PRODUCT

Mobile Data Service Projections

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EXECUTIVE SUMMARY

Study Objectives

The purpose of this study is to identify trends in the American mobile data services market and to develop forecasts for prevailing prices (both retail and wholesale) in the 2015 timeframe.

These projections, while generic, are designed to support the analysis of one of the Vehicle Infrastructure Integration options described in *VII: A Discussion of Potential Implementation Approaches*, ITS Joint Program Office, July 2004. In this option, it is envisioned that automobile manufacturers would install mobile data transceivers in all new automobiles to transmit probe data from vehicle sensors such as vehicle location, speed, air temperature, anti-lock brake activation, etc. This probe data is expected to be about 1 kilobyte of data transmitted once a minute. It is assumed that the automobile manufacturers would install the mobile data transceivers in all new cars starting in 2010. The automobile manufacturers would purchase the mobile data service to transmit the data, although they might resell the data or other services to recoup their costs. This study addresses the price that the automobile manufacturers would be expected to have to pay for the mobile data service. This price is expected to be a wholesale rather than retail price because of the large volume of mobile data transceivers involved.

Scope

Mobile data services consist of messaging and switched data services (including Internet access) offered over cellular/personal communications service networks. This study considered service adoption rates and pricing models for wireless data and related communication technologies. The cost of providing wireless services is also assessed. In addition, various factors affecting the supply and demand of wireless services, including a review of long-term pricing trends for communication technologies, were considered.

Summary Conclusions and Forecasts

- Flat-rate pricing, that is, a monthly charge for unlimited data transmission, is expected to be the dominant pricing method for mobile data services in the 2015 timeframe.

- The best *commercial retail* flat-rate monthly price for unlimited wireless data will be approximately $15 per transceiver, decreasing from $29.99 in 2003, and representing a compound annual growth rate (CAGR) of about negative 5.6 percent.

- The best *wholesale* flat-rate monthly price for unlimited wireless data will be in the range from $6.75 to $7.50 per transceiver, representing a 50-to-55 percent discount compared to best commercial retail prices.

- In 2015, the U.S. mobile service subscription rate will have converged to rates prevalent in other highly developed consumer societies. No fewer than 90 percent of U.S. inhabitants (or 281 million people[1]) will subscribe to mobile services, increasing from 54.3 percent in 2003, and representing a CAGR of 4.88 percent.

- Of those subscribing to mobile services, no less than two-thirds (67 percent or 188 million) will be users of messaging and mobile Internet services.

- Spending for telecommunications services will constitute about 2.5 percent of total household expenditures, increasing from 2.35 percent in 2003, and representing a CAGR of about 0.65 percent.

- Average monthly household spending for telecommunications services will be almost $115, increasing from $87.92 in 2003, and representing a CAGR of 2.2 percent.

- The average monthly household expenditure for wireless services (including voice and data) will be about $86, representing a CAGR of about 6.4 percent from 2003. The average monthly expenditure for fixed telecom services will decline to about $28, representing a CAGR of about negative 4 percent.

1 The U.S. Census Bureau forecasts (Middle Series estimate) a total of 312,268,000 inhabitants in July 2015. Refer to http://www.census.gov/population/projections/nation/detail/d2011_20.pdf

TABLE of CONTENTS

List of Figures

List of Tables

SECTION 1

INTRODUCTION

1.1 Purpose and Scope

The purpose of this study is to identify trends in the American mobile data services market and to develop forecasts for prevailing prices (both retail and wholesale) in the 2015 timeframe.

For the purposes of this study, mobile data services were considered to consist of messaging and switched data services (including Internet access) offered over cellular/personal communications service networks.

These projections, while generic, are designed to support the analysis of one of the Vehicle Infrastructure Integration options described in *VII: A Discussion of Potential Implementation Approaches*, ITS Joint Program Office, July 2004. In this option, it is envisioned that automobile manufacturers would install mobile data transceivers in all new automobiles to transmit probe data from vehicle sensors such as vehicle location, speed, air temperature, anti-lock brake activation, etc. This probe data is expected to be about 1 kilobyte of data transmitted once a minute.

It is assumed that the automobile manufacturers would install the mobile data transceivers in all new cars starting in 2010. More than 14,000,000 new automobiles are sold into the US market every year[2]. Thus, by the end of 2015, about 84 million vehicles would be transmitting probe data using mobile data services[3]. The automobile manufacturers would purchase the mobile data service to transmit the data, although they might resell the data or other services to recoup their costs.

This study addresses the price that the automobile manufacturers would be expected to have to pay for the mobile data service. This price is expected to be a wholesale rather than retail price because of the large volume of mobile data transceivers involved.

1.2 Approach and Organization of Report

The approach to developing wholesale mobile data price projections consisted of two steps. The first step was to forecast the characteristics of the mobile data services market by

2 National Transportation Statistics 2002 reports average new retail (passenger car) and factory (truck and bus) sales between 1990 and 2000 at 14 million vehicles per year, although total sales in 1999 and 2000 were about 16 million.

3 Assuming that all vehicles sold during the period 2010 and 2015 remain on the road during the period.

examining trends and considering both supply and demand of wireless services. The second step was to develop price forecasts by reviewing long-term pricing trends for communications technologies in light of the forecasted market, and factor in the impact of wholesale purchasing.

This report is organized as follows. Section 2 provides information on the mobile data market as it exists today and is expected to develop over the next few years. Section 3 describes the supply side—that is, how telecommunication companies are planning to provide mobile data services and the expected pricing trends. Section 4 addresses the demand side—that is, the expected consumer demand for mobile data services and projections on consumer willingness to pay. Section 5 provides conclusions and forecasts resulting from the analysis.

SECTION 2

CURRENT AND MID-TERM MOBILE DATA MARKET

2.1 Overview

Mobile data services represent a significant revenue growth opportunity for service providers worldwide. In most developed countries, wireless voice adoption rates have exceeded 67 percent; while in many markets, rates have exceeded 80 percent, as shown in Table 2-1. The price per minute of voice use continues to decline, and although minutes of use are increasing, revenue growth from voice services will slow over the next several years.

Table 2-1 Worldwide Adoption of Mobile Wireless Service

	Subscribers (Millions) 1998	Subscribers (Millions) 2003	CAGR[4] (%) 1998-2003	Subscribers Per 100 Inhabitants, 2003
Hong Kong	3.174	7.241	17.9	105.75
Italy	20.489	55.918	22.2	101.76
Czech Republic	0.965	9.709	58.7	96.46
Spain	6.437	37.507	42.3	91.61
Norway	2.106	4.163	14.6	90.89
Portugal	3.074	9.341	24.9	90.38
Finland	2.846	4.700	10.6	90.06
Sweden	4.109	7.949	17.9	88.89
Denmark	1.931	4.785	19.9	88.72
Austria	2.293	7.094	25.3	87.88
Ireland	0.946	3.400	29.2	84.47
United Kingdom	14.878	49.677	35.2	84.07
Singapore	1.0925	3.313	31.9	79.56
Belgium	1.756	8.135	46.7	78.56
Germany	13.913	64.800	36.0	78.54
France	11.210	41.683	30.0	69.59
Korea	14.019	33.592	19.1	69.37
Japan	47.308	86.659	12.9	67.96
United States	69.209	158.722	18.1	54.30
World	**317.675**	**1,340.667**	**33.4**	**21.91**

Source: International Telecommunication Union, May 10, 2004

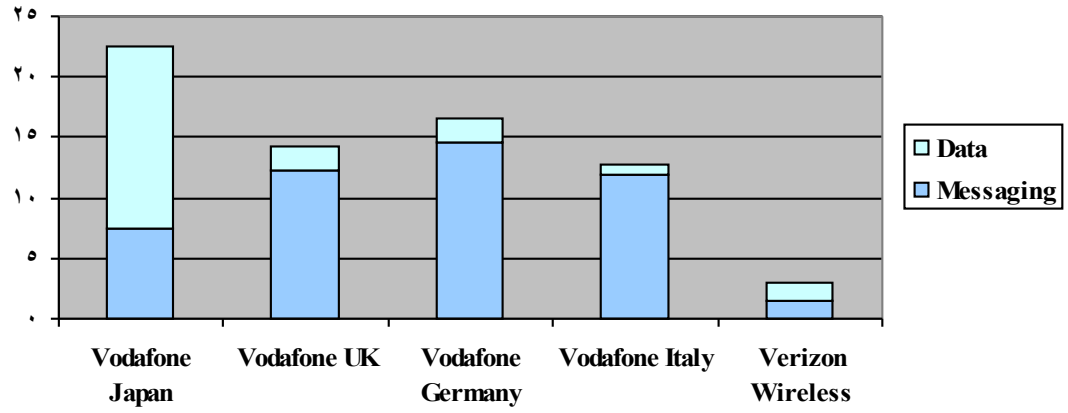
4 Compound Annual Growth Rate (CAGR).

In the United States, there are six national facilities-based mobile wireless service providers, many start-up providers of Wi-Fi and other fixed wireless solutions, and numerous regional competitors. This competition results in downward pressure on subscriber and revenue growth and profit margins. With such prevailing market conditions, data services—particularly Third Generation (3G)[5]—will become increasingly important to spur future revenue growth.

2.2 Mobile Data Services

Mobile data services are a nascent but rapidly growing market in the United States. Data services revenue for US carriers as a percentage of total revenue ranged between two and four percent in 2003. US-based wireless carriers, however, lag behind their counterparts in Europe and Japan, as shown in Figure 2-1. For purposes of this analysis, mobile data services shall consist of messaging and switched data services offered over cellular/personal communications service (PCS) networks[6].

Figure 2-1 Mobile Data as a Percentage of Total Revenue, 2003



Source: Vodafone 20-F, June 2004; Financial Times, July 2, 2004

2.2.1 Messaging Services

Short Messaging Service (SMS) traffic continues to grow quickly, although it is presently used by relatively few users. Approximately 15 percent of American mobile subscribers use

5 See Appendix A for a brief discussion on the Generations of Mobile Technology

6 This study does not address wireless local area networks (e.g., Wi-Fi or IEEE802.11-based networks) nor emerging fixed wireless solutions for the so-called *last/first mile* application (e.g., WiMax).

SMS compared to 80 percent of Spaniards, 61 percent of Belgians, 72 percent Finns, and 40 percent of Portuguese[7].

American use of SMS has lagged other developed countries mostly due to the relative expense of using wireless networks[8] compared with fixed networks. Historically, talk has been cheap in the US; local calls are not charged (or metered) on a per-call basis, unlike the rest of the world where per-call metering is standard. Un-metered local calls made logging on to the Internet, for hours at a time, the preferred mode of Internet access. American household usage of personal computers and fixed Internet access are now the highest in the world. According to ITU statistics[9], there were 65.89 PCs per 100 inhabitants in the US in 2003; moreover, 54 percent of Americans were Internet users. In Europe, there were 21.44 PCs per 100 inhabitants and 23.77 percent households had Internet access.

2.2.2 Switched Data Services

Switched data services account for one to three percent of the total wireless service revenue for most carriers in the developed world. The notable exception is Japan, where switched data revenues exceed 15 percent for Vodafone Japan and NTT DoCoMo, the leading wireless carriers. Switched data services include:

- High-speed circuit switched data (HSCSD) is a circuit-switched wireless data transmission technology for mobile users at data rates up to 38.4 Kbps. It is an evolutionary and interim step before 3rd generation wireless networks become pervasive. HSCSD is comparable to the speed of many computer modems that communicate with today's fixed telephone networks.

- Packet-switched data uses the Internet Protocol for data transmission. Mobile networks in the United States are gradually introducing IP-based data services[10]. AT&T Wireless and Cingular have recently launched the General Packet Radio Service (GPRS), a 2.5G technology. In October 2003, Verizon Wireless launched 3G wireless data services marketed under the *BroadbandAccess* brand. This offering is based on technology called CDMA2000 1x Evolution-Data Optimized (EV-DO).

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7 **European SMS Guide** prepared by Netsize, February 2003 refer to www.netsize.com

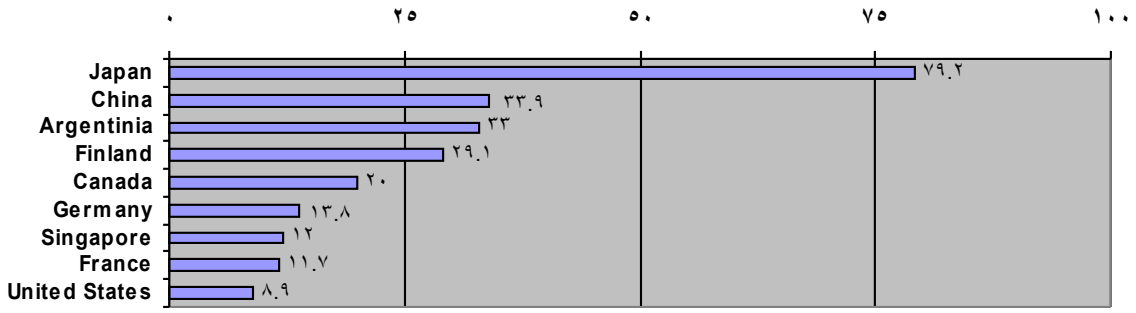
8 Mobile telephony usage in America has been hindered by charging users to receive calls; elsewhere in the world, only the calling party pays.

9 International Telecommunication Union, May 10, 2004

10 From a handset perspective, this transition will be an evolutionary one. In the initial rollout, voice traffic will still be circuit-switched with only data traffic using IPv4-based core networks. Enhancements, such as multiple concurrent packet data connections, will then be gradually rolled out over IP networks whether they are 2.5G or 3G. An important stage in this evolution will be the transition from IPv4 to IPv6, which will make every mobile phone individually addressable.

With 2G wireless technology, relatively few countries have been successful with mobile Internet services. Wireless Application Protocol (WAP) in Europe – a 2G technology – suffered from low transmission speeds and a scarcity of content. In contrast, Japan introduced a wide array of mobile Internet services, and witnessed significant growth in usage and subscribers. Wireless service providers in Japan made mobile Internet services an integral part of mobile phone ownership, and made charging for Internet content a reality. As shown in Figure 2-2, more than 79 percent of wireless subscribers in Japan were using some kind of mobile Internet services by 2003[11].

Figure 2-2 Mobile Internet Subscribers as a Percentage of Total Mobile Subscribers, 2003



Source: ITU, February 2004

In the United States, mobile Internet usage has increased recently with the introduction of 2.5G and 3G technologies. Consider the case of Verizon Wireless, the largest wireless service provider in the United States. During 2003, mobile Internet usage more than tripled as a result of Verizon's nationwide launch of 2.5G technology (1xRTT) and its limited introduction of 3G technology (1xEV-DO)[12]. Unabated near-term growth is expected, as more than 71 percent of Verizon customers have 2.5G-capable handsets[13] as of June 2004.

2.3 Prevailing Prices for Mobile Data Services (2004)

The mobile data service prices for messaging and switched data services are discussed below.

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11 **Shaping the Future Mobile Information Society: The Case of Japan,** International Telecommunications Union, Document: SMIA/06, 26 February 2004.

12 Verizon Investor Quarterly, January 29, 2004. Refer to http://investor.verizon.com/financial/quarterly/VZ/4Q2003/4Q03Bulletin.pdf

13 Verizon Second Quarter - 2004 Results Analyst Briefing. Refer to http://investor.verizon.com/news/20040727/20040727_bw.pdf

2.3.1 Messaging Prices

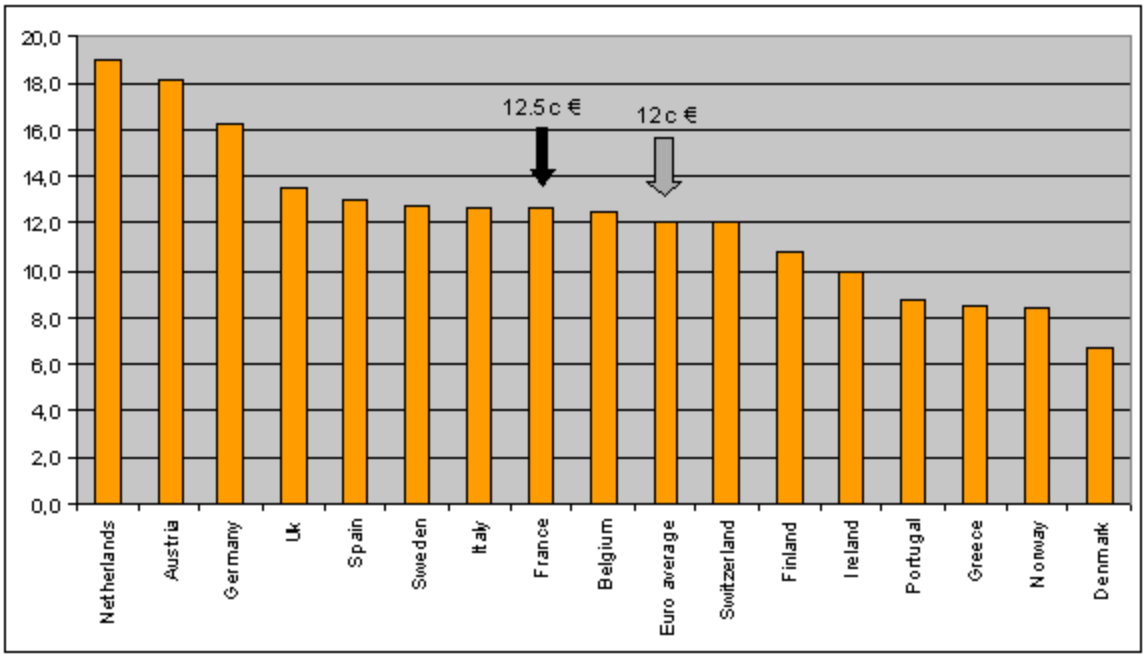
As noted in Section 2.2.1, SMS usage rates in the US are much lower than in Europe. However, the US usage rates are increasing, fueled largely by the declining prices. Table 2-2 indicates the current US pricing for SMS service. The SMS price in the US is now lower than in Europe where the January 2004 cost was about $0.15 (€0.12) per message on average across the European Union. Figure 2-3 shows the European SMS pricing as of January 2004.

Table 2-2 US SMS Rates (2004)

Carrier	SMS (up to 160 characters per message)
Verizon Wireless	$9.99 for 1000 messages, $0.02 receive, $0.10 send after that
AT&T Wireless	$19.99 for 1000 messages; $0.02 per message after that
Cingular	$9.99 for 750 messages; $0.03 per message after that
Sprint PCS	$10.00 for 1000 messages; $0.02 after that

Source: Company Websites, July 2004

Figure 2-3 European SMS Price Per Message (Euro cents, January 2004)



Source: Credit Suisse/First Boston 01/2004

2.3.2 Switched Data Services Prices

The price for switched data services in the US ranges from $29.00 for T-Mobile to $79.99 for Verizon Wireless, as shown in Table 2-3. The T-Mobile service is clearly the price leader for the currently available 2.5 G data technology.

Table 2-3 Switched Data Prices US (July 2004)

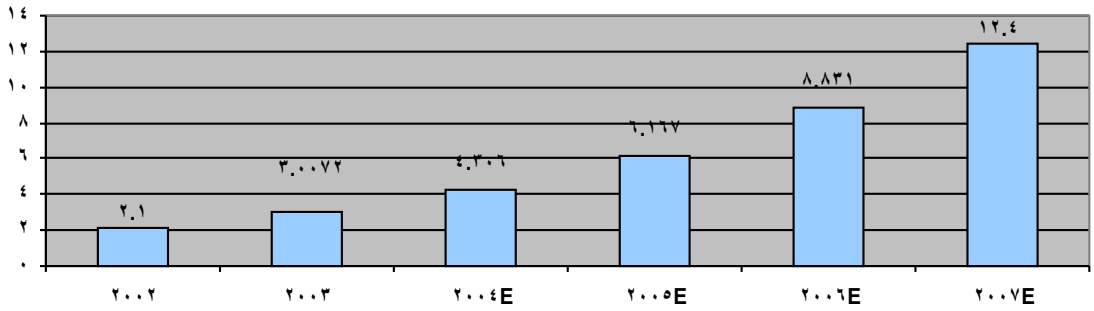
Carrier	Wireless Technology	Pay-per Use	Unlimited Usage, Monthly Fee
AT&T Wireless	GPRS/EDGE	$19.99 Monthly Subscription includes first 8 Mbytes $6.144/Mbyte (after exceeding 8Mbytes)	$49.99
Cingular	GPRS/EDGE	$9.99 Monthly Subscription includes first 2 Mbytes $10.24M/byte (after exceeding 2 Mbytes)	54.99
Nextel	iDEN	$19.99 Monthly Subscription includes first 5 Mbytes $9.22/Mbyte(after exceeding 2 Mbytes)	59.99
Sprint PCS	1xRTT/1xEV-DO	$40.00 Monthly Subscription includes first 20 Mbytes $2.05/Mbyte(after exceeding 2 Mbytes)	80.00 (limited to 300Mbyte)
T-Mobile USA	GPRS	n/a	29.99
Verizon Wireless	1xEV-DO	n/a	79.99

Source: Company Websites, July 2004

2.4 Medium-term Mobile Data Services Forecasts

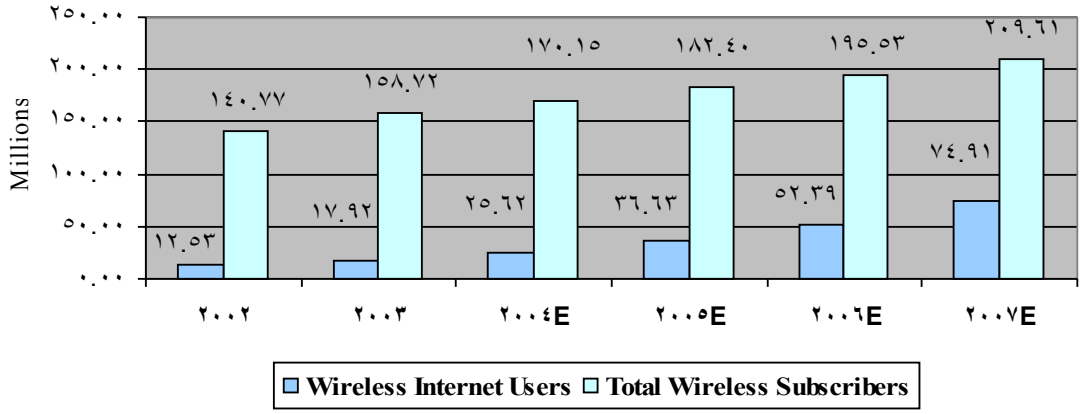
In the medium-term (circa 2002-2007), revenues for mobile data services are expected to grow significantly in the Unites States. The Gartner Group, a U.S.-based consultancy, estimates a compound annual growth rate of 41.7 percent, as shown in Figure 2-4. We estimate that in 2007 the number of mobile Internet users will exceed 74 million or approximately 36 percent of all mobile subscribers. Figure 2-5 shows the estimated number of wireless users and wireless Internet users over time.

Figure 2-4 US Mobile Data Revenue, US$ Billions



Source: Gartner, Inc., March 2004

Figure 2-5 Wireless Internet Users in US



Sources: ITU, Gartner, CTIA, Mitretek Systems

2.5 Cost of Providing Services

There is no simple formula to describe the wireless service provider cost structure. Costs, however, can be generally characterized by subscriber acquisition and retention costs, service delivery expenses, and network deployment and operating expenditures, as shown in Table 2-4[14, 15].

14 Refer to Appendix B for a detailed assessment of wireless service provider financials.

15 Note that telecommunication taxes are paid by the user, not the telecommunication provider.

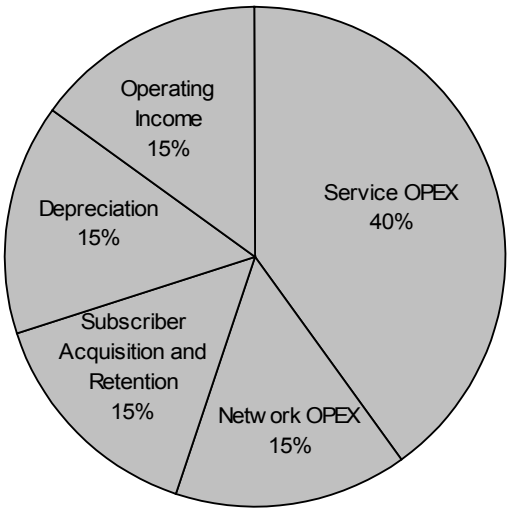
Table 2-4 Wireless Service Provide Cost Structure

Subscriber Acquisition	Service Delivery	Network
• Terminal subsidies • Promotion • Distribution	• Customer care and billing • Service creation and management • Content and interconnection	• Coverage cost/square mile • Capacity cost/MegaByte • Site rental • Leased lines and other transport

According to Nokia[16], one of the world's leading suppliers of wireless network infrastructure and mobile phones, a reasonable financial model for a wireless operator is presented in Figure 2-6. This model assumes that Earnings Before Interest, Taxes, and Depreciation and Amortization (EBITDA) is 30 percent of revenues. In 2003, AT&T Wireless recorded an EBITDA margin of [17] 28.1 percent; Verizon Wireless recorded an EBITDA margin of 35.4 percent; while Nextel recorded an EBITDA margin of 38.9 percent.

16 Refer to **The Prerequisites for Profitable Entry Business**, a white paper prepared by the Nokia Corporation, 2004.

17 AT&T Wireless reported an OIBDA margin of 28.1 percent. OIBDA is defined by AT&T Wireless as operating income (loss) before depreciation and amortization. OIBDA margin is calculated as OIBDA divided by services revenue. OIBDA and OIBDA margin are non-generally accepted accounting principles (GAAP) financial measures. They differ from operating income (loss), as calculated in accordance with GAAP in that they exclude depreciation and amortization, and differ from net income (loss) as calculated in accordance with GAAP in that they exclude (i) depreciation and amortization, (ii) other income (expense), (iii) interest expense, (iv) provision for income taxes, (v) net equity earnings (losses) from investments in unconsolidated subsidiaries, (vi) income (loss) from discontinued operations, and (vii) cumulative effect of change in accounting principle.



Sources: Nokia, Mitretek Systems

Figure 2-6 Nokia Model for Wireless Provider Cost Structure

2.5.1 Cost of Delivering 3G Data Services

Qualcomm has developed *pro forma* income statements for providing 3G mobile data, assuming a monthly flat rate of $40.00 per subscriber. Qualcomm estimates that the average cost of delivering one megabyte of mobile data ranges between $0.069 - $0.022, depending on technology[18], as shown in Table 2-5.

Table 2-5 Cost of Delivering Mobile Data

	WCDMA	CDMA2000 1X	CDMA2000 1xEV
Revenue/User/Month (1)	$40.00	$40.00	$40.00
Network Cost/User/Month	$18.49	$15.81	$5.90
SGA/User/Month (3)	$16.00	$16.00	$16.00
Earnings before Interest & Taxes	$5.51	8.19	18.10
EBIT margin	14%	20%	45%
Average Cost/Megabyte (2)	$0.069	$0.059	$0.022

(1) Source: Morgan Stanley Dean Witter, *The Mobile Internet Report*
(2) Excludes amortization of spectrum right-to-use licenses.
(3) Based on a compilation of projections for Sprint PCS, T-Mobile, AT&T Wireless, and Nextel

18 Refer to ***The Economics of Mobile Wireless Data***, a white paper prepared by the Qualcomm Corporation, 2001.

SECTION 3

THE FUTURE: MOBILE DATA SUPPLY SIDE

Most major US national carriers have launched 2.5G wireless data services, deploying either CDMA2000 1x RTT or GPRS technology, as shown in Table 3-6. Data speeds supported by these technologies are typically between 32 kb/sec and 64 kb/sec, although theoretically as high as 144 kb/s with 1x RTT. More recently, carriers have conducted limited service introductions of 3G data services, with broader goals to launch nationwide service in late 2004 and 2005.

Table 3-6 Mobile Data Services

Wireless Carrier	Current Technology	3G Roadmap	3G Status	Investment
Verizon Wireless	CDMA 1xRTT	EV-DO	Trials in Washington, D.C. and San Diego	US$5 B over 2004 - 2007
Cingular	GSM/GPRS	UMTS/High Speed Downlink Packet Access (HSDPA)	HSDPA Trial in Atlanta, Summer 2004 UMTS in 2005	US$5B over 2004 - 2007 pending successful acquisition of AT&T Wireless
AT&T Wireless	GSM/GPRS	UMTS	2004 - 2005	Not disclosed
Sprint PCS	CDMA 1xRTT	EV-DO	2nd Half 2004	US$1B mostly in 2005
Nextel Communications	iDEN	WiDEN	Not disclosed	Not disclosed
T-Mobile USA	GSM	Not disclosed	Not disclosed	Not disclosed

Sources: Company reports

3.1 3G Plans

The following subsections discuss the 3G plans of the two largest carriers—Verizon Wireless and Cingular.

3.1.1 Verizon Wireless 3G Plans

After conducting successful 3G trials in Washington, D.C. and San Diego, Verizon Wireless announced a significant expansion of its *BroadbandAccess* service based on CDMA 1xEvolution-Data Optimized (EV-DO) technology[19]. According to Dick Lynch, chief technology officer of Verizon Wireless, 30 percent of the carrier's network would be covered by EV-DO by the end of 2004, with "hundreds of cities" by the end of 2005. Verizon Wireless is initially targeting the mobile corporate workforce—often referred to as "road warriors". These enterprise customers can use *BroadbandAccess* as an extension of their corporate local area network (LAN) or intranet, allowing them to work from any location within the *BroadbandAccess* coverage area, as if they were in the office. *BroadbandAccess*, with average user speeds of 300 - 500 kilobits per second (kbps), is suitable for downloading files and business-critical information residing behind corporate firewalls and for accessing e-mail, intranets and the Internet.

3.1.2 Cingular 3G Plans

In May 2004, Cingular Wireless announced its intent to deploy a 3G UMTS (Universal Mobile Telecommunications System) trial network in the Atlanta market. The trial will allow Cingular to evaluate mobile voice, high-speed data and multimedia services.

The UMTS network will operate in the 1900 MHz spectrum, and will include testing of High Speed Downlink Packet Access (HSDPA), a technology that will ultimately support data speeds of up to 14.4 Megabits per second (Mbps). The network also will be designed to support voice over Internet protocol (VoIP) services in the future.

With this network, Cingular Wireless will be able to provide services such as high-speed downloads of film trailers, and video clips of sporting and entertainment events; mobile access to e-mail (including large attachments); and the ability to locate nearby services such as Automated Teller Machines (ATMs), restaurants or movie theaters.

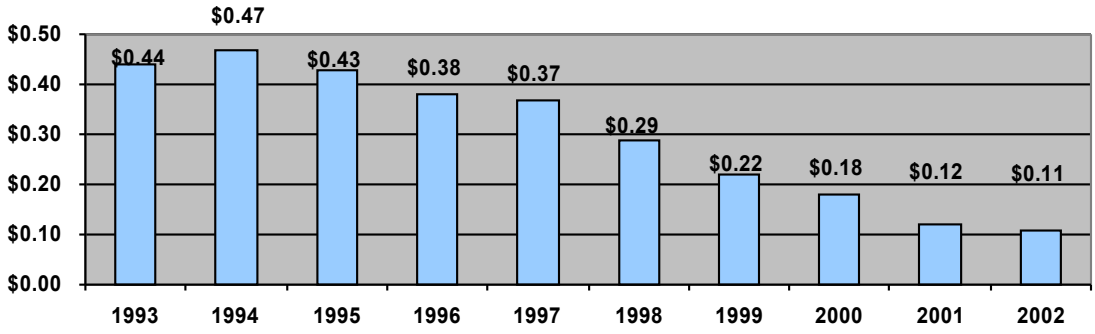
Additionally, this network deployment will allow Cingular to demonstrate technology that will enable businesses to provide their employees –such as field service and sales personnel —with high-speed mobile access to their corporate networks and all the business applications they normally use in the office.

3.2 Pricing Trends

In the United States, there are six national facilities-based mobile wireless service providers. This competition has resulted in diminished pricing power for the carriers. The price per minute continues to decline, as shown in Figure 3-7. Figure 3-8 shows that since 1997, the

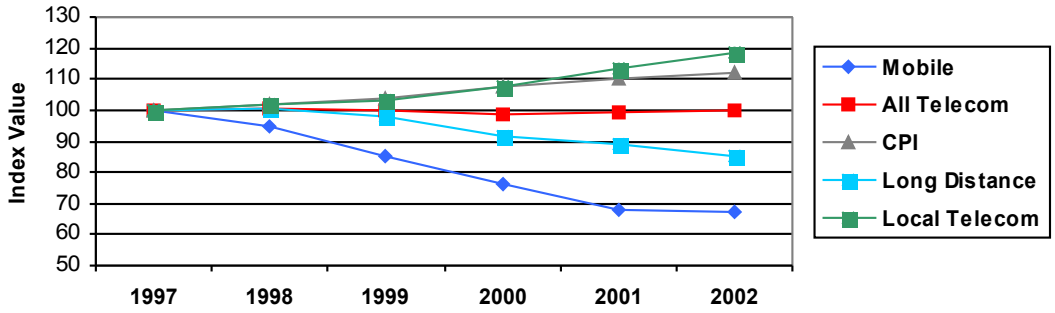
19 Refer to http://news.vzw.com/news/2004/01/pr2004-01-07.html

price for wireless service has decreased at a rate greater than all other telecom services, according to the U.S. Bureau of Labor Statistics.



Source: CTIA

Figure 3-7 Average Revenue Per Minute for US Wireless Service



Source: Bureau of Labor Statistics

Figure 3-8 Change in Consumer Price Index

3.2.1 Long-term Trends in Communications Pricing[20]

The general trend in communications has been towards simpler pricing and decreasing price discrimination[21]. The historical evidence suggests that flat-rate pricing has proven to be the most effective method for stimulating demand. Furthermore, some economists suggest that as marginal costs approach zero for telecommunication services, a flat rate for access may be the only practical pricing method[22]. Telecommunications has always been a declining cost industry—where marginal costs decrease as supply is expanded. Rapid technological change, however, has drastically reduced marginal costs in recent years.

Flat-rate pricing for unlimited wireless data usage has recently been introduced and is now available from all major carriers. Thus, wireless data is repeating the pricing patterns in the histories of communication technologies, including the postal system, the telephone, and the Internet.

The postal rates in Britain before 1840 charged far more for long distance mailings than justified by costs (a form of price discrimination). With the introduction of the uniform Penny Post in 1840, the volume of mail increased substantially. The British flat-rate postal rate scheme proved very influential, leading to reforms in other countries including the United States, as shown in Table 3-7.

Long distance telephone service in the U.S. presents an interesting case study. In the early 20th century, prices were high and traffic volume was low. In 1930, the Bell System carried around 160,000 toll calls per business day, compared to more than 300 million carried just by AT&T in the late 1990s. The expensive early prices initially depended on distance, but were the same around the clock. The first time-of-day pricing (a form of price discrimination) was introduced in 1919, with three rates: the highest from 4:30 am to 8:30 pm, a lower rate from 8:30 to midnight, and the lowest from midnight to 4:30 am.

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20 This section is adapted from **Internet pricing and the history of communications**, A. M. Odlyzko. *Computer Networks* 36 (2001), pp. 493-517. Also published in *Internet Services*, Lee McKnight and John Wroclawski, eds., MIT Press, 2001.

21 Charging different prices for the same good or service is known as Price Discrimination; it is very common in many markets, perhaps most notably in the pricing of airline tickets.

22 L. Anania and R.J. Solomon, **Flat – The Minimalist Price**, pp.91-118 in *Internet Economics*, L.W. McNight and J.P. Bailey, eds. MIT Press, 1997.

Table 3-7 U.S. Postal Service Rates for First Class Mail

Year	Parcel	Price
1799	Single Letters	
	No more than 40 miles	$0.008
	41 - 90 miles	0.10
	91 - 150 miles	0.125
	151 - 300 miles	0.17
	301 - 500 miles	0.20
	over 500 miles	0.25
1845	Single letters	
	No more than 300 miles	0.05
	Over 300 miles	0.10
1863	First half ounce	0.03
1885	First ounce	0.03
2004	First ounce	0.37

Source: A. M. Odlyzko

As prices continued to fall, distance-sensitive pricing decreased, but time-of-day discounts remained. Some forms of price discrimination increased markedly, however. The subsidization of local service by long distance revenues grew significantly in the 1950s, 1960s, and 1970s. The divesture of the Bell System led to major changes. The cross-subsidy of local service by long distance started its decline (these persist today in the form of access charges, i.e., the per-minute fees that local exchange carriers charge long-distance carriers for access to their networks). Drastic improvements in technology and competition led to further declines in prices and well as simplification of pricing plans. Distance-sensitive pricing was eliminated, and time-of-day variation was reduced typically to two tiers. Some of the most popular plans have uniform rates around the clock.

In the mid-1990s, the Internet was widely adopted by the general public. Prior to the Internet, there was a growing industry of commercial online services including CompuServe, Prodigy, and AOL. Each network had its proprietary user interface and a limited selection of content providers. As recently as 1996, pricing was based on a fixed monthly rate that included a small number of connect-time hours, and fees for each additional hour. There were also charges for e-mail messages. All these fees were unpopular with consumers.

As Internet Service Providers (ISPs) entered the market place, competition intensified, and flat-rate pricing was introduced. AT&T WorldNet was the first major ISP to offer it. The dominant pricing model today is the flat-rate, unlimited plan available from $9.95 to $21.95 for dial-up access. In addition, there are “free” access plans, supported by advertising.

3.2.2 Wholesale and Reselling of Wireless Services

The simple resale of telecommunications services is a long-established business model; it was introduced in the United States after the 1983 divestiture of the Bell System. Resellers typically make volume purchases of network services from facilities-based carriers and, in turn, offer discounts to their customers. According to the Washington, DC-based Telecommunications Resellers Association, there are more than 600 companies reselling telecommunications services in the U.S.

In recent years, a new variation of the simple resale model has emerged in the wireless services sector – namely, the Mobile Virtual Network Operator (MVNO). Table 3-8 shows the US MVNOs in existence as of February 2004. In contrast to simple resellers, MVNOs typically add value such as brand appeal, distribution channels, and other affinities to the resale of mobile services.

MVNOs often benefit from significant brand awareness among consumers. Consider Virgin Mobile USA (VMU), a joint venture owned by Richard Branson's Virgin Group and the US wireline and wireless carrier Sprint Corporation[23]. VMU offers wireless service to customers using the Sprint PCS network, although all service is branded VMU. Virgin Mobile USA is targeting its services at the youth market (ages 15 – 30), though its core market is the 18 to 24 year old age group. It is a prepaid service that aims to differentiate itself by positioning its service as a "hip, fun, honest" alternative to other wireless services available today.

23 **Virgin Mobile USA – Can an MVNO succeed in the US?** , *In-Stat/MDR InformationAlert,* Volume No. 24, June 27, 2002

Table 3-8 US Mobile Virtual Network Operators (February 2004)

MVNO	Underlying (Wholesale) Carrier
9278 Mobile	Sprint PCS
Air Voice Wireless	AT&T Wireless
Boost Mobile	Nextel
Call Plus	AT&T Wireless
EZ Link Plus	Cingular
GSR Mobile	Sprint PCS
JusTalk	AT&T Wireless
Liberty Wireless	Sprint PCS
Locus Mobile	AT&T Wireless
Mobile PCS	Sprint PCS
Omni Pre-paid Cellular	Verizon Wireless
Qwest	Sprint PCS
Page Plus	Verizon Wireless
STI Mobile	Sprint PCS
Tracfone	Verizon Wireless/Cingular
U Mobile	Sprint PCS
Virgin Mobile USA	Sprint PCS

Source: MobileIN.com

OnStar and Verizon Wireless. OnStar is a wholly owned subsidiary of General Motors, responsible for the design, development, and marketing of a telematics systems based on mobile wireless and Global Positioning System (GPS) technologies. The OnStar system provides users with route directions, emergency assistance, up-to-the-minute stock quotes, e-mail, and other services.

Verizon Wireless and OnStar have a longstanding wholesale relationship. OnStar uses the Verizon Wireless network, enabling OnStar subscribers to make calls from the vehicle and to communicate with the vehicle in the event of an emergency**.**

In July 2004, OnStar and Verizon Wireless announced[24] the *America's Choice*^{sm} *with OnStar* plan that combines Verizon Wireless service with OnStar service. This pricing plan lets customers receive one bill from Verizon Wireless for i) their wireless minutes used outside the vehicle with a Verizon Wireless handset and ii) inside the vehicle with the OnStar hands-

24 Refer to http://www.onstargm.com/promo/html/handset_program.html.

free in-vehicle phone. The *America's Choice℠ with OnStar* plan essentially allows two phones to use the same network while sharing or pooling airtime minutes.

The *America's Choice℠ with OnStar* starts at $49.99 per month – a $10 premium over comparable plans offered by Verizon Wireless. Customers who sign up for the new plan can select from two options: immediate call forwarding, whereby all calls from Verizon Wireless handheld phones are forwarded directly to their in-vehicle OnStar phones; or conditional call forwarding, in which customers can have their handheld phones ring four to five times before the call is forwarded to the in-vehicle OnStar phone.

The Economic Benefits of Wireless Resale. Traditional facilities-based mobile operators benefit from selling wholesale services to MVNOs and other resellers. Wholesale transactions entail the sale of excess network capacity at low marginal costs (often approaching zero). Moreover, wholesale sales require scant direct sales and marketing expenses, unlike the direct expenses incurred when acquiring retail customers[25] which range from $300 to $350 per customer for the major U.S. operators[26].

Most worldwide regulatory bodies favor the reselling of telecommunications services. Many actively promote simple resale as a means of fostering competition, which ultimately leads to greater consumer choice and lower prices.

Wholesale Rates. Wholesales prices available to the largest resellers are estimated to be 50 to 55 percent less than prevailing retail prices. The U.S. General Services Administration (GSA) is one of the largest resellers of telecommunications. GSA aggregates demand for more than 100 federal agencies, purchases telecom services at wholesale rates, and effectively resells such services for a nominal fee. According to its 2003 Annual Report, GSA offered prices which averaged 53 percent less than best commercial rates.[27]

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25 The average cost to a carrier of signing up an individual subscriber. Some of the factors included in the cost are handset subsidies, marketing, advertising and promotions.

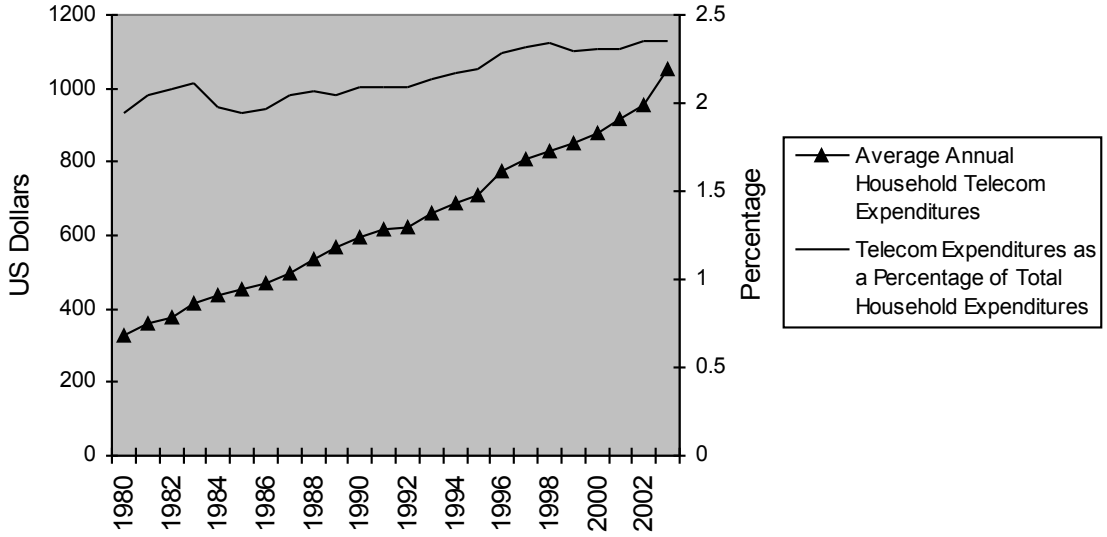
26 According to Dennis Spickler, MetroPCS vice president of finance, the company's cost per gross add (CPGA) in the 2003 was $100.50, less than one-third of many of the larger operators, which have CPGA figures in the $300 to $350 range. Quoted in Controlling Acquisition Costs, Wireless Week, March 15, 2004

27 p. 61, GSA 2003 Annual Performance and Accountability Report. Refer to http://www.gsa.gov/gsa/cm_attachments/GSA_DOCUMENT/2003GSAFullReport_R2F-aAB_0Z5RDZ-i34K-pR.pdf

SECTION 4

THE FUTURE: MOBILE DATA DEMAND SIDE

Among the factors positively affecting consumer demand for wireless data services are household disposable income and the propensity to substitute wireless services for traditional wireline services. The consumption of telecommunications services in the United States, as a percentage of household expenditures, has remained relatively constant in the past twenty years, as shown in Figure 4-9. As average household income and expenditures increase, consumers have tended to increase telecom expenditures at a similar rate. In future, telecommunications expenditures will likely grow at a rate commensurate to household expenditures (or income). Moreover, mobile wireless services will account for a greater proportion of total telecom expenditures, while fixed wireline services will account for less, a trend shown in Table 4-9, and Figure 4-10.



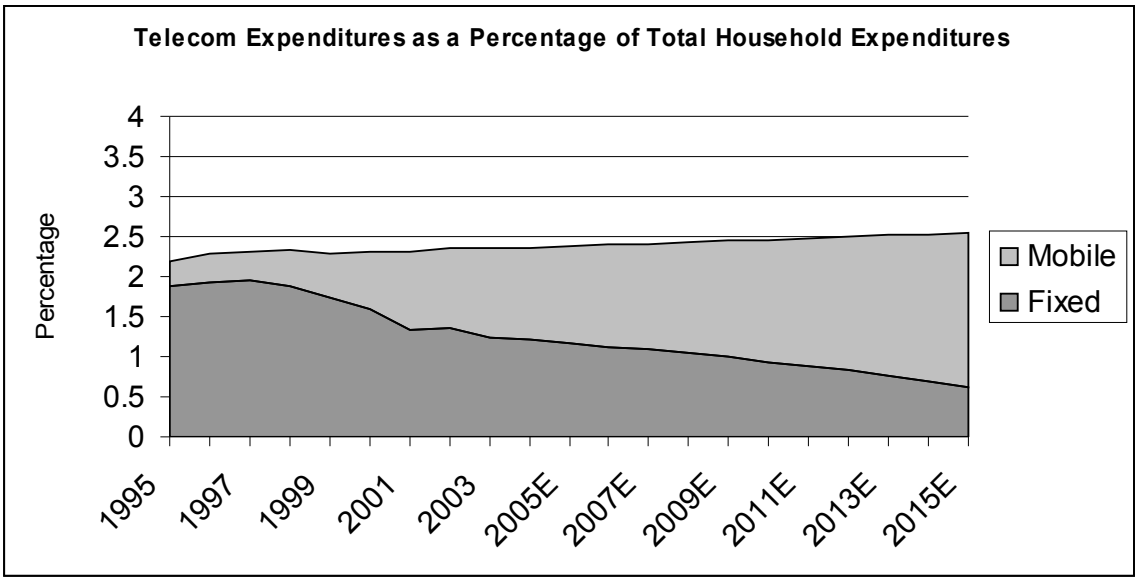
Sources: Bureau of Labor Statistics, FCC

Figure 4-9 Average Annual Household Telecom Expenditure

Table 4-9Average Annual Household Telecommunications Expenditures by Service Provider Type

Year	Local Exchange	Long Distance Carriers	Wireless Carriers	Total Expenditures
1995	$346	$250	$82	$596
1996	359	250	108	717
1997	379	305	129	813
1998	398	270	164	832
1999	402	257	205	864
2000	416	211	279	906
2001	426	176	351	953
2002	436	149	417	1001
2003	441	122	492	1055

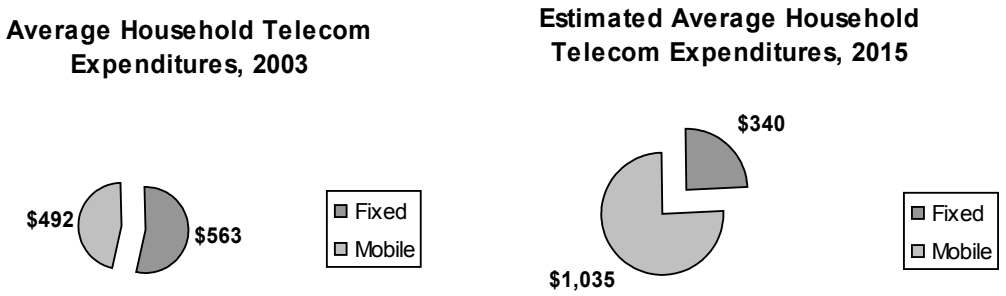
Source: TNS Telecom's Bill Harvesting® data



Sources: FCC, Mitretek Systems

Figure 4-10 Telecom Expenditures as a Percentage of Total Household Expenditures

We estimate that mobile expenditures as a percentage of total household expenditures will rise to just under 2 percent by 2015, as shown in Figure 4-10. We also estimate that average annual household expenditures for wireless services in 2015 will be about $1035, as shown in Figure 4-11.



Sources: FCC, Mitretek Systems[28]

Figure 4-11Household Telecom Expenditures

4.1 IM Migrates to Mobile

In the fixed Internet, Instant Messaging[29] (IM) service has proven to be very popular in America. According to In-Stat/MDR, there were 27.2 million AOL IM users, 22.7 million MSN IM users, and 15.6 Yahoo IM users in 2003. The growth of IM continues unabated. AOL reported that the use of IM doubled during 2003. More than two billion IM messages are sent and received on the America Online network daily, surpassing the 400 million e-mails sent daily by AOL users.[30]

IM services are now migrating to mobile networks and will spur greater demand for mobile messaging services. In December, 2003 Verizon Wireless announced the launch of IM services including interoperability with the three leading IM providers. Wireless carriers are targeting the burgeoning IM market – long the preferred mode of electronic chat among American teenagers. Moreover, the mobile terminal is becoming an expression of individual fashion and lifestyle, particularly for the 25 - 35 million people comprising America's *youth* market.

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28 We assume household expenditures increase at a CAGR of 2.2 percent during 2003-2015. In October 2003, the Blue Chip Consensus, an average of about 50 econometric forecasts, estimated a CAGR of 2.2 percent for the U.S. Consumer Price Index (CPI) for 2003-2006. The U.S. Congressional Budget Office estimated the CPI at 2.0 for the same period.

29 Instant Messaging alerts users when friends or colleagues are on line, allowing private online chat or "instant" communication. With instant messaging, a user creates a list of other subscribers with whom one wishes to communicate; AOL calls it the *buddy list*. When a *buddy* is on line, the service alerts the user and enables immediate interactive messaging with one's *buddy*.

30 AOL, Yahoo, and MSN to Integrate Messaging, The Washington Post, July 15, 2004.

4.1.1 Wireless Substitution

According to Ovum, a U.K-based consultancy, approximately 12 percent of households in the European Union are *mobile only* households[31]. While specific data is largely unavailable for the United States market, it appears that only about five percent of wireless customers use their wireless phones as their only phone, according to an FCC review of third-party research[32]. These customers have "cut the cord" in the sense of canceling their subscription to fixed wireline telephone service. There is increasing evidence, however, that U.S. consumers are substituting wireless service for traditional wireline communications[33]. Moreover, Forrester Research analyst Charles Golvin projects that the proportion of US wireless users without a fixed line will nearly triple to 13 percent by the end of 2006[34]. The U.S.-based consultancy In-Stat/MDR estimates that 29.8% of wireless subscribers will not have a landline by 2008[35].

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31 The use of mobile instead of fixed phone for calls or access is also called fixed to mobile substitution (FMS). FMS is potentially a major threat to fixed operators. In European markets, few users are `cutting the cord', however, many new users are going `straight to mobile'. Ovum estimated that 12% of the EU households are `mobile only' according to an EU commissioned survey in February 2004. This figure varies widely among countries: from 4% in Germany and Sweden, 6% in the UK, through to 16% in France, to a massive 29% of households in Finland that use mobile as their only access method.

32 pp 49-50, Annual Report and Analysis of Competitive Market Conditions With Respect to Commercial Mobile Services, Federal Communications Commission, FCC 03-150, July 14, 2003.

33 *Going Mobile: Substitutability between Fixed and Mobile Access*, M. Rodinim, M.R. Ward, and G.A. Woroch, **Telecommunications Policy**, 27 (2003), pp. 457-476.

34 As quoted in *Choosing Cell Over Landline can Bring Unexpected Pain*, J. Saranow and C. Bialik, The Wall Street Journal Online Edition, July 9, 2004

35 Clint Wheelock, Director, Wireless Research, **In-Stat/MDR**, February 2004.

SECTION 5

SUMMARY CONCLUSIONS AND FORECASTS

- Flat-rate pricing, that is, a monthly charge for unlimited data transmission, is expected to be the dominant pricing method for mobile data services in the 2015 timeframe. This is consistent with the trends discussed in Section . Telecommunications has always been—and will continue to be—a declining cost industry, where marginal costs decrease as supply is expanded. Rapid technological change will continue, contributing to further reductions in marginal costs. Some economists argue that as marginal costs approach zero for telecommunication services, a flat rate is be the only practical pricing method. In future, service providers will be compelled to offer flat-rate plans and bundle new and innovative services in order to maintain targeted average revenue per user (ARPU) figures.

- The best *commercial retail* flat-rate monthly price for unlimited wireless data will be approximately $15 per transceiver, decreasing from $29.99 in 2003, and representing a compound annual growth rate (CAGR) of about negative 5.6 percent. This decline in prices is consistent with the information presented in Section 3.2.

- The best *wholesale* flat-rate monthly price for unlimited wireless data will be in the range from $6.75 to $7.50 per transceiver, representing a 50-to-55 percent discount compared to best commercial retail prices. This discount is consistent with the GSA discount discussed in Section 3.2.2.

- In 2015, the U.S. mobile service subscription rate will have converged to rates prevalent in other highly developed consumer societies. No fewer than 90 percent of U.S. inhabitants (or 281 million people[36]) will subscribe to mobile services, increasing from 54.3 percent in 2003, and representing a CAGR of 4.88 percent.

- Of those subscribing to mobile services, no less than two-thirds (67 percent or 188 million) will be users of messaging and mobile Internet services.

- Spending for telecommunications services will constitute about 2.5 percent of total household expenditures, increasing from 2.35 percent in 2003, and representing a CAGR of about 0.65 percent.

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36 The U.S. Census Bureau forecasts (Middle Series estimate) a total of 312,268,000 inhabitants in July 2015. Refer to http://www.census.gov/population/projections/nation/detail/d2011_20.pdf

- Average monthly household spending for telecommunications services will be almost $115, increasing from $87.92 in 2003, and representing a CAGR of 2.2 percent.

- The average monthly household expenditure for wireless services (including voice and data) will be about $86, representing a CAGR of about 6.4 percent from 2003. The average monthly expenditure for fixed telecom services will decline to about $28, representing a CAGR of about negative 4 percent.

- The nominal price of delivering one megabyte of wireless data will be less than $0.02. According to classical economic theory, prices (eventually) decline and approximate the marginal cost of providing the particular good or service. Therefore, prevailing prices in 2015 will approximate the marginal cost of delivering one megabyte, which Qualcomm estimates at $0.02 using 3G technologies.

Appendix A—Generations of Mobile Technology[37]

Mobile wireless technology is most often described in terms of generations, or "Gs".

First Generation (1G) mobile phones and systems, which were introduced in the late 1970s, use analogue technology to transmit voice calls. Sound quality is fair, use of radio spectrum is inefficient, and fraudulent use is prevalent (i.e. cloning of cell phone user profiles). According to the CITA, there were more than 11 million analogue subscribers in the United States as of December 2003.

Second Generation (2G) mobile systems use digital encoding. Call set-up information between the handset and the base station is encrypted, making fraud nearly impossible. In addition to voice calls, 2G handsets can also send and receive rudimentary data such as text messaging. 2G systems do not support always-on connection, however. Most mobile phones in use today in the United States are 2G.

Enhanced Second Generation (2.5G) systems, which were introduced in the late 1990s, extend 2G technology to offer improved data capabilities, such as higher transmission rates and always-on connections, so these systems can support more advanced data services.

Third Generation (3G) phones will offer high-speed, always-on data connections.. Applications include video telephony and Internet access. 3G networks are also designed to support more users by more efficient spectrum use. In 2003, Verizon Wireless launched the first commercially available 3G service in the United States.

Wireless carriers will take a migration path to next-generation networks based upon various factors including performance, cost, feature capabilities, competitor offerings, and available radio spectrum. Figure A-1 illustrates the various evolutionary paths for wireless data technologies.

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37 This appendix is adapted from Emerging Wireless Services for Enterprises, Brosnan, G. A., Rice, H.J.and J. H. Scharen-Guivel, to appear in The Telecommunications Review, Mitretek Systems, 2005.

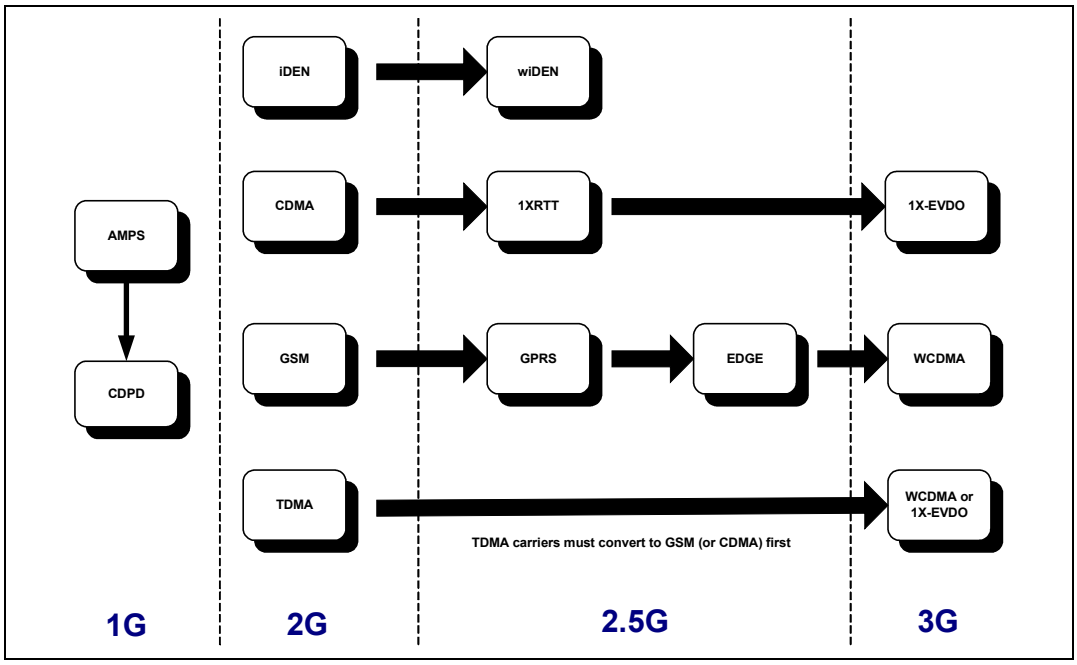

Figure A-1. Evolutionary Paths for Wireless Data Technologies

Wireless network technologies have evolved from disparate standards (i.e. proprietary, regional and national), resulting in a fragmented market.. For 2G digital service, two primary types of access technologies are deployed: Code Division Multiple Access (CDMA) and Time Division Multiple Access (TDMA). In the U.S., the market place is fragmented with providers offering services using both CDMA and TDMA technologies. Table A-1 summarizes the various wireless technologies currently deployed.

Table A-1. Wireless Technologies

Technology	Description
1XEVDO (CDMA2000)	Single Carrier (1x) "EVolution, Data-Only". 1xEV-DO is based on a technology initially known as "HDR" (High Data Rate) or "HRPD" (High Rate Packet Data), developed by Qualcomm. 1XEV-DO is a "3G" technology with speeds from 300 – 500 k/bps and burstable up to 2.0 M/bps and sometimes referred to as second phase of CDMA2000.
1XEVDV (CDMA2000)	Single Carrier (1X0) “Evolution Data Voice”.1XEV-DVand is characterized by a maximum data rate of 5.2 Mbps and the ability to support wireless Voice over IP (VoIP) services. It is sometimes referred to as the third phase of CDMA2000.

Technology	Description
1XRTT (CDMA2000)	Single Carrier (1x) Radio Transmission Technology. 1xRTT offers speeds from 40 – 60kbps and burstable up to 144 k/bps. It is a 2.5G technology and referred to as the first phase of CDMA2000.
AMPS	Advanced Mobile Phone Service. The 1G analog wireless transmission technology deployed in the 1980's in the United States.
CDMA	Code Division Multiple Access. CDMA is a spread spectrum technology, where each voice or data call uses the entire radio band and is assigned a unique code. It is a 2G digital wireless technology. The term "CDMA" is also commonly used to refer to one specific implementation: IS-95.
CDPD	Cellular Digital Packet Data. An open wireless transmission standard allowing two-way 19.2-Kbps packet data transmission over existing cellular telephone channels (AMPS with CDPD capability). CDPD technology uses idle network capacity caused by pauses in phone conversations and gaps between calls placed, etc. to transmit data.
EDGE	Enhanced Data for GSM Evolution. A 3G technology for GSM/GPRS networks that can handle data speeds up to 384 k/bps. EDGE works within existing radio spectrum.
GPRS	General Packet Radio Service. A 2.5G technology that offers speeds up to approximately 114 K/bps. GPRS provides a migration path for GSM carriers to offer higher data speeds.
GSM	Global System for Mobile Communication. It is a 2G digital wireless TDMA technology that is the worlds most widely used system.
iDEN	Integrated Digital Enhanced Network. A 2G TDMA-based digital wireless standard designed to work in special frequencies originally designated for analog Specialized Mobile Radio (SMR) networks. iDEN was invented by Motorola and used by Nextel within the US. iDEN supports voice, data, SMS and two way radio (P2T)
OFDM	Orthogonal Frequency Division Multiplex. OFDM is an efficient modulation scheme that can support an average data rate of around 1.5 Mbit/s while using only 1.25 MHz of spectrum. (Nextel is trialing this technology in the Raleigh Durham market).
TDMA	Time-Division Multiple Access. It is a 2G a digital wireless technology. In TDMA, the frequency band is split into a number of time slots so that several calls can share a single channel without interfering with one another. It is the prevalent technology for 2G wireless with 3 main versions: North American, European (GSM) and Japanese.
TD-SCDMA	Time Division Synchronous Code Division Multiple Access. It is a 3G digital wireless technology developed jointly by China Academy of Telecommunication

Technology	Description
	Technology along with commercial companies for wireless services being launched in China.
WCMDA	Wide Band Code Division Multiple Access. It is a 3G technology that uses spread spectrum technology, where each voice or data call uses the entire radio band and is assigned a unique code. It supports transmission speeds up to 2 M/bps.

Appendix B—Wireless Provider Operating Revenue and Costs

In general, wireless provider "operating income" and/or "margins" are affected by the following "operating costs" (some include depreciation and amortization):

1. Cost of providing wireless service
   - operate and maintain network—including direct switch and transmitter and receiver site costs, such as rent, utilities, property taxes and maintenance for the network switches and sites, payroll and facilities costs associated with network engineering employees, frequency leasing costs and roaming fees paid to other carriers;
   - fixed and variable interconnection costs, the fixed component of which consists of monthly flat-rate fees for facilities leased from local exchange carriers based on the number of transmitter and receiver sites and switches in service in a particular period and the related equipment installed at each site, and the variable component of which generally consists of per-minute use fees charged by wireline and wireless providers for wireless calls terminating on their networks and fluctuates in relation to the level and duration of wireless calls;
   - handset service and repair program
   - activate service for new subscribers

2. Cost of mobile end units and accessory revenues
   - handsets, other mobile devices, and accessories sold, order fulfillment related expenses and write-downs of handset and related accessory inventory for shrinkage.
   - Subsidies

3. Selling and marketing costs
   - customer acquisition, including residual payments to indirect dealers, commissions earned by indirect dealers, distributors and direct sales force for new handset activations,
   - payroll and facilities costs associated with direct sales force, stores and marketing employees, telemarketing, advertising, media programs and sponsorships, including costs related to branding

4. General and administrative costs
   - billing, customer care and information technology operations, bad debt expense and back office support activities including customer retention, collections, information technology, legal, finance, human resources, strategic planning and technology and product development, along with the related payroll and facilities costs
   - or costs to outsource any or all of the above

Recent Operating Costs and Operating Income percentage for the major wireless providers are depicted in Table B-1 (reference the Nokia model of 15% operating income as a comparison)

Table B-1. Recent Financial Data for Major Wireless Providers ($ Millions)

	Revenue			Cost of Revenue			SGA Cost			Operating Income %		
Wireless Provider	**2003**	**2002**	**2001**	**2003**	**2002**	**2001**	**2003**	**2002**	**2001**	**2003**	**2002**	**2001**
Nextel	10,820	8,721	7,689	3,151	2,516	2,869	3,453	3,039	3,020	23	18	Loss
AT&T Wireless (DoCoMo – 16%)	15,659	14,483	12,532	6,803	6,832	6,028	5,415	4,977	4,482	8	Loss	5
Verizon Wireless (Vodafone – 45%)	22,489	19,473	17,560	6,460	5,456	5,085	8,057	7,084	6,461	35	21	24
Cingular(SBC – 60%, Bellsouth – 40%)	15,483	14,903	14,268	5,683	5,106	4,564	5,422	5,426	5,235	28	29	31
Sprint PCS	12,690	12,074	9,725	6,155	5,783	5,295	3,136	3,411	2,917	27	24	Loss

The Wireless Provider Depreciation and Amortization charges are at times subtracted from Operating Revenues to yield the Operating Income. Also any restructuring charges are also subtracted from the Operating Revenues to yield the Operating Income. The provider depreciation and amortization charges are shown in Table B-2.

Table B-2 Wireless Provider Depreciation and Amortization Charges ($Millions)

Provider/Depreciation-Amortization	2003	2002	2001
Nextel	1,694	1,595	1,746
AT&T Wireless	3,181	2,751	2,502
Verizon Wireless	3,888	3,293	3,709
Cingular	2,089	1,850	1,921
Sprint PCS	2,486	2,267	2,150

The Wireless Provider Capital Expenditures over the last 3 year period are shown in Table B-3.

Table B-3. Wireless Provider Capital Expenditures ($Millions)

Provider Capital Expenditures	2003	2002	2001
Nextel	1,716	1,863	3,418
AT&T Wireless	2,774	5,302	5,205
Verizon Wireless	6,820	8,004	12,731
Cingular	2,734	3,085	3,156
Sprint PCS	2,150	2,668	3,751