WiMAX IEEE 802.16 technology

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What is WiMAX technology? - basics

- The standard for WiMAX technology is a standard for Wireless Metropolitan Area Networks (WMANs) that has been developed by working group number 16 of IEEE 802, specializing in point-to-multipoint broadband wireless access. Initially 802.16a was developed and launched, but now it has been further refined. 802.16d or 802.16-2004 was released as a refined version of the 802.16a standard aimed at fixed applications. Another version of the standard, 802.16e or 802.16-2005 was also released and aimed at the roaming and mobile markets.

Why We Use WiMAX IEEE 802.16?

- WiMAX technology is a wireless broadband communications technology based around the IEEE 802.16 standard providing high speed data over a wide area.

- Its range is upto 50 Km. It may provide speed upto 70 Mbps and it can operate in Non-Line-of-Sight. This technology is fast, convenient and cost effective.

- The letters of WiMAX stand for Worldwide Interoperability for Microwave Access (AXess), and it is a technology for point to multipoint wireless networking.

- WiMAX technology is able to meet the needs of a large variety of users from those in developed nations wanting to install a new high speed data network very cheaply without the cost and time required to install a wired network, to those in rural areas needing fast access where wired solutions may not be viable because of the distances and costs involved - effectively providing WiMAX broadband. Additionally it is being used for mobile applications, providing high speed data to users on the move.

WiMAX broadband technology uses some key technologies to enable it to provide the high speed data rates:

- **OFDM (Orthogonal Frequency Division Multiplex):** OFDM has been incorporated into WiMAX technology to enable it to provide high speed data without the selective fading and other issues of other forms of signal format.

- **MIMO (Multiple Input Multiple Output):** WiMAX technology makes use of multipath propagation using MIMO. By utilising the multiple signal paths that exist, the use of MIMO either enables operation with lower signal strength levels, or it allows for higher data rates.

Following is the chart of various IEEE 802.16 Standards related to WiMAX.

	802.16	802.16a	802.16e
Spectrum	10 – 66 GHz	2 – 11 GHz	<6 GHz
Configuration	Line of Sight	Non- Line of Sight	Non- Line of Sight
Bit Rate	32 to 134 Mbps (28 MHz Channel)	≤ 70 or 100 Mbps (20 MHz Channel)	Up to 15 Mbps
Modulation	QPSK, 16-QAM, 64-QAM	256 Sub-Carrier OFDM using QPSK, 16-QAM, 64-QAM, 256-QAM	Same as 802.16a
Mobility	Fixed	Fixed	≤75 MPH
Channel Bandwidth	20, 25, 28 MHz	Selectable 1.25 to 20 MHz	5 MHz (Planned)
Typical Cell Radius	1-3 miles	3-5 miles	1-3 miles
Completed	Dec, 2001	Jan, 2003	2nd Half of 2005

WiMAX network architecture
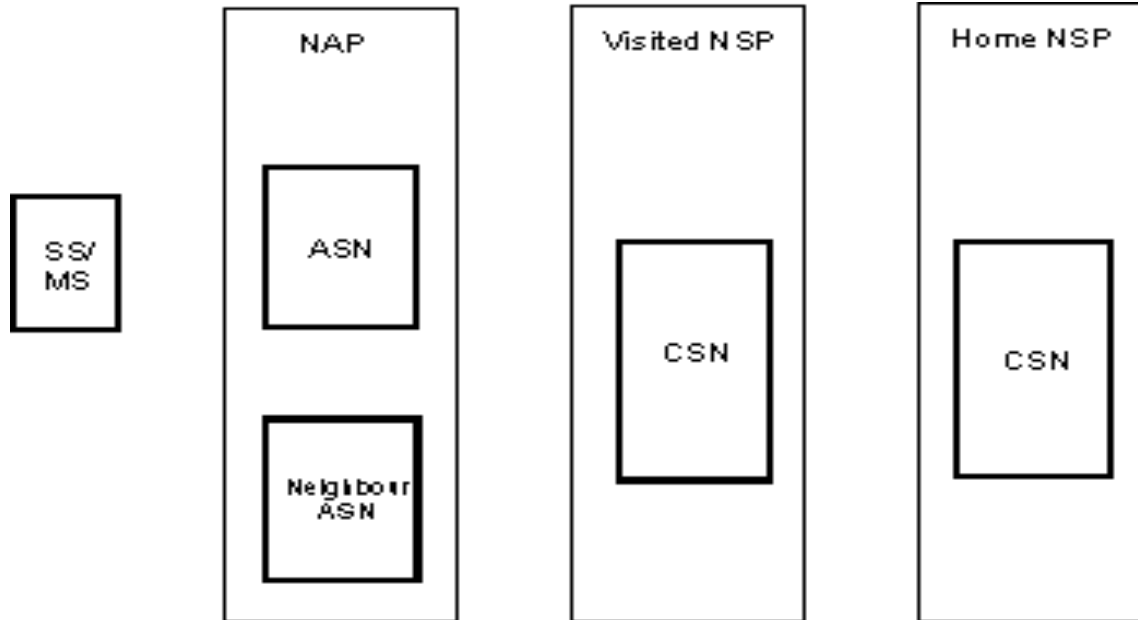
WiMAX Network Architecture Reference Model

The WiMAX architecture developed by the WiMAX form supports is a unified network architecture to support fixed, nomadic and mobile operation. The WiMAX network architecture is based upon an all-IP model.

The WiMAX network architecture comprises three major elements or areas.

- **Remote or Mobile stations:** These are the user equipments that may be mobile or fixed and may be located in the premises of the user.
- **Access Service Network, ASN :** This is the area of the WiMAX network that forms the radio access network at the edge and it comprises one or more base stations and one or more ASN gateways.
- **Connectivity Service Network, CSN:** This part of the WiMAX network provides the IP connectivity and all the IP core network functions. It is what may be termed the core network in cellular parlance.

The overall WiMAX network comprises a number of different entities that make up the different major areas described above. These include the following entities

- **_Subscriber Station, SS / Mobile Station, MS :_**   The Subscriber station, SS may often be referred to as the Customer Premises Equipment, CPE. These take a variety of forms and these may be termed "indoor CPE" or "outdoor CPE" - the terminology is self-explanatory. The outdoor CPE has the advantage that it provides better performance as a result of the better position of the antenna, whereas the indoor CPE can be installed by the user. Mobile Stations may also be used. These are often in the form of a dongle for a laptop, etc.
- **_Base Station, BS:_**   The base-station forms an essential element of the WiMAX network. It is responsible for providing the air interface to the subscriber and mobile stations. It provides additional functionality in terms of micro-mobility management functions, such as handoff triggering and tunnel establishment, radio resource management, QoS policy enforcement, traffic classification, DHCP (Dynamic Host Control Protocol) proxy, key management, session management, and multicast group management.

- **ASN Gateway, ASN-GW:** The ASN gateway within the WiMAX network architecture typically acts as a layer 2 traffic aggregation point within the overall ASN.

  The ASN-GW may also provide additional functions that include: intra-ASN location management and paging, radio resource management and admission control, caching of subscriber profiles and encryption keys. The ASN-GW may also include the AAA client functionality(see below), establishment and management of mobility tunnel with base stations, QoS and policy enforcement, foreign agent functionality for mobile IP, and routing to the selected CSN.

- **Home Agent, HA:** The Home Agent within the WiMAX network is located within the CSN. With Mobile-IP forming a key element within WiMAX technology, the Home Agent works in conjunction with a "Foreign Agent", such as the ASN Gateway, to provide an efficient end-to-end Mobile IP solution. The Home Agent serves as an anchor point for subscribers, providing secure roaming with QOS capabilities.

- **Authentication, Authorisation and Accounting Server, AAA:** As with any communications or wireless system requiring subscription services, an Authentication, Authorisation and Accounting server is used. This is included within the CSN.

How WiMAX works?

Think about how you access the Internet today. There are basically three different options:

- Broadband access - In your home, you have either a DSL or cable modem. At the office, your company may be using a T1 or a T3 line.
- WiFi access - In your home, you may have set up a WiFi router that lets you surf the Web while you lounge with your laptop. On the road, you can find WiFi hot spots in restaurants, hotels, coffee shops and libraries.
- Dial-up access - If you are still using dial-up, chances are that either broadband access is not available, or you think that broadband access is too expensive.

The main problems with broadband access are that it is pretty expensive and it doesn't reach all areas. The main problem with WiFi access is that hot spots are very small, so coverage is sparse.

Type of Services by Wi Max

• Wi MAX can provide two forms of wireless services,

1.Non-line-of-sight Service :-

• This is a WiFi sort of service. Here a small antenna on your computer connects to the WiMAX tower.

• In this mode, WiMAX uses a lower frequency range -- 2 GHz to 11 GHz (similar to WiFi).

2.Line-of-sight Service:-

• In this, a fixed dish antenna points straight at the WiMAX tower from a roof top or pole. • The line-of-sight connection is stronger and more stable, so it's able to send a lot of data with fewer errors.

• Line-of-sight transmissions use higher frequencies, with ranges reaching a possible 66 GHz.