

# WiMAX (Worldwide Interoperability for Microwave Access)

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**Abstract** - WiMAX (Worldwide Interoperability for Microwave Access) is a family of wireless communication standards based on the IEEE 802.16 set of standards, which provide multiple physical layer (PHY) and Media Access Control (MAC) options.

The name "WiMAX" was created by the WiMAX Forum, which was formed in June 2001 to promote conformity and interoperability of the standard, including the definition of predefined system profiles for commercial vendors. The forum describes WiMAX as "a standards-based technology enabling the delivery of last mile wireless broadband access as an

alternative to cable and DSL" IEEE 802.16m or Wireless MAN-Advanced was a candidate for the 4G, in competition with the LTE Advanced standard.

WiMAX was initially designed to provide 30 to 40 megabit-per-second data rates, with the 2011 update providing up to 1 Gbit/s for fixed stations.

**Key Words:** WIRELESS, 3G, 4G, LTE, Wi-Fi. MOBILE NETWORKING.

## 1. INTRODUCTION:

WiMAX refers to interoperable implementations of the IEEE 802.16 family of wireless-networks standards ratified by the WiMAX Forum. (Similarly, Wi-Fi refers to interoperable implementations of the IEEE 802.11 Wireless LAN standards certified by the Wi-Fi Alliance.) WiMAX Forum certification allows vendors to sell fixed or mobile products as WiMAX certified, thus ensuring a level of interoperability with other certified products, as long as they fit the same profile.

The original IEEE 802.16 standard (now called "Fixed WiMAX") was published in 2001. WiMAX adopted some of its technology from WiBro, a service marketed in Korea. Mobile WiMAX (originally based on 802.16e-2005) is the revision that was deployed in many countries, and is the basis for future revisions such as 802.16m-2011. WiMAX is sometimes referred to as "Wi-Fi on steroids" and can be used for a number of applications including broadband connections, cellular backhaul, hotspots, etc. It is similar to long range Wi-Fi, but it can enable usage at much greater distances.

## 1.1 Technical Information: The IEEE Standard:

WiMAX is based upon IEEE Std 802.16e-2005 approved in December 2005. It is a supplement to the IEEE Std 802.16-2004, and so the actual standard is 802.16-2004 as amended by 802.16e-2005. Thus, these specifications need to be considered together. IEEE 802.16e-2005 improves upon IEEE 802.16-2004 by:

- Adding support for mobility (soft and hard handover between base stations). This is seen as one of the most important aspects of 802.16e-2005, and is the very basis of Mobile WiMAX.
- Scaling of the fast Fourier transform (FFT) to the channel bandwidth in order to keep the carrier spacing constant across different channel bandwidths (typically 1.25 MHz, 5 MHz, 10 MHz or 20 MHz). Constant carrier spacing results in higher spectrum efficiency in wide channels, and a cost reduction in narrow channels. Also known as scalable OFDMA (SOFDMA).
- Other bands not multiples of 1.25 MHz are defined in the standard, but because the allowed FFT subcarrier numbers are only 128, 512, 1024 and 2048, other frequency bands will not have exactly the same carrier spacing, which might not be optimal for implementations. Carrier spacing is 10.94 kHz.

## 2. Integration with an IP Based Network

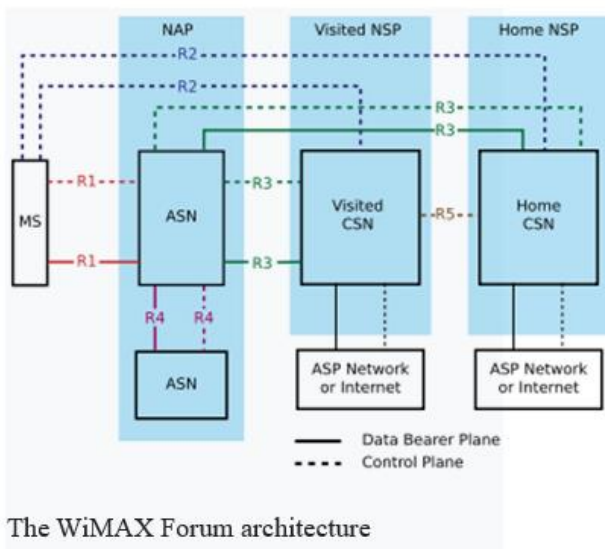


Fig 1- The WiMAX Architecture

The WiMAX Forum has proposed an architecture that defines how a WiMAX network can be connected with an IP based core network, which is typically chosen by operators that serve as Internet Service Providers (ISP); Nevertheless, the WiMAX BS provide seamless integration capabilities with other types of architectures as with packet switched Mobile Networks. The WiMAX forum proposal defines a number of components, plus some of the interconnections (or reference points) between these, labeled R1 to R5 and R8. It is important to note that the functional architecture can be designed into various hardware configurations rather than fixed configurations. For example, the architecture is flexible enough to allow remote/mobile stations of varying scale and functionality and Base Stations of varying size – e.g. femto, pico, and mini-BS as well as macros.

### 2.1 What is 802.16a ?

WiMAX is such an easy term that people tend to use it for the 802.16 standards and technology themselves, although strictly it applies only to systems that meet specific conformance criteria laid down by the WiMAX Forum.

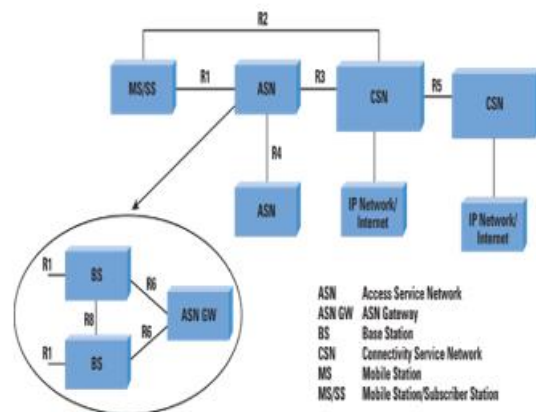
The 802.16a standard for 2-11 GHz is a wireless metropolitan area network (MAN) technology that will provide broadband wireless connectivity to Fixed, Portable and Nomadic devices. It can be used to connect 802.11 hot spots to the Internet, provide campus connectivity, and provide a wireless alternative to cable and DSL for last mile broadband access.

### 2.2 Network Architecture:

The IEEE 802.16e-2005 standard provides the air interface for WiMAX, but does not define the full end-to-end

WiMAX network. The WiMAX Forum's Network Working Group (NWG) is responsible for developing the end-to-end network requirements, architecture, and protocols for WiMAX, using IEEE 802.16e-2005 as the air interface. The WiMAX NWG has developed a network reference model to

serve as an architecture framework for WiMAX deployments and to ensure interoperability among various WiMAX equipment and operators.



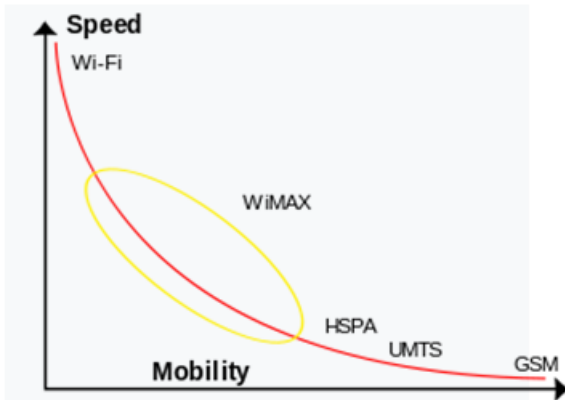
The network reference model envisions a unified network architecture for supporting fixed, nomadic, and mobile deployments and is based on an IP service model. Below is simplified illustration of an IP-based WiMAX network architecture.

### 2.3 Speed and Range:

WiMAX is expected to offer initially up to about 40 Mbps capacity per wireless channel for both fixed and portable applications, depending on the particular technical configuration chosen, enough to support hundreds of businesses with T-1 speed connectivity and thousands of residences with DSL speed connectivity. WiMAX can support voice and video as well as Internet data. WiMAX developed to provide wireless broadband access to buildings, either in competition to existing wired networks or alone in currently unserved rural or thinly populated areas. It can also be used to connect WLAN hotspots to the Internet. WiMAX is also intended to provide broadband connectivity to mobile devices. It would not be as fast as in these fixed applications, but expectations are for about 15 Mbps capacity in a 3 km cell coverage area. With WiMAX, users could really cut free from today's Internet access arrangements and be able to go online at broadband speeds, almost wherever they like from within a Metro Zone. WiMAX could potentially be deployed in a variety of spectrum bands: 2.3GHz, 2.5GHz, 3.5GHz, and 5.8GHz.

### 2.4 Competing Technologies:

Within the marketplace, WiMAX's main competition came from existing, widely deployed wireless systems such as Universal Mobile Telecommunications System (UMTS), CDMA2000, existing Wi-Fi and mesh networking.



Speed vs. mobility of wireless systems: Wi-Fi, High Speed Packet Access (HSPA), Universal Mobile Telecommunications System (UMTS), GSM

In the future, competition will be from the evolution of the major cellular standards to 4G, high-bandwidth, low-latency, all-IP networks with voice services built on top. The worldwide move to 4G for GSM/UMTS and AMPS/TIA (including CDMA2000) is the 3GPP Long Term Evolution (LTE) effort.

The LTE Standard was finalized in December 2008, with the first commercial deployment of LTE carried out by TeliaSonera in Oslo and Stockholm in December, 2009. Since then, LTE has seen increasing adoption by mobile carriers around the world.

In some areas of the world, the wide availability of UMTS and a general desire for standardization has meant spectrum has not been allocated for WiMAX: in July 2005, the EU-wide frequency allocation for WiMAX was blocked.

### 3. PROS and CONS:

#### PROS:

WiMAX is popular due to its low cost and flexible nature. In addition to internet access, WiMAX can provide voice and video transferring capabilities as well as telephone access.

Since WiMax transmitters can span a distance of several miles with data rates reaching up to 30-40 megabits per second (Mbps) (1 Gbps for fixed stations), it's easy to see its advantages, especially in areas where wired internet is impossible or too costly to implement.

#### CONS:

Because WiMAX is wireless by nature, the further away from the source that the client gets, the slower their connection becomes. This means that while a user might pull down 30 Mbps in one location, moving away from the cell site can reduce that speed to 1 Mbps or next to nothing.

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