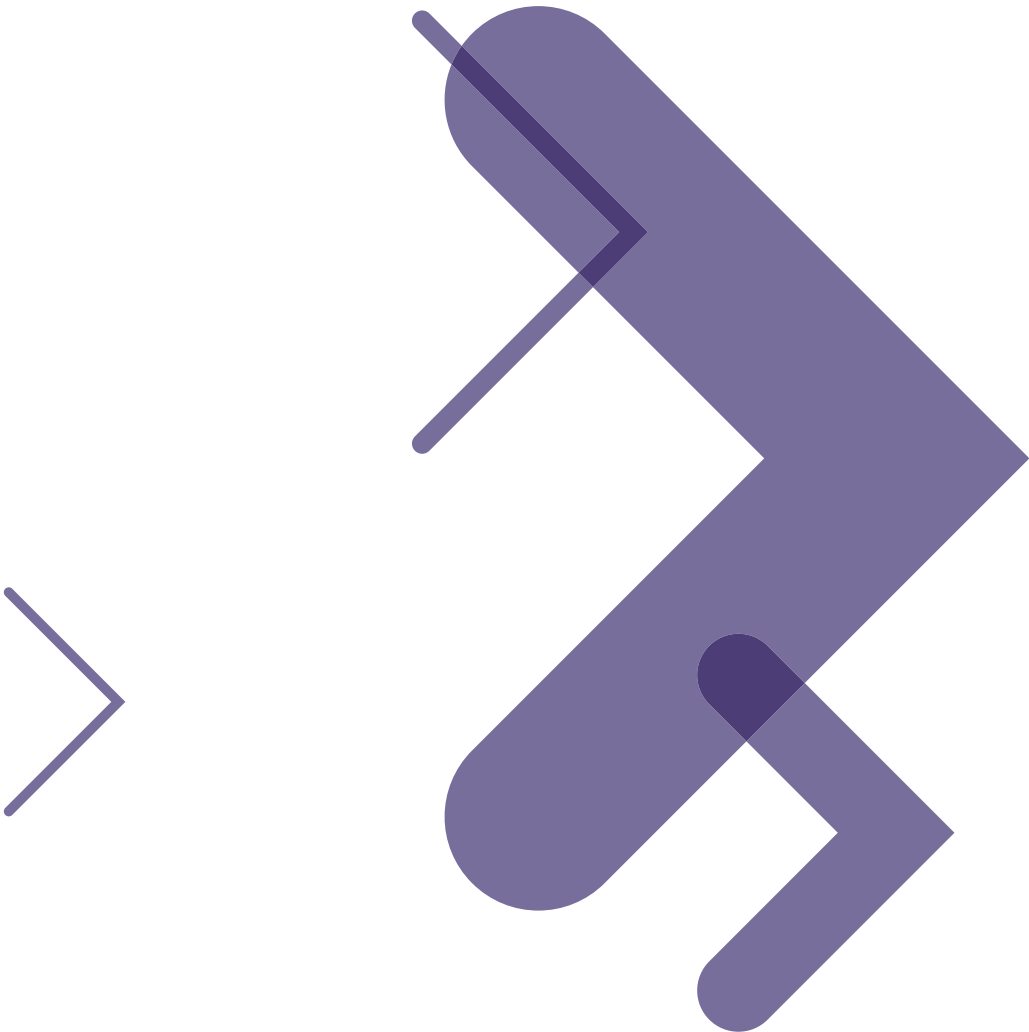




Long Term Evolution (LTE)





Long Term Evolution Overview

The recent increase of mobile data usage and emergence of new applications such as MMOG (Multimedia Online Gaming), mobileTV, Web 2.0, streaming contents have motivated the 3rd Generation Partnership Project (3GPP) to work on the Long-Term Evolution (LTE). LTE is the latest standard in the mobile network technology tree that previously realized the GSM/EDGE and UMTS/HSPA network technologies that now account for over 85% of all mobile subscribers. LTE will ensure 3GPP's competitive edge over other cellular technologies.

LTE, whose radio access is called Evolved UMTS Terrestrial Radio Access Network (E-UTRAN), is expected to substantially improve end-user throughputs, sector capacity and reduce user plane latency, bringing significantly improved user experience with full mobility. With the emergence of Internet Protocol (IP) as the protocol of choice for carrying all types of traffic, LTE is scheduled to provide support for IP-based traffic with end-to-end Quality of service (QoS). Voice traffic will be supported mainly as Voice over IP (VoIP) enabling better integration with other multimedia services. Initial deployments of LTE are expected by 2010 and commercial availability on a larger scale 1-2 years later.

Unlike HSPA (High Speed Packet Access), which was accommodated within the Release 99 UMTS architecture, 3GPP is specifying a new Packet Core, the Enhanced Packet Core (EPC) network architecture to support the E-UTRAN through a reduction in the number of network elements, simpler functionality, improved redundancy but most importantly allowing for connections and hand-over to other fixed line and wireless access technologies, giving the service providers the ability to deliver a seamless mobility experience

LTE has been set aggressive performance requirements that rely on physical layer technologies, such as, Orthogonal Frequency Division Multiplexing (OFDM) and Multiple-Input Multiple-Output (MIMO) systems, Smart Antennas to achieve these targets. The main objectives of LTE are to minimize the system and User Equipment (UE) complexities, allow flexible spectrum deployment in existing or new frequency spectrum and to enable co-existence with other 3GPP Radio Access Technologies (RATs).

LTE is backed by most 3GPP and 3GPP2 service providers who along with the other interested parties aim to complete and agree the EUTRAN Standards by Q4-2007 and the EPC by Q1-2008.

LTE planned features and capabilities

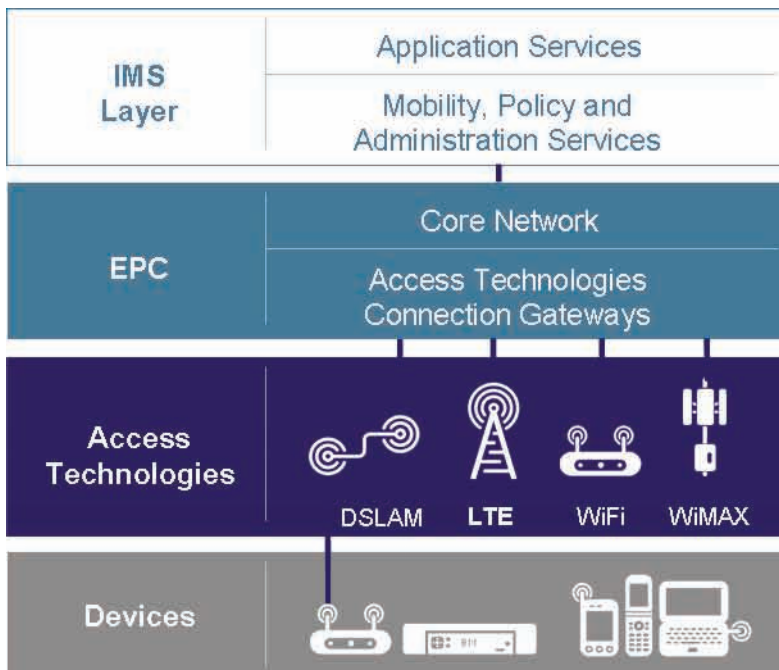
The simplified network architecture of LTE will offer the following features and capabilities:

Evolved UMTS Radio Access Network (EUTRAN)

- Downlink OFDM 100Mbps+ (20MHz spectrum)
- Uplink SC-FDMA 50Mbps+ (20MHz spectrum)
- (Orthogonal Frequency Division Multiplexing (OFDM) – based radio design and techniques are used to spread data over many sub-carriers provides greater immunity to fading, resulting in an overall increase in delivery reliability)
- FDD – Frequency Division Multiplex
- End-user latency <10mS
- Control plane latency (Transition time to active state) < 100mS (for idle to active)
- Flexible and Scaleable Bandwidth – (1.25, 2.5, 5, 10, 15 and 20MHz) 1.25MHz suitable for in-band migration (re-use of existing spectrum) and 5MHz – 20MHz for clear spectrum green field deployments and expansion of spectrum as demand grows
- Frequency spectrum choice and flexibility of deployment in GSM, CDMA, UMTS bands (450, 700, 850, 900, 1700, 1800, 1900, 2100, 2500MHz) means that global roaming will be possible
- Mobility will be supported up to 500kmph but like other technologies will be optimized for lower speeds (from 0 to 15kmph)
- Coverage (Cell sizes) 5 – 100km with slight degradation after 30km
- VoIP Roughly 3 times UMTS voice capacity
- MIMO - Advanced antennas already standardized will increase the overall sector throughput
- E2E QOS allowing prioritization of different class of service

Evolved Packet Core (EPC)

- New and simplified data centric (all IP) core network featuring collapsed architecture and improved redundancy
- Centralized mobility and application/services layer (IMS based)
- E2E QOS allowing prioritization of different class of service
- Access technology agnostic core network allowing connection to other wireless and fixed line access networks
- Connection to legacy GSM/UMTS core offers smooth subscriber LTE migration

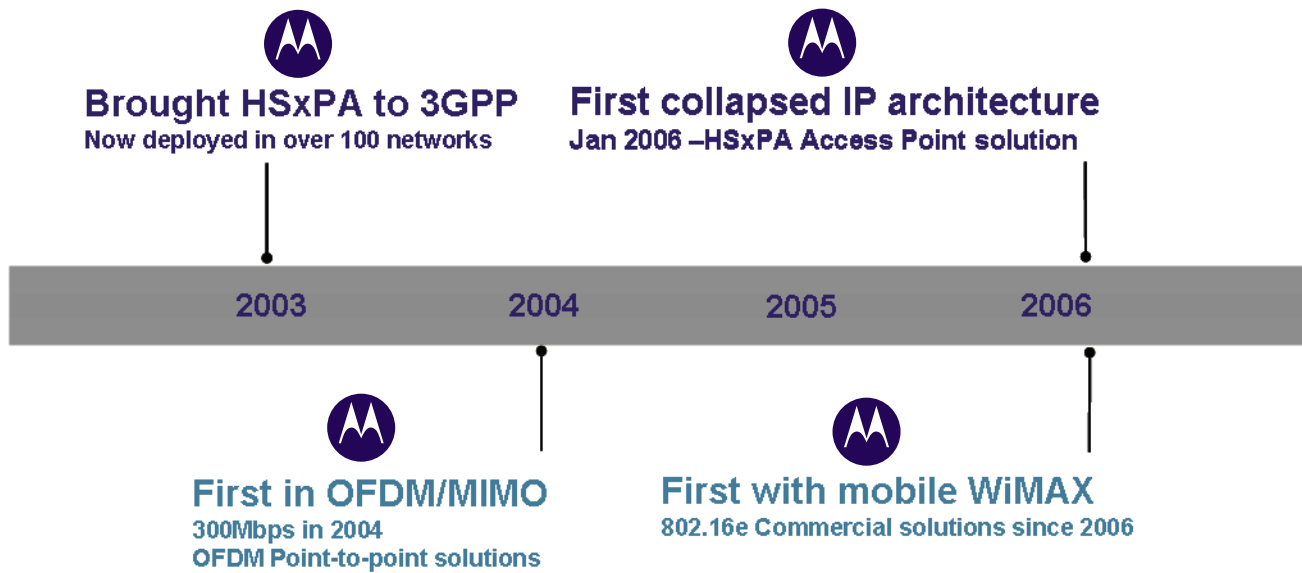


LTE Network Topography

Motorola and Long Term Evolution

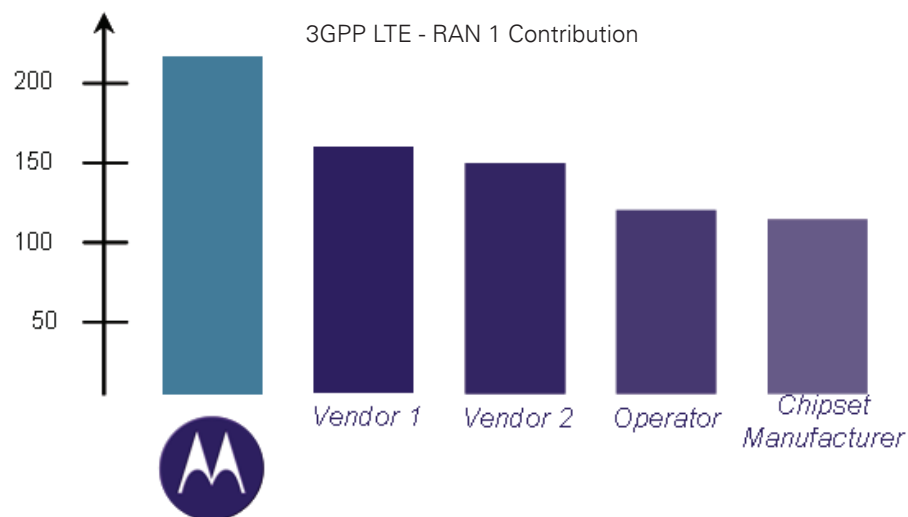
Motorola's Advances in Mobile Broadband

Motorola's advances in Mobile Broadband over the past decade have been significant. This learning and experience is now coming into its own as we move towards the next phase of technology development and subsequent deployment.



Motorola's Commitment

Motorola has always been an innovator and pioneer in the mobile telecommunications industry. We are very well placed and able to leverage our extensive WiMAX, IMS ecosystem and Seamless Mobility expertise to our advantage. This is reflected in our commitment and contributions to LTE where we are proud to be the leading contributor in LTE standards RAN 1 & 2 and a top 3 contributor to EPC 1 & 2 standards.



Network Evolution Path

LTE is expected to be the next generation mobile broadband technology for the 3GPP and 3GPP2 community from about 2010 onwards. As service providers expand their LTE coverage and the subscriber base migrates, it is feasible to consider repositioning the EDGE/HSxPA and CDMA/EV-DO assets as necessary. Existing 2G and 3G spectrum can gradually be re-farmed to LTE, providing a means to efficiently and cost effectively assimilate the ever increasing demand for both voice and data traffic.

Phased Service Deployment

A service provider may choose to deploy LTE for selected geographical areas to serve high traffic hot zones. LTE mobile terminals will also leverage existing 2G and 3G networks, thus allowing service to be offered in a phased deployment. For example, a service provider may offer EDGE/HSxPA or CDMA/EV-DO service ubiquitously, while LTE may at first be deployed to serve high density urban areas and strategic indoor locations (e.g. airports, business parks etc.).

Increased Voice Capacity

The increased spectral efficiency and resulting voice capacity is a needed aspect of the continuing evolution of mobile technologies. With LTE and VoIP, voice capacity is a direct function of the data rate or throughput. Indeed, early simulations indicate that a 1MHz LTE carrier (using an 8kbps CODEC) may support up to 105 simultaneous voice calls, a ~3 times improvement over UMTS Release 99.

This high voice capacity will not only provide a lower cost of voice delivery but can also facilitate in-band migration and spectrum mining, offering service providers the ability to retire and recycle existing spectrum allocations in the coming years, potentially improving coverage and meeting the ever increasing traffic demands.

Reduced Latency

In addition to greatly increasing the data rate and throughput, LTE is also expected to deliver significant improvements and end-user experience through reduced latency. Real-time and interactive applications (such as online gaming, multi-cast and VoIP) will deliver more compelling user experiences with reduced round trip latency. The reduced latency offers a very responsive experience, very short VoIP call set-up times and near instantaneous buffering for streaming services.

Coupled with IMS, LTE will be a key part of seamless mobility and Fixed-Mobile Convergence.

Lower cost per bit

The combination of LTE's increased spectral efficiency and flexibility, added capacity and simpler network architecture should offer a very cost effective value proposition. For example, each EUTRAN cell will support up to four times the data and voice capacity when compared to HSxPA Release 6. Combined with the improved coverage resulting from the possible deployment in low frequency bands and the use of advanced antenna systems, LTE networks will provide service providers with a significant improvement on cost per bit delivered.

Service Evolution

With LTE the end-user should experience performance comparable to today's wired broadband internet services, but with the added value that mobility brings. Today's services delivered by HSxPA or EV-DO can be delivered faster and better, improving the quality of service experience. For example, deployment of wideband codecs and higher resolution video conferencing for the mass market will be much more feasible and widespread. In addition, the high bandwidth and low latency will drive the development and uptake of real-time services with added mobility yet to be conceived.



Seamless mobility experience

Thanks to LTE's access agnostic core and centralised application layer, service providers will have the ability to offer full seamless mobility services. This will allow their subscribers to remain connected via any access technology (WiFi, WiMAX, xDSL, FTTx) wherever they are, ensuring that their applications, contents, streams will follow them through their journey whatever device (laptop, mobile, tablet PC, TV, etc...) they feel is the most appropriate to use at any given time.

Global appeal

LTE will be fully endorsed by ITU and will be deployed in ITU recognised frequency bands allowing global roaming capabilities similar to today's GSM/UMTS networks.

Because LTE devices will be backward compatible with GSM and UMTS, even at early stage of LTE deployment, LTE subscribers will be able to roam worldwide irrespective of the country they are in.

Today's 3GPP network technologies carry over 85% of mobile subscribers, it is expected that LTE will benefit from similar volume price effect to drive in momentum and benefit from numerous and affordable devices suitable for both developed and emerging markets.

Mobile Devices

LTE mobiles will carry the benefits of incorporating multi-mode and multi-band radios, allowing LTE mobiles to roam freely while seamlessly crossing the technology boundaries. LTE mobile vendors can anticipate a highly integrated chipset and complimentary RF modules for multi-mode terminals. Mobiles are expected to deliver improved performance in the Reverse Link, as the wider bandwidth of the carrier supports an improved speed-power metric. Initial mobile devices are likely to be data-cards (PCMCIA or embedded) for laptop PC and PDA deployments.

Conclusion

Motorola's LTE solution presents a straight-forward evolution to the world of mobile broadband for the 3GPP service provider. With the envisaged throughput and latency targets and emphasis on simplicity, spectrum flexibility, added capacity and lower cost per bit, LTE is destined to provide greatly improved user experience, delivery of new revenue generating exciting mobile services and will remain a strong competitor to other wireless technologies in the next decade for both developed and emerging markets.

To realize these goals Motorola is leveraging its extensive expertise in mobile broadband innovation, including OFDM technologies (wi4 WiMAX), cellular networking (EVDOa, HSxPA), IMS ecosystem, collapsed IP architecture, standards development and implementation, comprehensive services to deliver best-in-class LTE solutions.

Leveraging the benefits of Motorola's mobile broadband experience and proven expertise in OFDM network deployments, Motorola's LTE end-to-end solution will provide a seamless and flexible path to LTE with a high degree of future proofing for the service provider. Following this path, Motorola's customers will be well positioned to provide the world's most compelling mobile broadband service.

For more information on LTE, please talk to your Motorola representative.



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