LTE OVERVIEW

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 *SystemArchitectureEvolution* 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 *MultimediaOnlineGaming*, 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 Evolution

Year	Event
Mar 2000	Release 99 - UMTS/WCDMA
Mar 2002	Rel 5 - HSDPA
Mar 2005	Rel 6 - HSUPA
Year 2007	Rel 7 - DL MIMO, IMS *IPMultimediaSubsystem*
November 2004	Work started on LTE specification
January 2008	Spec finalized and approved with Release 8
2010	Targeted first deployment

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 FDD, 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 $to10ms$ 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.
- **Simple architecture:** Because of Simple architecture low operating expenditure $OPEX$.

LTE - QoS

LTE architecture supports **hard QoS,** with end-to-end quality of service and guaranteed bit rate GBR for radio bearers. Just as Ethernet and the internet have different types of QoS, for example, various levels of QoS can be applied to LTE traffic for different applications. Because the LTE MAC is fully scheduled, QoS is a natural fit.

Evolved Packet System EPS bearers provide one-to-one correspondence with RLC radio bearers and provide support for Traffic Flow Templates TFT. There are four types of EPS bearers:

- **GBR Bearer** resources permanently allocated by admission control
- **Non-GBR Bearer** no admission control
- **Dedicated Bearer** associated with specific TFT $GBRornon-GBR$
- **Default Bearer** Non-GBR, **catch-all** for unassigned traffic