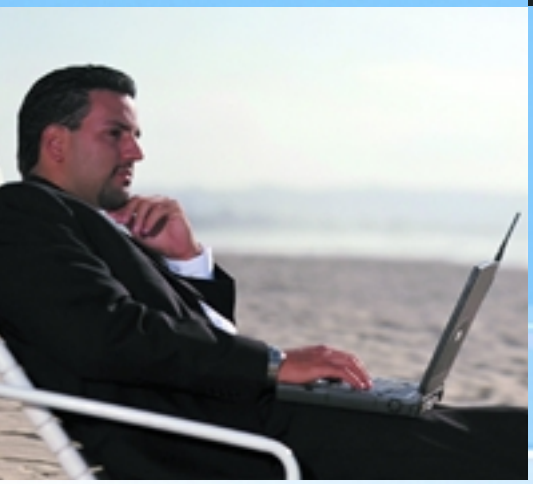
QUALCOMM®

THE ECONOMICS OF MOBILE WIRELESS DATA



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Except for the historical information contained herein, this paper contains forward-looking statements that are subject to risks and uncertainties, including the Company's ability to successfully design and have manufactured significant quantities of CDMA components on a timely and profitable basis, the extent and speed to which CDMA is deployed, change in economic conditions of the various markets the Company serves, as well as the other risks detailed from time to time in the Company's SEC reports, including the report on Form 10-K for the year ended September 24, 2000, and most recent report on Form 10-Q.

1. Introduction and Executive Summary

Wireless service operators are in the process of implementing, or are planning to implement, upgrades to their 2G networks. Several technology choices are available. The path chosen to 3G is expected to introduce significant competitive differentiation among wireless service operators in their ability to timely and effectively offer data services. Further, QUALCOMM® expects wireless data demand to grow dramatically over the next five years, and to provide significant revenue and profit opportunities for those operators with the network capability to respond.

This paper presents a methodology for understanding the differential in competitive advantage that operators will have based upon their 3G choice. The paper also explains QUALCOMM's forecast for wireless data demand.

The key points of this paper are:

1. CDMA 3G technologies offer the greatest data throughput capability and therefore the lowest cost data services. GPRS, a 2.5G TDMA technology intended to bridge GSM networks to 3G, does not have the throughput and performance capabilities of CDMA.
2. cdma2000sm 1xEV offers a substantial performance and cost advantage over all 2.5G and other 3G technologies for mobile wireless data services. cdma2000 1xEV has been standardized and its design optimized for data services.
3. Operators choosing cdma2000 1x and 1xEV are expected to have a significant time-to-market advantage over operators choosing WCDMA. cdma2000 1x networks are being deployed commercially in many countries today, while current efforts with WCDMA are either non-standardized or still in interoperability testing. cdma2000, operating with the efficient and proven 1.25 MHz bandwidth, can be used in existing 2G, as well as new 3G spectrum through evolution or overlay.
4. QUALCOMM forecasts that mobile wireless data demand will exceed 200 megabytes per user per month by the year 2006, based on increasing wireless data rate capabilities and improvements in wireless devices, applications, and access.
5. Based on our analysis, in a capacity limited environment with 5 MHz available for data traffic, the network cost to deliver data traffic will fall from several dollars per megabyte utilizing 2G technologies to less than $0.03 using cdma2000 1xEV, less than $0.07 for cdma2000 1x and WCDMA, and approximately $0.42 for GPRS.
6. Based on the costs in point 5 above, a user consuming 200 megabytes of data per month would cost a cdma2000 1xEV operator $4 per month in network expense, compared to $12 per month with cdma2000 1x, $14 per month with WCDMA, and $83 per month with GPRS.

2. Network Economics

Data throughput is the key driver of long-term wireless data network economics. With the introduction of 3G CDMA technologies, data throughputs will increase dramatically, driving down the cost to deliver a megabyte of data traffic to less than $0.07 with cdma2000 1x and WCDMA and less than $0.03 with cdma2000 1xEV.

2.1. The Economic Importance of Wireless Data

As voice services mature, mobile data, almost exclusively, will drive revenue and earnings growth.

Wireless data services represent a significant revenue growth opportunity to carriers worldwide. In many markets around the world, wireless voice penetration rates are beginning to slow as they reach 80% and higher. The price per minute of voice service continues to decline, and while minutes of use are increasing, revenue growth from voice services will likely slow over the next several years. In this environment, data services will become increasingly important to drive revenue growth.

The third generation (3G) technology decisions being made today will determine which operators will be successful in the increasingly competitive wireless marketplace in the coming years. Network technology is key to maximizing operator revenues and justifying the high prices paid for new 3G spectrum. Low cost, high performance solutions will enable operators to bring superior new features and services to the consumer, creating significant competitive and time-to-market advantages. Several technologies are now being considered for wireless data services.

2.2. Operator Alternatives for Meeting Data Demand

All 3G technology alternatives use CDMA, which provides high data and voice capacity, superior user experience, and low cost.

Most operators today have deployed second generation (2G) systems, which include GSM, TDMA, and IS-95-A CDMA networks. To take advantage of higher voice and data capacity, most, if not all, operators are planning to use CDMA for their third generation, even operators who are not using cdmaOne® equipment in their second generation system. Third generation systems are defined in the IMT-2000 standard of the International Telecommunications Union (ITU) and include modes based on Code Division Multiple Access (CDMA) technology referred to as cdma2000 and WCDMA.

cdma2000℠ 1x, which is currently being launched in commercial networks, supports voice and data on the same 1.25 MHz carrier, or radio frequency channel. In addition, a high data rate evolution, called cdma2000 1xEV, has been standardized by the Telecommunications Industry Association (TIA) and is expected to be added to the

IMT-2000 standard in the near future. 1xEV is optimized to carry only data traffic in a single 1.25 MHz carrier.

WCDMA, a technology designed as an alternative to cdma2000, supports voice and data traffic on a single 5 MHz carrier. WCDMA is currently in the standardization process. QUALCOMM expects that, although limited systems are scheduled to begin operation this year, widespread and standardized WCDMA networks will not begin operation until 2003 or later, given that the WCDMA standard and interoperability testing is not yet complete.

GPRS (intended as a bridge to 3G for GSM operators) is not competitive with CDMA data services.

General Packet Radio System (GPRS) is the only widely anticipated packet data technology that is not CDMA based. Many GSM operators expect to deploy GPRS as a 2.5G bridge technology while waiting for WCDMA to become available. Although GPRS is a relatively minor evolution of GSM, commercial implementation of GPRS has been delayed due in part to excessive heating in subscriber phones, losses of data during handoff, need to optimize algorithms for apportioning capacity between voice and data, and substantially lower data rates than initially anticipated. While GPRS will improve GSM data services, QUALCOMM does not believe that GPRS will be competitive with the more powerful CDMA-based packet data services, either on a cost or performance basis.

2.3. Technology Data Rates: Peak Versus Throughput

Throughput capacity drives network economics.

Peak rate affects user experience.

Data throughput is often confused with peak rate. It is important to appreciate the difference between these metrics to properly understand what drives the cost advantages and disadvantages of the various technologies. Peak rate is the maximum transmission speed an individual user may experience in ideal conditions. Throughput is the average total capacity available to multiple users within a cell sector. As throughput increases, each cell site can handle higher volumes of data traffic, and the network requires less equipment and fewer cell sites, reducing operational expenses and capital investment. Peak rate affects an individual user's experience, while throughput affects both the operator's cost to deliver service and the user's experience.

Table 1. Wireless Packet Data Technologies: Peak Data Rates and Estimated Throughput

Technology	Carrier Bandwidth	Forward Peak Rate per Standard (kbps)	Mature Network Average Throughput per RF-Carrier per Sector			Normalized Mature Network Average Throughput per 5 MHz per Sector		
			Stationary (kbps)	Pedestrian (kbps)	Vehicular (kbps)	Stationary (kbps)	Pedestrian (kbps)	Vehicular (kbps)
cdma2000 1x	1.25 MHz	625	450	350	350	1,350	1,050	1,050
cdma2000 1xEV	1.25 MHz	2,458	1,400	1,080	530	4,200	3,240	1,590
WCDMA	3.84 MHz	2,000	1,500	1,100	900	1,500	1,100	900
GPRS	0.20 MHz	115	40	40	40	80	80	80

Table 1 notes:

1. cdma2000 1x throughput per RF carrier per QUALCOMM simulations. Throughput per 5 MHz of spectrum assumes three 1.25 MHz carriers plus guard band.
2. cdma 2000 1xEV throughput per RF carrier based on QUALCOMM field trial results and simulations based on ITU models, assuming single antenna implementation. Dual antenna configuration would increase throughput per RF carrier per sector to 1,470 kbps for pedestrian and 880 kbps for vehicular. Throughput per 5 MHz of spectrum assumes three 1.25 carriers plus guard band.
3. WCDMA throughput per carrier based on the following sources: WCDMA - RTT Submission to ITU Summary Simulation Results, page 131; Understanding the Capacity - Coverage Trade-off, Nokia Presentation, GSM World Congress 2000; ARIB Evaluation Report by NEC, UCSD Conference on Wireless Communications, March 2, 1999, San Diego, USA. Throughput per 5 MHz of spectrum assumes one 3.84MHz carrier plus guard band.
4. GPRS throughput assumes 10 kbps per time slot based on implementation of coding scheme #2 and a target C/I of 12 dB. Assumes 4 time slots to account for collisions and interference. Throughput per 5MHz of spectrum assumes 2 TRX based on a 200 kHz carrier bandwidth and 3/9 or 4/12 re-use.

2.4. Economics of Technology Alternatives

QUALCOMM believes an effective way to compare the economics of alternative technologies is the network cost to deliver a megabyte of data traffic. Table 2 shows the results of alternative network solutions designed to deliver data services in varying traffic density environments. The cost-per-megabyte results are strongly tied to the throughput capacity of each technology in Table 1.

All CDMA technologies enjoy a substantial cost advantage over GPRS.

Table 2. Cost Per Megabyte

	Data Traffic Density		
	Low	Medium	High
Cost per Mbyte			
cdma2000 1x	$ 0.153	$ 0.064	$ 0.059
cdma2000 1xEV	$ 0.074	$ 0.025	$ 0.022
WCDMA	$ 0.214	$ 0.074	$ 0.069
GPRS	$ 0.472	$ 0.417	$ 0.415
Based on:			
kbps per Square Kilometer	764 kbps	3,818 kbps	7,635 kbps
Users per Square Kilometer			
…if 205 Mbytes/User/Month	200 users	1,000 users	2,000 users
…if 102 Mbytes/User/Month	400	2,000	4,000
…if 41 Mbytes/User/Month	1,000	5,000	10,000

Table 2 notes:

1. Data traffic only.
2. 5 MHz spectrum available for data services at 1900 MHz band.
3. 15% of data traffic volumes at busy hour.
4. Includes network operating costs and depreciation on capital investments specific to each network technology; excludes common Internet interconnect cost.
5. In-building penetration loss: 15 dB; pedestrian environment.
6. Greenfield deployments.
7. Assumes normalized throughput per 5 MHz bandwidth, based on the pedestrian model in Table 1.
8. Assumes 7 year straight line depreciation of all capital.

The cost per megabyte in Table 2 reflects the network operating costs and depreciation on capital investment required to design a network to support a given busy hour traffic load. For comparison purposes, we evaluate the cost to deliver data traffic in low, medium, and high data traffic density regions given 5 MHz of spectrum available for data traffic. We assume 15% of total traffic demand occurs in the busy hour.

Based on the busy hour traffic demand, we optimized the network configuration for each technology. Capital costs for cell site and network equipment are based on the GartnerGroup® Market Price Forecast: Worldwide Cellular Telephony Infrastructure,™ 1993-2002, Market Trends,™ 2/26/99, extended using an 80% experience curve based on EMC℠ Worldwide Subscriber Forecasts, Feb-2001 EMC Market Database.

Ease of initial network migration does not drive long-term economic competitive advantage.

The cost-per-megabyte analysis assumes new network deployments to objectively compare technologies. Certain technologies are designed to enable an efficient migration from current generation networks, such as cdmaOne to cdma2000 or GSM to GPRS. QUALCOMM believes ease of migration may minimize the original capital expense necessary to provide initial packet data services, but that total average data throughput is the most important variable influencing long-term network economics and competitive advantage.

The cost per megabyte analysis evaluates the cost to deliver data traffic in low, medium, and high traffic density environments. At 205 megabytes per user per month, the low density scenario is representative of a typical number of users per square kilometer in a suburban environment. Likewise, the medium density scenario is representative of an urban environment, and high density is representative of dense urban environments. Even in low density traffic environments, CDMA-based technologies have an economic advantage over GPRS due to the very limited throughput capacity of GPRS. As data traffic densities increase, the CDMA technologies scale more efficiently to deliver data traffic at low cost. cdma2000 1xEV is the best positioned technology to support data traffic, having a two to three times cost advantage over cdma2000 1x and WCDMA.

cdma2000 1xEV has a significant throughput and cost-per-megabyte advantage over other mobile wireless data technologies because it has been optimized for data vs. voice traffic. Specifically, the airlink has been designed for data based on the realization that voice and data traffic requirements are quite different. Power is used more efficiently as the full power of the base station is dedicated to a single user at any given time rather than sharing power as in WCDMA and cdma2000 1x. The user's data rate is dynamically determined as the access terminal constantly measures pilot strength and requests the maximum data rate allowed for the given channel conditions. Combined with advanced scheduling techniques, this enables the system to select and serve users at the highest possible data rates when they are in more favorable channel conditions, creating throughput gains by multi-user diversity. 1xEV also takes advantage of parallel codes and turbo decoding techniques. Higher performance does not come at a higher cost. 1xEV retains 100% RF compatibility with IS-95 using the same chip rate, link budgets and RF designs. As a result, 1xEV leverages the existing CDMA cost curves for chipsets and equipment, enabling low cost deployment. Finally, 1xEV optimizes spectral efficiency to maximize the value of scarce spectrum resources.

cdma2000 1xEV offers the greatest competitive advantage because it is optimized for data throughput.

GPRS has a substantial disadvantage in throughput and therefore cost per megabyte for several reasons. First, GPRS is designed as a software extension of a 2G voice technology. GPRS is a time division based technology that is limited to eight time slots. While eight time slots are available, four time slots may be practically used for data in order to effectively manage the impact of collisions and interference. Each time slot is limited to a throughput of approximately 10 kbps based on implementation of coding scheme #2 and an expected C/I target of 12 dB. While higher coding schemes are available, they require significantly better C/I conditions to effectively enhance throughput, which would be costly to implement. Finally, GPRS uses a 3/9 or 4/12 frequency reuse pattern, which limits the number of RF carriers, or TRX's, that can be utilized in a given amount of spectrum.

QUALCOMM believes that the cost to deliver data traffic will be a key differentiator between service providers. The higher throughput of cdma2000 1xEV will enable richer, more compelling data service offerings and significantly lower network costs. These advantages can provide an operator with a substantial competitive advantage in the wireless data market, enabling a unique opportunity to gain market share.

3. Wireless Mobile Data Volume Forecast and Rationale

Wireless mobile data volumes are poised to exceed 200 megabytes per user, per month by the year 2006. Enhancements in applications and devices and rapidly increasing data rates will drive wireless data volumes and usage to levels typical of today's wireline Internet. Accordingly, an operator must select and deploy the most efficient 3G solution, in a timely manner, to be competitive.

3.1. Comparison of Wireline and Wireless

Wireline data traffic volumes increased dramatically from one megabyte per user, per month in 1991 to nearly 200 megabytes per user, per month by 1999 [based on AT&T® Labs - Research, *Internet growth: Is there a "Moore's Law" for data traffic?*, July 2000, and *The size and growth rate of the Internet*, Coffman & Odlyzko, October 1998.] due to a convergence of increasing usability and higher data rates. Beginning in 2001, higher data rates and greater usability will drive the same type of rapid growth in wireless data that has already taken place in wireline. Figure 1 shows QUALCOMM's forecast of the demand for wireless data traffic per wireless data user, per month over the next five years. In addition to the increase in data volumes, improved usability and higher data rates will drive substantial acceptance and penetration of wireless data services. In this paper, we define usability as an event or series of events that enable or contribute to meaningful market adoption of wireless data services.

The wireless mobile data market will emerge driven by

- *Higher data rates*
- *Lower cost service*
- *Enhanced usability (access, devices, and applications)*

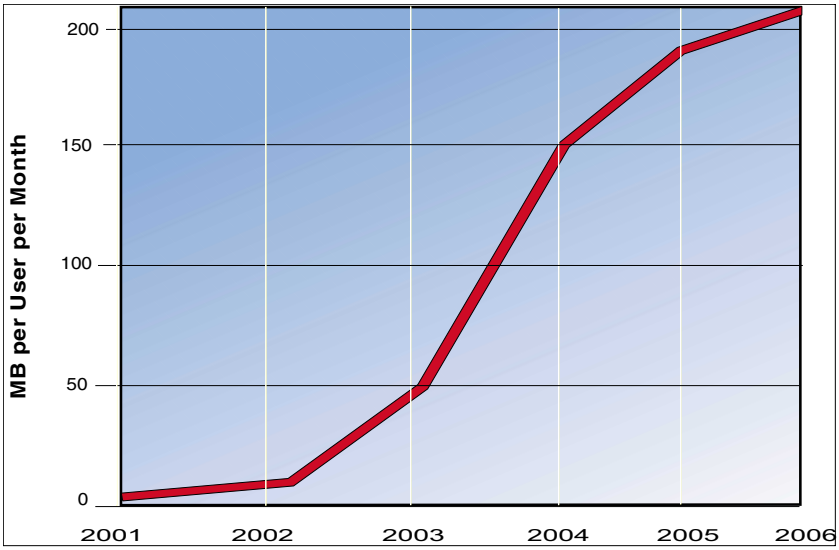

Figure 1. Wireless Mobile Data Forecast

Wireline data traffic volume increased due to availability of higher data rates and an improved user experience.

Wireless data volumes will increase for the same reasons.

Today's wireless data experience mirrors the wireline experience from the early 1990s. Early wireline applications, like Archie™ and Mosaic®, were cryptic at best. Inputs were difficult to create, and outputs were primarily limited to text and low-resolution graphics. Today's wireless applications share the same attributes with early wireline applications. For example, Short Messaging Service (SMS™), Wireless Application Protocol (WAP™) and i-Mode™ suffer from abbreviated interfaces with primarily text-only outputs and low-resolution graphics. Compelling, rich media applications typical of today's wireline experience are not yet widely available for wireless. However, high speed wireless data rates and improved usability will quickly make these richer experiences common on wireless devices in the coming years.

In the early 1990's, when wireline data volumes in the United States averaged one megabyte per user, per month, few would have forecasted that number would reach 196 megabytes per user, per month by 1999. However, usability increased dramatically with Netscape®'s introduction of a graphical interface and the steady increase in available data transfer speeds from 9.6 kbps to 56 kbps for dial up services, 128 kbps for ISDN service, and several hundreds of kilobits per second for DSL and cable services.

New devices and applications are about to ignite a similar usability revolution in wireless data, and wireless data rates are poised to follow the same rapid increase experienced by wireline in the 1990s. See Figure 2.

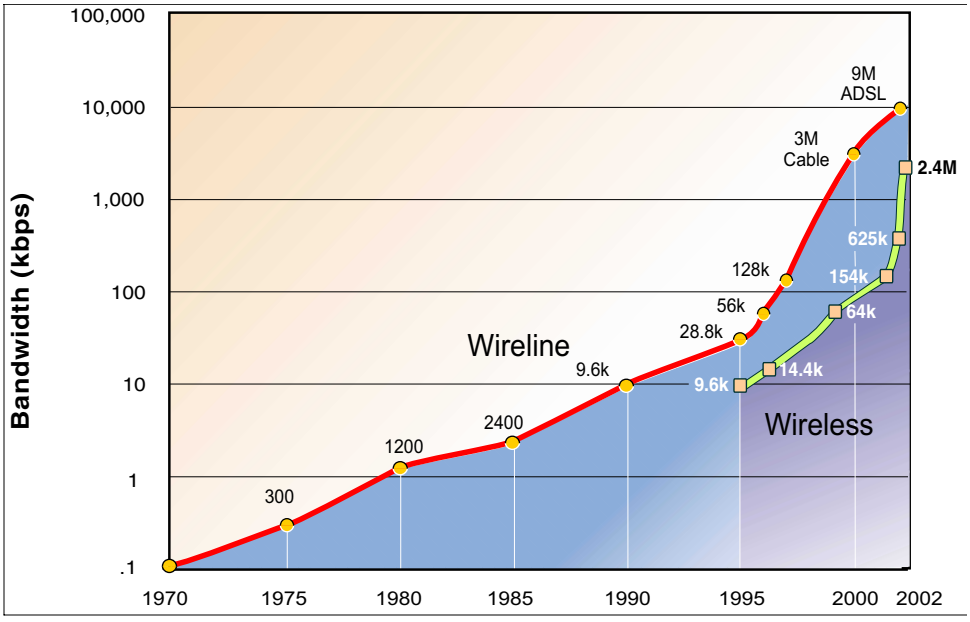

Figure 2. Wireline and Wireless Mobile Data Rate Growth

3.2. Usability

The wireless data experience will become more compelling for operators and consumers alike as improvements to content, access, and software applications are developed, devices are enhanced, and low cost access to high data rates is enabled (Table 3).

Table 3. Key Wireless Data Enabling Factors

Access	Applications	Devices
• Low cost delivery of high bandwidth	• Access to full media-rich content	• Availability of a wide range of wirelessly enabled devices
• Availability of higher data rates	• Common development platform and applications interface	• Improved cost/performance of wireless devices
• Ubiquitous coverage	• Enabling of unique applications such as multimedia and position location technologies	• Increased affordability of high capability devices

3.2.1. Enabling Access

Cost per megabyte will fall dramatically with 3G CDMA technologies.

Higher data rates, ubiquitous coverage, and low cost services will open the mass market to wireless data services and drive demand for more graphically rich multimedia content.

- With the deployment of CDMA technology, the network cost to deliver data traffic will fall from several dollars per megabyte utilizing 2G technologies to less than $0.03 using cdma2000 1xEV, less than $0.07 for cdma2000 1x and WCDMA, and approximately $0.42 for GPRS. As the cost per megabyte falls, significantly higher data traffic can be delivered at a reasonable price to the consumer and a reasonable margin to the operator.

Table 4. Cost to Deliver a Megabyte of Data Traffic*

Technology	Cost/MB
CDMA 1x	$0.059
CDMA 1xEV	$0.022
WCDMA	$0.069
GPRS	$0.415

* Assumes 15% of traffic demand occurs at the busy hour.

Note: costs include network operating expense and depreciation.

Note: NTT™ DoCoMo™'s i-Mode service is currently priced at over $23 per megabyte based on its pricing of $0.003 per packet and 128 bytes per packet [Eurotechnology, imode-the Benchmark for Wireless Internet, 2000].

- A three-minute MP3® file, which is about 3 megabytes, could be delivered for a cost of under $0.07 with cdma2000 1xEV. Similarly, a two-minute, medium resolution video clip at 6 megabytes could be delivered to the consumer for a cost of about $0.13. Over the course of a month, an operator could deliver 205 megabytes of traffic for a network cost of just $4.50 with cdma2000 1xEV.

  At $0.022 per megabyte, wireless operators may consider offering consumer Internet services in markets underserved by broadband wireline.

- Higher data rates will dramatically enhance the performance a user can achieve on the network. As shown in Table 5, higher data rate technologies will enable access to multimedia applications and content that cannot be reasonably achieved at lower data rates.

High data rates make rich content feasible.

Table 5. Time Required to Download a 3-Minute Song

Air interface	Peak Data rate	Download time in minutes
GSM	9.6 kbps	41.7 minutes
IS-95-A CDMA	14.4 kbps	28 minutes
GPRS	40 kbps	10 minutes
IS-95-B CDMA	64 kbps	6.3 minutes
cdma2000 1x (implemented)	307 kbps*	1.3 minutes
cdma2000 1x (standard)	625 kbps*	0.6 minutes
WCDMA (implemented)	384 kbps	1 minute
WCDMA (standard)	2.0 Mbps	0.2 minutes
cdma2000 1xEV (HDR)	2.4 Mbps	0.15 minutes

*Peak data rate for first commercial release of 1x terminals will be 153.8 kbps

- Ubiquitous coverage of higher speed networks will promote widespread adoption of data services as usability is enhanced. cdma2000 1x networks are beginning deployment in North and South America, Japan and South Korea in 2001, enabling data rates of up to 625 kbps. In 2002, cdma2000 1xEV networks will begin to be deployed enabling data rates up to 2.4 Mbps. In 2001, NTT DoCoMo plans a limited WCDMA deployment in Japan with data rates ranging from 64 to 384 kbps in a mobile environment and 2 Mbps when stationary. QUALCOMM expects that operators will begin significant WCDMA commercial services in 2003 and 2004.

3.2.2. Enabling Applications

MPEG4 will enable video delivery to wireless devices beginning in 2001.

Significant new content and applications are emerging for wireless data services that offer compelling value to the consumer.

- The emergence of XHTML™ and ultimately eXtensible Markup Language (XML™) will enable all internet content to be more accessible by wireless devices by eliminating the need to separately program web content in Wireless Markup Language (WML™) as used in WAP.
- Access to multimedia applications has been enabled through the integration of MPEG-4™ into QUALCOMM chipsets for the Personal Digital Assistant (PDA®) market and the integration of MP3 capabilities into QUALCOMM's MSM™ phone chips beginning in 2001. MPEG-4 will allow streaming of VHS-quality video at approximately 425 kbps. MP3 will enable near CD-quality audio to be streamed at 128 kbps (16 bit 44 kHz, stereo). Companies today, including Time Warner®, Marvel® Entertainment, Disney® and CNBC® are reportedly developing screen icons, games, music and short films/clips specifically for wireless devices.
- Position location technology will be enabled in U.S. wireless networks beginning in 2001 with full coverage expected by 2004. This technology will open up significant new applications. Position location technology is already deployed in Japan and South Korea, where we estimate that it is generating in excess of one million position references per day on initial applications.

BREW opens the phone platform to third party applications development.

- QUALCOMM's Wireless Internet Launchpad™ and Binary Runtime Environment for Wireless (BREW™) application development environment create a uniform development platform and a common Application Programming Interface (API™) for third party applications development. Opening up the wireless phone platform to third party developers will provide many new and unique applications leveraging the enabling technologies integrated in the chipset including MPEG-4 video, MP3 music compression, voice chat, MIDI player, Q-Synth™ 128-sound synthesizer, voice recognition and gpsOne™ position location and Bluetooth℠ capabilities.

3.2.3. Enabling Devices

New devices will be introduced and existing devices will evolve to provide a more enhanced wireless data experience.

- Wireless modem cards allow laptop and notebook computers to access the Internet and intranet anywhere, anytime. Sierra Wireless™ announced an agreement to supply its cdma2000 1x PC Card to Verizon® Wireless for shipment starting in the first quarter of 2001. With large, color displays and keyboard/mouse input, we believe wireless access will enhance the usability of laptop computers and drive substantial wireless data traffic. As coverage for

When wirelessly enabled, the usability of laptops and PDAs improves dramatically.

higher speed service becomes ubiquitous, wireless modems will become widely used in many portable computing devices.

- Wireless smartphones and PDA devices are already being introduced, such as Kyocera's™ pdQ2™, which was recently introduced by Verizon Wireless. Also, the Handspring™ Visor™ will incorporate a CDMA modem card in late 2001. Compaq™ is working with Sierra Wireless to wirelessly enable the popular iPaq™ for both CDMA and GPRS markets in 2002. Larger displays, more processing power and greater memory will enable a high quality wireless data experience, particularly for accessing more media rich content and applications.
- Phones with larger, higher resolution color displays will enter the Japanese market this year, enabling a richer visual experience for wireless applications and services. As resolution and screen sizes improve and color replaces black and white, applications and content will incorporate more graphics and multimedia features, thereby driving higher bandwidth demand.
- Many other device-related factors will drive higher demand for bandwidth, including improved power management through shrinking chip geometries and lower power consumption, lower cost, higher density memory, and the proliferation of wireless Internet appliances and application specific devices, such as the RIO™ portable MP3 player.
- As higher functionality phones, PDAs, wireless Internet appliances and modem cards are made in higher volumes at lower costs, they will become more affordable to the mass market.

Figure 3 highlights the timing of the usability events discussed above. As usability is enhanced, demand for wireless data traffic will grow significantly.

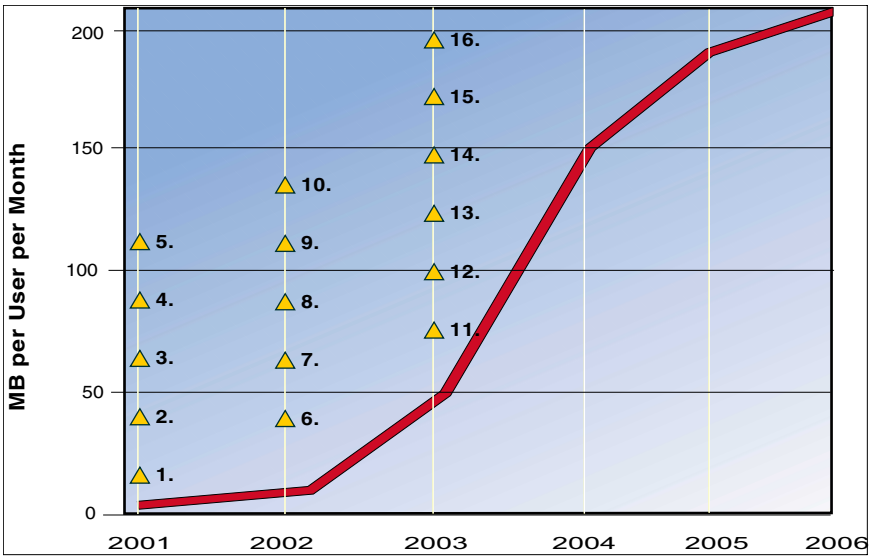

Figure 3. Wireless Data Volume Enabling Events

Figure 3 notes:

2001

1. QUALCOMM Wireless Internet Launchpad
2. QUALCOMM BREW
3. MPEG4 Compression in Wireless Devices
4. MP3 Player in Cell Phones/PDAs
5. Basic Voice Recognition

2002

6. Wirelessly Enabled, Color-Screen PDA
7. Wirelessly Enabled Laptops (Modem Cards)
8. Prevalence of Wireless Data Applications
9. Extensible Markup Language (XML)
10. Low Cost Data Delivery for Rich Media Wireless Data Services

2003

11. Complex Voice Recognition
12. Widespread Deployment of Position Location Technology
13. Mini-Keyboards
14. Wirelessly Enabled Internet Appliances
15. Reasonable Cost Phones/PDA's
16. Ubiquitous high data rate coverage

4. User Profile and Revenue Opportunity

Substantial wireless data traffic will be driven by a wide variety of compelling applications and devices. We expect applications and services will become integrated into the user's lifestyle, driving frequent use. Additionally, we believe laptops and PDAs will be significant platforms for wireless data services with their larger color displays and better input/output.

4.1. User Profile

Demand for wireless data will be driven by a wide variety of applications and devices.

QUALCOMM believes increasing data rates and a substantial improvement in usability will drive data traffic demand to over 200 megabytes per user, per month by 2006. We expect traffic to come from a variety of users, with many different types of applications and an assortment of devices. In Table 6, we profile two representative user groups—professionals and teenagers—to provide a better understanding of our data forecast.

Professional users will be important early adopters of wireless data services. Email and file access, as well as web browsing will drive the majority of traffic in 2002, with professionals accessing corporate intranets with laptop and PDA devices. As the costs of devices and service come down over time and as high bandwidth networks are more widely deployed, multimedia traffic, such as streaming video, will become increasingly important. By 2006, we expect a significant number of professionals to be using handheld or mobile laptop devices, enabling the mobile office environment.

Teenagers are also expected to be early adopters of wireless data services with entertainment applications driving traffic demand. We expect downloading MP3 files, streaming music videos and playing online games will make up a significant portion of daily traffic requirements. Active position location services such as locating friends or stores with certain products or using directional/mapping services will also be important. By 2006, we expect teenagers to be even more significant users of wireless data services as improvements in devices (larger, color displays and better input/output) and lower cost services substantially enhance the user experience. Multimedia content will represent more and more of the data traffic as users demand more compelling content and applications.

Table 6. User Profile

Application	Kbytes per Session	Session Defined	2002 Professional		2006 Professional		2002 Teenager		2006 Teenager	
			Sessions per Active Day	Kbytes	Sessions per Active Day	Kbytes	Sessions per Active Day	Kbytes	Sessions per Active Day	Kbytes
Position Location - Active	10	one ping					2	20	6	60
Position Location - Passive	10	one ping					10	100	10	100
Position Location - w/Map	350	one ping with map	2	700	6	2,100	2	700	6	2,100
Personal Information Manager	50	one sync	2	100	4	200				
M-Commerce	50		1	50	3	150	1	50	3	150
Networked Games	2,000						2	4,000	2	4,000
MP-3	3,500	1 MB/min, 3.5 min per song avg.					2	7,000	3	10,500
Audio Clips	25	50 KB/min, 30 seconds	1	25	3	75	1	25	3	75
Streaming Video - Low Res	188	250 KB/minute, 45 seconds	3	563			2	375	4	750
Streaming Video - Medium Res	2,250	3 MB/minute, 45 seconds			5	11,250				
Device Art / Personality Download	100						1	100	1	100
Cartoon Messaging / Interactive	100						1	100	1	100
E-mail	10	One e-mail	15	150	40	400				
E-mail Attachment	500	One attachment	5	2,500	10	5,000				
Text Messager	0.5	30 characters					12	6	12	6
Broadcast Chat	25	50 KB/min, 30 seconds					1	25	1	25
News, Sports, Weather	25	50 KB/min, 30 seconds	1	25	2	50	1	25	1	25
Encyclopedia	100						0.5	50	0.5	50
Trivia	50						0.5	25	0.5	25
Horoscope	50						0.5	25	0.5	25
Browsing - Phone	270	5 min, 30 screens, 9 KB/screen					1	270		
Browsing - PDA	1,350	10 min, 30 pages, 45 KB/page	2	2,700					3	4,050
Browsing - Webpad/Laptop	2,700	10 min, 30 pages, 90 KB/page	2	5,400	4	10,800				
Network Access / File Transfer - Small	100		2	200						
Network Access / File Transfer - Large	500		2	1,000	3	1,500				
Kbytes per active day				13,413		31,525		12,896		22,141
Active days per month				20		20		20		20
Kbytes per month				268,250		630,500		257,920		442,820

4.2. Revenue Opportunity

Network costs dictate service offerings and service offerings dictate revenue growth.

Based on the user profiles provided in Table 6 and the cost per megabyte calculated above, we can begin to understand the wireless data revenue opportunity for the operator. Morgan Stanley Dean Witter™ estimates that consumers in the U.S. can afford to spend $25-$50 per month for wireless data services based on current spending patterns for communications and entertainment. (Source: Morgan Stanley Dean Witter; *The Mobile Internet Report*; 10/00; p.52). Table 7 highlights the economics of alternative networks dimensioned to deliver 268 megabytes per month to the professional user from Table 5. Assuming access revenue of $40/user/month and 268 megabytes of traffic, an operator could generate a 45% EBIT (earnings before interest and taxes) margin with cdma2000 1xEV, and a 15-20% EBIT margin with cdma2000 1x and WCDMA. GPRS cannot cost effectively support this level of traffic. As shown in Table 6, the driver of economics is network operating costs. cdma2000 1xEV can deliver 268 megabytes of data traffic for just $5.90, compared to $16 for cdma2000 1x, $18.50 for WCDMA and over $110 for GPRS. Of note, the differential in network costs drives an over 3 times advantage in profit per user for cdma2000 1xEV compared to WCDMA.

The ability to offer higher peak rates and, therefore, higher performance service at a substantially lower cost will create a significant competitive advantage for an operator. Selection of the right 3G technology is key to enabling that competitive advantage over the next several years and beyond. Driving toward higher traffic per user—by supporting rich multimedia applications and content and more compelling devices such as laptops and PDAs—will leverage the advantages of CDMA technologies and enhance that competitive advantage. Only cdma2000 1x and cdma2000 1xEV can provide this competitive advantage with the lowest cost, in a timely manner without the risk of delays in technological development and deployment.

Table 7. Comparative Costs of Providing Data

	GPRS	WCDMA	1X	1xEV
Access Revenue/User/Month [1]	**$40.00**	**$40.00**	**$40.00**	**$40.00**
Cost/Mbyte @ Capacity [2]	$0.415	$0.069	$0.059	$0.022
Mbytes/Month/User	268	268	268	268
Network Cost/User/Month	**$111.22**	**$18.49**	**$15.81**	**$5.90**
Sales & Mktng and G&A/User/Month [3]	$16	$16	$16	$16
Earnings Before Interest & Taxes	–$87.22	$5.51	$8.19	$18.10
EBIT Margin	***–218%***	***14%***	***20%***	***45%***

[1] Source: Morgan Stanley Dean Witter; The Mobile Internet Report; 10/00; p.52. Estimates affordability of wireless data to be $25–$50 per month

[2] Excludes amortization of spectrum costs.

[3] Source: Based on a compilation of analyst projections for Sprint, VoiceStream, AT&T Wireless and Nextel.

5. Conclusion

QUALCOMM believes quality of service and the cost to deliver data traffic will be key differentiators between wireless mobile data service providers. The higher throughput of cdma2000 1xEV will enable richer, more compelling data service offerings and significantly lower network costs. Specifically, in 5MHz of spectrum, cdma2000 1xEV will have throughput per sector of over 3.2 Mbps compared to 1.1 Mbps with cdma2000 1x and WCDMA and just 80 kbps with GPRS. As a result, in a capacity limited environment, the network cost to deliver a megabyte of data traffic is just over $0.02 with cdma2000 1xEV, approximately $0.07 with cdma2000 1x and WCDMA, and about $0.42 with GPRS.

Wireless mobile data volumes are poised to exceed 200 megabytes per user, per month by the year 2006. Enhancements in applications and devices and rapidly increasing data rates will drive wireless data volumes and usage to levels typical of today's wireline Internet. Accordingly, an operator must select and deploy the most efficient 3G solution, in a timely manner, to be competitive. Given the cost per megabyte mentioned above, a GPRS operator would incur approximately $83 per month in network expenses to deliver 200 megabytes of data traffic, as opposed to $14 for WCDMA, $12 for cdma2000 1x and, $4 for cdma2000 1xEV. In addition to this dramatic cost of service advantage, cdma2000 operators will have a substantial time-to-market advantage relative to operators deploying WCDMA.

The ability to offer higher peak rates and, therefore, higher performance service at a substantially lower cost will create a significant competitive advantage for an operator. Selection of the right 3G technology is key to enabling that competitive advantage over the next several years and beyond. Driving toward higher traffic per user, by supporting rich multimedia applications and content and more compelling devices such as laptops and PDAs, will leverage the advantages of CDMA technologies.