LTE (Long Term Evolution)

Introduction

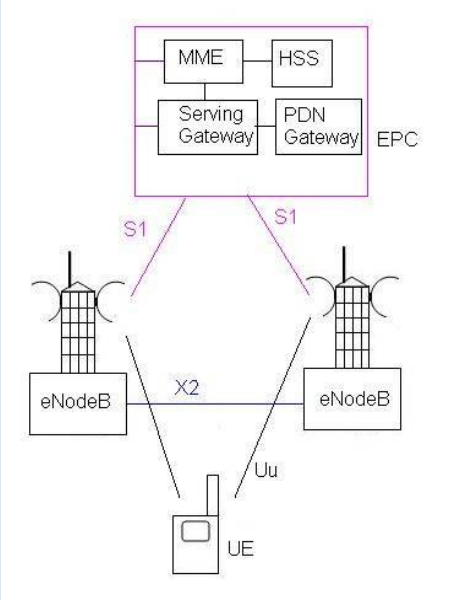
LTE stands for *Long Term Evolution* and it was started as a project in 2004 by telecommunication body known as the Third Generation Partnership Project (3GPP). SAE (System Architecture Evolution) is the corresponding evolution of the GPRS/3G packet core network evolution. The term LTE is typically used to represent both LTE and SAE.

LTE evolved from an earlier 3GPP system known as the Universal Mobile Telecommunication System (UMTS), which in turn evolved from the Global System for Mobile Communications (GSM). Even related specifications were formally known as the evolved UMTS terrestrial radio access (E-UTRA) and evolved UMTS terrestrial radio access network (E-UTRAN). First version of LTE was documented in Release 8 of the 3GPP specifications.

A rapid increase of mobile data usage and emergence of new applications such as MMOG (Multimedia Online Gaming), mobile TV, Web 2.0, streaming contents have motivated the 3rd Generation Partnership Project (3GPP) to work on the Long-Term Evolution (LTE) on the way towards fourth-generation mobile.

The main goal of LTE is to provide a high data rate, low latency and packet optimized radioaccess technology supporting flexible bandwidth deployments. Same time its network architecture has been designed with the goal to support packet-switched traffic with seamless mobility and great quality of service.

LTE System Architecture Evolution



As shown in the figure LTE SAE(System Architecture Evolution) consists UE,eNodeB and EPC(evolved packet core). Various interfaces are designed between these entities which include Uu between UE and eNodeB, X2 between two eNodeB, S1 between EPC and eNodeB. eNodeB has functionalities of both RNC and NodeB as per previous UMTS architecture.LTE is completely IP based network.

The basic architecture contains the following network elements.
1. LTE EUTRAN (Evolved Universal Terrestrial Radio)
2. LTE Evolved Packet Core.

LTE EUTRAN

It is a radio access network standard meant to be a replacement of the UMTS, HSDPA and HSUPA . Unlike HSPA, LTE's E-UTRA is an entirely new air interface system. It provides higher data rates, lower latency and is optimized for packet data. EUTRAN (Evolved Universal

Terrestrial Radio) consists of eNB (Base station). EUTRAN is responsible for complete radio management in LTE. When UE powered is on, eNB is responsible for Radio Resource Management, i.e. it shall do the radio bearer control, radio admission control, allocation of uplink and downlink to UE etc. When a packet from UE arrives to eNB, eNB shall compress the IP header and encrypt the data stream. It is also responsible for adding a GTP-U header to the payload and sending it to the SGW. Before the data is actually transmitted the control plane has to be established. eNB is responsible for choosing a MME using MME selection function. The QoS is taken care by eNB as the eNB is only entity on radio. Other functionalities include scheduling and transmission of paging messages, broadcast messages, and bearer level rate enforcements also done by eNB.

LTE Evolved Packet Core (EPC)

The LTE EPC consists of MME, SGW, PGW, HSS and PCRF.

Mobility Management Entity (MME):

The **MME** is a control entity. It is responsible for all the control plane operations. All the NAS signaling originates at UE and terminates in MME. MME is also responsible for tracking area list management, selection of PGW/SGW and also selection of other MME during handovers. MME is also responsible for SGSN (Serving GPRS Support Node) selection during LTE to 2G/3G handovers. The UE is also authenticated by MME.MME is also responsible for bearer management functions including establishment of dedicated bearers for all signaling traffic flow.

Serving Gateway (SGW):

Serving gateway terminates the interface towards EUTRAN. For each UE there is a single Serving GW associated with EPS at a given point of time. SGW acts as a local mobility entity for inter eNB handovers. It also acts a mobility anchor for inter 3GPP mobility. SGW is responsible for packet routing and forwarding, buffering the downlink packets. As eNB is responsible for uplink packet marking, SGW is responsible for downlink packet marking.

PDN Gateway (PGW):

PGW terminates SGi interface towards the PDN. PGW is responsible for all the IP packet based operations such as deep packet inspection, UE IP address allocation, Transport level packet marking in uplink and downlink, accounting etc. PGW contacts PCRF to determine the QoS for bearers. It is also responsible for UL and DL rate enforcement.

Home Subscriber Server (HSS):

The **HSS** is a central database that contains user-related and subscription-related information. The functions of the HSS include functionalities such as mobility management, call and session establishment support, user authentication and access authorization. It also holds information about the PDNs to which the user can connect. In addition the HSS holds dynamic information such as the identity of the MME to which the user is currently attached or registered. The HSS

may also integrate the authentication center (AUC), which generates the vectors for authentication and security keys.

Facts about LTE

- LTE is the successor technology not only of UMTS but also of CDMA 2000.
- LTE is important because it will bring up to 50 times performance improvement and much better spectral efficiency to cellular networks.
- LTE introduced to get higher data rates, 300Mbps peak downlink and 75 Mbps peak uplink. In a 20MHz carrier, data rates beyond 300Mbps can be achieved under very good signal conditions.
- LTE is an ideal technology to support high date rates for the services such as voice over IP (VOIP), streaming multimedia, videoconferencing or even a high-speed cellular modem.
- LTE uses both Time Division Duplex (TDD) and Frequency Division Duplex (FDD) mode. In FDD uplink and downlink transmission used different frequency, while in TDD both uplink and downlink use the same carrier and are separated in Time.
- LTE supports flexible carrier bandwidths, from 1.4 MHz up to 20 MHz as well as both FDD and TDD. LTE designed with a scalable carrier bandwidth from 1.4 MHz up to 20 MHz which bandwidth is used depends on the frequency band and the amount of spectrum available with a network operator.
- All LTE devices have to support (MIMO) Multiple Input Multiple Output transmissions, which allow the base station to transmit several data streams over the same carrier simultaneously.
- All interfaces between network nodes in LTE are now IP based, including the backhaul connection to the radio base stations. This is great simplification compared to earlier technologies that were initially based on E1/T1, ATM and frame relay links, with most of them being narrowband and expensive.
- Quality of Service (QoS) mechanism have been standardized on all interfaces to ensure that the requirement of voice calls for a constant delay and bandwidth, can still be met when capacity limits are reached.
- Works with GSM/EDGE/UMTS systems utilizing existing 2G and 3G spectrum and new spectrum. Supports hand-over and roaming to existing mobile networks.

Advantages of LTE

- **High throughput:** High data rates can be achieved in both downlink as well as uplink. This causes high throughput.
- **Low latency:** Time required to connect to the network is in range of a few hundred milliseconds and power saving states can now be entered and exited very quickly.
- **FDD and TDD in the same platform:** Frequency Division Duplex (FDD) and Time Division Duplex (TDD), both schemes can be used on same platform.
- **Superior end-user experience:** Optimized signaling for connection establishment and other air interface and mobility management procedures have further improved the user experience. Reduced latency (to 10 ms) for better user experience.
- **Seamless Connection:** LTE will also support seamless connection to existing networks such as GSM, CDMA and WCDMA.
- **Plug and play:** The user does not have to manually install drivers for the device. Instead system automatically recognizes the device, loads new drivers for the hardware if needed, and begins to work with the newly connected device.

Reference

- www.google.com
- www.wikipedia.com
- www.studymafia.org