

A Study On Broadband Wireless Access-Wimax

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Abstract- The IEEE 802.16 standard, commonly known as WIMAX is an emerging broadband wireless technology for providing large scale coverage and last mile solution for supporting higher bandwidth and multiple service classes with various quality of service (QoS) requirement. WIMAX networks are inherently simple, spectrally efficient and easy to deploy. WIMAX fixed and mobile broadband is already a reality that presents tremendous opportunity to new entrants. Because WIMAX is a cast effective, standard based wireless technology. In this paper we study on broadband wireless technology and its development.

Keywords - WIMAX, broadband wireless access, QoS, new entrants

I. INTRODUCTION

Worldwide interoperability for microwave access (WIMAX), on otherhand is cummarization of the IEEE 802.16 standard and is meant to provide high speed wireless data service over large scale geographical area. WIMAX targets to provide brand wireless access network which will provide high bandwidth and large coverage than are currently available with existing wireless such as 4G.

The first IEEE 802.16 standard introduced in 2001 specified a frequency range of 10 to 66 GHz with the theoretical maximum bandwidth 120 Mb/s and maximum transmission range 30 mile. This standard only support line of sight (LoS) transmission and does not seems to favor deployment in urban area. In 2003 IEEE 802.16a was published with physical layer specification for 2 to 11 GHz frequency range. [4]

These standards further revised several times. The new standards, IEEE 802.16j and IEEE 802.16m are also being developed for expanding the mobility further with enhanced coverage, performance and higher data rates (of order of 100 Mb/s) for a WIMAX network. The WIMAX standard air interface includes the definition of both the medium

access control (MAC) layer and physical (PHY) layers for the subscriber station and base station while the access network operability is defined by WIMAX Forum.

II. BASIC WIMAX STRUCTURE

The IEEE 802.16 consist two main layers physical layer (PHY) and medium access control layer (MAC). The physical layer provide two way mapping between MAC protocol data unit and the PHY layer frames received and transmitted through coding and modulation of radio frequency signals. MAC layer further divided in three sub layers shown in the fig and described as follows. [5]

- Service specific convergence sub layer (CS):- the main function of the CS is to transform or map external data from the upper layers into appropriate MAC service data units (SDUs) for the MAC CPS. This includes classification of external data with the proper MAC service flow identifier (SFID) and connection identifier (CID). An SDU is the basic data unit exchanged data between two adjacent protocol layers
- MAC common part sub layer (MAC CPS):- it provides the core functions for system access, allocation of bandwidth and connection establishment and is tightly integrated with the security sub-layer. This sub layers also handles the QoS aspect of data transmission.
- Security Sub-layer:- it provides functions such as authentication, secure key exchange and encryption and decryption of data exchange between MAC and PHY layers.

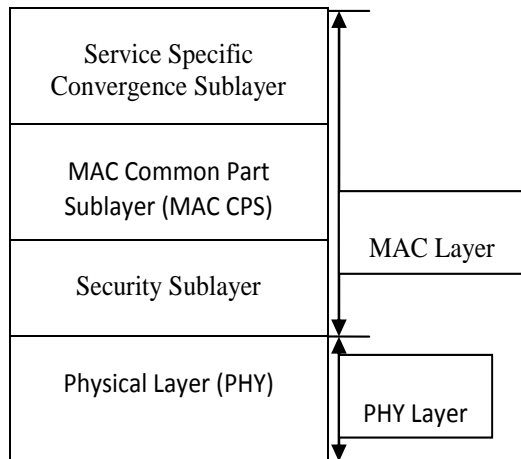


Figure 1: Basic WiMAX structure

III. WIMAX NETWORK ARCHITECTURE

WIMAX technology support two modes of operation, first one PMP (point to multipoint) mode and second one is mess (multipoint to multipoint) mode. The network architecture for mobile WIMAX consist two networks: - (a) Access Service Network (ASN) and (b) Connectivity Service Network (CSN). The core elements in the ASN are the base station (BS) and ASN gateway (ASNGW) and these core elements are connected over an IP infrastructure. The ASNGW provides the security anchoring, traffic accounting and mobility to support the mobile station (MS).

- Point to multipoint: - In PMP mode multiple service subscribers served by a centralized service provider. In PMP mode uplink transmissions from a subscriber station (SS) to a base station (BS) occur in separate timeframes. In downlink subframe, the base station can transmit a burst of MAC protocol data units (PDUs). Since the downlink transmission is broadcast, an SS listening to the data transmitted by the BS is only required to process PDUs addressed to itself or explicitly intended for all SSs. PMP mode could support the mobile WIMAX in 802.16e.
- Multipoint-to-multipoint: - Unlike PMP mode, there are no explicitly separate downlink and uplink subframe in mesh mode. Each station is able to establish direct communication to a number of stations in the system. The key difference is that in mesh mode all SSs may have direct links with other SSs.

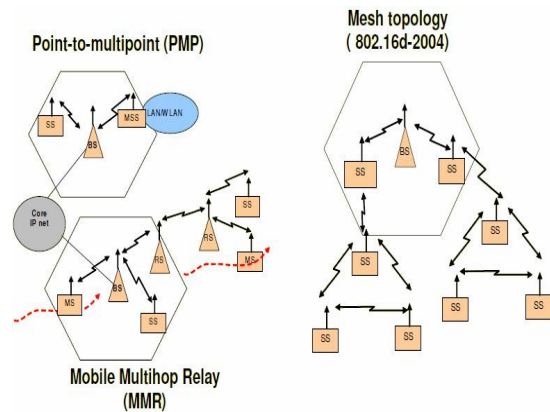


Figure 2: WIMAX network architecture

IV. QUALITY OF SERVICE

QoS provisioning is the one of the most important issues given the inherent QoS specification in the WIMAX MAC layer definition. It is in anticipated that IEEE 802.16 is fully capable of supporting multimedia transmission with differentiated QoS requirements through the use of scheduling mechanisms. With the rising popularity of multimedia applications in the Internet, IEEE 802.16 provides the capability offer new wireless services such as multimedia streaming, real-time surveillance, Voice over IP (VoIP), push-to-talk (PTT), online gaming require low delay, and multimedia conferencing. Due to its long-range and high-bandwidth transmission, IEEE 802.16 has also been considered in areas where it can serve as the backbone network with long separation among the infrastructure nodes.

QoS issues including service flow and bandwidth grant services. A service flow defined as a one flow of MAC SDUs on a connection associated with specific QoS parameters such as latency, jitter and throughput. These QoS parameters such are used for transmission and scheduling. Service flows are typically identified by SSs and BSs based on their SFID. There are three basic types of service flows: provisioned service flows, admitted services flows and active service flows. A provisioned service flow is defined in the system with SFID, but it might not have any traffic presence. It may be waiting to be activated for usage. An admitted service flow undergoes

the process of activation. In response to an external request for a specific service flow, the BS/SS will check for available resources based on the QoS parameters to see if it can support the request. If there are sufficient resources the service flow will be admitted. The resources assigned to this service flow may still be used by other services. A service flow will be active when all check are completed and the resources are allocated.

Bandwidth grant services define bandwidth allocation based on the QoS parameters associated with a connection. In downlink transmissions a BS has sufficient information to perform scheduling, but in uplink transmission a BS performs the scheduling of various service transmissions based on information gathered from SSs. In such cases an SS will request uplink bandwidth from the BS and the bs will allocate bandwidth on an as needed basis.

WIMAX defines five scheduling services for several applications which vary from being real time with stringent QoS requirements to non-real time with relaxed QoS requirements. Table 1 enlists various WIMAX services and their QoS requirements provided in the IEEE 802.16 standard.

Table 1: WIMAX Services and QoS requirements

QoS service class	Application	QoS specification
UGS (Unsolicited Grant Service)	VoIP	<ul style="list-style-type: none"> • Minimum reserved rate • Maximum sustained rate • Traffic priority • Maximum latency tolerance
rtPS (Real Time Polling Service)	Streaming audio or video, Tele medicine, e-learning	<ul style="list-style-type: none"> • Maximum reserved rate • Maximum sustained rate • Traffic priority • Maximum latency tolerance
nrtPS (Non Real Time Polling Service)	FTP, document sharing	<ul style="list-style-type: none"> • Minimum reserved rate • Maximum sustained rate • Traffic priority
BE (Best Effort)	Data transfer, web browsing, e-mail	<ul style="list-style-type: none"> • Maximum sustained rate • Traffic priority
ertPS (Extended Real Time Polling Service)	VoIP with silence suppression	<ul style="list-style-type: none"> • Minimum reserved rate • Maximum sustained rate • Traffic priority • Maximum latency tolerance • Jitter tolerance

V. OPPORTUNITY FOR NEW ENTRANTS

WIMAX provide true wireless broad band with multi-megabits of throughput in downlink and uplink. WIMAX also supports low latency applications such as VoIP and gaming. New entrants have a window of opportunity to capture true wireless broadband market share and reap high margins since many nimble, industry incumbents are committed to latency technology that is not equipped to meet the growing wireless demand. There are significant opportunities for new entrants to offer extended coverage to unreserved rural areas by providing economical fixed /mobile broadband WIMAX IS an ideal technology to accomplish this because it offers wide area, cellular like coverage, higher throughputs and a broad range of service platform.

- Bridging the digital divide: - The WIMAX spectrum and encouraging new entrants to use this spectrum to bridge the digital divide. New entrants have opportunity in both developed and emerging markets to tap millions of new subscribers by accelerating the broadband penetration. WIMAX technology is particularly versatile so a new entrant can offer mobile or fixed broadband service. By offering a fixed system now and mobility later, the service provider can maintain a comparative edge by easily adapting the WIMAX network to the evolving demands of customers.
- Meeting demand for mobile broadband: - There is tremendous demand for mobile broadband and subscribers are ready to pay a premium for wireless broadband. New entrants have opportunity to offer differentiated services based on WIMAX high throughput and mobile broadband. While current mobile cellular system have insufficient capacity or coverage to handle bandwidth intensive activity, WIMAX with cellular like mobility and coverage, provides a true mobile broadband experience with throughputs that are many times greater than traditional cellular network.
- Introducing niche services: - WIMAX provides a great opportunity for new entrants to target a particular segment of the

broadband market and provide a branded niche services because it offers a broad range of devices and chipsets, common IP core and five classes of wire line-like QoS. Previously, an operator was dependent on an incumbent for a differentiated service with unique application. With WIMAX, new entrants can introduce niche services directly to the end user.

- Extending connections to small medium enterprise:- small and medium enterprises demand fixed and mobile broadband to support their businesses at home and in remote locations. There is untapped opportunity to serve the SME with a “broadband on the go” solution. This “broadband on the go” solution will give the SME competitive advantage and more time for the customers.
- Capitalizing on roaming fees: - New entrants can capitalize on impressive ARPU opportunity from travelers roaming in their licensed territory. This is like early cell phone days when users paid a premium to have their connection while roaming. WIMAX networks are already being deployed around the globe. The promise of WIMAX is clearly becoming the reality of WIMAX as major suppliers, equipment vendors and service providers join forces to create the new WIMAX ecosystem.

VI. THE WIMAX TECHNOLOGY ADVANTAGE

WIMAX is flexible, brilliant technology that offers both coverage and capacity advantages. Its easy scalability will allow networks to evolve for the needs of tomorrow. WIMAX is uniquely suited to meet the needs of new entrants because it is cost effective and quick and easy to deploy. It also offers simple system integration, affordable access to spectrum and access to a broad range of next generation devices

- Cost advantages: - since WIMAX technology is based on a globally accepted standard, WIMAX delivers great advantages. WIMAX offers the industry a very capable platform by which to deliver

the demanding service requirements for mobile broadband today and tomorrow. With the added support for a variety of advanced multi- antennas implementations such as MIMO (multiple in multiple out) and beamforming. WIMAX offers the new entrant consider edge compared to incumbent in meeting their demands and achieving higher performance, fewer sites, less and less spectrum.

- The WIMAX forum uses a common WIMAX reference architecture (fig. 3) with four modular areas that make up the WIMAX ecosystem. Device and infrastructure developers, operators, media and content providers, and application developers use this architecture to achieve interoperability. This process is enforced with certification standards to assure WIMAX is a cohesive, cost effective solution.
- WIMAX infrastructure uses all the advantages of the most efficient wireless and digital technologies – while remaining smaller and more economical. WIMAX uses light infrastructure and can be deployed in speeds never imagined before. WIMAX offer cost savings by utilizing backhaul with IP interface, high speed wireless interface and tower top access with zero footprint implements.
- Simple system integration: - The WIMAX distributed architecture is a simpler, more powerful alternative to traditional hierarchical cellular networks based on complex layers control. WIMAX networks and supplemental solutions take maximum advantages of the power of, utilizing the latest advancement in mobility management and providing a robust and versatile platform.
- License spectrum is available at an affordable cost: - WIMAX has support from regulators worldwide because it is the one of the fastest and most cost effective mechanism that can bridge the digital

divide. WIMAX spectrum allocations are completely different from large auctions of cellular spectrum. WIMAX licenses are made available globally at significantly low prices compared to cellular licenses. WIMAX operates in the licensed spectrum and hence avoids interference and guarantees services to subscribers. The WIMAX forum has approved licensed spectrum in 3.5 GHz, 2.5GHz, and 2.3GHz frequency band. These new spectrums are easily available and affordable .the availability provides a competitive edge to WIMAX broadband operators and provides opportunity for independent deployment models.

- Access to devices: - WIMAX vendors have developed a broad portfolio of high-performing, feature rich WIMAX devices as part of their end-to-end WIMAX solutions suite. The WiMAX entry level devices with sleek styles and reduced cost are tailored to appeal to end-users. They deliver fast, reliable, high-speed wireless broadband connectivity with no wait for installation, no complex configuration and no operator intervention. The simple, low-profile, appealing form-factor manages to pack tremendous technology capabilities including multi-antenna operations and sophisticated signal processing, flexible and reprogrammable hardware for over-the-air updates, and a series of features that include embedded Wi-Fi and VoIP capability. A key success factor in wireless broadband is easy access to devices and chipsets. Today there is a growing variety of WiMAX CPEs (Customer Premises Equipment), WiMAX devices, PCMCIA cards, and chipsets. These devices are next generation, cost efficient devices with multiple screens for various applications. They are multi-modal (Wi-Fi/WiMAX, GSM/WiMAX) to capitalize on roaming fees.

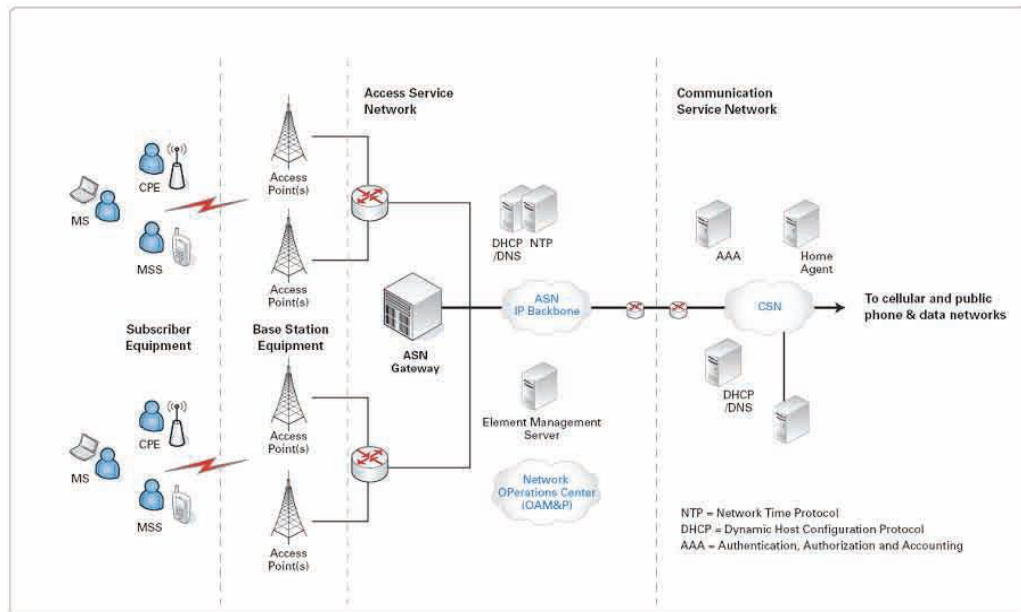


Figure 3: WiMAX Reference Architecture's modular view

VII. CONCLUSION

The main features and evaluation of the standards with focus on the current standard IEEE 802.16e and its standard families and new entrants for WIMAX. MAC layer in WIMAX has many unique features from which supporting different QoS classes is the most important. WIMAX provided supports for QoS classes but didn't define the scheduling mechanism for those classes in all modes. This paper explores how new industry entrants can gain early market share and benefit from a number of new opportunities to bridge the digital divide, capitalize on roaming fees and extended connections to small and medium enterprises. This paper also discusses why WIMAX technology has specific advantages such as cost effective solutions, simple system integration, affordable spectrum and access to available devices - that make these business opportunities possible in ways that few other technologies have done before. This study gives a good reference or a good start for understanding WIMAX technology and the main research issue.

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