LTE : The Future of Mobile Broadband Technology

Erick Setiawan
tukangbajaksawah@gmail.com

Become a necessity today, where the wireless broadband technology needed to meet increasing expectations in terms of speed, bandwidth and availability in global access, for aspects of the utilization in business, mobile applications to the entertainment aspect that is accessed through a mobile device, of course, with better speed. LTE offers significant advantages to meet these needs, where users are able to get today's wired networks experience from a mobile device, whether it is about downloading and uploading or the needs of communication to such social networking.

The objective of this paper is to analyze LTE, then generate the appropriate conclusions why the standard of choice for future wireless broadband with the literature research methodology.

Long Term Evolution (LTE) is the leading technologies for next-generation mobile broadband. The information presented here will help readers understand the benefits of LTE, and why it could be a choice of future mobile broadband technology. Also the wireless technology overview to delivers the information about LTE evolution from one of its predecessor, GSM.

LTE offers benefits such as providing a global ecosystem with inherent mobility, easier access and use with greater security and privacy, dramatically improves speed and latency, delivers enhanced real-time video and multimedia for a better overall experience, enabling high-performance mobile computing, supports real-time applications due to its low latency, creates a platform upon which to build and deploy the products and services of today and those of tomorrow, reduces cost per bit through improved spectral efficiency, thus can give a vast potential for greater broadband speed and access.

Wireless technologies enable one or more devices to communicate without an actual wired connection. Radio frequency is used to transmit the data. Such technologies are rapidly evolving to meet a variety of communications needs, from simple to complex.

Wireless communications needs can all be classified in one of three ways, based on the distance they are meant to cover. These include: wireless personal area networks (WPAN), wireless local area networks (WLAN), and wireless wide area networks (WWAN).

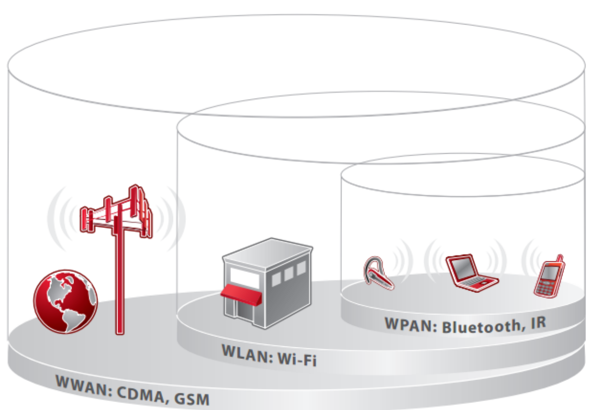

Figure 1 Wireless network technology overview

Wireless networks form the transport mechanism between devices and traditional wired networks. WPANs are limited to distances under about 10 meters and include technologies such as infrared (IR), Bluetooth® technology, and ultra-wideband (UWB). WLANs cover a local area with distances of individual access points reaching to about 100 meters, and include technologies such as Wi-Fi (802.11a/b/g/n). WWANs cover even larger areas, using cellular data networks. This section discusses some of the most popular and widely used wireless technologies to provide readers with a point of reference for the use of 3G technology.

WPAN typically provide ad hoc network connections designed to dynamically connect devices to other devices within close range of each other. These connections are termed ad hoc because they do not generally need to connect to any network infrastructure to operate. They can simply connect to each other and perform necessary communications without the need of any access network devices, such as access points or base stations. Bluetooth has emerged as the most widely used WPAN network standard. The Bluetooth standard is an industry specification that describes how mobile phones, headsets, computers, handhelds, peripherals, and other computing devices should interconnect with each other. Bluetooth network applications include wireless headsets, hands-free operation, wireless synchronization, wireless printing, advanced stereo audio, dial-up networking, file transfer, and image exchange, to name a few.

WLAN provide connections designed to connect devices to wired networks. Unlike a wired LAN, a WLAN does not require cabling to connect the device to a switch or router. Devices connect wirelessly to nearby wireless access points that are attached to the local network using an Ethernet connection. A single access point communicates with nearby WLAN devices in a coverage area of about 100 meters. This coverage area allows users to move freely within range of an access point with their notebook computers, handhelds, or other network devices. Multiple access points can be coordinated together by a network WLAN switch to allow users to hand off between access points. Wi-Fi (or IEEE 802.11) is the set of standards established to define wireless LANs. A number of different protocols are defined in the 802.11 family of standards, addressing various operating frequencies and maximum throughputs. The 802.11g standard is currently the predominant protocol deployed in WLAN implementations.

WWANs provide broadband data networks with a far greater range, using cellular technologies such as GPRS, HSPA, UMTS, 1xRTT, 1xEV-DO, and LTE. Wireless data devices connect to a wireless broadband network through a commercial carrier's data network, allowing broadband performance without the need for a cabled connection to a network infrastructure (much like a WLAN), while providing end users with far greater mobility. These WWANs typically incorporate sophisticated user identification techniques to ensure that only authorized users are accessing the network. Multiple base stations are coordinated by base station controllers to allow users to hand off between base stations (cell sites). 1xEV-DO is the broadband wireless network standard developed by the Third-Generation Partnership Project 2 (3GPP2) as part of the CDMA2000 family of standards. EV-DO networks were first launched based on release 0 of the standard. The standard is currently in revision A, which has been deployed nationally by Verizon Wireless, and provides average download speeds of 600 Kbps to 1.4 Mbps, and average upload speeds of 500 to 800 Kbps, with low latency, typically between 150 and 250 milliseconds.

First-generation (1G) radio networks were analog-based and limited to voice services and capabilities only. 1G technology was vastly inferior to today's technology. 1G devices were easily susceptible to cloning and one channel supported only one device at a time. Today's technology allows multiple devices to be supported by a single channel at the same time.

Global System for Mobile Communications (GSM) is 2G technology that offers both voice and data capabilities. GSM differs from 1G by using digital cellular technology and time division multiple access (TDMA) transmission methods, rather than CDMA. GSM offers data transmission rates of up to 9.6 Kbps, while enabling such services as short messaging service (SMS) or text messaging, as it is more commonly known, and international roaming.

Wideband Code Division Multiple Access (W-CDMA) brings GSM into 3G. W-CDMA is a type of 3G cellular network and is a high-speed transmission protocol used in Universal Mobile Telecommunications System (UMTS). UMTS offers packet-based transmission for text, digitized voice, video, and multimedia content

High-Speed Packet Access (HSPA) is a mobile telephony protocol that helps improve the performance of UMTS. HSPA uses improved modulation schemes, while refining the protocols that mobile devices and base stations use to communicate. These processes improve radio bandwidth utilization provided by UMTS.

High-Speed Downlink Packet Access (HSDPA) is a 3G mobile telecommunications protocol from the HSPA mobile protocol family. HSDPA enables higher data transfer speeds and capacity in UMTS-based networks. The standard currently supports peak downlink speeds of up to 14.4 Mbps in 5 MHz bandwidth.

High-Speed Uplink Packet Access (HSUPA) is also a 3G mobile telecommunications protocol from the HSPA mobile protocol family. The HSUPA protocol enables peak uplink speeds of up to 5.76 Mbps.

Evolved HSPA (HSPA+) is a wireless broadband standard that provides peak speeds of up to 42 Mbps on the downlink and 22 Mbps on the uplink, using multiple-input multiple-output (MIMO) technology and higher order modulation.

	W-CDMA	HSPA	HSPA +	3GPP LTE
Peak speeds	2 Mbps (downlink)*	1.8 Mbps–14.4 Mbps (downlink) 384 Kbps–2 Mbps (uplink)	42 Mbps (downlink) 22 Mbps (uplink)	100 Mbps (downlink) 50 Mbps (uplink)
Average user throughput	100 Kbps–320 Kbps (downlink)* Less than 100 Kbps (uplink)*	Up to 2 Mbps (downlink only)* Uplink speeds vary by device	5 Mbps (downlink)* 3 Mbps (uplink)*	5–12 Mbps (downlink)** 2–5 Mbps (uplink)**

Table 1 Comparing Table of LTE predecessor and average user throughput

RESULT

Once fully deployed, LTE technology offers a number of distinct advantages over other wireless technologies. These advantages include increased performance attributes, such as high peak data rates and low latency, and greater efficiencies in using the wireless spectrum. Improved performance and increased spectral efficiency will allow wireless carriers using LTE as their 4G technology to offer higher quality services and products for their customers.

Benefits expected from LTE technology:

A. + High peak speeds:
   - 100 Mbps downlink (20 MHz, 2x2 MIMO)—both indoors and outdoors
   - 50 Mbps uplink (20 MHz, 1x2)

B. At least 200 active voice users in every 5 MHz (i.e., can support up to 200 active phone calls)

C. Low latency:
   - < 5 ms user plane latency for small IP packets (user equipment to radio access network [RAN] edge)
   - < 100 ms camped to active
   - < 50 ms dormant to active

D. Scalable bandwidth:
   - The 4G channel offers four times more bandwidth than current 3G systems and is scalable. So, while 20 MHz channels may not be available everywhere, 4G systems will offer channel sizes down to 5 MHz, in increments of 1.5 MHz.

E. Improved spectrum efficiency:
   - Spectrum efficiency refers to how limited bandwidth is used by the access layer of a wireless network. Improved spectrum efficiency allows more information to be transmitted in a given bandwidth, while increasing the number of users and services the network can support.
   - Two to four times more information can be transmitted versus the previous benchmark, HSPA Release 6.

F. + Improved cell edge data rates:
   - Not only does spectral efficiency improve near cell towers, it also improves at the coverage area or cell edge.
   - Data rates improve two to three times at the cell edge over the previous benchmark, HSPA Release 6.

G. + Packet domain only

H. + Enhanced support for end-to-end quality of service:

- Reducing handover latency and packet loss is key to delivering a quality service. This reduction is considerably more challenging with mobile broadband than with fixed-line broadband. The time variability and unpredictability of the channel become more acute. Additional complications arise from the need to hand over sessions from one cell to another as users cross coverage boundaries. These handover sessions require seamless coordination of radio resources across multiple cells

Peak performance downlink	Power-efficient uplink	Scalable and compatible with 3G networks	Flat all-IP architecture for performance and efficiency
+ Efficiency OFDM/OFDMA in the downlink • Spectral efficiency (2-5 times, Rel.6) • Resistant to multi-path interference + MIMO antennas • Doubles the throughput • Deployment simplicity	+ SC-FDMA • Lower peak-to-average ratio • Longer mobile battery life • Larger cell coverage + Collaborative (multi-user or virtual) MIMO • Simplifies mobile implementation + Increases uplink capacity	+ Scalable spectrum allocation (1.4, 3, 5, 10, 15, 20 MHz) • Great for in-band deployment + Mobility with 3GPP and non-3GPP access • Smooth network migration to LTE and beyond + Global roaming with other 3GPP networks	+ High performance network • Efficient IP routing reduces latency • Increased throughput • Fast state transition time (enhanced always-on) • Less than 50 ms transition from dormant to active

Table 2 Summary of LTE Capabilities

CONCLUSION

Trends had driven the transition to 4G technology, such as :

A. Unified Technology

Today's global economy needs a "borderless" or unified wireless platform. The world is shrinking and mobile users conduct business all across the world, much like they used to do with people around the corner. Users need the ability to communicate, conduct business, and move around the globe as easily and seamlessly as they did with the "around the corner" set.

B. Diverse Use

As capabilities advance and prices become more competitive, more people use wireless networks for heavier data and application access. As a result, bandwidth demand continues to rise. Also, people are becoming increasingly mobile, further changing the way they access and use the Internet.

C. Increasing Expectations

Today, customers require the same broadband experience they get at the office or at home, regardless of their locations. They want easy access and use, high speed and low latency, better security and privacy, and seamless, global mobility.

D. Rich Media

Music and video downloads, high-quality video conferencing, high-definition movie downloads, video on demand, and other trends are driving the need for 4G networks and their increased data capacity.

E. Personal Expression

Mobile users today want to do more than simply consume information. They want to create things and share them. They also want to do it anytime, anywhere through blogs, social networks, and similar applications they use with fixed-line Internet connections.

Then those trends would make LTE as a proper candidate standar technology in mobile brodband, as it offers a number of distinct advantages, high data rates and lower latency make LTE connections more responsive, enabling real-time multicast applications, such as online gaming and video conferencing.

LTE also offers mobile users better coverage as they travel by providing seamless handover and roaming for true mobility.

LTE is better suited for global adoption than WiMAX. Although 2.5 GHz, 3.5 GHz, and 5.8 GHz bands are allotted in many regions of the world, many growth markets require new allocations to service their populations. Given the diverse requirements and regulations of various governments, it will be a challenge for WiMAX to achieve global harmonization.

LTE has strong and widespread support from the mobile industry, including support from a majority of the industry's key players.

Many vendors will enable operator transition to LTE in a progressive, scalable, and cost-effective way—protecting investments in existing technologies made by today's GSM and CDMA carriers.

GSM is the most popular mobile communications standard currently in use. Carriers on the GSM standard predominate around the globe and will use LTE as their wireless network upgrade pathway.

REFERENCE

Verizon Wireless. (2010). LTE : The Future of Mobile Broadband Technology White Paper.
Rohde & Schwarz. LTE-Advanced Technology Introduction White Paper