4G Services – Market Opportunities and Implications

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The benefits of 4G networks will enable a greater range of services and use-cases. However, the business models and eco-systems required to drive adoption from a customer and service provider perspective have not yet been established. Next generation networks will lead to the emergence of a diverse range of eco-systems that better support the various players via new business models servicing a wide range of segments, customers and uses.

On the heels of the prevailing 3G rollout battle, still evident by the now infamous "there's a map for that" advertising campaign, the groundwork for the next series of skirmishes is set. All major mobile operators have already announced their upcoming 4G deployments using LTE or WiMAX. These deployments are expected to generate rapid growth in 4G service capabilities; LTE infrastructure market is expected to hit $5 billion in annual revenues by 2013 with up to 85 million subscribers expected to migrate to 4G during that same period.

US Big-Four Mobile Network Evolution Plans

(Recent Announced Plans)

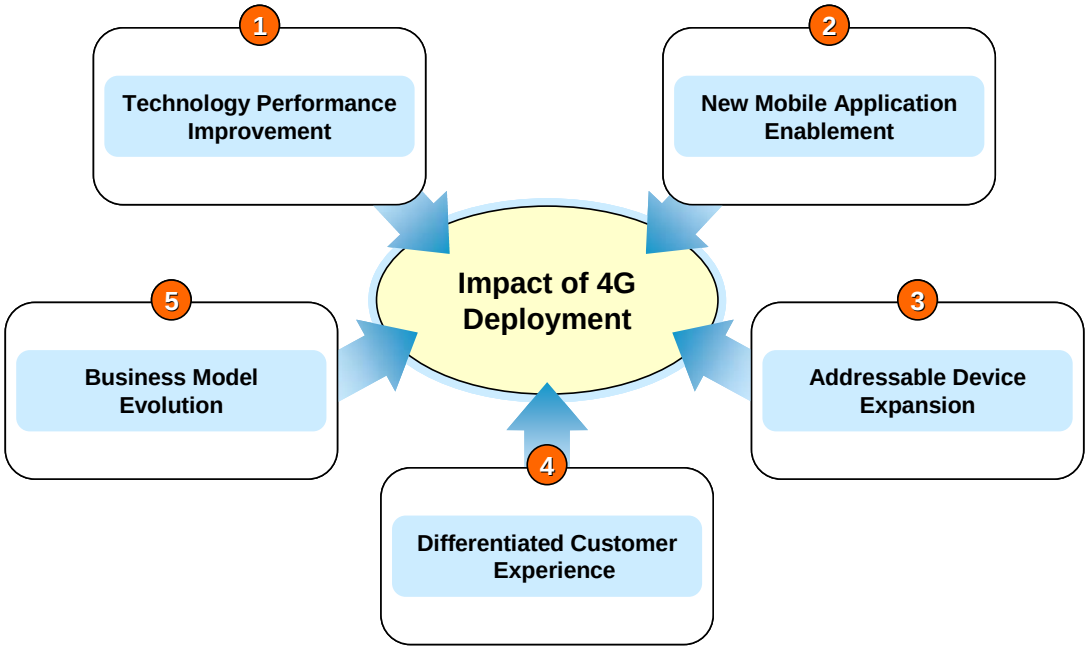
	Today	2010	2011	2012	2013	2014
verizon wireless	• EVDO-Rev A – 287M POPs	• 25-30 LTE markets commercial • 100M POPs			• Nationwide LTE rollout complete	
at&t	• WCDMA / UMTS / HSDPA – 350 major metro areas	• LTE trials • HSPA 7.2 in 25 of top 30 markets	• LTE deployment begins • HSPA 7.2 in 90% of 3G footprint	Unknown when LTE rollout expected to be completed		
Sprint	• EVDO-Rev A – 253M POPs • Mobile WiMAX in 8+ major cities	• 120M mobile WiMAX POPs		Unknown if further expansion planned beyond 120-140M POPs		
T-Mobile	• Still building 3G • WCDMA / UMTS / HSDPA – 121M POPs – 200M POPs by EOY	• HSPA+ deployed nationwide by year end		Expects to evolve over long term to LTE, but no timetable		

Source: Company websites, Fierce Wireless September 2009, CSMG analysis

Digging a little deeper, all carriers cite a similar set of rationale for these technology upgrade announcements, namely; faster throughput, lower latency and lower costs per Mbps. As new services are launched, service providers and other players in the eco-system are poised for improvements in two areas: delivering existing services faster and better; delivering new services that create new revenue streams. The question to be more fully addressed is how will subscribers truly benefit from the technology upgrade and how can carriers best position themselves to monetize the gains? In the near term, it will be important to understand where 4G offers improvements over 3G and why that might matter to users.

We believe there are five major areas of impact resulting from 4G networks that need to be explored to better answer this question: 1) Technology Performance, 2) Application Enablement, 3) Device Expansion, 4 Customer Experience and 5) Business Model Evolution.

Impact of 4G Deployment



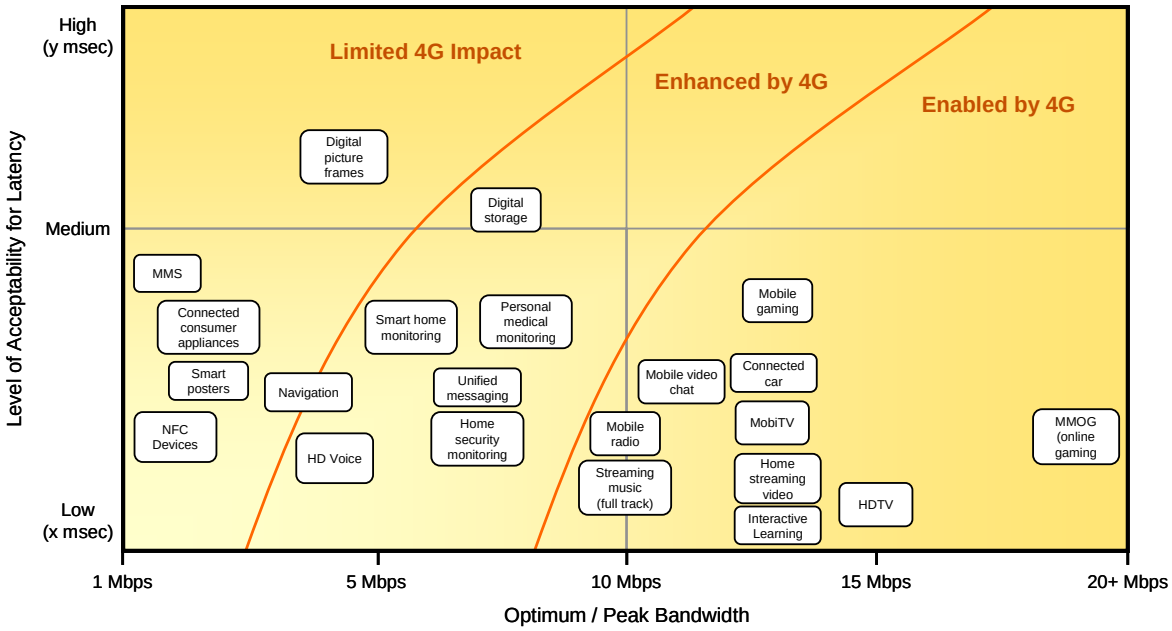
1) **Technology Performance Improvement:** Delivers higher downlink and uplink throughput in addition to lower latency and network capabilities.

   It is generally accepted that mobile data traffic will continue to grow significantly over the coming years. It is also true that regardless of the 4G technology selected (LTE or WiMAX), when compared to 3G, most core transport and throughput bottlenecks will certainly be addressed by the technology itself. 4G technologies offer at least 2x more efficient use of spectrum, higher max speeds, and improved support for real-time applications.

   However there are additional network and capacity challenges such as signaling management and edge or gateway management that will need to be fully addressed to maximize benefits from the upgrade.

2) **New Mobile Application Enablement:** Enables new mobile applications (like Telepresence) and enhances existing ones (Streaming Music).

Mobile Application Enablement



Some 4G services will be enhanced by improved 4G bandwidth and latency such as smart home monitoring or digital storage. Other services will see no measurable gain from riding on a 4G network, such as MMS, digital picture frames and many near-field communication applications. Therefore, it's critical to take a very close look at those services and applications that are expected to become fully enabled by 4G improvements. We see services such as streaming video, MMOG/gaming and specialized applications such as interactive learning and connected cars to gain the most from the technology's deployment.

3) **Addressable Device Expansion:** Network capabilities and chipset scale could extend connectivity to many new types of devices.

   Handset technologies continue to evolve along a vast array of features enabling new value added services via smartphones and more specialized devices. The Terminal operating model has traditionally favored a carrier controlled service experience. Commercial operating systems such as RIM or Windows Mobile have reduced some control, in turn attracting heavy data users but in turn creating increased network congestion. Additionally, the increasingly open eco-systems, further enabled by 4G, present a challenging opportunity for operators as third parties develop applications and customization tools to meet user needs. Devices are becoming highly configurable through open standards and more specialized devices – netbooks, tablets, eReaders, etc. – are entering the market.

   We believe vendors need to consider a micro-segmentation based device roadmap to meet smaller customer segment needs; new distribution channels are required to support adoption of Converged Mobile Devices and 4G applications.

4) **Differentiated Customer Experience:** Managing the customer expectation and experience with new services and care.

   In gaining a deeper understanding of how these services are fully enabled we consider the customers experience and how it blends into the fabric of how we live, the need or ability to deploy specialized or configured devices to support enablement, and lastly, how to make money and when to share the revenue from service delivery.

To date, understanding the 4G user experience has been insufficient and it is unclear how much the user experience will change as more and different 4G services come on line. We do know that consumer expectations around price points are resetting with mounting expectations to pay "a little for a little" which challenges the current pricing and monetization approaches. We also believe that customers are expecting more bundling of services into a "solution" that supports the way they live. So, successful adoption of 4G services will be highly dependent on determining the most likely Use Cases for 4G services.

5) **Business Model Evolution:** 4G will be key to enabling alternative partnership and monetization models.

The past two or so years have exposed the industry to the fallacy of all you can eat pricing models, or flat rate voice and data plans. This has encouraged behavior consistent with Pareto's rule for data usage where 4% of subscribers usually consume upwards of 70% of the available bandwidth. The resulting network bottlenecks constrain access in cities with a high count of smart devices. The bandwidth needs of many 4G use cases suggests this problem will only get worse if existing pricing approaches move forward. One option currently being contemplated by operators encourages moving toward tiered pricing based on typical factors such as speed, time and quality of service. Another potential service model is bandwidth on demand and the correlated pricing approach to charge premium pricing for these burst requests. This may prove beneficial to planned high bandwidth consuming events such as streaming video or mobile TV.

Given what we know today, 4G will require expansion of payment models to favor lower up-front costs (subscriptions, one time purchases, ad-based, freemium and per-use). However, open development platforms and collaborative solution development/deployment approaches may impact how multiple charging models might work. Clearly new 4G service use cases and eco-system arrangements lead to the important question of who will generate the bill for services and how will revenues be shared.

In our opinion, the real story around 4G services are the inherent business improvements. 4G will enable delivering new applications via new partnership models, supported by intelligent systems and controls that have cross-platform operability. We see a world where increasingly open networks, with a greater variety of applications across varied device types drive the uptake of 4G services. With that, the growth of 4G – enabled by new solutions and devices, will likely require a new approach to the traditional 3G eco-systems. Especially considering the breadth of target segments (consumer, prosumer, SMB, Governments), the existing and emerging devices (modems, embedded cards, smartphones, embedded CE devices, specialized enterprise devices, M2M devices), and the plethora of spectrum and transport services (fixed, nomadic, mobile, VoIP, OTT Video, etc.). These new eco-systems will need to consider how to monetize the additional services delivered to customers and how these services are woven into the fabric of potential user's lives.

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