Evolution of Wireless Applications and Services

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[1] Introduction

It would be hard to imagine a world without wireless applications and services. Around the globe, mobile services are playing increasingly important roles in many facets of our society. Just a decade ago, mobile services consisted primarily of basic voice communication. Today, we depend on mobile services not only for communication, but also for education, entertainment, healthcare, location and m-commerce. Mobile services have also made significant inroads into developing nations, by improving the quality of life for many of their citizens.

In this paper, we will discuss the many ways in which people use mobile services daily, as well as how the evolution of wireless technologies enabled the progression of those services. Moreover, we will explore how convergence in wireless technologies and devices are encouraging more mobile-data usage, and how the evolution of wireless technologies, services and devices benefits operators and consumers. It is our goal that readers will gain valuable insights into the driving forces that enable mobile services past, present and future.

[2] Mobile Services at the Center of Life

As a society, we are becoming more dependent on mobile services to assist us in life's everyday requirements. On a typical day, over 1 billion people worldwide rely on mobile-service offerings to get them through their daily routine. In the next several paragraphs, we briefly explore various mobile services that people around the world are using each and every day with growing occurrence.

Mobile Communication—Mobile services are changing the landscape of how we communicate daily; specifically, the why, when, how often, and in what degree we communicate. Today, mobile communication can be ubiquitous (anytime, anywhere, anyplace), personal (instant messaging, picture cards, video messaging) or interactive (push-to-talk [PTT], video telephony, video sharing). Using mobile communication services has never been easier or more entertaining.

Mobile Enterprise—Mobile enterprise services are at the forefront of early wireless-technology service adoption. The implementation of mobile enterprise services provides a competitive advantage to corporations wanting to gain an edge.

Mobile Entertainment—The days of waiting to get home to indulge your passion for entertainment are long gone. Like never before, mobile entertainment has given end users the flexibility and freedom to engage their favorite form of entertainment programming on their terms. Mobile TV (live or cached), videos and movies (streaming or on demand), music (full tracks), gaming (casual and 3D multiplayer), or social networking (user-generated or community-developed content) are all available at your fingertips.

Location-Based Services (LBS)—For the enterprise customer, LBS means the efficient tracking of goods and services. For a consumer, LBS enhances the level of comfort by knowing the location of a child or elderly parent. For retail shops and restaurants, LBS provides timely directions for a customer who is lost. Mobile LBS provide end users with location information when and where they need it most.

Mobile Healthcare—Mobile healthcare services are designed to enable a better quality of life 24 hours a day, seven days a week for outpatient treatment and monitoring procedures. These services allow the capture of patients' medical data at the point of care, enabling faster diagnosis and timelier treatments. Mobile healthcare services provide freedom, mobility and an enhanced sense of wellness for outpatients, and peace of mind for caregivers.

Mobile Commerce—The old adage "time is money" has never been truer than in today's fast-paced economy. Mobile-commerce services (m-banking, m-payment, e-money, etc.) provide a new level of convenience and safety for managing money transactions.

Mobile and Remote Education—Mobile education services have created new avenues of learning. Never before has the ability to receive live or cached classroom instruction or vocational training in a mobile or distance-learning environment been so accessible.

Emerging Markets—Mobile services in emerging markets are empowering citizens with social and economic choices that many never dreamed of having. People in emerging markets are adopting mobile services where, traditionally, there were no services available to them, notably services such as mobile banking, remote learning and healthcare (*e.g.*, village clinics).

The mobile services just reviewed are but a sampling of the many services currently offered worldwide. As we look into the future, the ways in which we use mobile services will continue to grow, due to our limitless imagination for improvement in the lives of our fellow man.

[3] Evolution of Wireless Technologies Enables the Progression of Mobile Services

During the past 10 years, mobile services have evolved from basic voice communication to mobile-broadband multimedia services. The mobile-broadband applications and services commercially available around the world owe their existence to the evolution of wireless-technology advancements of yesterday and today.

The technology advancements achieved through airlink-performance enhancements—higher data rates, optimized quality of service (QoS), reduced latency and increased network capacity—have led to new and enhanced service offerings for mobile operators. As seen in *Figure 1*, the evolution of wireless technologies has a symbiotic relationship with the evolution of mobile services.

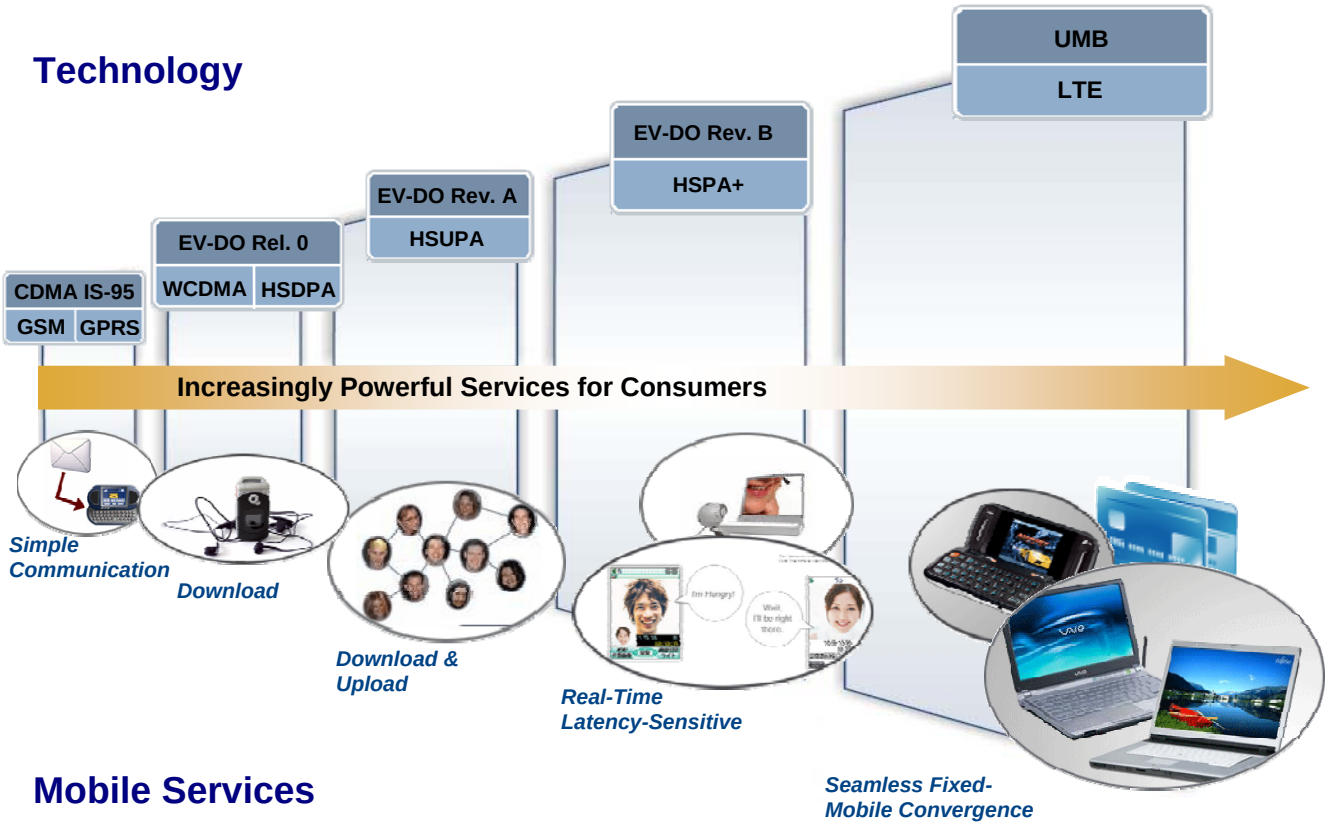

Figure 1. Evolution of Wireless Technologies Enables Progression of Mobile Services

To date, we have experienced four stages in the progression of mobile services, namely simple communication, high-speed downloading, high-speed downloading and uploading, and real-time latency-sensitive services. A fifth stage, seamless fixed-mobile convergence, is about to enter service. In this section, we will briefly review the evolution of each mobile service, in the order of progression.

The first mobile-service progression, simple communication services, was enabled by wireless-technology advancements in the CDMA IS-95 and GSM/GPRS air interfaces. Simple communication consists of basic voice and text, *e.g.*, SMS and email services. These basic services took advantage of enhanced voice and data capabilities.

The second mobile-service progression, high-speed downloading, introduced mobile broadband services to the market. High-speed downloading services were enabled by wireless-technology advancements in the EV-DO Release 0 and HSDPA air interfaces. EV-DO Rel. 0 and HSDPA brought improvements in the efficient delivery of best-effort asymmetric traffic. In particular, significant increases were realized in downlink transmission rates and expansion in sector capacity. Operators capitalized on these latest technology advancements by introducing new services centered on the downloading of multimedia content such as music on demand, video on demand, ringtones and Internet browsing. Existing mobile services like SMS and email were also enhanced, to include multimedia attachments. The enhanced end-user experience of mobile-broadband downloading services led to users demanding more wireline-like services in the mobile environment.

To this end, the third and fourth mobile-service progressions—high-speed downloading and uploading and real-time latency-sensitive services—addressed user demands for more wireline-like offerings in a mobile environment. These latest mobile services were enabled by wireless-technology advancements in the EV-DO Revision A and HSUPA air interfaces. Moreover, EV-DO Rev. A and HSUPA introduced substantial delivery efficiencies for uplink traffic transmissions, advanced QoS capabilities and improved latency reduction. In addition, they achieved higher network capacity for more simultaneous users, and higher data usage per user. These advancements enabled operators to enhance existing and create new download offerings such as multicast services, while simultaneously introducing new upload services such as multimedia messaging services (MMS) and user-generated content services (*e.g.*, social networking, media sharing).

With the introduction of real-time latency-sensitive mobile services, operators now have the capability of offering latency-sensitive and simultaneous voice and data services such as VoIP, PTT, video telephony, video sharing and live multiplayer gaming.

Today, the evolution of wireless technologies continues to improve airlink performance; however, additional emphasis is placed on seamless wireless-converged enhancements. With end-user trends shifting from wired to wireless, as evidenced by an increased demand for higher-quality mobile video, increased sharing of mobile content by mobile users, and the place-shifting of content so that it is accessible anytime, anywhere, mobile operators are seeking new services that involve a seamless converged element.

The fifth mobile-service progression, seamless fixed-mobile convergence, addresses the shifting of end-user trends from wired to wireless services. Seamless fixed-mobile convergence is designed to enable seamless, ubiquitous connectivity between mobile networks (WWANs), home networks (WLANs and femtocells), and consumer electronics (CE), by supporting multiple air interfaces over a common all-IP core network.

Seamless fixed-mobile convergence is being promoted as the right technology for the right service. For instance, end users will be able to use mobile devices to synch with home surveillance systems, watch favorite TV programs on the go, and transfer video-telephony calls from their mobile device to their home monitors seamlessly. Converged services such as these will continue to enhance the end-user experience and encourage more data usage over fixed and mobile networks.

In the next section, we will discuss how mobile devices are going through their own evolution, with convergence as the principle driving force.

[4] Device Evolution Increases Consumption of Mobile Data

The evolution of device technologies has led to reductions in cost, size and power consumption, which have enabled CE devices to increase their complexity, processing capability and usability. For example, technology innovations have led to converged mobile devices containing multimode wireless capabilities, digital cameras, MP3 players and GPS functionality. Some of these converged mobile devices are complemented by either single or dual processors running at speeds of up to 1 GHz, with external expandable memory.

Converged devices are also becoming easier to use, thanks to constant technology improvements in user interfaces (UI). End users are now more inclined to browse the Internet, view higher-quality video, and pay for enhanced communication with multimedia components, such as user-composed ringtones, ringbacks and wallpaper. Moreover, converged devices are also keeping pace with wireless-technology advancements by supporting higher bandwidths (*i.e.*, mobile broadband, richer multimedia and increased battery life), which have enabled consumers to consume more data at any time.

Furthermore, as converged devices become more integrated, many are becoming more genre-specialized, tailored specifically towards the operators' richer mobile-service offerings, such as mobile entertainment (music, gaming, mobile TV), MMS and family services (VoIP, digital and video cameras, LBS), and enterprise services (using OS options such as Microsoft Mobile, Symbian, RIM and Linux).

[5] Operators and Customers Benefit from Evolution of Wireless Technologies, Services and Devices

Through advancements in wireless technologies, operators have achieved continuous improvements and cost savings in their mobile networks via higher data speeds, QoS enhancements and increased network capacity. The ability to offer higher data rates has enabled operators to offer new premium services like mobile broadband access and video-on-demand and music-on-demand services. Moreover, the higher streaming rates and faster uplink capabilities enable operators to offer richer, more compelling mobile services, which provide higher-quality video and audio content with longer-running content sessions. These new and enhanced mobile data services are seen as a primary catalyst for increasing operators' overall revenues and ARPU worldwide.

Furthermore, operators are encouraged to adopt broadband devices and develop newer services like on- and off-deck portal services (*e.g.*, for social or gaming communities) due to enhanced capacity and improvements in latency. These same improvements also benefit operators by allowing support for more simultaneous data users.

Customers have also benefited from the technology evolution. For instance, enterprise customers reap benefits from worker productivity, efficiencies in operations and increased customer satisfaction levels. Consumer benefits include enhanced personal communication (video telephony, video sharing and MMS), increased convenience (LBS, healthcare and m-commerce) and expanded entertainment (VoD, MoD, place/time shifting of multimedia). At no other time in history has communication and access to information been so flexible and accommodating to an individual's lifestyle.

[6] Conclusion

As the evolution of wireless technologies continues to advance, the progression of mobile services will continue to evolve into ever-richer, more compelling mobile and converged services. With end users demanding more and higher-quality multimedia content in all environments, the evolution of device technologies will continue to enhance the increasing consumption of data usage.

Two key beneficiaries of the evolution of wireless technologies, services and devices are mobile operators and consumers. For mobile operators, realized benefits include improved profitability (*i.e.*, lower operating costs and increased ARPU), an increased subscriber base and enhanced customer loyalty. For consumers, benefits include enhanced personal communications, increased convenience and improved entertainment. As mobile services for communication, education, enterprise, entertainment, healthcare, location and retail proliferate, and their consumer adoption increases around the world, one may say that mobile services are indeed becoming the center of life.