

FAIR MARKET VALUATION REPORT:

**PERSONAL COMMUNICATIONS SERVICE
PIONEER'S PREFERENCE LICENSE**

QUALCOMM, INC.

AS OF DECEMBER 31, 1999

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January 27, 2000

Dear Mr. Kelley:

PricewaterhouseCoopers LLP was retained to perform valuation services for QUALCOMM, Inc. ("QUALCOMM" or "QCOM") in connection with determining the current value of a Federal Communications Commission ("FCC") Pioneer's Preference Personal Communications Service ("PCS") license. We understand that our value determination will be used for litigation purposes resulting from a 1993 denial of an FCC Pioneer's Preference PCS license to QUALCOMM for the City of Miami, Florida and a subsequent granting of restitution by the U.S. Court of Appeals in July 1999. The effective date of our valuation is December 31, 1999. We have not been engaged to make specific purchase, sale, or financing recommendations and our valuation should not be construed as a fairness opinion. Our work may not be included or referred to in any Securities and Exchange Commission Filing or other public document, or relied upon by shareholders or potential investors for investment decisions.

Our valuation analysis was prepared in conformance with the Uniform Standards of Professional Appraisal Practice of the Appraisal Foundation and is subject to the Statement of General Assumptions and Limiting Conditions that is attached to this report.

The basis of value in our analysis is Fair Market Value. Fair market value is the amount at which property would change hands between a willing seller and a willing buyer when neither is acting under compulsion and when both have reasonable knowledge of all relevant facts. This concept of value is supported by definitions set forth by the Internal Revenue Service and has been further established and elaborated upon in numerous court decisions dealing with Fair Market Value.

The scope of the engagement involved (to the extent appropriate):

- Review and analysis of the FCC Pioneer's Preference PCS licensing process.
- Review and analysis of recent PCS license auctions held by the FCC.
- Review and analysis of transactions involving the original three Pioneer's Preference PCS licenses.
- An analysis of current sales of other PCS systems as well as any available FCC license values as documented in publicly available purchase price allocation information.
- Analysis and determination of potential adjustments to market data in order to arrive at the Fair Market Value of the Miami A-block PCS License.
- A presentation and discussion of our findings in a narrative report detailing and supporting our findings and conclusions of value.

Based on the analysis discussed in this report and presented in the attached Exhibits, it is our opinion that, as of December 31, 1999, the Fair Market Value of the Federal Communications Commission Pioneer's Preference Personal Communications Service License denied to QUALCOMM was \$186,000,000, as shown in Exhibit J.

Very truly yours,


PricewaterhouseCoopers LLP

VALUATION REPORT:

THE FAIR MARKET VALUE OF
FCC PIONEER'S PREFERENCE PCS LICENSE
FOR QUALCOMM, INC.
AS OF
DECEMBER 31, 1999

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I. INTRODUCTION

A. Background

Pursuant to your request, we have prepared this valuation report relating QUALCOMM, Inc.'s ("QUALCOMM") 1992 denial of a Federal Communications Commission ("FCC") Pioneer's Preference Personal Communications Service ("PCS") license for the Miami Major Trading Area ("MTA") (the "License"). QUALCOMM applied for the License based on their work with CDMA technology but was originally denied the application. A subsequent court ruling determined that the FCC had used different criteria to evaluate the QUALCOMM application than other applications, and that QUALCOMM was unjustly denied the License. In July of 1999, the U.S. Court of Appeals in Miami, in *QUALCOMM v. FCC*, ordered the FCC "forthwith to grant a pioneer's preference to QUALCOMM and to take prompt action to identify suitable spectrum and award QUALCOMM the license for it."

B. Purpose of the Engagement

We understand that our valuation will be used by QUALCOMM in negotiations with the FCC to assist in the assignment of suitable spectrum. The effective date of this analysis is December 31, 1999 (the "Valuation Date"). This report presents our estimation of the fair value of the denied License.

C. Sources of Information

In the course of our valuation analysis, we relied upon financial and other quantitative and qualitative information obtained from various public, financial, and industry sources. Our conclusions are dependent on such information being complete and accurate in all material respects. However, as is customary in the business valuation profession, the scope of our work does not enable us to accept responsibility for the accuracy and completeness of such provided information.

The principal sources of information used in performing our valuation included:

- *US PCS Marketplace:1999, US PCS Marketplace:1998 and US PCS Marketplace:1997* published by The Strategis Group
- *Wireless Telecom Investor* newsletters published by Paul Kagan Associates

- Equity Analyst's reports published by Donaldson, Lufkin and Jenrette ("DLJ"), Salomon Smith Barney, Goldman Sachs, and Credit Suisse First Boston
- Standard & Poor's *Communications: Wireless Industry Guide*
- The First, Second, Third and Fourth *Annual Report and Analysis of Competitive Market Conditions with Respect to Commercial Mobile Radio Services* published by the FCC
- Recent articles regarding trends in the wireless telecommunications industry
- Compustat's PC Plus database of publicly traded companies
- Bloomberg's on-line database covering financial markets, commodities, and news
- Telecommunications Reports' on-line database of news and information about the telecommunications industry
- Kagan.com's on-line database covering telecommunications services, transactions, and news, and
- Other information deemed to be relevant.

D. Scope of Work

In general, our procedures included, but were not limited to, the following:

- Analysis of conditions in, and the economic outlook for, the telecommunications services industry
- Analysis of general market data, including economic, governmental, and environmental forces
- Analysis of the FCC Pioneer's Preference PCS licensing process
- Analysis of primary and secondary sales of FCC PCS licenses
- Analysis of transactions involving the three issued FCC Pioneer's Preference PCS licenses
- Analysis of operating and financial results of public companies operating PCS systems
- Valuation computations for the License and
- Analysis of other facts and data considered pertinent to this valuation to determine the fair value of the License

II. COMPANY DESCRIPTION¹

A. Overview and History

QUALCOMM, Inc. is a wireless telecommunications industry leader. The Company was originally incorporated in California in 1985 and incorporated again in 1991 in Delaware. The Company made Code Division Multiple Access ("CDMA") technology commercially viable through its innovations, inventions and research. QUALCOMM develops advanced chipsets and system software products for subscribers, and mobile information management systems. QUALCOMM has licensed its CDMA technology to over 65 communications manufacturers worldwide.

The Company is the worldwide leader in the development of the CDMA technology, which is used in mobile phones, wireless telecom equipment and satellite ground stations. QUALCOMM manufactures wireless phones and chipsets. QUALCOMM currently has plans to sell off its handset business to Kyocera of Japan, however it will continue to develop its CDMA chipsets and license the technology to others. QUALCOMM is also responsible for the OmniTRACS global positioning system, used by the trucking industry, as well as the Eudora e-mail software program.

Through its many lucrative mobile phone patents, QUALCOMM was one of the leading stock performers in 1999 with its market value up 112.02 percent to close 1999 at \$116.3 billion. QUALCOMM closed the year with its stock price at \$176.25, up 2,621 percent after the stock split 4-for-1 on December 30, 1999. Analysts expect the stock price to double in 2000.

B. Pioneer's Preference Background

QUALCOMM applied for a license for wireless spectrum through the FCC's Pioneer program. The program was created to spur the development of new services and technologies in wireless communications by offering incentives to applicants who were developing cutting-edge technology. Participants received discounts and preferential treatment on licenses. The recipients of the Pioneer's Preference received additional benefits such as favorable, long-term payment plans and a first mover advantage in the marketplace.

¹<http://www.qualcomm.com> and <http://www.hoovers.com>

The FCC first denied QUALCOMM's application for a Pioneer's Preference in 1992 claiming that they did not deserve the award because their CDMA technology was only an adaptation of an existing technology. The FCC rejected QUALCOMM again in subsequent reviews, until QUALCOMM appealed to the U.S. Court of Appeals in 1994. The Court ruled against the FCC in 1997 on the grounds that the FCC regulators' decision had been arbitrary and capricious. The Court also stated that QUALCOMM had "performed significant new work." The remand only gave the FCC the responsibility to find QUALCOMM an equivalent license to the Miami license and not to review the case itself. However, by the time the Court made its ruling, the FCC said it no longer had authority to grant Pioneer licenses.

In 1997, Congress passed the balanced budget act that ended the Pioneer's Preference practice and replaced it with wireless auctions. On July 23, 1999, the U.S. Court of Appeals for the District of Columbia reversed the 1997 and 1998 FCC decisions not to issue a Pioneer's Preference license to QUALCOMM. QUALCOMM at one point was lobbying for Sprint PCS (the Miami A-block PCS license holder) or PrimeCo Personal Communications, LP ("PrimeCo") (the Miami B-block PCS license holder) to give up their licenses to make space in the spectrum for the Miami MTA. Sprint PCS and PrimeCo acquired their respective licenses through the FCC wireless auction that concluded in March 1995.

III. GENERAL ECONOMIC OUTLOOK²

A. Objective

The following discussion and analysis describes the U.S. economic environment in 1999. This data consists of information pertaining to leading economic indicators such as unemployment rates and inflation levels. In addition to evaluating the state of the economy, we also examined the performance of the financial markets over time and described any recurring trends and/or anomalies that occurred throughout the period.

B. General Economic Environment

The U.S. economy closed out another remarkable year in 1999, with steady growth and low inflation driving the ninth consecutive year of expansion. Spurred by strong consumer confidence, which led to robust spending as well as tight labor markets, the U.S. economy soared to continue its record expansion. Although in 1998, Asia (Japan specifically) experienced severe economic contractions, Russia incurred massive debt defaults, and the Brazilian currency was devalued, the U.S. was still able to experience strong growth. Three interest rate cuts implemented by the Federal Reserve Board ("Fed") also played a significant role in the U.S. economy's success throughout this year. This strong economic performance fueled another record year on Wall Street, with the Dow Jones Industrial Average soaring to all time highs and the NASDAQ Composite leading the way.

Analysts' growth expectations were exceeded in 1999. The high level of consumer confidence led to buoyant consumption, which in turn drove the financial markets to record highs. Although many analysts still believe the market is overvalued and that a correction is pending, general economic indicators all support a continued thriving economy. The economy's current expansion of 107 consecutive months began in the second quarter of 1991 and set a record for the longest peacetime expansion ever experienced by the U.S.

²The Dow Jones Retrieval Service, the Bureau of Labor Statistics, Bloomberg Business News, the Federal Reserve Board, the Atlas of Economic Indicators, and the Wall Street Journal

C. Economic Indicators

This segment discusses and highlights leading economic indicators and their significance to the economic welfare of the nation.

- *Index of Leading Indicators* - The Index of Leading Economic Indicators ("LEI") is a composite of several different indicators designed to predict future aggregate economic activity. As a rule of thumb, turning points in the economy are signaled by three consecutive monthly LEI changes in the same direction. The LEI fell 0.1 percent in August for the second time in 11 months. Analysts had expected this decrease as the index increased by 0.03 percent in each of the prior three months. In November the leading index increased 0.3 percent, the coincident index increased 0.2 percent, and the lagging index increased 0.3 percent. Six of the ten indicators that comprise the leading index increased in November. Some of the contributors to the increase were stock prices, manufacturers' new orders of consumer goods and materials, and the money supply. The three composite indexes together with their components show a healthy economy. The leading index rose to 108.3 in November.
- *GDP* - Real or inflation adjusted GDP, the market value of all final goods and services produced in the U.S., witnessed levels of \$8.80 trillion and \$8.87 trillion during the first and second quarters respectively. First quarter GDP experienced a 4.3 percent annual growth rate compared to a 1.6 percent annual growth rate for the second quarter. The second quarter's figure marks the U.S. economy's slowest expansion since a 0.4 percent rate in the second quarter of 1995. Analysts believe the low level of growth was primarily due to business's slow pace in accumulating inventory, which rose just \$7.4 billion during the period. Third Quarter GDP closed at \$9.29 trillion up 5.7 percent annually, the fastest since 5.9 percent in the fourth quarter of 1998.
- *Inflation* - The Consumer Price Index ("CPI") is the most widely used index of price changes over time. This is a key indicator, as it measures the level of inflation and the purchasing power of the dollar. The CPI closed the fourth quarter of 1998 at 163.9. The latest monthly increase, for November 1999, was 0.4 percent, a 2.6 percent increase year over year. This increase brought the CPI to its current level of 167.10. This was the largest monthly escalation since March 1997, when the index rose by 0.2 percent. The current CPI movement calmed concerns that inflation is accelerating. In fact, the Core CPI, which excludes volatile energy and food prices, increased by only 0.2 percent in November. This represents an increase of 2 percent from last year. Energy prices remained constant after a slight 0.1 percent decrease in October. Food prices rose 0.1 percent in November after a 0.2

percent rise in October. Air fares rose slightly while new vehicle prices and transportation costs overall remained largely unchanged.

The Producer Price Index ("PPI") is another inflationary measure that pertains specifically to prices charged by factories, refineries and food processing plants. The PPI experienced a downward trend for much of the past two years. The PPI for finished goods rose 1.1 percent in September of 1999. This marks the largest increase since September 1990, when prices of finished goods rose 1.3 percent. According to analysts, however, the increase did not reflect a general upswing of the index, but rather sharp increases in select items. Accounting for the bulk of the increase were tobacco, energy and food prices. This is not surprising for tobacco, as many tobacco companies raised prices in order to pass on high legal settlement costs to their customers. In September, wholesale cigarette prices increased by 9.5 percent while tobacco prices climbed 8.4 percent. The energy sector experienced price increases with wholesale energy prices rising 2.2 percent, gasoline prices increasing by 2.2 percent, and residential gas prices experiencing an upswing of 2.5 percent. Food prices also were affected, as crisis-hit economies in Asia and Latin America continue to recover. Food prices, which account for 23 percent of the overall index, rose by 1 percent during the month of September. In October the index decreased 0.1 percent and rose again in November by 0.2 percent. The core index, which excludes food and energy prices, remained unchanged in November. Most of the increase in November was attributable to a 1.4 percent increase in energy prices, due to increases in prices for heating oil and residential natural gas.

- *Consumer Confidence* - Consumer Confidence is a leading gauge of economic activity. The Consumer Confidence Index ("CCI") is the measuring stick for this statistic, which when high is characterized by high consumer demand, general optimism and increased spending. After a downward trend, the Consumer Confidence Index rose from 104.2 percent to 105.4 percent in December, a 0.2 percent increase. Confidence levels finished the year at all-time highs, as there does not seem to be any decline in consumer spending. According to analysts, the slow down in consumer confidence during the year was not significant and still implies optimistic attitudes about the economy and job prospects.
- *Employment Statistics* - The unemployment rate continued to be historically low throughout 1999 finishing the year at 4.1 percent, down from 4.4 percent in the fourth quarter of 1998. The rate for September was 4.2 percent, virtually unchanged since March of this year. Manufacturing employment decreased by 21,000, government jobs fell 23,000, and 49,000 jobs were lost in the retail trade. This trend was also observed at the end of 1998 when manufacturing jobs declined by 13,000 in the month

of December. The high level of productivity the economy recently experienced was boosted by the large infusion of low-cost labor into the job markets. This is at least partially a result of the government restricting welfare benefits to only those in legitimate need, thus forcing a larger percentage of the population to go out and seek work. As noted by Alan Greenspan in a May 6, 1999 speech, "A pickup in the growth of labor productivity—beyond the effects of the business cycle—appears to have been an essential factor behind the slowing in inflation."

- *Trade Balance* - This indicator measures a country's exports in relation to its imports. A positive trade balance indicates that a country exports more goods than it imports. The U.S. trade deficit rose to another monthly record of \$25.9 billion in October. Foreign oil bills led the surge with the deficits with Japan and China increasing as well. The October deficit was the seventh monthly record in the U.S., an increase of 7.4 percent from September. U.S. exports decreased 0.1 percent to \$81.9 billion while imports rose 1.6 percent to a record \$107.9 billion. The key factor in the widening gap has been rising oil prices as the average price has doubled since January. Throughout the year the trade deficit ran at an annual rate of \$262 billion, which is a significant increase from the record deficit of \$164.3 billion in 1998. The strength of the American economy has caused the demand for imports to outpace the demand for exports thus leading to a widening trade deficit. As economies in Asia, Latin America and Europe improve, the demand for American exports of goods and services rises. This may cause the Fed to become wary about revived inflation.
- *Construction Housing and Real Estate* - The housing sector, which accounts for roughly 5 percent of the overall U.S. economy, continued to soar for the first three quarters of 1999, as 30-year mortgage rates fell to 7.82 percent in September from 7.94 percent a month earlier (a 0.015 percent decrease). New single family home sales were up 7 percent for the year through August and new home sales rose to their second-highest level on record, to a seasonally adjusted rate of 983,000 units. New housing construction fell in September, slowed by hurricane Floyd, higher interest rates and shortages of workers and materials. Housing starts, a leading indicator of economic activity, fell 3.2 percent in August to a seasonally adjusted annual rate of 1.62 million units. Likewise, building permits fell to their lowest level in nine months to 1.50 million down from 1.62 million during August, a 7.3 percent decrease. This marks the lowest rate since 1.46 million in December of 1997.

November construction spending rose 0.3 percent from October despite mortgage rates near 8.5 percent. New home sales rose 16.3 percent in October to a record 986,000 units. The National Association of Home Builders' housing market index fell to 72 in December from 73 in November.

The index scale runs from zero to one hundred with zero representing the weakest economic conditions. The Standard & Poor's homebuilding index rose 4.12 percent to 106.28 for December. Since the housing sector accounts for such a large percentage of the overall U.S. economy, it is regarded as a leading indicator. It is usually the first indicator to turn down when the economy goes into recession and the first to turn up when the economy is in a boom.

- *National Association of Purchasing Managers Index ("NAPM")* - NAPM, a survey of purchasing executives, is a major indicator of overall factory sector trends. Historically, rates above 50 have represented an expanding manufacturing sector and overall economic growth near 2.5 percent. Rates that fall between 44 and 50 have been associated with a contracting manufacturing sector and rates below 44 denote a contraction in both the manufacturing sector and the overall economy. Recently, NAPM represented the highest level since November 1994 (59.2 percent), as orders and production soared. The NAPM factory index rose to 57.8 percent in September compared to 54.2 percent in August. It then declined slightly to 56.2 percent in November. The indexes gauging factory production, deliveries, and exports all surged, indicating strong demand for goods at all levels.

D. Equity Markets

The Dow Jones Industrial Average ("Dow") rose 25.2 percent to close at 11,497 in 1999, up from the December 31, 1998 close of 9,181. The Dow experienced strong growth as it has closed at 9,786, 10,970 and 10,336 in the first three quarters, respectively. The quarterly percentage changes for 1999 were 6.58 percent, 12.09 percent, -5.78 percent, and 11.22 percent (quarter over quarter) respectively. The worst decline occurred on the 15th of October, when Alan Greenspan issued a warning to investors about the dangers of underestimating the risk in owning shares and implied a rising inflation rate. This caused the Dow to decrease by 266.90 points or 2.6 percent to 10,017, the biggest drop since October 1, 1998. This setback was temporary as solid corporate earnings and rising consumer confidence helped the Dow rebound to close at 10,470 the following week.

The NASDAQ Composite Index also continued on an upward trend from 1998. On November 3, the index closed at 3,028, propelled by enthusiasm for technology stocks. This was the first time that the index closed above 3,000. This composite has more than doubled in value since early October of 1998. The NASDAQ finished 1999 at 4,069 up 48 percent from the third quarter. The NASDAQ Composite Index rose an unprecedented 85.6 percent.

The Standard and Poor's Composite Index ("S&P 500") climbed above 1,400 during July, attaining record levels. The index closed the year at 1,469, up 19.53 percent from December 31 of 1998. The quarterly percentage changes for the year were 4.65 percent, 6.71 percent, -6.56 percent, and 14.54 percent, respectively. The S&P and the Dow finished with double-digit increases for the fifth consecutive year in 1999.

E. Interest Rates and The Bond Market

U.S. Treasuries, considered a safe haven for most investors, exhibited rising yields for most of 1999 causing the prices of bonds to fall. This year saw rising interest rates, inflation worries and concern about year-2000 computing disruptions. All these factors sunk bond prices in nearly every bond category. The only positive for the bond market this year was the lack of inflation, which would have only added to the decline in fixed-income market. The total return on 30-year benchmark treasury bills fell 14.78 percent, after a 17.06 percent rise in 1998. Analysts put forth two reasons for rising bond yields. Firstly, the Fed is thought to be reacting slowly to inflationary pressure such as a tight labor market and rapid growth in consumer spending. Secondly, the growth elsewhere in the world is picking up as foreign economies improve, thus offering more attractive investments than risk-free treasuries.

In 1999, the Fed has raised the federal funds target interest rate on three separate occasions, adopting the decision to tighten monetary policy and keep a hold on inflationary pressure. The fed funds rate increased by a total of 75 basis points. The rate increased from 4.75 percent to 5.00 percent and eventually stayed steady at its current rate of 5.50 percent since November 16th. The yield on 30-year Treasuries ended the month of December at 6.35 percent, the highest since September 1997. This is probably a sign of market expectations of another increase in interest rates.

F. Future Outlook

Many market analysts and economists expect the economy to continue its steady growth going forward. Exports are expected to improve aided by a global recovery and the economy is expected to grow at a 3.1 percent annual rate, down from the expected 3.9 percent for the economy this year. Economists expect the gap between short and long-term interest rates to remain fairly constant over the next two years. Growth will slow slightly due to a decrease in interest sensitive spending because of slightly higher interest rates. Housing construction is expected to be the hardest hit as home buyers choose to wait for the mortgage rate to drop from its current 8.50 percent. Economists predict inflation to be around 2.4 percent in 2000 based

on decreases in the CPI. Growth in compensation and global competition will limit pricing power, offsetting the growth in productivity.

The key factor in the economy for next year will be Federal Reserve policy. While some analysts believe the Federal Reserve will not raise interest rates to keep price gains in check, most analysts believe that more rate hikes are probable and the key is how much. Consumer and business demand will be the main driver of Federal Reserve policy, as the Fed will work to keep the economy growing steadily while keeping a keen eye on inflation. Chairman Alan Greenspan is expected to be asked to stay on for another four years. If he does, slight rate hikes should be expected.

In the months ahead, jobs should remain plentiful. The unemployment rate ended 1999 at 4.1 percent, tying a 29-year low. Foreign economies, namely in Asia, Russia and Latin America, seem to be on the mend and should no longer remain grave concerns for the U.S. economy. The stock market soared this year led by communications, technology and media firms. These three sectors will probably continue to lead the market boom as information continues to become more important in business and commerce across the globe. People bullish on the market cite the unprecedented tech-stock gains as evidence of a new era in technological innovation that is changing the rules of the economy and market dynamics. Many analysts are skeptical however, continuing to believe that security prices are overvalued and that the market is due for a correction in the near future. However, with the expectations of positive GDP growth, high consumer confidence, increasing levels of productivity and controlled levels of inflation, it appears that the business climate in the United States will remain fairly favorable throughout the year 2000 and the following year.

IV. INDUSTRY OUTLOOK³

A. The History of the Wireless Industry

Early wireless communications, such as citizens band (“CB”) radios, were limiting in that they only allowed for one-way communication. Communication through such a radio relied on verbal cues to indicate when a user was finished speaking. The next generation of wireless communication introduced “full-duplex” platforms, where the networks transmit and receive at the same time. Another challenge of wireless networks was one of convenience – the ability to use the wireless technology while moving. In order to accomplish this, wireless networks had to be able to “hand off” calls to adjacent networks, allowing customers to travel without dropping a call.

Cellular

Cellular service was developed by Bell Laboratories in the 1960s and operates with five basic components: the cell, or the small regions into which a service area is divided, the cell site, the Mobile Telephone Switching Office (“MTSO”), the subscriber handset and the Public Switched Telephone Network (“PSTN”). The cell generally covers a geographic area of 1-20 miles in diameter, the size of which is based on topography and estimated usage demand. The cell site is located within the cell and consists of the transmitter/receiver containing the equipment to provide communication for the channels assigned to that cell. The MTSO is the building that houses the mobile telephone switch, which is connected to the cell sites and controls the cellular system. The switch connects the caller to the landline or other cellular customer and relays the cellular caller from one cell to the next. The handset contains equipment that transmits and receives as well as allowing it to communicate with the closest cell site. Cellular service operates in the 824 MHz to 849 MHz and 869 MHz to 894 MHz bands and may operate using analog or digital technology.

PCS

Personal Communications Services was introduced in the 1990s and is based on digital technology. It is defined by the FCC as “radio communications that encompass mobile and ancillary fixed communication that provides services to individuals and businesses and can be integrated with a variety of competing networks.”⁴ PCS comprises numerous wireless services such as telephony, paging and data transmission and technically operates similarly to cellular. The radio signals are transmitted from towers that operate the

³ The Strategis Group, 1999, Standard & Poor’s *Telecommunications: Wireless*, and the DLJ Wireless Telecom Report

⁴ FCC: <http://www.fcc.gov/wtb/pcs/bbftsh.html>

same as cell sites. The difference between PCS and cellular is that PCS can operate at lower power levels than cellular and utilize capacity more efficiently. Accordingly, PCS cells are smaller and require more cell sites to cover a given area.

In 1996 the landscape changed dramatically for the wireless operators. Whereas wireless markets were once set up as licensed duopolies, the FCC PCS auctions created the possibility of having up to nine wireless operators in each market, including one provider of Enhanced Specialized Mobile Radio (“ESMR”). Cellular, as the incumbent, was still the driving force behind the market, representing 95 percent of the total 1996 wireless telecommunications revenue of \$23.6 billion, but it was expected that competition would heat up in the coming year.⁵

ESMR

Enhanced Specialized Mobile Radio (“ESMR”) is an alternative method to provide wireless service that is based on digital TDMA technology and operates with individual base stations. ESMR operates in the 800 MHz to 900 MHz band. The main player in ESMR was Nextel Communications, led by Craig McCaw. Nextel planned to deploy a nationwide network on 800 MHz frequencies providing digital cellular service, voice mail and alphanumeric paging.

Satellite Technology

Low earth orbit (“LEO”) satellite-based systems will potentially provide significant competition for the land-based mobile phone networks. LEO mobile satellite services operate in the band between one and three GHz, while new systems will transmit in the 20 GHz to 30 GHz spectrum. The service provides enhanced quality and ubiquitous coverage than the land-based wireless service, but is expensive. The expected service costs range from \$0.70 per minute to \$3.00 per minute – well above the cost per minute of other wireless carriers. The transition from idea to actual network and service has been difficult so far for the mobile satellite sector. Companies have had significant difficulty attracting customers, as well as numerous distribution and technical problems due to pricing and market acceptance.

License Auction

The Federal Government seemingly gained approximately \$18 billion in proceeds from the auctions for the A, B, and C-blocks. The A and B-block licenses were auctioned simultaneously and, after 112 rounds of bidding, yielded \$7.7 billion with an average net price per potential customer (“POPs”) of \$15.57. The C-

⁵ Telecommunications: Wireless. Standard & Poor’s. July 1997



block auction was much more intense, even though it offered half the amount of spectrum of the A and B block licenses and was reserved for “entrepreneurs” as defined by the FCC.

The C-block net price per pop averaged \$39.88 with net bids totaling approximately \$10.2 billion. Although there were 89 winning bidders, the three largest bidders accounted for over 66 percent of the net bids made at the auction.⁶ However, although the C-block auction yielded much higher bids, the bidders only had to pay 10 percent upfront, had 10 years to pay off the remaining balance at favorable financing terms and received a 25 percent bidding credit.

The D/E/F-block auctioned off 1,479 Basic Trading Area (“BTA”) licenses, three in each geographic area, and raised approximately \$2.5 billion. There was less interest in these licenses because they were for 10 MHz spectrum, much smaller spectrum than that offered in the A, B and C-blocks. Additionally, potential bidders might have been scared off by the high prices paid during the C-block auctions. The D and E-blocks were open to anyone, while the F-block was restricted to entrepreneurs to lessen their barrier of entry into the market.

FCC Re-auctions

Following the bankruptcy of many C-Block companies and their subsequent inability to pay, the FCC organized a reauction of the licenses. The C-Block reauction raised \$904.6 million in total net revenues, compared with \$874.2 million in the original auction for the same licenses. The 18 license coverage areas contain a total of 15.5 million POPs. The auction began July 3, 1999 with 32 bidders, and lasted 8 days, closing with seven winning bidders.

The reauction for the C, D, E, and F-Blocks began March 23, 1999 with 67 bidders, and ended after 78 rounds of bidding on April 15. A total of 347 licenses were up for auction covering 30 MHz, 15 MHz and 10 MHz of spectrum space. The reauction raised more than \$412 million in net bids. The licenses issued were for 10 year terms from the initial grant date with certain bidders receiving bidding credits based on gross revenues and other factors. The winning bidders were not given favorable financing terms in this reauction. The two most expensive licenses sold were for Chicago and Dallas at \$117.9 million and \$62.4 million respectively.

⁶ Cellular Overview: Duopoly to Competition – Industry Report, Bankers Trust Research, March 10, 1997

Pioneer's Preference

Prior to selling the above licenses at auction, the FCC awarded three Pioneer's Preference Awards for broadband PCS service in the cities of New York, Los Angeles and Washington, D.C. These licenses were designed for companies that were developing new spectrum-using communications services and technologies and were ultimately awarded to American Personal Communications, Cox Enterprises Inc. and Omnipoint Communications Inc. In 1995, the FCC modified the pioneer's preference rules to state that in services in which licenses were awarded by competitive bidding, the pioneers must pay 85 percent of the average price paid for comparable licenses. The payments could be in a lump sum or in installment payments, but could not extend beyond a period of five years.

The pioneer's preference program gave a distinct advantage to the PCS companies that were granted licenses through it. American Personal Communications ("APC") had the first active PCS network in the U.S. in the Washington D.C./Baltimore area. Omnipoint was granted a license for New York and Cox California PCS ("Cox") was granted Los Angeles/San Diego through the program.

B. Wireless Industry Trends and Projections

The wireless industry has been an explosive industry, experiencing tremendous growth in the 90s, particularly through the advent of PCS technology.

The wireless industry has been able to ride growing globalization and increased intersecting of computers, telecommunications and the Internet. As prices continue to fall and the technology keeps getting better, the demand for wireless telecommunications is increasing. Many high-end consumers are beginning to see wireless telephony as a clear alternative to more traditional landline telephone service. In developing countries across the globe, governments and businesses are looking to wireless telecommunications to build a communications infrastructure that would be expensive, time intensive and cumbersome through traditional land line construction.

Pricing

The tremendous growth in subscribers has more than offset the decline in prices to drive revenues up. Service and equipment pricing has continued to decline as the PCS industry begins to achieve economies of scale and competition increases. Cellular carriers have been forced to lower their prices significantly to compete with the upstart PCS providers who offer expanded services at a competitive price. Wireless telephony providers are competing for customers through a combination of rate cuts, multiple free minutes,

flexible pricing plans, enhanced service and expanded coverage. Pricing has fallen as much as 28 percent over the past year showing the effects of competition on pricing.

Equipment pricing continues to fall as well. The cost of expensive handsets was one of the main barriers to adoption by consumers. In the early years of the wireless industry cellular phones were an expensive business tool, exclusive to high-income customers. Today many subscribers receive their phones for a nominal fee or at no costs at all, provided they sign a service contract. However, this is not true yet for digital phones which are more expensive than cellular phones. Subscribers can often expect to pay \$100 to \$300 for digital cellular and PCS handsets and the price can serve as a barrier to increased digital adoption. According to a survey by the Strategis Group, users chose their phone primarily based on price, with promotional offers, and size following in importance.⁷ CDMA is the most popular platform for PCS subscribers in the U.S. CDMA is also the most expensive of the more popular platforms

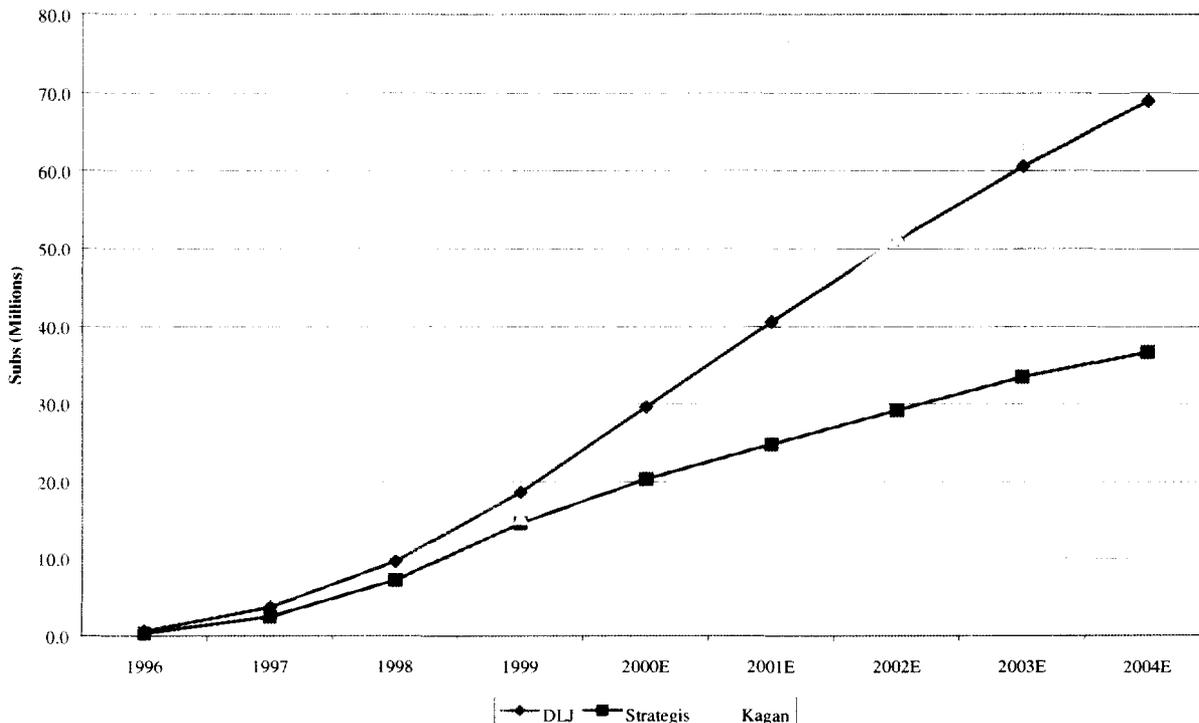
Subscriber Growth

PCS revenues continue to be driven by subscriber growth despite falling prices in airtime, access, equipment and roaming. In 1993, the mobile phone industry had close to 16 million subscribers. By the end of 1998 the industry had grown to almost 70 million subscribers.⁸ Cellular and PCS accounted for 66 million of those subscribers with PCS taking up 11 percent of the base. Published CTIA figures show that annual revenues for the mobile phone industry grew from \$178 million in 1984 to more than \$33 billion in 1998. Subscriber penetration has exceeded analyst's expectations with companies bundling coverage, fixed price and service to attract customers. PCS subscribers are expected to achieve 13 percent penetration of the U.S. population by the year 2004. Estimates for PCS subscribers in 2004 vary from 37 million to 76 million.

⁷ The Strategis Group, 1999, p.306

⁸ The Strategis Group, 1999, p.223

U.S. PCS Subscriber Forecast



Sources: DLJ, The Strategis Group, 1999, and Kagan

Enhanced Services

Enhanced services are being used to differentiate carriers more and more in markets where they are newly deployed. However, competitors can copy virtually all enhancements. Some of the enhanced services are used to capture and retain the most attractive subscribers in the market. Whereas enhanced services used to be offered at market premiums, they are now often being bundled to help retain and attract subscribers. Call waiting, voice mail and caller ID are the most widely used enhanced services, used by 24 percent, 25 percent and 20 percent of wireless users respectively.⁹ In 1998 roaming accounted for 14 percent of subscribers' airtime.

Data Services

The latest trend for the end of 1999 and the beginning of 2000 is data transfer and web access to mobile telephones. Mobile wireless web access has been in the works for a while but now through recent

⁹ The Strategis Group, 1999, p.7

technology it is becoming a viable service to wireless customers. This expanded service could prove to be very lucrative to PCS companies as customers will likely have to trade in old handsets for the newer ones. Average minutes will probably go up as well with the added feature. "Smart" phones have an emphasis on data and could be very popular with business users. The Internet and e-mail are increasing in popularity and the increased reliance on their services could drive demand for smart phones. There is some concern over whether or not voice and data functionality will be built into a universal device or if people will prefer to carry the two in separate devices. The market potential for smart phones is attracting the attention of major companies who are allocating tremendous resources to strengthen and enhance the service. The success and impact of these phones will depend largely on the buildout and enhancement of wireless networks around the world.

Of particular interest is the Wireless Application Protocol ("WAP") group, an industry organization working towards creating standards for wireless micro-browsers. As faster data speeds approach, broadband wireless operators are expected to change to Internet Protocol ("IP"), or packet-based systems for transmitting data. WML is a wireless version of HTML, which allows wireless data to be converted to Internet-ready language. WML is optimized for wireless handsets which have numeric keypads, small displays, limited memory, and limited processing power and battery life. Creating standards for WML will be a large step toward creating true Internet mobility through wireless technology. At present there are a few main groups who are fighting to dominate the market for data transfer technology with regards to wireless phones.

Consumer Trends

Brand awareness is increasing among cellular and PCS users as well as among the general public. Nationwide marketing campaigns and high visibility by companies such as AT&T, Sprint PCS and Airtouch are making the public more aware of wireless companies and the services they provide. Studies show that the lower priced phones are still by far the biggest sellers while minutes of use remains steady after years of decline. More subscribers are seeing wireless as an alternative to traditional landline phones with the most usage coming from business subscribers who average 304 minutes per month.

Safety and emergency use is the leading reason for purchase among cellular users with 44.2 percent of users citing this reason for acquired service. These users have much lower minutes of usage compared to other subscribers. The average age of wireless users continues to decrease as prices continue to fall. Users in the 18 to 24 age group increased to 7.9 percent in 1998. More than 53 percent of non-users between the

ages of 18 and 29 express interest in beginning wireless service with 72 percent likely to begin service within the next year.¹⁰

Regulation

The total licensed spectrum is 120 MHz with PCS operating in the 1850-1910 MHz and 1930-1990 MHz bands. The PCS service areas are defined by the FCC according to the Rand McNally definitions of 51 MTAs and 493 BTAs.

Frequency (MHz)				
Band	Bandwidth	Mobile	Base	Service Area
A	30 MHz	1850-1865	1930-1945	MTA
B	30 MHz	1870-1885	1950-1965	MTA
C	30 MHz	1895-1910	1975-1990	MTA
D	10 MHz	1865-1870	1945-1950	BTA
E	10 MHz	885-1890	1965-1970	BTA
F	10 MHz	1890-1895	1970-1975	BTA

Source: Federal Communications Commission

The expansion of companies in the market and the ability to obtain financing in the industry has been limited due to financial difficulties in the C-block. Almost 80 percent of the net prices bid in the C-block auction are tied up in bankruptcies or have been returned to the FCC.¹¹ On March 23, 1999 the FCC began a reauction of 356 C-block licenses. This reauction included licenses returned to the FCC according to the payment options offered to financially troubled C-block licensees. The auction ended on April 15, 1999 after 78 rounds. The U.S. Treasury reportedly gained net revenues of \$412,840,945.¹² Currently, 94 percent of C-Block licenses are not in operation.

The FCC has set forth certain standards that wireless telephony companies must meet for 911 and emergency phone calls. An order voted on by the FCC in May, 1999 dictated that analog and dual-mode cellular phones must be capable of separate processing for 911 calls that permit those calls to be serviced by other carriers. The requirement will become effective in January 2000. The order sets forth emergency

¹⁰ The Strategis Group, 1999, p.2

¹¹ The Strategis Group, 1999 p.1

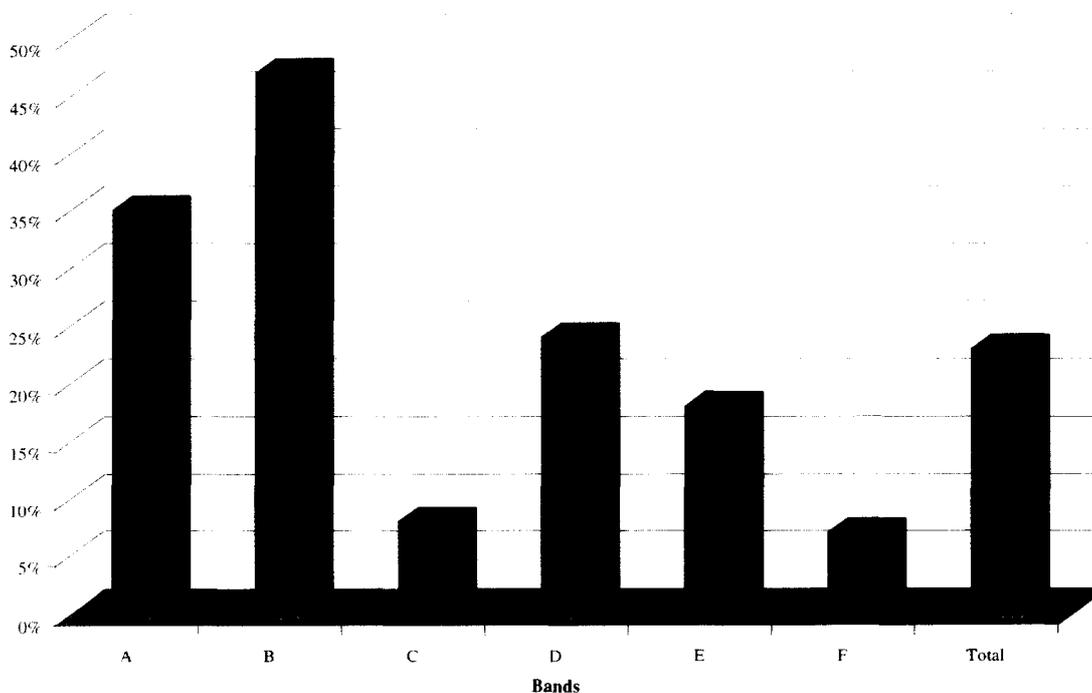
¹² The Strategis Group, 1999 p.25

call completion procedures that satisfy FCC rules. This order is designed to eliminate dead zones in service and coverage.¹³ Wireless operators must also provide the location of their mobile users within the closest cell site with an accuracy of 125 meters. The standards were put in place due to problems with state 911 operators who were unable to direct emergency assistance to mobile users because they lacked information.

C. Wireless Infrastructure and Network Build-out

According to the Strategis Group, there were close to 60,000 cellular and PCS sites in operation in 1998 and by year end 2003 there will be close to 100,000. Based on the number of BTA markets and the number of competitors in each market there are currently 2,922 possible PCS networks in the U.S. Currently 23 percent of these systems are active with the percentage varying greatly by band. A and B-block systems have launched in 35 and 47 percent of their respective licensed markets, a greater percentage than the other bands.

Percentage of Active PCS Networks, 1999



Source: The Strategis Group, 1999

¹³ The Strategis Group, 1999 p. 31

Wireless carriers made \$14.5 billion in capital investments between 1997 and 1998. These investments will continue as PCS carriers continue to buildout networks. PCS carriers have been forced to move up buildout to compete with cellular carriers who have widespread coverage. PCS rollout has slowed after an initial surge from A and B-block carriers due to difficulty in acquiring capital and emphasis on high traffic areas. 10 MHz licensees have begun to build networks though which has caught the attention of A and B-block carriers who seek to make agreements in order to expand their coverage. Through agreements the A and B-blocks can expand major markets and provide seamless service coverage, by focusing on major transit corridors.

Another important issue is the buildout of towers to expand networks. It is estimated that more than 40,000 new sites will be needed by various wireless carriers to provide adequate coverage for subscribers. PCS operators will be in particular need of gaining new sites as they are still fairly new to the marketplace. The creation of new tower sites has become a difficult and often times controversial task. There have been complaints that towers for mobile phones are an eye sore in the community and also hurt the environment. Because of these issues, of collocation, the sharing of structures by different carriers, has become more popular. This trend could become lucrative to some major wireless carriers particularly from the A and B-blocks who got an early start on tower location and can lease their space to other carriers.

Satellites

Many proposed satellite networks had early difficulties but the sector is beginning to make some headway. The companies are beginning to acquire financing and rollout their networks. The main barriers currently are prices and service. The phones used by the networks are expected to cost well over \$600 and are much more bulky than current mobile phones. Satellite phones also have long antennas and require a direct path between the satellite and receiver, making them difficult to use in highly populated urban centers with large buildings. For these reasons, widespread public acceptance is not expected for the next 5 to 7 years with satellite companies focusing on business data communications.

Mergers & Acquisition

Great consolidation and continued rapid growth describe the wireless industry in 1999. After the end of the FCC auctions for PCS spectrum, market forces began to take effect, pushing stronger companies to the top and weaker companies to be acquired or bankrupt. A major deal occurred almost every month, led by MCI WorldCom with its acquisition of Sprint and Sprint PCS. VoiceStream acquired competitor Aerial in September and also announced plans to acquire Omnipoint in a deal valued at \$4.9 billion. Vodafone and

Bell Atlantic joined each other in the U.S. in September. Dobson bought American Cellular in October, while Arch and MobileMedia won approval in bankruptcy court for their proposed merger. MCI WorldCom also announced its attention to acquire SkyTel to compete in the wireless data market.

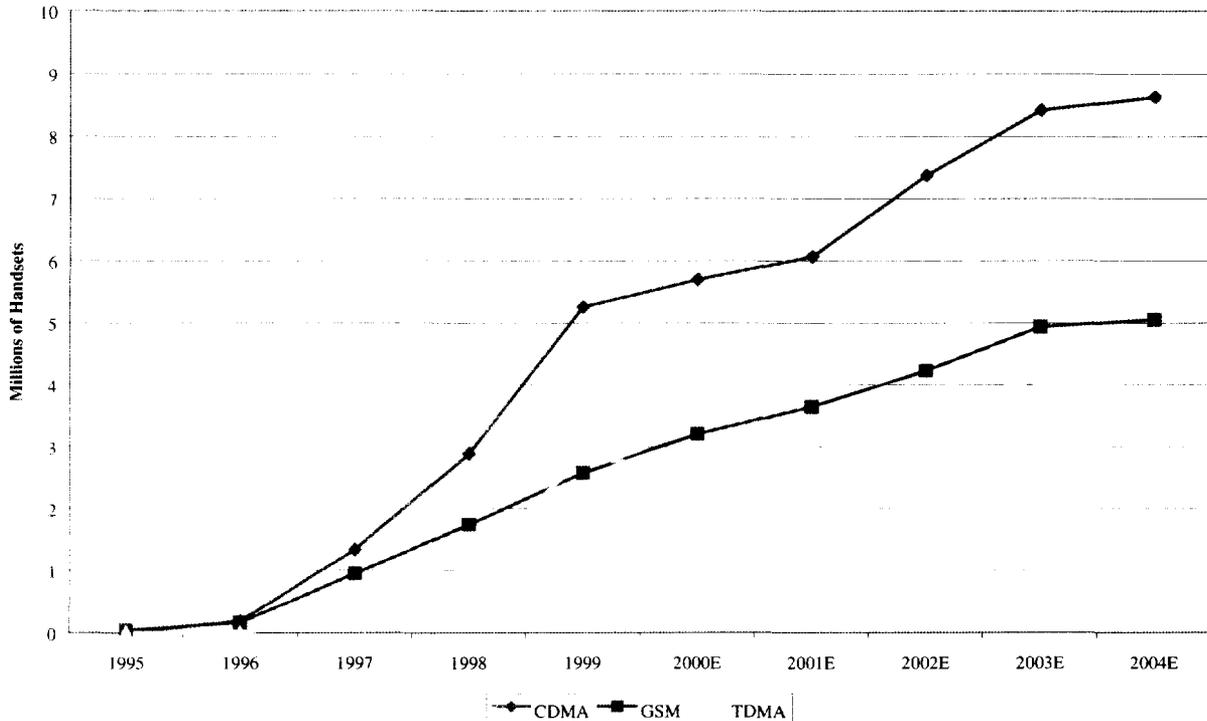
Global Crossing and Qwest Communications International are both looking to acquire Frontier Corp. and U.S. West. Global Crossing agreed to acquire Frontier and merge with U.S. West but Qwest stepped in and made counter proposals to both companies. After Qwest's stock price declined it was forced to give a better offer to both companies and now Global Crossing's deal is on hold while officials from Frontier and U.S. West review Qwest's offers. Bell Atlantic has a merger pending with GTE and SBC is looking to merge with Ameritech. Alltel acquired Aliant Communications to increase its national customer base. Consolidation within the industry is expected to continue with companies selling for high premiums.

D. Industry Outlook

It is expected that the current trends of the wireless telecommunications industry will continue into the future. Companies are racing to widen service offerings and this will increase as more firms continue to merge, form alliances and strategic partnerships in search of their optimal size. Prices will continue to fall as more firms begin to bundle services with competitive price packages.

The long distance market is expected to slowly move away from its oligopolistic nature as competition intensifies. As the local telephone companies satisfy FCC regulations and begin to offer long distance service, dial-arounds continue to offer low rates, and upstart carriers use the Internet to route phone calls, competition will increase. Long distance rates have decreased substantially from a decade ago. Some companies offer rates as low as 3.5 cents per minute. Analysts believe that a new pricing structure will emerge, similar to the Internet in which consumers pay one fee for unlimited usage. Long-distance will be just one element on a single bill as companies move towards becoming 'one-stop' shops and offer an overall package including wireless service, Internet, long distance, local service and cable service. Bundling may reduce churn, or customer turnover, as the more services consumers buy from a company the less likely they will leave. This trend is already in progress as AT&T offers local, long distance, wireless and Internet services in certain areas.

PCS Handset Sales by Technology



Source: The Strategis Group, 1999

CDMA technology is expected to take over as the dominant wireless technology worldwide as it is more efficient and provides better cost savings compared to the other PCS platforms available. CDMA has been the leader in PCS handset sales since the first networks became active. Many countries in Asia and Latin America have chosen CDMA as their primary technology including Japan, China, Brazil and Peru. GSM is the standard platform in Europe but the speed and efficiency of voice and data transmission is expected to make CDMA the worldwide favorite in the years to come. Data transmission is becoming increasingly more important. All of these factors will cause CDMA to become more popular as the platform of choice.

The wireless industry is currently growing at a pace surpassed only by the Internet. Global demand is increasing at a rapid rate as the convergence of voice and data services continues to influence prices in ways that benefit both carriers and consumers. Wireless service is particularly convenient for smaller, less developed markets where the costs to build a land line infrastructure are too great. These market forces should ensure the continued growth of the wireless telecommunications industry for years to come.