Mobile WiMax

INTRODUCTION

Broadband wireless sits at the confluence of two of the most remarkable growth stories of the telecommunications industry in recent years. Both wireless and broadband have on their own enjoyed rapid mass-market adoption. Wireless mobile services grew from 11 million subscribers worldwide in 1990 to more than 2 billion in 2005 [4]. During the same period, the Internet grew from being a curious academic tool to having about a billion users.

This staggering growth of the Internet is driving demand for higher-speed Internet-access services, leading to a parallel growth in broadband adoption. In less than a decade, broadband subscription worldwide has grown from virtually zero to over 200 million [5]. Will combining the convenience of wireless with the rich performance of broadband be the next frontier for growth in the industry? Can such a combination be technically and commercially viable? Can wireless deliver broadband applications and services that are of interest to the end-users? Many industry observers believe so. Before we delve into broadband wireless, let us review the state of broadband access today. Digital subscriber line (DSL) technology, which delivers broadband over twisted-pair telephone wires, and cable modem technology, which delivers over coaxial cable TV plant, is the predominant mass-market broadband access technologies today. Both of these technologies typically provide up to a few megabits per second of data to each user, and continuing advances are making several tens of megabits per second possible. Since their initial deployment in the late 1990s, these services have enjoyed considerable growth. The United States has more than 50 million broadband subscribers, including more than half of home Internet users. Worldwide, this number is more than 200 million today and is projected to grow to more than 400 million by 2010 [5]. The availability of a wireless solution for broadband could potentially accelerate this growth. What are the applications that drive this growth? Broadband users worldwide are finding that it dramatically changes how we share information, conduct business, and seek entertainment. Broadband access not only provides faster Web surfing and quicker file downloads but also enables several multimedia applications, such as real-time audio and video streaming, multimedia conferencing,

and interactive gaming. Broadband connections are also being used for voice telephony using voice-over-Internet Protocol (VoIP) technology.

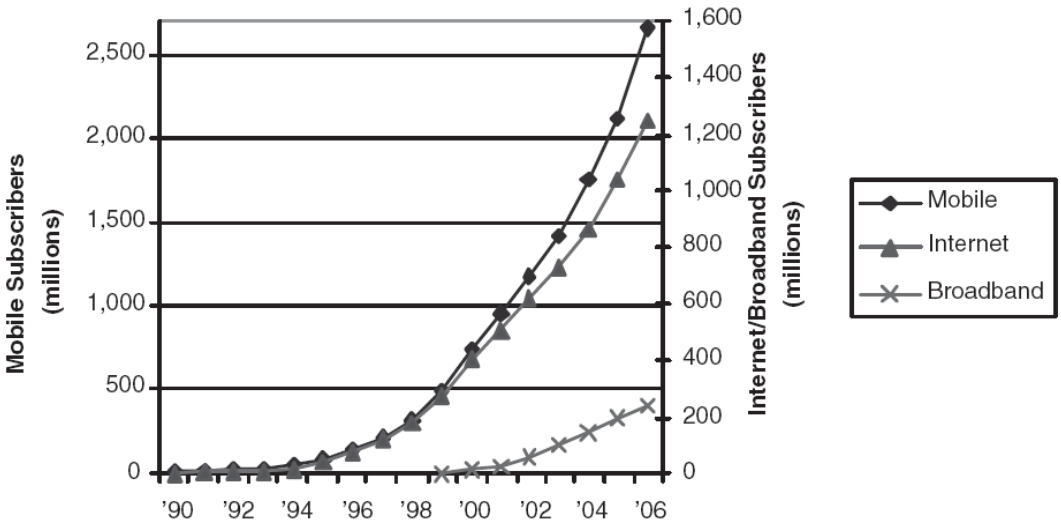

Figure 1.1 Worldwide subscriber growths 1990–2006 for mobile telephony, Internet usage, and broadband access

More advanced broadband access systems, such as fiber-to-the-home (FTTH) and very high data rate digital subscriber loop (VDSL) enable such applications as entertainment-quality video, including high-definition TV (HDTV) and video on demand (VoD). As the broadband market continues to grow, several new applications are likely to emerge, and it is difficult to predict which ones will succeed in the future.

So what is broadband wireless? Broadband wireless is about bringing the broadband experience to a wireless context, which offers users certain unique benefits and convenience. There are two fundamentally different types of broadband wireless services. The first type attempts to provide a set of services similar to that of the traditional fixed-line broadband but using wireless as the medium of transmission. This type, called fixed wireless broadband, can be thought of as a competitive alternative to DSL or cable modem. The second type of broadband wireless, called mobile broadband, offers the additional functionality of portability, nomadicity,1

and mobility. Mobile broadband attempts to bring broadband applications to new user experience scenarios and hence can offer the end user a very different value proposition.

Necessity

In many parts of the world, existing fixed-line carriers that do not own cellular, PCS, or 3G spectrums could turn to WiMax for provisioning mobility services. As the industry moves along the path of quadruple-play service bundles—voice, data, video, and mobility—some service providers that do not have a mobility component in their portfolios—cable operators, satellite companies, and incumbent phone companies—are likely to find WiMax attractive[1]. For many of these companies, having a mobility plan will be not only a new revenue opportunity but also a defensive play to mitigate churn by enhancing the value of their product set.

Existing mobile operators are less likely to adopt WiMax and more likely to continue along the path of 3G evolution for higher data rate capabilities. There may be scenarios, however, in which traditional mobile operators may deploy WiMax as an overlay solution to provide even higher data rates in targeted urban centers or metro zones. In addition to higher-speed Internet access, mobile WiMax can be used to provide voiceover- IP services in the future. The low-latency design of mobile WiMax makes it possible to deliver VoIP services effectively. VoIP technologies may also be leveraged to provide innovative new services, such as voice chatting, push-to-talk, and multimedia chatting. New and existing operators may also attempt to use WiMax to offer differentiated personal broadband services, such as mobile entertainment.

The flexible channel bandwidths and multiple levels of quality-of-service (QoS) support may allow WiMax to be used by service providers for differentiated high-bandwidth and low-latency entertainment applications. For example, WiMax could be embedded into a portable gaming device for use in a fixed and mobile environment for interactive gaming. Other examples would be streaming audio services delivered to MP3 players and video services delivered to portable media players. As traditional telephone companies move into the entertainment area with IP-TV (Internet Protocol television), portable WiMAX could be used as a solution to extend applications and content beyond the home.

Objectives

The WiMax standard has been developed with many objectives in mind. These are summarized below:

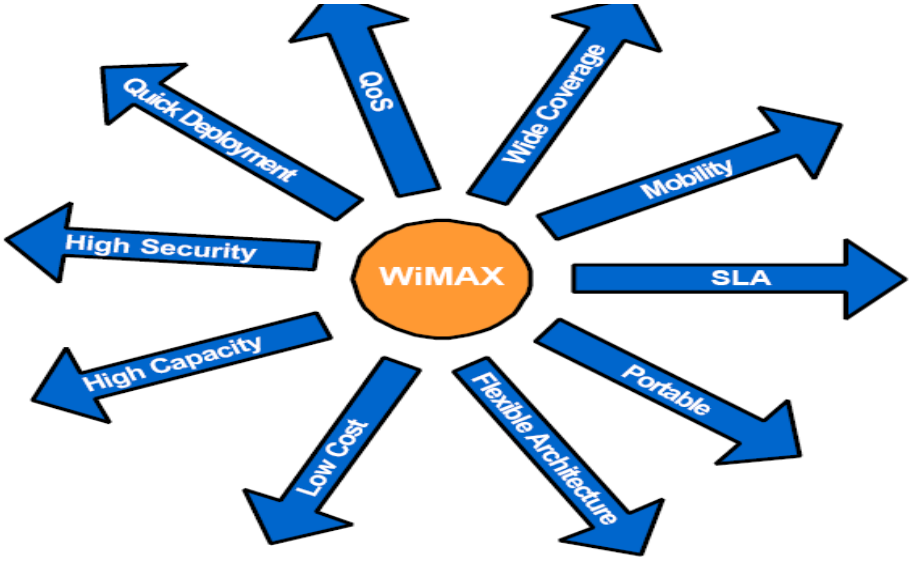

Fig 1.2 Objectives of WiMax

- **Flexible Architecture:** WiMax supports several system architectures, including Point-to-Point, Point-to-Multipoint, and ubiquitous coverage. The WiMax MAC (Media Access Control) supports Point-to-Multipoint and ubiquitous service by scheduling a time slot for each Subscriber Station (SS). If there is only one SS in the network, the WiMax Base Station (BS) will communicate with the SS on a Point-to-Point basis. A BS in a Point-to-Point configuration may use a narrower beam antenna to cover longer distances.

- **High Security:** WiMax supports AES (Advanced Encryption Standard) and 3DES (Triple DES, where DES is the Data Encryption Standard). By encrypting the links between the BS and the SS, WiMax provides subscribers with privacy (against eavesdropping) and security across the broadband wireless interface. Security also provides operators with strong protection against theft of service. WiMax also has built-in VLAN support, which provides protection for data that is being transmitted by different users on the same BS.

- **Quick Deployment:** Compared with the deployment of wired solutions, WiMax requires little or no external plant construction. For example, excavation to support the trenching of cables is not required. Operators that have obtained licenses to use one of the licensed bands, or that plan to use one of the unlicensed bands, do not need to submit further applications to the Government. Once the antenna and equipment are installed and powered, WiMax is ready for service. In most cases, deployment of WiMax can be completed in a matter of hours, compared with months for other solutions.

- **Multi-Level Service:** The manner in which QoS is delivered is generally based on the Service Level Agreement (SLA) between the service provider and the end-user. Further, one service provider can offer different SLA s to different subscribers, or even to different users on the same SS.

- **Interoperability:** WiMax is based on international, vendor-neutral standards, which make it easier for end-users to transport and use their SS at different locations, or with different service providers. Interoperability protects the early investment of an operator since it can select equipment from different equipment vendors, and it will continue to drive the costs of equipment down as a result of mass adoption.

- **Portability:** As with current cellular systems, once the WiMax SS is powered up, it identifies itself, determines the characteristics of the link with the BS, as long as the SS is registered in the system database, and then negotiates its transmission characteristics accordingly.

- **Mobility:** The IEEE 802.16e amendment has added key features in support of mobility. Improvements have been made to the OFDM and OFDMA physical layers to support devices and services in a mobile environment. These improvements, which include Scalable OFDMA, MIMO, and support for idle/sleep mode and hand-off, will allow full mobility at speeds up to 160 km/hr.

- **Cost-effective:** WiMax is based on an open, international standard. Mass adoption of the standard, and the use of low-cost, mass-produced chipsets, will drive costs down dramatically, and the resultant competitive pricing will provide considerable cost savings for service providers and end-users.

- **Wider Coverage:** WiMax dynamically supports multiple modulation levels, including BPSK, QPSK, 16-QAM, and 64-QAM. When equipped with a high-power amplifier and operating with a low-level modulation (BPSK or QPSK, for example), WiMax systems are able to cover a large geographic area when the path between the BS and the SS is unobstructed.

- **Non-Line-of-Sight Operation:** NLOS usually refers to a radio path with its first Fresnel zone completely blocked. WiMax is based on OFDM technology, which has the inherent capability of handling NLOS environments. This capability helps WiMax products deliver broad bandwidth in a NLOS environment, which other wireless product cannot do.

- **High Capacity:** Using higher modulation (64-QAM) and channel bandwidth(currently 7 MHz, with planned evolution towards the full bandwidth specified in the standards).

Organization

The report is organized into five chapters.

- **Chapter 1** Deals with the introduction part of the report. It provides the background information necessary for understanding WiMax. Provides a brief introduction of broadband wireless, necessity of WiMax & its objectives.

- **Chapter 2** Deals with literature review of WiMax (related information available in standard books, journals, internet websites etc.)

- **Chapter 3** Deals with the System development of WiMax . For example IEEE 802.16, IEEE 802.16a, WiMax vs. WLAN, WiMax Vs. WiFi, HIPERMAN, Mesh Networks, Wireless Services, WiMax Infrastructure, End-to-End WiMax Architecture, WiMax Protocol, Mobile WiMax and Advanced Features of WiMax.

- **Chapter 4** Deals with the Performance Analysis of WiMax .This chapter shows Markets for WiMax, Current Status of WiMax, The WiMax Scenario, and WiMax versus 3G and Wi-Fi & Competing technologies.

- **Chapter 5 D**eals with the Conclusion , future scope & Applications of WiMax

LITERATURE SURVEY

- **Zakhia Abichar, Yanlin Peng, and J. Morris Chang in 2006 shows WiMax: The Emergence of Wireless Broadband T**he much-anticipated technology of WIMax,the Worldwide Interoperability for Microwave Access, aims to provide business and consumer wireless broadband services on the scale of the Metropolitan Area Network (MAN).WiMax will bring a standards- based technology to a sector that otherwise depended on proprietary solutions.The technology has a target range of up to 31 miles and a target transmission rate exceeding 100 Mbps and is expected to challenge DSL and T1 lines (both expensive technologies to deploy and maintain) especially in emerging markets.

- **Dusit Niyato and Ekram Hossain in 2007 shows Integration of WiMax and WiFi** Broadband wireless access networks based on WiMax can provide backhaul support for mobile WiFi hotspots. We consider an integrated WiMax/WiFi network for such an application where the licensed WiMax spectrum is shared by the WiFi access points/routers to provide Internet connectivity to mobile WiFi users. The WiMax backbone network and WiFi hotspots are operated by different service providers. Issues such as protocol adaptation, quality of service support, and pricing for bandwidth sharing that are related to integration of these networks are discussed. In addition, they propose a model for optimal pricing for bandwidth sharing in an integrated WiMax/WiFi network.

- **Chizu Fukao Jun in 2007 Study on the Detection Scheme of WiMax signal for DAA Operation in MB-OFDM**. In the first, by comparing the power 1-3 of the WiMax signal derived from the FFT outputs of the MB-OFDM receiver with the background noise, power detection scheme is performed. And using the central limit L theorem, Correlation detection comparing power detection scheme. It was confirmed that this scheme has much better performance than the power detection scheme under low signal to noise ratio

situation. Therefore, it references is considered that the use of the guard interval information "Ultra-Wide Bandwidth. Time of WiMax signal is very effective for the detection of the Hopping Spread-Spectrum Impulse Radio for Wireless Multiple-Access Communications signal.

- **Kejie Lu and Yi Qian in 2007 shows a Secure and Service-Oriented Network Control Framework for WiMax Networks,** Worldwide Interoperability for Microwave Access, is an emerging wireless communication system that can provide broadband access with large-scale coverage. As a cost-effective solution, multihop communication is becoming more and more important to WiMax systems. To successfully deploy multihop WiMax networks, security is one of the major challenges that must be addressed. Another crucial issue is how to support different services and applications in WiMax networks. Since WiMax is a relatively new standard, very little work has been presented in the literature. In this article we propose a secure and service-oriented network control framework for WiMax networks. In the design of this framework we consider both the security requirements of the communications and the requirements of potential WiMax applications that have not been fully addressed previously in the network layer design. The proposed framework consists of two basic components: a service-aware control framework and a unified routing scheme. Besides the design of the framework, we further study a number of key enabling technologies that are important to a practical WiMax network. Our study can provide a guideline for the design of a more secure and practical WiMax network.

- **A Joon Ho Park, Mingji Ban in 2008 Designed Mobile WiMax System for Military Applications and Its Performance in Fading Channels** The IEEE 802.16e mobile WiMax system may not be quite suitable in some applications where the uplink (UL) requires higher transmission rate than the downlink (DL). In particular, many cases in military applications often require higher transmission rate in the uplink. Proposal for a new mobile WiMax scheme that provides the DL to UL ratio (DUR) to be 9:33 by modify the frame structure. Fading channels for the modified mobile WiMax system are

presented. They evaluate the bit error rate (BER) performance and compare the throughput at the different DUR. The IEEE 802.16e mobile WiMax system may not be quite suitable in some applications where the uplink (UL) requires higher transmission rate than the downlink (DL). In particular, many cases in military applications often require higher transmission rate in the uplink. In this paper, they propose a new mobile WiMax scheme that provides the DL to UL ratio (DUR) to be 9:33 by modify the frame structure. Fading channels for the modified mobile WiMax system are presented. They evaluate the bit error rate (BER) performance and compare the throughput at the different DUR.

- **D. J. Shyy Jamie Mohamed in 2008 designed WIMax RF Planner** Fixed WiMax (IEEE 802.16d) is positioned as a wireless broadband alternative to the traditional cable and Digital Subscriber Line (DSL) technologies. Mobile WiMax (IEEE 802.16e) has been chosen as the 3G/4G technology by major mobile/cellular service providers around the globe. Many Government organizations are also interested in the WIiMax technologies. We have built a WIMax RF Planner, a WiMax cell planning tool. The WiMax RF Planner incorporates all the standard features of commercial RF planning tools with additional features tailored for government requirements including: support of base station mobility as well as interfacing to WiMax radios, OPNET and Google Earth.

- **Rajeshree Raut in 2008 presented Codec Design for WiMax System** Wireless communication is the fastest growing segment of the communication industry. New services are being added and data is provided at higher bit rates to the end users. With these advancements any communication system has to critically consider data integrity. This requires, maintaining a lower bit error rate. Present work focuses on the Broadcast Wireless Access standard named WiMax (Worldwide Interoperability for Microwave Access). Possible options for maintaining a lower bit error rate in WiMax System are worked out. In particular a Novel Approach which uses a concatenation of RS and Turbo Codes for the Codec design in The WiMax Communication System is presented. The paper also discusses use of OQPSK Modulation Technique in place of the conventional

QPSK system, for performance improvement. The comparative simulation results of existing WiMax System and the system using the novel approach are also provided. These results are used to draw useful conclusions for reducing the bit error rate.

- **Lang Wei-min in 2008 proposed a simple Key Management Scheme based on WiMax** WiMax security has two goals, one is to provide privacy across the wireless network and the other is to provide access control to the network. The security sub-layer of IEEE 802.16 employs an authenticated client/server key management protocol in which the BS, the server, controls the distribution of keying material to the client SS. This paper analyzes the physical layer threat and MAC layer threat of WiMax, and then lists the security requirements of a WiMax system. Furthermore, they propose the security architecture of WiMax and the key management scheme from the aspects of Authorization Key (AK) exchange, TEK exchange and AK management. In conclusion, this paper gives the security issues and countermeasures in WiMax system.

- **Sassan Ahmadi in 2009 present an Overview of Next-Generation Mobile WiMax Technology** The IEEE 802.16m is designed to provide state of-the-art mobile broadband wireless access in the next decade and to satisfy the growing demand for advanced wireless WiMax profile are expected to be completed by2011. Multihop relay architecture, multi-carrier operation, self-configuration, advanced single user/ multi-user multi-antenna schemes and interference mitigation techniques, enhanced multicast-broadcast service, increased VoIP capacity, improved cell-edge user throughput, and support of vehicular speeds up to 500 km/h, and so on are among the most prominent features that would make IEEE 802.16m one of the most successful and advanced broadband wire time applications and services.

- **Steven J. Vaughan in 2009 proposed Mobile WiMax The Next Wireless Battleground** The IEEE plans to adopt mobile WiMax 2.0—formally called IEEE 802.16m. The technology would offer data rates of 100 Mbps for mobile uses and 1 Gbps

for fixed applications via enhanced MIMO technology. If adopted on schedule, industry observers expect mobile WiMax 2.0 to appear in products by 2012.

- **Jarno Pinola and Kostas Pentikousis in 2009 proposed IPTV over WiMax with MIPv6 Handovers** As the IPv4 unallocated address pool nears exhaustion, an increasing number of IPv6 deployments is anticipated. In the domain of mobility management research and development, Mobile IPv6 has long been favored over Mobile IPv4. Nevertheless, although in principle WiMax supports IPv6 in various configurations and requires MIPv6 for network-level mobility management, in practice, vendors are actively deploying these capabilities only in part. They provide a thorough review of the role of IPv6 and MIPv6 in WiMax networks, surveying the work in relevant standardization bodies. The second contribution of is a test bed evaluation of IPTV streaming over WiMax. They employ two WiMax test beds deployed in Finland and Portugal, interconnected by GEANT and Quantify MIPv6 performance in a real-time multimedia streaming scenario over WiMax. Beyond demonstrating the feasibility of such a deployment, their results indicate that WiMax can provide a viable option as both access and backhauling technology.

- **Yue Li1 & Demetres Kouvatsos in 2009 shows Performance Modeling and Bandwidth Management of WiMax Systems** Worldwide Interpretability for Microwave Access is a competitive connection oriented technology for metropolitan broadband wireless access with very high data rate, large service coverage and flexible quality of service (QoS). Due to the large number of connections, the efficient bandwidth management and related channel allocation for the uplink access in WiMax networks is a very challenging task of the medium access control (MAC) protocol. In order to provide better bandwidth utilization and network throughput, a cost-effective WiMax bandwidth management scheme is devised, named as the WiMax partial sharing scheme (WPSS) and compared against a simpler scheme, named as the WiMax complete sharing scheme (WCPS). An analytic maximum entropy (ME) model is proposed for the cost-effective performance evaluation of the two bandwidth management schemes associated with

networks with a large number of stations and/or the connections. In this context, an open queuing network model (QNM) is devised.

SYSTEM DEVELOPMENT

IEEE 802.16

The IEEE 802.16 Working Group is the IEEE group for wireless metropolitan area network. The IEEE 802.16 standard defines the Wireless MAN (metropolitan area network) air interface specification (officially known as the IEEE Wireless MAN standard). This wireless broadband access standard could supply the missing link for the "last mile" connection in wireless metropolitan area networks. Wireless broadband access is set up like cellular systems, using base stations that service a radius of several miles/kilometers.

Base stations do not necessarily have to reside on a tower. More often than not, the base station antenna will be located on a rooftop of a tall building or other elevated structure such as a grain silo or water tower. A customer premise unit, similar to a satellite TV setup, is all it takes to connect the base station to a customer. The signal is then routed via standard Ethernet cable either directly to a single computer, or to an 802.11hot spot or a wired Ethernet LAN.

The IEEE 802.16 designed to operate in the 10-66 GHz spectrum and it specifies the physical layer (PHY) and medium access control layer (MAC) of the air interface BWA systems. At 10-66 GHz range, transmission requires Line-of-Sight (LOS).IEEE 802.16 is working group number 16 of IEEE 802, specializing in point-to-multipoint broadband wireless access.

The IEEE 802.16 standard provides the foundation for a wireless MAN industry. However, the physical layer is not suitable for lower frequency applications where non-line-of-sight (NLOS) operation is required [2]. For this reason, the IEEE published 802.16a standard to accommodate NLOS requirement in April 2003. The standard operates in licensed and unlicensed frequencies between 2 GHz and 11 GHz, and it is an extension of the IEEE

802.16standard.The IEEE 802.16 Working Group created a new standard, commonly known as WiMax, for broadband wireless access at high speed and low cost, which is easy to deploy, and which provides a scalable solution for extension of a fiber-optic backbone.

WiMax base stations can offer greater wireless coverage of about 5 miles, with LOS (line 12 of sight) transmission within bandwidth of up to 70 Mbps.

WiMax is supported by the industry itself, including Intel, Dell, Motorola, Fujitsu, AT&T, British Telecom, France Telecom, Reliance Infocomm, Siemens, Sify,Price Warehouse Coopers and Tata Teleservices – forming an alliance called WiMax Forum. It represents the next generation of wireless networking [3]. WiMAX original release the 802.16standard addressed applications in licensed bands in the 10 to 66 GHz frequency range. Subsequent amendments have extended the 802.16 air interface standard to cover non-line of sight (NLOS) applications in licensed and unlicensed bands in the sub 11 GHz frequency range.

Filling the gap between Wireless LANs and wide area networks, WiMAX-compliant systems will provide a cost-effective fixed wireless alternative to conventional wire-line DSL and cable in areas where those technologies are readily available. And more importantly the WiMAX technology can provide a cost-effective broadband access solution in areas beyond the reach of DSL and cable. The ongoing evolution of IEEE 802.16 will expand the standard to address mobile applications thus enabling broadband access directly to WiMAX-enabled portable devices ranging from smart phones and Pads to notebook and laptop computers.

Summary of 802.16 Standards

Completion Date	802.16 Dec 2001	802.16a/ 802.16REVd 802.16a: Jan 2003 802.16Revd: Q3 2004	802.16e 2005
Spectrum	10 to 66 GHz	< 11 GHz	< 6 GHz
Channel Conditions	Line-of-Sight only	Non-Line-of-Sight	Non-Line-of-Sight
Bit Rate	32 to134 Mbps	75 Mbps max 20-MHz channelization	15 Mbps max 5-MHz channelization
Modulation	QPSK 16QAM 64QAM	OFDM 256 subcarrier QPSK 16QAM 64QAM	Same as 802.16a
Mobility	Fixed	Fixed	Pedestrian mobility Regional roaming
Channel Bandwidths	20, 25 and 28 MHz	Selectable between 1.25 and 20 MHz	Same as 802.16a with uplink subchannels
Typical Cell Radius	1 to 3 miles	3 to 5 miles (30 miles max based on tower height, antenna gain, and power transmit)	1 to 3 miles

IEEE 802.16a

The IEEE 802.16a standard allows users to get broadband connectivity without needing direct line of sight with the base station. The IEEE 802.16a specifies three air interface specifications and these options provide vendors with the opportunity to customize their product for different types of deployments. The three physical layer specifications in 802.16a are:

- Wireless MAN-SC which uses a single carrier modulation format.
- Wireless MAN-OFDM which uses orthogonal frequency division multiplexing (OFDM) with 256 point Fast Fourier Transform (FFT). This modulation is mandatory for license exempt bands.
- Wireless MAN-OFDMA which uses orthogonal frequency division multiple access (OFDMA) with a 2048 point FFT. Multiple accesses are provided by addressing a subset of the multiple carriers to individual receivers.

In 1998, the IEEE (The Institute of Electrical and Electronics Engineers) began a standards project to specify a point-to-multipoint broadband wireless access system suitable for the delivery of data, voice, and video services to fixed customer sites. The initial standard, designated IEEE 802.16, was developed for the higher microwave bands (> 10 GHz) where line-of-sight between system antennas is required for reliable service. Despite the availability of licensed spectrum for potential deployments, completion of the standard in 2001 failed to have a significant impact; most vendors abandoned their proprietary equipment and did not attempt to implement high-frequency multipoint systems based on the 802.16 standard.

Factors beyond equipment cost (e.g., installation, roof rights, backhaul, spectrum costs) were significant contributors to the poor economics of the high-frequency multipoint systems. In early 2000, work on a low-frequency (<11 GHz) revision of the 802.16 standard was begun by the IEEE working group. This revision (designated 802.16a) incorporated new radio link system options more suitable for low-frequency service while maintaining most of the access control system specifications of the original standard Completed in January 2000, the 802.16a standard included features supporting:

- Non-line-of-sight service capability
- Multiple radio modulation options (single carrier, OFDM)
- Licensed and unlicensed band implementations

Versatile access control and QoS features, including TDM and packet services, advanced security A corrected and modified version of 802.16a (designated 802.16-REVd) was completed in June 2004. Initial WiMAX profiles are a subset of the 802.16-REVdstandard. A mobile extension to the low-frequency 802.16 standard is now being developed by the IEEE 802.16e working group. This extension will support delivery of broadband data to a moving wireless terminal, such as a laptop computer with an integrated WiMAX modem being used by a

passenger on a commuter train. The WiMAX Forum expects to endorse a mobile profile following completion of the 802.16e standard.

WiMax vs. WLAN

Unlike WLAN, WiMAX provides a media access control (MAC) layer that uses a grant request mechanism to authorize the exchange of data. This feature allows better exploitation of the radio resources, in particular with smart antennas, and independent management of the traffic of every user. This simplifies the support of real-time and voice applications.

One of the inhibitors to widespread deployment of WLAN was the poor security feature of the first releases. WiMAX proposes the full range of security features to ensure secured data exchange:

- Terminal authentication by exchanging certificates to prevent rogue devices,
- User authentication using the Extensible Authentication Protocol (EAP),
- Data encryption using the Data Encryption Standard (DES) or Advanced Encryption Standard (AES), both much more robust than the Wireless Equivalent Privacy (WEP) initially used by WLAN. Furthermore, each service is encrypted with its own security association and private keys.

WiMax VS. WiFi

WiMAX operates on the same general principles as WiFi -- it sends data from one computer to another via radio signals. A computer (either a desktop or a laptop) equipped with WiMAX would receive data from the WiMAX transmitting station, probably using encrypted data keys to prevent unauthorized users from stealing access.

The fastest WiFi connection can transmit up to 54 megabits per second under optimal conditions. WiMAX should be able to handle up to 70 megabits per second. Even once that70 megabits is split up between several dozen businesses or a few hundred home users, it will provide at least the equivalent of cable-modem transfer rates to each user.

The biggest difference isn't speed; it's distance. WiMAX outdistances WiFi by miles. WiFi's range is about 100 feet (30 m). WiMAX will blanket a radius of 30 miles (50 km) with wireless access. The increased range is due to the frequencies used and the power of the transmitter. Of course, at that distance, terrain, weather and large buildings will act to reduce the maximum range in some circumstances, but the potential is there to cover huge tracts of land.

WiMax is not designed to clash with WiFi, but to coexist with it. WiMax coverage is measured in square kilometers, while that of WiFi is measured in square meters. The original WiMax standard (IEEE 802.16) proposes the usage of 10-66 GHz frequency spectrum for the WiMax transmission, which is well above the WiFi range (up to 5GHz maximum). But 802.16a added support for 2-11 GHz frequency also[4]. One WiMax base station can be accessed by more than 60 users. WiMax can also provide broadcasting services also. WiMax specifications also provides much better facilities than WiFi, providing higher bandwidth and high data security by the use of enhanced encryption schemes. WiMax can also provide service in both Line Of Sight (LOS) and Non-Line Of Sight (NLOS) locations, but the range will vary accordingly.

WiMax will allow the interpenetration for broadband service provision of VoIP, video, and internet access – simultaneously. WiMax can also work with existing mobile networks. WiMax antennas can "share" a cell tower without compromising the function of cellular arrays already in place.

Hiperman

The ETSI has created wireless MAN standard for frequency band between 2 GHz and 11GHz. The ETSI Hiperman standard was issued in Nov 2003. The ETSI works closely with the IEEE 802.16 group and the HIPERMAN standard has essentially followed 802.16's lead.

The Hiperman standard provides a wireless network communication in the 2 – 11 GHz bands across Europe. The Hiperman working group utilizes the 256 point FFT OFDM modulation scheme. It is one of the modulation schemes defined in the IEEE 802.16a standard.

WiMax

Worldwide Interoperability for Microwave Access (WiMAX) is currently one of the hottest technologies in wireless. The Institute of Electrical and Electronics Engineers (IEEE) 802 committee, which sets networking standards such as Ethernet (802.3) and WiFi (802.11), has published a set of standards that define WiMAX. IEEE 802.16-2004 (also known as Revision D) Was published in 2004 for fixed applications; 802.16 Revision E (which adds mobility) is duplicated in July 2005. The WiMAX Forum is an industry body formed to promote the IEEE 802.16 standard and perform interoperability testing. The WiMAX Forum has adopted certain profiles based on the 802.16 standards for interoperability testing and "WiMAX certification".

These operate in the 2.5GHz, 3.5GHz and 5.8GHz frequency bands, which typically are licensed by various government authorities. WiMAX, is based on an RF technology called Orthogonal Frequency Division Multiplexing (OFDM), which is a very effective means of transferring data when carriers of width of 5MHz or greater can be used. Below 5MHz carrier width, current CDMA based 3G systems are comparable to OFDM in terms of performance.