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Comparison of Handoff Using Mobile WiMAX

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Abstract: The next-generation Wireless Metropolitan Area Networks, using the Worldwide Interoperability for Microwave Access (WiMAX) as the core technology based on the IEEE 802.16 family of standards, is evolving as a Fourth-Generation (4G) technology. With the recent introduction of mobility management frameworks in the IEEE 802.16e standard, WiMAX is now placed in competition to the existing and forthcoming generations of wireless technologies for providing ubiquitous computing solutions. However, the success of a good mobility framework largely depends on the capability of performing fast and seamless handovers irrespective of the deployed architectural scenario. Now that the IEEE has defined the Mobile WiMAX (IEEE 802.16e) MAC-layer handover management framework, the Network Working Group (NWG) of the WiMAX Forum is working on the development of the upper layers. However, the path to commercialization of a full-fledged WiMAX mobility framework is full of research challenges. In this paper focuses on potential handover-related issues in the existing and future WiMAX mobility framework.

Key Words: Wimax, IEEE 802.16, BPSK, QPSK, QAM

I. INTRODUCTION

WiMAX is the next generation broadband wireless technology. It offers high speed, secure, sophisticate and last mile broadband services along with a cellular pull back and Wi-Fi hotspots. The evolution of WiMAX began shortly when scientists and engineers felt the importance of having a wireless Internet access and other broadband services which works well in rural and urban areas and also in those areas where it is not possible to establish wired infrastructure. IEEE 802.16, also known as IEEE Wireless-MAN, explored both licensed and unlicensed band of 2-66 GHz which is standard of fixed wireless broadband and included mobile broadband application. WiMAX forum, a private organization was formed in June 2001 to coordinate the components and develop the equipment those will be compatible and inter operable. After several years, in 2007, Mobile WiMAX equipment developed with the standard IEEE 802.16e got the certification and they announced to release the product in 2008, providing mobility and nomadic access. The IEEE 802.16e air interface based on Orthogonal Frequency Division Multiple Access (OFDMA) which main aim is to give better performance in non-line-of-sight environments. IEEE 802.16e introduced scalable channel bandwidth up to 20 MHz, Multiple Input Multiple Output (MIMO) and AMC enabled 802.16e technology to support peak Downlink (DL) data rates up to 63 Mbps in a 20 MHz channel through Scalable OFDMA (S-OFDMA) system. IEEE 802.16e has strong security architecture as it uses Extensible Authentication Protocol (EAP) for mutual authentication, a series of strong encryption algorithms, CMAC or HMAC based message protection and reduced key lifetime.

WiMax is basically a new shorthand term for IEEE Standard 802.16, which was designed to support the European standards. 802.16's predecessors (like 802.11a) were not very acc ommodative of the European standards, per se.

The IEEE wireless standard has a range of up to 30 miles, and can deliver broadband at around 75 megabits per second. This is theoretically, 20 times faster than a commercially available wireless broadband.

The 802.16, WiMax standard was published in March 2002 and provided updated information on the Metropolitan Area Network (MAN) technology. The extension given in the March publication, extended the line-of-sight fixed wireless MAN standard, focused solely on a spectrum from 10 GHz to 60+ GHz.

This extension provides for non-line of sight access in low frequency bands like 2 - 11 GHz. These bands are sometimes unlicensed. This also boosts the maximum distance from 31 to

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50 miles and supports PMP (point to multipoint) and mesh technologies

The IEEE approved the 802.16 standards in June 2004, and three working groups were formed to evaluate and rate the standards. WiMax can be used for wireless networking like the popular WiFi. WiMax, a second-generation protocol, allows higher data rates over longer distances, efficient use of bandwidth, and avoids interference almost to a minimum. WiMax can be termed partially a successor to the Wi-Fi protocol, which is measured in feet, and works, over shorter distance.

II. OVERVIEW WiMax

The IEEE standard committee introduced standards for networking elements, for an instance, IEEE 802.16 in 1999. The 802.16 family standard is introduced as Wireless Metropolitan Area Network (MAN) commercially known as WiMAX (Worldwide interoperability for Microwave Access) which is an nonprofit, industry-led organization and responsible for certificating, testing, and promoting the compatible interoperable wireless products based on IEEE 802.16 working group and ETSI's HiperMAN standard. The original IEEE standard addressed 10 to 66 GHz in licensed bands and 2 to 11 GHz in unlicensed frequency range. They certified different versions of WiMAX based on different criteria such as carrier based wireless (single and multi carrier), fixed and portable wireless devices etc.

Standard IEEE 802.16 versions

802.16

The first 802.16 standard was released in December 2000. It provides a standard point-to-multipoint broadcast in 10 to 66 GHz frequency range for Line of Sight (LOS) environment.

802.16a

The second version of WiMAX standard 802.16a was an amendment of 802.16 standard and has the capability to broadcast point-to-multipoint in the frequency range 2 to 11 GHz. It was established in January 2003 and assigned both licensed and unlicensed frequency bands. Unlicensed bands cover maximum distance from 31 to 50 miles. It improves the Quality of Service (QoS) features with supporting protocols for instance Ethernet, ATM or IP.

802.16c

The third version of WiMAX standard 802.16c was also an amendment of 802.16 standards which mostly dealt with frequency ranging 10 to 66 GHz. This standard addressed various issues, for instance, performance evaluation, testing and detailed system profiling. The system profile is developed to specify the mandatory features to ensure interoperability and the optional features that differentiate products by pricing and functionality.

802.16d

In September 2003, a revision project known as 802.16d began which aimed to align with a particular view of European Telecommunications Standards Institute (ETSI) Hiper-MAN. This project was deduced in 2004 with the release of 802.16d-2004 including all previous Performance Evaluation of IEEE 802.16e (Mobile WiMAX) in OFDM Physical versions' amendments. This standard supports mandatory and optional elements along with TDD and FDD technologies. Theoretically, its effective data rate is 70 Mbps but in reality, the performance is near about 40 Mbps. This standard improves the Quality of Service (QoS) by supporting very large Service Data Units (SDU) and multiple polling schemes.

802.16e

802.16e was an amendment of 802.16d standard which finished in 2005 and known as 802.16e-2005. Its main aim is mobility including large range of coverage. Sometimes it is called mobile WiMAX. This standard is a technical updates of fixed WiMAX which has robust support of mobile broadband. Mobile WiMAX was built on Orthogonal Frequency Division Multiple Access (OFDMA). It mentioned that, both standards (802.16d-2004 and 802.16e-2005) support the 256-FFT size. The OFDMA system divides signals into sub-channels to enlarge resistance to multipath interference. For instance, if a 30 MHz channel is divided into 1000 sub-channels, each user would concede some sub-channels which are based on distance.

Due to the absence of handoff technique, the Wi-Fi users may move around a building or a hotspot and be connected but if the users leave their location, they lose their connectivity. But with the 802.16e-2005, the mobile users will be connected through Wi-Fi when they are within a hotspot and then will be connected to 802.16 if they leave the hotspot but will stay in the WiMAX coverage area.

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III. HANDOFF

In a cellular telephone network, handoff is the transition for any given user of signal transmission from one base station to a geographically adjacent base station as the user moves around. In an ideal cellular network, each end user's telephone set or modem (the subscriber's hardware) is always within range of a base station. The region covered by each base station is known as its cell. The size and shape of each cell in a network depends on the nature of the terrain in the region, the number of base stations, and the transmit/receive range of each base station. In theory, the cells in a network overlap; for much of the time, a subscriber's hardware is within range of more than one base station. The network must decide, from moment to moment, which base station will handle the signals to and from each and every subscriber's hardware.Each time a mobile or portable

cellular subscriber passes from one cell into another, the network automatically switches coverage responsibility from one base station to another. Each base-station transition, as well as the switching processor sequence itself, is called handoff. In a properly functioning network, handoff occurs smoothly, without gaps in communications and without confusion about which base station should be dealing with the subscriber. Subscribers to a network need not do anything to make handoff take place, nor should they have to think about the process or about which base station is dealing with the signals at any given momentWhen a mobile user travels from one area of coverage or cell to another cell within a call's duration the call should be transferred to the new cell's base station. Otherwise, the call will be dropped because the link with the current base station becomes too weak as the mobile recedes. Indeed, this ability for transference is a design matter in mobile cellular system design and is call .

Type of handover in mobile wimax

Mobile WiMAX provides three handover mechanisms: hard handover (HHO), fast base station switching (FBSS), and macro-diversity handover (MDHO). HHO is mandatory, while FBSS and MDHO are optional .During hard handover (HHO) the MS communicates with only just one BS in each time. Connection with the old BS is broken before the new connection is established. 50 Handover is executed after the signal strength from neighbour's cell is exceeding the signal strength from the current cell. Hard handover is more bandwidth-efficient than soft handover, but it causes longer delay. When macro-diversity handover (MDHO) is supported by MS and BS, the diversity set is maintained by MS and BS. Diversity set is a list of the BS's, which are involved in the handover procedure as shown in Figure There is always one BS in the diversity set that is defined as an anchor BS. The HHO is a special case of MDHO when there is only one BS in the diversity set. There might be also BSs that can be reached with the MS, but the signal is too weak for real traffic. These BSs are kept outside the diversity set and named as neighbour BSs. Naturally, while moving towards a neighbour BS, at some moment the signal is strong enough and the BS can be included in the diversity set, or if the signal strength is too weak the BS will be removed off form the diversity set.

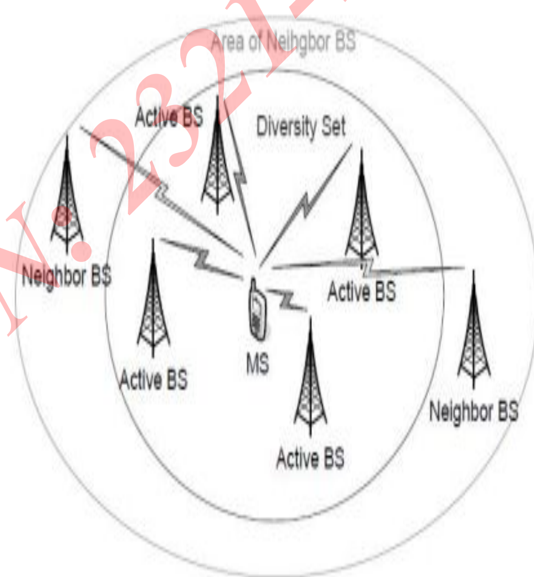

Figure 1: Macro-diversity Handover

In fast base station switching (FBSS), the MS and BS diversity set is maintained similar as in MDHO. MS continuously monitors the base stations in the diversity set and defines an anchor BS. Anchor BS in only one base station of the diversity set that MS communicate with all uplink and downlink traffic .This is the BS where MS is registered, synchronized, performs ranging and also monitoring downlink channel for control information. The adding/dropping of members of the diversity set is similar to the one with MDHO above. In fact, all the BSs in the diversity set receive the data addressed to the MS, but only one of them transmits the data over the air interface while the others eventually drop the received packets. The anchor BS can be changed from frame to frame depending on BS selection

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scheme. This means every frame can be sent via different BS in diversity set

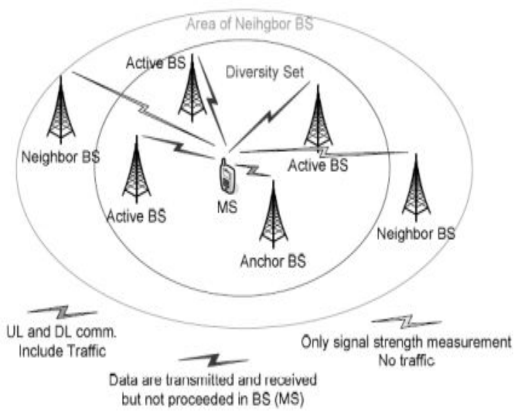

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Figure 2 Fast Base Station Switch

IV. SIMULATION RESULTS

Simulation results shown as following :

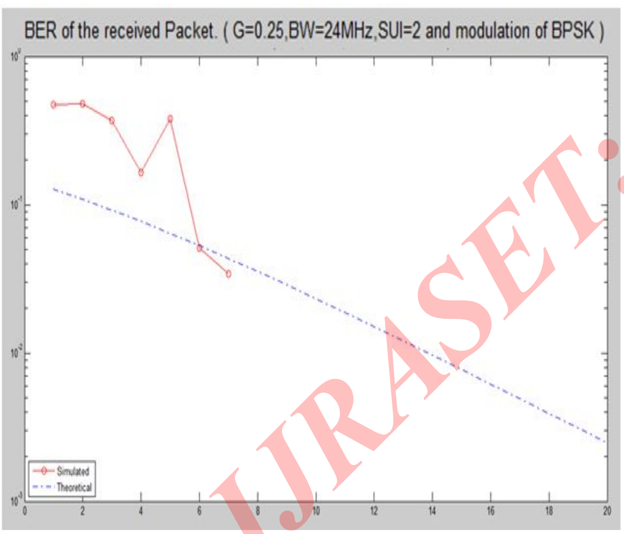

Figure 3 Simulation output for BPSK

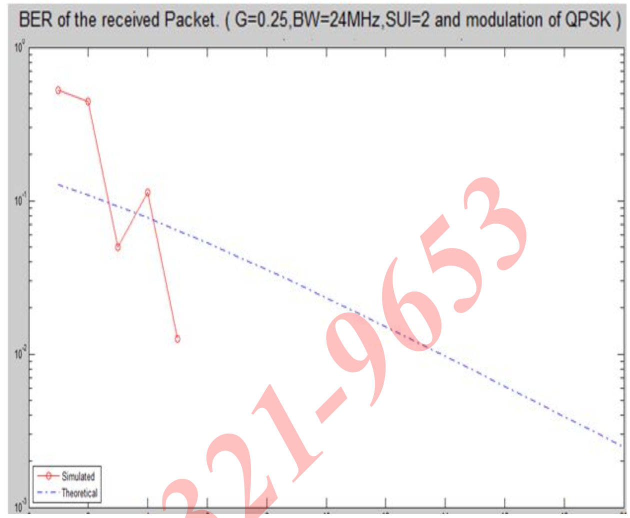

Figure 4. Simulation output for QPSK

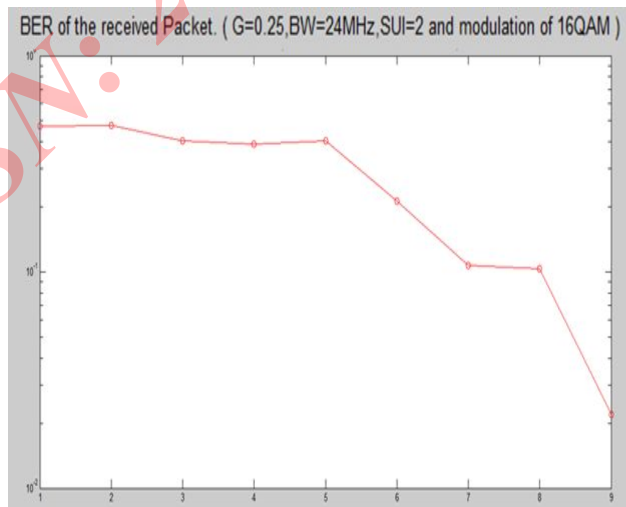

Figure 5 Simulation output for 16-QAM

Analysis: In all this simulation process we want to comprise soft handoff and hard handoff. In all of the two graphs BPSK QPAK blue dotted line represent the soft handoff and red line represent the hard handoff. In the 16QAM graph only hard handoff represented for the soft handoff we need a very high frequency that not possible through this coding. So this ideal case for the hard handoff. In all the three graph G (Cyclic prefix) which provide the prefix value for the all three types of modulation scheme, BW (Bandwidth) high value of bandwidth provide the clarity in the output we have several value of the bandwidth we select the high value for the clarity ,SUI (simulation unit).We

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need the OFDM symbol for Simulate the output which is multiply the 20 because OFDM has 20 bit symbol.

V. CONCLUSION

In this paper we have simulated WiMAX OFDM physical layer, mobile systems, using modulation techniques BPSK, QPSK and 16 QAM. In all aspects of adaptive modulation technique, it can be concluded that the performance of Mobile WiMAX as Binary Phase Shift Keying (BPSK) is more power efficient and needs less bandwidth. In another case, Quadrature Phase Shift Keying (QPSK) and 16-QAM modulation techniques are in middle of those two (BPSK and 64-QAM) and they requires higher bandwidth. QPSK and 16-QAM are less power efficient than BPSK.During all simulations we got, BPSK has the lowest BER and 64-QAM has the highest BER than other modulation techniques.

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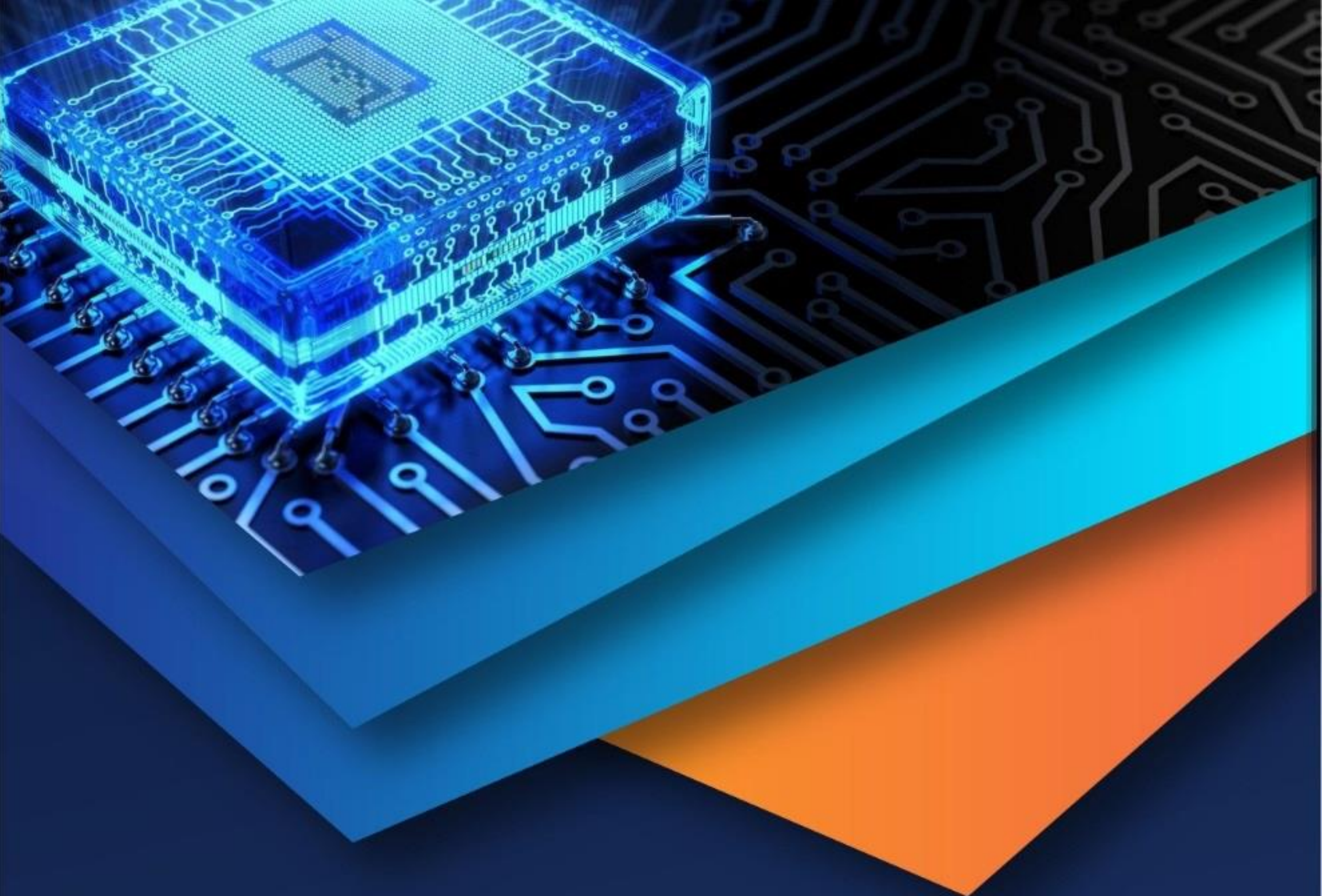

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