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A Comparison between WIMAX and LTE Based on Multicarrier Technology

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ABSTRACT: Worldwide Interoperability for Microwave Access (WIMAX) is realized on IEEE 802.16, while LTE is realized on 3GPP, both providing high speed data over a wide area. 4G is a promising wireless broadband technology with providing data rates up to 1Gbps. WIMAX and LTE (Long Term Evolution standards) have realized on a multiple access technique called OFDMA. The two main competitors in the 4G wireless system are WIMAX and LTE. OFDMA has utilized multiuser diversity of LTE, whereas the frequency diversity is utilized in WIMAX. LTE reacts faster than the WIMAX according to the traffic demand, but the design of WIMAX is easier than LTE.

KEYWORDS: WIMAX, IEEE, LTE, 3G, 4G, 3GPP

I. INTRODUCTION

WIMAX and LTE both are the promising is the first version of WIMAX and LTE R8 is the latest version of LTE, both are not meeting the requirement of 4G technology in cellular communication. WIMAX is based on IEEE 802.16e and LTE is a third generation partnership project (3GPP), these are the two standards dominating in the fourth generation (4G) wireless projects [1]. WiMAXv1 and LTE R8 are not in the category of 4G wireless systems because they do not meet the requirements accordingly to the International Telecommunication Union (ITU) [2]. A second-generation protocol (WIMAX) that allows more efficient use of bandwidth, interference avoidance, and allow higher data rates over longer distances. WiMAXv1 standard wireless systems. The evolution of WIMAX based on IEEE standards called WiMAXv2 and the evolution of LTE called LTE-Advanced (LTE-A).

LTE and WIMAX has several common techniques with suitable differences [3]. Orthogonal frequency-division multiple access (OFDMA) is a very popular technique [4]. In WIMAX, OFDMA is used both the downlink and the uplink technology, while in LTE used only on the downlink. The technology behind the uplink of LTE is single carrier frequency division multiple access (SCFDMA).

LTE is a 4G mobile communications standard. LTE Users has data speeds 10 times faster than the current 3G network. 2G and 3G networks are not compatible with LTE therefore a separate wireless spectrum is required to design LTE. OFDM has ability to regulate well with multiple-input multiple-output (MIMO-OFDM) technology is an important part in the of OFDMA [1, 2]. MIMO technology helps to achieve high spectral efficiencies. High peak-to-average power ratio (PAPR) is the reason for not using OFDMA for the uplink in LTE. WIMAX has the ability to design a light weight architecture.

II. RELATED WORK

LTE originated from the growth path of 1G, 2G, 3G mobile generations of the telecom companies and their 3GPP and 3GPP2 associations. 1G is an analogous system defined by companies like TACS in Europe and AMPS in North America. 2G systems of GSM and cdma-one came as digital solution with circuit switched voice capacity as objective.

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Moderate data rates were enabled using 2.5G packet switched enhancements like GPRS and EDGE. WCDMA was the adopted system of 3GPP in Europe and many other parts of the world. CDMA2000 was the 3G system of North America (NA). Both of these two used a pair of separate frequency bands to transmit and receive in what is called Frequency Division Duplex (FDD) mode. The beginning of OFDM established all IP LTE in 3GPP release with TDD and FDD modes seemed to incite migration of NA's systems to it targeting a unified telecom standard. ITU in 2003 [4] set the framework and overall objectives of 4G systems and accelerated the work toward these systems by setting October 2009 as a deadline date for submitting proposals by IMT-Advanced initiative. It sets a determined high data rate of 1.0 Gbps peak rate for fixed services and 100 Mbps for mobile service. LTE-Advanced based on 3GPP UMTS Rel 10 in 2011, is an officially recognized 4G technology satisfying IMT-Advanced. WiMAX grew out from IEEE standards adopted by data companies with deep roots in wired technologies (e.g. the Ethernet standards of IEEE 802.3, etc.) and WiFi wireless technologies (IEEE 802.11). To provide metropolitan wireless broadband in early attempts were based on fixed wireless access techniques that require line of sight and rooftop antennas and operated at high frequencies that can be affected by rain and atmospheric conditions [5]. These attempts had little success. WiMAX was officially recognized as 3G technology in 2007 [6] many years after the recognition of the initial 3G technologies in 2000. IEEE 802.16m, standardized in March, 2011, was measured for WiMAX Release 2.0.

III. FRAME STRUCTURE

Time-division duplexing (TDD) is realized in WiMAX, Typical frame duration of WiMAX is 5 ms with common deployment bandwidths of 5 and 10 MHz [5]. 2 types of WiMAX, Fixed and Mobile, are based on IEEE 802.16 standards and are defined by the Wi-MAX forum.

Fixed WiMAX- Orthogonal frequency division multiplexing (OFDM) physical layer of the 802.16-2004 specifications is the basis of fixed WiMAX.

Mobile WiMAX- standard 802.16e-2005, physical layer, which is the new version of the original Fixed WiMAX standard. Functions like base station handoffs, multiple input multiple output (MIMO) transmit/receive diversity, and scalable fast Fourier transform (FFT) sizes [6] provided by Mobile WiMAX.

The upcoming generations in the wireless systems need to handle both data and voice communications technologies like GSM, UMTS (2G and 3G technology) works on audio with some support for low to medium data rates. WiMAX has a very flexible structure. Frame division is into OFDM symbols, some are allocated for uplink and some are downlink design. IEEE 802.16 uses a wide range of frequencies from 2-66GHz [10].

On the other hand LTE (Long Term Evolution) or the E-UTRAN the fixed frame duration is 10 ms, which is divided into subframes of 1 ms duration. Two slots of size 0.5 ms duration are formed out of a subframe. Every slot has either six or seven OFDM symbols, depending on the Cyclic Prefix (CP) length. Beam forming, Spatial Division Multiple Access, and MIMO have been used in Mobile LTE. Using of Multiple antenna techniques led to increase transmission rates, capacity of voice and data, and improved the efficiency in mobile (4G-LTE) systems [7]. LTE supports division duplex scheme as well as frequency division duplex scheme (TDD/FDD).

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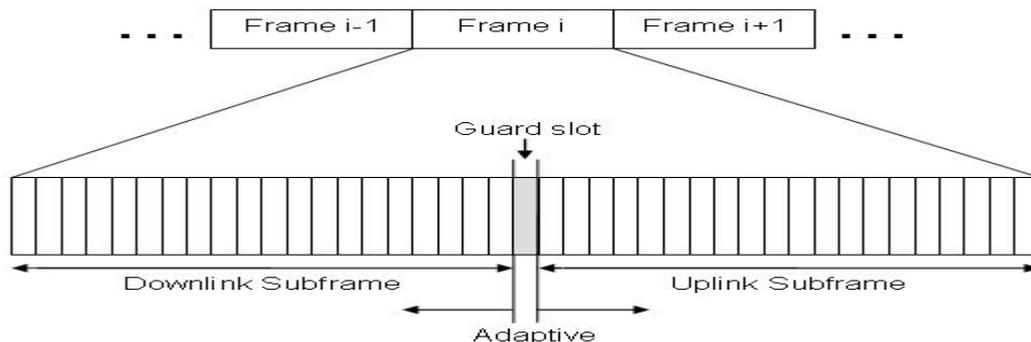


FIG.1 WIMAX FRAME STRUCTURE

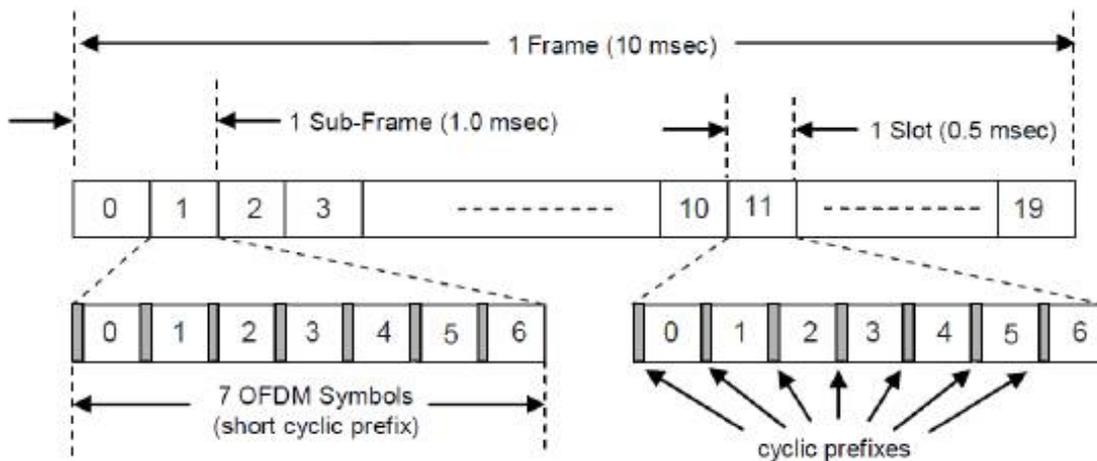


FIG.2 LTE FRAME STRUCTURE

IV. MULTIPLE ANTENNA TECHNIQUE

In any radio transmission multiple antenna technique plays a very important role. Multiple antenna technique is used to strengthen signal robustness, increases system capacity with higher data rates. Both LTE and WIMAX use multiple antenna technique to improve its system performance.

WIMAX supports multiple antenna system (MAS) technology. WIMAX supports both open loop and close loop MIMO systems. In open loop systems space time block coding, and in close loop spatial beamforming operation is to be performed. Transmitter adaptive antenna determines the side information of channel to increase system capacity.

V. SYNCHRONIZATION

At the starting of every frame duration a preamble is transmitted in a WIMAX system. The time domain properties of a preamble sequence is utilized to achieve frame synchronization for the mobile users. It is based on the use of every third subcarrier along with the structure of the cyclic prefix (CP) [8]. In LTE, the frame synchronization is achieved by locating the primary synchronization sequence (PSS), which is sent twice in a fixed frame duration of 10 ms.

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VI. SECURITY

Security mechanisms are the fundamental for wireless networks like LTE, WIMAX. A security sub-layer is defines by the IEEE802.16 at the lowest point of the Medium Access Control (MAC) layer. Privacy and Key Management (PKM) protocols and encapsulation protocols of sub-layer are the 2 protocols used. The PKM protocol of the IEEE 802.16 provides security keys among the base station, mobile station and the encapsulation protocol for the encryption of transmitted data [12]. LTE also provides security mechanisms alike WIMAX, using security keys in between the mobile devices and the base station to encrypt the information [7].

VII. QUALITY OF SERVICES (QOS)

The main part of the network planning of QOS, when applying 4G/LTE fixed broadband wireless communication. End to end support provided by LTE means bearer characteristics are defined and controlled through the session [11]. MAC layer of WIMAX is to support numbers of applications like voice and multimedia services. WIMAX has 5 kinds of QOS. QOS is defined by an index QOS class identifier (QCI) and Allocation and retention priority (ARP).

VIII. CONCLUSION AND FUTURE SCOPE

A comparison between WIMAX and LTE has presented in this article. Basic technology behind WIMAX and LTE is OFDMA. Day by day increasing demand of higher data rates in wireless communication delivering voice, video, data that makes an interest in telecom industry to implementing new technologies to provide all the services at low cost and higher efficiency. LTE-A is true 4G technology. WIMAX had the precedence advantage over LTE in bringing to light much of the themes currently adopted such as the flat architecture, all IP network and TDD structure. 3GPP on the other hand, moved from all circuit switched of 2G, through half packetized of 2.5G and 3G and finally to all IP in LTE and LTE-Advanced. 3GPP provided a smooth path of transition of its current technologies to LTE and LTE advanced.

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