Long-Term Evolution (LTE): The Path to Deployment

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DRIVING THE NETWORK EVOLUTION

Growing Consumer Trends and LTE

The mobile paradigm is evolving. Proliferation of broadband adoption is enabling applications such as YouTube, Facebook and MySpace on mobile devices. Users are demanding increasingly sophisticated applications like interactive TV, mobile video blogging and advanced gaming on mobile devices. This recent explosion of mobile data usage and the abundance of new mobile applications are the drivers for Long-Term Evolution (LTE), the latest step in the evolution of mobile access technology that promises to fundamentally change the mobile paradigm and enable new capabilities well beyond traditional voice and data services.

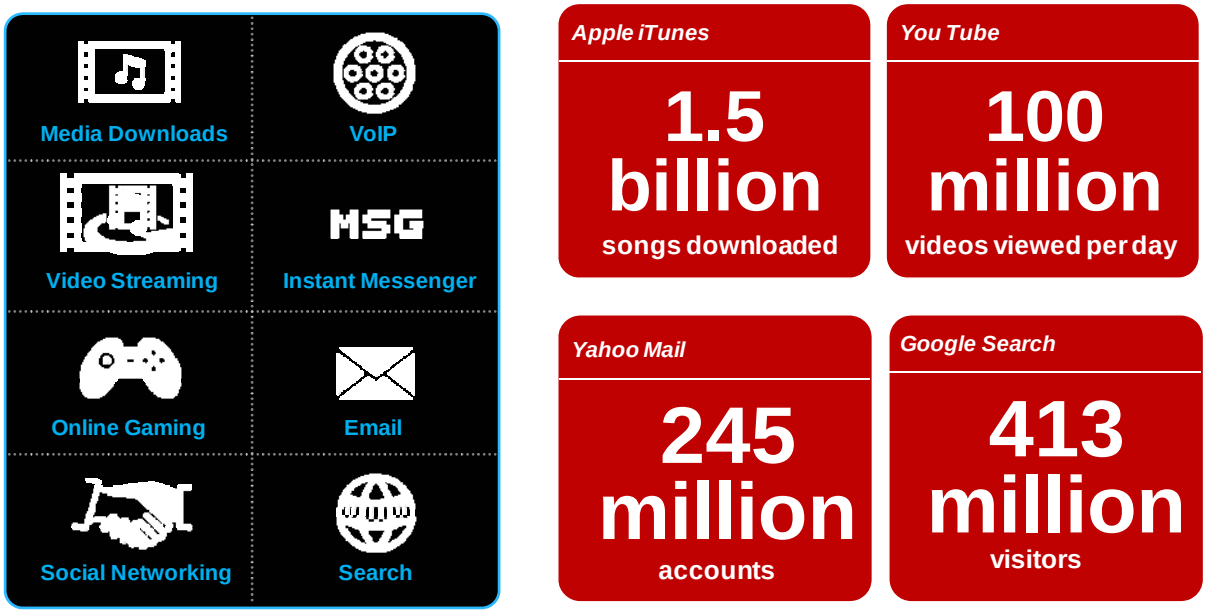


Figure 1: Growing Consumer Trends Worldwide

The promise of LTE is in the new data capabilities it has to offer at a significantly lower cost structure than 3G data solutions. High data rates and exceptionally low latency will significantly improve the user experience for bandwidth-hungry content and applications. In addition, the all-IP architecture with end-to-end Quality of Service (QoS), spectral efficiency, and bandwidth flexibility, promises to improve overall network economics and significantly improve the user experience. Initial deployments of LTE are expected by 2010 with commercial availability on a larger scale a few years later.

LTE Challenges and Opportunities

The move to LTE is being driven by operators' need to provide ubiquitous global wireless broadband connectivity and mobility. LTE will enable operators to continue to meet business customer demands for a higher bandwidth, low latency service, while helping them to meet consumer demand for mobilizing the many applications they frequently use when tethered to high bandwidth wired networks. However, operators will be faced with a few challenges as they look to realize the revenue gains from LTE.

Key among the top mobile operator concerns as they move to LTE are 1) cost-effective evolution to LTE and IMS, 2) Service Quality, 3) Indoor Coverage Performance and 4) CapEx

and OpEx efficiencies. Evolving to LTE necessitates managing technology risk, maintaining network & service quality during transition, managing capital expenditures, controlling backhaul costs, and developing a device ecosystem. Successful transition involves minimizing cost per data bit to support profitability in an open access environment.

The following sections examine some specific LTE challenges in these areas and how operators worldwide are planning to address them.

Delivering Voice over LTE

LTE's economic benefits are clearly grounded in the new data capabilities it has to offer. However, the delivery of voice service over LTE is being approached by operators in many different ways based on where they currently are in their network evolution. Some operators are looking to roll out full IMS services concurrent with LTE, with support for IP telephony on day one. However, others are taking a phased approach, rolling out data services with LTE first.

Given current economic times, many operators across the globe are looking to leverage their existing core assets to provide voice over LTE services. Voice and SMS are the primary revenue generating services for mobile operators today. For the past several years, operators have been investing heavily in mobile softswitches to support 2G and 3G voice and circuit-based services (like SMS), delivering stable, reliable and cost-effective services with upgrades to their softswitches. As operators look to roll out voice on LTE as well as conserve CapEx, reusing these existing assets is of clear value, especially since the core voice infrastructure faces several years of depreciation.

Beyond the standard implementation of IMS, there are a number of alternative approaches that operators as well as standards bodies are considering to enable the delivery of Voice over LTE. The first approach, an active work item in the 3rd Generation Partnership Project (3GPP) (TS 23.272), is to let the mobile device fall back to GSM or UMTS for incoming and outgoing voice calls. This model is considered attractive since on the legacy side of the network, little or no work is required because the LTE network, and specifically the MME, acts like a 3G SGSN and therefore all procedures already existing for 3G to 3G/2G handovers can be reused. However, as with any new technology, this approach is not quite as straightforward as one might think. A concern that is typically raised with this approach is the amount of time that could be added to the call establishment time via this fallback mechanism, in addition to the negative impact this might have on the user's perception of the service.

Another approach fast gaining momentum in the industry (3GPP TR 23.879) makes the existing telephony infrastructure a packet service delivered over IP via LTE. This allows avoiding a major switch in the voice call control paradigm as well as retaining the currently provided functionalities such as the charging mechanisms (calling party pays), supplementary services provision and so on. The idea of re-using CS (Circuit Switched) voice over IP is not a new one. UMA-based dual-mode VoWLAN does the same - the handset's telephony application remains unaware that it is being transported over WiFi. This approach allows the operators to reuse their installed voice core infrastructure. Originally applied to fixed broadband networks like DSL and cable, and later forming a basis for the femtocell standard Iuh, the GAN or UMA approach is being considered to deliver voice over LTE. This approach is being promoted by newly formed VoLGA (Voice over LTE via Generic Access), a forum formed in March of 2009 with an already strong list of supporters including T-Mobile and Ericsson.

The VoLGA approach allows the operator to reuse their existing MSC Servers that control establishment of voice calls and handling of SMS. Impacts on the existing MSC Server are avoided by “outsourcing” the necessary adaptation functions into an Interworking Function (IWF), essentially a GANC - GAN Controller composite (includes controller, media gateway and optionally a security gateway). No changes are needed in the CS infrastructure in order to support this solution.

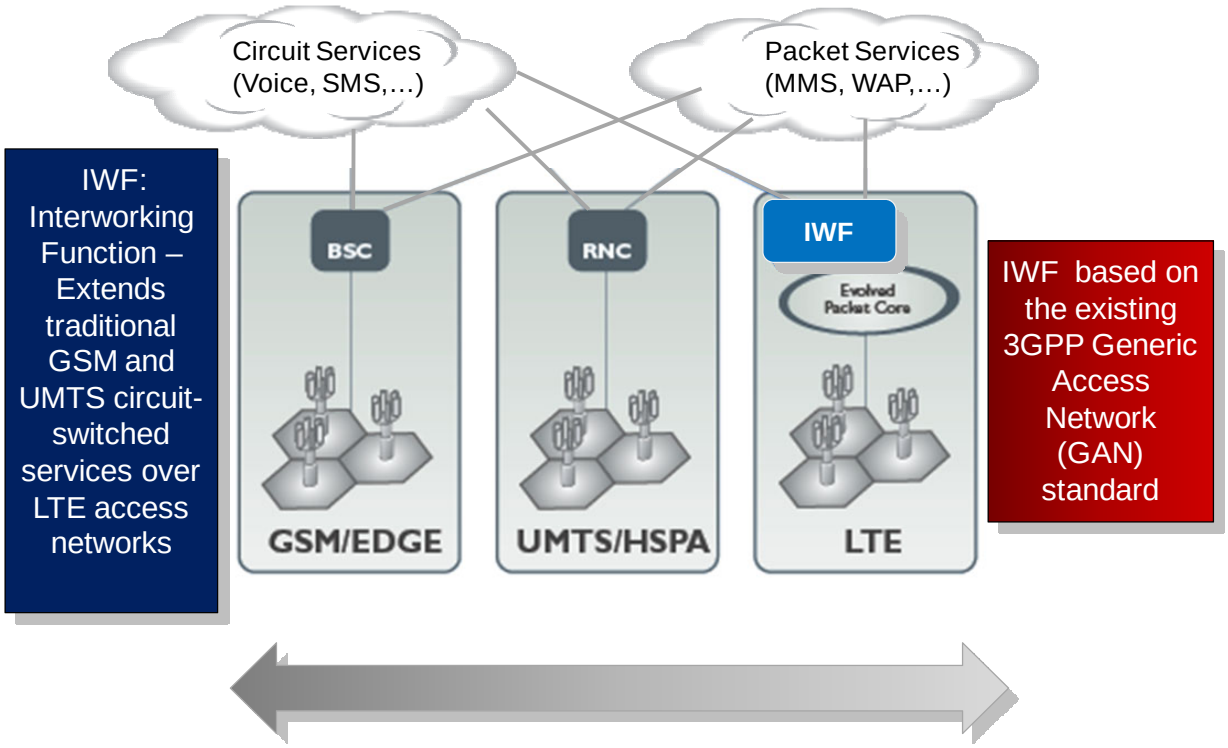
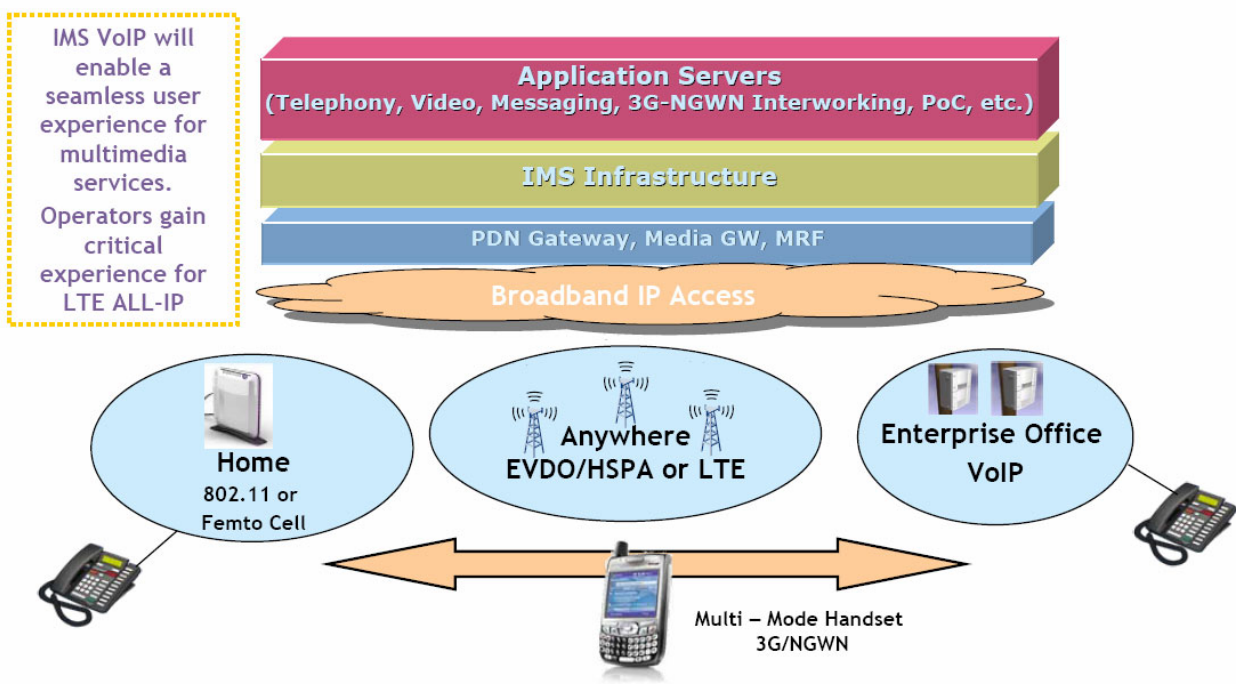


Figure 2: Delivering Voice over LTE via GAN

By leveraging the 3GPP GAN standard to extend voice services from an existing core voice network over LTE, operators can maximize their investment protection in core telephony services. This solution allows them to seamlessly deliver multimedia services over packet access networks as well as reuse the same infrastructure to deliver LTE femtocells.

Paving the path to IMS

Over time, most operators believe that they will deliver an all IP core for converged multimedia services through IMS. In fact, many believe that LTE will accelerate the rollout of IMS cores. There are operators, especially in the Asia Pacific Region (APAC), that have already made heavy investments in IMS and will deploy it in early LTE rollouts. IMS will be a cornerstone technology in the evolution of many large operators’ services infrastructure. Many Tier 1 operators plan to offer IMS-based IP converged applications and services on their wireless networks, and LTE will be one of the key wireless access networks linked to the IMS technology.



As operators roll out new VoIP cores with IMS, they will be faced with the challenge of reducing the infrastructure cost. They will look to reuse exiting network elements that have been deployed, are “proven”, and can meet the growing demands for scale and performance. They will also look for a smooth migration to the new IP core. The key to achieving this smooth migration involves moving to a distributed architecture which allows them to scale the signaling and media planes independently of each other, given the extremely different requirements for each function. In addition, operators will look to combine key network elements with similar functions, such as IP to IP Border gateways and Media gateways on single platforms. This will reduce both costs and latency, as well as provide a smooth transition to IP without forklift upgrades.

Ultimately, operators’ decisions on deploying these new technologies will be about investment protection.

Femtocells in LTE Rollouts

Femtocells are clearly being seen as a major change to the industry – with technology, trials and business cases evolving. In fact, before LTE becomes widespread, 3G HSPA femtocells are expected to become more widely deployed by operators who would be interested in a 4G LTE model. With the explosion of data traffic, one of the key drivers for femtocells is the need to dramatically reduce the cost per bit as the growth of data traffic far outpaces the growth of mobile data revenue. Femtocells provide a significant opportunity for these operators to do just that. 3G femtocells are likely to provide more than enough capacity to cost-effectively satisfy the most demanding mobile device consumer.

Figure 1.4: Global mobile data revenues and traffic, 2007-2012

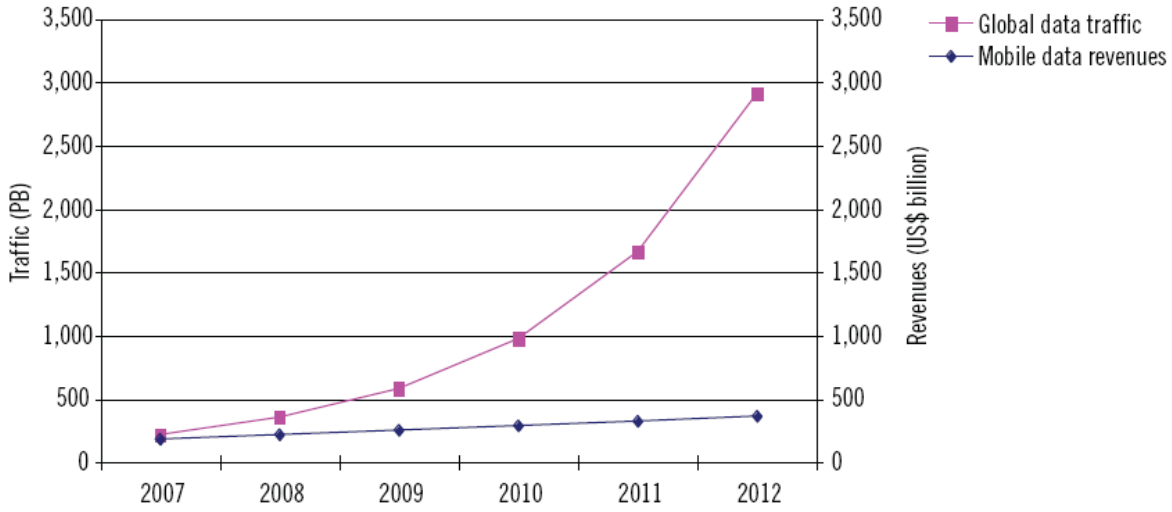


Figure 3: Source Informa 2008

Most operators considering the roll-out of LTE have already deployed widespread HSPA networks. Given that the initial rollout of LTE will most likely be with multimode handsets (LTE and HSPA and GSM, for example), it is expected that 3G femtocells will continue to be deployed indoors. This is due to the substantial savings available as a result of technological innovations that are driving down the bill of material costs for residential femtocells. Many consider femtocells as a first step of Next Generation Mobile Network (NGMN) rollouts that allow operators to deliver initial NGMN services to consumers and enterprises at an earlier stage at home and in offices.

The benefits of femtocells will be even more apparent as operators transition their networks to LTE. Operators worldwide are increasingly insistent on the benefits of automation in the move to LTE and are mandating self-organizing network (SON) principles in vendor roadmaps and the 3GPP standards process. This is being done most notably through the Next Generation Mobile Networks initiative. The Femto Forum, however, points out that femtocells are in fact the first realization of SON.

By deploying femtocells, operators can increase capacity much more substantially than by changing the radio interface alone. The capability to self-manage, self-optimize and self-organize means that femtocells will adapt to the surrounding environment and automatically configure themselves - saving on costs and complexity of deployment. As noted by Professor Simon Saunders, Chairman of the Femto Forum, femtocells are expected to be an integral component of NGMN. Whereas femtocells were an afterthought during 3G rollout, femtocells are designed into the NGMN standards from day one. Release 9 of 3GPP will deliver LTE standards-based femtocells.

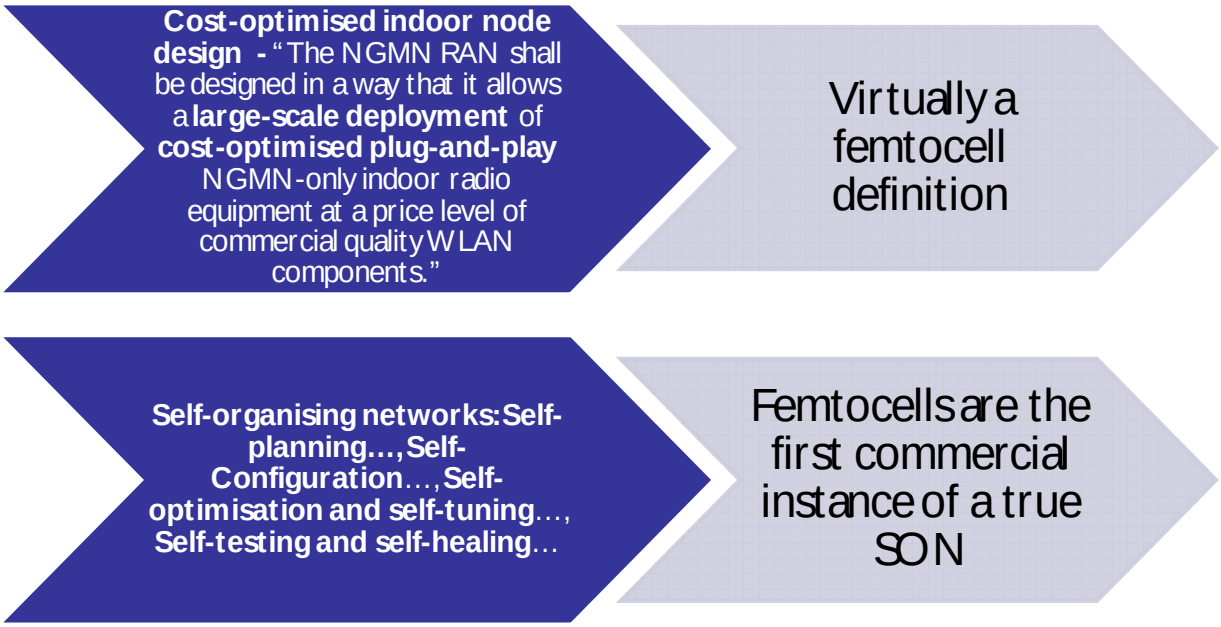


Figure 4: Femtocells meet NGMN SON Requirements (source Femto forum)

Aside from the cost advantages of LTE femtocells, based on the regions deploying LTE, these devices will become a necessity for LTE rollouts since providing in-building coverage is a technical problem at the gigahertz (GHz) frequencies used for LTE. Unlike North American operators, most European operators will be deploying LTE in the GHz frequency range. As transmission frequency increases, in-building penetration degrades, and the additional signal attenuation reduces throughput for those users who are in indoor locations. This problem cannot be addressed by making traditional macrocells allocate more power to reach the indoor user, since this increases the interference for other users. Femtocells are being perceived by operators as a natural means to solving this problem.

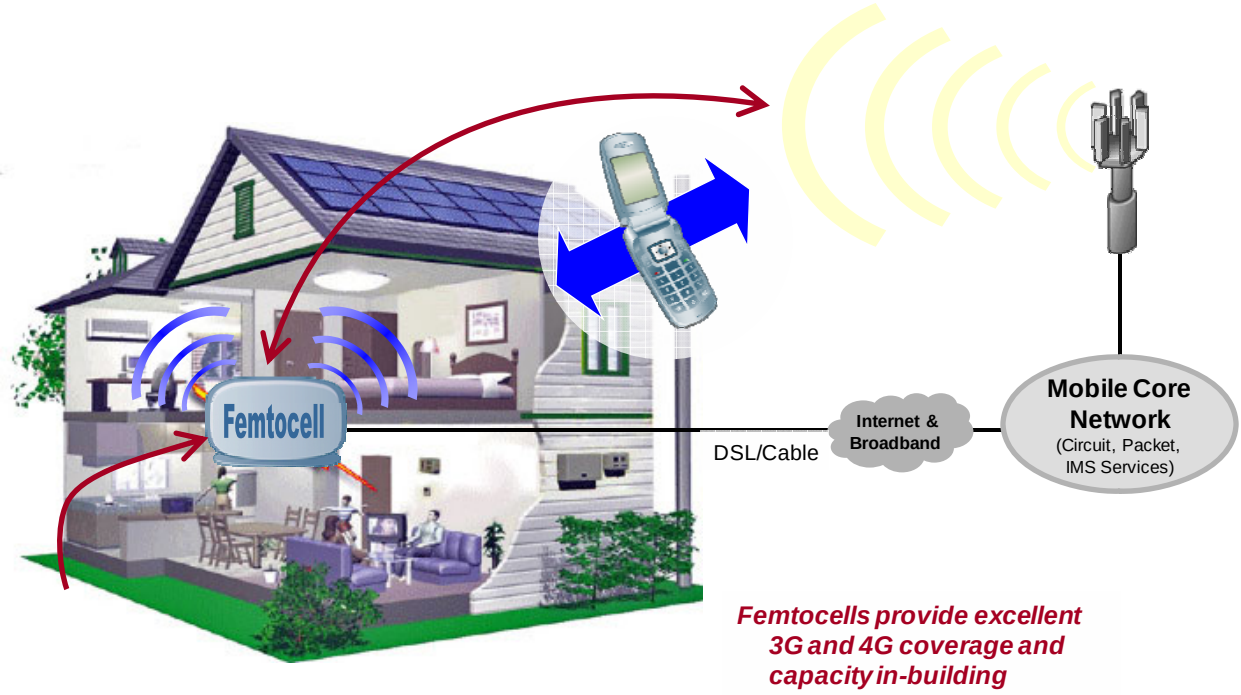


Figure 5: Femtocells provide excellent LTE coverage

Finally, femtocells will reduce the financial risks faced by the operators and increase the overall value associated with next-generation rollouts. Femtocells allow operators to build out their networks matching the demands of the consumers with very little delay, in contrast to building out massive macro-cellular networks that attempt to anticipate demand.

Evolving Security Paradigm

In the market today there is a proliferation of increasingly intelligent handsets based on Windows Mobile, Google's Android, and the Apple iPhone. With the onset of LTE, these intelligent handsets will have network connections equal or superior to typical PCs on broadband connections. This suggests that the LTE network will follow the same path as wireline networks and will thus become quickly dominated by Peer-to-Peer (P2P) and web traffic, making it susceptible to aggressive network security attacks.

Threats targeted at the user and his/her device will increase due to the increase in mobile device usage. In addition, unpredictable and dynamic topology changes of networks will create challenges for identity management, security of routing, and management of roaming security. Applications may establish automated connections to a variety of information sources. The authenticity of the source and the validity of data will need to be verified through strong authentication and authorization mechanisms. Secure access will be a key requirement in an all IP world.

Open Networks…

New devices and applications…

> *" With the uptake of HSPA and HSDPA and proliferation with Smart Phones (with associated open developer environments) Mobile Operators will be introduced to the same issues that have plagued fixed operators & ISP's"*

The mobile security paradigm is shifting. The newer market and network deployment trends with LTE will require a different level of network security, with support for large scale, bandwidths and performance. Users will need stronger levels of authentication, and data may need to be encrypted to protect against tampering -- much like for over the top (OTT) services in the wireline world today. In addition, due to the complexity and abundance of new applications, security will need to be "intelligent" to prevent attacks from reaching the handsets, and P2P traffic will need to be throttled down to protect more valuable Web, e-mail or mobile video traffic while not blocking it entirely. All these security mechanisms will be much easier to handle at the edge of the core network, rather than at the individual handsets.

New Monetization Opportunities for Mobile Operators

"Intelligence" at the edge of the network not only addresses security concerns for Mobile Operators, but opens up new revenue generating opportunities as well. Wireless carriers to date have not been successful in taking the per-minute pricing model of mobile calling and also applying it to new mobile data services. As a result, carriers are left looking for advanced services for which they can charge subscribers a premium in order to recoup their investment in LTE technology.

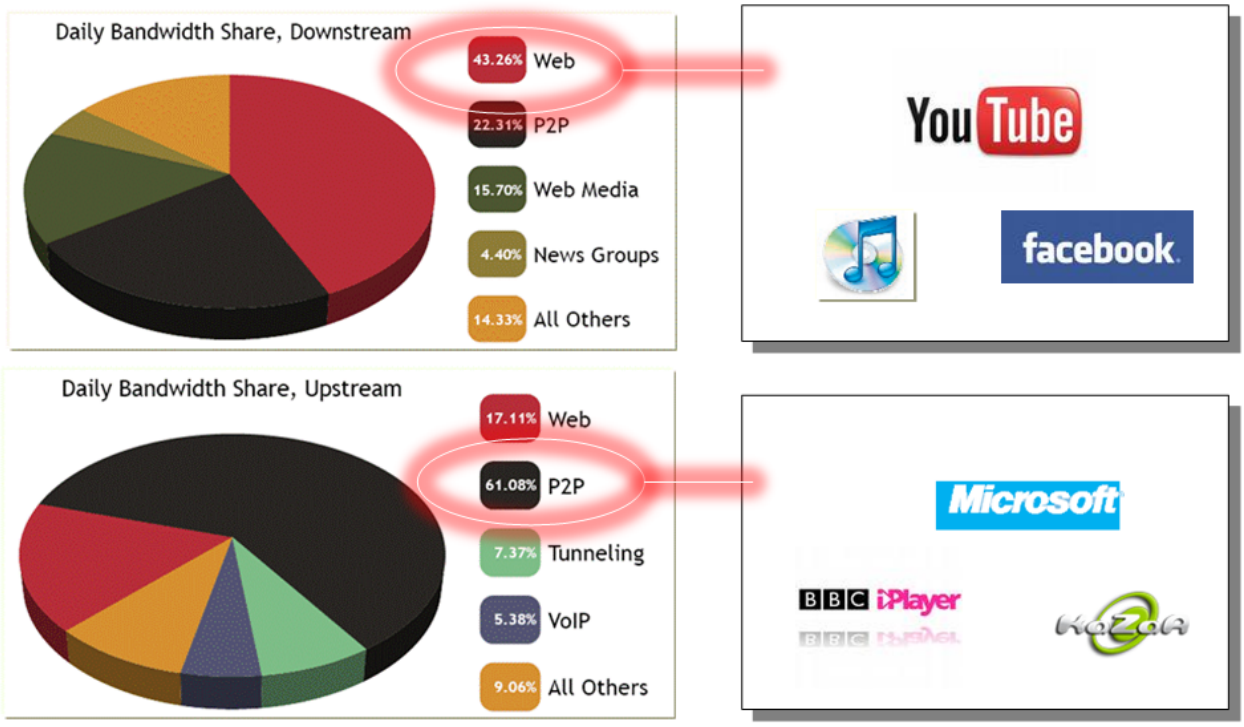
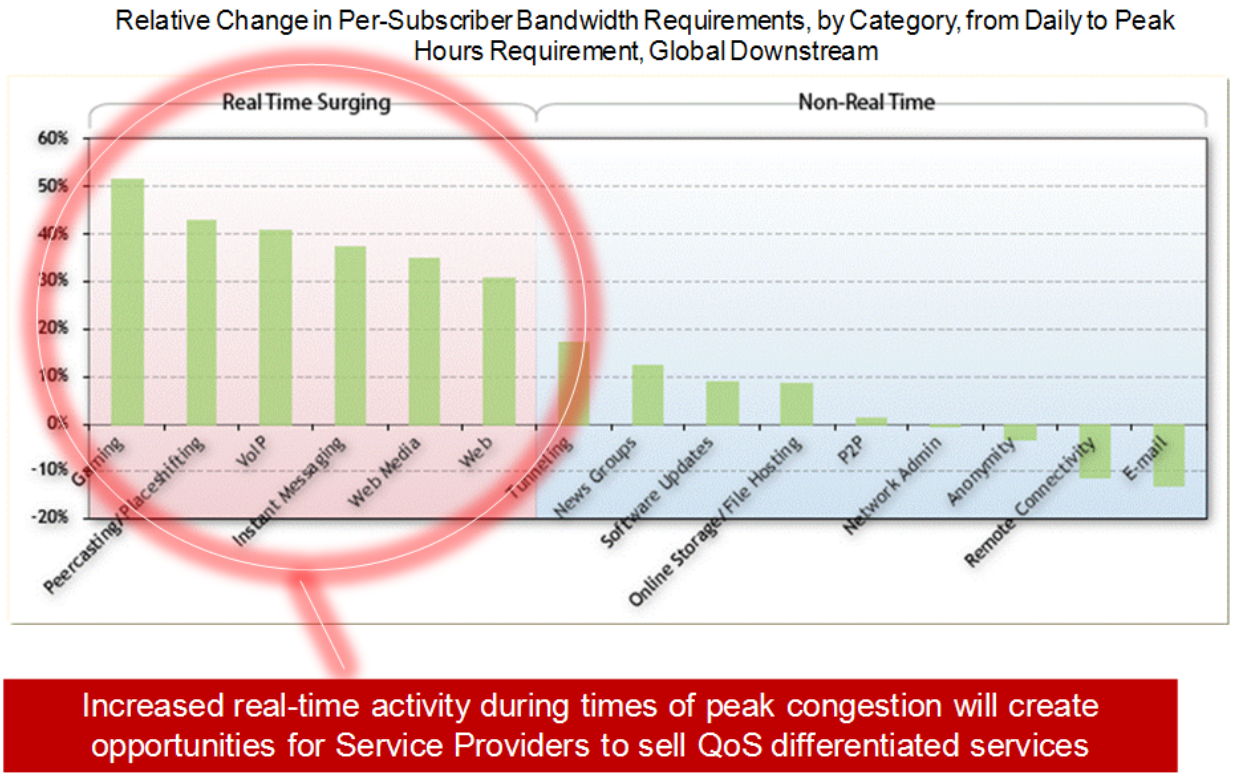


Figure 6: 2008 Global Broadband Traffic Mix

Intelligent Traffic management can form the basis for innovative new services that allow carriers to differentiate their offerings or garner additional revenue through offering different bandwidth levels to premium users -- delivering a service that prioritizes gaming, VoIP and video conferencing traffic, for example. Similarly, intelligent traffic management can be used for gathering market intelligence to create targeted mobile advertising. The possibilities are boundless, and this technology provides carriers with a new set of business tools to increase average revenue per user (ARPU). Increased real-time activity during times of peak congestion will create opportunities for carriers to sell QoS differentiated services.



Deep Packet Inspection (DPI) will also be a key requirement for LTE with the first true "All-IP" converged Evolved Packet Core (EPC). While the flat IP core delivers significant benefits to a mobile operator because of its inherent simplicity, it also brings with it the challenge of traffic management and QoS, in addition to security discussed in the previous section. Intelligent Traffic management via DPI will be essential for prioritizing real-time voice traffic over data and other less time-sensitive traffic.

Where will DPI functionality be deployed in an LTE network? There are two schools of thought on this. The first believes that DPI should be integrated in existing network elements such as Serving Gateways, Security Gateways as well as Packet Data Gateways, which are the entry points for different types of traffic into the core network, whether it is over a trusted network or an untrusted network via femtocells or dual mode WiFi handsets. Adding DPI functionality on the existing nodes reduces the number of separate boxes in the network, thereby reducing OPEX. It also increases the ease of administration and improved packet latency through the system by reducing the number of hops in the network.

However, others are quick to point out that many of the Serving gateways and PDN gateways will be upgrades to the operator's SGSN and GGSN platforms. Can they really perform their core functions as well as DPI without performance degradation? In such cases, standalone DPI solutions adjacent to the large Serving/PDN gateways might be the better option. At this point, most operators are leaving both options as viable. In any case, most operators believe that applying DPI closest to the edge is a good approach since it gives the operators better and more granular control of the traffic.

Conclusion

Operators around the world are looking to accelerate LTE deployments. Leveraging existing assets to maximum advantage will be a key factor for their success. Most operators will look to interwork existing technologies with LTE as efficiently as possible. Rather than delivering an undifferentiated broadband connection, operators will focus on delivering value added data services first while keeping their existing telephony services intact. By leveraging existing standards to extend voice services from an existing core voice network, operators will obtain the advantage of a fast, low risk path to LTE telephony.

To maximize returns from the massive growth in data traffic, operators are developing innovative plans to address subscriber demand for advanced services. Many are looking at femtocell technology to smooth the transition to LTE and offload traffic to femtocells where needed. In addition, operators are exploring new business models by converting ordinary "bit pipes" into smart pipes using DPI technology and creating new revenue streams.

Securing mobile broadband networks cannot be an afterthought. Poor QoS and lapses in security are imminent threats to mobile broadband adoption, particularly in an All-IP environment like LTE. If network operators are to capitalize on the tremendous growth opportunity of mobile broadband, strong security solutions will be a must.

Finally, as mobile operators start to deliver voice over their IP networks, they will need to fundamentally shift to a distributed architecture to meet the growing scale requirements that result from new multimedia applications.

GENBAND - Keeping Operators Competitive during Transition to LTE

GENBAND is a market leader and pioneer in connecting, securing, and enabling efficient communications between network borders. The company's carrier class line of gateway and security products provide interconnection and migration solutions at the borders of circuit and IP networks, as well as advanced security and session management at the borders where IP networks meet.

As operators look to deliver Voice over LTE, GENBAND’s G9 Converged Gateway will deliver CS Voice over LTE by fulfilling the role of Interworking function. The S-Series Security Gateway will optionally provide secure access over an IP network.

The femtocell market promises to reach mass deployment with the onset of LTE. GENBAND’s field-proven G9 Converged Gateway and S-Series Security Gateway play a key role in femtocell deployments worldwide, providing secure access and media interworking that enable the secure transport of femtocell calls over broadband access networks and into the mobile core. GENBAND’s femtocell platforms lower operating and capital costs of femtocell solutions through unmatched scalability and a unique combination of media adaptation and signaling gateway functionality.

In the LTE core architecture, the Evolved Packet Data Gateway (ePDG) delivers voice and data services over the untrusted Internet and WiFi networks to femtocells and dual-mode handsets. GENBAND’s S-Series Security Gateway fulfills the role of the ePDG. It authenticates subscribers and uses IPsec to securely tunnel voice and data to devices over the Internet and

WiFi. These platforms provide industry-leading Security Gateway capabilities for the most scalable femtocell deployments, supporting up to 1.2 million tunnels in a single system.

Finally, as mobile operators roll out multimedia services with IMS, GENBAND's distributed session management (S- Series) and border gateway (G-series) solutions provide cost effective migration to IP with the highest scale.

About GENBAND

GENBAND is a global leader and innovator of next generation IP media, session border and fixed mobile convergence security solutions deployed in over half of the world's 100 largest service providers. These high-performance gateway solutions are at the core of fixed and mobile networks around the world - evolving, securing and enhancing communications networks. Headquartered in Plano, Texas, GENBAND has Centers of Excellence in Brazil, China, Maryland, Massachusetts and Texas, and serves customers and partners in more than 80 countries. Additional information is available at www.genband.com.

About the Author

Dr. Natasha Tamaskar brings over 20 years of industry experience with particular expertise in FMC solutions. As the Vice President of Product Marketing for GENBAND, Dr. Tamaskar drives the market strategy for GENBAND's Security, FMC and NGN Mobile solutions. Prior to GENBAND, Dr. Tamaskar was the Vice President of Product Management and Marketing for NextPoint Networks, where she drove the product and market strategy for NextPoint's Integrated Border Gateway and FMC solutions. Dr. Tamaskar joined NextPoint through the merger of Nextone and ReefPoint, where she was responsible for driving Product Management and product direction for ReefPoint's Universal Convergence Gateway products. She also built and launched the company's IP Multimedia Subsystem (IMS) product portfolio. Prior to Reef Point Systems, Dr. Tamaskar was the Integrated Product Team Lead for Nortel's Enterprise Secure Edge Router platform and a part of the Packet Data Network's Architecture team. She has also held several technical leadership positions with Mei Technology, which was acquired by MATCOM in 1999. Dr. Tamaskar holds a Ph.D. in Computational Physics from the Liquid Crystal Institute at Kent State University; an M.S. in Physics from the University of South Florida; and a B.S. in Physics from the University of Delhi, India.

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