Mobile Wimax

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Abstract

WiMAX stands for the Worldwide Interoperability for Microwave Access. Mobile WiMAX is a fast growing broadband access technology that enables low-cost mobile Internet applications, and realizes the convergence of mobile and fixed broadband access in single air interface and network architecture. Mobile WiMAX gives full mobility of cellular networks at higher broadband speeds than other broadband networks like Wi-Fi and WiMAX will offer broadband wireless access at data rates of multiple Mbit/s to the end-user and within a range of several kilometres. WiMAX will develop as a powerful radio access solution with many integration synergies in mobile or fixed network architecture.

Keywords:

MIMO, Threats, Protocol Architecture, Security Frame Work, WiMAX, OFDMA

Introduction:

The WiMAX technology, based on the IEEE 802.16-2004. 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. Mobile WiMAX is a broadband wireless solution that gives convergence of mobile and fixed broadband networks through a common wide area broadband radio access technology and flexible network architecture. The Mobile WiMAX Air Interface adopts Orthogonal Frequency Division Multiple Access (OFDMA) for on Scalable OFDMA technology. The new technologies updated for Mobile WiMAX result in lower improved multi-path performance in non-line-of-sight environments. Mobile WiMAX physical layer is based equipment complexity and simpler mobility management due to the all-IP core network and provide Mobile WiMAX systems with many other advantages over CDMA-based 3G systems. WiMax promises to deliver the Internet throughout the globe, and connect the "last mile" of broadband wireless connectivity services.

Definition:

WiMAX stands for Worldwide Interoperability for Microwave Access and is technically referred to by the IEEE as 802.16. WiMAX is also commonly termed 4Gnetwork. It is a wireless wide area network (WAN) that can cover what DSL lines can cover, but without wires. It can give Internet connectivity to computers in the way GSM has given phone connectivity to mobile phones and made them replace fixed landline phones. Wired connectivity, like DSL, provides broadband access but besides being fixed, is expensive and does not reach certain areas. On the other side, Wi-Fi, the most common wireless technology, has very limited coverage and it is not always easy to find a Wi-Fi hotspot. WiMAX comes as a solution mid-way between these two: it provides high quality broadband access

and has a very high penetrability, in that the microwaves it emits can be accessed at every nook and corner of its large coverage area.

MIMO

Introduction to MIMO :

MIMO stands on Multiple Input and Multiple Output. It is an antenna technology that is used in both transmission and receiver equipment for wireless radio communication. MIMO exploits the space dimension to improve wireless systems capacity, range and reliability. Wireless signals transmitted via single antennas are distorted by hills, buildings, valleys and other landscape features. These alternative signal paths separated in time, multipath, result in distortions such as fading, picketing or cliff effects, but on the other hand MIMO takes the advantage of this Multipath, as per MIMO.

How MIMO Works:

In MIMO Mathematical algorithms are used to spread the user data across the multiple transmitters. The transmitted signals are three dimensional and described in terms of time, frequency and space. The spatial multiplexing is a common transmission technique in MIMO to transmit independent and separately encoded data signals from each of the multiple transmits antennas. Therefore, the space dimension is reused, or multiplexed, more than one time. At the receiver, a special channel calibration signal at the beginning of the packet allows the different signals to be identified during the recombination process. The technique of separating out different paths in the radio link is what allows the MIMO radio to transmit multiple signals at the same time on the same frequency, and thereby improve the use of the spectrum many "virtual wires" over which to transmit signals.
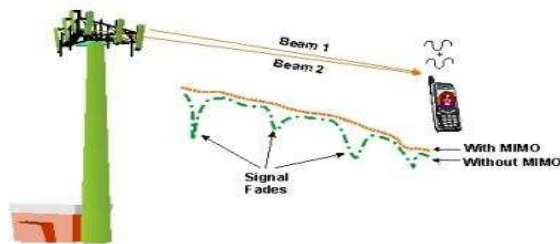
Features of Mobile WiMAX:

Mobile WiMAX systems offer scalability in both radio access technology and network architecture, thus providing a great deal of flexibility in network deployment options and service offerings. Some of the salient features supported by Mobile WiMAX are:

1. High Data Rates: The inclusion of MIMO antenna techniques along with flexible sub-channelization schemes, Advanced Coding and Modulation all enable the Mobile WiMAX technology to support peak DL data rates up to 63 Mbps per sector and peak UL data rates up to 28 Mbps per sector in a 10 MHz channel.

Mobile Wimax *Vipin Shukla &Nikhil*

2 .Quality of Service (QoS): The fundamental premise of the architecture is QoS. It defines Service Flows which can map to DiffServ code points or MPLS flow labels that enable end-to-end IP based QoS. Additionally, sub-channelization and MAP-based signaling schemes provide a flexible mechanism for optimal scheduling of space, frequency and time resources over the air interface on a frame-by-frame basis.

3. Scalability: Despite an increasingly globalized economy, spectrum resources for wireless broadband worldwide are still quite disparate in its allocations. Mobile WiMAX technology therefore, is designed to be able to scale to work in different channelization from 1.25 to 20 MHz to comply with varied worldwide requirements as efforts proceed to achieve spectrum harmonization in the longer term. This also allows diverse economies to realize the multi-faceted benefits of the Mobile WiMAX technology for their specific geographic needs such as providing affordable internet access in rural settings versus enhancing the capacity of mobile broadband access in metro and suburban areas.

4. Security: The features provided for Mobile WiMAX security aspects are best in class with EAP-based authentication, AES-CCM-based authenticated encryption, and CMAC and HMAC based control message protection schemes. Support for a diverse set of user credentials exists including; SIM/USIM cards, Smart Cards, Digital Certificates, and Username/Password schemes based on the relevant EAP methods for the credential type.

5. Mobility: Mobile WiMAX supports optimized handover schemes with latencies less than 50 milliseconds to ensure real-time applications such as VoIP perform without service degradation. Flexible key management schemes assure that security is maintained during handover.

Security in Mobile WiMAX:

At higher level view WiMax Security Process is divided in to following three steps as shown in the Figure below too.

i.   Authentication

ii.   Key Establishment

iii.   Data Encryption

A .Authentication but also the establishment of encryption Keys. based-on Mobile WiMAX defines Privacy Key Management (PKM) protocol in security sub-layer, which allows three types of authentication.

The first type is RSA (Rivest-Shami-Adleman) based authentication. RSA based authentication applies digital certificates together with RSA encryption. In this authentication mode, a BS authenticates the MS through its unique digital certificate that has been issued by the MS manufacturer.

The second type is EAP (Extensible Authentication Protocol) based authentication. In the caseof EAP based authentication, the MS is authenticated either by virtue of a unique operator issued credential, such as a SIM subscriber identity modulator. There are three types of EAP :the first type is EAP-AKA (Authentication and Key Agreement) for SIM based authentication; the second type is EAP-TLS (Transport Layer Security) for based authentication; the third type is EAP-TTLS (Tunneled Transport Layer Security) for SS- CHAPv2 (Microsoft Challenge Handshake Authentication Protocol). And the third type is RSA based authentication followed by EAP authentication.

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B. Data Key Exchange Once authentication is complete, the BS and MS share an activated AK (Authentication key) which can be called as Key Establishment or Data Key Exchange.

This step is considered as Initial Network Entry Procedure and the initial network entry procedure mainly consists of four processes:

Initial Ranging process.

MS basic capability negotiation - process.

PKM authentication process.

Registration process.

C. **Data Encryption :**

Encryption in WiMAX Technology involves taking a stream or block of data to be protected, called plain text, and using another. Stream or block of data, called the encryption key, to perform a reversible mathematical operation to generate a cipher text. The cipher text is unintelligible and hence can be sent across the network without fear of being eavesdropped.The receiver does an operation called decryption to extract the plaintext from the cipher text, using the same or different key. When the same key is used for WiMAX Encryption and decryption, the process is called symmetric key encryption. This key is typically derived from a shared secret between the transmitter and the receiver and for strong encryption typically it should be at least 64 bytes long. When different keys are used for encryption and decryption, the process is called asymmetric key encryption. Both symmetric and asymmetric key encryptions are typically used each serving different needs supports DES-CBC (Data Encryption Standard – Cipher Block Chaining) and three AES (Advance Encryption Standard) modes of operation for data encryption: CBC(Cipher Block Chaining), counter (CTR), and CTR with CBC message authentication code (CCM). Any of the three specified AES modes is acceptable for protecting data message confidentiality. .Advanced Encryption Standard (AES) which is the data encryption standard adopted by the National Institute of Standards as part of Federal Information Processing Standard (FIPS) and is specified as a link-layer encryption method to be used in WiMAX Technology. Advanced Encryption Standard (AES) is based on the Rijndael algorithm, which is a block ciphering method believed to have strong cryptographic properties. Besides offering strong encryption, Advanced Encryption Standard (AES) is fast, easy to implement in hardware or software, and requires less memory than do other comparable encryption schemes. The computational efficiency of Advanced Encryption Standard (AES) has been a key reason for its rapid widespread adoption. The Advanced Encryption Standard (AES) algorithm operates on a 128-bit block size of data, organized in a 4 x 4 array of bytes called a state. The encryption key sizes could be 128, 192, or 256 bits long; WiMAX Technology specifies the use of 128- bitkeys.

Future of Mobile WiMAX:

WiMAX technology can make high speed wireless broadband internet services available to much larger areas than can typical Wi-Fi hot spots. WiMAX implementations can provide a wireless range of up to 30 miles or 50 kilometers, much greater than the physical distance limitations of Wi-Fi hot spots or DSL, WiMAX technology can also be used to interconnect existing Wi-Fi networks. WiMAX Technology promises many strategic opportunities, not just as a backhaul solution for Wi-Fi delivering additional bandwidth to hot spots, but potentially for 3G networks too. WiMAX Technology initially may

Mobile Wimax *Vipin Shukla &Nikhil*

be deployed as a wireless backhaul solution, but will be upgraded to a mobility application, once the 802.16e standard is approved and WiMAX Technology capable client devices enter the market, marking a major increase in the anticipated market.

WiMAX Technology can compliment existing and emerging 3G mobile and wired networks, and can play a significant role in helping service providers deliver converged services that can be accessed using a broad range of devices on a wide variety of networks.

Applications of Mobile WiMAX:

WiMAX technology brings a new ingredient to today's mobile community. The most important application offered by Wimax Technology is business, consumer connectivity, and backhaul.

Wimax Technology carry real augmentation to communications through which you can get benefit not only from voice but also video and data transmission to get quick response to situation.   Through WiMAX Technology a client can deploy a temporary communication services and speed up their network to support events and circumstances. Wimax technology applications enable you to get temporary access to media, visitors and employees. If you are exist in tower range then you can get easy access to premises equipment for such events. The basic strength behind the Wimax Technology applications are high bandwidth, high quality services, security, deployment, full duplex including DSL and versus cable, and its cost.
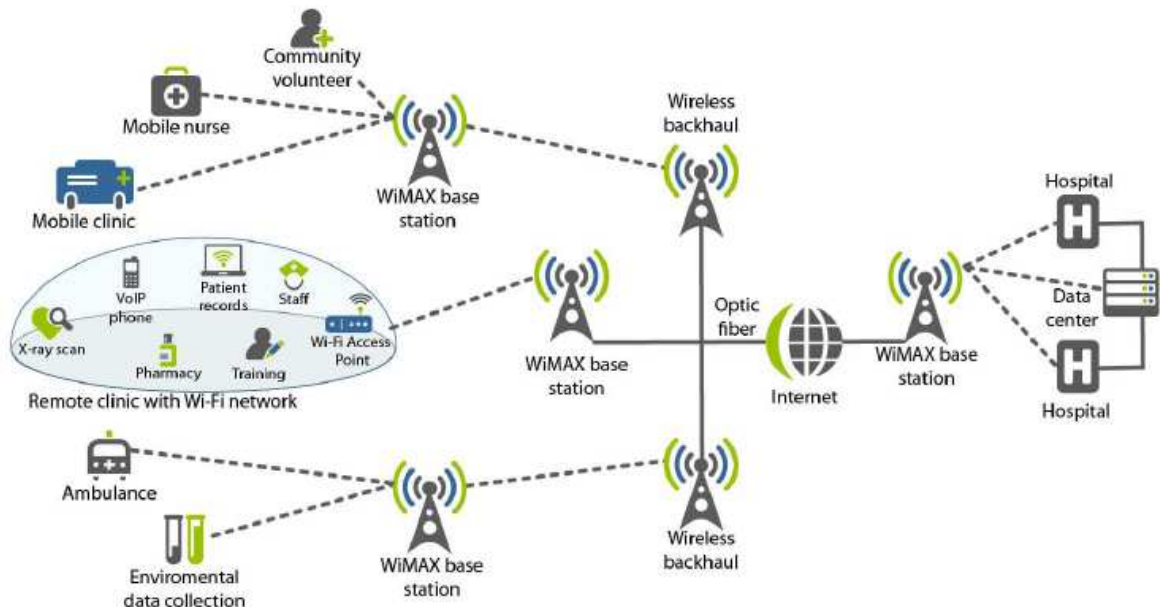
Broadband for Developing Countries

There are many countries such as Asia, Africa, and Eastern Europe are likely to achieve the most from the fixed wide area wireless networking technology. The analyst of West Technology Research Solutions the developing countries have

limited cable transportation, because the expenditure to install a WiMax station in concurrence with an accessible cellular tower or yet as a private hub will be very small in contrast to developing a wired solution. At the start, computers will require extraordinary add-on WiMax PC cards. Though, Intel is preparation to put

Mobile Wimax *Vipin Shukla &Nikhil*

WiMax into its Centrino chips. On the whole WiFi and WiMax is becoming the same thing with the option to depend on your preference that which network you connected to.

Private Networks

Mostly small and medium sized business man pay Wimax to get access but big companies having large campuses may finally deploy and control their own WIMAX networks. Such private networks are expected to be the very last WIMAX application. All private networks, Roaming broadband of developing countries are emphasizing the logical position of WIMAX as the wireless technology for the Metropolitan Area Network (MAN). The Voice over IP is the logic behind the design of Wimax technology and may be could further force both business and residential clients from customary mobile operators and copper wire.

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Mobile Wimax *Vipin Shukla &Nikhil*