International Journal of Recent Engineering Research and Development (IJRERD)
ISSN: 2455-8761
www.ijrerd.com || Volume 02 – Issue 09 || September 2017 || PP. 119-123

A Study of Various LTE Standards: A Survey

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Abstract: LTE technology enhances positioning performance, provides flexibility for applications and creates new business opportunities for location-based applications and services. Because no single positioning method works well in all environments, new-generation positioning systems must have integrated solutions that combine a wide range of complementary positioning methods and techniques together with the ability to learn about and adapt to the radio environment. Indeed, the need for multi-standard positioning solutions is obvious in a world where such a large variety of radio access and positioning standards coexist. This paper shows a detailed overview of LTE Architecture and various Services in LTE Standards. A statistical survey was also carried out about LTE.

Keywords: LTE, WIRELESS, TCP/IP, ARCHITECTURE.

I. Introduction

LTE, an initialism of long-term evolution, marketed as 4G LTE, is a standard for wireless communication of high-speed data for mobile phones and data terminals. It is based on the GSM/EDGE and UMTS/HSPA network technologies, increasing the capacity and speed using a different radio interface together with core network improvement. Driving the evolution of wireless broadband technology is increasing expectations for speed, bandwidth, and global access [9]. People want more information, such as business and consumer applications, and entertainment available through their mobile devices, but with greater speeds. For wireless carriers to achieve greater speeds and pervasive connectedness, their networks need to start behaving more like landline IP-based networks. This line of thinking represents a fundamental shift in perspectivefrom mobile services to broadband connections for customers and service providers alike. Enter the fourth generation (4G) wireless network. Unlike earlier wireless standards, 4G technology is based on TCP/IP, the core protocol of the Internet. TCP/IP enables wireless networks to deliver higher-level services, such as video and multimedia, while supporting the devices and applications of the future.

II. LTE Development Background

Various technology standards bodies began to explore options for their 4G wireless technology offerings. Two groups, the Third Generation Partnership Project (3GPP), representing the family of networks generally referred to as GSM, and the Third Generation Partnership Project 2 (3GPP2), representing the family of networks generally referred to as CDMA, are working together to lay the foundation for LTE [1]. Established in 1998, 3GPP is a collaborative agreement that brought together multiple telecommunications standards bodies known as Organizational Partners. This group initiated the 3GPP LTE standards project to improve the UMTS mobile phone standard and to better meet future wireless technology needs. UMTS is one of the many 3G wireless technologies in use today. The most common form of UMTS uses W-CDMA as its underlying air interface and represents the European answer to the ITU IMT-2000 requirements for 3G cellular radio systems. 3GPP2 represents collaboration between the numerous telecommunications associations that helped develop CDMA standards for 3G.

LTE is a global 4G standard, with researchers and development engineers throughout the world participating in the joint-LTE radio access standardization effort, involving more than 60 operators, vendors, and research institutes. This is the same standards body that researched and established the GSM, GPRS, W-CDMA, and HSPA wireless standards. The LTE standard is tightly integrated with GPRS/UMTS networks and represents an evolution of radio access technologies and networks for UMTS.

III. Overview of LTE Architecture

Refer Figure 1 gives a general overview of LTE architecture. On the radio side of an LTE system, several important changes to earlier standards have been introduced. The radio access technology used, Orthogonal Frequency Division Multiple Access(OFDMA), is completely new and is designed to increase throughput over the radio link and improve spectral efficiency [8]. This should provide higher potential data rates between the mobile device and the base station, and greater capacity per MHz of spectrum. New, highly flexible scheduling and spectrum allocation mechanisms allow the system to better adjust radio resources to accommodate changes in the traffic flow on both the uplink and the downlink. Advanced forms of antenna technology are also written into the LTE standards [2].

For example, a technique known as Multiple Input Multiple Output (MIMO) uses an array of antennas, instead of just one, to increase peak data rates. Beam-forming technology helps provide more consistent Quality of Service (QoS) throughout the LTE network by improving the coverage of the radio signal so that data rates do not drop precipitously at the outer edges of a base station coverage area.

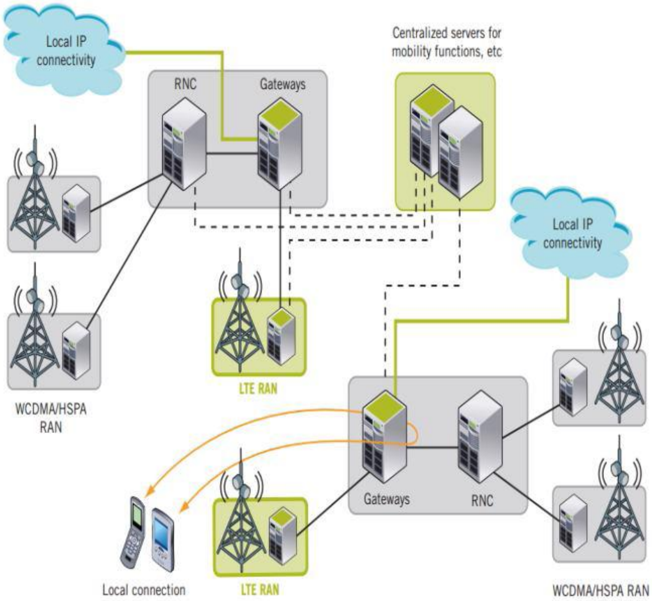


Figure 1: An Overview of LTE Architecture

In the core network (EPC), the LTE standards provide the following key elements:

• A common anchor point and gateway node for all access technologies — A common anchor pointnot only enables service continuity across varioustypes of access networks so that, for example, LTEuser devices can connect to 2G wireless and fixedline endpoints, but it also provides a point at whichpolicy enforcement can be implemented.

• **Optimized architecture for the user plane** — In the LTE architecture, user traffic passes through only two node types (base stations and gateways) [5]. Optimized user plane architecture is often referred to as a “flat architecture,” and is designed to help minimize end-to-end latency and enable high quality real-time multimedia services.

• **IP-based protocols at all interfaces** — An all-IP infrastructure eliminates the bandwidth and throughput constraints of circuit switched connections except perhaps in cases where the user session requires a connection to endpoints in a legacycircuit switched network. It also reduces the overhead of some trans-coding and trans-rating functions needed in current systems to convert between circuit switched protocols for the radio link and IP protocols on the other end.

• RAN-CN functional split similar to that of WCDMA/HSPA — keeping a similar functional distribution as the network evolves fromWCDMA/HSPA to LTE can ease the introduction of new elements into the network and reduce operational complexities in hybrid networks. In a mobile network, many tasks are involved in the “mobility management” function, which tracks the location of moving endpoints and maintains communications connections as radio signal quality, elements in the connection path, and even local network capabilities vary [6]. Network evolution can be simplified if the distribution of the discrete tasks involved in this process for LTE networks is similar to the distribution in predecessor networks

• Control/user plane split between the mobility management entity (MME) and the gateway — A split in the control/user plane between distinct elements in the core network improves cost effectiveness by allowing the network operator to scale capacity where needed. For example, user traffic is anticipated to grow at a considerably faster pace than the related control traffic.

• Integration of non-3GPP access technologies using client- as well as network-based mobile IP —The integration of non-3GPP access technologies potentially extends the reach of LTE services to user endpoints outside of the LTE coverage area.

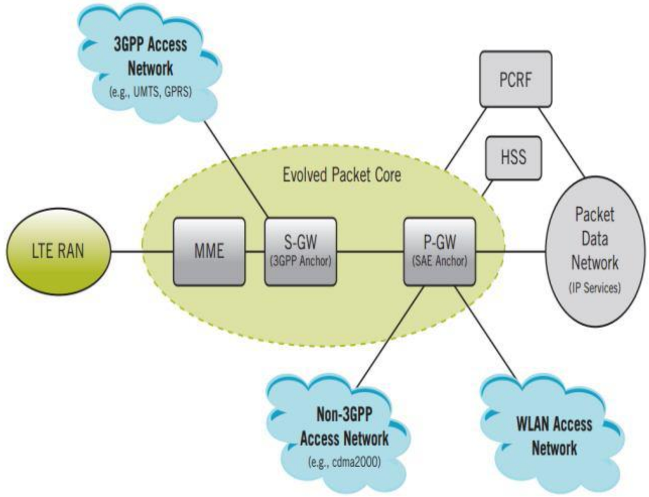


Figure 2: LTE Architecture

The fundamental architectural entities of the EPC areshown in the central oval in Figure 2. Their basic functions are:

• **Serving Gateway (S-GW)** — Referred to as the 3GPP Anchor, the S-GW is the mobility anchor for the user plane when the mobile endpoint is connected via an LTE radio link or another 3GPP Radio Access Technology (RAT). It provides a stable IP point of presence, allowing user traffic to flow uninterrupted as the user endpoint moves from one eNB to another within a 3GPP environment. The S-GW handlesmobility functions related to handovers between eNBs within a network or between eNBs in different3GPP networks [5]. The latter scenario would occurwhenever a user moves from an LTE network to a UMTS (3G) or GSM (2G) network, or from one LTE network to another [4]. The functions of the S-GW also include packet routing and forwarding, as well as certain low-level QoS procedures.

• **PDN Gateway (P-GW)** — The P-GW provides the interface for LTE user traffic to/from external packet data networks. Referred to as the SAE anchor, the PGW also serves as the mobility anchor point for user traffic transmitted over non-3GPP RATs, such as CDMA and WiMAX networks. It provides a stable IP point of presence for user sessions regardless of access technology or movement between access networks. In addition to performing handoff functions, the P-GW provides Deep Packet Inspection (DPI), policy enforcement, and higher-level QoSprocedures.

• **Mobility Management Element (MME**) — MME terminates control signaling from the RAN, handles overall mobility management within an LTE network, and maintains the status of user endpoints [10]. The MME handles signaling between 3GPP networks for mobility-related procedures and supports interfaces to the Serving GPRS Support Node (SGSN) in legacy 3GPP networks. In a network deployment, it would likely be combined with the SGW.

Services in LTE Standards

The primary types of services available in an LTE environment are described below:-

Multimedia Telephony Services for IMS (MTSI)

MTSI provides real-time bidirectional conversational transfer of speech, video, or data between two or more users. Communication is point-to-point between endpoints and involves one or more types of media, and additional types of media may be added as the communication progresses. MTSI is intended to cover the usage models of traditional telephony services and supplementary services that are based on speech or speech combined with additional media components, although MTSI services are not required to involve speech.

Multimedia Messaging Services (MMS)

MMS provides non-real-time transmission between mobile users that involves one or more media elements combined in an ordered and synchronized manner. It will allow users to send and receive messages exploiting the entire array of media types available today (for example, text, images, audio, voice, video) while also enabling support for new content types as they become popular.

Packet-Switched Streaming Services (PSS)

PSS deals with mechanisms that allow media content to be rendered at an endpoint at the same time as it isbeing transmitted over the network. PSS can support on demand applications, such as music video and news-on-demand, and live information delivery applications, such as live (but not broadcast) radio and television programs, which can be built on top of streaming services.

Multimedia Broadband and Multicast Services (MBMS)

MBMS is a unidirectional point-to-multipoint service in which data is transmitted from a single source in the network to multiple endpoints. A traditional broadcast service transmits data to all users in the broadcast area who have enabled the broadcast service [7]. A multicast service transmits data that can be received only by user endpoints which have subscribed to the particular multicast service.

Location Services (LCS)

Location services provide information about the current location of a user's terminal or the likely location of a specific mobile entity, along with additional attributes describing the location information provided, such as accuracy, coverage, privacy, and transaction rate.

Presence Services

Presence services allow access to information about a user's context and availability as well as information about user devices, services, and service components managed by the network. The definition of presence service capabilities in the LTE standards is intended to support the interoperability of these services in both wireless and fixed telecommunications networks and with external networks, although existing internet presence services are often closed, proprietary systems

IV. Statistical Results

Below is some results that were obtained, based on thesurvey carried out on LTE:-

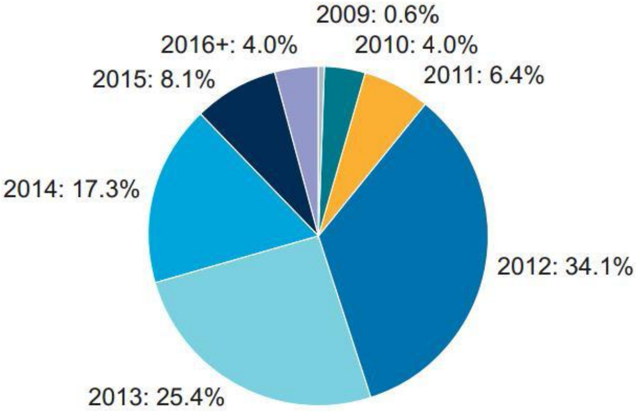
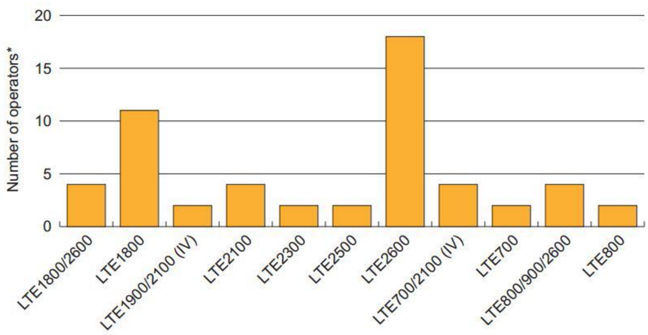
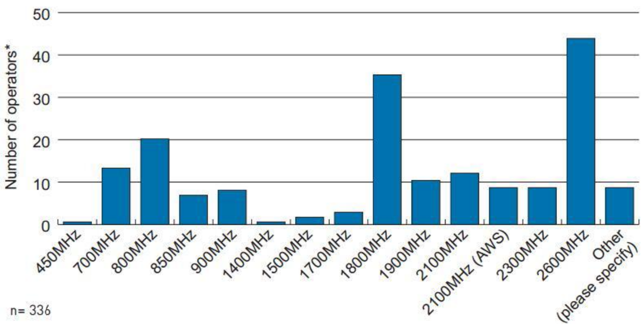


Figure 3: When are you planning to launch commercial servicesusing LTE?
(Source: Informa Telecoms & Media)

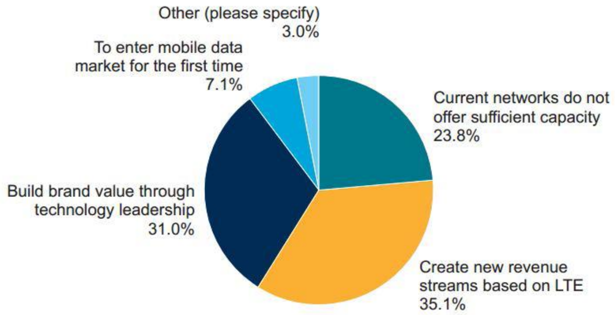


(source: InformaTelecoms media)
Figure: 4 Global, LTE launches by technology and band, 1Q12



(source: Informa Telecoms & Media)

Figure 5: Which spectrum bands do you intend to use to deployLTE



(source: Informa Telecoms & Media)

Figure 6: What is your primary motivation for deploying LTE

Conclusion

LTE networks are changing the nature of mobilecommunications and interaction with content. Smartphones and tablets are now the primary interface to digital services and will be joined in time by devices such as "wearables" and other machinetype wireless devices, as the "Internet of things" emerges. This drives a need to redesign service platforms to create "content-centric networks." The target is to build high-performance LTE access in combination with compute hardware from the IT world to support new modes of service delivery. LTE is the future of wireless broadband network. LTE will be able to support more of the products and services in use today, because of its backward compatibility to 3GPP networks

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