

Maximizing Network Value: Capitalizing on the next wave of mobile broadband data applications

October 2007

Prepared by: CDMA Development Group





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EXECUTIVE SUMMARY

As new competitors enter the market and average revenue per user (ARPU) for voice continues to decline, mobile operators can no longer build a sustainable business purely on voice, and the revenues provided by data become more critical for them. For most tier one operators, mobile data already comprises over 6 percent of revenues and in some Asian countries, over 30 percent. Plus, many studies have shown that the more services and features subscribers use, the less likely they are to churn. Hence mobile data solutions benefit the mobile operators' businesses in terms of revenues, service differentiation and customer loyalty and are key strategic considerations for their future business strategies.

Mobile data applications and services have been available for over 15 years and have evolved over time as the demand for information, content and value-added services has grown and data-enabling enhancements, such as higher data speeds, lower latencies and greater device processor speed and memory, have been introduced to mobile networks and devices.

The availability of mobile data services has closely followed the evolution of network technologies and it has evolved in three distinct stages, from Short Message Service (SMS) enabled by 2G systems in the early 1990s to 3G-enabled multimedia services in the early 2000s, and mobile video, music download, 3D gaming and location-based services with the introduction of CDMA2000® 1xEV-DO and other mobile broadband technologies in the mid 2000s.

The wireless industry is now entering the next major transition, to all-IP next generation systems, which deliver low latencies, ultra high-speed data and advanced quality of service (QoS) and support the quadruple-play: mobile digital video, voice, broadband and broadcast. They will enable operators to compete with fixed Internet-based businesses, offer a wide range of services, including VoIP, advertising, social networking and mobile TV, and differentiate by integrating presence, location and mobility into these services.

CDMA2000 operators have benefited from a robust wireless data platform that has proven easy to evolve as market needs dictate. They have also been able to introduce new services ahead of their GSM and WCDMA competition, usually by 6 months to 1 year or more — in a competitive market, this is a significant advantage.

As this paper demonstrates, CDMA2000 operators have had tremendous success with data services and have leveraged them to drive double-digit growth in data revenues. In South Korea and Japan, they are already generating 30 percent of their revenues from data services, and in the U.S., they are generating around 20 percent. As a result of higher data revenues, CDMA2000 operators have been able to maintain their overall ARPU, while 2G GSM/GPRS/EDGE operators have seen a significant decline.

The CDMA2000 evolution path, which includes EV-DO Revision A (Rev. A), Revision B (Rev. B) and Ultra Mobile Broadband™ (UMB™) ensures that operators on this path will be able to expand their service portfolio, sustain their growth rates and maintain their time-to-market leadership in the future.

This paper examines the evolution of mobile data services and evaluates the market potential for future data services. It then describes the evolution to CDMA2000 data services by providing operator case studies. Finally, it analyzes future services that next-generation CDMA2000 will enable.



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MOBILE DATA MARKET OVERVIEW

Mobile data services have been imagined since the very early days of the wireless industry. Today, data has become a profitable business and a strong focus for most mobile operators. The importance of mobile data services is driven by a number of market and technological factors:

- **Demand:** Growth of Internet-based services and the desire of customers to have access to information while on the go. This is true of mature markets and increasingly so for developing regions.
- **Advancements in wireless technologies:** The availability of 3G CDMA wireless broadband technologies with enhanced data capabilities and greater efficiencies has enabled a broad range of data services with a low cost of delivery.
- **Decline in voice ARPU:** The average voice revenue generated by a subscriber continues to fall in every region around the world due to competition, higher usage, and the expansion of the subscriber base into lower-spending segments. Mobile operators, therefore, can no longer build a sustainable business purely on voice revenues. Although on average, data still contributes a relatively small share of an operator's revenue, especially in developing markets, it is growing and represents a significant opportunity as the mobile data industry further develops.
- **Higher profit margin associated with data revenues:** The operating margins from data services, especially content, are generally higher than for voice (which is highly commoditized) and can significantly boost an operator's profitability. The profit margin on a single ring tone, for example, can be as high as 70 percent for the mobile operator.

Assessing Market Potential

The number of mobile data users has increased five-fold in the past six years, from 96 million in 2000 to more than 641 million in 2006 (Figure 1). Up until 2003, the global growth of data users was relatively steady, but in 2004 the size of the subscriber base significantly accelerated, mainly due to the availability of new 3G CDMA broadband data services. Operators in Japan, Asia Pacific, Europe and North America aggressively introduced mobile data technologies and services in the 2002 - 2004 time frame.

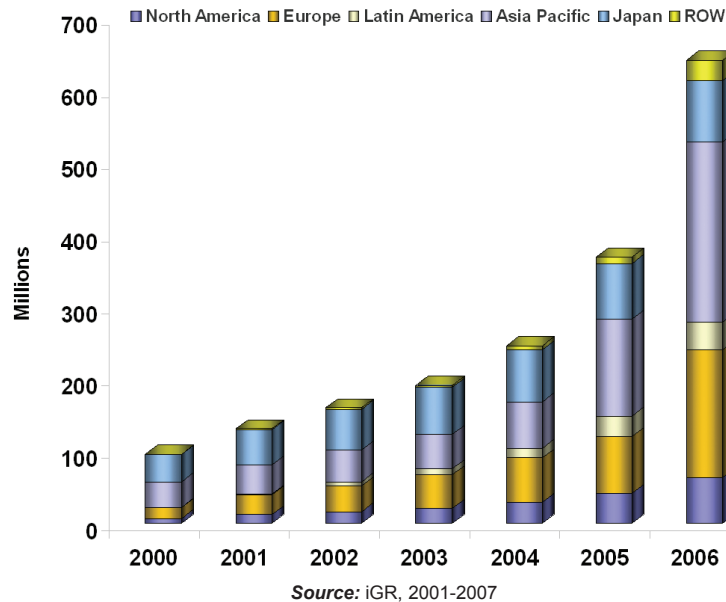


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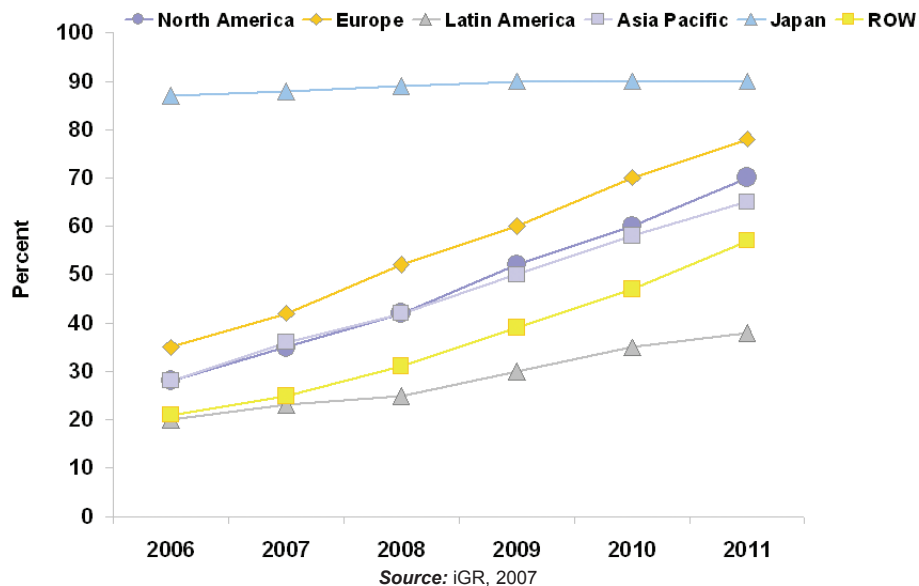
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Figure 1: Global Wireless & Mobile Data Users, 2000 - 2006 (000)



This trend is expected to continue. IGR estimates that by 2011, 2.3 billion, or 65 percent of the world's total subscriber base of 3.5 billion people, will use data services other than SMS (Figure 2). The penetration in Asia Pacific will increase 2.5 times, reaching 65 percent and in Europe and North America will more than double to reach 78 and 70 percent respectively. CALA penetration rates will grow from 20 percent in 2006 to 38 percent in 2011.

Figure 2: Global Wireless & Mobile Data Users — Market Penetration, 2006 - 2011



With accelerated deployments of EV-DO and HSPA broadband technologies, the number of mobile broadband users will grow exponentially. Analysts expect that by 2010, there will be 518 million mobile broadband users worldwide, and 94 percent of them will be using iterations of existing technologies, such as EV-DO and HSPA, which will eclipse all alternative broadband technologies for the foreseeable future (Figure 3).

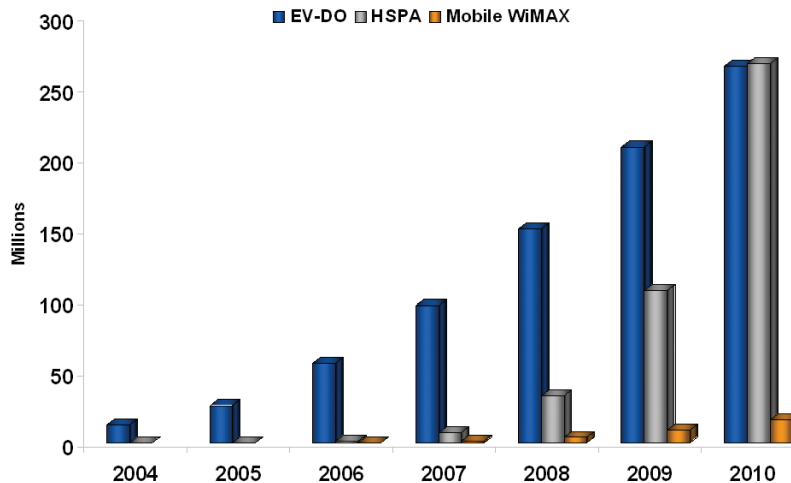


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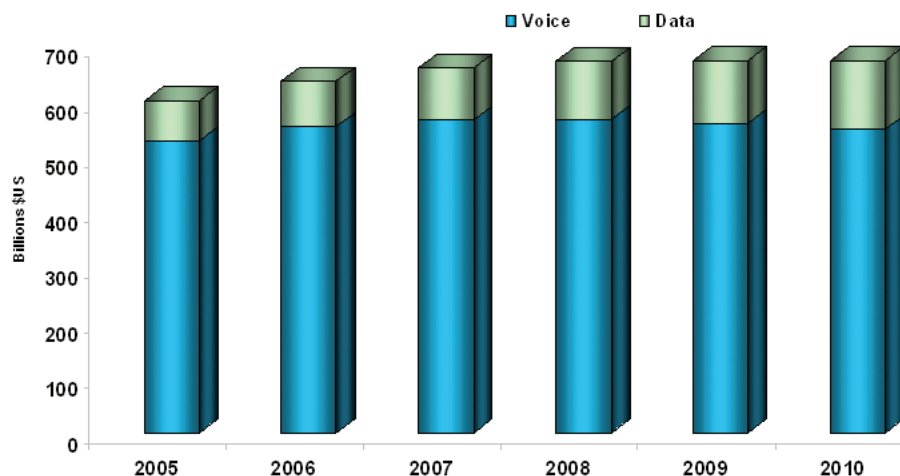
Figure 3: Mobile Broadband Subscribers



Sources: Strategy Analytics, Worldwide Cellular User Forecast, September 2006, and Mobile Broadband Subscriptions Forecast, November 2006
 Ovum, Mobile Regional Forecasts, December 2006
 Yankee Group, Global Mobile Forecast, December 2006
 In-Stat/MDR, 3G, Wi-Fi, WiMAX and others battle for wireless supremacy, February 2007
 Informa, Future Mobile Broadband: HSPA, EV-DO, WiMAX & LTE
 Yankee Group, Modest WiMAX Grows Despite Uncertainty, January 2007

The growth in data revenues will be in step with the growth of data subscribers and usage. Informa predicts that mobile data revenues globally will grow 70 percent from \$82.5 billion in 2006 to \$124.5 billion in 2010 and will contribute 18.4 percent of total operators' revenues, up from 12 percent today (Figure 4). The regional differences will persist with Asia Pacific, Europe and North America experiencing significantly higher growth in data revenues as compared to CALA, Africa and the Middle East (Figure 5).

Figure 4: Operator Revenue — Voice and Data 2005 - 2010



Source: Informa, 2006

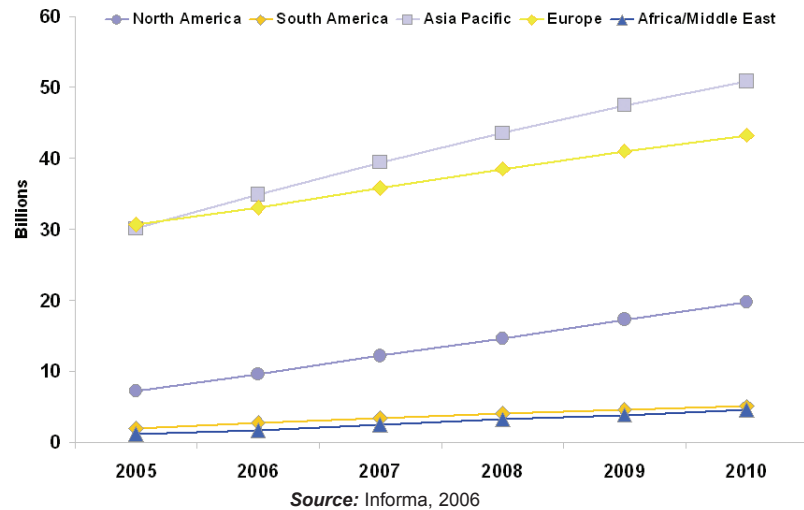


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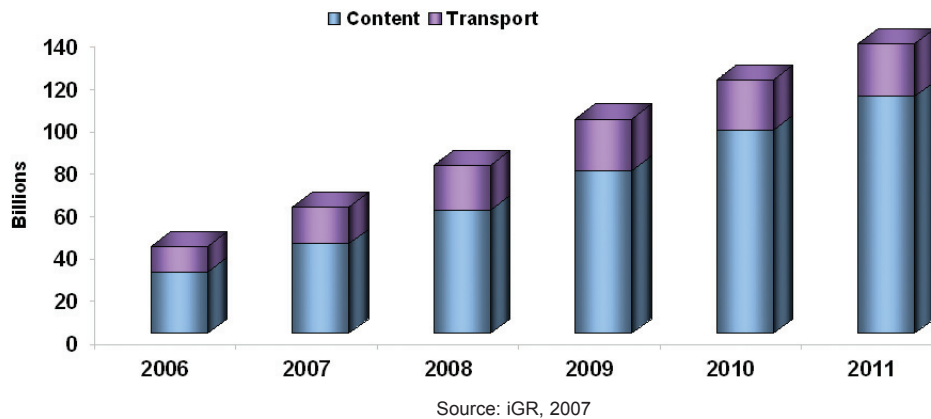
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Figure 5: Operator Data Revenue by Region 2006 - 2010



iGR forecasts mobile data revenues will grow at a compounded rate of 27 percent over the next five years. This compares to a growth of only 4 percent in voice revenues over the same period. Mobile content revenues (fees associated with the subscriber purchasing content such as ring tones and games) will grow at over 30 percent and generate \$119 billion in 2011, while data transport revenues (the charges associated with providing a mobile data connection) will account for 13 percent of the overall data revenue or \$18 billion.

Figure 6: Worldwide Wireless Data Revenue, 2006 - 2011



Taking one step further to determine which applications will drive revenues, Informa estimates that peer-to-peer messaging will remain by far the most popular and will generate 70 percent of data revenues for operators in 2010 (Figure 7). Besides messaging, the enterprise market represents the greatest revenue opportunity and it is expected to generate nearly \$9 billion, or 25 percent, of non-messaging revenues in 2010, compared to \$2.5 billion and 11 percent in 2006. In the consumer segment, revenues from advanced mobile broadband services, such as video and gaming, will grow the fastest and each will contribute 13 percent of non-messaging revenues in 2010, while revenues from 2.5G-type services, such as browsing and images, will decline.

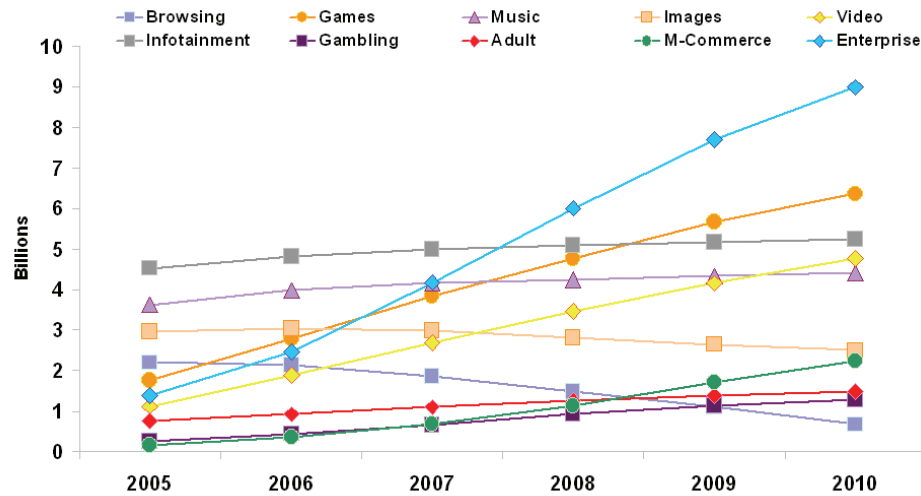


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Figure 7: Operator Revenues by Main Data Non-Messaging Service Sector



Source: Informa, 2006

MOBILE DATA SERVICE EVOLUTION: FROM SMS TO MOBILE TV

Mobile Data Network Evolution

Applications and services require certain network parameters to support them and provide the necessary consumer experience; thus, mobile data service evolution follows closely the evolution of network technologies. The requirements for mobile data applications can generally be described by three key criteria:

- **Data speeds:** The bandwidth available for uploading and downloading content determines what applications can be offered and the quality of the user experience. While web browsing and other applications are possible with GPRS and EDGE networks, the download times are long and quality is poor. With 3G EV-DO/HSPA broadband networks, subscribers can use a wide range of applications and services, just as they would on a LAN or cable modem connection at home.
- **Latency:** This is the 'delay' in a packet network for the data to be transmitted. While the bandwidth can be high, meaning the data is sent quickly over the air interface, high latency means that the data is delayed since the request for data by the mobile device must be submitted and received from a distant IP node in the network. While this is not usually a problem for downloading e-mail, data files or applications (including games and music), the non-linear effect of high latency networks means that real-time applications such as video and voice-based applications can appear fragmented, garbled and disjointed (e.g., lip synch). Generally, the lower the network latency, the higher the quality of voice and video.
- **Device processor speed and memory:** Once the data or content is sent over the network to the device, it must be stored and processed. Modern 3G devices have the equivalent processing power and memory capabilities of a desktop PC and incorporate camera and video capabilities to support applications such as video encoding, 3D imaging and video conferencing.

Table 1 shows the evolution of network capabilities, data rates and latencies of wireless technologies, while Figure 8 maps the minimum data speeds and latencies required for key consumer and enterprise applications.



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Table 1: Comparative Performance Values of Leading Mobile Access Technologies

Access Technology*	User Peak Data Rate Full Mobility (DL) (kbps/Mbps)	User Peak Data Rate Full Mobility (UL) (kbps/Mbps)	Aggregate Data User Throughput - Full Mobility (DL) (kbps)	Aggregate Data User Throughput - Full Mobility (UL) (kbps)	Average Latency (msec)	Multicasting Support	Commercial Deployment
GPRS	80 kbps (4 t-slots, CS4)	80 kbps (4 t-slots, CS4)	280 (5 MHz, FDD)	280 (5 MHz, FDD)	700	No	June 2000
EDGE	236.8 kbps (4 t-slots, MCS 9)	236.8 kbps (4 t-slots, MCS 9)	620 (5 MHz, FDD)	620 (5 MHz, FDD)	500	No	June 2003
CDMA2000 1X	153.6 kbps (1.25 MHz, FDD)	153.6 kbps (1.25 MHz, FDD)	900 (5 MHz, FDD)	900 (5 MHz, FDD)	250	No	October 2000
CDMA2000 1xEV-DO Rel 0	2.40 Mbps (1.25 MHz, FDD)	153.6 kbps (1.25 MHz, FDD)	3,150 (5 MHz, FDD)	900 (5 MHz, FDD)	110	Yes	January 2002
CDMA2000 1xEV-DO Rev A	3.10 Mbps (1.25 MHz, FDD)	1.80 Mbps (1.25 MHz, FDD)	3,840 (5 MHz, FDD)	1,500 (5 MHz, FDD)	50	Yes	October 2006
CDMA2000 EV-DO Rev B Software Upgrade	9.30 Mbps (5 MHz, FDD)	5.40 Mbps (5 MHz, FDD)	3,840 (5 MHz, FDD)	1,500 (5 MHz, FDD)	35	Yes	Early 2008
CDMA2000 EV-DO Rev B Hardware Upgrade	14.70 Mbps (5 MHz, FDD)	5.4 Mbps (5 MHz, FDD)	4,200 (5 MHz, FDD)	2,430 (5 MHz, FDD)			
UMB MIMO 2x2	33.00 Mbps (5 MHz, FDD)	17.00 Mbps (5 MHz, FDD)	5,810 (5 MHz, FDD)	3,600 (5 MHz, FDD)	16	Yes	Mid-2009
WCDMA Rel 99	384 kbps (5 MHz, FDD)	384 kbps (5 MHz, FDD)	550 (5 MHz, FDD)	550 (5 MHz, FDD)	300	No	December 2001
HSDPA Rel 5	7.20 Mbps (5 MHz, FDD)	384 kbps (5 MHz, FDD)	2,200 (5 MHz, FDD)	550 (5 MHz, FDD)	110	No	December 2005
HSUPA Rel 6	10.80 Mbps (5 MHz, FDD)	5.76Mbps (5 MHz, FDD)	3,300 (5 MHz, FDD)	1,200 (5 MHz, FDD)	50	Yes	Mid-2007
HSPA + Phase 1 Rel 7	21.60 Mbps (5 MHz, FDD)	11.52 Mbps (5 MHz, FDD)	4,200 (5 MHz, FDD)	1,450 (5 MHz, FDD)	50	Yes	Mid-2009
3G LTE MIMO 2x2	35.85 Mbps (5 MHz, FDD)	14.03 Mbps (5 MHz, FDD)	5,550 (5 MHz, FDD)	3,520 (5 MHz, FDD)	44	Yes	Mid-2010

***Notes:**

FDD: Frequency Division Duplexing, 2 x 5 MHz
TDD: Time Division Duplexing, 1 x 10 MHz
2x2: 2 Receive x 2 Transmit antennas
MIMO: Multiple Input Multiple Output
1/3: Frequency Re-use factor of 1/3 for Mobile WiMAX networks
Rev. B Software Upgrade: Software upgrade to existing EV-DO Rev A channel cards
Rev. B Hardware Upgrade: New Rev. B channel card

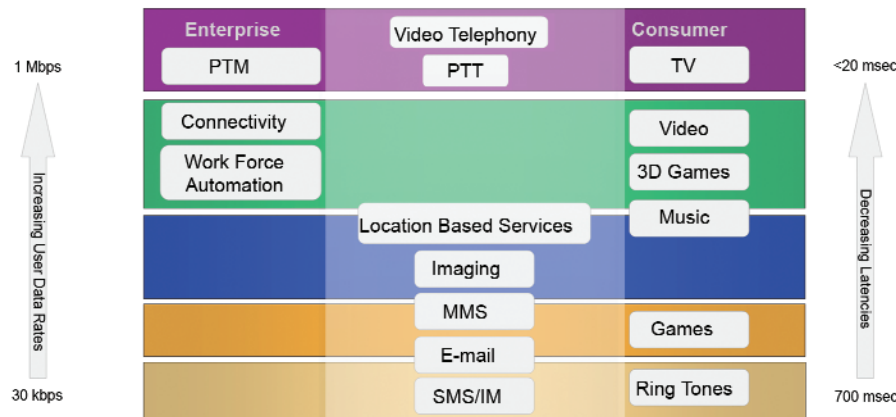


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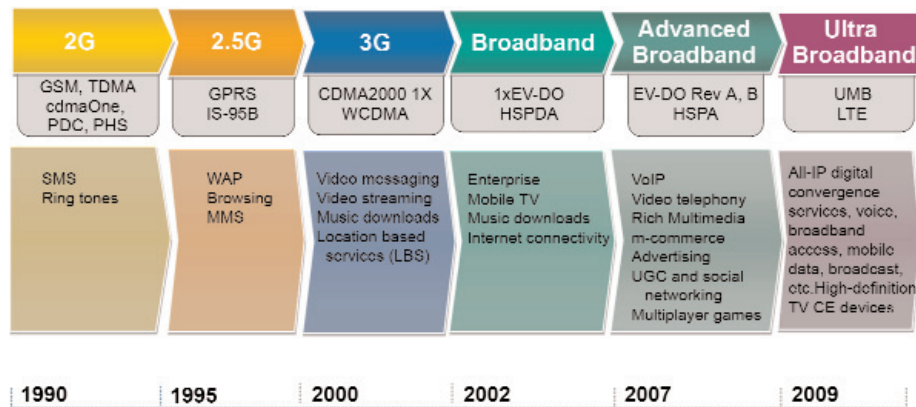
Figure 8: Consumer and Enterprise Applications



Source: IGR, 2007

Mobile Service Evolution

Mobile data services have evolved in distinct stages enabled by the introduction of enhanced network data capabilities.



Source: CDG, 2007

The first instance was the widespread availability of 2G and the commercial growth of Short Message Service (SMS). Using the digital control channel in TDMA, GSM and CDMA systems, SMS supports the transmission of messages up to 160 characters in length. While extremely popular in all major markets around the world, SMS is not usually considered to be a 'true' mobile data service, although it is categorized by many as data and included in their data revenue numbers today.

The second stage of mobile data development was with the deployment of the 2.5G packet-switched networks (GPRS, IS-95B). These networks support higher data speeds (up to 64 kbps, but usually averaging around 40 kbps) and enable basic Web access and simple multimedia messaging (MMS).

The next stage of the mobile data evolution came with the introduction of 3G CDMA systems and their high-speed data capability. The world's first 3G system was commercially launched by SK Telecom (South Korea) in October 2000 using CDMA2000 1X. WCDMA was deployed a year later in Japan. 3G networks enabled a new range of services including video messaging, video streaming, music download and a richer Web browsing experience.



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Two years after the first 3G networks were launched, the industry entered into the wireless broadband services phase with the first EV-DO broadband systems deployed in 2002. Three years later, in 2005, HSDPA was introduced in the U.S. by Cingular (now known as AT&T).

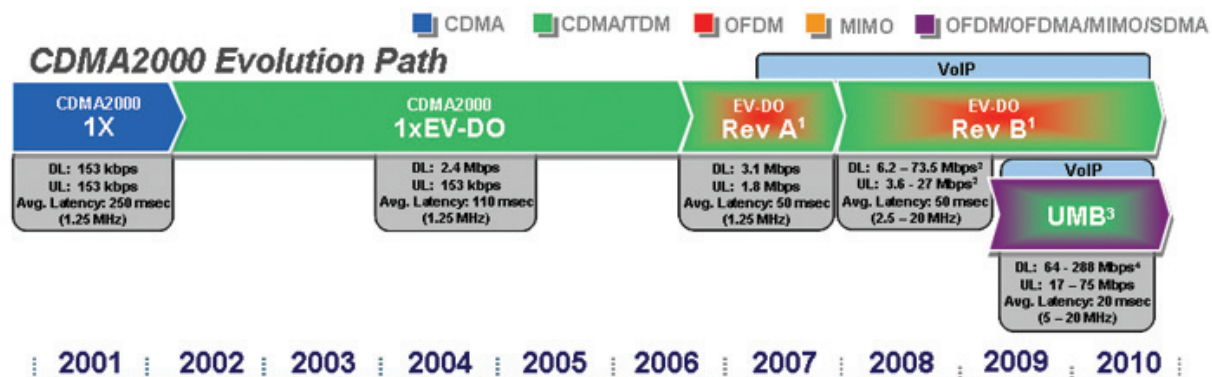
Mobile wireless broadband technologies, such as EV-DO, have taken wireless data to the next level, enabling robust data services and improving their ease-of-use and overall customer experience. Mobile operators are now able to target the highly profitable enterprise market with high-speed data connectivity and have introduced new services such as sending and receiving e-mail with large attachments, video conferencing and sales force automation tools. The consumer has also benefited from the availability of HSDPA and EV-DO handsets supporting mobile TV, music download, 3D gaming, other entertainment services and location-based services. In many countries, wireless broadband technologies are being deployed as a more economical DSL substitute (for example, Telefónica 02 in Czech Republic, Telefónica in Guatemala, and ZAPP Mobile in Romania are using EV-DO to provide high-speed broadband connectivity).

Next-generation mobile technologies, EV-DO Rev. A, Rev. B and UMB, HSPA and LTE, are IP-based and will enable operators to compete with wireline, cable and Internet service provider (ISP) businesses by offering a wide range of value-added services, including voice over IP (VoIP), advertising, social networking, e-commerce, radio and television, and differentiate them by integrating presence, location and mobility. In addition, these technologies will provide:

- **Enhanced user experience:** Improved performance, enhanced Quality of Service (QoS), and service flexibility. QoS includes the ability to prioritize applications and customers, provide low and consistent latencies, support fast connection times, and provide seamless mobility for delay sensitive applications.
- **Pricing flexibility:** Mobile operators will be able to offer new pricing schemes based on a wide range of factors including location, time of day, prior purchases, usage, and the user's relationship to other communities and portals. Pricing may also be varied by peak and average data rates (users will pay more for higher bandwidth) and by service priority.

CDMA2000 EXPERIENCE: CAPITALIZING ON MOBILE DATA TO CREATE VALUE

CDMA operators have benefited from a robust wireless data platform that has proven easy to evolve to meet the demands of the market. From 2G IS-95A systems introduced in 1995, CDMA technologies have evolved to a family of 3G CDMA2000 standards, which include CDMA2000 1X, EV-DO Rel. 0 and Rev. A (commercially deployed today) and Rev. B and UMB solutions (which will be available in early 2008 and 2009, respectively).



Source: CDG, 2007



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From Day One, CDMA was designed with data in mind to allow operators to deliver a robust selection of data services. The CDMA evolution path, built on the principle of backward and forward compatibility, has enabled operators to introduce new services ahead of their GSM and WCDMA competitors — usually by 6 months to 1 year or more. In a competitive market, this is a significant advantage. Also, a wide range of devices has become available very quickly following the introduction of a new CDMA2000 network technology. In fact, in the case of Rev. A, devices were introduced prior to the launch of the first commercial network.

Being first-to-market with 3G and broadband data services allowed CDMA2000 operators to gain a significant competitive advantage and generate substantial data revenues, as witnessed in Korea, Japan and the United States. On a global basis, CDMA2000 operators support a greater percentage of data users than their GSM counterparts (Figure 9). With 75 million EV-DO users worldwide at the end of the 2nd quarter of 2007, CDMA2000 operators dominate the wireless broadband market. Most CDMA2000 operators have witnessed double-digit growth in wireless data revenues, between 35 to 70 percent on an annual basis, which has allowed them to sustain their total ARPU, while GSM operators have seen a significant decline in ARPU (Figure 10). For most leading CDMA2000 operators, the percentage of mobile data (including SMS) revenue is now approaching 20 percent of total average monthly revenue, and in some advanced markets, such as Japan and South Korea, this figure has surpassed 30 percent.

Several case studies are included in this section to show how CDMA2000 has enabled operators to develop their wireless data businesses. As these mobile operators will readily confess, developing a successful mobile data business is not simple, requiring the right combination of network technology, application development capabilities, devices and marketing. But CDMA2000 is included in every mobile data success story.

Table 2: Advanced Services and Applications for Selected Carriers

Sample Advanced Services	KDDI - Japan	SKT - Korea	VZW - U.S.	Sprint - U.S.
Media Clip Downloads	Yes	Yes	Yes	Yes
Video on Demand (Streaming)	Yes	Yes	—	Yes
Social Networking - Video/Media Exchange	Yes	Yes	Yes	Via Helio
Mobile TV	Yes	Yes	Yes	Yes
Live Video Feeds (traffic, home, etc.)	Yes	Yes	—	—
Video Messaging	Yes	Yes	Yes	Yes
Video Dating	Yes	—	—	—
Music Downloads (incl. full track, concerts)	Advanced	Yes	Yes	Yes
Music Streaming/Radio	Yes	Yes	Yes	Yes
Gaming (Single, Multi-user)	Yes	Yes	Yes	Yes
Handset Internet access	Yes	Yes	Yes	Yes
Notebook Internet access	Yes	Yes	Yes	Yes
PDA Internet access	Yes	Yes	Yes	Yes
GPS + LBS + Nav Services	Advanced	Advanced	Advanced	Advanced
M-Commerce (reservations, ticketing, payment)	Advanced	Advanced	—	—
M-coupons/Car code scanning	Advanced	Yes	—	—
Alerts (available content, news, weather, finan.)	Yes	Yes	Yes	Yes
Flat Fee Data Plan(s)	Yes	Yes	Yes	Yes

Source: CDG, 2007

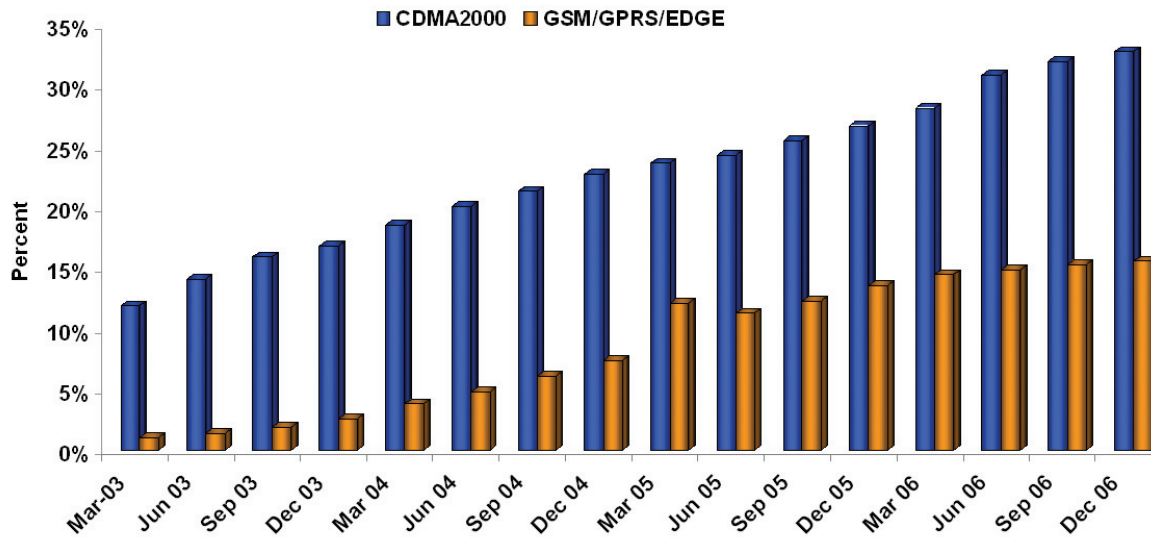


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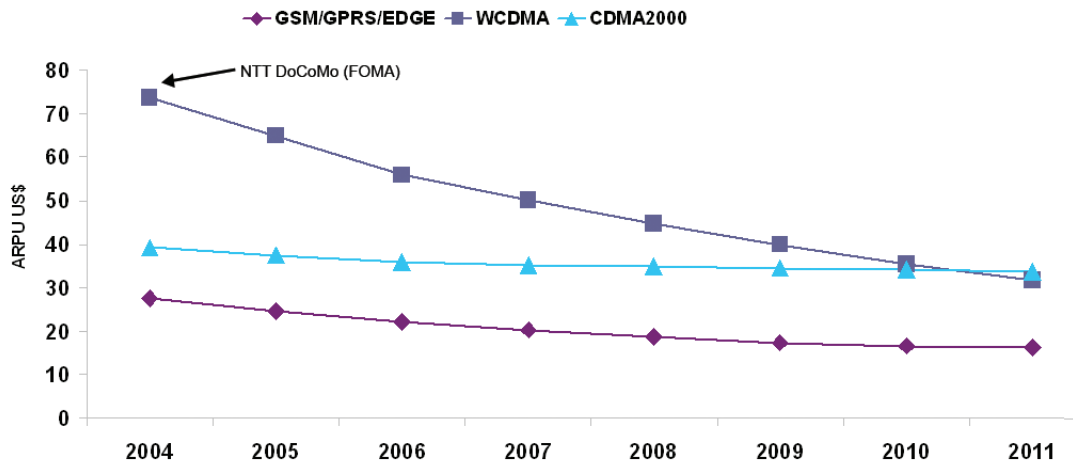
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Figure 9: Percent of Data Subscribers by technology



Source: EMC, March 2007

Figure 10: Global Average Revenue Per User (ARPU) for Leading Wireless Technologies



Source: Strategy Analytics, September 2006

SK Telecom

The story of CDMA2000 begins with SK Telecom (SKT) in South Korea, which launched 1X in September 2000. It was the first 3G network deployed in the world. CDMA2000 1X allowed SKT to establish a basis for offering high-speed data services and to introduce a diverse range of multimedia content. Under the **NATE** brand, the operator launched services such as MMS, short broadcasting, multimedia clips and e-commerce applications. In June 2001, SKT launched the world's first commercial multimedia service offering video on demand (VOD) and audio on demand (AOD) content to mobile handsets.

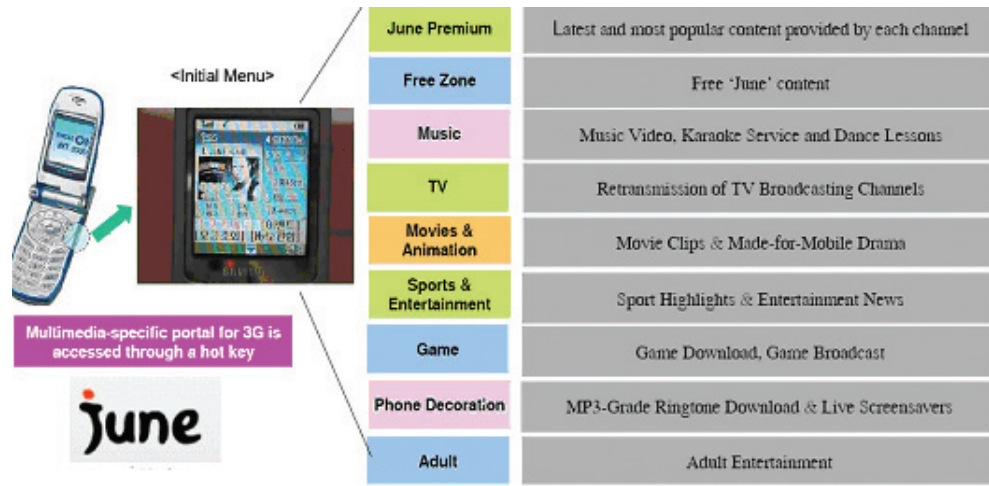


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Two years after launching 1X, SKT introduced a commercial EV-DO network in November 2002 to deliver mobile broadband data services for the very first time. The new EV-DO-based services — branded **June** — offered new entertainment services, such as TV broadcasts, movie clips, music videos, newscasts, sports news, music downloads, polyphonic ringtones, karaoke, and games.



Source: SK Telecom, 2007

In June 2003, SKT implemented a video telephony service allowing people to talk while viewing each other on their mobile handsets. The video phone service includes value-added services such as "video message box" and "email transmission of video messages," enabling the storage and notification of videos sent to users.

SKT has been very innovative in the development of mobile data services and applications. For example, the **Digital Home** service, which was introduced in June 2005, allows subscribers to control their home appliances and consumer electronic devices from their handsets.

EV-DO services have become increasingly popular. In the first 18 months after the commercial deployment, SKT reached 1 million subscribers in March 2004 and at the end of June 2007, it had nearly 11.8 million subscribers, representing 55 percent of its total subscriber base (Figure 11).

In 2006, SKT saw an 11% year-on-year increase in wireless Internet sales to KRW 2.7 trillion (US\$2.9 billion)¹. Advanced services such as music, games, community services and video account for around 53.2 percent of their total data revenues. In the 2nd quarter of 2007, data accounted for 24.8 percent of the operator's total cellular revenue.

¹Informa, 2007

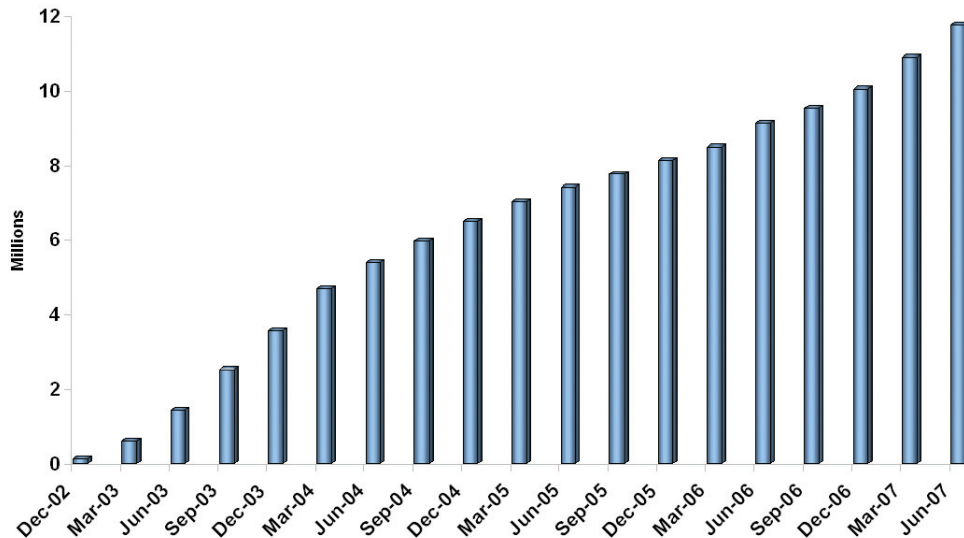


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Figure 11: SK Telecom EV-DO Subscribers, 2002 - 2007



Source: SK Telecom, July 2007

KDDI

In Japan, KDDI took a slightly different approach from that of SKT to the introduction of 3G in South Korea. To "educate" its subscribers, KDDI launched "Next-Generation" Services such as location-based services (**EZnavigation**) and short movie-clip downloads (**EZmovie**) on its cdmaOne™ network in December 2001, four months ahead of its CDMA2000 1X launch.

When 1X was introduced in April 2002, additional services were also announced, such as movie mail, allowing subscribers to attach a 15 - 20 second video to an email message. After the first month of service, KDDI acquired just over a third of a million 1X subscribers — by the end of 2002, this figure had risen to more than 4.6 million users (out of a total subscriber base of 12.4 million).

KDDI attributes some of its early success with 3G to the popularity of the "**Chaku-Uta**" music download service which allowed 1X subscribers to download CD-quality short music clips (up to 30 seconds) to use as ring tones.

KDDI launched EV-DO broadband data services ahead of its competition in November 2003, under the brand name **CDMA 1X WIN**. The operator broke uncharted ground when they introduced **EZ Flat**, a flat rate data tariff plan offering users unlimited **EZweb** access for a fixed monthly charge of 4,200 yen (US\$34.70).

New WIN services included **EZChannel** (a service that automatically distributes various genres of programming) and **Live Camera** (to deliver requested video content in real-time). The operator also enhanced the popular "**Chaku-uta**" service offering full track music downloads, and added automated song search and instant purchase services.



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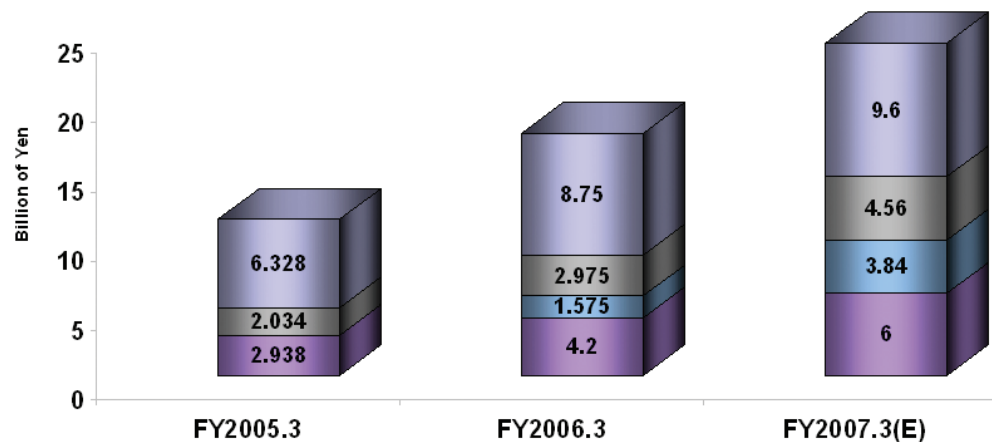
KDDI also offers other innovative services over its EV-DO network; for example:

- **EZ au Auctions** which allows subscribers to post and bid on auctions from their handsets.
- **EZ Felica** which is a mobile commerce service that enables subscribers to make e-payments, pick-up tickets, board airlines, unlock their homes, and even sign-in at karaoke bars via their handsets. *EZ Felica* handsets can download and store prepaid money, view account balances and usage history, confirm the subscriber's identification or membership, purchase products at a point of sale, complete electronic ticketing, and collect online credit.
- **G-Book mX Pro** which is a telematics service KDDI offers with Toyota Motor, to provide car navigation, traffic news, car tracking, emergency notification, and automatic notification of air-bag activation in case of an accident.

Advanced 3G services, such as these, have been driving KDDI's revenue growth. Revenue from content continues to grow 1.5 times per annum. Much of that growth is driven by rich content, advertising and e-commerce.

Figure 12: KDDI Content and Media Sales

■ Collaborative content ■ EC ■ Advertising ■ Content-fee collection



Source: KDDI, July 2007

The strong portfolio of broadband data services enabled by EV-DO has generated significant revenues for KDDI and has put it in the lead in the highly competitive mobile market in Japan:

- The number of EV-DO **au WIN** subscribers continues to increase, totaling 15.6 million at the end of 2nd quarter 2007, representing 56 percent of the total base,
- KDDI offers access to 6,355 different web sites and services, including 313 *EZ Movie* and 111 *EZ Navi* sites and 872 Java and BREW based applications.
- Close to 24 million, or 85 percent, of KDDI's subscribers use mobile data (*EZweb*) services.
- KDDI's average data ARPU was over US\$17.5 for the 2nd quarter 2007, accounting for 33 percent of its overall ARPU. For an average **au WIN** subscriber, data accounts for 40 percent of the monthly bill.



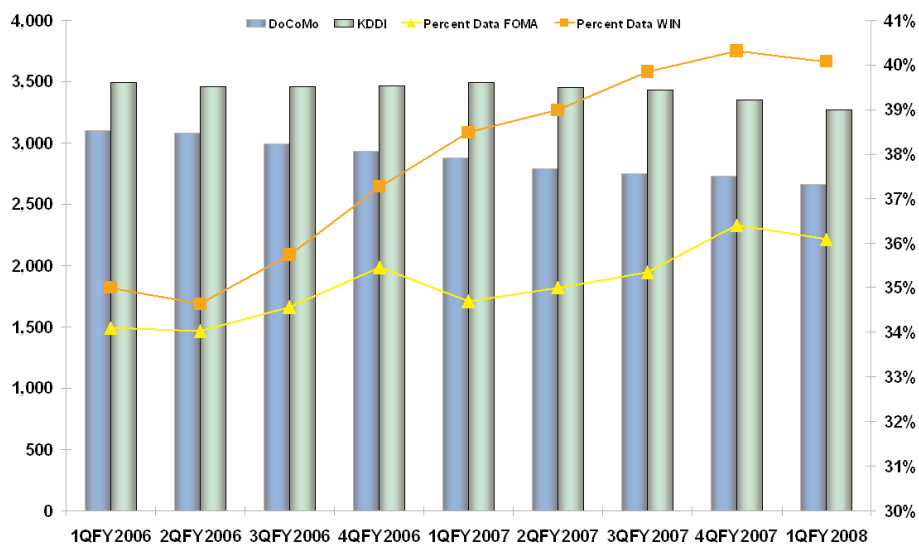
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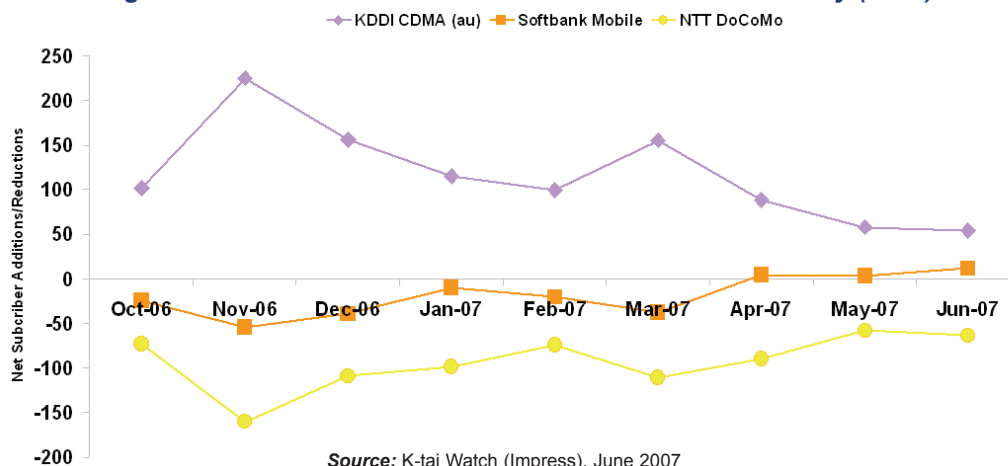
- KDDI also has higher total and data ARPU than its main competitor, NTT DoCoMo (see Figure 13).
- Partly due to the popularity of its mobile data services, KDDI's churn rate continues to decline and reached 0.97 percent in the 2nd quarter of 2007, down from 1.09 percent a year earlier.
- Since Mobile Number Portability (MNP) went into effect in Japan in October 2006, up to 1 million people had switched to KDDI as of June 2007 (Figure 14)
- As of February 2007, more than 100 million *Chaku-Uta Full* songs (1.5 MB - 2.0 MB files) have been downloaded. The *Chaku-Uta Full* service has placed KDDI as the leader in the \$12.2 billion on-line music distribution, in Japan.

Figure 13: DoCoMo and KDDI Data ARPU, FY2006 -- FY2007



Source: DoCoMo and KDDI, July 2007

Figure 14: Net Additions Due to Mobile Number Portability (MNP)



Source: K-tai Watch (Impress), June 2007

Note: Numbers are rounded and do not match exactly



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United States

CDMA2000 was the first 3G system deployed in the United States in January 2002 by Verizon Wireless, and in just over 5 years it has become the dominant wireless technology in the market with a cumulative subscriber base of over 116 million users representing 47 percent of the market share at the end of 2nd quarter 2007. There are 30 CDMA2000 operators in the country, 5 of which have launched EV-DO. Sprint and Verizon Wireless launched Rev. A advanced broadband data services in late 2006 and early 2007, respectively. Both are industry leaders in providing value-added data services and they generate higher total revenues and data revenues than their GSM/EDGE/WCDMA competitors.

Sprint

Sprint launched 1X services in late 2001, initially offering PC cards and smartphones for businesses and a limited selection of consumer handsets. The 3G CDMA2000 coverage matched that of their 2G cdmaOne™ network and some of the new applications included: **Picture Mail**, **Premium Content** (i.e., ringtones, games, screen savers), **Business Connection**SM for enterprises, **Enhanced Messaging**, **ReadyLink**[®] (push-to-talk services) and **Sprint TV**SM.

Sprint introduced EV-DO services in the summer of 2005. Initially, the operator targeted business users with its PC cards and PDAs and **Sprint Mobile Broadband** service offering unlimited data plans. EV-DO handsets were launched in November 2005 together with the **Sprint Music Store** which allows subscribers to download full-length songs over-the-air into their handset. Initially, each song cost US\$2.50; today, the **Sprint Music Store** offers songs at \$0.99 with a Power VisionSM data plan.

In 2007, Sprint introduced several hybrid CDMA/iDEN devices branded **PowerSource** phones. Additionally, Sprint offers a variety of mobile broadband devices, including PC cards, Express Cards, USB devices, mobile broadband routers and laptops with built-in mobile broadband capability.

Sprint has delivered industry firsts with its **Sprint Music Store**, location-based services, mobile imaging, and Emmy Award winning **Sprint TV**. Currently, Sprint's multimedia services are marketed under the **Power Vision** brand, and include a full range of service categories:

- **Sprint Music:** offers a full array of music content, with song downloads (available over-the-air and via side-loading), streaming music and video, exclusive content, ringtones, ringbacks and a music manager.
- **Sprint TV:** allows subscribers to watch live TV with full motion video and sound. Sprint became the first provider in the U.S. to launch mobile TV (MobiTV) in 2003. In spring 2007, Sprint was the first carrier to deliver on demand, full-length episodes of hit series from ABC entertainment. Programming includes 60 TV channels with news, sports, weather, movie trailers, and entertainment from major brands such as CNN, ESPN, FOX Sports, Weather Channel, ABC News Now, MTV and Comedy Central. Sprint offers original programming with **Sprint Power View**, the first made-for-mobile programming network with exclusive music, entertainment and sports shows.
- **Location-based services:** include turn-by-turn directions, point-of-interest and specialty solutions. **Sprint Navigation** powered by TeleNav provides the power of a full-featured GPS device on select Sprint phones, and **Sprint Family Locator** enables a parent to use a phone or PC to identify the location of a child on a map along with the address, surrounding landmarks, and accuracy of information within a specified radius. Sprint was the first U.S. wireless carrier to offer a consumer-focused location-based services application in 2003 and first to offer a GPS-enabled phone to support E911 services in 2001.



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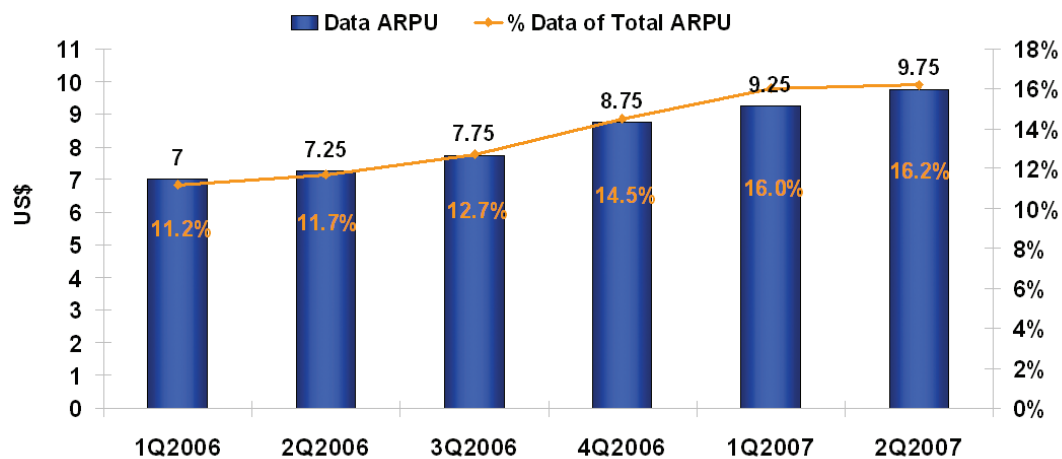
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- **Games:** Sprint offers a library of over 200 standalone and multi-player games, with some network-based game categories such as action and adventure, card and board, strategy, retro and arcade.
- **Power Imaging:** Sprint was the first U.S. carrier to offer a picture sharing service with *Sprint Picture Mail* in 2002 and first to offer a video sharing service with *Sprint Video Mail* in 2004. *Sprint Picture Mail* and *Video Mail* offer ways to capture, share, store, edit and print digital pictures using a *Sprint Power Vision* phone.
- **Power Communications:** Sprint offers ways to communicate without saying a word with text messaging; voice SMS messaging; Instant Messaging from providers such as AOL, MSN and Yahoo!; mobile chat applications from Webdate Mobile, AirG and more; ***Sprint Mobile Email***, with one-stop access to multiple email accounts from AOL, MSN, Gmail and others, mobile greeting cards and fun messaging; and mobile access to social networking communities such as Facebook, Xanga, LiveJournal and more.
- **Power Personalization:** Sprint customers can personalize their *Sprint Power Vision* phone with ringers, *Call Tones* (ringback tones), screen savers, themes that provide a customized user interface and On-Demand, a service that offers updated news, weather, alerts and other information tailored to the users' selections.

Sprint was the first U.S. carrier to formalize and commercially launch a mobile advertising initiative in October 2006. The ***Sprint Mobile Media Network (SMMN)*** enables advertisers to reach millions of Sprint wireless data subscribers with carefully targeted mobile advertising programs and opportunities for contextual, demographic and behavioral targeting.

Sprint's data business has grown considerably as a result of its focus on EV-DO coverage and offering high-value data applications and services. In the 2nd quarter 2007, Sprint reported total data service revenues increased 40 percent compared to the year-ago period and 4 percent sequentially. Data contributed approximately \$9.75, or 16 percent, of overall post-paid ARPU in the quarter. Data ARPU on the CDMA platform of approximately \$12.75 continued to lead the rest of the wireless industry by a substantial margin.

Figure 15: Sprint Nextel Data Statistics



Source: Sprint, August 2007

Verizon Wireless

Verizon Wireless introduced 1X services in January 2002. Consumer applications were branded under the ***Get It Now***® banner and included downloadable ringtones, games and graphics.



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Verizon Wireless began a national expansion of its EV-DO wireless broadband network in early 2004, and focused initially on business users with laptop PC cards and **BroadbandAccess** service. As demand for wireless broadband services grew, Verizon Wireless offered a flat rate for unlimited data and, in late 2005, introduced embedded EV-DO wireless modems in PC laptops and notebooks by HP, Dell and Lenovo. This strategy has been very successful for Verizon Wireless and today, 1/3 of the company's data revenue comes from business applications.

EV-DO handsets targeted at the consumer were introduced in February 2005, with the launch of **V CAST**[®], providing subscribers with video clips and entertainment content. Today, **V CAST** offers a full range of multimedia services, including short video downloads, browsing for news and information, music downloads, gaming, Mobile TV, Mobile Web and e-mail. For a flat \$15 per month (in addition to a voice plan), the user has unlimited access to daily updated short videos from news, sports, entertainment, weather and unlimited browsing for news and information from popular channels. A \$3- per- day fee also is available.

- **V CAST Music**, introduced in early 2006, enables customers to purchase full track music from a library of more than 2 million songs. In May 2007, Verizon Wireless launched **V CAST Song ID**, an exclusive service that lets customers identify music playing on the radio or from any music source, then purchase and download the corresponding ringtone, ringback tone and full-track song from **V CAST Music**. Verizon Wireless also entered into an exclusive distribution agreement with Prince to offer his latest single through **V CAST Song ID** for free before general release to the public.
- In March 2007, Verizon Wireless launched **V CAST Mobile TV**, using MediaFLO USA. The initial launch covers many major U.S. markets and includes programming from top-tier entertainment brands, including CBS, Comedy Central, Fox, MTV, NBC News, NBC Entertainment and Nickelodeon. With 24-30 frames per second, **V CAST Mobile TV** significantly improves the quality of video and user experience as compared with previously available video services.
- Verizon Wireless also has a robust location-based navigation service, called **VZ Navigator**, which allows consumers to get turn-by-turn driving directions, and locations of restaurants, hotels and local attractions. Other location-based services include:
 - **Field Force Manager**, a management tool that provides businesses with the ability to locate, monitor and communicate with their mobile field workers.
 - **Chaperone**SM service, which allows parents to check the location of a child's handset and track its movements.
 - **Bones in Motion (BiM)**, which enables athletes to record time, distance, speed, location and calories burned while exercising.

While it is always difficult to attribute increased revenues to a single network upgrade or change in technology, Figure 16 shows the growth in Verizon Wireless' data revenues over the past four years. During this time, data revenues have grown significantly as Verizon Wireless deployed 1X, and later built the nation's first wireless broadband network using EV-DO technology.

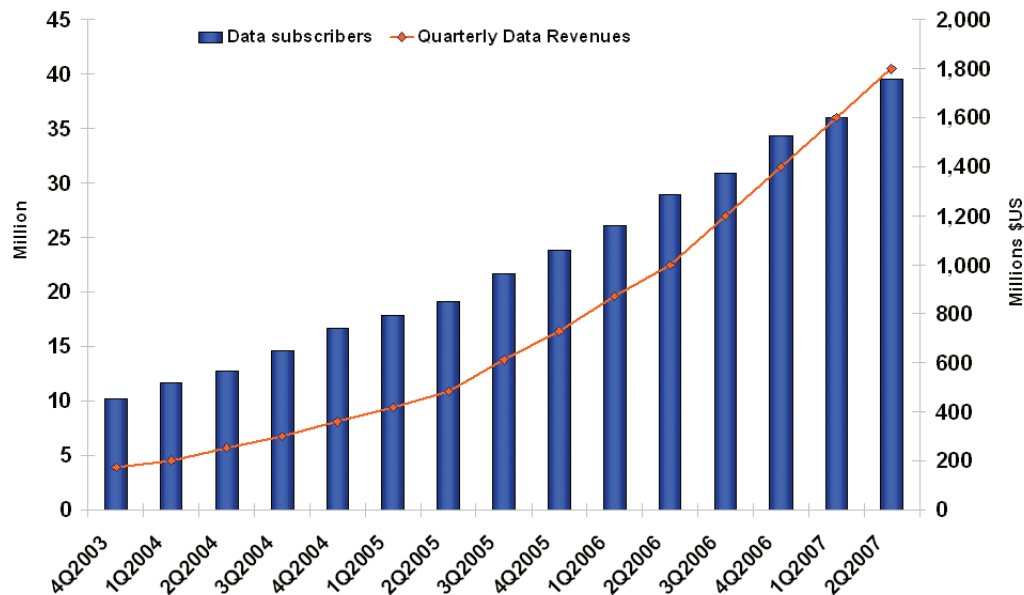


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Figure 16: Verizon Wireless Data Statistics



Source: Verizon Wireless, July 2007

Verizon Wireless has been a very successful operator, by any measure, and offering mobile data services has contributed to its success:

- Generated \$4.5 billion in data revenue in 2006, double its 2005 data revenue. For second quarter 2007, data revenues were \$1.8 billion, up 70 percent from the same period in 2006.
- Nearly 19 percent of total wireless service revenues came from data services in second quarter 2007, up from nearly 13 percent in second quarter 2006.
- Retail data service ARPU reached \$9.84, up 48 percent year-over-year.
- During the second quarter 2007, Verizon Wireless customers sent or received 575 million picture/video messages and completed nearly 25 million music and video downloads.

THE NEXT WAVE: NEXT-GENERATION CDMA2000 SERVICES

As the world of fixed and mobile telecommunications rapidly migrates towards converged services through the delivery of services over IP-based networks, mobile operators are redefining their business models and looking for ways to improve and differentiate their services. The CDMA2000 evolution path enables operators to capitalize on this next wave and to stay ahead of their competition. The next-generation of IP-based CDMA2000 standards, Rev. A, multi-carrier Rev. B and UMB, support significantly higher speeds, provide more flexibility, support enhanced QoS and lower the cost of delivering the next generation Internet-based services.

EV-DO Rev. A, Rev. B and UMB will allow mobile operators to offer a full range of new applications and services and the quadruple-play — telephone, Internet access, television, and broadband data services over an IP-based network. These services are not unique to the CDMA2000 evolution path and other advanced technologies, such as HSPA and LTE, will support them, yet they will be available 1 to 2 years sooner on the CDMA2000 networks.



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The applications delivered by these advanced technologies can be broadly categorized as: voice and messaging; location-based services; video; entertainment; mobile commerce; and user generated content. Examples of these applications are given below, although, in reality the scope of the new services will be limited only by the developers' imaginations and not by network performance.

Voice and Messaging

- **VoIP:** Low-latency broadband networks, such as Rev. A, will realize the full potential of VoIP. VoIP is simply defined as an IP-based voice service that offers the equivalent quality of circuit-switched communications over an IP network. VoIP offers several advantages such as the ability to enrich existing voice applications with data (and vice versa), the ability to dynamically add and mix multimedia within a single call, and to support simultaneous voice and data on a mobile device. For example, a user may check email or browse the Internet while making a voice call. For the mobile operator, VoIP offers a significant cost advantage compared to traditional circuit voice, as well as the advantages of flexibility in application packaging and faster time-to-market for new voice services. A Signals Research² study reports that capital expenses (CapEx) are 70 percent lower and operational expenses (OpEx) are nearly 50 percent lower for delivering voice and data over an IP-based Rev. A network than for circuit-switched implementations over a ten-year period.
- **Push-to-Talk/Media:** Push-to-Talk (PTT) provides instant communication in a one-on-one or group setting with the press of a handset button. Push-to-Media (PTM) extends PTT to include text, picture and video — this provides considerable improvements in flexibility and usability compared to today's messaging services. As with VoIP, packet-based PTT and PTM benefit the mobile operator with a lower cost of delivery, ease of deployment, faster time-to-market and ease of integration into other services and applications.
- **Video Messaging with Voice Attachment:** Users simply record a message using the mobile device's video camera and send it to another broadband user (not necessarily on a mobile network). If the receiving user has video playback capabilities, the message will be replayed. A broadband, low latency network is required to provide the quality necessary for such a commercial service.

Location-based Services

- **Advanced Location-based Services:** Subscribers will be able to receive more location-based information than they do today, with better accuracy. Enhancements to the current model, using higher bandwidth, lower latency networks, will enable users to view live video feeds to show traffic situations and alternate routes, and enable the camera on another handset to 'see' where the device is and send advertising and marketing messages to the handset in connection with a person's location.

Video

- **Video Conferencing:** Mobile operators will have the opportunity to combine video conferencing with other communications and content capabilities. Concurrent voice and data service can also be extended to multiplayer gaming and voice blogging.
- **Video Monitoring:** With increased bandwidths, video images can be streamed from remote camera(s) to a broadband mobile handset. For example, remote monitoring may be used to monitor the well-being of a child at a daycare center (the so-called nanny-cam) or the status of a building or valuable equipment. Video monitoring also extends to the ability to remotely watch TV, IPTV or programming on a Personal Video Recorder (PVR).

²Signals Research, CA-CHING OR KER-PLUNK: THE DOLLARS AND SENSE OF 3G, July 2006



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- **See What I See (SWIS)** is an extension of both video conferencing and video monitoring, allowing the user to show an audience what the user is looking at via the camera on the mobile device.

Entertainment

- **True mobile TV:** Current network speeds limit the quality of existing mobile TV services. Rev. A, Rev. B and UMB will dramatically increase the quality of the video delivered to mobile devices and hence improve the user experience comparable to the home TV. Mobile TV is considered by many in the industry to be an important service for mobile operators and many broadcasters believe that mobile devices could be a way to drive traditional television viewing. While mobile subscribers are unlikely to watch a season's worth of their favorite sitcom on their cell phone, they can receive previews of upcoming episodes which will entice them to tune in to that broadcast or send a signal to their digital video recorder to record the upcoming program. In this way, mobile television services can be an effective enabler for traditional television viewing. With UMB, the transmission of high definition TV (HDTV) content to a mobile device will be feasible.
- **Gaming:** Future broadband packet data networks will support a higher level of multi-player interactivity, allowing mobile operators and game developers to offer new games and improve the gaming experience. As well as enabling larger gaming applications to be downloaded, the increased bandwidth and lower latency will support true multiplayer connectivity, not just 'turn based' gaming. Community-based games will be enabled by complementary services such as VoIP, push-to-talk, push-to-media, push-to-game lobby, instant messaging, presence and location information. The mobile operator will be able to reduce churn through added community loyalty, promote their brands with a highly differentiated experience and recognize additional revenues from new gaming categories.
- **Remote Control of Personal Video Recorder (PVR):** Having the ability to receive notifications of an upcoming TV show and then remotely set a digital PVR to record the show is not far-fetched — this type of capability is being openly discussed by cable companies and Sprint under their joint venture. This application takes advantage of presence information and the ability to connect to different broadband networks. Broadband, low latency networks, such as Rev. A, are required to ensure the consumer receives the expected experience.

Mobile Commerce

- **Mobile Advertising/Purchasing:** Although some data opportunities for mobile purchasing currently exist, mobile television offers another opportunity for mobile commerce, allowing advertising companies to work short commercials into their mobile content. Purchasing also includes the ability to authenticate the customer via the mobile handset. In addition to the usual PIN, more advanced biometric authentication may be used, including fingerprints.
- **Proximity Payments:** With Near Field Communications (NFC) subscribers will be able to purchase goods and services with the swipe of their mobile device. User identity features, such as fingerprint recognition, are being developed to ensure the security of the transactions.
- **Mobile Banking:** Accessing bank accounts, paying bills, receiving funds, transferring money, setting alerts, etc., will enable users to manage their finances using a mobile device.



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User Generated Content

- **User Generated Content (UGC):** Capturing videos and uploading them to the Internet for others to view has become a phenomenon that has extended to the world of mobility. Improved mobile handset camera resolution, storage capacity and greater bandwidths will expand the UGC business.

AHEAD OF THE WAVE: OPERATOR STRATEGIES FOR REV. A

CDMA2000 operators are already deploying EV-DO Rev. A, with first commercial services available in Canada, the Caribbean, Czech Republic, Japan, New Zealand, Republic of Congo and the U.S. Most all CDMA operators are planning to fortify their competitive position by deploying Rev. A using diverse market strategies:

- **Bell Mobility** plans to use the Rev. A capabilities to enhance their service portfolio for business users and consumers. Their business subscribers will be able to upload large data files, access the Internet and Intranet and conduct video conferences. Consumers will be able to upload and share higher-quality stereophonic music, capture and upload high-resolution photography and personal videos, and watch real-time video, directly on their phones or other mobile devices.
- **KDDI** launched Rev. A in December 2006 to improve quality of service and introduce new services, starting with television, enhanced multimedia messaging, video telephony and VoIP-enabled communications. The operator also plans to use Rev. A for blogs, email (that can forward large attachments) and other high-bandwidth and delay sensitive services.
- **Mobilkom (Czech Republic)** deployed Rev. A to support its DSL replacement business by offering high-speed PC cards, modems and Wi-Fi routers.
- **Sprint** continues to deploy Rev. A technology and expects to deploy a new push-to-talk feature on its Rev. A mobile broadband network in early 2008. Meanwhile, the operator is promoting the high-speed, low latency features of Rev. A technology selling a portfolio of devices, including PCMCIA cards, Express Cards, USB devices, mobile broadband routers and laptops with built-in mobile broadband capability.
- **Telecom New Zealand** started the upgrade from EV-DO Rel. 0 to Rev. A in December 2006, with the goal of providing business users and consumers with advanced services and applications. A secondary goal was to position TNZ to be able to provide fixed-mobile converged services in the future. TNZ markets its Rev. A services based on the benefits of increased upload and download speeds, lower latency, improved user productivity and improved QoS.
- **Televork (Estonia)** launched its Rev. A network in July 2007, to offer its enterprise and government clients bi-directional, high-speed broadband access to the Internet and virtual private networks (VPNs) using the much faster downlink and uplink connections enabled by its data only cellular network.
- **Verizon Wireless** announced its Rev. A plans in July 2006, and completed the upgrade of its entire EV-DO network in the 2nd quarter 2007. The operator aims to meet increased customer demand for more high-bandwidth, real-time communication services such as wireless broadband Internet access via embedded laptops, video telephony and advanced multimedia applications.



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CONCLUSION

There is no doubt that mobile data services, applications and products are now an important part of most carriers' mobile businesses, not just in terms of revenues but also as a market differentiator. A viable mobile data business is no longer an option for mobile operators: to be competitive and to meet consumer needs, the carrier must offer a range of mobile data solutions and superior end-user experience.

Building a successful mobile data business today requires the right combination of the technology capable of supporting applications and marketing strategies to package them to the users. The technology has to be able to support high-speed data, low latencies, QoS, superior economics and a smooth evolution path towards all-IP delivery of multimedia services across multiple telecommunication networks. The key elements of successful marketing strategies include: time-to-market advantage, exceeding user expectations, a broad range of attractive devices at affordable prices and flexibility to address the needs of diverse market segments.

As the success of the mobile operators profiled in this paper shows, the CDMA2000 family of network technologies have met these criteria and have allowed operators to be ahead of their competitors in riding the wave of mobile broadband data services. CDMA2000 operators have benefited from a robust wireless data platform that has proven easy to evolve as the market needs dictate, have been able to introduce services faster, and offer more device choices. The result has been double-digit growth in data revenues, sustained ARPU and higher customer loyalty.

The latest EV-DO Rev. A networks now being launched are leading in the next evolution of mobile data services which will allow operators to enter the quadruple-play — telephone, Internet access, television, and broadband data services over an IP-based network. Rev. B and UMB, coming to market in the next couple of years, will further enhance the capabilities and expand the market and revenue opportunities for operators. In short, the CDMA2000 industry has and will continue to be ahead in capitalizing on the mobile broadband data revolution.