide the most dependable and capable service. Some of the qualifications enterprises should look for in an operator include:

- Has the field capability and experience to maintain a highly available network.
- Can provide redundant systems.
- Have the spectral resources to support its customers today and into the future.
- Has an orientation towards business customers.
- Has a thorough understanding of how networking applications function over its network through alliances with the right suppliers and through actual testing.
- Can help enterprise customers troubleshoot complex application environments.

Enterprises will find that AT&T Wireless excels in all these areas. The company's knowledge and experience in the business market translates into better products and services for business customers. That is why more than 70% of the Fortune 500 are contracted with AT&T Wireless. In addition to testing the core network and devices, the company performs extensive tests internally and with suppliers to test lines of business software, VPNs, and vertical market devices to improve performance of the total mobile solution.

With new and emerging networks, it may seem difficult to know when to deploy wireless applications. Deploying too early may mean the network does not offer the desired coverage. Deploying too late may mean loss of competitive advantage. The answer is relatively simple for enterprises

whose mobile worker base falls mostly into a metropolitan area where the operator offers coverage with its advanced network. Thus, enterprises that operate mostly in the Seattle, San Francisco Bay Area, Detroit, and Phoenix metropolitan areas are in an ideal position to take advantage of the AT&T Wireless UMTS network immediately.

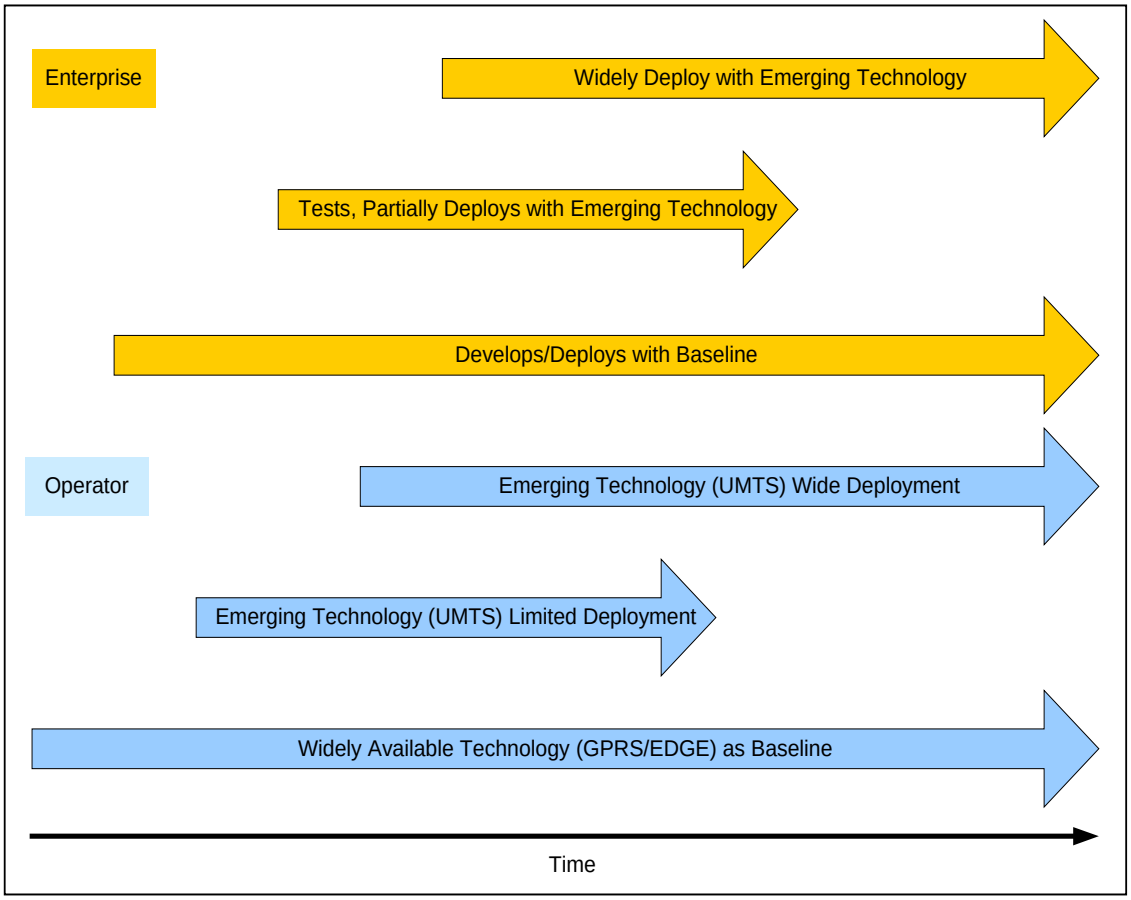
For companies with mobile workers who operate outside the UMTS coverage area, AT&T Wireless offers the EDGE network. Coverage is available in more than 7500 U.S. cites and along more than 30,000 miles of U.S. highway (covering a population area of 225 million).

For enterprises operating across a wider range of metropolitan areas, the situation is more complicated. However, an effective approach is to design and deploy wireless applications using the baseline technology that is available across a wide area, such as GPRS/EDGE (which AT&T Wireless offers nationally), and that is also available from operators globally. The enterprise can then treat UMTS coverage areas as:

- A metropolitan area broadband hotspot for increased performance in those areas.
- A testing/proving ground for future wireless application deployments.

The following figure depicts this deployment strategy.

Figure 4: Strategy for Adopting New Wireless Technologies



Different enterprises have different degrees of experience and expertise with mobile and wireless computing. Depending on enterprise needs, AT&T Wireless has relationships with a wide range of integration and consulting firms from whom enterprises can obtain assistance. AT&T Wireless sales representative have further information. The AT&T Wireless devCentral Web site at http://www.attwireless.com/developer contains additional information about UMTS technology, devices, security, networking, and application development. For information on AT&T Wireless' UMTS service, see http://www.attwireless.com/broadband.

5. Conclusion

In summary, UMTS technology addresses enterprise mobility needs for the following reasons:

- UMTS offers one of the best performing wide area wireless data technologies available, allowing mobile workers to access business systems and applications remotely.
- UMTS high speed access and low latency allows companies to extend their office LANs and offer a broad range of business applications to mobile employees.
- UMTS offers an attractive upgrade path to next generation high speed wireless technology with full forward and backward compatibility, helping to protect your investment.
- UMTS is based on global GSM standards that will be supported by more operators in more countries than any other standard, resulting in more product choices, lower costs and broader global coverage area.
- UMTS is based on a technology that is commercially proven and stable.
- UMTS has been tested for compatibility and effectiveness with a wide range of enterprise applications.
- UMTS is available from an operator with a proven track record supporting enterprise customers.