LTE Deployment and Timing Considerations

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When considering the deployment and timing considerations for LTE and LTE Advanced and their inter-relation with existing 3G wireless technologies like HSPA & EV-DO, a well thought out migration strategy needs to be in place for deployment including spectrum considerations, plans to address capacity constraints/demands, implications with respect to handling new services including Voice/VoIP, QoE (Quality of Experience) issues as well as key business impacts.

With the standardization of LTE Advanced, a legitimate question being posed by operators who are considering a launch is around timing, should they start with LTE or leap-frog and launch with LTE Advanced? Two perspectives are provided, one that of an MNO (Mobile Network Operator) who has an existing 3G network (either UMTS/HSPA or CDMA/EVDO) and the other that of fixed line operator who is looking to leverage existing assets for wireless play.

Mobile broadband demand continues to surge fuelled by the success of 3G-enabled laptops, ultra-mobile PCs/tablets, innovative smart phones, M2M, plus online video and social-networking applications. In fact, a recent report from Ericsson shows mobile data traffic increasing ten-fold between the period from 2011 and 2016, mainly driven by video.

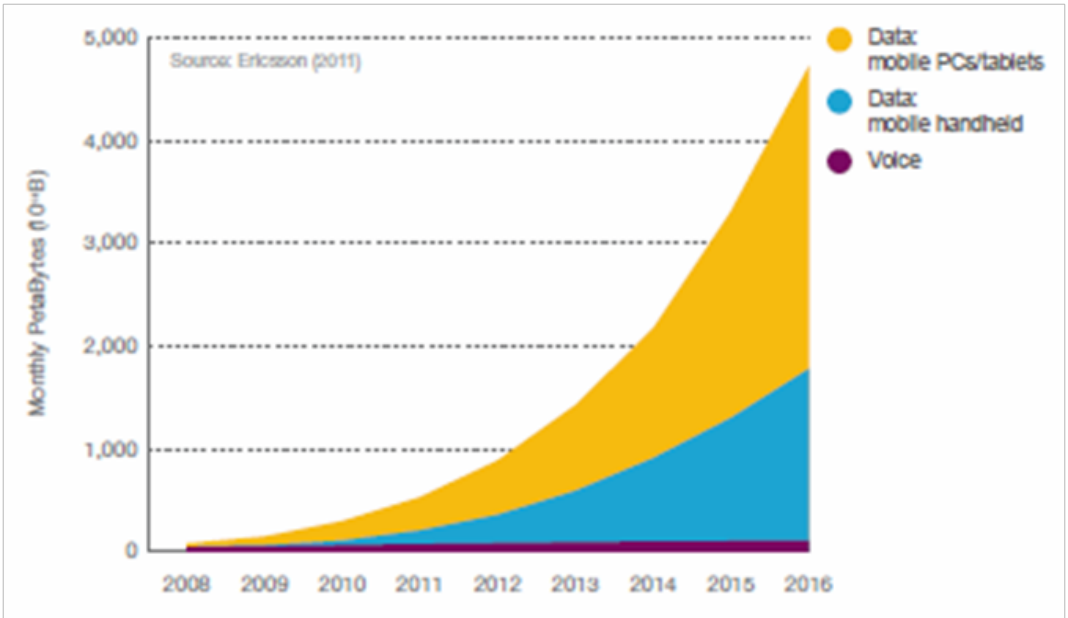

Figure 1: www.ericsson.com/thecompany/press/releases/2011/11/1561267 [1]

End users are demanding enriched, personalized services with a guaranteed Quality of Experience (QoE). It is no longer about voice or SMS in a two-way communication. Today a single user with a single device communicates with multiplicity of applications over the mobile web. This end user and application communication has escalated bandwidth demand. Mobile data traffic surpassed voice traffic at the end of 2009 and is currently growing at close to 100 percent year on year in developed countries. It is well known that user-paid revenues are not increasing as fast as the traffic growth and data usage.

To meet these challenges, operators need a next-generation wireless broadband network that can support the increasing demand for bandwidth and QoE, while reducing total cost of ownership (TCO). Besides this, operators need innovative business models that can generate additional revenue from content providers, 3rd party application providers and other new sources. See [Ref1]. GSA frequently publishes worldwide facts & market data related to 3GPP technologies.

LTE provides the promise of a low TCO network , offering significantly increased peak data rates, improved spectrum efficiency, low latency, scalable bandwidth (1.4 MHz up to 20 MHz), flat all-IP architecture (requires fewer network nodes), offers acceptable system and terminal complexity, cost and power consumption, and is compatible with earlier releases.

The CAPEX requiring upgrades to LTE include 2G/3G RAN upgrade, IP transport capacity upgrade, evolution to the evolved packet core, IMS Core upgrade, application enablers (SDP), application server upgrades for new LTE subscribers and applications. The OPEX includes LTE device subsidies, end-to-end network OPEX, fees paid to 3rd party applications and content providers, besides costs associated with operator marketing and sales, G&A, billing and customer care.

The key deployment considerations for LTE include:
• Spectrum Availability, usage modes, & timing
• Targeted coverage at LTE commercial launch: urban, suburban, national, rural

• Network upgrade strategy: LTE “overlay” or “inlay”
• Fallback technology in non-coverage areas: HSPA+, HSPA, EV-DO
• Device offerings: USB dongles, tablets, desktop CPE (e.g. Mi-Fi router)
• LTE pricing: premium, unlimited, tiered, speed
• LTE service bundle: value-added services (VAS) (See [Ref2])
• LTE rollout issues: LTE or LTE advanced, regulatory, site access, CAPEX strategy, roaming partners, critical mass
• Voice over LTE support

Thus, LTE is not just about RAN upgrade. MNOs need complementary ecosystem of devices, IP-based mobile core network elements, new service architectures, application enablers, and innovative business models. LTE standard (Release 8) was published in 2008 and is only now starting to see commercial launches. Recent history has shown that it takes 6-7 years for a wireless technology from standardization to becoming a profitable market reality. Not surprisingly LTE is only now beginning to taken off lead by major Tier 1 operators. According to a Heavy Reading report, even the most optimistic scenario for LTE device shipment is pegged at 10 million units in 2012. As is with any new technology, LTE coverage in US is still spotty based on recent Verizon announcements. There exist some pockets of LTE coverage in a sea of 3G!

For the majority of commercial launches in US, Europe & Asia, LTE is being introduced in hot spots in urban areas and the coverage is expanded to other areas over time. Operators, for example, in the German market, are also inclined to deploy LTE in rural areas during early phases owing to regulatory reasons or to provide broadband connectivity to areas where there is a lack of fixed infrastructure to provide broadband services. In Europe and other markets where HSPA has been launched the situation is even more perplexing. HSPA, in contrast to CDMA2000 evolution technologies like EV-DO has managed to provide an evolution, known as HSPA Evolution or HSPA+.

Today MNOs in Europe and Asia Pacific have launched commercial HSPA networks that support cell speeds up to 42 Mbps and some MNOs have announced that they plan to launch 84 Mbps in 2012. 3GPP has also been standardizing HSPA speeds like 168 & even 312 Mbps utilizing techniques like carrier aggregation even in different bands like in LTE-Advanced. The evolution of HSPA is one of reasons why LTE despite the initial launches of TeliaSonera in Sweden & Norway has not taken off significantly in Europe.

Normally higher frequencies are targeted for capacity augmentation in the urban areas while lower frequency bands are used for coverage in the rural areas. Low frequency bands have better propagation characteristics for indoor coverage.
LTE Advanced (LTE Rel-10) is the evolution of LTE offering wider bandwidths (including spectrum aggregation), advanced multi-antenna solutions, repeater/relaying functionality, and co-ordinated multi-point transmission. With LTE-Advanced, 1 Gbps data rate can be achieved by 4x4 MIMO and transmission bandwidth wider than approx. 70 MHz. LTE-Advanced also provides higher spectral efficiency.

Figure 2 shows the features of LTE Advanced. As a point of caution, it should be noted that LTE Advanced introduces multi – antenna solutions for the terminal side. LTE as defined in 3GPP R8 and R9 defines up to 4 transmit and receive antennas in the downlink but only single antenna in the uplink. LTE-Advanced as introduced in 3GPP R10 increases the amount of antennas in the downlink from 4 to 8 with uplink MIMO introduced as 4 transmit and 8 receive antennas (Figures 2 c & d). The commercialization of these scenarios and the availability of chipsets and terminals to support this large number of antennas is still a subject of debate by many industry players. Nevertheless, MNOs like Sprint have already made announcements that they will deploy LTE-Advanced multi antenna solutions by mid 2013.

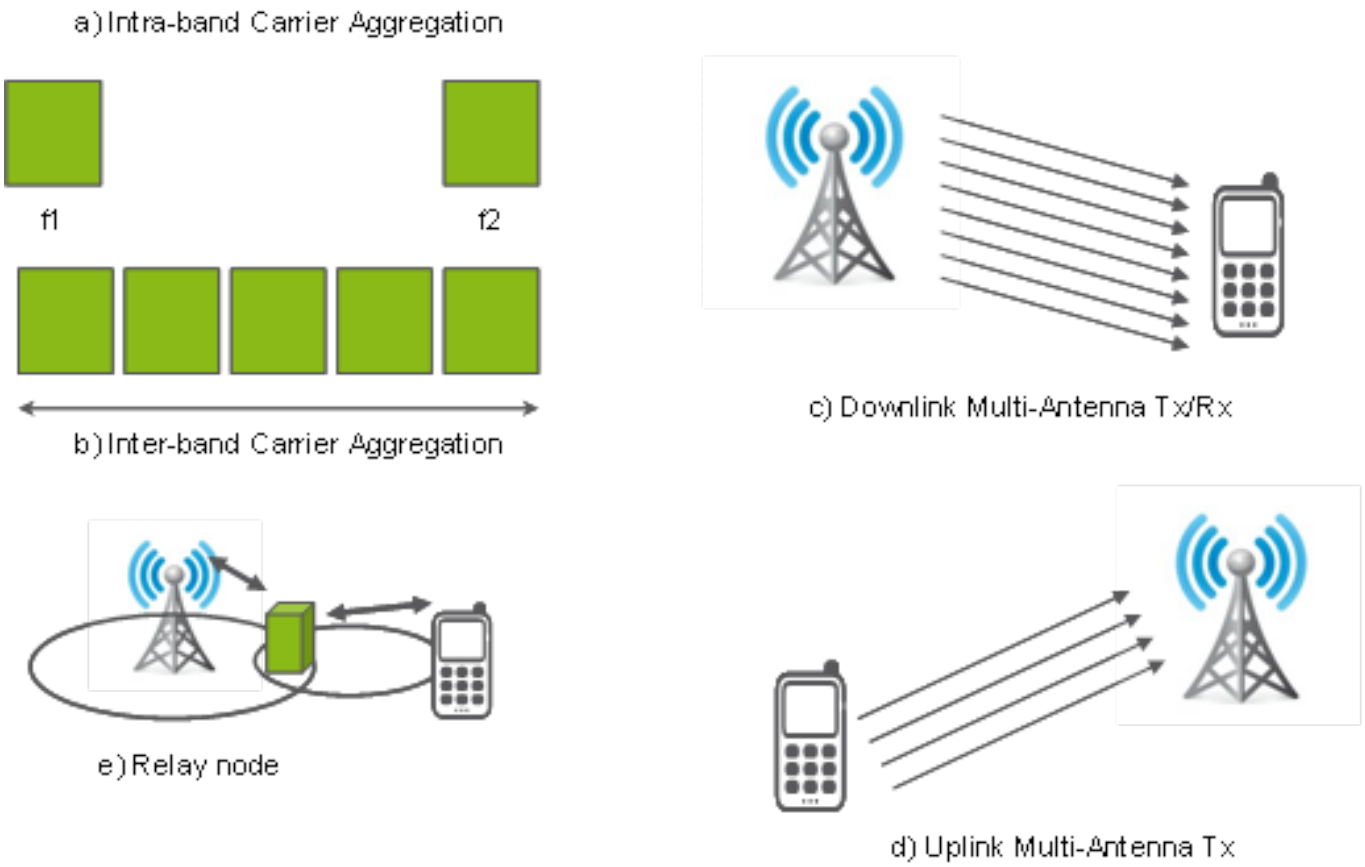

Figure 2: LTE Advanced

Major carriers in the US are already seeing trends of spectrum exhaust, especially in metro areas. With LTE-Advanced, the situation will be further exacerbated since up to 100 MHz of spectrum is needed in various bands. Further, several technological challenges remain for LTE Advanced deployment such as seamless interoperation in a heterogeneous network environment comprising of super macro cell, micro cell, pico cell, relays, hot spot solutions, and indoor/outdoor coverage solutions. LTE Advanced has been standardized as part of 3GPP R10 architecture in December of 2010. Actual timelines do not support a commercial launch any time soon. We are yet to see firm commitments from chipset or terminal vendors for LTE-Advanced. Existing business models are under stress from severe competition from OTT service providers, CAPEX and OPEX challenges remain for LTE Advanced. We believe the realistic time-frame for commercial LTE Advanced launch is from 2014-2015 onwards.

Based on the above, the MNO should focus on an LTE launch and leverage significant economies of scale from a maturing LTE ecosystem for devices, network nodes, and service enablers. They should have a device strategy, require network vendors to provide low incremental complexity to include LTE-Advanced, develop “open” environment for 3rd party application development and personalized services, carefully craft a spectrum strategy (e.g., re-farming, coverage areas, usage modes), and focus of metro areas (hot spots) for early deployment. They should also develop a compelling business strategy for differentiated service introduction. Further, they should identify areas for OPEX improvements in network infrastructure, IT systems and network operations. To offset challenges with spectrum exhaust, they need to develop a capacity reinforcement strategy for data and signaling offload, such as Wi-Fi offload, and femto/pico cell offload. They should introduce LTE-Advanced incrementally when field proven. LTE terminals should be able to access LTE-Advanced capable carriers.

For a fixed line operator (i.e., cable, copper or fiber), a counter strategy may be suitable. Since they have not made investments in “legacy” wireless technologies like CDMA EVDO or 3GPP WCDMA / HSPA, they may chose to make a disruptive entry with LTE Advanced -- "first with LTE advanced". They could consider launching it in selected areas but initially only as fixed wireless access. For example, providing access at home and enterprises through a femto cell or a pico cell and slowly moving to a macro cell. They could then have a roadmap to introduce portable devices like dongles and mobile smart phones. This approach allows them to leverage their fixed access assets and move into mobile. They will have to address their spectrum challenges, however, since LTE-Advanced requires up to 100 MHz of spectrum that may be difficult to obtain in low frequencies. They could then move to handle LTE with LTE Advanced.

In this article, we provided a view into to deployment and timing considerations for LTE and LTE Advanced relevant to a typical MNO or a fixed line operator and in relation to existing legacy technologies that the operator has deployed. The role of terminals and the existence of an evolving ecosystem around the deployed network technology were also identified. Several other considerations specific to the MNO or fixed line operator are needed to decide the go-forward strategy on a case by case basis. Our intent was to highlight in a general manner the issues that need to be considered to choose a particular approach.

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