SOLUTION PAPER

The Drivers to LTE

Introduction

Over the last 20 years, the advancement of new telecommunications and computer technologies has had a profound impact on society. Capabilities that seemed like science fiction two decades ago, are now taken for granted. Cellular telephony has lead to the expectation of anytime, anywhere accessibility. The wide-spread availability of broadband connectivity provides access to the largest repository of information and entertainment materials on the planet (the world-wide-web). Consequently, with more information, available in more places, people can be more and more mobile in both their work and personal life. Now, on the realm of taking these advances in connectivity to the next level plane, is a new technology called Long Term Evolution, or LTE. LTE is the next generation mobile broadband network from the 3GPP standards group (GSM/UMTS/HSPA).

Still with every new mobile technology comes the question, do we really need it?

This paper will look at what is driving the development of LTE, how this will impact future LTE subscriber experiences, and ultimately how it will help drive operators businesses.

Telecom Market Dynamics

The Telecom Market has seen tremendous changes and this trend will certainly continue. New entrants and existing operators continue to adopt and integrate new Telecom technologies, reinventing and reinvigorating their business models. Today we are seeing the traditional Telecom boundaries blurring with traditional Mobile Operators moving into the fixed line broadband business and Fixed Operators looking to expand their reach outside of the home. The goal is to capture the maximum ARPU, trying to fulfill all subscribers' communication and entertainment needs, with TV, Internet, Telephone & Mobile often referred to as "Quadruple play".

Both Mobile and Fixed line operators are facing certain challenges in their traditional businesses, with Voice ARPU being driven down by low cost VoIP services like Skype™ or available on all Instant Messaging software. A significant opportunity to compensate for this decline, resides in delivering data services to the home and on the move. With recent 3-3.5G deployments combined with new Mobile data plans offering a flat rate tariff, mobile data has become a reality. Mobile data revenue (excluding SMS revenue) is reported to be growing by ~25% during 2006[1].

While mobile data presents an exciting opportunity for operators, the cost of providing this service is significant. This is one of the main reasons why mobile data tariffs today are still relatively expensive compared to fixed line broadband pricing. Recent industry analyst figures show significant growth in the number of mobile data service subscribers and in data consumption; these factors combined will result in exponential growth of the amount of data that will soon be flowing through mobile networks. While it is not impossible to fulfil this demand on legacy networks, it will require operators to significantly invest to continue to provide an acceptable user experience, hence limiting their pricing flexibility in order to remain profitable.

The mobile market is also seeing many new entrants; former ISP and fixed line operators, who are considering deploying WiMAX or WiFi Mesh networks to offer alternative "Broadband on the Go" services at very competitive prices.

The penetration of fixed line broadband and WiFi in the home has had a profound impact on expectations, and most users are looking for a comparable experience (data rate in Mbps and latency <50ms) when they start using data on their mobiles, something that currently mobile network technologies cannot deliver.

Finally, what is important to note is the importance of the internet and broadband services in people's life. A recent consumer survey ranked 'fixed line broadband connection' as the most indispensable service - in front of voice service or even TV.[2].

[1] - Based on calculation made from Informa Telecom, 2007 figures.

[2] - Extracts : PWC 5-15-07

All the above contribute to the evolution of mobile network technology driving towards more efficient networks (WiMAX/LTE/UMB) that address these market needs (See Table 1).

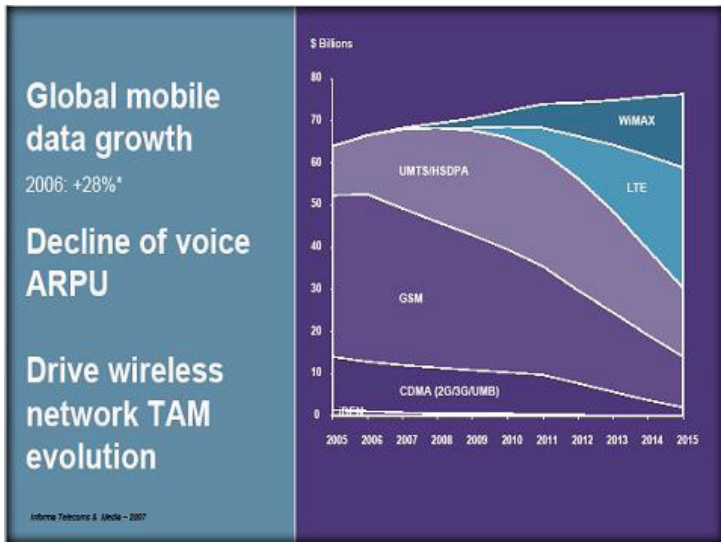


Table 1: Wireless Market TAM

Innovation shaping our lifestyle

All these recent changes have had a great impact on our lifestyle, making us not only more mobile than ever, but also much more responsive. These changes are now driving new needs that are not yet fulfilled by today's telecom services. For example, at macro level, networks are still very much fragmented and separated by invisible barriers. Today, a single user, at any given time, might need to interact with and move between several networks: home networks, office networks, mobile networks, local networks (i.e. the Airport). A voice call initiated today on your fixed line at home cannot be easily transferred to your mobile, or your music collection available on your home Wi-Fi network cannot be easily accessed outside.

There is still a significant opportunity for other devices to become connected. Most of the latest gadgets like MP3 players, digital cameras, GPS units, are still stand alone devices. Imagine the expanded possibilities if all devices were enabled with a mobile broadband chipset. The same opportunity exists for cars; that are destined to sooner than later, become a communication hub connected.

Emerging markets present an interesting case where legacy mobile networks have made a profound impact on an individual's lifestyle and the local economy. The further potential of reaching rural areas in emerging markets with mobile broadband technology is likely to have a very positive impact.

The future telecom network, and what most operators are seeking to achieve in the long term with convergence plans, is a network that would provide subscribers access to any content, anytime, anywhere, on any device, at speeds high enough so as to not be noticeable by the end-user. This describes Motorola's vision of Seamless Mobility. Long Term Evolution (LTE) will further enable the vision of Seamless Mobility.

What is LTE?

LTE is the latest technology from the 3GGP standards group that brought the world GSM and UMTS which now account for over 85% of all worldwide mobile subscribers.

LTE RAN (also referred to as Evolved UMTS Terrestrial Radio Access Network (E-UTRAN)), is expected to substantially improve end-user throughputs, sector capacity and reduce user plane latency, bringing a 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 will 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 with commercial availability on a larger scale expected 1-2 years later.

So what makes LTE different? If we look at the overall LTE value proposition, a key difference is that LTE delivers on two separate axes. Traditionally, new network technologies have focused mainly on improved performance. LTE however, not only delivers substantial performance improvements, but also creates new business models for operators, improving the overall value proposition to the subscriber.

With LTE, operators will not only have a platform to deliver truly ubiquitous mobile broadband services, but also a much improved business proposition compared to legacy technologies (see table 2). LTE brings lower cost per bit, higher capacity, a high level of flexibility, and have significant global appeal compared to 2G and 3G wireless technologies.

	Faster	True Mobile Broadband
	More Responsive	
	Lower Cost	Improved Business Proposition
	Added Capacity	
	Flexible	
	Global	

Table 2: LTE Value proposition

LTE Enables New Applications

With expected throughput in excess of 100Mbps and latency lower than 10ms, LTE will provide subscribers with a user experience very comparable to what they have at home today with xDSL and cable connections. In addition, LTE breaks the boundaries between "home and outside", meaning that applications can be shared between the home computer and outside the home.

In addition because of LTE's lower cost per bit, it also makes a number of typically gigabyte hungry applications, cost effective and viable to use in a mobile environment.

Table 3: LTE Enabled Applications

High Definition (HD) video streaming will be possible with LTE, thanks to the increased data rate, giving the user the ability to watch the latest blockbuster on their laptops on the way to work for example. The increased uplink data rate of LTE will also enable "Video Blogging", or the ability to upload video content to social networking sites. For example, the mobile phone is the perfect tool for teens to regularly update their social profile and even use live video to let their friends know where they are and what they are doing. Social networking is one of the fastest growing applications, with over 12 million consumers in the United States and Western Europe now accessing and updating their social networking page using their mobile device[3]. With LTE, users – even those beyond their teens -- will be able to upload and download high quality videos in real time from anywhere, using their mobile phone or even a LTE enabled camcorder. HD video streaming on the uplink also has great potential for business users who could for example, use it for transmitting live video of difficult repair tasks to other team members for input.

[3] M:Metrics, June 2007

Users with LTE will be able to keep all devices continually (and effortlessly) synchronized. So, for example, snapshots taken on an LTE enabled digital camera or mobile phone will automatically be synchronized with and backed up on their home computer and made available to view through their IPTV set top box. Another example might be that a document that you save at work on your desktop computer will be available, seconds later, just as you last saved it, on your PDA or other device.

Real-time online gaming, popular on the home PC today, will be a reality anywhere thanks to the low latency inherent in LTE. Peer2Peer file exchange will not only be enabled through the high upload and download speeds but, also economically viable thanks to the very low cost of data delivery in LTE.

LTE - Future Proof Data Rate

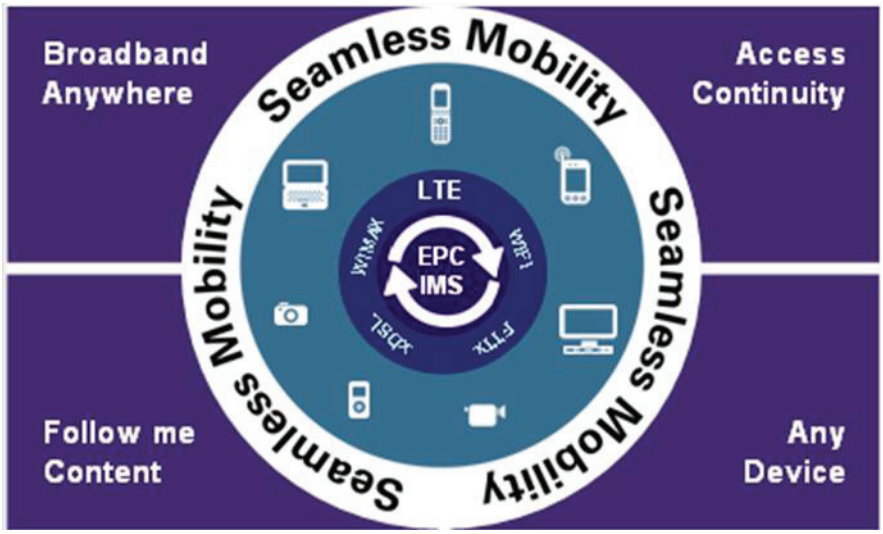
Do people really need the kind of bandwidth we are talking about for LTE? If we consider different usage case scenarios in 2-3 years time (mobile, laptop-nomadic in hotspot and household via femtocell), we realize that the maximum bandwidth needs can be achieved with LTE whereas 2G and 3G wireless technologies would struggle to deliver enough capacity in all 3 instances. In many case, the technologies are more uplink limited.

Table 4: Theoretical Peak Data Rate

This diagram shows the maximum theoretical speed required in three different usage scenarios. (Internal Motorola Information)

LTE Enables Seamless Mobility

Motorola believes LTE is a key technology in realizing the full promise of Seamless Mobility. The LTE core EPC, IP Based Evolved Packet Core, allows for connectivity and hand-over to other access technologies, including all 3GPP & 3GPP2 technologies, such as GSM, UMTS, CDMA/EV-DO, as well as Wi-Fi or even fixed line broadband services like xDSL, GPON. And, the IMS layer or service layer will provide the user seamless continuity of services.



In a LTE-EPC network, subscribers will have continuous access – that means not having to determine what type or level of connectivity is available. An operator with Wi-Fi networks in airports for instance, can allow for subscribers devices to hand over to the Wi-Fi network if the current macro reception becomes weak; without impacting customer quality.

Subscribers will benefit from "follow me content" and broadband speed anywhere. LTE, thanks to its ability to interconnect to other technologies, delivers a simplified and fully integrated service level and experience. Imagine walking out of your home with the recorded TV series you were just watching in your living room seamlessly transferring to your handset for you to continue watching.

Functionality in the EPC and IMS/Service Layer allow operators to provide the same services and applications across all access network technologies (fixed lined and wireless). Enabling for example, one phone number and one voice mail making the user accessible in the home, on their mobile, in the office (if desired) and even on through an IM application.

Finally, LTE offers full end-to-end QoS enabling operators to promote new value added, and higher priority applications and services. For example, operators could offer a video streaming application with a guaranteed level of service to a repair crew in the field that depends on good quality video streaming to effectively execute their work; whereas casual users could use the free video service provided on the internet.

LTE Business Proposition

With greater spectrum efficiency, simpler architecture and the ability to re-use low frequency spectrum, LTE will boast much improved capacity for both voice and data delivered at a significantly lower cost compared to legacy technologies.

These improvements contribute to a lower cost per bit for both voice and data services. In fact, some simulations are showing voice services on UMTS to be several times more expensive than LTE. The relative total cost of ownership (TCO) for LTE by Subscribers GB/month also presents significant improvement opportunities over existing 3.5G networks.

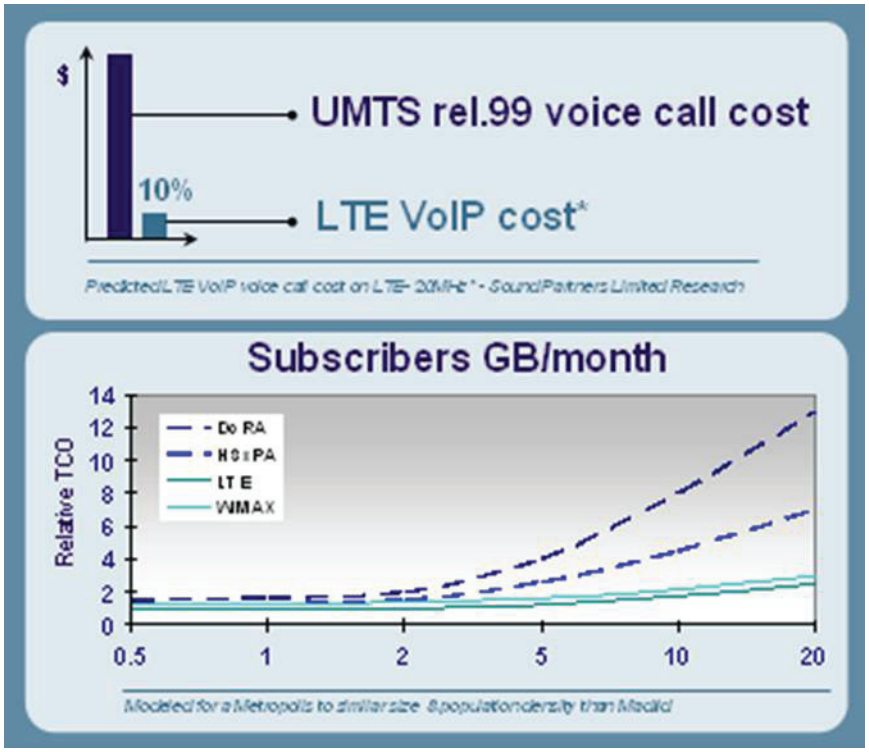


Table 5: LTE Voice Cost Comparison and GB/Month TCO

LTE will bring significant flexibility in regards to spectrum. LTE has been defined to be deployed in spectrum ranging from 1.25MHz to 20MHz. This means that operators will be able to re-farm their existing GSM or CDMA spectrum to deploy LTE, and continue to expand in that spectrum as it becomes available. Additionally, because LTE can be deployed in spectrum as wide as 20 MHz, operators will be able to make the most of the capacity offered by new spectrum bands.

New LTE networks will interconnect seamlessly with legacy 3GPP and 3GPP2 networks, providing the convenience of keeping the existing global roaming agreements and the ability to hand-over to the 2G/3G sub-layer where LTE coverage is not available. This provides for a very smooth upgrade path when an existing 3GPP/3GPP2 network is present as LTE can deployed in phases and still provide ubiquitous connection.

The support behind 3GPP and the market share of 3GPP technologies will also help LTE go to market quickly and provide significant economies of scale for both infrastructure and end use devices.

Based on Motorola's own internal simulations and business modelling, the improvements brought by LTE, in totality, could give LTE operators a significant advantage in the market place against 2G, 3G operators. In effect, these operators could offer a flat rate mobile broadband tariffs at a price level attractive to the mass market, supporting the growth in mobile data traffic while keeping a positive NPV.

Conclusion

In this paper, we looked at the drivers for LTE, how consumers will benefit from LTE services and how LTE can fulfil operators' long term strategy by giving them the ability to bring innovative services, to drive ARPU growth and gain a competitive advantage.

With the anticipated throughput, latency targets, emphasis on simplicity, spectrum flexibility, added capacity and lower cost per bit, LTE will provide operators in developed and emerging markets the basis to support their business models. It is flexible to support an internet bit pipe model, an offering focused on content delivery and differentiated premium services, or an MVNO business model.

Motorola's LTE solution will leverage our extensive expertise in OFDM technologies - first demonstrating OFDM at speeds of up to 300 Mbps back in 2004, our leadership in IEEE 802.16e WiMAX, vast expertise in collapsed IP architecture and our leadership in LTE RAN standards. In addition to LTE infrastructure, Motorola's leadership in home and video solutions, handsets and CPE, leading backhaul solutions and experience in deploying OFDM mobile broadband networks means that Motorola will bring a compelling LTE end-to-end ecosystem while offering a smooth migration path for both 3GPP and 3GPP2 service providers, traditional wire-line service providers and new entrants.

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

Glossary:

ARPU – Average Revenue Per User

CDMA – Code Division Multiple Access

EPC – Evolved Packet Core

FTTx – Denotes the different variants of FTT – Fiber To The

GSM – Global System for Mobile Communications

HSxPA – Denotes HSDPA/HSUPA – High Speed Downlink/Uplink Packet Access

IMS – IP Multimedia System

IP – Internet Protocol

ISP – Internet Service Providers

LTE – Long Term Evolution

OFDM – Orthogonal Frequency Division Mutliplexing

QoS – Quality of Service

SMS – Short Messaging Service

TCO – Total Cost of Ownership

UMB – Ultra Mobile Broadband

UMTS – Universal Mobile Terrestrial Services

VoIP – Voice over IP

WiMAX – Worldwide Interoperability for Microwave Access

xDSL – Denotes the different variants of DSL – Digital Subscriber Line

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