

WiMAX AND THE FUTURE OF WIRELESS TECHNOLOGY

Connecting the new millennium

What you need to know before you decide
if WiMAX is right for you



IJIS Institute

EMERGING TECHNOLOGY WHITE PAPER

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INTRODUCTION

WiMAX is a wireless digital communications standard, also known as IEEE 802.16, which is intended for wireless metropolitan area networks (MAN) and last-mile wireless broadband services (backhaul). In a MAN, WiMAX can provide broadband wireless access (BWA) up to 30 miles (50 km) for fixed stations, and 3 - 10 miles (5 - 15 km) for mobile stations. In contrast, the WiFi/802.11 wireless local area network standard is limited in most cases to only 100 - 300 feet (30 - 100m).

With WiMAX, WiFi-like data rates are easily supported, but the issue of interference is lessened. WiMAX operates on both licensed and non-licensed frequencies, providing a regulated environment and viable economic model for wireless carriers.

WiMAX can be used for wireless networking in much the same way as the more common WiFi protocol. WiMAX is a second-generation protocol that allows for more efficient bandwidth use, interference avoidance, greater quality of service, built-in security mechanisms and is intended to allow higher data rates over longer distances. WiMAX accomplishes some of these through the use of Orthogonal Frequency Division Multiplexing (OFDM). This same modulation scheme is also used in 802.11a and g.

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The IEEE 802.16 standard defines the technical features of the communications protocol, specifically the MAC (media access control) layers of the protocol which uniquely identify each node of a network. WiMAX can actually support a great number of different physical layers, specifically, any frequency range from 2 GHz up to 60 GHz. The WiMAX forum (not the IEEE) defines “profiles” for each physical layer. At the time of the publication of this document (April 2007), all certified products are within the 3.5 GHz profile.

DOMAIN APPLICATION OF WiMAX

Fixed vs. Mobile - The original 802.16 standard (and the first few revisions) were focused on fixed broadband solutions. WiMAX was originally conceived as a wireless “last mile” to connect end customers to their Internet Service Provider in which the subscriber station is stationary, such as a residential unit. The wired equivalents are cable modems and DSL in the consumer market and T1 connections in the business market. However, the 802.16e standard (ratified by IEEE in December, 2005) allows for mobile subscriber stations. With the addition of mobility as defined in 802.16e, WiMAX could become a potential 4G cellular

solution. With data rates up to 100x faster than current cellular “high speed” solutions (such as EDGE and EV-DO), WiMAX has the potential to severely disrupt the cellular industry. At least one Cellular Provider has announced plans to deploy WiMAX technology.

Applications - There are many applications of WiMAX technology in Criminal Justice and Public Safety (J&PS). The figures below show several examples including support for mobile technology, facility interconnectivity, backhaul for WiFi hotspots, and backhaul for other wireless networks.

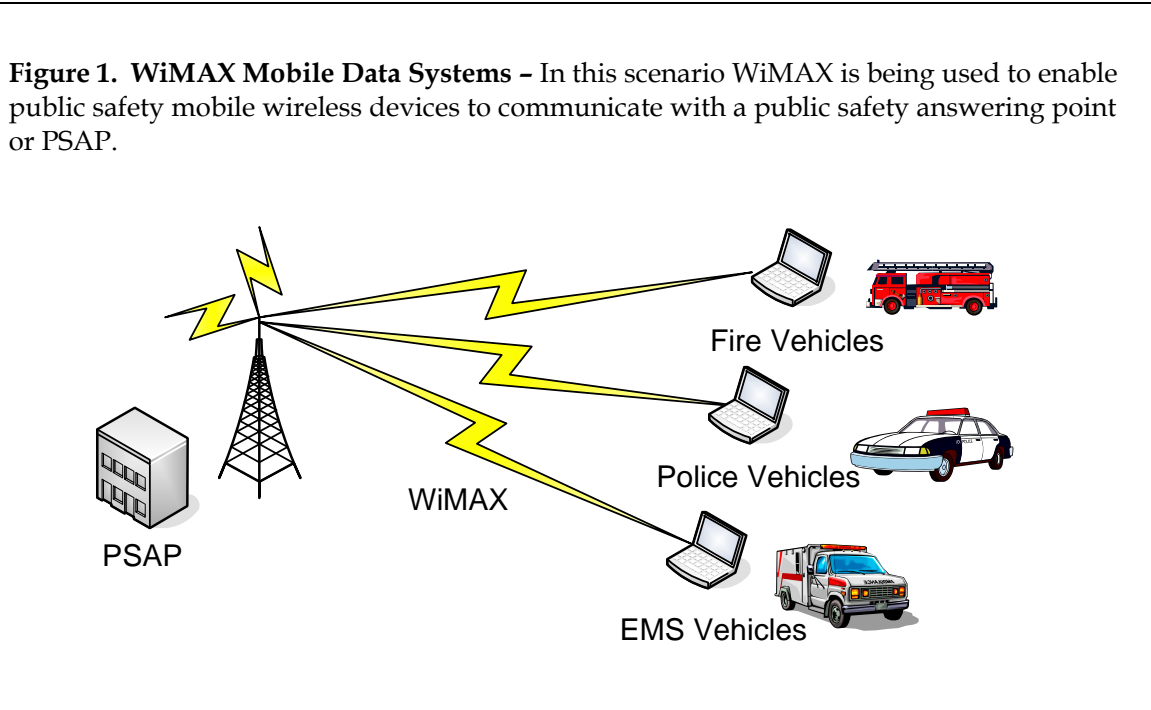


Figure 2. Facility Interconnect - In this example WiMAX is being used to provide high speed connectivity between facilities such as a state police headquarters and an emergency operations (EOC) facility.

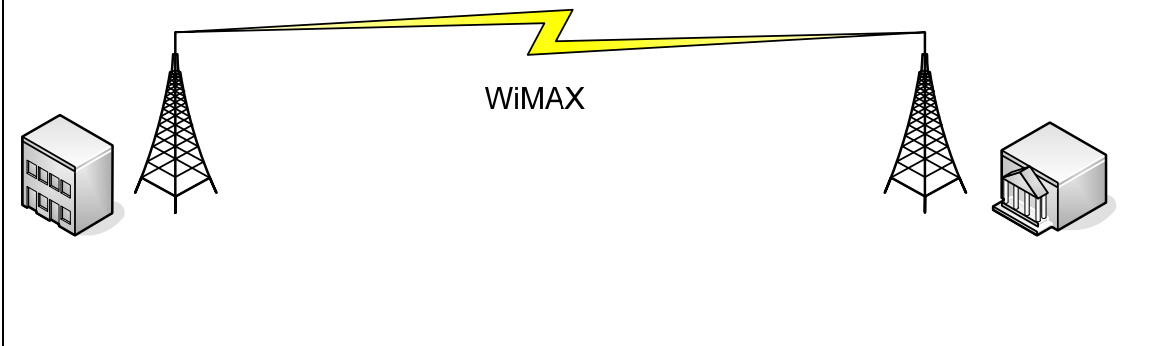


Figure 3. Backhaul for WiFi Networks - In this example WiMAX provides a high speed and secure network to connect multiple Wi-Fi networks to a network operations center (NOC). Previously this type of high speed connection necessitated the use of hard wired networks.

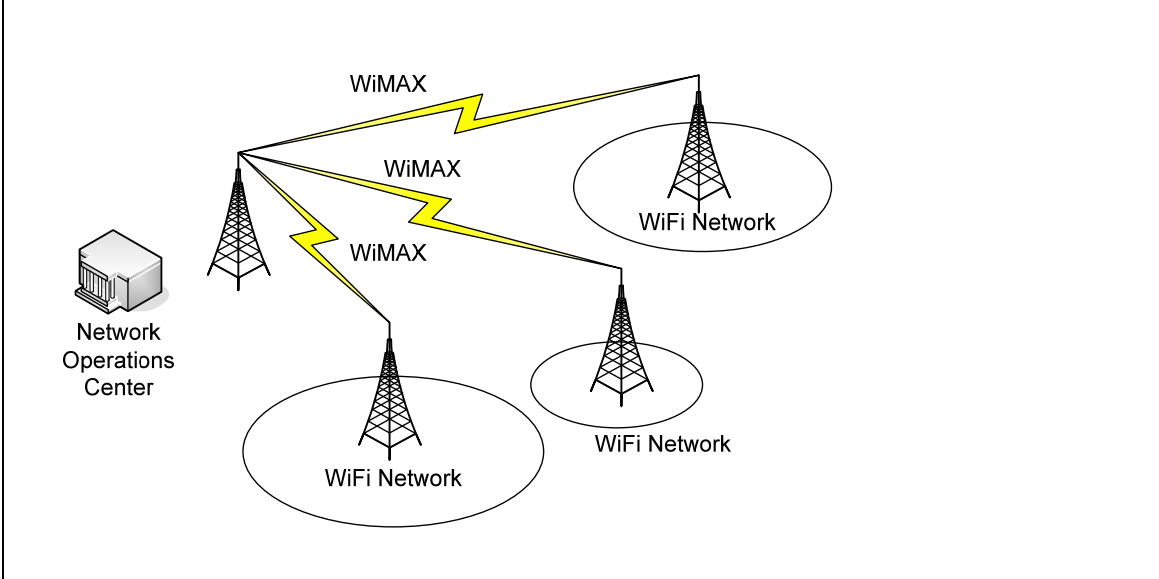
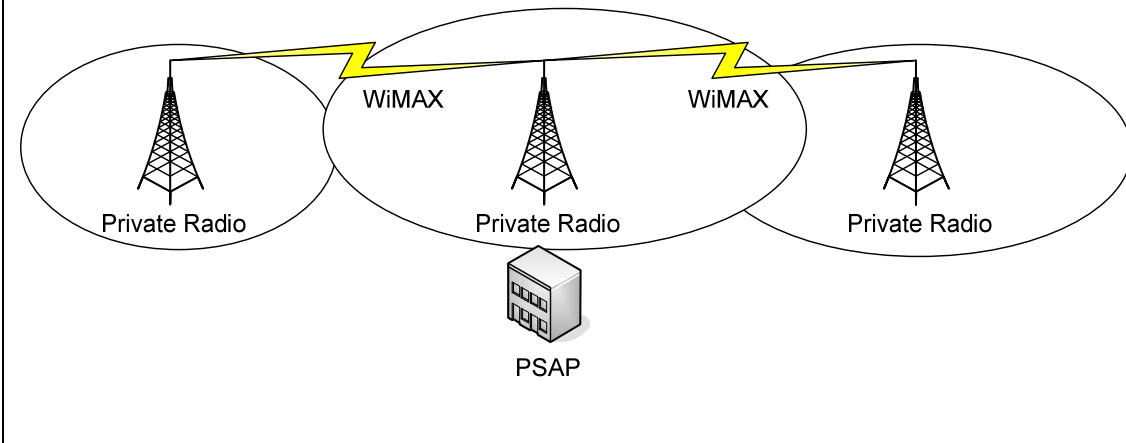


Figure 4. Backhaul for other wireless networks - In this example WiMAX provides a high speed and secure network to connect multiple private radio regions together such as for state-wide law enforcement communications systems. Previously this type of high speed connection necessitated the use of hard wired networks.



WiMAX will allow metropolitan area networks to be implemented at a lower cost than current technology. WiMAX can also be used to replace expensive point-to-point circuits currently using microwave or T-1 circuits. The faster data rate will allow a broader range of applications and allow for more efficient deployment of Web/SOA-based applications and image technology to the field.

HARDWARE OR SOFTWARE REQUIREMENTS

Status of Hardware – Currently, the only “certified” hardware falls under the older 802.16-2004 standard (one of the fixed standards) in the 3.5 GHz range. However, vendors have certified products including base stations, subscriber stations and chipsets.

Licensed vs. Unlicensed Spectrum – The WiMAX standard is designed to operate on both licensed and unlicensed spectrum. The WiMAX Forum has begun the process of certifying initial fixed and stationary equipment in the 3.5 GHz and 5.8 GHz bands. For mobile applications, initial profiles have been developed for 2.3 GHz, 2.5 GHz, and 3.5 GHz in response to the earliest and strongest market opportunities.

COMPANY/INSTITUTION RESEARCHING OR DEVELOPING WiMAX

IEEE – The Institute of Electrical and Electronic Engineers Standards Association (IEEE-SA) is the leading developer of global standards in a broad range of industries.

Vendor Community (Equipment & Carriers via WiMAX Forum) – Defines profiles of the standard and performs certification and interoperability testing.

AVAILABILITY, COST, AND FORECAST PRESENCE

Pre-WiMAX (non-certified) products are available now from several vendors. The base stations run in the \$2000 range while subscriber stations cost around \$500.

Certified (802.16-2004 3.5 GHz) products are available now from a handful of vendors with pricing the same as the pre-WiMAX products. Mobile (802.16e) products are expected in early 2007. WiMAX hardware is expected to be widely available by the 3rd quarter of 2007.

	2005	2006	2007
1st Certification Lab Opens (Cetacom, Spain)	▼		
1st Certified Fixed WiMAX Products		▼	
802-16e Air Interface Standard Ratified	▼		
Mobile WiMAX Rel-1 System Profiles		▼	
Mobile WiMAX Rel-1 Certification Profiles		▼	
2nd Certification Lab Opens (TTA Labs, Korea)		▼	
Launch of WiBro services in Korea		▼	
1st Mobile WiMAX -Certified Products			▼

STRENGTHS, WEAKNESSES, AND POSSIBLE RISKS

Strengths

- Standards ensure interoperability between different vendors' equipment.
- Security built into the standard (unlike WiFi).
- Quality of Service - Service level agreements (SLA's) built into the standard to provide different levels of service for a tiered pricing model.
- Quicker, cheaper metropolitan deployments compared to shorter range technologies.

Weaknesses

- Current spectrum focus limits US deployments (3.5 GHz is licensed spectrum in the US, but unlicensed in most of the rest of the world).
- Subscriber units not widely available. They are not yet integrated into manufacturer default configurations of laptops as WiFi cards are today.

Possible Risks

- Longer range makes for a larger "listening area" for attackers.
- Management frames are not encrypted allowing an attacker to collect information about subscribers in the area as well as other sensitive network information.
- The original 802.16 spec did not specify an authentication method for base stations making subscribers susceptible to man-in-the-middle attacks. 802.16e adds EAP authentication for base stations to resolve this.

ASSOCIATED STANDARDS

WiMAX falls under the IEEE 802.16 family of standards (802.16-2004 & 802.16e).

CURRENT MAINSTREAM OR ALPHA/BETA USERS OF THIS TECHNOLOGY

Sprint/Nextel has ambitious plans to deploy mobile WiMAX throughout the United States, with Chicago and Washington D.C. first on the schedule. With hardware provided by Samsung, Motorola, and Nokia, Sprint/Nextel is investing nearly \$3 billion in mobile WiMAX technology over the next two years.

Horizon Wi-Com is deploying WiMAX last-mile access for residential, business, and emergency restoration markets in Boston, New York, Philadelphia, Pittsburg, Baltimore, Buffalo, Washington D.C., Richmond, and Cincinnati. Implementation began in early 2007 and is anticipated to go on throughout the year

Urban WiMAX has deployed WiMAX service in the greater London area and is proposing a rollout across the UK. Focusing on business customers, Urban WiMAX is offering high speed (1mb – 10 mb) internet access, voice services and plans to offer online backup/disaster recovery and video teleconferencing via WiMAX.

WiBro is a South Korean variant of WiMAX which is currently being deployed throughout the entire country. WiBro (Wireless Broadband) is a service that provides high-speed broadband communications in the mobile environment. WiBro is based on Mobile WiMAX technology, which is based on IEEE 802.16e standards. Service is currently available in Seoul and surrounding cities. Nationwide deployment is planned for 2007-2008.

In all, there have been over 150 trials of WiMAX or pre-WiMAX systems throughout the world.

LINKS TO MORE WIMAX INFORMATION

Standards

- Institute of Electrical and Electronics Engineers, Inc. (IEEE): www.ieee.org
- WiMAX Forum: www.wimaxforum.org
- The IEEE 802.16 Working Group on Broadband Wireless Access Standards: www.wirelessman.org

Vendors

- Airspan: www.airspan.com
- Alcatel-Lucent: www.alcatel-lucent.com
- Alvarion, Ltd.: www.alvarion.com
- Aperto: www.aperto.com
- Axxcelera Broadband Wireless: www.axxcelera.com
- Cisco Systems, Inc.: www.cisco.com
- Intel Corporation: www.intel.com
- Motorola, Inc.: www.motorola.com
- Proxim Wireless Corporation: www.proxim.com
- Redline Communications: www.redlinecommunications.com
- Sequans Communications: www.sequans.com
- Siemens AG: www.siemens.com
- SR Telecom Inc.: www.srtelecom.com
- Wavesat: www.wavesat.com