LTE and WiMAX Comparison

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Audience

The target audiences of this paper are the Management and Technical personnel from Telecommunications and Networking industry, especially decision makers and engineers working on the development of next-generation wireless technologies, students from Electrical and Computer Science background, and anyone interested in a comparative study of the two leading contenders for 4G broadband wireless access technologies: LTE and WiMAX.

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Overview

Over the last few years, there has been increasing demands for accessing the Internet over the mobile devices. To address this, the wireless telecommunication industry has been striving hard to define a new air interface for mobile communications to provide a framework for high mobility broadband services and increase the overall system capacity; reducing latency; and improving spectral efficiency and cell-edge performance.

Two emerging technologies, the IEEE 802.16 WiMAX (Worldwide Interoperability for Microwave Access) and the 3GPP LTE (Third Generation Partnership Project Long Term Evolution) aim to provide mobile voice, video and data services by promoting low cost deployment and service models through Internet friendly architectures and protocols. Both these technologies are being considered as candidates for the fourth generation (4G) of mobile networks.

This paper performs a detailed comparison of the LTE and WiMAX standards and delves into the intricacies of each of them. The paper begins with a brief history and technology overview of WiMAX and LTE. It then performs a detailed comparison of the System Architecture for each and also discusses the seamless integration of LTE and WiMAX technologies into the evolved 3GPP networks. It performs a detailed study of the Air Interface Radio Aspects such as access modes, transmission bandwidths, supported frequency bands, antenna techniques; the protocol aspects and various other features including control mechanisms, Quality of Service (QoS) and security for each of them.

Towards the end, the paper provides an overview of the competition in the wireless market and challenges and roadmap for each of these next-generation wireless standards.

Introduction

The communication industry has been formulating new standards to efficiently deliver high speed broadband mobile access in a single air interface and network architecture at low cost to operators and end users. Two standards, IEEE 802.16 (WiMAX) and 3GPP LTE are leading the pack towards forming the next-generation of mobile network standards.

The WiMAX (IEEE 802.16 standard) comes from IEEE family of protocols and extends the wireless access from the Local Area Network (typically based on the IEEE 802.11 standard) to Metropolitan Area Networks (MAN) and Wide Area Networks (WAN). It uses a new physical layer radio access technology called OFDMA (Orthogonal Frequency Division Multiple Access) for uplink and downlink. While the initial versions 802.16-2004 focused on fixed and nomadic access, the later version 802.16-2005, an amendment to 802.16-2004 include many new features and functionalities needed to support enhanced QoS and high mobility broadband services at speeds greater than 120 Km/h. The 802.16-2004 is also called 802.16d and is referred to as fixed WiMAX while the 802.16-2005 is referred to as 802.16e or Mobile WiMAX. The Mobile WiMAX uses an all IP backbone with uplink and downlink peak data rate capabilities of upto 75 Mbps depending on the antenna configuration and modulation, practicable to 10 Mbps within a 6 miles (10 Km) radius. The earliest iterations of WiMAX was approved with the TDMA TDD and FDD with line of sight (LOS) propagation across the 10 to 66 GHz frequency range which was later expanded to include operation in the 2 to 11 GHz range with non line of sight (NLOS) capability using the robust OFDMA PHY layer with sub-channelization allowing dynamic allocation of time and frequency resources to multiple users. The 802.16m (Mobile WiMAX Release 2) Task-force is currently working on the next-generation systems with an aim for optimizations for improved interworking and coexistence with other access technologies such as 3G cellular systems, WiFi and Bluetooth and enhance the peak rates to 4G standards set by the ITU under 'IMT-Advanced' umbrella which calls for data rates of 100 Mbps for high mobility and 1 Gbps for fixed/nomadic wireless access.

The LTE, on the other hand evolves from the Third-generation technology which is based on WCDMA and defines the long term evolution of the 3GPP UMTS/HSPA cellular technology. The specifications of these efforts are formally known as the evolved UMTS terrestrial radio access (E-UTRA) and evolved UMTS terrestrial radio access network (E-UTRAN), commonly referred to by the 3GPP project LTE. The first version of LTE is documented in Release 8 of the 3GPP specifications. It defines a new physical layer radio access technology based on Orthogonal Frequency Division Multiple Access (OFDMA) for the downlink, similar in concept to the PHY layer of Mobile WiMAX, and uses SC-FDMA (single Carrier Frequency Division Multiple Access) for the uplink. LTE supports high performance mobile access functional upto

350Km/h with 500Km/h under consideration. Peak data rates range from 100 to 326.4Mbps on the downlink and 50 to 86.4 Mbps on the uplink depending on the antenna configuration and modulation depth. The LTE also targets to achieve the data rates set by the 4G 'IMT-Advanced' standard. The development of LTE interface is linked closely with the 3GPP system architecture evolution (SAE) which defines the overall system architecture and Evolved Packet Core (EPC). The LTE aims to provide an all IP backbone with reduction in cost per bit, better service provisioning, flexibility in use of new and existing frequency bands, simple network architecture with open interfaces, and lower power consumption.

The figure below shows the wireless technology evolution path for WiMAX and LTE towards the ITU defined 'IMT-Advanced' 4G standard.

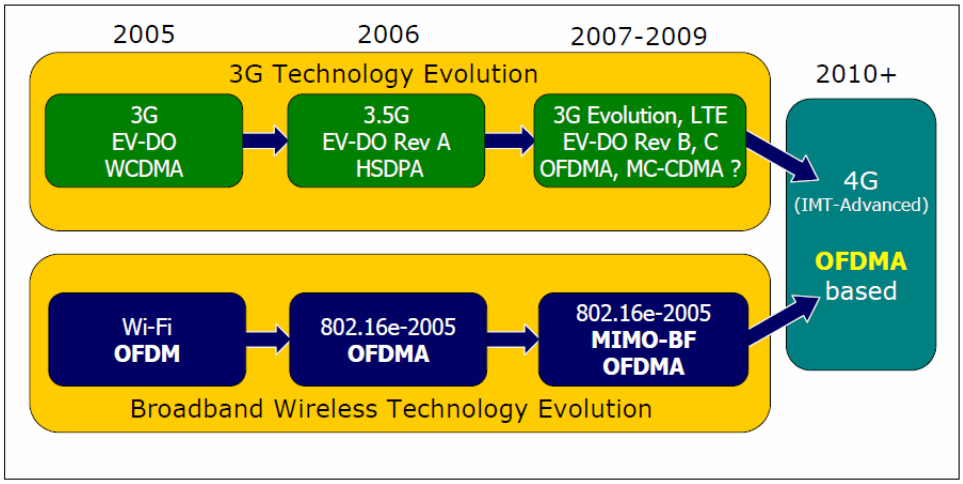

Figure-1: Evolution path of Mobile wireless technologies towards 4G [12]