Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)
	)
Implementation of Section 6002(b) of the	)
Omnibus Budget Reconciliation Act of 1993	)
	)
Annual Report and Analysis of Competitive	)
Market Conditions With Respect to Commercial	)
Mobile Services	)
	)

FIFTH REPORT

Adopted: August 3, 2000 **Released:** August 18, 2000

By the Commission:

Table of Contents

I. INTRODUCTION

A. Overview

In 1993, Congress created the statutory classification of Commercial Mobile Services[1] to promote the consistent regulation of mobile radio services that are similar in nature.[2] At the same time, Congress established the promotion of competition as a fundamental goal for CMRS policy formation and regulation. To measure progress toward this goal, Congress required the Federal Communications Commission ("Commission") to submit annual reports that analyze competitive conditions in the industry.[3] This report is the fifth of the Commission's annual reports on the state of CMRS competition.[4]

With one exception discussed below, this report follows the same general structure as the *Fourth Report*.[5] This report bases its analysis on a consumer-oriented view of wireless services by focusing on specific product categories, regardless of their regulatory classification. In some cases, this includes an analysis of offerings outside the umbrella of "services" specifically designated by the Commission as CMRS.[6] However, because licensees of these other spectrum-based services often compete with CMRS providers, as well as with other providers of telecommunications services, the Commission believes that it is important to consider them in the analysis.

This report focuses on three categories of wireless services: mobile telephony,[7] mobile data,[8] and dispatch.[9] This is a departure from the report's two previous editions, in which there was also a separate

[1] Commercial Mobile Services came to be known by the Commission as the Commercial Mobile Radio Services, or "CMRS."

[2] The Omnibus Budget Reconciliation Act of 1993, Pub. L. No. 103-66, Title VI, § 6002(b), amending the Communications Act of 1934 and codified at 47 U.S.C. § 332(c) ("*1993 Budget Act*").

[3] *1993 Budget Act* codified at 47 U.S.C. § 332(c)(1)(C).

[4] This report, like the others before it, discusses CMRS as a whole because Congress called on the Commission to report on "competitive market conditions with respect to commercial mobile services." 47 U.S.C. §332 (c)(1)(C). An individual proceeding in which the Commission defines relevant product and geographic markets, such as a proposed license transfer, may present facts pointing to narrower or broader product markets than any used, suggested, or implied in this report.

[5] Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993, Annual Report and Analysis of Competitive Market Conditions with Respect to Commercial Mobile Services, *Fourth Report*, 14 FCC Rcd 10145 (1999) ("*Fourth Report*"). A copy of the *Fourth Report* that includes color versions of the maps may be found on the Commission's Internet site: <http://www.fcc.gov/wtb/reports/fc99136.pdf>.

[6] *See, e.g.*, Section II.C, *infra*.

[7] This report defines the mobile telephone segment to include cellular, broadband Personal Communications Services ("broadband PCS"), and digital Specialized Mobile Radio ("SMR") operators.

[8] The mobile data industry encompasses a wide array of services ranging from data transmitted over one-way pagers to vehicle tracking from satellites to wireless Internet connections via portable computers or Personal Digital Assistants ("PDAs"). Participants include both CMRS and non-CMRS providers, many of whom also offer mobile telephone and dispatch services.

section for paging/messaging. The Commission believes that mobile data services warrant a more extensive treatment in this year's report. While there are still only a limited number of mobile data services available in the United States beyond paging/messaging, that number is growing rapidly, and it seems clear that a larger mobile data sector is in the process of emerging. In the context of this developing sector, paging/messaging services can be viewed as a part of the larger landscape. In fact, some paging/messaging operators have begun to market themselves as competitors in the emerging mobile data world.[10] Therefore, in this year's report, the paging/messaging section has become a subsection of a larger discussion of mobile data services.[11]

The three consumer-oriented service categories discussed in this report are not as clearly delineated when viewed from the carriers' perspective. For example, some dispatch operators also offer mobile telephone services. In addition, many mobile telephone, paging/messaging, and dispatch operators are leveraging their core assets to enter the growing market for mobile data services.[12] Therefore, while these service categories are used to provide structure for this CMRS competition report, the Commission's view of operators is not limited by the categories in which this report places them.

B. Status of Competition

In the year 2000, the CMRS industry continues to benefit from the effects of increased competition as evidenced by lower prices to consumers and increased diversity of service offerings. For example, by year-end 1999, the number of mobile telephone subscribers had reached 86.0 million or 32 percent of the country's population.[13] In addition, according to the U.S. Department of Labor's Bureau of Labor Statistics, the price of mobile telephone service declined by 11.3 percent between the end of January

(Continued from previous page)

[9] This report's discussion of the dispatch market includes several different segments of that market, including: interconnected commercial dispatch carriers, which operate primarily in the 800 MHz, 900 MHz, and 220 MHz bands and are referred to as "trunked dispatch;" and non-interconnected, non-CMRS, commercial dispatch service carriers, which are referred to as "traditional dispatch." *See* Application of Various Subsidiaries of Geotek Communications, Inc., *Memorandum Opinion and Order*, DA 99-1027 (rel. Jan. 14, 2000).

[10] For example, the paging/messaging operator Pagemart Wireless, Inc. recently changed its name to Weblink Wireless, Inc., stating that the change was made to reflect the company's change "from selling simple alert, telephone-centric services to wireless data Internet-based products and services." *PageMart Wireless Officially Becomes WebLink Wireless*, News Release, Weblink Wireless, Inc., Dec. 1, 1999.

[11] This report defines the paging/messaging segment to include paging and narrowband Personal Communications Services ("narrowband PCS") operators.

[12] *See* Section II.B, *infra*.

[13] The nationwide penetration rate is calculated by dividing total mobile telephone subscribers by the total U.S. population. The 32 percent figure is based on a 1999 U.S. population estimate of 271.0 million. *See* Dennis Leibowitz *et al*, *The Global Wireless Communications Industry*, Donaldson, Lufkin & Jenrette, Winter 1999/2000, at 15 ("*DLJ Report*").

1999 and the end of January 2000.[14] Another analyst estimates that mobile telephone prices fell 20 percent between 1998 and 1999.[15]

The process of carriers building nationwide footprints[16] continues to be a significant trend in the mobile telephone sector. The two most prominent mobile telephone mergers announced during 1999 involved large regional operators seeking to create nationwide footprints in order to compete effectively with existing operators offering attractive nationwide pricing plans.[17] In parallel with the process of footprint building, mobile telephone operators continue to deploy their networks in an increasing number of markets, expand their digital footprints, and develop innovative pricing plans.

In the mobile data sector, the ongoing transition from paging/messaging to more advanced mobile data services makes it difficult to generalize about the status of competition. The paging/messaging subsector has long been highly competitive, but there has been little change in the demand for paging services.[18] At the same time, virtually all wireless providers – from existing mobile telephone operators to numerous new entrepreneurs – have announced plans to offer consumers an impressive variety of mobile data services. However, many of the providers currently offer mobile data as an add-on to existing mobile voice services. Further, the services currently offered by a variety of carriers are diverse in a number of characteristics including different levels of geographic coverage and various target markets.

In the dispatch sector, 220 MHz licensees are beginning to deploy their networks. In addition, some mobile telephone operators are beginning to offer services that cater to the needs of the dispatch sector, creating the potential for inter-service competition.

C. Industry Development

Mobile Telephony. Since the release of the *Fourth Report*, the mobile telephony sector of CMRS has experienced another year of strong growth and competitive development.[19] In the twelve months ending December 1999, the mobile telephony sector generated over $40 billion in revenues,[20] increased

[14] U.S. Department of Labor, Bureau of Labor Statistics databases, Bureau of Labor Statistics' Internet site at <http://www.bls.gov/sahome.html> ("*BLS Database*").

[15] The Strategis Group, Inc., 2000; *see* Section II.A.1.d, *infra*, for a detailed discussion of price competition.

[16] "Footprint" is an industry term of art referring to the total geographic area in which a wireless provider can offer services over its own facilities.

[17] For a further discussion of nationwide pricing plans, *see Fourth Report*, 14 FCC Rcd at 10159-10160.

[18] *See* Section II.B.3, *infra*.

[19] All of the data in this report are taken from publicly available sources. These sources include: trade associations, securities analysts, company releases and Web sites, filings with the Securities and Exchange Commission ("SEC"), newspaper and periodical articles, and certain materials made available to the Commission that were prepared by research companies and consultants that study various aspects of the wireless industry. The accuracy of the data from these materials, however, was not independently verified by the Commission. The inclusion of these data in this report does not constitute a representation or warranty by the Commission of their accuracy or completeness.

[20] *See* Appendix B, Table 1, p. B-2.

subscribership from 69.2 million to 86.0 million,[21] and produced a nationwide penetration rate of roughly 32 percent.[22] Broadband PCS carriers and Nextel Communications, Inc. ("Nextel") continue to deploy their networks.[23] To date, 222 million people, or 88 percent of the total U.S. population, have three or more different operators (cellular, broadband PCS, and/or Nextel) offering mobile telephone service in the counties in which they live. Over 172 million people, or 69 percent of the U.S. population, live in areas with five or more mobile telephone operators competing to offer service. And 11 million people, or 4 percent of the population, can choose from among seven different mobile telephone operators.

The rise of digital technology in the mobile telephone sector continues unabated. The combined effect of increasing digital and declining analog customers has been that, at the end of 1999, digital subscribers made up 51 percent of the industry total, up from 30 percent at the end of 1998.[24] Finally, in part because of growing competition in the marketplace, it appears that the average price of mobile telephone service has fallen substantially during the year since the *Fourth Report*, continuing the trend of the last several years.[25] According to the U.S. Department of Labor Bureau of Labor Statistics, the price of mobile telephone service declined by 11.3 percent between the end of January 1999 and the end of January 2000.[26] Another analyst estimates that mobile telephone prices fell 20 percent between 1998 and 1999.[27]

Mobile Data. While analysts estimate that only 2 percent of mobile traffic currently carries data,[28] many analysts believe that the mobile data sector has turned a corner and that it is finally beginning to bring long-promised growth to mobile telephone and other wireless operators.[29] The development of a number of new technologies has contributed to this turn of events. One of the most discussed technological transitions for the industry is the coming migration of mobile telephone networks to third generation (or "3G") technologies with service offerings such as high speed Internet access and video conferencing. In addition, new protocols and technologies are being developed that facilitate the ability of mobile telephones and other handheld devices to access the Internet, as well as laptop computers and printers without cables.

---

[21] *Id.*

[22] *See supra* note 13.

[23] Nextel is included in the areas where it has launched its digital SMR-based mobile telephone service.

[24] *See* Section II.A.1.b, *infra*, for a detailed discussion.

[25] *Id.*

[26] *BLS Database*.

[27] The Strategis Group, Inc., 2000; *see* Section II.A.1.d, *infra*, for a detailed discussion of price competition.

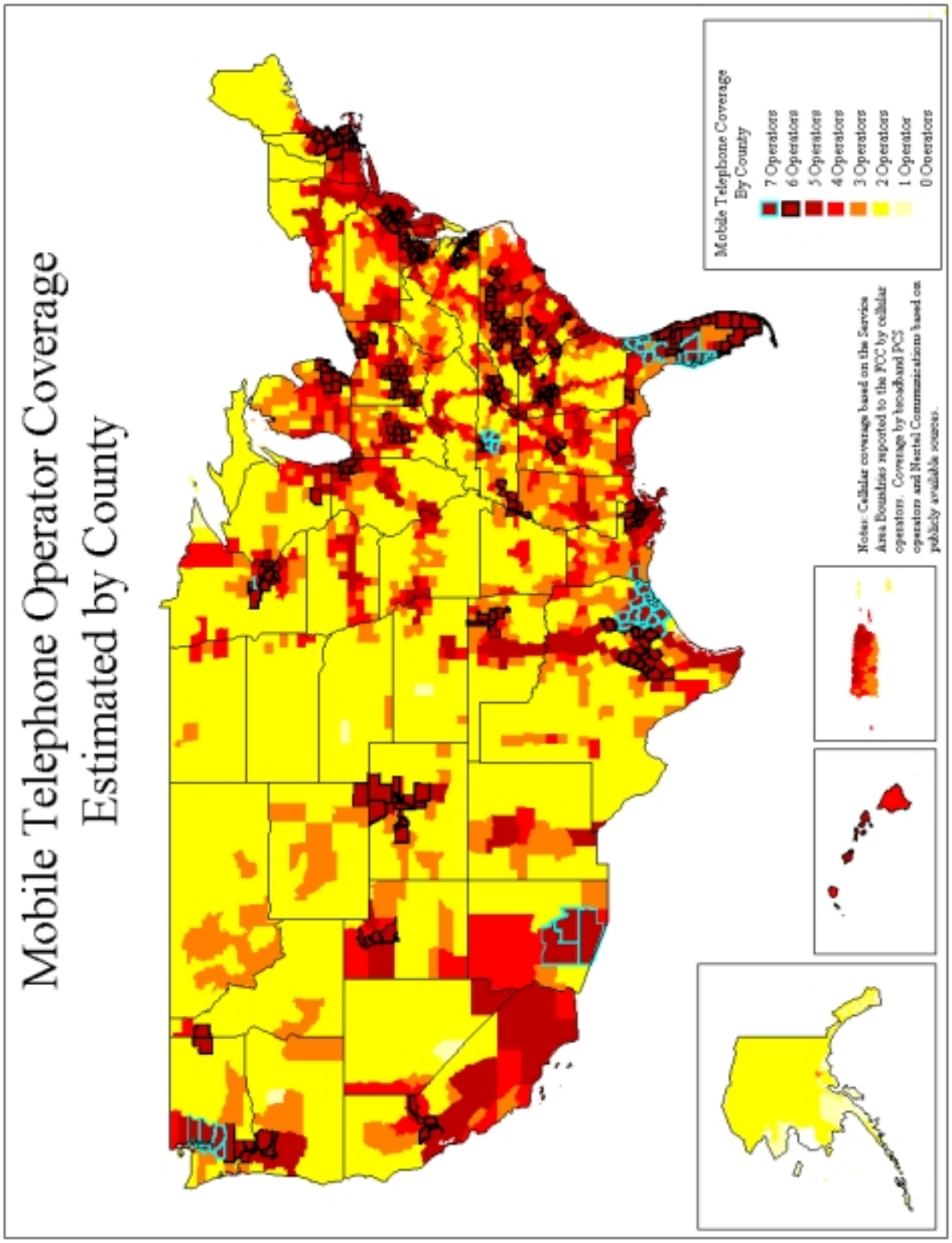
[28] Jonathan Collins, *Sprint's Aggressive Ad Campaign Could Fire Up Demand For Wireless Net Access Or Give It A Bum WAP*, TELE.COM, Feb. 21, 2000, *available in* WL 10907294.

[29] Joe McGarvey, *Wireless Access Set to Explode*, INTER@CTIVE WEEK, Sept. 22, 1999.

Dispatch. One analyst finds that in 1999 the commercial dispatch industry's total subscribership increased by 30 percent from 4.6 million in 1998 to 6.0 million.[30] While Nextel is the largest provider, its services include both mobile telephone and dispatch. Focusing on SMR providers without regard to the particular service markets involved, Nextel possesses by far the largest subscriber base. Using its iDEN technology, Nextel provided service to roughly 4.5 million digital subscribers at the end of 1999, 62 percent more than the 2.8 million it served at the end of 1998.[31] However, a number of mobile telephony providers now offer plans that allow unlimited calling among members of a defined group, such as a family, or among all of an operator's subscribers in a defined area.

[30] *See* The Strategis Group, Inc., "Dispatch Service in a Competitive Market," Presentation at AMTEX'98 Conference & Exposition, Nov. 13, 1998: THE STRATEGIS GROUP, INC., US DISPATCH MARKETS (January 2000) ("*Strategis Dispatch Report*").

[31] *See* Appendix D, Table 1, p. D-3.


Mobile Telephone Operator Coverage
Estimated by County
Mobile Telephone Coverage
By County
7 Operators
6 Operators
5 Operators
4 Operators
3 Operators
2 Operators
1 Operator
0 Operators
Notes: Cellular coverage based on the Service Area Boundaries reported to the FCC by cellular operators. Coverage by broadband PCS operators and Nextel Communications based on publicly available sources.

II. THE CMRS INDUSTRY

A. Mobile Telephony

This report defines the mobile telephone sector to include all operators that offer commercially available interconnected mobile phone services. These operators provide access to the public switched telephone network ("PSTN") via mobile communication devices employing radiowave technology to transmit calls. As discussed in last year's report,[32] providers using cellular radiotelephone, broadband PCS, and SMR licenses dominate this sector.[33] Because these licensees offer mobile telephone services that are essentially interchangeable for most consumers, they are discussed in this report as a cohesive industry sector. Mobile telephone services are also offered by resellers and operators using satellite systems.

The discussion below begins with an overview of the mobile telephone market as a whole. This is followed by subsections for cellular operators; broadband PCS operators; the digital SMR provider, Nextel; other SMR operators; resellers; and satellite providers.

1. Mobile Telephone Overview and Analysis

a. Mobile Telephone Sector Structure and Performance

In 1999, the mobile telephone sector experienced another record year. As of December 1999, the sector had over 86.0 million subscribers,[34] which translates into a nationwide penetration rate of roughly 32 percent.[35] It represents a 24 percent increase over the 69.2 million subscribers reported for December 1998 and is the largest twelve-month increase in total number of subscribers in the history of the sector. In addition to the penetration rate rising to 32 percent, a recent study concluded that 43 percent of all households had service at the end of 1999, up from 35 percent in 1998.[36] The financial performance of the mobile telephone sector also continued to be strong. In 1999, the sector's annual total service revenue was over $40 billion,[37] an increase of 21 percent over the year ending December 1998.

The past year also has seen rapid changes in the structure of the mobile telephone sector. The most dramatic change has been the emergence of two new nationwide[38] operators. At the time of the *Fourth*

---

[32] *See Fourth Report*, 14 FCC Rcd at 10151-10152.

[33] As codified at 47 C.F.R. §§ 22.900, 24.200, 90.601.

[34] *See* Appendix B, Table 1, p. B-2.

[35] *See supra* note 13.

[36] *Wireless Telephone Penetration in U.S. Soars to Unprecedented Levels*, News Release, J.D. Power and Associates, Feb. 29, 2000.

[37] *See* Appendix B, Table 1, p. B-2.

[38] When an operator is described as being "nationwide," it does not necessarily mean that the operator's license areas, service areas, or pricing plans cover the entire land area of the United States. The six mobile telephony carriers that analyst reports and this report often describe as nationwide all offer service in at least some (continued….)

Report, there were only three operators with nationwide footprints: AT&T Services ("AT&T"), Sprint PCS Group ("Sprint PCS"), and Nextel. Since then, Bell Atlantic Corp. ("Bell Atlantic," now known as Verizon)[39] and VoiceStream Wireless Corp. ("VoiceStream") have used joint ventures and mergers to join the ranks of the nationwide operators. These mergers are discussed below.

b. Major Operational Trends

Building Nationwide Footprints. A significant trend in the mobile telephone sector during 1999, as in previous years, was the continued effort of carriers to build nationwide footprints. As shown in Table 3 in Appendix B,[40] between December 1998 and December 1999, five of the top 25 operators by subscribership combined with other carriers. Furthermore, since the end of 1999, five operators in the year-end 1999 top 25 have merged with other carriers, and the joint venture between BellSouth Corporation ("BellSouth") and SBC Communications, Inc. ("SBC"), announced in April 2000, is currently pending before the Commission.[41] As noted in last year's report, one of the driving forces behind many of these transactions has been the desire of large regional carriers to enhance their ability to compete with nationwide operators such as AT&T, Sprint PCS, and Nextel that are offering attractive nationwide pricing plans.[42]

The Commission previously concluded that operators with larger footprints can achieve economies of scale and increased efficiencies compared to operators with smaller footprints.[43] Such benefits permit companies to introduce and expand innovative pricing plans such as digital-one-rate type ("DOR") plans,[44] reducing prices to consumers. Analysts have drawn similar conclusions, predicting that the current consolidation will intensify competition among nationwide wireless providers.[45]

(Continued from previous page)
portion of the western, middle, and eastern United States. *See* Colette Fleming, Mark Kinarney, and Rohit Sharma, *The Urge to Merge – 2000*, Morgan Stanley Dean Witter, May 22, 2000, at 4-5 ("*The Urge to Merge*").

[39] This reports sometimes discusses information and events from the period prior to the merger of Bell Atlantic and GTE Corp. ("GTE") creating Verizon Communications ("Verizon"), and the Bell Atlantic-Vodafone AirTouch PLC ("Vodafone") joint venture creating Verizon Wireless; therefore, the names "Bell Atlantic" and "Vodafone" will be used in those instances.

[40] *See* Appendix B, Table 3, p. B-5.

[41] *BellSouth, SBC Create 2nd Largest Wireless Company With $10.2 Billion in Revenues*, News Release, BellSouth Corp., Apr. 5, 2000.

[42] For a more complete discussion of the motivations for this phenomenon, s*ee Fourth Report*, 14 FCC Rcd at 10159-10160.

[43] *See Fourth Report*, 14 FCC Rcd at 10159; *Third Report*, 13 FCC Rcd at 19766; *Second Report*, 12 FCC Rcd at 11281.

[44] *See Innovative Pricing Plans*, *supra* and *Fourth Report*, 14 FCC Rcd at 10155-10156 for a discussion of DOR plans.

[45] Mary Mosquera, *Wireless Footprint Required For Competition*, TECHWEB (visited Oct. 8, 1999) <http://www.techweb.com/wire/story/TWB19990930S0006>.

Indeed, as discussed in Section II.A.1.d, *infra*, there is some evidence that the addition of new nationwide operators already may be contributing to decreasing prices. Moreover, it is important to emphasize that, along with the process of consolidation, the mobile telephone sector continues to experience heightened competition as a result of the expansion by broadband PCS carriers and Nextel.[46]

Voicestream/Omnipoint/Aerial - The broadband PCS operator VoiceStream, the largest U.S. carrier using GSM technology, merged with Omnipoint Corp. ("Omnipoint") and Aerial Communications, Inc. ("Aerial"), which were two of the other largest independent GSM-based operators in the country.[47] The new combined company controls PCS licenses covering 220 million POPs[48] and serves approximately 2.2 million customers.[49]

Verizon Wireless - Bell Atlantic, GTE, and Vodafone have combined their cellular and broadband PCS licenses into a single company, Verizon Wireless.[50] In April 2000, Bell Atlantic and Vodafone joined the assets of Bell Atlantic Mobile, AirTouch Communications, Inc. ("AirTouch"), and PrimeCo Personal Communications (formerly a joint Bell Atlantic – AirTouch broadband PCS venture) to create Verizon Wireless. On June 30, 2000, Bell Atlantic completed its merger with GTE, and the new company became Verizon.[51] At that time, GTE's cellular and broadband PCS assets were merged into Verizon Wireless.[52] Verizon Wireless has a footprint covering 232 million POPs (more than 90 percent of the U.S. population),[53] and is the largest mobile telephony provider with approximately 25 million subscribers.[54] Verizon owns 55 percent of Verizon Wireless, and Vodafone owns 45 percent.

---

[46] *See* Section II.A.1.c, *infra*.

[47] *See VoiceStream Wireless Closes Omnipoint Merger*, News Release, VoiceStream Wireless Corporation, Feb. 28, 2000; *VoiceStream Wireless Closes Aerial Merger*, News Release, VoiceStream Wireless Corporation , May 5, 2000.

[48] *Id*. POPs is an industry term referring to population, usually the number of people covered by a given wireless license or footprint. One "POP" equals one person.

[49] *See* Appendix B, Table 3, p. B-5.

[50] *Bell Atlantic and Vodafone AirTouch to Form New U.S National Wireless Competitor*, News Release, Bell Atlantic Corp., Sept. 21, 1999; *Bell Atlantic and Vodafone AirTouch Launch Verizon Wireless*, News Release, Verizon Wireless, Apr. 4, 2000; *Bell Atlantic and GTE to Create Verizon, The Next Great Brand in Communications*, News Release, Bell Atlantic Corp., June 16, 2000.

[51] *Bell Atlantic, GTE Complete Merger*, News Release, Bell Atlantic Corp. and GTE Corp., June 30, 2000.

[52] In the areas where GTE's cellular licenses overlapped those of Verizon Wireless, one of the cellular licenses was sold off. In the areas where the two companies' cellular licenses overlapped their 30 MHz broadband PCS licenses, Verizon Wireless is divesting 20 MHz of broadband PCS spectrum. *See United States of America v. Bell Atlantic Corporation, GTE Corporation, and Vodafone AirTouch PLC*, Civil No. 1-99CV01119 (LFO) (D.D.C. April 18, 2000) (Final Judgment).

[53] *Bell Atlantic and Vodafone AirTouch to Form New U.S. National Wireless Competitor*, News Release, Bell Atlantic Corp., Sept. 21, 1999.

[54] *See* Appendix B, Table 3, p. B-5.

SBC/BellSouth – In April, SBC and BellSouth announced they would combine their U.S. wireless operations into a joint venture, Alloy LLC.[55] If the proposed joint venture is approved by the Commission and consummated, the new venture would cover 175 million POPs and serve 16.2 million subscribers, making it the second largest wireless carrier.[56]

While the most high profile transactions have been on a national stage, there have been several smaller mergers that have been completed or announced since the release of the *Fourth Report*. Many of these have involved existing nationwide or regional operators purchasing smaller companies in order to expand or enhance their existing footprints.[57] Smaller operators have also made acquisitions in an attempt to increase the size of their footprints.[58]

International Alliances/Expansion. In addition to the domestic transactional activities that have taken place since the release of the *Fourth Report*, there also has been international activity in the form of both foreign operators investing in U.S. companies and U.S. companies seeking to expand their access to foreign markets.

The most notable entry into the U.S. market was Vodafone's merger with AirTouch.[59] With this acquisition, Vodafone, which was already the largest mobile telephone operator in the world, acquired what was, at the time, the largest carrier in the United States by number of subscribers. In addition, in July, Deutsche Telekom announced it would acquire VoiceStream.[60] Other examples of foreign operators investing in U.S. carriers include the Finnish company Sonera acquiring a 9 percent stake in the broadband PCS operator PowerTel Inc. ("PowerTel"),[61] and Hong Kong company, Hutchison

---

[55] *BellSouth, SBC Create 2nd Largest Wireless Company With $10.2 Billion in Revenues*, News Release, BellSouth Corp., Apr. 5, 2000; *See* SBC Communications Inc. and BellSouth Corporation Seek FCC Consent To Transfer Control of, or Assign Licenses to Joint Venture, WT Docket No. 00-81, *Public Notice*, DA 00-1581 (rel. May 19, 2000).

[56] *BellSouth, SBC Create 2nd Largest Wireless Company With $10.2 Billion in Revenues*, News Release, BellSouth Corp., Apr. 5, 2000.

[57] For example, AT&T's acquisition of Wireless One Network, LP, and its joint venture to acquire American Cellular Corp. (*See AT&T Announces Acquisition of Wireless One*, News Release, AT&T, Corp., Feb. 7, 2000; *AT&T and Dobson Communications Form Joint Venture To Purchase American Cellular*, News Release, AT&T Corp., Oct. 6, 1999); SBC Communications' acquisitions of Radiofone, Inc. and Cellular Communications of Puerto Rico (*See SBC Communications Completes Acquisition of Radiofone, Inc.*, News Release, SBC Communications, Inc., Mar. 2, 1999; *Cellular Communications of P.R. Acquisition Complete*, News Release, SBC Communications, Inc., Aug. 24, 1999); ALLTEL Corp.'s mergers with Aliant Communications Inc. and Liberty Cellular, Inc. (*See ALLTEL, Aliant Complete $1.8 Billion Merger*, News Release, ALLTEL Corp., July 2, 1999; *ALLTEL, Liberty Cellular Complete $600 Million Merger*, News Release, ALLTEL Corp., Sept. 30, 1999).

[58] For example, Rural Cellular Corp.'s acquisition of Triton Cellular Partners, LP (*See Rural Cellular Corporation Agrees to Acquire Assets of Triton Cellular*, News Release, Rural Cellular Corp., Nov. 8, 1999).

[59] *Vodafone and AirTouch to Complete Merger*, News Release, Vodafone Group PLC, June 25, 1999.

[60] *Deutsche Telekom to Acquire VoiceStream For $50.7 Billion, Creating First Wireless Operator Using GSM Standard Worldwide*, New Release, VoiceStream Wireless Corporation, July 23, 2000.

[61] *See Sonera Expands Presence in U.S. Wireless Market*, News Release, Powertel, Inc., Aug. 19, 1999. Sonera also acquired an 8.6 percent interest in VoiceStream through VoiceStream's merger with Aerial. *See* Aerial (continued….)

Telecommunications Limited, owning a 23 percent stake in VoiceStream after VoiceStream completed its acquisitions of Omnipoint and Aerial.[62]

A number of U.S. mobile telephone operators have been investing in foreign mobile telephone businesses for some time, most notably, BellSouth, Bell Atlantic, and AirTouch (prior to its acquisition by Vodafone).[63] While these companies continued to invest abroad in 1999, other U.S. companies began to look to foreign markets for the first time, including some broadband PCS operators that employed strategic partnerships to expand their footprints to other parts of North America. For example, VoiceStream made a significant investment in the Canadian GSM operator Microcell Telecommunications, Inc.[64] In addition, Sprint PCS acquired 30.5 percent of Mexican operator Pegaso PCS.[65] During the past year, AT&T increased its wireless presence in North America by acquiring one-third of the Canadian carrier Rogers Cantel Mobile Communications Inc. through a joint investment with British Telecommunications.[66]

Continued Rise of Digital. The rise of digital technology in the mobile telephone sector documented in the *Fourth Report* continues unabated.[67] During 1999, the number of customers subscribing to digital services doubled from approximately 20.7 million to 44.1 million.[68] At the same time, the number of analog subscribers declined for the first time, from 48.5 million to 41.9 million. The combined effect of these two trends was that at the end of 1999, digital subscribers made up 51 percent of the industry total, up from 30 percent at the end of 1998. All four of the primary competing digital technologies

(Continued from previous page)
Communications, Inc., and VoiceStream Wireless Holding Corporation, For Consent to Transfer Control of Licenses and Authorizations, WT Docket No. 00-3, *Memorandum Opinion and Order*, ¶ 15 (rel. Mar. 31, 2000).

[62] *See* Aerial Communications, Inc., and VoiceStream Wireless Holding Corporation, For Consent to Transfer Control of Licenses and Authorizations, WT Docket No. 00-3, *Memorandum Opinion and Order*, ¶ 11 (rel. Mar. 31, 2000); VoiceStream Wireless Corporation or Omnipoint Corporation and VoiceStream Wireless Holding Company, et al, For Consent to Transfer of Control and Assignment of Licenses and Authorizations, File Nos. 0000016354, *et al.*, File No. 0000054383, File No. 50001-CW-AL-00, *Memorandum Opinion and Order*, ¶ 14 (rel. Feb. 15, 2000).

[63] *See* Appendix B, Table 4, at B-6 for a summary of U.S. operators' foreign holdings.

[64] *See Microcell Announces Equity Investment by VoiceStream*, News Release, Microcell Telecommunications, Inc., Feb. 14, 2000.

[65] *See Leap Cuts Losses, Adds Markets*, WIRELESS TODAY, Mar. 22, 2000, *available in* 2000 WL 6391221.

[66] *See BT and AT&T Corp. Announce Strategic Telecommunications Investments In Canada*, News Release, AT&T Corp., Aug. 5, 1999.

[67] *See Fourth Report*, 14 FCC Rcd at 10154.

[68] *See* Appendix B, Table 5, p. B-8.

experienced growth in subscribership ranging from 65 to 147 percent.[69] In addition, analysts estimate that 80 percent of all new mobile phones sold in 1999 were digital.[70]

While the all-digital broadband PCS operators primarily fueled this growth, many of the major cellular carriers have moved a large portion of their subscriber base from analog to digital services. For example, according to AT&T, almost 70 percent of its cellular subscribers were using digital telephones as of September 30, 1999.[71] Similarly, Bell Atlantic reported that at the end of 1999, nearly 40 percent of its total customers used digital services[72] and 72 percent of its busy hour traffic came from its digital customers.[73]

Wireless/Wireline Competition. The *Fourth Report* discussed a growing trend of some mobile telephone carriers using a variety of methods to target homes with wireline-based second telephone lines.[74] There are indications that at least one carrier is achieving some measure of success in this market, and there is evidence that wireless services have begun to replace some customers' primary wireline phone. For example, the *Fourth Report* mentioned that in early 1999 Chase Telecommunications Holdings Inc., whose licenses were acquired by Leap Wireless International, Inc. ("Leap") in March 2000,[75] began offering a mobile telephone service in Chattanooga, Tennessee designed to compete with wireline local telephone service.[76] Leap's service has met with some success. The company reported that by the end of 1999, after only ten months of service, it had over 22,000 customers in Chattanooga, which represents a penetration rate of seven percent.[77] It has also been reported that 61 percent of these customers are using the service as their primary phone, accounting for an average of 1,000 minutes of use ("MOUs") each month, while the others are using it as a second phone line.[78] Leap expanded its service to the Nashville, Tennessee market in January 2000.

---

[69] The four technologies are: Code Division Multiple Access ("CDMA"), Global System Mobile Communications ("GSM"), integrated Digital Enhanced Network ("iDEN"), and Time Division Multiple Access ("TDMA").

[70] *DLJ Report*, at 58-59.

[71] AT&T Corp., Form S-3, Feb. 2, 2000, at 35.

[72] *Bell Atlantic Announces Fifth Consecutive Year of Double-Digit Earnings Growth; Fourth Quarter Revenues Rise 6.6% on Strong Sales*, News Release, Bell Atlantic Corp., Jan. 24, 2000.

[73] *Id*.

[74] *See Fourth Report*, 14 FCC Rcd at 10156-10159.

[75] *Leap Wireless International Completes Acquisition of Operating Licenses in Tennessee*, News Release, Leap Wireless International, Mar. 20, 2000.

[76] *See Fourth Report*, 14 FCC Rcd at 10157-10158.

[77] *See Leap Wireless International Reports Results For First Quarter of Fiscal 2000*, News Release, Leap Wireless International, Inc., Jan. 5, 2000.

[78] *Wireless Is Having Relatively Small Impact on First Wired Telephone Lines*, COMMUNICATIONS DAILY, Mar. 1, 2000, at 6.

In March, Midwest Wireless launched a similar service called "Realm" in four Minnesota communities.[79] The company indicates that the service is similar to the traditional cordless phone service used at home, but also allows customers to use their phone as a mobile phone.[80] For $39.99 per month and 1000 minutes, Realm subscribers may call anywhere in their own area code toll free and anywhere else in the United States for $0.12 per minute (or unlimited for an additional $12.95 per month).[81]

Finally, a recent survey sponsored by the Personal Communications Industry Association ("PCIA") and the Yankee Group lends supports to the view that some customers are replacing their wireline phone with a wireless handset. In the survey released in September 1999, 2 percent of respondents indicated that their mobile phone functions as their only phone.[82]

Use of Overlapping Cellular and Broadband PCS Licenses. Several mobile telephone operators have purchased broadband PCS licenses that overlap the geographic areas of their cellular licenses. The Commission estimates that mobile telephone operators own overlapping cellular and broadband PCS licenses (at least 35 MHz of total spectrum) in areas containing over 110 million POPs.[83] These areas include: large portions of the mid-Atlantic from Philadelphia to South Carolina; Chicago and northern and central Illinois; Houston and eastern Texas; parts of southern and northern California; and parts of Oregon and Washington.

The carrier with the largest amount of overlapping cellular-PCS spectrum is AT&T, whose overlap areas contain approximately 100 million POPs and include portions of the Pacific Northwest, Pennsylvania, West Virginia, Maine, Oklahoma, Ohio, and Arkansas; and major cities such as New York, Los Angeles, San Francisco, Denver, Dallas, and Miami.

In addition to AT&T, other cellular licensees have acquired 10 MHz broadband PCS licenses to supplement their cellular licenses. For example, in 1999 Bell Atlantic acquired six D and E block broadband PCS licenses from Rivgam Communications, LLC ("Rivgam"), which cover five markets in its east coast cellular service area.[84] In 1998, Vodafone also purchased from Rivgam several 10 MHz PCS licenses that overlap its cellular markets in California and Nevada.[85] Verizon Wireless's license areas now include additional cellular and broadband PCS overlaps in Florida, Alabama, Texas, Virginia, Ohio, Indiana, Illinois, Wisconsin, and Washington, as a result of the combination GTE's wireless assets with those of

[79] *Minnesota Communities Receive First-Of-Its-Kind Wireless Phone Service*, Midwest Wireless, News Release, Mar. 27, 2000.

[80] *Id*.

[81] *Id*. *See also*, Midwest Wireless, *Midwest Wireless: Cellular 2000 and ClearlyDigital* (visited June 13, 2000) <http://www.midwestwireless.com/mwc_plans/mwc_plans_realm.html>.

[82] *PCIA and The Yankee Group Release Largest Wireless Consumer Survey at PCS '99*, PCIA, News Release, Sept. 23, 1999.

[83] Federal Communications Commission estimates, based on publicly available information.

[84] *See* Lynnette Luna, *BAM Buys Rivgam Licenses To Boost Capacity*, RCR RADIO COMMUNICATIONS REPORT, Sept. 13, 1999, *available in* 1999 WL 7792312. In addition, as was reported in the *Fourth Report*, Rivgam Communications, LLC had previously sold its west coast E block broadband PCS licenses to AirTouch. *See Fourth Report*, 14 FCC Rcd at 10172.

[85] Colette Fleming *et al*, *US Wireless Services*, Morgan Stanley Dean Witter, May 22, 2000, at 9.

Verizon Wireless. As mentioned earlier, Verizon Wireless has agreed to divest 20 MHz and retain 10 MHz of the 30 MHz PCS licenses in these areas as part of its divestiture agreement with the U.S. Department of Justice.[86] Under the proposed SBC and BellSouth wireless joint venture, the new company would have overlapping cellular-PCS spectrum in Los Angeles, central Indiana, and portions of Louisiana and Mississippi.

These moves by carriers to own overlapping cellular and PCS spectrum indicate that they plan to use the broadband PCS licenses in conjunction with their cellular licenses as a means to expand capacity and/or offer additional services. In order to use both sets of frequencies in the same geographic area, carriers must deploy the same digital technology (either CDMA or TDMA) in both their cellular and PCS systems, and their subscribers must use dual-band handsets. AT&T is reportedly testing a dual-band network in the Miami, Florida area.[87] According to the report, AT&T's system can automatically switch back and forth between cellular and broadband PCS frequencies in the same geographic area, depending on available network capacity. If the trial is successful, the system may be expanded to other areas of AT&T's wireless network.[88]

Innovative Pricing Plans. In the mobile telephone sector, a single operator often tries a new and innovative pricing plan, and is later imitated by competitors once the plan has proven to be successful. For example, many in the industry questioned AT&T's wisdom when it introduced the first DOR plan in May 1998.[89] Today virtually all of the major operators offer a similar type of DOR pricing plan,[90] where customers can purchase a bucket of MOUs (Minutes of Use) on a nationwide or on a nearly-nationwide network without incurring roaming or long distance charges. The entry price point for these plans has fallen substantially. In May 1998, AT&T's least expensive DOR plan cost $89.99 for 600 minutes.[91] Now Sprint PCS's least

[86] The Department of Justice allowed the combined company to keep only up to 10 MHz of PCS spectrum in the overlapping cellular-PCS areas. The companies also had the choice of selling the entire 25 MHz cellular or entire 30 MHz PCS license in those areas. *See United States of America v. Bell Atlantic Corporation, GTE Corporation, and Vodafone AirTouch PLC*, Civil No. 1-99CV01119 (LFO) (D.D.C. April 18, 2000) (Final Judgment).

[87] Steve Gold, *AT&T Taps Ericsson for Dual Band Wireless Network*, NEWSBYTES NEWS NETWORK, Dec. 14, 1999, *available in* 1999 WL 29943972.

[88] *Id*.

[89] *See AT&T Launches First National One-Rate Wireless Service Plan*, News Release, AT&T Corp., May 7, 1998.

[90] For example, Verizon Wireless's five SingleRate plans allow customers to purchase different levels of minutes per month with no roaming and no long distance charges, with rates ranging from $35 for 150 minutes to $150 for 1500 minutes. Verizon Wireless, Inc., *SingleRate* (visited June 5, 2000) <http://www.verizonwireless.com/ver_five_plans.html>. Sprint PCS's Free & Clear Plan also allows customers to purchase different buckets of minutes at different monthly rates with no roaming and no long distance charges, as long as customers remain on Sprint's nearly-nationwide network. The rates range from $19.99 for 20 minutes to $399.99 per month for 4,000 minutes. Sprint PCS, *Sprint PCS Free & Clear Plans* (visited June 5, 2000) <http://s2.sprintpcs.com/store/cc_Pricing.asp>.

[91] *See Fourth Report*, 14 FCC Rcd at 10155.

expensive Free & Clear plans cost $19.99 for 20 minutes and $29.99 for 180, and Verizon Wireless offers its SingleRate plan beginning at $35 for 150 minutes.[92]

The past year has seen another example of pricing innovation in family-oriented plans. These plans allow a family to establish an account with a certain number of family members within the same calling area. Each family member has his or her own wireless phone and phone number, and can make unlimited calls to the other wireless numbers on the account and to and from the family's home number within the defined family calling area. The charges are usually provided on a single bill. This type of family plan was first introduced by AT&T in the third quarter of 1999,[93] and SBC Communications has since instituted its own such plan called "FamilyTalk."[94]

In October 1999, Bell Atlantic introduced a different type of family pricing plan, called "Share-A-Minute."[95] With this type of plan, two or more customers – generally members of the same family – can share monthly airtime by each making calls from the same bucket of minutes while maintaining separate phones and phone numbers. The customers on the account can also make unlimited calls to each other without deducting from the bucket of minutes.

c. Market Entry

The past two editions of this report provided summaries of estimated broadband PCS coverage by BTAs.[96] For this year's report, in an attempt to provide a more precise picture of network deployments, the Commission has decided to re-estimate and enhance these coverage maps using county boundaries.[97] This analysis is based on publicly available sources of information released by the operators such as

---

[92] Verizon Wireless, Inc., *SingleRate* (visited June 5, 2000) <http://www.verizonwireless.com/ver_five_plans.html>. Sprint PCS, *Sprint PCS Free & Clear Plans* (visited June 5, 2000) <http://s2.sprintpcs.com/store/cc_Pricing.asp>. Free & Clear customers must remain on Sprint PCS's nearly-nationwide network in order to avoid roaming and long distance charges.

[93] *Third Quarter Operational Earnings Were $0.54 Per Share Pro Forma Revenues Grew 5.6%*, AT&T Corp., AT&T Group Earnings Commentary, Oct. 25, 1999, at 8.

[94] SBC Communications, Inc., *Digital Edge - FamilyTalk* (visited Mar. 2, 2000) <http://www.getcellone.com/pro-serv2.html#family>.

[95] *Bell Atlantic Mobile Inspires Whole Families, Small Businesses to Go Wireless with New Share-A-Minute Plan*, News Release, Bell Atlantic Corp., Oct. 29, 1999.

[96] BTAs are Material Copyright (c) 1992 Rand McNally & Company. Rights granted pursuant to a license from Rand McNally & Company through an arrangement with the Personal Communications Industry Association. BTAs are geographic areas drawn based on the counties in which residents of a given BTA make the bulk of their shopping goods purchases. Rand McNally's BTA specification contains 487 geographic areas covering the 50 states and the District of Columbia. For its spectrum auctions, the Commission added additional BTA-like areas for: American Samoa; Guam; Northern Mariana Islands; San Juan, Puerto Rico; Mayagüez/Aguadilla-Ponce, Puerto Rico; and the United States Virgin Islands.

[97] In order to allow comparisons with previous years, tables in Appendix B also estimate coverage on a BTA basis. *See* Appendix B, Tables 2A-2D, at pp. B-3 – B-4.

news releases, filings with the SEC, and coverage maps available on operators' Internet sites.[98] On July 10, 2000, broadband PCS A and B block licensees submitted information on their coverage areas to the Commission as evidence that they have met their five-year buildout requirements. This information will be made publicly available; however, it is not included in this report's analysis of coverage and buildout.

There are several important caveats to note when considering this data. First, to be considered as "covering" a county, an operator need only be offering service in a portion of that county. Second, multiple operators shown as covering the same county are not necessarily providing service to the same portion of that county. Consequently, some of the counties included in this analysis may have only a small amount of coverage from a particular provider. Third, the POPs and square miles figures in this analysis include all of the POPs and all of the square miles in a county considered to have coverage. Therefore, this analysis overstates the total coverage in terms of both geographic areas and populations covered. Fourth, in a small number of areas, sufficient coverage information was not available to move from BTA-by-BTA determinations to county-by-county determinations. In each of these cases, the population and square miles of the entire BTA are included. Lastly, all population figures are based on the 1990 census.

In the five years since the Commission first granted the A and B block broadband PCS licenses, non-cellular carriers[99] have built extensive networks covering a large portion of the country's population. To date, 222 million people, or 88 percent of the total U.S. population, have three or more different operators (cellular, PCS, and/or Nextel) offering mobile telephone service in the counties in which they live. However, these counties make up only 35 percent of the total land area of the United States, reflecting the nation's uneven population distribution. On the other hand, the land area of these counties, 1.3 million square miles, is roughly equal to the combined land area of the 15 members of the European Union. Over 173 million people, or 69 percent of the U.S. population, live in areas with five or more mobile telephone operators competing to offer service. And 11 million people, or 4 percent of the population, can choose from among seven different mobile telephone operators.

d. Price Competition

As the Commission observed in the previous two reports, it is difficult to identify sources of information that track mobile telephone prices in a comprehensive manner.[100] However, a number of reports and

[98] The Commission's buildout rules for geographic area licenses do not require operators to deploy networks such that the entire geographic area of a specific license receives coverage. For example, the construction requirements for 30 MHz broadband PCS licenses (blocks A, B, and C) state that an operator's network must serve an area containing at least one-third of the license area's population within five years of the license being granted and two-thirds of the population within ten years. *See* 47 C.F.R. § 24.203(a). Similarly, the construction requirements for 10 MHz boradband PCS licenses (blocks D, E, and F) state that an operator must cover one-quarter of a license area's population, or provide "substantial service," within five years of being licensed. *See* 47 C.F.R. § 24.203(b). The details concerning exactly which geographic areas or portions of the population should be covered to meet these requirements are left to the operators. In addition, decisions about whether to increase coverage above these requirements are left to the operators. For information on the buildout requirements for cellular licenses, *see* 47 C.F.R. §§ 22.946, 22.947, 22.949, 22.951.

[99] For the purposes of this analysis, "non-cellular carriers" are defined as operators using broadband PCS spectrum or Nextel in the areas where it has launched its digital SMR product.

[100] *See Fourth Report*, 14 FCC Rcd at 10164-10165.

other available data indicate that the entrance of new competitors into this market continues to reduce prices. Because these studies use different methodologies and market samples, their findings vary and are comparable only in the broadest terms. Nevertheless, they clearly show that the average price of mobile telephony has fallen substantially since the *Fourth Report*, continuing the trend of the last several years.[101]

According to one estimate, prices declined by approximately 8 percent during the last six months of 1999.[102] The same survey also stated that the biggest price declines came in plans offering 150 minutes of talk time each month, which dropped by 12 percent during that 6-month period.[103] This may indicate that competition is continuing to make mobile telephone services more affordable for all Americans and not just those who can afford price plans that provide 500 or 1,000 MOUs per month. As discussed earlier,[104] the entry level price of DOR plans has also fallen substantially. When AT&T introduced its DOR plan in May 1998, the least expensive package cost $89.99. Now Sprint PCS and Verizon Wireless offer DOR plans starting at $19.99 and $35 per month, respectively. Another analyst estimates that prices fell by 20 percent between 1998 and 1999.[105]

According to a report by a third analyst, subscribers with medium usage level (200 to 360 MOUs per month) saw the greatest benefits of price competition during 1999.[106] This is a change from this analyst's same study from the previous year in which it concluded that price competition had focused primarily on high-usage customers (over 400 MOUs per month) during 1998.[107] By examining the median price per MOU in 1999 of four different usage levels (60, 240, 420, and 600 MOUs per month), this analyst found the greatest price per MOU drop of 29 percent (from $0.21 to $0.15) was seen in usage levels of 240 MOUs per month.[108] The price per MOU for the lowest level of usage (60 MOUs per month) remained constant at $0.40 per minute during 1999, while higher levels of usage – 420 and 600 MOUs – saw price decreases of 20 percent (from $0.15 to $0.12) and 8 percent (from $0.12 to $0.11), respectively.[109]

The results of this third analyst's study do not account for promotional prices such as free bonus minutes or free weekend minutes. The study concedes that the prices it reports would have been even lower if it had included promotions, as they move MOU prices down even further.[110]

---

[101] *Econ One News Release*; *BLS Database*.

[102] *Econ One News Release*.

[103] *Id.*

[104] *See* Section II.A.1.b, *supra*.

[105] The Strategis Group, Inc., 2000.

[106] David A. Freedman, *Wireless Telephony: Untethered Stories & Stats Medium Users Benefited Most in 1999*, Bear, Stearns & Co. Inc., June 2000, at 4-6.

[107] *Id.*

[108] *Id.*

[109] *Id.*

[110] *Id.*

Another source of price information is the cellular telephone services component of the Consumer Price Index ("Cellular CPI") produced by the United States Department of Labor's Bureau of Labor Statistics.[111] In the 12 months between the end of January 1999 and the end of January 2000, the Cellular CPI decreased by 11.3 percent. In comparison, during the same period of time, the local telephone services component increased by 2.5 percent and the long distance telephone services component decreased by 1.4 percent. The overall consumer price index increased by 2.7 percent.

Roaming. According to one analyst, there has been a reduction in roaming rates in the past year or two.[112] The analyst estimates that U.S. Cellular Corporation dropped its local average roaming rate per minute by 50 percent between the fourth quarter of 1997 and the first quarter of 1999 from $0.75 to $0.37.[113] Another analyst estimates that the average effective roaming yield (roaming revenues divided by MOUs) for five companies will fall from $0.44 to $.0.36 between 1999 and 2000.[114] One analyst attributes the reduction in roaming rates primarily to a new switching capability and rural buildout by affiliates of major carriers.[115] First, carriers have developed the functionality to allow digital handsets to switch between the A and B cellular and PCS bands, provided the customer has a dual band phone and the digital standards are compatible. In contrast, old analog phones were programmed to search only for one of the two cellular bands and had to be manually reprogrammed to roam on another network. Due to this technological advancement, the major carriers are able to leverage large bundles of roaming minutes when negotiating for roaming rates. Second, several major carriers have negotiated agreements with affiliates to build out their secondary and rural markets.[116] As a result, carriers have additional alternatives for their traffic, potentially lowering roaming rates.[117] Competition from firms with large or nationwide footprints that are able to minimize the need for roaming by their customers may be forcing other firms to lower their roaming rates.[118]

---

[111] The Consumer Price Index ("CPI") is a measure of the average change over time in the prices paid by urban consumers for a fixed market basket of consumer goods and services. The basket of goods includes over 200 categories including items such as food and beverages, housing, apparel, transportation, medical care, recreation, education, and communications. The CPI provides a way for consumers to compare what the market basket of goods and services costs this month with what the same market basket cost a month or a year ago. Starting in December of 1998, this basket of goods included a category for cellular telephone services. All CPI figures discussed in this paragraph were taken from U.S. Department of Labor, Bureau of Labor Statistics databases found on the Bureau of Labor Statistics' Internet site at <http://www.bls.gov/sahome.html>.

[112] *The Urge to Merge*, at 9.

[113] *Id*. The rates quoted do not include toll charges. *Id*.

[114] Linda J. Mutschler and Naeemah Lajoie, *The Next Generation IV Wireless in the US*, Merrill Lynch & Co., Mar. 10, 2000, at 41 ("*2000 Merrill Lynch Report*").

[115] *The Urge to Merge*, at 9.

[116] *See* Section II.A.3.a, *supra*.

[117] *The Urge to Merge*, at 9.

[118] *Id*.

Prepaid. Although a number of analysts predict that at least half of new wireless users will subscribe to a prepaid pricing plan within the next several years, only approximately 6 percent of U.S. wireless phone users currently subscribe to prepaid plans.[119] This contrasts sharply with the experience of prepaid wireless in Europe. For example, almost all new wireless subscribers in Italy and the United Kingdom were prepaid in 1999.[120]

Prepaid subscribership has generally increased at a more gradual rate in the United States. As reported in the *Fourth Report*, Powertel is a broadband PCS operator with a substantial number of prepaid subscribers.[121] As of March 31, 2000, Powertel reported that 44 percent of its subscriber base was on prepaid pricing plans.[122] This is a substantial increase over the 20 percent of Powertel subscribers on prepaid plans as of the end of the first quarter of 1999.[123] VoiceStream reported that as of March 31, 2000, it had 500,000 prepaid subscribers out of a total subscriber base of 1.8 million.[124] AT&T announced a national prepaid plan in September that permits wireless subscribers to call from any location without incurring any additional roaming or long distance charges.[125] Sprint PCS has been promoting an alternative approach to traditional prepaid called "Automatic Spending Limits" ("ASL"), in which the wireless subscriber pays a deposit that becomes their monthly spending limit.[126] ASL, which enables subscribers to access the same pricing plans as postpaid subscribers, accounted for about 15 percent of the Sprint PCS subscribership as of May 9, 2000, whereas traditional prepaid accounted for about 2 percent.[127] Leap Wireless is offering a prepaid local wireless service in Chattanooga and Nashville.[128] This prepaid service, which is marketed under the Cricket brand, is priced at $29.95 per

---

[119] Elizabeth V. Mooney, *Prepaid faces its conundrum: It's more expensive*, RCR RADIO COMMUNICATIONS REPORT, Apr. 3, 2000, at 14, reporting on predictions from analysts at Donaldson, Lufkin & Jenrette Securities Corp., Strategis Group, and The Yankee Group.

[120] Todd Rethemeier, *The Mobile Millennium – Wireless Telecommunications Services*, J.P. Morgan Securities, Inc., May 3, 2000, at 13. This report suggests two main reasons for the greater number of prepaid subscribers in Europe: (1) European consumers are much more accustomed to prepaying for purchases; and (2) calling party pays enables prepaid wireless subscribers to use the phone for incoming calls without incurring any charges.

[121] *See Fourth Report*, 14 FCC Rcd at 10160-10161.

[122] *Powertel, Inc. Announces First Quarter 2000 Financial Results*, News Release, Powertel, Inc., Apr. 27, 2000.

[123] *Powertel, Inc. Announces First Quarter 1999 Financial Results*, News Release, Powertel, Inc., Apr. 29, 1999.

[124] *VoiceStream Wireless Announces First Quarter 2000 Financial Results*, News Release, VoiceStream Wireless Corp., May 8, 2000.

[125] *AT&T Launches National PrePaid Wireless Offer*, News Release, AT&T, Sept. 13, 1999.

[126] Linda J. Mutschler and Naeemah Lajoie, *Sprint PCS*, Equity Research, Merrill Lynch & Co., May 9, 2000, at 3.

[127] *Id*.

[128] *Affordable, Flat-Rate Cricket Wireless Service Launches in Nashville*, PR Newswire, Jan. 31, 2000.

month to make and/or receive an unlimited number of local calls and was designed to compete with local wireline service.[129]

e. Consumer Response

Some of the key metrics reported by mobile telephone operators, such as net new subscriber growth, MOUs, and increasing average revenue per unit ("ARPU"), demonstrate the increased demand for and reliance placed on mobile services.

Net New Subscriber Growth. As discussed above, 1999 saw a 24 percent increase in the number of subscribers, compared to increases of 25 percent in 1998 and 26 percent in 1997.[130] In absolute terms, 1999 net additional subscribers, 16.8 million, reached a new high compared to previous year increases.[131]

The *Fourth Report* discussed the fact that, since their initial launches in 1995, non-cellular carriers have consistently taken an increasing share of the industry's subscriber growth, previously reaching as high as 50 percent in 1998.[132] That trend has continued during the past year, with non-cellular carriers attracting between 50 and 64 percent of the industry's total new subscribers in each quarter of 1999.[133] According to at least one analyst, this trend will continue, with these carriers achieving a 75 percent share of annual growth by the middle of this decade.[134]

Minutes-of-Use. As discussed in last year's report, operators have designed their pricing plans to increase subscribers' MOUs, not just total subscribership.[135] This trend continued during 1999. While estimates of average MOUs per subscriber per month ("average MOUs") vary, all show an increase between 1998 and 1999. According to the Cellular Telecommunications Industry Association's ("CTIA") mobile telephone survey, average MOUs were 180 between July and December 1999, an increase of 38 percent from 130 MOUs during the same period in 1998.[136] Two other industry analysts, using somewhat different methodologies, reported higher 1999 MOUs but a lower growth rate than

---

[129] *Id*. Subscribers cannot roam on this system, but long distance calling is available at an additional charge through a separate prepaid account. *See also* Carleen Hawn, *E-Commerce: Mobile Manicurist: Wireless providers have long catered to the wealthy. At last, an upstart unveils a service tailored to working stiffs.* FORBES, Dec. 13, 1999, available in 1999 WL 28466848.

[130] *See* Appendix B, Table 1, p. B-2.

[131] *Id*.

[132] *See Fourth Report*, 14 FCC Rcd at 10167.

[133] *See* Appendix B, Table 7, p. B-10.

[134] *See DLJ Report*, at 15.

[135] *See Fourth Report*, 14 FCC Rcd at 10169.

[136] *CTIA Reports 1999 Survey Results*, News Release, Cellular Telecommunications Industry Association, Apr. 11, 2000. CTIA aggregated all of the carriers' MOUs from July 1 through December 31, 1999, then divided by the number of subscribers, and then divided by six. Telephone conversation with Robert Roche, CTIA, June 16, 2000.

CTIA. The first analyst estimated average MOUs of 200 in 1999,[137] an increase of 20 percent from 170 MOUs in 1998.[138] The second analyst calculated 242 average MOUs in 1999, also a 20 percent increase from 199 in 1998.[139]

Increasing MOUs most likely reflect the decreasing prices and the general wider acceptance of and reliance upon wireless service. This trend may also indicate that mobile telephony is moving away from just complementing existing wireline voice service and towards competing directly with it. According to one analyst, mobile telephone customers' share of total voice MOUs has increased from 3.2 percent in 1997 to 4.5 percent in 1998, and to 7.1 percent in 1999.[140]

Average Revenue Per Unit. One of the reasons operators sought to increase the MOUs of their subscribers appears to be a belief that doing so would help counteract any negative effect falling prices are having on the average monthly revenue per subscriber (often referred to as average revenue per unit, or ARPU). For the mobile telephone sector, ARPU has decreased almost continuously since CTIA began gathering data on it, going from a peak of $98.02 in December 1988 to a low of $39.43 in December 1998.[141] However, in 1999, ARPU has actually increased slightly, first to $40.24 in June 1999 and then to $41.24 in December 1999. Analysts attribute this rise to increasing MOUs.[142]

f. Factors Affecting Growth and Competitive Development

(i) Coverage by Technology Type

The desire by operators to create nationwide footprints for their chosen digital technology continued during 1999. The *Fourth Report* discussed how this drive stems from cellular operators needing to improve capacity as well as increase their advanced service offerings, and from broadband PCS and digital SMR operators needing to expand their footprints to increase their competitiveness.[143] To estimate the current levels of deployment of the four main digital mobile telephone technologies

[137] Paul Kagan Associates, Inc., *Kagan Projections: Wireless Heading Towards One-Third Total U.S. Usage*, WIRELESS MARKET STATS, Oct. 27, 1999, at 5.

[138] *See* Paul Kagan Associates, Inc., *Wireless Share of Total U.S. Communications MOUs: 1997-2007*, WIRELESS MARKET STATS, Jan. 31, 1998, at 2, and Paul Kagan Associates, Inc., *Kagan Projections: Wireless Heading Towards One-Third Total U.S. Usage*, WIRELESS MARKET STATS, Oct. 27, 1999, at 5.

[139] *AT&T Wireless Surges to the Lead in Nine Out of 13 Markets Included in Study*, News Release, J. D. Power and Associates, Sept. 23, 1999.

[140] *See* Paul Kagan Associates, Inc., *Wireless Share of Total U.S. Communications MOUs: 1997-2007*, WIRELESS MARKET STATS, Jan. 31, 1998, at 2 *and* Paul Kagan Associates, Inc., *Kagan Projections: Wireless Heading Towards One-Third Total U.S. Usage*, WIRELESS MARKET STATS, Oct. 27, 1999, at 5.

[141] *See* Appendix B, Table 1, p. B-2.

[142] *See DLJ Report*, at 7.

[143] *See Fourth Report*, 14 FCC Rcd at 10170.

(CDMA, TDMA, GSM, and iDEN), the Commission has prepared maps of each technology combining the coverage by all of the relevant operators.[144]

CDMA and TDMA technologies are deployed in the networks of both cellular and broadband PCS operators.[145] To date, CDMA has been launched in at least some portion of counties containing 204 million people, or 80.8 percent of the U.S. population.[146] To date, TDMA has been launched in at least some portion of counties containing 207 million people, or 81.6 percent of the U.S. population.[147] Based on the footprints of the carriers that have committed to using the two technologies, CDMA could potentially be deployed to 100 percent of the U.S. population and TDMA could potentially be deployed to 98.6 percent.

In the United States, only broadband PCS operators are deploying GSM technology. Carriers that have committed to using GSM have a combined footprint covering 247 million POPs, or 91 percent of the U.S. population. To date, GSM has been launched in at least some portion of counties containing 165 million people, or approximately 65.3 percent of the U.S. population.[148]

The analysis of iDEN coverage is limited to the largest digital SMR provider, Nextel. While Nextel is not the only provider using iDEN,[149] it is the only one for which detailed coverage information is available. To date, Nextel has launched iDEN-based service in at least some portion of counties containing over 185 million people, or approximately 73.3 percent of the U.S. population.[150]

g. Foreign Mobile Telephone Market Comparison

As mentioned above, many U.S. carriers are beginning to form alliances or acquire networks in foreign markets in order to expand into additional mobile telephone markets. A comparison of the major trends in the U.S. mobile telephone market with those in Western Europe, which most resembles the United States in terms of economic development, shows that while penetration levels are higher in Western Europe, average MOUs are higher in the United States. Also, innovative mobile data applications are being used more widely in Europe than in the United States. These and other international mobile data developments are discussed in Section II.B, *infra*.

---

144 *See* Appendix F, Maps 2-5, pp. F-3 – F-6.

145 The broadband PCS-based coverage is estimated using counties and the cellular-based coverage is estimated using Metropolitan Statistical Areas ("MSAs") and Rural Service Areas ("RSAs"). MSAs and RSAs are sometimes referred to collectively as Cellular Market Areas ("CMAs"). The same caveats mentioned above in Section II.A.1.c apply to these data as well.

146 *See* Appendix B, Table 7, p. B-10 *and* Appendix F, Map 2, p. F-3.

147 *Id*. at p. B-10 and p. F-4.

148 *Id*. at p. B-10 and p. F-5.

149 *See infra* note 185.

150 *See* Appendix B, Table 7, p. B-10 *and* Appendix F, Map 5, p. F-6.

The most prominent difference between the U.S. and Western European mobile telephone markets is that the Western European markets are achieving greater penetration levels and higher average penetration growth.[151] On average, Western European penetration reached 40 percent at the end of 1999 compared to 32 percent in the United States.[152] The penetration rates of individual countries vary widely, however, ranging from a low of 28 percent in Germany to a high of 65 percent in Finland. In 1999, Western Europe also increased penetration levels at a faster rate than the United States. On average, Western Europe's average penetration increased by 67 percent over its 24 percent average penetration in 1998. This is almost three times higher than the 23 percent penetration growth in the United States during 1999. Two countries, Spain and Greece, were able to at least double their penetration levels – from 18 percent to 38 percent and from 18 percent to 36 percent, respectively.

While a higher percentage of the Western European population currently subscribes to mobile phone service, average MOU data shows that subscribers in the United States are using their phones to a greater extent. One analyst estimates that average MOUs in Western Europe will be 145 at the end of 2000.[153] The same analyst estimates that average MOUs in the United States will be 52 percent higher at 221 at the end of 2000.[154] The analyst speculates this may be due to the higher penetration of prepaid service in Europe, which tends to dilute per subscriber traffic.[155]

While many of the countries in Asia and Latin America have less developed mobile telephone industries than the United States and Western Europe, mobile telephone subscribership is nonetheless expanding rapidly in many of these countries.[156] For example, while the People's Republic of China's mobile telephone penetration did not pass the 3 percent level until 1999,[157] mobile telephone operators in that country added more than 16 million new customers between October 1998 and October 1999.[158] In addition, although no country in Latin America has penetration levels comparable to those of the United States and Western Europe, mobile telephone subscribership is growing rapidly there. According to one analyst, eight countries in Latin America at least doubled their penetration levels between June 1998 and June 1999.[159]

Given the large number of differences between telecommunications markets around the globe, it is difficult to provide a simple explanation for the performance differences between the U.S. and various

---

[151] All of the foreign penetration figures mentioned in this paragraph are taken from the *DLJ Report*, at 62.

[152] *See supra* note 13.

[153] Michael I. Rollins and Thomas P. Vincent, *The Wireless EDGE*, Salomon Smith Barney, May 23, 2000, at 5.

[154] *Id*.

[155] *Id*.

[156] Japan and Hong Kong, similar to the United States and Western Europe economically, have higher penetration levels than the United States, of 37 percent and 57 percent, respectively. *DLJ Report*, at 75.

[157] Excluding Hong Kong.

[158] *DLJ Report*, at 75.

[159] *Id*. at 84.

foreign markets. Analysts offer a wide variety of reasons, such as differences in governmental regulation (including licensing and standards policies), the extent of competition in the wireless market, the prices and quality of existing wireline telecommunications infrastructure, and the status of overall economic development in the country or region. Despite these differences, one clear theme emerges: wireless technologies are rapidly becoming one of the central elements of the world's telecommunications infrastructure. Regardless of the many differences among countries, the result over the past several years has been the same: mobile telephony is becoming an essential part of most cultures and economies across the globe.

h. Increased Demand For Spectrum

It appears that the market value of licenses enabling use of spectrum suitable for mobile applications has been rising over the last year. For example, in December 1999 Nextel offered a total of $8.3 billion, or $2.31 per MHz-pop, for the licenses formerly held by NextWave Telecom, Inc.[160] (This offer was contingent on elimination of the rule that reserves these licenses for "entrepreneurs" and would prohibit Nextel from acquiring them.) In an April 2000 auction held in the United Kingdom for spectrum to be used for 3G mobile services, winning bids averaged $4.27 per MHz-pop.[161] In comparison, winning bids in the original A/B block auction, which closed in March 1995, averaged $0.46 per MHz-pop.[162] This increase in values is generally considered to result from increased predictions about future *demand* for mobile services, including mobile data services in particular.[163] The Commission has been moving to provide spectrum to satisfy this increased demand. For example, the auction of licenses for certain C and F block PCS spectrum has been scheduled for this year and the licenses for 700 MHz spectrum will be auctioned in March 2001.[164] In addition, the Commission's general policy of allowing flexible use of spectrum licenses, rather than allowing only specific, narrow uses, should help make spectrum resources available to satisfy competing demands in an effective fashion.[165] Similarly, Commission efforts to facilitate the development of secondary markets for spectrum licenses will also help to meet new

[160] Nextel Communications, Inc., Petition For Expedited Declaratory Ruling, In the Matter of Clarification of the Commission's Rules and Policies Pertaining to the Designated Entity Holding Period and Related Rules and Policies in Cases of Licensee Default and Bankruptcy (December 21, 1999).

[161] John M. Bensche, et al., *Spectrum Auction Update – Lessons from the U.K.*,Lehman Brothers, May 11, 2000 ("*U.K. Lessons*"); FCC calculations based on publicly available information.

[162] Commercial Mobile Radio Service Information: Announcing The Winning Bidders In The FCC's Auction Of 99 Licenses To Provide Broadband PCS In Major Trading Areas: Down Payments Due March 20, 1995, *Public Notice* (rel. March 13, 1995). The results of the recent FCC auctions of PCS and paging licenses do not contradict the finding that values have been rising. The PCS auction ended in April 1999, before much of the recent increase occurred, and high bids in that auction were also reduced because participation was limited to firms qualifying as entrepreneurs. The paging auction that closed in March 2000 primarily involved highly encumbered licenses.

[163] *See e.g., U.K. Lessons*, at 2 and 18.

[164] Auction of Licenses for C and F Block Broadband PCS Spectrum Postponed Until November 29, 2000, *Public Notice*, DA 00-1246 (rel. June 7, 2000); Auction of Licenses in the 747-762 and 777-792 MHz Bands Postponed Until March 6, 2001, *Public Notice*, WT Docket No. 99-168 (rel. July 31, 2000).

[165] *See* Principles for Reallocation of Spectrum to Encourage the Development of Telecommunications Technologies for the New Millennium, *Policy Statement*, 14 FCC Rcd 19868 (1999).

demands for spectrum.[166] While this information appears in the mobile telephone section, it is equally relevant to mobile data.

2. Cellular Sector Analysis

The Commission began licensing of commercial cellular systems in 1981 and completed licensing the majority of systems by 1992. The Commission divided the United States and its possessions into 734 cellular market areas (305 Metropolitan Statistical Areas ["MSAs"] and 428 Rural Service Areas ["RSAs"], and a market for the Gulf of Mexico). Two cellular systems were licensed in each market area. The Commission allocated 50 MHz of spectrum in the 800 MHz frequency band for the two competing cellular systems in each market (25 MHz for each system).

a. Cellular Sector Structure

The effects of the consolidation discussed above have been particularly noticeable in the cellular sector. Of the 12 companies on the mobile telephone sector's list of the top 25 operators by subscribership (*pro forma* year-end 1999) that have consolidated since the end of 1998, seven were cellular-only operators and two others were predominantly cellular carriers with broadband PCS operations.[167] As a result, the three largest carriers on the *pro forma* year-end 1999 top 25 subscriber list controlled systems serving 82 percent of all cellular customers.[168] The top three carriers previously had controlled only 40 percent at the end of 1998.[169]

b. Response to Competition

The efforts of cellular operators to increase their capacity and expand their service offerings by deploying digital technologies, as discussed in the *Fourth Report*,[170] has continued during the past year. Digital technology allows expansion of capacity without degradation of service for existing customers. The extra capacity also permits the inclusion of advanced services such as short messaging service ("SMS"). As discussed above, cellular operators are also attempting to deal with capacity constraints by testing and deploying the technology to utilize both cellular and PCS frequencies within the same geographical area.[171]

To track digital rollouts, the Commission has compiled a list of MSAs and RSAs with some level of digital coverage by the incumbent cellular operators. These data are based on publicly available information released by the operators, such as news releases, filings made with the SEC, and coverage maps available on operators' Internet sites. The Commission has found that digital cellular services are

---

166 *See* FCC Announces Agenda For Public Forum on Secondary Markets in Radio Spectrum, *Public Notice*, DA 00-862 (rel. May 23, 2000).

167 *See* Appendix B, Table 3, p. B-5.

168 *Id*.

169 *Id*.

170 *See Fourth Report*, 14 FCC Rcd at 10173.

171 *See* Section II.A.1.b, *supra*.

available in approximately 420 MSAs and RSAs, which have a combined coverage of more than 230 million POPs, or 84 percent of the nation's total population.[172]

3. Broadband PCS Sector Analysis

Broadband PCS is similar to cellular service, except that broadband PCS systems operate in different spectrum bands and are designed to use a digital format. The Commission has set aside the spectrum between 1850 MHz and 1990 MHz for broadband PCS. This spectrum includes 120 MHz divided originally into three blocks of 30 MHz[173] each and three blocks of 10 MHz each. Two of the 30 MHz blocks are assigned on the basis of 51 Major Trading Areas ("MTAs").[174] One of the 30 MHz blocks and all of the 10 MHz blocks are assigned on the basis of 493 BTAs.[175] The Commission's broadband PCS allocation also includes 20 MHz of spectrum for unlicensed broadband PCS.[176]

The year since the release of the *Fourth Report* has been one of strong growth for broadband PCS operators. In that time, seven new broadband PCS operators have commenced service, and subscribership of operators for whom public information is available has increased by more than 100 percent to 14.5 million.[177]

---

[172] FCC estimates are based on 1998 MSA/RSA populations.

[173] The Commission has tentatively concluded that each 30 MHz C block license available in future broadband PCS auctions should be reconfigured into three 10 MHz C block licenses. *See FCC Proposes Rule Changes For Upcoming C and F Block Auction To Encourage Advanced Wireless Services and Small Business Opportunities Nationwide*, News Release, (rel. June 1, 2000).

[174] Major Trading Areas are Material Copyright (c) 1992 Rand McNally & Company. Rights granted pursuant to a license from Rand McNally & Company through an arrangement with the Personal Communications Industry Association. MTAs are combinations of two or more BTAs. Rand McNally's MTA specification contains 47 geographic areas covering the 50 states and the District of Columbia. For its spectrum auctions, the Commission has added the following MTA-like areas: (1) Guam and the Northern Mariana Islands, (2) Puerto Rico and the U.S. Virgin Islands, and (3) American Samoa. In addition, Alaska was separated from the Seattle MTA into its own MTA-like area.

[175] In June 1998, broadband PCS C block licensees were permitted to elect to disaggregate their licenses and return 15 MHz of C block spectrum to the Commission. As a result, a number of licensees elected to disaggregate some or all of their licenses, creating some BTAs with seven spectrum licenses. *See* Amendment of the Commission's Rules Regarding Installment Payment Financing for Personal Communications Services (PCS) Licensees, WT Docket No. 97-82, *Second Report and Order and Further Notice of Proposed Rule Making*, 12 FCC Rcd 16436 (1997); Amendment of the Commission's Rules Regarding Installment Payment Financing for Personal Communications Services (PCS) Licensees, WT Docket No. 97-82, *Order on Reconsideration of the Second Report and Order*, 13 FCC Rcd 8345 (1998).

[176] Unlicensed broadband PCS is used for short-range communications such as local area networks in offices. Such systems operate with very low power and have a limit on the duration of transmissions.

[177] *See* Appendix B, Table 6, p. B-9 and Table 8, p. B-11.

a. Broadband PCS Sector Structure

The current structure of the broadband PCS sector revolves around four groups of companies: (1) AT&T and its partners; (2) Sprint PCS and its partners; (3) VoiceStream and its partners; and (4) other companies. The AT&T family consists of AT&T's significant, wholly-owned cellular and PCS properties, as well as the joint ventures it has with four companies: Cincinnati Bell (now a subsidiary of Broadwing), TeleCorp PCS Inc., Tritel Inc.,[178] and Triton PCS Holdings Inc. AT&T has sold portions of some of its broadband PCS licenses to the joint ventures in return for a minority ownership interest in them. These companies are currently deploying TDMA technology and AT&T service under the brand name SunCom in certain areas of the country. The Sprint PCS family consists of Sprint PCS and 18 affiliates. Each of the affiliates has an agreement with Sprint PCS in which it agrees to use Sprint's PCS licenses to deploy CDMA technology and Sprint PCS-branded service in specific areas of the country.[179] Some of the affiliates also own their own broadband PCS licenses, and at least two affiliates – US Unwired and Via Wireless – are using a combination of their own spectrum and Sprint's to deploy service. The VoiceStream family, which began as a unit of the cellular operator Western Wireless Corp., now includes licenses that VoiceStream has acquired from Omnipoint and Aerial, as well as five joint ventures in which VoiceStream has a minority ownership interest. These companies are deploying a GSM-based network that covers a large portion of the country. The remaining companies include Verizon Wireless, the SBC/BellSouth wireless joint venture, and Powertel, along with a number of smaller operators. Like AT&T, Verizon Wireless has significant cellular operations, but now owns PCS licenses covering 101 million POPs.[180] Under the proposed SBC and BellSouth wireless joint venture, the new company would cover approximately 47 million POPs primarily in the southeastern, midwestern, and western United States with mainly TDMA and GSM technologies.[181] Lastly, PowerTel is constructing a GSM-based network throughout much of the southeastern United States.

b. Competitive Development

While the broadband PCS sector has made great strides over the past five years, its coverage is not as extensive as the coverage of cellular networks. There are still many smaller markets that have yet to see any operators compete with the incumbent cellular operators. Consequently, the tracking of broadband PCS deployments remains an important metric of sector development.

Currently, broadband PCS operators have deployed networks that provide coverage in at least some portion of counties containing more than 217 million people, which is nearly 86 percent of the nation's total population. These counties also cover more than 1.1 million square miles, which equals 32 percent of the country's land area.[182]

---

[178] In August, Telecorp PCS Inc. acquired Tritel Inc. subject to regulatory approval of the FCC. Matt Moore, *Tritel, Telecorp PCS Complete 'Merger of Equals,'* ASSOCIATED PRESS NEWSWIRES, Aug. 8, 2000.

[179] *See, e.g.*, US Unwired Inc., Form 4249(B)(1), May 17, 2000, at 7.

[180] *The Urge to Merge*, at 36.

[181] *Id*. at 53-54. Some CDMA markets are in the process of being converted to TDMA. *Id*. at 48.

[182] *See* Appendix B, Table 9A, p. B-13 *and* Appendix F, Map 6, p. F-7.

To illustrate the types of markets in which broadband PCS operators have been concentrating their deployment efforts, this report divides the counties into quartiles by their total populations.[183] Of the counties in the top quartile, 85.8 percent have at least one broadband PCS operator providing some coverage. In the second quartile, 52.5 percent of counties have some coverage, and 33.4 percent and 12.0 percent of counties in the bottom two quartiles, respectively, have some broadband PCS coverage.

4. Other Competitors: Nextel Communications, Other Specialized Mobile Radio Operators, Resellers, and Satellite Operators

This section discusses four other types of operators that are competing in the mobile telephone segment: the digital SMR provider, Nextel; other SMR operators; resellers; and satellite operators.

a. Nextel Communications, Inc.

For a number of years, SMR service providers have been a source of competition in some mobile telephone markets. The Commission first established SMR in 1979 to provide land mobile communications on a commercial basis. While the primary use for SMR traditionally has been dispatch services,[184] SMR systems have always had the ability to offer "interconnected" service allowing access to the PSTN. However, until recently SMR systems have suffered from limited capacity.

By increasing capacity, digital technologies have enabled SMR providers to become more significant competitors in mobile telephone markets. As explained in the *Fourth Report*, the operator most responsible for using digital technology to make SMR a mobile telephone competitor has been Nextel, with its deployment of Motorola, Inc.'s iDEN technology.[185] Nextel has combined various billing features, a near-nationwide footprint, and handsets that can be used for both interconnected service as well as traditional dispatch type services (marketed as "Direct Connect®") to create an offering targeted to business users.[186] Nextel continues to compete successfully in the mobile telephone market. During 1999, Nextel was the second fastest growing operator, adding more than 1.7 million customers.[187] Nextel's iDEN subscribership of 4.5 million makes it the seventh largest mobile telephony provider in the United States. The company has rolled out service in counties covering over 70 percent of the nation's population. Nextel also continued to have the highest ARPU levels in the industry, reaching as high as $74 per subscriber per month, during 1999.[188]

---

[183] *See* Appendix B, Table 9G, p. B-14.

[184] *See* Section II.C, *infra*, for a discussion of the dispatch market.

[185] *See Fourth Report*, 14 FCC Rcd at 10176-10177. To our knowledge, the only other SMR licensee currently offering service using digital technology is the Southern Company, with its Southern LINC telecom subsidiary. Southern LINC uses an iDEN network and focuses more on the traditional dispatch market. *See* Section II.C, *infra*. In the past year, one new SMR licensee, Pacific Wireless Technologies, Inc., announced plans to deploy an iDEN network in central California. *See Motorola and Pacific Wireless Sign Agreement To Provide iDEN Integrated Digital Network in California's Central Valley*, News Release, Motorola Corp., Dec. 1, 1999.

[186] *See* Nextel Communications, Inc., Form 10-K, Dec. 31, 1998, at 3.

[187] *Nextel Reports 1999 Results*, News Release, Nextel Communications, Inc., Feb. 22, 2000.

[188] *Nextel Reports Record Third Quarter 1999 Results*, News Release, Nextel Communications, Inc., Oct. 18, 1999.

b. Other Specialized Mobile Radio Operators

Traditionally, urban SMR operators had only a limited ability to offer mobile telephone services. This limitation has been due to a number of factors, including limited spectrum availability and the preclusion of spectrum reuse by traditional, analog, high-power, single site transmitter systems employed by SMR operators.[189] In contrast, SMR operators in less spectrum-scarce, rural areas have faced fewer capacity difficulties and, consequently, have had a greater ability to offer mobile telephone services.[190] For example, prior to its 1997 merger with Nextel, Pittencrieff Communications, Inc. focused on rural areas and presented its service as an alternative to cellular service.[191] As recently as 1996, SMR operators other than Nextel had several hundred thousand customers using interconnected service.[192]

c. Resellers

Resellers offer service to consumers by purchasing airtime at wholesale rates from facilities-based providers and reselling it at retail prices.[193] According to a survey performed for the Association of Communications Enterprises ("ASCENT," formerly the Telecommunications Resellers Association), the resale sector currently accounts for approximately 3 percent of all mobile telephone subscribers.[194] In 1999, the top 20 resale providers had over 1.4 million subscribers, which is an increase of 29 percent over 1998.[195] Worldcom, Inc. ("WorldCom," formerly MCI WorldCom Inc.) is by far the largest reseller with 950,000 customers in 1999, accounting for over half of all the subscribers reported by the 20 largest resellers. The remainder of the top 20 resale providers saw their combined subscribership decrease by 60,000 during 1999.[196]

---

[189] Nextel Communications, Inc., Form 10-K, Dec. 31, 1996, at 5.

[190] Pittencrieff Communications, Inc., Form 10-K, Dec. 31, 1996, at 4.

[191] *Id.*

[192] *See RCR Top 20 SMRs*, RCR RADIO COMMUNICATIONS, Feb. 10, 1997, at 14. This is the most recent Top 20 SMRs list published by RCR Radio Communications.

[193] Interconnection and Resale Obligations Pertaining to Commercial Mobile Radio Services, CC Docket No. 94-54, *First Report and Order*, 11 FCC Rcd 18455, ¶¶ 10-11 (1996), 61 Fed. Reg. 38399 (July 24, 1996).

[194] *TRA Releases Yankee Group Study on Wireless Resale; Report Predicts Size of Resale Market Will Triple in 5 Years*, News Release, Telecommunications Resellers Association, Feb. 23, 2000.

[195] *See* Appendix B, Table 11, p. B-16.

[196] This may be due to the declining margins for resellers. According to the above referenced Yankee Group study commissioned by ASCENT, wireless retail prices fell by 24 percent in the past two years while wholesale rates for resellers fell less than 15 percent. Nancy Gohring, *Spectrum: Resale To Re-Emerge*, TELEPHONY, May 1, 2000. WorldCom, due to its large bargaining power, might have been able to negotiate more favorable terms.

d. Satellite Operators

The first global satellite-based mobile telephony operator,[197] Iridium LLC ("Iridium"), filed for Chapter 11 bankruptcy protection from creditors on August 13, 1999.[198] On March 17, 2000, Iridium announced that it was ceasing operations.[199] At this time, Motorola, the system's operator, continues to maintain the system, and limited service is being provided through operational gateways. Iridium had about 50,000 subscribers at the end of 1999.[200]

ICO Global Communications Ltd. ("ICO") declared bankruptcy in August 1999. In December 1999, the bankruptcy court granted final approval of a $1.2 billion bailout package led by Craig McCaw.[201] McCaw is now focused on ICO and his own proposed satellite network, Teledesic.[202]

In February 2000 Globalstar Telecommunications Ltd. ("Globalstar") announced the commercial availability of its mobile satellite service throughout the United States.[203] Globalstar's 48 satellite system utilizes a "bent-pipe" architecture, in which each call goes up to the nearest satellite.[204] The satellite receives the signal and retransmits it to the nearest land-based gateway where the signal is routed into the landline system. Globalstar's tri-mode handheld phones operate in satellite mode, and in digital and analog cellular modes wherever cellular service is available.[205] The handsets weigh slightly more than 11 ounces, and are priced around $1,500.[206] The company is offering a number of domestic pricing plans, with monthly service fees ranging from $30 to $370 and per-minute fees from $1.69 to $1.39.[207] Data

[197] Services provided directly to end users by mobile satellite licensees are considered to be CMRS. *See* 47 CFR § 20.9(10).

[198] Leslie Cauley, *Iridium Files for Bankruptcy Protection After Its Bondholders Submit Petition*, WALL STREET JOURNAL, Aug. 16, 1999, *available in* 1999 WL-WSJ 5464565.

[199] *No Buyer Found: Iridium Begins Process Of Shutting Down*, COMMUNICATIONS DAILY, Mar. 20, 2000, *available in* 2000 WL 4694740.

[200] Scott Thurm, *Iridium Set to Get $75 Million From Investors Led by McCaw*, WALL STREET JOURNAL, Feb. 10, 2000, *available in* 2000 WL-WSJ 3017486.

[201] Antony Bruno, *McCaw, Chandra Bail Out ICO*, RCR RADIO COMMUNICATIONS REPORT, Dec. 13, 1999, *available in* 1999 WL 28241242.

[202] *McCaw Readies Plans For ICO And Teledesic*, COMMUNICATIONS DAILY, Apr. 21, 2000, *available in* 2000 WL 4695098.

[203] *Globalstar USA Launches Full Commercial Availability of Mobile Satellite Phone Service: Voice Coverage Now Reaches Everywhere in the United States, Canada and Mexico*, News Release, Globalstar Telecommunications Ltd., Feb. 28, 2000.

[204] *Id.*

[205] *Id.*

[206] *Id.*

[207] The "Beyond Basic" plan is $29.99 per month plus $1.69 per minute for satellite airtime. The "Beyond 100" plan is $169.99 per month and includes 100 minutes of satellite airtime; additional minutes are $1.49. The "Beyond 250" plan is $369.99 and includes 250 minutes of satellite airtime; additional minutes are $1.39. *Id.*

capabilities at 9.6 kbps include e-mail, fax and file transfer, as well as short message service, and are expected to be available later in 2000.[208]

In March 2000, Globalstar lowered its handset prices by as much as 25 percent.[209] The company also launched a price promotion that gave new and existing subscribers 30 percent off of their monthly access fees and domestic airtime until July 15.[210] While Globalstar's original predictions called for nearly 700,000 mobile subscribers by the end of 2000, it has reduced that number closer to 400,000.[211]

B. Mobile Data

1. Introduction

Mobile data service is the delivery of non-voice information to a mobile device.[212] Mobile data services run the gamut from paging/messaging, to Internet access, to e-mail delivery.[213] Mobile data devices include telephone handsets, pagers, handheld computers, personal digital assistants ("PDAs"), and laptop computers equipped with wireless modems. A variety of wireless providers are involved with these rapidly evolving services.

For years, analysts discussed mobile data extensively, remarking in each of the past several years that "this will be the year that mobile data takes off."[214] Despite such prognostications, however, analysts estimate that just 2 percent of mobile traffic is currently data.[215] Analysts note that this may be due partly

---

[208] *Id.*

[209] *Globalstar Slashes Airtime, Hardware Costs*, WIRELESSNOW, Mar. 27, 2000. In addition, a number of Globalstar resellers, including ICC Public Communications Systems, Norsat, and GMPCS are offering rebates to win former Iridium customers. GMPCS, for example, has designed two incentives to convert Iridium customers. The first plan offers a $295 trade-in rebate toward the purchase of a new Globalstar phone. The second plan offers a $495 trade-in rebate toward the purchase of a new Globalstar phone with a car kit. *Globalstar USA To The Rescue Of Iridium Customers Left Holding The Phone:Distributors Offer Trade-in Rebates for Iridium Phones*, News Release, Globalstar Telecommunications Ltd., Mar. 16, 2000.

[210] *Spring Forward With Globalstar USA: Limited Promotional Rates; Introducing Beyond 50 Minute Plan*, News Release, Globalstar Telecommunications Ltd., Mar. 31, 2000.

[211] Andy Pasztor, *Globalstar's Chief Says the Sky Isn't Falling On Satellite Phone Service but Asks for Patience*, WALL STREET JOURNAL, Mar. 30, 2000, *available in* 2000 WL-WSJ 3023681. The project needs one million subscribers to break even. *Id.*

[212] Thomas J. Lee, *The U.S. Mobile Data Report – A Special Edition of Mobile Outlook*, Equity Research: United States Wireless Services, Salomon Smith Barney, Sept. 21, 1999, at 8 ("*SSB Report*").

[213] *Id.*

[214] Aaron Pressman, *Internet Luminaries Herald Wireless Web World*, Feb. 27, 2000 (visited Feb. 29, 2000) <http://www.foxnews.com/vtech/022700/wireless.sml>.

[215] Jonathan Collins, *Sprint's Aggressive Ad Campaign Could Fire Up Demand For Wireless Net Access Or Give It A Bum WAP*, TELE.COM, Feb. 21, 2000, *available in* 2000 WL 10907294.

to unsatisfied demand for voice services driving the growth of new subscribers.[216] Still others argue that, as with wireline Internet service, a critical mass must be achieved in order for widespread market appeal to materialize.[217]

Many analysts believe, however, that the mobile data sector has turned a corner and that it is finally beginning to witness the long-promised growth in demand and revenues to mobile telephone providers and other wireless operators.[218] Several developments are contributing to this change. First, technologies offering somewhat faster data speeds are beginning to be deployed and others with much faster speeds are on the near horizon as the industry starts the transition to third generation ("3G") mobile telephone networks,[219] which promise services such as high-speed Internet access and mobile video conferencing. Second, recent technological advances are helping to transform mobile telephone handsets from simple voice tools to sophisticated data devices. These advances include: Wireless Application Protocol ("WAP"), a recently-developed protocol for wireless devices; Bluetooth, a technology that allows devices such as mobile handsets and laptop computers to interact without cables; and operating systems designed for mobile telephones and other handheld computing devices. Third, as evidenced in the wireline context, other technological advances and proliferating applications have made wireline Internet use an everyday event and have thereby increased the demand for mobile access to the World Wide Web, e-mail, and e-commerce. The U.S. data services/Internet market is not only sizeable (generating $40 billion in annual revenues) but is estimated to be growing at more than 30 percent annually.[220] In some markets, wireline data traffic is equal to wireline voice traffic.[221] In this regard, research indicates that existing mobile telephone subscribers provide a large potential market of mobile data users. For example, one study shows that 46 percent of mobile telephone subscribers (or almost 40 million) have wired Internet access at home.[222] Wireless carriers are anxious to capture even a small portion of such a vast market.[223]

---

[216] Anita Farrell and Adnaan Ahmad, *Mobile Data Handbook, The Road to the Mobile Internet*, Europe Technology, Merrill Lynch & Co., Sept. 1999, at 2 ("*1999 Merrill Lynch Report*").

[217] *SSB Report*, at 8-9.

[218] Joe McGarvey, *Wireless Access Set to Explode*, INTER@CTIVE WEEK, Sept. 22, 1999; *2000 Merrill Lynch Report*, at 32.

[219] Different terms are often used when referring to "technologies." For example, an analyst may label a technology as either a network or a standard. *See* Linda J. Mutschler and Naeemah Lajoie, *A Day in the Future, The Evolution to 3G*-Wireless/Cellular, Merrill Lynch & Co., Apr. 4, 2000, at 2 ("*Merrill Lynch Evolution Report*"). Others use the term specification. *See IMT-2000 Radio Interface Specifications Approved in ITU Meeting in Helsinki*, News Release, ITU, Nov. 5, 1999. For purposes of this report, these terms are used interchangeably and are not intended to give meaning other than the most ordinary.

[220] *SSB Report*, at 24.

[221] Krishnan Thiagarajan, *Mobile Phone Industry Sprints to 3G*, BUSINESS LINE, Oct. 25, 1999, *available in* 1999 WL 28942358.

[222] *DLJ Report*, at 10 (citing Yankee Group).

[223] Joe McGarvey, *Wireless Access Set to Explode*, INTER@CTIVE WEEK, Sept. 22, 1999.

Other potential growth drivers of the mobile data sector include: the tremendous growth in digital handset use; the low retail pricing for short messaging service ("SMS"); and greater computer literacy.[224]

Analysts forecast tremendous growth potential in the U.S. for mobile data services.[225] One forecast estimates that by 2002 wireless data subscribers will outnumber wireline data subscribers.[226] Another analyst expects at least $35-$40 billion in revenues by 2007 – an annual growth rate of 25 to 30 percent—and 100 million subscribers using some form of mobile data.[227]

Much of what is driving estimates of the potential growth in U.S. mobile data services is based on trends observed elsewhere. Japanese carrier NTT Mobile Communications Network Inc. ("NTT DoCoMo"), for example, launched its i-mode data service in February 1999 and within one year had almost 5 million mobile data customers (or roughly 16 percent of its total voice and data subscriber base) and by June had more than 7 million subscribers.[228] As a result, one analyst estimates that NTT DoCoMo is the largest Internet Service Provider ("ISP") in Japan.[229] Its i-mode service offers e-mail and Internet access at 9.6 kbps to a mobile telephone handset. Service is offered on a per transmission basis and the average incremental revenue per month to NTT DoCoMo for the average i-mode user is $11.20 to $12.15.[230] By February 2000, i-mode subscribers had access to over 6,000 Web sites and content provided by 341 companies.[231]

For purposes of this report, the discussion of the mobile data services sector is structured predominately according to the types of devices a consumer would choose for his or her mobile data needs: mobile telephone handsets, traditional paging and messaging devices, and other handset devices. Short discussions on dedicated data networks and telemetry are also included. This structure is somewhat arbitrary but convenient given the current state of the mobile data sector. However, because the world of mobile data services is rapidly evolving, due to the emergence of and convergence of technologies and services, it is quite possible that next year's report will be structured in a different manner.

---

[224] *1999 Merrill Lynch Report*, at 19; Charles Mason, *If It's Wireless, It Must Be Data*, AMERICA'S NETWORK, July 15, 1999, *available in* 1999 WL 11825410.

[225] *See* Appendix C, Table 1, p. C-2.

[226] allNetDevices, *Wireless World Coming, IDC Says* (visited Apr. 12, 2000) <http://www.allnetdevices.com/news/0004/000411idc.htm> (citing IDC).

[227] *SSB Report*, at 6-7.

[228] Linda J. Mutschler, Kiyohisa Ota, and Naeemah Lajoie, *Mobile Data Dynamics - Mobile Data in Japan: Robust Growth of Data Goes On and On*, United States Telecom Services-Wireless/Cellular, Merrill Lynch & Co., Feb. 11, 2000, at 1; Dennis Leibowitz et al, THE GLOBAL WIRELESS COMMUNICATIONS INDUSTRY, Donaldson, Lufkin & Jenrette, Summer 2000, at 72.

[229] *2000 Merrill Lynch Report*, at 19.

[230] *Id*. at 21.

[231] *Id*. at 18, 20.

2. Data Services to Mobile Telephone Handsets

To appreciate the types of data services available over mobile telephone handsets, it is important to understand the evolution of mobile telephone technologies from the first generation to the emerging third generation ("3G") of mobile phones.[232] The first generation of mobile telephone network technologies, sometimes termed "1G," represented pioneer analog cellular systems that permitted two-way voice communications, circuit-switched data transmission,[233] and, through an upgrade, Cellular Digital Packet Data ("CDPD") services. In the United States, the two original cellular carriers in each geographic area deployed Advanced Mobile Phone Service ("AMPS"), which is still widely used today.

In recent years, U.S. cellular and PCS operators have been actively deploying their second-generation networks ("2G"). GSM, TDMA,[234] and CDMA are the 2G network technologies deployed in the United States.[235] 2G networks are the first digital mobile telephone networks and offer voice services such as voice mail and caller ID as well as SMS.[236] In addition, the networks permit packet-switched and circuit-switched data transmission at speeds of 9.6 to 19.2 kbps,[237] compared to traditional wireline rates up to 56 kbps and ISDN rates of 128 kbps. This means that a mobile user currently needs 10 minutes to download a one megabyte file over a 2G network at 14.4 kbps compared to less than 3 minutes using traditional wireline and only one minute using ISDN. The fourth digital technology currently deployed by U.S. operators is iDEN. As previously discussed, iDEN is a proprietary technology used by some SMR operators, most notably Nextel.[238] While iDEN is not always classified within the 2G category, for purposes of this report, iDEN will be discussed in the same section as the three other 2G technologies.

International Mobile Telecommunications-2000 ("IMT-2000") is an initiative of the International Telecommunication Union ("ITU") seeking to integrate the various wireless systems, both fixed and mobile, currently being deployed and developed under a family of standards to promote global service capabilities and interoperability after the year 2000. These systems are known outside the ITU as third

---

[232] Analysts recently began discussing 4G technology, which can offer throughputs at multi-megabits per second and which, some assert, could be commercialized within two to five years. Meg McGinity, *Fourth Time's The Charm*, INTERACTIVE WEEK FROM ZDWIRE, Mar. 20, 2000, *available in* 2000 WL 4065402.

[233] Circuit-switched data transmission sets up and keeps a circuit open between two or more users, such that the users have exclusive and full use of the circuit until the connection is released. A voice call is sent over a circuit. On the other hand, packet-switched data transmission is used for data only and the addresses are read on the packets by the switches. Each packet can be sent via a different path and then reassembled at the other end for delivery. The Internet is a packet-switched network. HARRY NEWTON, NEWTON'S TELECOM DICTIONARY (14th ed. 1998), at 154. With a packet-switched network, many users can use the same path, allowing for "connectionless" access. Linda J. Mutschler and Naeemah Lajoie, *A Day in the Future*, United States Telecom Services-Wireless/Cellular, Merrill Lynch & Co., Apr. 4, 2000, at 7-8.

[234] TDMA is sometimes referred to as IS-54 or IS-136.

[235] CDMA is also referred to as IS-95A or cdmaOne.

[236] *1999 Merrill Lynch Report*, at 26.

[237] CDMA, TDMA, and GSM have throughput rates of 9.6 to 14.4 kbps. CDPD, which operates as an overlay to AMPs as well as TDMA and CDMA, offers speeds up to 19.2 kbps. *See* Section II.B.2.c, *infra*.

[238] *2000 Merrill Lynch Report*, at 66.

generation or 3G systems.[239] 3G technology promises Internet access with speeds up to two megabits per second ("Mbps") from a fixed location, 384 kbps at pedestrian speeds, and 144 kbps at traveling speeds of 100 kilometers per hour.[240] Planned 3G services include video and audio streaming and location-based services that could, for example, notify travelers of a concert in a city they are visiting.[241] In May 2000, the ITU adopted a recommendation that contained specifications for five IMT-2000 terrestrial radio interfaces: CDMA Direct Spread (also known as WCDMA), [242] CDMA Multi-Carrier (also known as cdma2000), TDMA Single Carrier (also known as UWC-136), CDMA TDD, and FDMA/TDMA (also known as DECT).[243] According to the ITU, the specifications allow existing mobile operators to seamlessly evolve their networks towards 3G service capabilities and permit equipment vendors to build handsets that work anywhere in the world irrespective of the specific network or radio options chosen by the operator providing mobile services at that specific location.[244]

Many analysts believe that the transition to 3G will be accomplished in phases. The first phase of 3G is often referred to as 2.5G.[245] Depending on the source, however, a technology may be classified as 2.5G or 3G.[246] For example, Enhanced Data for GSM Evolution ("EDGE"), a major component in the UWC-136 standard that some TDMA carriers propose deploying,[247] is also compatible with GSM networks. Some sources refer to EDGE as 2.5G, while others refer to it as a 3G technology.[248] Any categorization

---

[239] *Fourth Report*, 14 FCC Rcd at 10161.

[240] *Third Generation Wireless: Strategies for Global Markets* (Conference Call Slides), Heather M. Henyon, Consultant, International Wireless Practice, The Strategis Group, Inc., July 21, 1999.

[241] Gilbert Held, *The Wide World of Wireless*, NETWORK MAGAZINE, Dec. 1, 1999, *available in* 1999 WL 11272215; Dee McVicker, *So Where is the Wireless Web?*, UPSIDE MAGAZINE, Apr. 1, 2000, *available in* 2000 WL 2005067.

[242] WCDMA is also referred to as UMTS in Europe. David Pringle and Connie Ling, *I-Mode Success Poses Threat to Industry Giants*, THE ASIAN WALL STREET JOURNAL, July 25, 2000, *available in* 2000 WL-WSJA 23746038.

[243] *ITU Adopts 5 Formats For New Generation Mobile Phones*, JAPAN ECONOMIC NEWSWIRE, May 5, 2000.

[244] *IMT-2000 Radio Interface Specifications Approved in ITU Meeting in Helsinki*, News Release, ITU, Nov. 5, 1999.

[245] Sally Ruth Bourrie, *CDMA's Next Generation: A Market Driven Scenario*, WIRELESS WEEK, Nov. 15, 1999, at 10A; Melissa A. Sanzo, *CDMA's Data Evolution*, WIRELESS REVIEW, Mar. 31, 1999, *available in* 1999 WL 10100627.

[246] *See* Peggy Albright, *Adding A Big Dash Of Acronyms - The Path To 3G Includes Recipe For Ambiguous Terminology*, WIRELESS WEEK, Jan. 3, 2000, at 24; *See also* Lois Mentrup, *Spectrum – To Thine Own: 3G be True*, TELEPHONY, Feb. 28, 2000, *available in* 2000 WL 7091869 ("*Mentrup Article*"); *See also* John M. Bensche, Jennifer A. Cooke, and Elisabeth H. Job, *Rising Wireless Data Tide Lifts All Ships*, Lehman Brothers, Mar. 2000, at 7 ("*Lehman Brothers Report*").

[247] *Frequently Asked Questions about TDMA-EDGE & WIN* (visited Apr. 25, 2000) <wysiwyg://5//www.tdma-edge.org/edge/tdma_faq.html>.

[248] Lehman Brothers, for example, refers to EDGE as 3G in both the GSM and TDMA environments. *Lehman Brothers Report*, at 25.

of technologies contained in this report is intended merely to facilitate discussion and should not be interpreted as a statement about how the Commission believes these technologies should be classified.

Each 2G technology has different migration paths to 3G networks. Depending on their particular situations, some carriers will choose to take an incremental approach and upgrade to a high-speed 2.5G technology while some operators may wait until 3G is available.[249] Analysts suggest that the migration path to 3G will depend in part on: (1) whether the mobile operator is an incumbent or a new entrant; (2) what 2G standard the carrier's network is based on; (3) what investments have been made for 2G; (4) the licensing regulations (whether spectrum is available, number of 3G licenses awarded, and whether nationwide coverage is required); (5) capacity constraints on the existing system; (6) existing frequency range; (7) current demand for mobile data; and (8) intensity of competition in the operator's market.[250]

Analysts offer a wide range of dates for 3G deployment. However, many analysts believe that Japan will be the first to launch 3G services, followed by Europe and then the United States.[251] Many European countries are in the process of auctioning and/or licensing spectrum for 3G use.[252] Most recently, the United Kingdom auctioned five nationwide 3G licenses for $35.5 billion.[253]

Beyond the migration paths to 3G, mobile telephone operators must also consider two other issues in order to provide mobile data services: handset capabilities, and what services and products to offer. All three issues are addressed below.

a. Migration Paths to 3G

In the United States, mobile telephone providers are beginning to deploy 2.5G technologies. Equipment manufacturers are in the process of developing 3G equipment and operators are testing technologies. This section briefly discusses the current mobile data capabilities of the four digital mobile telephone technologies and the 2.5G and 3G software and infrastructure upgrades available for each technology.[254] The discussion includes the theoretical data speeds for each upgrade and, where available, the estimated

[249] THE YANKEE GROUP, NEXT-GENERATION CELLULAR DATA: NOW FOR THE ROLLOUT (1999), at 21 ("*Yankee Report*").

[250] *1999 Merrill Lynch Report*, at 44-45.

[251] *Yankee Report*, at 5; *Mobile Diary*, MOBILE COMMUNICATIONS REPORT, Dec. 27, 1999, *available in* 1999 WL 8753026 (citing The Strategis Group Inc); Christopher Jones, *3G Phones Divide and Conquer*, WIREDNEWS, Dec. 14, 1999 <http://www.wired.com/news/technology/0,1282,33056,00.html>.

[252] *U.K.'s Success Prompts Europe To Revise Wireless License Fees*, WSJ INTERACTIVE EDITION, Apr. 17, 2000 (visited Apr. 18, 2000) <wysiwyg://2/http://interactive.wsj.com/articles/SB955919640364457424.htm>. *See* Appendix C, Table 2, p. C-3, for a list of 3G spectrum allocation plans of other countries.

[253] Stephanie Gruner and Marc Champion, *Britain Hits Jackpot in Telecom Auction*, WALL STREET JOURNAL, Apr. 28, 2000, at A17.

[254] Standards bodies have not approved all of these upgrades at this time. Lynnette Luna, *Players Square Off on Data Enhancements*, RCR RADIO COMMUNICATIONS REPORT, Mar. 27, 2000, at 1.

cost of the upgrade. Because the cost estimates are often quite specific to an operator's network, relevant cost comparisons across various upgrades cannot be made. Technology tests are also briefly discussed.[255]

CDMA. Several U.S. CDMA operators are offering circuit-switched mobile data services at rates up to 14.4 kbps.[256] CDMA operators have several potential upgrades as they transition to 3G networks. One such upgrade is IS-95B, which is a packet-based network that combines 8 channels and is expected to offer data transmission rates up to 64 kbps.[257] Foreign carriers have begun to deploy software upgrades in the core and radio networks for IS-95B at a cost of $50 to $120 million per operator.[258] According to analysts, SK Telecom (Korea) began rolling out service in 1999, and DDI-IDO (Japan) began offering service in early 2000.[259] Thus far, no U.S. carriers have announced their intent to deploy IS-95B.[260]

QUALCOMM is developing a data-only upgrade to work with CDMA, called High Data Rate ("HDR"), that offers data rates of up to 2.4 Mbps for fixed applications using the existing 1.25 MHz channel.[261] HDR requires both hardware and software upgrades.[262] According to analysts, US WEST, Inc. ("US WEST," which was acquired by Qwest Communications International, Inc. on June 30, 2000) and Cisco Systems began a trial of HDR in 1999 and Korean Telecom Freetel plans to adopt HDR in 2002.[263]

1xRTT (Radio Transmission Technology, also referred to as cdma2000 Phase 1)[264] will enable data speeds of up to 144 kbps.[265] The technology uses the same 1.25 MHz channel used by the existing 2G

---

[255] For a further list of tests, *see* Appendix C, Table 4, p. C-5 - C-7. For a list of contracts, *see* Appendix C, Table 3, p. C-4.

[256] For a further discussion of these services, *see* Section II.B.2.c, *infra*.

[257] Craig J. Mathias, *Will 'Mobile, Broadband Wireless' Redefine Access?*, BUSINESS COMMUNICATIONS REVIEW, Mar. 1, 2000, *available in* 2000 WL 11608524.

[258] *1999 Merrill Lynch Report*, at 37.

[259] *Different Data Markets Create Widely Varying 3G Strategies*, WIRELESS DATA NEWS, Sept. 29, 1999, *available in* 1999 WL 7899437; Chuck Holt, *Plug & Play*, WIRELESS REVIEW, Feb. 29, 2000, *available in* 2000 WL 7119094.

[260] *2000 Merrill Lynch Report*, at 61.

[261] *Mentrup Article*; *2000 Merrill Lynch Report*, at 62.

[262] *High Data Rate (HDR) Overview – The Internet Unleashed*, Presentation at Office of Engineering and Technology sponsored tutorial on "Wireless Access to the Internet," Nov. 30, 1999. *See* The Office of Engineering and Technology Adds a Morning Session to the "Wirelss Access to the Internet" Tutorial on November 30, 1999 in the Commission Meeting Room at 9:00 a.m., *Public Notice*, PNET 9024 (rel. Nov. 15, 1999).

[263] Scott Thurm and Quentin Hardy, *Cisco, Motorola Plan Wireless-Net Deal*, THE ASIAN WALL STREET JOURNAL, Feb. 8, 1999, *available in* 1999 WL-WSJA 5427542; *2000 Merrill Lynch Report*, at 62.

[264] *2000 Merrill Lynch Report*, at 62. 1xRTT is also referred to as cdma2000A, cdma2000 1X, or IS-95C.

[265] Cynthia M. Motz, Steven D. Glik, Sheryn M. Kinsey, and Bradford K. Neuman, *Hey Babe, Take a Walk on the Wireless Side...*,U.S./Wireless Teecommunications Services, Credit Suisse First Boston Corporation, May 5, 2000, at 73 ("*Credit Suisse Report*").

network (denoted by the use of the term "1x").[266] Unlike some of the other technologies discussed, 1xRTT has the added benefit of doubling voice capacity.[267] The upgrade to 1xRTT requires operators to install new cards at base stations,[268] which Sprint PCS estimates will cost $400 to $600 million for its entire system.[269] While existing CDMA handsets will function on 1xRTT networks, they will not provide the higher 1x data rates or help improve voice capacity.[270] One analyst believes that every major U.S. CDMA carrier will upgrade to 1xRTT starting in 2001.[271] For example, Sprint PCS is currently testing 1xRTT[272] and according to an analyst plans initial deployment by mid-2001.[273] Verizon Wireless also plans to launch service in 2001.[274] One analyst indicates that Telstra (Australia) plans to begin 1xRTT trials in June 2000 and SK Telecom (Korea) plans to introduce 1xRTT service in the fourth quarter of 2000.[275]

In June, Lucent and Sprint PCS announced they would conduct a joint trial of 1xEvolution technology ("1xEV") which is based on HDR and incorporates the 1xRTT technology.[276] According to the CDA Development Group, 1xEV enables data capabilities of at least 2 Mbps and even greater voice capacity in the existing 1.25 MHz channel.[277] In March, Nokia and Motorola announced the development the

---

[266] *See Merrill Lynch Evolution Report*, at 4. CDMA assigns a pseudo-random "code" for each user, which assigns a certain frequency spectrum and time slot for each user. These codes are used to insert the user channels into the wideband spread spectrum signal (IS-95 carrier spacing is 1.25 MHz). At the other end, the receiver decodes the spread spectrum signal into the original user channels using the same codes. *Id*. at 3.

[267] *Mentrup Article*.

[268] *1999 Merrill Lynch Report*, at 37.

[269] *2000 Merrill Lynch Report*, at 61.

[270] Sherry Blume and Gwenn Larsson, *Data – 3G Whiz*, WIRELESS REVIEW, Feb. 29, 2000, *available in* 2000 WL 7119100.

[271] *Merrill Lynch Evolution Report*, at 4.

[272] In April, Sprint PCS, Bell Mobility, Nortel Networks, Qualcomm, and Samsung successfully completed a series of wireless calls using 1xRTT. *Fast 3G Coming Soon, CDMA Group Says* (visited Apr. 17, 2000) <http://www.allnetdevices.com/news/0004/0004143g.htm>.

[273] Lynnette Luna, *Sprint Completes 1xRTT Call In 3G Testing*, RCR RADIO COMMUNICATIONS REPORT, Apr. 3, 2000, at 23.

[274] *Mentrup Article* (citing Gerry Flynn, Executive Director of Technology development for Bell Atlantic Mobile).

[275] *Different Data Markets Create Widely Varying 3G Strategies*, WIRELESS DATA NEWS, Sept. 29, 1999, *available in* 1999 WL 7899437.

[276] *Lucent Technologies and Sprint to Trial High-Speed Data Solution for Mobile Internet*, MS PRESSWIRE, June 23, 2000, *available in* 2000 WL 22277993. The CDMA Development Group also submitted the 1xEV specification to the global standards group, Third Generation Partnership Project 2. *Id*.

[277] *CDMA World Congress Successfully Concludes; Third Generation Evolution Plans Revealed; China CDMA Plans to Move Forward*, BUSINESS WIRE, June 26, 2000.

1XTREME technology that promises integrated voice and data with transmission speeds up to 5.2 Mbps also in the existing 1.25 MHz channel.[278]

3xRTT, or cdma2000 Phase 2, supports packet data rates of up to 2 Mbps or higher depending on the user's mobility and requires 5 MHz of spectrum.[279] As its name implies, 3xRTT triples the bandwidth capabilities and requires three of CDMA's 1.25 MHz channels.[280] Analysts indicate that a number of carriers are testing 3xRTT, including Sprint PCS in conjunction with Nortel Networks.[281] After 1xRTT, the choice between the higher speed networks may depend on a carrier's capital expenditure plans, spectrum considerations, and demands for high-speed data services by customers.[282]

The other CDMA-based 3G standard is WCDMA, which analysts anticipate that many European carriers will deploy and which requires 5 MHz of bandwidth.[283] Contracts have been executed and based on analyst's reports, several trials of WCDMA are in progress abroad including efforts by Nortel and Vodafone (U.K.), and Ericsson and Telia (Sweden).[284]

Analysts note that while WCDMA and cdma2000 both use a CDMA air interface, they are not compatible.[285] The main difference between WCDMA and cdma2000 is network synchronization.[286] WCDMA is asynchronous, requiring that it use a unique long code sequence per user channel.[287] Cdma2000, on the other hand, is synchronous, and can therefore reuse the spreading codes through phase shifting.[288]

TDMA. TDMA networks have deployed a CDPD overlay to enable packet data to be carried alongside voice traffic.[289] CDPD offers data speeds of up to 19.2 kbps.[290] Several carriers, including AT&T, have offered mobile data services for several years using a CDPD overlay on its TDMA network.[291]

---

[278] *Nokia, Motorola to Push 1XTREME into Open Wireless Standards*, M2 PRESSWIRE, Mar. 22, 2000, *available in* 2000 WL 16126365.

[279] *Credit Suisse Report*, at 74.

[280] *Mentrup Article*.

[281] *2000 Merrill Lynch Report*, at 62.

[282] *Id*.

[283] *1999 Merrill Lynch Report*, at 42.

[284] *See* Appendix C, Table 4, pp. C-5 – C-7.

[285] *2000 Merrill Lynch Report*, at 66.

[286] *Id*.

[287] *Id*.

[288] *Id*.

[289] *Id*. at 63. For a further discussion of CDPD services, *see* Section II.B.2.c, *infra*.

TDMA carriers may deploy General Packet Radio Service ("GPRS") because it is compatible with both TDMA and GSM networks. GPRS is a packet-based data-only upgrade that ultimately allows data rates up to 115 kbps by aggregating up to eight 14.4 kbps channels.[292] In order to migrate to EDGE, TDMA carriers will use a core GPRS backbone for IP and EDGE as the radio interface technology.[293] EDGE will provide the higher data rates envisioned by 3G (up to 384 kbps), but according to analysts will not offer voice-over-IP until 2003.[294] EDGE is compatible with both TDMA and GSM networks and will enable convergence of GSM and TDMA technology.[295] AT&T plans to use EDGE for its 3G strategy and has announced commercial launch in 2002.[296] According to analysts, SBC/BellSouth plans to launch EDGE in late 2001 or early 2002.[297] Lucent and Ericsson are currently running trials with AT&T.[298]

GSM. The current data offerings of GSM operators include SMS and circuit-switched data transmission at 9.6 kbps.[299] A number of potential upgrades have been developed. High Speed Circuit Switched Data ("HSCSD") increases the bit rate to 14.4 kbps and, by combining four channels, offers reported data rates of 57.6 kbps.[300] Analysts estimate that the software upgrade cost will be relatively low at $20 million to $30 million for European operators.[301] Analysts believe that if the demand for mobile Internet services does not materialize as quickly as anticipated, then HSCSD may be an economical upgrade choice. However, because HSCSD ties up four dedicated channels, it uses a large amount of bandwidth and reduces voice capacity over the network. As data traffic grows, this problem will be exacerbated.[302]

(Continued from previous page)

[290] *Wireless Industry Round Table Discussion on the Table: CDPD*, WIRELESS DATA NEWS, May 27, 1998, *available in* 1998 WL 8015363.

[291] *Fourth Report*, 14 FCC Rcd at 10199-10200.

[292] *1999 Merrill Lynch Report*, at 29-31; *Mentrup Article*.

[293] *Merrill Lynch Evolution Report*, at 4.

[294] *Lehman Brothers Report*, at 23. One analyst states that while EDGE theoretically offers speeds up to 384 kbps, its practical speed is 150 kbps. *2000 Merrill Lynch Report*, at 65.

[295] Brad Smith, *Data Speed Limits Climbing*, WIRELESS WEEK, June 7, 1999, at 58; Mats Nilsson, *Third-Generation Radio Access Standards*, ERICSSON REVIEW, 1999, at 117.

[296] *IBM and AT&T To Deliver Wireless Data Services to Corporate Customers*, News Release, AT&T, Feb. 25, 2000; Prospectus of AT&T Wireless Group Tracking Stock, Mar. 28, 2000, at 55.

[297] *Wireless Internet Plans*, RCR RADIO COMMUNICATIONS REPORT, May 15, 2000, at 1.

[298] *Lucent Technologies Leads Wireless Market*, BUSINESSWORLD (PHILIPPINES), Jan. 21, 2000, *available in* 2000 WL 4647706; *Wireless Debate Begins to Build Consensus on Fewer Standards*, MOBILE COMMUNICATIONS REPORT, Oct. 5, 1998, *available in* 1998 WL 10705910.

[299] THE STRATEGIS GROUP, INC., U.S. MOBILE DATA MARKETPLACE: 1999 (1999), at 59-60. ("*Strategis Mobile Data Report*").

[300] *1999 Merrill Lynch Report*, at 29.

[301] *Id*.

While HSCSD infrastructure and handsets are available, some analysts believe that no U.S. operator will deploy HSCSD.[303] Several European operators, including Sonera (Finland), Europolitan (Sweden), and E-Plus (Germany), have deployed HSCSD networks.[304]

In the U.S. and abroad, GPRS is believed by some analysts to be the primary migration path for GSM operators due to its reliance on packet rather than circuit switching.[305] GPRS uses the same 200 KHz bandwidth used for GSM voice calls.[306] European operators estimate that the upgrade from GSM to GPRS will cost from $50 million to $120 million.[307] Among U.S. carriers, Omnipoint (prior to its merger with VoiceStream) expected the upgrade to GPRS to cost less than $10 million.[308] VoiceStream indicates that most of the costs of the GPRS upgrade were included in the company's original equipment cost estimates and, therefore, the incremental costs will be insignificant.[309] While vendors have negotiated a number of GPRS contracts with both U.S. operators and those abroad, handsets are not yet commercially available.[310] The first U.S. GPRS trial involving Omnipoint was announced in December 1999, and an analyst reports that the merged VoiceStream/Omnipoint/Aerial plans to launch services in the fourth quarter of this year.[311] The same analyst indicates that Powertel and PacBell Wireless are also expected to begin deployment by the end of this year.[312] A number of GPRS trials are in progress abroad, and, according to analysts, in November 1999 BT CellNet (U.K.) transmitted the first GPRS data-transfer call.[313] Reports indicate that BT CellNet plans to launch service this summer.[314]

(Continued from previous page)

[302] *Id*. at 30.

[303] *2000 Merrill Lynch Report*, at 63.

[304] *Centerel Introduces Nokia's IP Security Solution*, RUSSIA XTENSION, Dec. 16, 1999, *available in* 1999 WL 13985960.

[305] *1999 Merrill Lynch Report*, at 31; *2000 Merrill Lynch Report*, at 65.

[306] *Merrill Lynch Evolution Report*, at 4.

[307] *2000 Merrill Lynch Report*, at 64.

[308] *Mentrup Article*.

[309] *2000 Merrill Lynch Report*, at 64.

[310] Lynette Luna, *Carriers Anxious for GPRS Handsets*, RCR RADIO COMMUNICATIONS REPORT, Feb. 14, 2000, at 16.

[311] *First American GPRS Trials Begin*, Dec.17, 1999 (visited Dec. 20, 1999) <http:www.allnetdevices.com/news/9912/991217gprs.htm>; *Merrill Lynch Evolution Report*, at 4.

[312] *Merrill Lynch Evolution Report*, at 4.

[313] Chuck Holt, *Plug & Play*, WIRELESS REVIEW, Feb. 29, 2000, *available in* 2000 WL 7119094.

[314] *BT Sets Mobile Data Pace – High-Speed Service From BT CellNet Is Put to the Test*, COMPUTING, Jan. 27, 2000, *available in* 2000 WL 8412957.

Some GSM carriers plan to deploy EDGE as a migration path from GPRS. EDGE uses the same 200 KHz of carrier bandwidth as GPRS but, based on the numbers available for European operators, it is much more expensive than either HSCSD or GPRS at $300 million to $600 million per network.[315] Worldwide, analysts believe that EDGE will be used by carriers who do not obtain a 3G license but wish to upgrade their TDMA systems, or by carriers who deploy 3G only in urban "islands" markets and want to cover their rural and suburban markets with EDGE.[316] Analysts indicate that U.S. GSM operators are still evaluating the deployment of EDGE.[317] As noted above, analysts anticipate that many 3G European operators will deploy WCDMA.

iDEN. The iDEN system is a communications system that combines the capabilities of digital dispatch, digital cellular-like interconnect, short messaging service, and both circuit switched and packet switched data into a single system.[318] iDEN packet data permits end users access to kbps of effective throughput via a single 25 kHz channel.[319] In April, Nextel launched Nextel Online, a wireless Internet service for business customers offering speeds of 19.2 kbps.[320] Service is available in 43 markets with full coverage expected by mid-2000.[321] For a further discussion of Nextel's Internet service, *see* Section II.B.2.c(ii), *infra*.

Southern LINC offers packet data and Internet services over its iDEN-based network. To date, the company offers wireless Internet dispatching services, public safety/law enforcement services, and "My LINC" business services, which permit users to access news headlines, weather reports and stock quotes; view and update their address book; and send and receive e-mail.[322]

iDEN operators have not publicly announced a migration path to 3G beyond the existing iDEN technology.[323] However, some analysts note that iDEN operators may deploy EDGE and WCDMA.[324]

---

[315] *1999 Merrill Lynch Report*, at 29, 35; *Merrill Lynch Evolution Report*, at 4.

[316] *1999 Merrill Lynch Report*, at 35.

[317] *Merrill Lynch Evolution Report*, at 4.

[318] Telephone conversation with Ognjen Redzic, Product Manager, iDEN, Motorola, Feb. 22, 2000. iDEN is considered by its developer, Motorola, to be equivalent to a 2.5G network. *Id*.

[319] *Id*.

[320] *Nextel Introduces Nextel Online(SM): Wireless Internet Service for Business*, News Release, Nextel Communications, Inc., Apr. 25, 2000; *Credit Suisse Report*, at 72.

[321] *Id*.

[322] *Southern LINC Brings Wireless Data & Internet Services to Business Market*, News Release, Southern LINC, Oct. 20, 1999.

[323] *Merrill Lynch Evolution Report*, at 4.

[324] *Credit Suisse Report*, at 74; *see also 2000 Merrill Lynch Report*, at 66.

b. Handset Capabilities

A variety of advanced handsets are already in use today, with many more in development.[325] Many analysts refer to these handsets as "smartphones" that may include features such as a microprocessor, memory, screen, built-in modem, microbrowser to access the Internet, voice, access to e-mail, and PDA.[326] Smartphone handsets are available for all four digital technologies, and some work over multiple spectrum bands.[327] Handsets are currently available for some network upgrades (*e.g.*, HSCSD) and are being developed for others (*e.g.*, GPRS).[328] Handsets for 3G are still in the trial and development phase. Analysts note that 3G handsets will likely not only have to support two or more 3G standards to permit roaming, but they will also have to support existing 2G standards. This is because many 3G technologies will be implemented in large population centers first, and handsets will fall back onto 2G networks outside these areas.[329] One forecast predicts that handsets for WCDMA will debut in Japan in 2001, followed by the cdma2000 handsets in Korea and possibly the United States.[330]

Beyond network upgrades, three other recent technological advances are facilitating the transformation of mobile telephone handsets from simple voice tools to sophisticated data devices. As noted above, these advances include: WAP, a recently developed protocol for wireless devices; Bluetooth, a technology that allows devices such as mobile handsets and laptop computers to interact without cables; and, operating systems designed for handheld devices.

(i) WAP

Wireless Application Protocol, or WAP, is a set of technologies that allows mobile phones, handheld computers, and other portable devices to access the Internet. Ericsson, Nokia, Motorola, and a start-up software company called Phone.com founded the WAP Forum in June 1997 to establish a global, open industry standard for bringing the Internet to handheld devices and wireless phones. WAP is a "technology enabler," meaning that it is not a product itself but a set of non-proprietary standards that the entire wireless data industry can use to develop its products. Technically, it is referred to as a communications protocol specification. The goal of WAP is to allow all wireless devices, regardless of their manufacturer or network, to access the Internet in essentially the same way.

---

[325] *See* Appendix C, Table 5, p. C-8 for a list of smart phones currently on the market or in development.

[326] Wireless Data Forum, *Wireless Data Glossary* (visited Feb. 15, 2000) <http://www.wirelessdata.org/primer/terms.asp>; Karen Rodriguez, *Sprint Poised to Boost Wireless Internet Access*, WASHINGTON BUSINESS JOURNAL, Aug. 27, 1999, *available in* 1999 WL 28658251.

[327] Sebastin Rupley, *Calling the Web: Smart Phones Get Smarter*, PC MAGAZINE, Dec. 14, 1999, *available in* 1999 WL 6783097.

[328] Lynnette Luna, *Carriers Anxious For GPRS Handsets*, RCR RADIO COMMUNICATIONS REPORT, Feb. 14, 2000, *available in* 2000 WL 9540073.

[329] Eoin Licken, *Are You Ready?*, COMMUNICATIONS INTERNATIONAL, Feb. 1, 2000, *available in* 2000 WL 10977184.

[330] Vadim Zlotnikov, *Culling Ahead In Wireless-Chip Market*, ELECTRONIC BUYERS' NEWS, Feb. 28, 2000, *available in* 2000 WL 2159567.

WAP is a means of helping the wireless industry overcome the challenges of accessing the Internet from a handheld device or wireless phone, which is quite different from accessing the Internet from a desktop or laptop computer. Handheld devices and wireless phones have smaller screens, different keypads (usually numbers instead of QWERTY), less memory, and a relatively short battery life. In addition, mobile wireless networks, at least at the current time, are less predictable in their availability and stability and are slower than wireline networks. Furthermore, wireless users generally demand products and services that are quick and easy to use, and often use their handhelds to accomplish small, specific tasks, while possibly doing other things simultaneously. Mobile handset users are also more price-sensitive than PC users; a $50 difference in price is small for a PC, but is significant for a handset. Producers of mobile handheld devices must therefore add significant value at a low cost, and WAP allows them to do this.[331]

Industry Cooperation. WAP has been developed and supported by nearly the entire wireless industry and is the product of its cooperation. Since 1997, more than 200 companies have joined the WAP Forum,[332] including wireless carriers with more than 100 million subscribers worldwide.[333] Handset manufacturers with a combined global market share of 90 percent have committed to shipping WAP-enabled devices.[334] This will reportedly lead to the availability of tens of millions of WAP products by the end of 2000.[335] Because of the broad acceptance of WAP by the industry, thousands of third-party developers have begun to build WAP-based products and applications.[336]

WAP allows the different segments of the wireless industry – equipment manufacturers, network operators, and application and content providers – to develop products that are independent from yet interoperable with the products of the other segments. WAP is designed to work on any mobile device that meets minimum specifications and on any mobile telephone network – CDMA, TDMA, GSM, or iDEN – regardless of its protocol.[337] While the WAP specification works across different types of wireless technologies, companies can still layer their own unique features on top of WAP in order to differentiate their products. WAP can also evolve as wireless networks increase in bandwidth and carriers develop new applications for wireless phones.[338] WAP allows all Web content and applications for mobile devices to be hosted on standard Web servers,[339] and WAP can also be used with any

---

[331] WAP Forum, *W@P White Paper Wireless Application Protocol*, WIRELESS INTERNET TODAY, June 1999, at 1. ("WAP White Paper")

[332] *DLJ Report*, at 22-23.

[333] WAP Forum, *W@P White Paper Wireless Application Protocol*, WIRELESS INTERNET TODAY, June 1999, at 1. ("WAP White Paper")

[334] *Id*.

[335] *Id*.

[336] *DLJ Report*, at 22-23.

[337] WAP White Paper, at 5.

[338] *DLJ Report*, at 22-23.

[339] *1999 Merrill Lynch Report*, at 50-52.

operating system.[340] Because the WAP specification is open and public, mobile device manufacturers can integrate it at minimal cost.[341]

While WAP has many positive features, some members of the wireless industry note that certain problems with the standard have arisen with its implementation. For example, the way in which vendors have integrated WAP into their products has sometimes made those products incompatible with others. A WAP-enabled phone made by Nokia reportedly has had difficulty interacting with a WAP server made by Phone.com, and some additional problems have arisen with the interoperability of applications.[342] Another criticism of WAP has been the lack of an end-to-end security solution to enable e-commerce applications.[343] Some companies view WAP as one of many interfaces and as an interim step in mobile data evolution.[344]

Current WAP Offerings. A few equipment manufacturers have developed WAP-enabled handsets, and a few carriers worldwide are currently offering Web-based services with these handsets.[345] For example, Nokia began shipping its first WAP-enabled phone, "the 7110," in September 1999 and had shipped 100,000 units by November 1999.[346] For a further overview of rollouts of WAP-enabled phones worldwide, see Table 6 in Appendix C. It is estimated that by 2004, 95 percent of mobile phones sold will be WAP-enabled.[347]

(ii) Bluetooth

Bluetooth is a protocol standard for establishing a wireless connection between electronic devices that are up to 10 meters apart.[348] It uses unlicensed spectrum in the 2.45 GHz band and can send signals in all directions, without a direct line of sight.[349] Connectivity speeds are expected to reach up to 1 Mbps.[350]

---

[340] For a discussion of operating systems, *see* Section II.B.2.b(iii), *infra*.

[341] WAP White Paper, at 2.

[342] *See* Antony Bruno, *WAP Interoperability Increasing Concern*, RCR RADIO COMMUNICATIONS REPORT, Jan. 17, 2000, at 1, 42; Antony Bruno, *WAP Proponents Face Interoperability Challenges as Standard Evolves*, RCR RADIO COMMUNICATIONS REPORT, Oct. 25, 1999, at 3.

[343] Antony Bruno, *Market Gap Producting WAP Alternatives*, RCR RADIO COMMUNICATIONS REPORT, Feb. 21, 2000, at 1, 90.

[344] Carol Wilson, *To WAP Or Not To WAP*, ZDNET: INTER@CTIVE WEEK, Dec. 6, 1999.

[345] *An Introduction to WAP* (visited Feb. 17, 2000) <http://www.mobileSMS.com/wp/wp4.htm>.

[346] *RPT-Nokia Says WAP Phone Demand Unprecedented*, YAHOO! FINANCE, <http://biz.yahoo.com/rf/991129/26.html> Nov. 29, 1999.

[347] David Haskin, *Analysts: Smart Phones to Lead E-Commerce Explosion*, ALLNETDEVICES, Nov. 3, 1999.

[348] Nobilangelo Ceramalus, *Bluetooth Will Byte Deep*, MANAGEMENT, Aug. 1, 1999, *available in* 1999 WL 13583982.

[349] *1999 Merrill Lynch Report*, at 53*; Intel Says Bluetooth Products Will Emerge Next Year*, COMPUTERGRAM INTERNATIONAL, June 2, 1999, *available in* 1999 WL 8112490.

Bluetooth was initially developed by Ericsson, Nokia, Intel, IBM, and Toshiba,[351] and is now backed by over 1,400 companies worldwide,[352] including Microsoft, Lucent, Motorola, and 3Com.[353]

Bluetooth eliminates the need for cables and other PC hardware accessories. It can be used to connect devices such as mobile and wireline phones, handheld devices, personal computers, computer accessories, digital cameras, kitchen and household appliances, and electronic car devices to each other and to the Internet – essentially creating a wireless LAN in one's home. A user could, for example, send documents from a laptop to a printer or desktop computer without using a cable. Some more futuristic examples include using Bluetooth to start a car from inside without going outside or to turn on the dishwasher at home from an Internet connection at work. In order for devices to "talk" to each other they must have a Bluetooth transceiver or set of Bluetooth-enabled chips. Analysts expect that chips will cost $20 to $30 initially but that prices will fall as volume increases.[354]

The first Bluetooth software development kit, which companies can use to integrate Bluetooth into their products, was made available in April 2000.[355] In November 1999, Ericsson unveiled a Bluetooth-enabled wireless headset that allows people to answer their wireless phones from up to 30 feet away.[356] Analysts believe that most of the initial Bluetooth-enabled products will be laptops, wireless phones, and PDAs.[357] Analysts also predict that by the end of 2003, 70 percent of mobile phones will incorporate Bluetooth and a total of 200 million Bluetooth-enabled devices will have been shipped.[358]

(iii) Operating Systems

Operating systems are software programs that manage the basic operations of a computer system. The operations include memory apportionment, the order and method of handling tasks, and flow of

(Continued from previous page)

[350] *1999 Merrill Lynch Report*, at 53.

[351] Nobilangelo Ceramalus, *Bluetooth Will Byte Deep*, MANAGEMENT, Aug. 1, 1999, *available in* WL 13583982.

[352] *Hexagon Launches Bluetooth Company – Expanding Within Wireless Communication*, News Release, Hexagon AB, Feb. 16, 2000.

[353] *Microsoft, 3Com, Lucent, Motorola Back Bluetooth Wireless Standard*, DOW JONES NEWSWIRES, Dec. 1, 1999.

[354] *1999 Merrill Lynch Report*, at 53; *Bluetooth Market Pegged at $2 Billion Opportunity in Five Years*, WIRELESS DATA NEWS, Oct. 13, 1999 (citing Allied Business Intelligence, Inc.), *available in* 1999 WL 7899443.

[355] *First Bluetooth Software Development Kit Now Available*, CNNFN.COM, Apr. 10, 2000.

[356] *Microsoft, 3Com, Lucent, Motorola Back Bluetooth Wireless Standard*, DOW JONES NEWSWIRES, Dec. 1, 1999.

[357] *DLJ Report*, at 25-26.

[358] *DLJ Report*, at 25-26 (citing Cahners In-Stat Group).

information into and out of the main processor and to peripherals (*e.g.*, printers).[359] Operating systems perform similar functions on mobile handsets and facilitate the provision of mobile data services.

A number of operating systems compete to serve the mobile telephone handset sector, including Pocket PC, Palm OS, and EPOC. Pocket PC is the successor to Microsoft's Windows CE system and includes features such as Word and Excel.[360] Pocket PC operates as a slimmed down version of Windows for the desktop PC and is compatible with existing Internet protocols. Pocket PC operates on a number of devices, which are discussed in Section II.B.4, *infra*.

Palm Inc. promotes its Palm OS operating system. In addition to functioning as the operating system for Palm Inc.'s line of Palm PDA devices, Palm OS is installed on Kyocera's pdQ phone.[361]

In 1998, Nokia, Ericsson, Motorola, and Psion Software joined to form Symbian to develop the software and hardware standards for the next generation of wireless smart phones and other handheld devices.[362] Symbian's operating system is EPOC, which uses the WAP protocol. Sun, Phillips, and NTT DoCoMo have joined the Symbian alliance and licensed EPOC. Most recently, IBM, with support from a number of other entities, announced plans to develop an open, scalable platform based on EPOC.[363]

It is too early to determine whether any of the operating systems discussed above will ultimately dominate the handset market as Palm has thus far dominated the handheld device market.[364]

c. Services and Products

In order to be successful, providers must determine what mobile data services end users demand.[365] One analyst anticipates two groups of users: "casual data users" who receive certain preselected information on a periodic basis, including short messages and Internet e-mail sent to and from mobile devices, and "interactive data users" who will routinely access e-mail, Web services, or e-commerce on a wireless basis.[366] The same analyst believes that casual data user revenues will amount to $8 billion by 2007, with

[359] Wireless Data Forum, *Wireless Data Glossary WDF: Events* (visited Feb. 15, 2000) <http://www.wirelessdata.org/primer/terms.asp>.

[360] Aaron Ricadela, *Vendor Upgrades Windows CE in Hopes of Capturing a Bigger Piece of the* PDA, INFORMATIONWEEK, Apr. 24, 2000, *available in* 2000 WL 8166509; Microsoft, *Pocket PC Features* (visited May 1, 2000) <http://www.microsoft.com/mobile/pocketpc/features/default.asp>.

[361] In February 2000, QUALCOMM sold its mobile phone manufacturing unit to Kyocera. *Qualcomm, Kyocera Close Deal on Phone Unit*, News Release, QUALCOMM, Feb. 23, 2000.

[362] *The Futurefonezone White Paper* (visited Feb. 17, 2000) <http://www.mobileSMS.com/wp/whitepaper.html>.

[363] *IBM Talks Openly On Wireless Data*, PC DEALER, Mar. 22, 2000, *available in* 2000 WL 9069595.

[364] Carmen Nobel, *Win CE Aimed at Embedded*, PC WEEK FROM ZDWIRE, Apr. 3, 2000, *available in* 2000 WL 18176928.

[365] *Data-Enabled Wireless Handsets To Gain Huge Market Share, Research Group Ovum Says*, PCS WEEK, July 21, 1999, *available in* 1999 WL 7870989.

[366] *SSB Report*, at 24-25, 28.

over one-third of the total attributed to mobile phone subscribers using their wireless phones for data services.[367] Interactive data users will require a more powerful access device such as a laptop with wireless modem, a Palm VII, or a smartphone handset such as the Nokia 9000 Communicator.[368] Interactive data users are anticipated to include both individual consumers and businesses, although businesses will constitute the bulk of the market in early years.[369] This analyst forecasts that by 2007 annual revenues attributable to interactive data users will reach $7 billion for mobile e-mail and $11 billion for mobile Internet.[370]

The earliest offerings over the four existing digital networks have consisted primarily of one-way SMS. However, carriers are starting to offer more sophisticated data services, including Internet access and e-mail, e-commerce, and location-based services such as roadside assistance and mobile yellow pages.

(i) SMS

Short messaging service provides the ability to send and receive text messages to and from mobile handsets with message length ranging from 140 to 256 characters.[371] SMS can be used to deliver a wide range of information to mobile users, including stock prices, sport scores, weather reports, and horoscopes. All four digital networks are capable of offering SMS over many of their handsets.[372] Most carriers charge between $2 and $10 per month for SMS, but a few carriers offer subscribers SMS at no charge.[373] One analyst estimates that by 2003 over 66 percent of all wireless subscribers will use SMS to send and receive messages, get information, make data inquiries, and schedule reservations.[374]

SMS is particularly popular in Europe. By April 1999, customers in the European Union were transmitting one billion short messages per month.[375] Sonera (Finland) reports that by year-end 1999 more than 60 percent of its 2.1 million subscribers were using SMS and averaged 21 messages per month.[376]

---

[367] *Id*. at 26.

[368] *Id*. at 28.

[369] *Id*. at 29.

[370] *Id*. at 30.

[371] Andrew M. Seybold, *Short Messaging Service (SMS)*, MOTHERING MAGAZINE, June 25, 1999, *available in* 1999 WL 16633524. GSM networks permit messages of 160 characters, CDMA permits 256 characters, and iDEN allows 140 characters. *Id*. To date, GSM and iDEN networks have 2-way SMS capabilities and TDMA and CDMA networks are in the process of implementing 2-way capabilities. Telephone conversation with Marc Cabi, Managing Director, Equity Research, Credit Suisse First Boston, May 23, 2000.

[372] *Strategis Mobile Data Report*, at 59.

[373] *Id*.

[374] Charles Mason, *What Have We Wrought*, AMERICA'S NETWORK, July 1, 1999, *available in* 1999 WL 11825376, citing Dataquest, Inc.

[375] Brad Smith, *New Handsets Challenge Novices*, WIRELESS WEEK, Dec. 6, 1999, at 21.

[376] *2000 Merrill Lynch Report*, at 25.

(ii) Internet Access

A number of U.S. operators are currently offering mobile Internet access at rates of 9.6 kbps to 19.2 kbps. The services vary in terms of what content can be accessed, how content is accessed, and the costs associated with accessing content. This subsection begins with a discussion of the Internet access offerings of several U.S. operators and very briefly touches on the type of content that operators are offering as well as the associated costs. The subsection concludes with a brief summary of how carriers are delivering content to their mobile Internet subscribers.

Carrier Offerings. Three examples of carriers offering Internet access services are Sprint PCS, AT&T, and Nextel. A more detailed list of carriers' offerings is provided in Appendix C, Table 7. On September 20, 1999, Sprint PCS launched nationwide Wireless Web service offering connectivity up to 14.4 kbps through both an Internet-ready handset and connected to a laptop using their handset in place of a modem.[377] Initially, Wireless Web's content included Yahoo!'s "My Yahoo!," which allows a user to customize content directly from the Yahoo! Web site that is sent to the wireless handset.[378] The offerings have been increased to include MapQuest, InfoSpace, Bloomberg, and Amazon.com, among other services.[379] Sprint PCS offers three pricing plans for its Wireless Web service.[380] As of year-end 1999, Sprint had a low single digit percentage of its customer base subscribing to its lowest cost Wireless Web service ($9.95 per month).[381]

AT&T's PocketNet, a mobile Internet phone and data service offered over CDPD for several years, covers a total of 145 million POPs including areas covered by roaming agreements.[382] CDPD permits data speeds up to 19.2 kbps.[383] In May 2000, AT&T repackaged its PocketNet service by offering existing customers either: (1) free access to 40 Web sites for existing AT&T customers or (2) a $6.99 or $14.99 per month plan for additional services including e-mail, faxing, calendars, and access to additional Web sites.[384] AT&T offers its PocketNet subscribers access to a number of Web sites

---

[377] Sprint PCS, *Sprint PCS – FAQ* (visited June 5, 2000) <http://s2.sprintpcs.com/services/faq/faq_wwconnect.html>; *Sprint Announces 'Grand Opening of the Wireless Internet' with Nationwide Availability of Sprint PCS Wireless Web*, PR NEWSWIRE, Sept. 20, 1999.

[378] *Sprint Announces 'Grand Opening of the Wireless Internet' with Nationwide Availability of Sprint PCS Wireless Web*, PR NEWSWIRE, Sept. 20, 1999.

[379] *2000 Merrill Lynch Report*, at 57.

[380] *See* Appendix C, Table 7, p. C-10.

[381] *Lehman Brothers Report*, at 13.

[382] *2000 Merrill Lynch Report*, at 58; *AT&T Begins Rolling Out Paradyne Modem Pools to Coincide With CDPD New York City Commercial Launch*, WIRELESS DATA NEWS, Nov. 1, 1995, *available in* 1995 WL 6615015.

[383] Cameron Crouch, *A Web Phone Is Still a Phone*, PC WORLD ONLINE, May 25, 2000, *available in* 2000 WL 8856388.

[384] MSNBC, *AT&T Wireless Plans to Offer Mobile Internet Access For Free* (visited May 22, 2000) <wysiwyg://4/www.msnbc.com/news/409100.asp>.

including E*Trade, MapQuest, Barnes and Noble.com, and abcnews.com.[385] As of summer, AT&T had more than 100,000 PocketNet customers.[386]

In April 2000, Nextel launched Nextel Online, a wireless Internet service offering data speeds up to 19.2 kbps for business customers.[387] Service is available in 43 markets with full coverage expected by mid-2000.[388] Nextel offers flat-rate pricing beginning at $14.95 per month and unlimited access to online content and commerce.[389] Nextel is partnering with Microsoft's MSN and offers access to services such as MSN Hotmail, MoneyCentral, and Expedia.com.[390] No subscribership figures are available at this time.

While some mobile telephone operators currently offer price per minute or fixed bucket of minutes' data plans, analysts believe that ultimately flat rate pricing will be necessary since users are accustomed to that pricing structure.[391]

Content. As noted briefly above, operators are pursuing a number of methods to provide content to subscribers, including alliances with wireless portal providers and the creation of their own wireless Internet portals. Analysts note that a portal may be a great way to promote new mobile service and products.[392] Eventually, similar to wired Internet portal providers, analysts believe that wireless Internet portal providers should be able to charge a commission for transactions completed at their Internet portals as well as charge for advertising.[393] For example, customers signing on to Sprint's Wireless Web service are sent to Sprint's home page, and Yahoo! and AOL are listed as links.[394] Sprint receives revenues from the companies when it sends customers to either Yahoo! or AOL.[395]

---

[385] AT&T, *AT&T Wireless Services – AT&T Digital PocketNet Service – InfoSpace Preview* (visited May 22, 2000) <http://www.attws.com/personal/explore/pocketnet/infospace_preview.html>.

[386] *AT&T Reports Wireless and Cable Growth*, COMMUNICATIONS DAILY, July 26, 2000.

[387] *Nextel Introduces Nextel Online(SM): Wireless Internet Service for Business*, News Release, Nextel Communications, Inc., Apr. 25, 2000; Becky Waring, *Just Connect -- And You're Hooked Nextel Online Serive Is Easy To Get Used To*, THE SAN FRANCISCO CHRONICLE, Apr. 27, 2000.

[388] *Id*.

[389] *Id*.

[390] *Id*.

[391] *SSB Report*, at 10; *DLJ Report*, at 25.

[392] David Pringle, *Internet-Enabled Phones Cause A Fight For Phone Users Eyes*, THE WALL STREET JOURNAL INTERACTIVE EDITION, Feb. 29, 2000 (visited Mar. 1, 2000) <http://interactive.wsj.com/articles/SB951846779576984200.htm>.

[393] *Id*.

[394] Nikhik Hutheesing, *Who Owns Your Portal?*, FORBES, May 22, 2000, at 23.

[395] *Id*.

There are many players positioning themselves to enter the wireless Internet portal market. In addition to those mentioned above, a number of carrier/portal alliances have been announced, including: AOL and Nextel; Infospace and GTE Wireless; and Excite and NTT DoCoMo.[396] In addition, several European carriers have already launched wireless portals, including Orange (UK)[397] and Telia Mobile (Sweden).[398] Sonera (Finland) has developed a portal called "Zed" that allows users to set up and manage their accounts and personal home pages through the Internet, and then access them over their handsets.[399] As of the end of January 2000, Zed had more than 600,000 users.[400] For additional wireless portals, see Appendix C, Table 8.

At this early stage, the service models are still in flux, with ISPs and even mobile operators creating integrated and seamless portals (often including customer service and account access) or choosing to maintain a separate stand-alone portal as a related, but unique operation. At the same time, portals such as Yahoo! are providing formatting that allows Web-enabled phones/PDAs access to content. The lines continue to blur between service providers, content providers, and hardware providers.

(iii) E-Commerce

The Internet offers users a variety of e-commerce applications including, the ability to pay bills online, trade stocks, participate in auctions, and purchase a seemingly endless array of goods and services from around the globe.[401] Some analysts believe that mobile e-commerce, or what is sometimes referred to as "m-commerce," will generate revenues of $23 billion by 2004.[402] However, others believe that the type of lengthy Internet browsing that is typically done from desktop computers will not be as widespread on mobile devices because of physical limitations, such as screen size, that will persist despite the technological advances outlined above. Instead, mobile data users will desire more limited information quickly.[403] As a result, these analysts believe that e-commerce applications such as accessing bank

---

[396] Andrew J. Cole, *Wireless Portals: The Hidden Enemy?*, RCR RADIO COMMUNICATIONS REPORT, Sept. 13, 1999, *available in* 1999 WL 7792263; Cameron Crouch, *Microsoft Updates MSN on Phones*, PC WORLD ONLINE, Feb. 28, 2000, *available in* 2000 WL 8855830.

[397] *Orange Launches Orange.net ISP, Portal; Enables Internet Access Via Mobiles*, AFX, Nov. 24, 1999, *available in* 1999 WL 27750502.

[398] Wayne Walley, *Wireless: WAP Happy*, GLOBAL TELEPHONY, Nov. 30, 1999, *available in* 1999 WL 18136275.

[399] Bruno Giussani, *Mobile Data Is Set to Take Off, But Glitches Remain*, EUROBYTES (visited Oct. 19, 1999) <http://www.nytimes.com/library/tec…0/cyber/eurobytes/19eurobytes.html>.

[400] *2000 Merrill Lynch Report*, at 26.

[401] For example, in February 2000, Amazon.com announced that its books may be purchased through Sprint's Wireless Web service. Aaron Pressman, *Internet Luminaries Herald Wireless Web World* (visited Feb. 29, 2000) <http://www.foxnews.com/ntech/022700/wireless.sml>.

[402] Linda J. Mutschler and Naeemah Lajoie, *A Day in the Future*, United States Telecom Services-Wireless/Cellular, Merrill Lynch & Co., Apr. 4, 2000, at 7-8.

[403] *SSB Report*, at 14.

accounts, transferring funds, or executing stock trades, which typically do not require lengthy browsing sessions, will be quite popular among mobile data subscribers.[404]

(iv) Location-Based Services

A number of location technologies have been developed that will be used by wireless carriers to offer enhanced 911 access to mobile telephone handsets.[405] Network-based solutions use radio-signal-processing methods.[406] Some handset-based solutions use the U.S. military's Global Positioning System[407] ("GPS") satellites.[408] Such so-called "hybrid" systems use upgrades to the network and handsets, but do not rely on the GPS system.[409]

Location technologies can also be used by wireless carriers to deliver commercially valuable, location-specific information such as roadside assistance, mobile yellow pages, direction services, and asset tracking, to users of various wireless devices.[410] For example, Sprint PCS offers the location-based information services of Go2 Systems Inc. ("Go2") to its Wireless Web subscribers.[411] Subscribers can

---

[404] *E-Commerce Is Killer App for Wireless, Says VeriSign CEO***,** BUSINESS WIRE, Feb. 15, 2000.

[405] *See* Revision of the Commission's Rules To Ensure Compatibility with Enhanced 911 Emergency Calling Systems, CC Docket No. 94-102, *Report and Order and Further Notice of Proposed Rulemaking*, 11 FCC Rcd 18676 (1996) ("*E911 First Report and Order* and *E911 Second NPRM*"), *on recon*., 12 FCC Rcd 22665 (1997) ("*E911 First Reconsideration Order*"); 14 FCC Rcd 20850 ("*E911 Second Memorandum Opinion and Order*"); 14 FCC Rcd 10954 ("*E911 Second Report and Order*"), *on recon*., 15 FCC Rcd 1144 (*E911 Third Memorandum Opinion and Order*). In September 1999, the Commission revised its enhanced 911 rules to require carriers to provide to the designated Public Safety Answering Point (PSAP) the location 911 calls, with the following accuracy and reliability: (1) for network-based technologies: 100 meters for 67 percent of calls, 300 meters for 95 percent of calls; (2) for handset-based technologies: 50 meters for 67 percent of calls, 150 meters for 95 percent of calls. *See* 14 FCC Rcd at 17388 (1999) ("*E911 Third Report and Order*"), *recons. pending*.

[406] Steve Poizer and Karissa Todd, *Extending GPS Capabilities*, WIRELESS REVIEW, May 1, 1999, *available in* 1999 WL 10100680.

[407] The Global Positioning System permits us to figure out precisely where we are anywhere on earth. The system will eventually consist of a constellation of 21 satellites orbiting the earth at 10,900 miles. The U.S. Government is investing over $10 billion to build and maintain the system. HARRY NEWTON, NEWTON'S TELECOM DICTIONARY (14th ed. 1998), at 328.

[408] Steve Poizer and Karissa Todd, *Extending GPS Capabilities*, WIRELESS REVIEW, May 1, 1999, *available in* 1999 WL 10100680. The U.S. Government recently turned off its "selective availability" that degraded the publicly available signals from GPS satellites thus increasing the accuracy of the signals. *Government Gives Users of GPS A Gift That's Sure to Please*, THE BALTIMORE SUN, May 15, 2000, *available in* 2000 WL 10012548.

[409] Heather Forsgren Weaver, *Carriers, Vendors Poised to Capitalize on 911 Mandates*, RCR RADIO COMMUNICATIONS REPORT, Mar. 20, 2000, at 18-19.

[410] Steve Poizer and Karissa Todd, WIRELESS REVIEW, May 1, 1999, *available in* 1999 WL 1010680; Robert McGarvey, *Wireless Craze*, UPSIDE MAGAZINE, Mar. 1, 2000, *available in* 2000 WL 2005063.

[411] Heather Forsgren Weaver, *Carriers, Vendors Poised to Capitalize on 911 Mandates*, RCR RADIO COMMUNICATIONS REPORT, Mar. 20, 2000, at 19.

access more than 300 sites including services such as hotels and banking.[412] Currently, the customer's location is determined either through manual input of their present location or through customer selection from a preprogrammed list of locations (*e.g.*, office).[413] One company called InfoMove combines the Internet, wireless (via CDPD), automotive, GPS, and text-to-speech technologies to help carriers deliver Internet information to commuting consumers. According to the company's plan, drivers can place their palm-sized PC, handheld PC or Internet-ready handset in a cradle in their cars. Customers then receive personalized content instantly, including real-time traffic advisories, audible directions, vehicle diagnostics and maintenance alerts, emergency services, location-based advertising, and text-to-speech e-mail capabilities.[414] InfoMove anticipates that service will be available in the third quarter of this year.[415]

3. Traditional Paging and Messaging Devices

Since the writing of the *Fourth Report*, the paging/messaging industry[416] has continued its restructuring efforts in the face of competition from mobile telephone carriers, who have rolled out digital service in most major U.S. markets and lowered their monthly rates. Paging/messaging operators are attempting to position themselves as major players in the emerging mobile data sector. During 1999 and early 2000, several operators introduced two-way services that allow subscribers to access e-mail and information from the Internet.[417] The two-way technology deployed in their networks also allows paging companies to enter the largely untapped market of wireless telemetry.

During 1999, the paging industry experienced a slight increase in subscribership and a drop in total revenue from its traditional one-way business. However, many companies are using this traditional business, which generally has positive earnings, to fund the deployment of more expensive two-way networks.[418]

---

[412] *Id.*

[413] Telephone Conversation with Lee Hancock, President and CEO, Go2 Systems, Inc., June 28, 2000. Go2 also provides a service called Go2 Address that registers abbreviated names for locations, which shortens the locations that must be entered. *Id*.

[414] Kelly Carroll, *Data to Ride Shotgun: InfoMove Helps Connect Cars to Internet*, TELEPHONY, Dec. 13, 1999, *available in* 1999 WL 11172656.

[415] *InfoMove Secures $5.5 Million in Second Round of Funding Infusion of Capital Includes Who's Who List of Strategic Corporate and Individual Investors*, News Release, InfoMove, Apr. 11, 2000.

[416] As used herein, paging and messaging refer broadly to traditional one-way paging and advanced or two-way messaging services, as well as services provided over narrowband PCS spectrum. The Commission auctioned regional and nationwide narrowband PCS licenses in 1994 and noted that such licenses could be used to provide voice messaging paging, two-way acknowledgement paging and other two-way data services. FCC, *FCC Auction – Regional Narrowband PCS – Fact Sheet* <http://www.fcc.gov/wtb/auctions/npcs/rnp1fact.html>. In May 2000, the Commission modified its narrowband PCS rules. *See* Amendment of the Commission's Rules to Establish New Personal Communications Services, Narrowband PCS, *Second Report and Order and Second Further Notice of Proposed Rulemaking*, GEN Docket No. 90-314, FCC 00-159 (rel. May 18, 2000).

[417] *See* Appendix C, Table 14, p. C-18 for an overview of these operators and the two-way services they offer.

[418] *WebLink Wireless Reports Fourth Quarter Results; Company Receives First Wireless Data Subscriber Devices This Week as The Network Stands Ready*, News Release, WebLink Wireless Inc., Feb. 2, 2000.

This report's discussion of the paging/messaging industry begins with a summary of the industry's performance and structure during 1999 and includes information about specific carriers. This summary is followed by an analysis of the strategies and operational trends employed by the industry to compete with other CMRS carriers. These include the rollout of two-way Internet-based services, the development of common standards, and consolidation. The paging/messaging section concludes with an assessment of competition and industry projections.

a. Paging Industry Structure and Performance

According to one analyst, the paging industry experienced slight growth in subscribership during 1999, while its annual revenues decreased.[419] Based on this estimate, 700,000 new paging units (including both one-way and advanced messaging) were added during 1999 for a total of 45.8 million units in service, an increase of 1.6 percent over 1998.[420] However, total revenues fell about 0.7 percent to $4.426 billion.[421] Another analyst estimated 52.5 million units were in service at year-end 1999, a 2.9 percent increase from the previous year. That analyst calculated a 2 percent increase in one-way paging subscribers and a 100 percent increase in two-way subscribers.[422]

Paging Network, Inc. ("PageNet") remained the largest paging carrier in 1999 with 9 million subscribers.[423] In November 1999, PageNet announced its merger with the second largest paging carrier, Arch Communications ("Arch"). The merger is discussed in detail below. Based on 45.8 million subscribers, PageNet has 20 percent of all paging customers, Arch has 15 percent, and Metrocall, Inc. ("Metrocall") has 13 percent. BellSouth Wireless Data ("BSWD") and Motient Corp. ("Motient," formerly American Mobile Satellite Communications, Inc.) also offer two-way advanced messaging services nationwide in competition with traditional paging companies, using the Mobitex and DataTAC network technologies, respectively.[424] In April 2000, Motient formed a strategic alliance with Metrocall that will result in Metrocall reselling Motient's services.[425]

---

[419] Appendix C, Table 9, p. C-13 lists the total subscribers, annual revenues, and ARPU for the paging industry for the years 1996-1999. Appendix C also includes the public paging companies' revenues, EBITDA/operating cash flow, and EBITDA/operating cash flow margin. *See* Appendix C, Tables 10-13 at pp. C-14 – 17.

[420] THE STRATEGIS GROUP, THE STATE OF THE U.S. PAGING INDUSTRY: 1999 (1999), at 119. The *Fourth Report* shows Strategis's estimate of 53.3 million total paging units in service at the end of 1998. However, Strategis revised this estimate during 1999 to 45.1 million units in service.

[421] *Id.* at 124.

[422] PCIA, PCIA Wireless Market Portfolio, 1999, at 6 (citing Donaldson, Lufkin & Jenrette, U.S. Paging Forecast, 1999).

[423] *Paging Network To Miss Interest Payments*, DOW JONES NEWS SERVICE, Jan. 27, 2000.

[424] Motient's messaging subsidiary was formerly know as the ARDIS Company, which Motient (then American Mobile Satellite Corporation, Inc.) acquired from Motorola in 1998. However, Motient no longer appears to be offering its messaging services under the ARDIS name.

[425] *Metrocall & Inciscent Announce Alliance with American Mobile*, News Release, Metrocall, Inc., April 10, 2000.

Three leading paging/messaging operators – PageNet, WebLink Wireless, Inc. ("WebLink," formerly PageMart Wireless), and SkyTel – offer nationwide facilities-based services using their narrowband PCS licenses. A number of other narrowband PCS licensees, including Vodafone and Metrocall, have negotiated strategic agreements with existing narrowband PCS operators to initially resell services and then construct their own facilities, sharing the capital and expenses with the existing carriers.[426]

At least two carriers are offering satellite-based paging services.[427] For example, QUALCOMM Inc. offers advanced messaging for trucking companies using geostationary satellite ("GEO") systems, and ORBCOMM Global LP offers two-way messaging using low earth orbiting ("LEO") satellite systems.[428] Over 1,200 U.S. transportation fleets use QUALCOMM's GEO-based system, called OmniTRACS, for two-way data messaging and position tracking.[429] In addition, most paging/messaging carriers use satellites to backhaul traffic on their networks.[430]

b. Operational Trends and Competitive Strategies

Both analysts and members of the paging industry believe the plateau in subscribership during 1999 was caused largely by heightened competition from cellular and broadband PCS carriers.[431] In 1999, mobile phone operators improved, expanded, and lowered the price of their digital voice services, which are often bundled with an SMS-based advanced messaging component at little or no additional cost.[432] These developments continued to diminish the traditional advantages of paging, which include size, unobtrusiveness, long battery life, price, and nationwide and in-building coverage.[433]

---

[426] *Metrocall, PageMart Join on Narrowband PCS Buildout Effort*, RCR RADIO COMMUNICATIONS REPORT, Nov. 2, 1998, at 23; *AirTouch Paging and PageMart Wireless Form Narrowband PCS Strategic Alliance; AirTouch to Offer ReFLEX 25 Advanced Messaging Services by Middle of Year*, News Release, PageMart Wireless, Inc., Mar. 30, 1999; *AirTouch Paging Launches Its First Advanced Messaging Service Nationwide*, News Release, Vodafone AirTouch PLC, June 6, 1999.

[427] PageNet had begun reselling Iridium's satellite-based WorldPage Service in January 1999 for its customers wanting global paging/messaging coverage. However, due to financial difficulties, Iridium ceased operations in early 2000. *See* Section II.A.4.d, *supra*, for a further discussion of Iridium.

[428] *See Fourth Report*, 14 FCC Rcd at 10187.

[429] QUALCOMM, Inc., Form 10-K405, Sept. 26, 1999, at 9-10; QUALCOMM, Inc., *Wireless Business Solutions* (visited July 14, 2000) <http://www.qualcomm.com/qwbs/>.

[430] Antony Bruno, *Sky Falls on Pager Service*, RCR RADIO COMMUNICATIONS REPORT, May 25, 1998, *available in* 1998 WL 8226238. In 1998, 90 percent of all paging customers lost service when a Galaxy 4 satellite owned by PanAmSat Corp. broke down. *Id.*

[431] *State of the US Paging Industry* (Conference Call Slides), The Strategis Group, Inc., Dec. 16, 1999, at 3; *DLJ Report*, at 35-37.

[432] *See* White Paper Supporting Elimination of the Narrowband PCS Spectrum Aggregation Limit, PCIA, Feb. 10, 2000, at 10.

[433] *See id*. at 9, 12.

A December 1999 survey of paging customers by the Strategis Group illustrates the declining demand for paging services.[434] Of the paging subscribers who intended to churn in the next three months, 65 percent stated they would discontinue paging service altogether.[435] Over 40 percent of paging customers stated they were likely to purchase a mobile phone within the next year.[436] Another study reported that the purchase of a cellular phone is one of the top ten reasons paging customers discontinue service.[437] On the other hand, the number of concurrent pager/mobile phone users has increased. In 1999, the total was over 25 million – a fivefold increase from 1994 and an 8 percent increase from 1998.[438] Fifty percent of Arch's customers and 60 percent of Metrocall's customers have both a pager and a mobile phone.[439] Analysts believe that traditional one-way paging will continue to drop in subscribership and become a niche application, rather than a mass-market product, used by certain types of professionals such as doctors and engineers.[440]

In late 1999, the average paging bill was only one-fifth of the average cellular bill.[441] However, mobile telephony providers are offering more and more minutes per month for smaller increases in price.[442] Paging operators will face even greater competition as mobile telephony operators add mobile data services such as Internet access to their existing voice offerings.[443] Paging carriers, however, tend to view the Internet as an asset in their restructuring efforts, as many have begun to integrate the Internet into their products in order to compete in the mobile data sector.[444]

---

[434] *CellTRAC and PageTRAC: Consumer Trends for Cellular/PCS and Paging* (Conference Call Slides) The Strategis Group, Inc., Jan. 27, 2000.

[435] *Id*.

[436] *Id*.

[437] PCIA White Paper at 10-11 (citing PCS Americas U.S. Paging Operations Marketing Research and Information, *The Market Monitor Report: Insights to the Adult Paging Market*, July 1999, at 331).

[438] *CellTRAC and PageTRAC: Consumer Trends for Cellular/PCS and Paging* (Conference Call Slides), The Strategis Group, Inc., Jan. 27, 2000.

[439] *Paging Industry Execs: Don't Write Us Off Yet*, LAND MOBILE RADIO NEWS, Oct. 1, 1999, *available in* 1999 WL 6447107.

[440] Jeffrey Scott-Joynt, *Paging's Prognosis*, COMMUNICATIONS INTERNATIONAL, Nov. 1, 1999, *available in* 1999 WL 12450523 (citing Kagan World Media).

[441] *DLJ Report*, at 35.

[442] *Id*.

[443] *Id*.

[444] Jeffrey Scott-Joynt, *Paging's Prognosis*, COMMUNICATIONS INTERNATIONAL, Nov. 1, 1999, *available in* 1999 WL 12450523.

(i) Internet-Based, Two-Way Services

As discussed in the *Fourth Report*, paging/messaging companies began offering advanced services between 1995 and 1998.[445] These advanced services included text-to-speech messaging, 1.5-way guaranteed messaging, two-way messaging, and some customized information updates.[446] The paging industry expanded these advanced services during 1999 and early 2000 to include Internet-based offerings, such as e-mail and customized Web content. And, like most of the other mobile data devices on the market, many of the new advanced messaging units include integrated PDA features, such as an address book, date book, and to-do list.

BSWD, Motient, and SkyTel appear to be the furthest along in competing in the emerging mobile data sector. SkyTel began deploying its two-way network in 1995 and began offering service with the Motorola PageWriter 2000 in 1997.[447] During 1999 and 2000, the three companies began offering two-way, Internet-based mobile data services with interactive pagers made by Research In Motion.[448] Research In Motion also markets a two-way messaging service under the name Blackberry. The devices have a larger screen than most pagers and a small but full QWERTY keypad, are smaller than a cigarette pack, and cost around $400.[449] With the devices, users can send and receive Internet e-mail messages,[450] as well as receive customized information updates, such as stock quotes, news headlines, and weather reports, from a variety of content providers.[451] The devices also include standard PDA features that can be synchronized with desktop software.[452]

In an effort to transition to Internet-based services, PageMart Wireless changed its name to WebLink Wireless on December 1, 1999.[453] In October 1999, WebLink began marketing its e-Pager service; users' devices have an e-mail address instead of a telephone number.[454] During 1999, PageNet and WebLink completed the deployment of the ReFLEX 25 two-way technology in their networks and awaited the availability of ReFLEX 25-compatible end user devices from equipment manufacturers Motorola and Glenayre. Before their network upgrades were complete and devices available, both PageNet and WebLink resold SkyTel's two-way services. In February 2000, both companies began offering two-way

---

[445] *See Fourth Report*, 14 FCC Rcd at 10185-10189.

[446] *See id*. at 10180-10191.

[447] Tom Abate, *2-Way Pagers*, SAN FRANCISCO CHRONICLE, Mar. 30, 1999, *available in* 1999 WL 2683418.

[448] *DLJ Report*, at 23-24.

[449] Om Malik, *Look Ma, No Wires*, FORBES.COM, Feb. 28, 2000, at 32.

[450] *Id*.; *DLJ Report*, at 23-24.

[451] *Id*.

[452] *DLJ Report*, at 23-24.

[453] *Analysts: WebLink Smart to Distance Itself from Paging*, FEDERAL FILINGS NEWSWIRES, Dec. 16, 1999; Gregory Twachtman, *The Future of Paging Tied to the Internet*, WIRELESS DATA NEWS, Nov. 24, 1999, *available in* 1999 WL 7899467.

[454] Bruce Brown and Marge Brown, *One-Way Wireless Web: The WebLink e-Pager is a Smart Paging Package Designed for Everyday Users*, PC MAGAZINE, Jan. 18, 2000, *available in* 2000 WL 2065041.

services over their own networks.[455] A summary of the advanced messaging services offered by BSWD, Motient, SkyTel, PageNet, WebLink, Vodafone, and other carriers can be found in Table 14 in Appendix C.

To strengthen their Internet-based, advanced messaging products, several paging companies formed partnerships with Internet content providers, ISPs, and PC manufacturers during the past year. Some analysts believe that converging with the Internet is what will help the paging/messaging industry remain viable.[456] WebLink, for example, offers specialized content to e-Pager subscribers from several Internet sites, including Yahoo!, MSN.com, HitMeNow.com, BlueLight.com, and LynkUs.com.[457] Motient formed an alliance with GoAmerica Communications Corp, a leading wireless Internet service and content provider. GoAmerica's Go.Web service includes access to corporate intranets and personalized Web-clipped content such as stock, news, travel, sports, and weather updates.[458] eBay initiated a one-way service through which SkyTel's customers can receive auction updates notifying them when they have won an auction, been outbid, or sold an item. eBay hopes to make the service two-way in the future.[459]

In February 2000, PSINet, a leading business ISP, bought a 9.9 percent stake in Metrocall. Metrocall, PSINet, and two other companies that invested in Metrocall agreed to form a joint venture called Inciscent that will offer services such as Internet access, paging, two-way wireless data, and e-mail hosting to small office/home office ("SOHO") and medium-sized business customers.[460]

In addition to offering Internet-based and two-way services, industry analysts and players believe that paging companies will become important providers of commercial telemetry services.[461] Wireless

---

[455] *PageNet Launches 2-WayPlus on Its Own Advanced Wireless Data Network*, News Release, Paging Network, Inc., Feb. 2, 2000; *WebLink Wireless Reports Fourth Quarter Results; Company Receives First Wireless Data Subscriber Devices This Week as the Network Stands Ready*, News Release, WebLink Wireless, Inc., Feb. 2, 2000.

[456] Chuck Holt, *Paging: Phoenix or Dodo?*, WIRELESS REVIEW, Jan. 1, 2000, *available in* 2000 WL 7119045.

[457] Antony Bruno, *Paging Carriers Court Information Partnerships*, RCR RADIO COMMUNICATIONS REPORT, Oct. 25, 1999, *available in* 1999 WL 28240961; *e-pager Makes National Debut for Holidays as PageMart Wireless Combines Paging and the Internet*, PR Newswire, Oct. 22, 1999; *WebLink Wireless Partners With LynkUs.com to Provide Internet Content To Consumers On-the-Go*, News Release, WebLink Wireless, Inc., Apr. 4, 2000; *HitMeNow.com Brings Hot Deals to WebLink Wireless Customers; Service Offers Personalized Discount Notification*, News Release, WebLink Wireless, Inc., Apr. 17, 2000; *WebLink Wireless to Offer Wireless Products and Services Online Through Kmart Solutions and BlueLight.com*, News Release, WebLink Wireless, Inc., Mar. 13, 2000.

[458] *GoAmerica Offers Wireless Web Access Via American Mobile; Wireless Network Provider American Mobile to Resell Go.Web Service*, BUSINESS WIRE, Oct. 5, 1999.

[459] Jennifer Lee, *Paging All eBay Fanatics*, FORT WORTH STAR-TELEGRAM, Aug. 25, 1999, *available in* 1999 WL 23945915.

[460] *PSINet and Hicks, Muse, Tate & Furst Make Significant Investment in Metrocall*, News Release, Metrocall, Inc., Feb. 3, 2000.

[461] Analysts at Kagan World Media, Frost & Sullivan, Strategic Analytics, Donaldson Lufkin & Jenrette, as well as Glenayre, Motorola, and other paging companies have touted telemetry as an important product for the (continued….)

telemetry is the use of wireless technology by companies to monitor equipment in remote locations.[462] Telemetry transmissions work well over paging and narrowband spectrum as they are short and low cost, and require devices that are highly reliable and have a long battery life.[463] One analyst believes telemetry represents a substantially larger market than the consumer advanced messaging services that compete with broadband mobile phone services.[464] *See* Section II.B.5.b, *infra*, for a more complete discussion of telemetry services.

(ii) Common Standards

In 1999, an alliance of ten leading paging companies, including Glenayre, Motorola, PageNet, WebLink, and SkyTel, agreed to adopt a wireless transport communication protocol ("WTCP") that gives messaging devices a common interface with the Internet.[465] The protocol prevents the fragmentation that could develop if different industry players offered different products and services that did not work with each other. It also ensures that application developers will have a large enough market for their advanced messaging, e-commerce, and telemetry products to make their investments profitable.[466] WCTP has not yet been made compatible with WAP,[467] but analysts and companies believe that doing so would be advantageous to paging companies, as it would allow them to integrate the numerous applications currently being developed for WAP.[468] The Personal Communications Industry Association ("PCIA"), the trade association of the paging/messaging industry, approved WTCP in December 1999.[469]

(Continued from previous page)
paging industry. *See* Brian O' Connell, *"Mobile Mentality" Drives Paging/Messaging Market – Report*, NEWSBYTES NEWS NETWORK, Sept. 24, 1999, *available in* 1999 WL 20020275; *US Paging Penetration to Level Off in 2002, Says Report*, TELECOMWORLDWIRE, Nov. 19, 1999; *The Global Wireless Communications Industry*, Donaldson, Lufkin & Jenrette, Summer 1999, at 33-39. Chuck Holt, *Paging: Phoenix or Dodo?*, WIRELESS REVIEW, Jan. 1, 2000, *available in* 2000 WL 7119045; M. Major, *The Changing Face of Paging*, MOBILE RADIO TECHNOLOGY, Sept. 30, 1999, *available in* 1999 WL 10200127; Jeffrey Scott-Joynt, *Paging's Prognosis*, COMMUNICATIONS INTERNATIONAL, Nov. 1, 1999, *available in* 1999 WL 12450523.

[462] *See Fourth Report*, 14 FCC Rcd at 10275.

[463] Sylvia Dennis, *US Paging to Peak at 21 Percent Penetration in 2002 – Report*, NEWSBYTES NEWS NETWORK, Nov. 18, 1999, *available in* 1999 WL 29943161.

[464] Dennis Leibowitz et al, *The Global Wireless Communications Industry*, Donaldson, Lufkin & Jenrette, Summer 1999, at 33-39.

[465] Gregory Twachtman, *Paging Carriers United in More Ways than One*, WIRELESS DATA NEWS, Jan. 5, 2000, *available in* 2000 WL 7382423

[466] Gregory Twachtman, *Paging Will Be Laid to Rest without Advanced Messaging*, WIRELESS DATA NEWS, Dec. 8, 1999, *available in* 1999 WL 7899471.

[467] For a further discussion of WAP, *see* Section II.B.2.b(i), *supra*.

[468] Gregory Twachtman, *Paging Will Be Laid to Rest without Advanced Messaging*, WIRELESS DATA NEWS, Dec. 8, 1999, *available in* 1999 WL 7899471.

[469] *Id*.

(iii) Consolidation

There were two key acquisitions in the paging industry during 1999: Arch/PageNet and WorldCom/SkyTel.[470] In addition, Metrocall announced its plans to acquire NationPage from AT&T in February 2000. NationPage was once the paging subsidiary of Vanguard Cellular, a company acquired by AT&T in May 1999, and is a leading regional paging/messaging provider in Pennsylvania, New Jersey, and New York.[471] The paging industry views consolidation as a way to compete more effectively with wireless phone operators, decrease costs, and increase interoperability.[472]

Arch/PageNet. In November 1999, the second largest paging company, Arch,[473] announced its plans to acquire PageNet, the nation's largest paging operator. The Commission approved the companies' transfer of licenses in April 2000.[474] In order to expedite the merger, PageNet filed for Chapter 11 bankruptcy protection on July 24, 2000.[475] The merger is expected to close by the third quarter of 2000.[476] Arch/PageNet will be the largest U.S. paging company, with 35 percent of the 50 million subscribers.[477] As part of the merger agreement, PageNet will spin off its wireless data subsidiary, Vast Solutions.[478] Vast Solutions was formed in January 1999 to develop mobile data services and applications, especially integrated products that large corporations could use to link their employees to intranets and internal databases.[479]

WorldCom/SkyTel. On October 1, 1999, WorldCom completed its acquisition of SkyTel.[480] While many large telecommunications companies had been divesting their paging units and many of the recent paging mergers had been horizontal, the WorldCom/SkyTel merger was an exception to both of those trends.[481]

---

[470] Wireless Telecommunications Bureau and International Bureau Grant Consent for Transfer of Control of Licenses of Skytel Communications, Inc. to MCI WorldCom, Inc., *Public Notice*, DA 99-1711 (rel. Aug. 25, 1999).

[471] *Metrocall Acquires NationPage from AT&T Wireless*, News Release, Metrocall, Inc., Feb. 3, 2000.

[472] Chuck Holt, *Paging: Phoenix or Dodo?*, WIRELESS REVIEW, Jan. 1, 2000, *available in* 2000 WL 7119045.

[473] Arch became the second largest paging company after it acquired MobileMedia in June 1999.

[474] *Arch, PageNet Receive Approval to Transfer Control of Licenses in Merger*, PR NEWSWIRE, Apr. 27, 2000.

[475] *PageNet Initiates Voluntary Reorganization Under Chapter 11 in Effort to Expedite Arch Merger*, Paging Network, Inc., News Release, Jul. 24, 2000.

[476] Paging Network, Inc., Form 10-Q, Mar. 31, 2000.

[477] *Paging Network To Miss Interest Payments*, DOW JONES NEWS SERVICE, Jan. 27, 2000.

[478] Lee Conrad, *Paging Makes News in Quiet Market*, HIGH YIELD REPORT, Jan. 31, 2000, *available in* 2000 WL 3903519.

[479] *Paging Network To Miss Interest Payments*, DOW JONES NEWS SERVICE, Jan. 27, 2000.

[480] Matt Moore, *SkyTel Shareholders Approve MCI WorldCom Buy of Paging Company*, ASSOCIATED PRESS NEWSWIRES, Sept. 29, 1999.

[481] About a month before WorldCom announced its acquisition of SkyTel, Company Sleuth (a Web site that delivers customized information about companies) discovered that WorldCom had registered domain names (continued….)

Aside from its investment in Metricom,[482] WorldCom's only mobile wireless asset is SkyTel. Analysts believe WorldCom recognized the trend towards Web-based, wireless advanced messaging products and SkyTel's potential to serve that market. SkyTel also allows WorldCom to bundle those products with its other telecom offerings.[483]

c. Conclusion

In the previous CMRS Competition Reports, the Commission concluded that the paging segment of the CMRS industry was highly competitive. Despite the recent merger of the largest and second-largest paging companies, the Commission continues to believe that the paging/messaging industry is highly competitive for a number of reasons. First, there is still an average of 30 paging licensees serving each of the 25 largest cities in the United States (not including resellers) and an average of 10 paging licensees serving each of the 25 smallest MSAs.[484] Second, the spectrum capacity held by these firms should be sufficient to ensure they can provide meaningful competition.[485] Third, switching costs for consumers remain relatively low. Fourth, as discussed above, paging carriers are facing strong competition from other sectors of the wireless industry.

Analysts consistently agree that paging's future is in advanced services, including two-way and Internet-based products, [486] and that the industry currently has a window of opportunity in which to retain its current one-way customers by offering them advanced services before user-friendly, WAP-based Internet access technology becomes widespread on mobile telephone handsets and other devices.[487]

4. Other Handheld Devices

Several PDAs, also referred to as handheld devices or palm pilots, now offer users a wireless connection to the Internet, either through a built-in wireless modem or a separate wireless modem card. The three categories of wireless handheld devices discussed below are: 1) the Palm devices made by Palm, Inc.; 2)

(Continued from previous page)
combining the names of the two companies. At that time, WorldCom denied it was purchasing SkyTel. Dinah Wisenberg Brin, *New Life for Infonautics after 'Near Death Experience,'* DOW JONES NEWS SERVICE, Nov. 4, 1999.

[482] *See* Section II.B.5.a, *infra*, for a discussion of Metricom.

[483] Dennis Leibowitz et al, *The Global Wireless Communications Industry*, Donaldson, Lufkin & Jenrette, Summer 1999, at 33-39.

[484] RCR Publications, RCR'S 1999 PAGING DATABASE, 1999.

[485] *See, e.g.*, Letter from Kathryn A. Zachem, Wilkinson Barker Knaur LLP, Capacity Analysis of Arch's and PageNet's Competitors in 30 of the Top 100 Urban Areas in the U.S., Ex Parte Presentation, Paging Network, Inc., Arch Communications Group, Inc., WT Docket No. 99-365, DA 99-3028 (Feb. 23, 2000).

[486] Antony Bruno, *Paging Poised for Two-Way*, RCR RADIO COMMUNICATIONS REPORT, Jan. 10, 2000, *available in* 2000 WL 9539726 (citing the Yankee Group).

[487] *See Number of One-Way Paging Subscribers Will Plummet to Fewer than 38 Million by 2004, The Strategis Group Reports*, PR NEWSWIRE, Nov. 30, 1999; Gregory Twachtman, *Paging Will Be Laid to Rest without Advanced Messaging*, WIRELESS DATA NEWS, Dec. 8, 1999, *available in* 1999 WL 7899471 (citing The Strategis Group, Inc.).

the various Pocket PC and Windows CE devices; and 3) the recently-unveiled Proton made by Research in Motion.[488] The Palm VII, the most advanced of the devices made by Palm Inc., was the first PDA to connect directly to the Internet wirelessly without an external device.[489] Because of this innovation and because Palm Inc. claims a large share – 73 percent – of the total PDA market, our discussion of wireless handhelds initially focuses on the Palm VII. The devices in the second category run Microsoft's Windows CE or newer Pocket PC operating system and can connect to the Internet via a separate wireless modem card or Internet-ready mobile phone. The third category includes only the Proton, which, like the Palm VII, can establish a wireless connection to the Internet through a built-in modem.

Palm Inc. Devices. Palm Inc. currently manufactures two handheld devices that can connect to the Internet wirelessly. Both contain all of the basic PDA features such as an address book, date book, note pad, calculator, expense record, and data storage. Users of the Palm V can access the Internet by attaching a separate wireless modem, but the Palm VII has a built-in antenna and wireless connection to the Internet. In addition, in April 2000, Palm Inc. announced it was planning to sell new versions of the Palm III and Palm V with the built-in wireless connection of the Palm VII.[490]

Users of the two Palm devices discussed above can access the Internet using a technology called "Web clipping." Web clipping allows the Palm devices to display small amounts of text information from Internet sites that have been specially designed for the proprietary Palm platform. There are over 250 Web clipping applications that Palm users can download from companies such as MapQuest, the Wall Street Journal, Starbucks, and Travelocity. Users can access information from these sites but cannot surf beyond them.[491] While data transfer rates are slow, about 8 kbps, Palm Inc. will cache some content for its users, meaning that it will hold and constantly update Web-clipped sites that a user visits frequently on its servers. Thus, cached sites can be accessed faster than non-cached sites.

While Palm users can check e-mail, they can receive e-mail only that is sent to their palm.net account, not to a different, pre-existing account. However, they can send messages to any Internet e-mail address. Palm devices do not automatically notify a user when an e-mail message has been received; therefore, users must periodically dial in to check the account.

The Palm VII currently costs approximately $450,[492] and monthly connectivity charges are additional. In February 2000, Palm Inc. introduced a flat rate pricing plan for Palm Internet access of $44.95 per month for unlimited usage.[493] For $9.95 per month, users can get 50 kilobytes worth of e-mail and Internet

---

[488] *See* Appendix C, Table 15, p. C-19 for a complete overview of handheld devices that can establish a wireless connection to the Internet, either with a built-in or separate wireless modem.

[489] Leslie Hillman, *Wireless Toys Keep Internet within Reach*, SUN-SENTINEL, Dec. 10, 1999, *available in* 1999 WL 28716503.

[490] Stephanie Miles, *Palm Looks To Add Wireless to All Devices*, CNET NEWS.COM, Apr. 14, 2000.

[491] *Beyond PCs the Era of Computers that Fit in Palms and Pockets Has Begun, but Much More Lies Ahead*, FORTUNE MAGAZINE TECHNOLOGY GUIDE, Winter 2000.

[492] Om Malik, *Look Ma, No Wires*, FORBES.COM, Spring 2000, at 33.

[493] *Palm Offers Flat-Rate Wireless Access For Palm VII*, Feb. 22, 2000 <http://www.allnetdevices.com/news/0002/000222palmvii.htm>

content, or 150 screens of information.[494] For $39.95 per month, they can receive 300 kilobytes, with additional kilobytes costing 20 cents each.[495]

The Palm VII was released nationwide in the fall of 1999. Because the Palm devices connect to the network of BellSouth Wireless Data, they can be used in 260 major cities nationwide and have no roaming charges. Palm Inc. had sold a total of 5 million Palm units (including those that do not connect to the Internet) and a few thousand Palm VIIs as of the end of 1999.[496]

Pocket PC/Windows CE Devices. In April 2000, Microsoft launched its latest handheld operating system, Pocket PC.[497] Pocket PC is a more advanced version of Windows CE and includes PDA versions of many of Microsoft's desktop software applications, such as Word, Excel, and Outlook.[498] Pocket PC also includes Pocket Internet Explorer, which allows users to browse the entire Web, not Web-clipped applications as with the Palm.[499] As noted earlier, neither Windows CE nor the newer Pocket PC devices have a built-in modem. Users must therefore attach a separate wireless modem or an Internet-ready mobile phone.[500] Four companies, including Hewlett-Packard, Casio, Symbol, and Compaq, manufacture handheld devices that run Pocket PC.[501]

Proton. In April 2000, RIM unveiled its wireless PDA, called the Proton or RIM 957 Wireless Handheld.[502] The Proton has some of the same features as RIM's Blackberry Interactive Pager,[503] such as a wireless connection, a small QWERTY keypad and two-way e-mail access. However, the Proton is larger, and has a bigger screen, more memory, more advanced organizer software, and a WAP-enabled Web browser. RIM began selling the devices in May 2000 at a price of $499 with unlimited monthly

---

494 Om Malik, *Look Ma, No Wires*, FORBES.COM, Spring 2000, at 33.

495 *Id*.

496 *Beyond PCs the Era of Computers that Fit in Palms and Pockets Has Begun, but Much More Lies Ahead*, FORTUNE MAGAZINE TECHNOLOGY GUIDE, Winter 2000.

497 Todd Spangler, *Microsoft to Take Pocket PC Wireless*, YAHOO! NEWS, Apr. 17, 2000.

498 Microsoft, *Pocket PC Features*, (visited May 1, 2000) <http://www.microsoft.com/mobile/pocketpc/features/default.asp>. Pocket PC runs on new PDA devices and is not simply a software upgrade of Windows CE.

499 Microsoft, *Pocket Internet Explorer*, (visited May 1, 2000) <http://www.microsoft.com/mobile/pocketpc/features/pie.asp>.

500 Microsoft, *Pocket PC FAQ*, (visited May 1, 2000) <http://www.microsoft.com/mobile/pocketpc/faq.asp>; *Socket and PacketVideo Show How Mobile Phones Can Deliver Wireless Multimedia Web Content to PDAs Powered by Intel's StrongARM Processor*, BUSINESS WIRE, Jan. 6, 2000; *Socket's Digital Phone Cards Now Available for Sprint's PCS Network*, BUSINESS WIRE, Oct. 26, 1999.

501 Microsoft, *Who Makes Pocket PCs?* (visited May 1, 2000) <http://www.microsoft.com/mobile/pocketpc/manufacturers.asp>.

502 Stephanie Miles and Micahel Kanellos, *RIM Takes on Palm in Handheld Market*, CNET NEWS.COM, Apr. 11, 2000.

503 The Blackberry is discussed in Section II.B.3.b(i), *supra*.

Internet access costing $39. Like the Palm devices, the Proton uses BSWD's network. However, the Proton has a built-in instant messaging capability and therefore does not require users to dial-in to check their e-mail accounts.[504]

5. Miscellaneous Data Devices

There are a number of other mobile data providers and services that do not fall into the categories described above or that offer additional services not included above. These include dedicated data networks and telemetry services.

a. Dedicated Data Networks

There are a number of mobile data providers that offer only data services. Many of these networks began by initially serving vertical markets such as asset tracking and field service and have evolved to serve horizontal markets such as messaging and Internet access. Examples of dedicated data networks include Motient Network (formerly the ARDIS Network),[505] BSWD, Metricom, Inc. ("Metricom"), and Teletrac, Inc. ("Teletrac").

Motient Network is a packet-switched network offering applications such as mobile e-mail and Internet access, telemetry, transportation and package delivery, and field service.[506] It operates in the 800 MHz SMR band and had approximately 122,200 subscribers at year-end 1999.[507] BSWD is also a packet-switched network operating in the 900 MHz band that primarily offers field service and dispatch applications.[508] In addition, BSWD provides the network over which the Palm VII accesses the Internet.[509]

Metricom offers packet-switched services using 900 MHz and 2.4 GHz unlicensed spectrum, as well as 2.3 GHz Wireless Communications Service ("WCS") licensed spectrum. As of the end of 1999, Metricom was offering Ricochet Wireless Internet service ("Ricochet") in a few metropolitan areas and several airports and college campuses.[510] Ricochet basic service costs $29.95 per month for unlimited Internet access from a laptop through a Ricochet wireless modem and an e-mail account. In June 1999,

---

[504] Stephanie Miles and Micahel Kanellos, *RIM Takes on Palm in Handheld Market*, CNET NEWS.COM, Apr. 11, 2000.

[505] *Motient Marks 10th Anniversary of the Beginning Of the Largest Wireless Data Network in the Country*, PR NEWSWIRE, June 26, 2000.

[506] *Motient Marks 10th Anniversary of the Beginning Of the Largest Wireless Data Network in the Country*, PR NEWSWIRE, June 26, 2000; American Mobile Satellite Corporation, Form 10-K, Dec. 31, 1998, at 2.

[507] American Mobile Satellite Corporation, Form 10-K, Dec. 31, 1998, at 13.

[508] *Strategis Mobile Data Report*, at 89.

[509] *Id*. at 93. *See* Section II.B.3.b(i), *supra*.

[510] Metricom, Inc., Form 10-K, Dec. 31, 1999, at 2.

WorldCom began reselling Ricochet.[511] As of year-end 1999, Metricom had 30,000 subscribers.[512] While Metricom currently provides data transmission speeds of 28.8 kbps, the company plans to upgrade its network and offer data speeds exceeding 128 kbps by the end of summer 2000.[513] By the end of summer 2001, Metricom plans to offer the service in 46 markets covering 100 million POPs.[514]

Teletrac offers vehicle location and two-way mobile data services to approximately 3,200 corporate customers with 70,000 vehicles.[515] It operates over licensed frequencies in the 900 MHz band.[516] Teletrac provides service in 12 metropolitan markets and recently began to provide vehicle location and two-way digital messaging to its customers using CDPD and GPS by reselling CDPD airtime purchased from cellular carriers.[517] By using other carriers' facilities, this new service allows the company to offer its services in additional markets.[518]

b. Telemetry

Some companies also use wireless technology to monitor their equipment in remote locations, generally referred to as wireless telemetry. One common example of wireless telemetry is automatic meter reading ("AMR").[519] Some utilities offer telemetry services more advanced than simple AMR. For example, Puget Sound Energy in the Seattle metropolitan area has created a two-way service that allows customers to manage their energy consumption during peak hours and control their home thermostats over the Internet.[520]

---

[511] *Metricom Reports Fourth Quarter 1999 Results; Ends Year With $18.5 Million In Revenue*, CAMBRIDGE TELECOM REPORT, Feb. 21, 2000, *available in* 2000 WL 7984233.

[512] *Id*.

[513] *Ricochet Advisory: Downtown Houston Alive With Ricochet Field Trials*, Metricom Press Release, Metricom, Inc., Apr. 6, 2000.

[514] Prospectus Supplement of Metricom, Inc., Jan. 6, 2000, at S-4. As of April 2000, the company had begun construction to offer Ricochet in 21 markets. *Metricom Reports First Quarter2000 Results Ricochet Under Construction in 21 Markets*, News Release, Metricom, Inc., Apr. 20, 2000.

[515] *Teletrac Reports Year-End and Fourth Quarter Results; Location and Data Solutions Company Reports Record Service Revenues and Further Improvements in Cash Flow*, Press Release, Mar. 1, 2000.

[516] *Strategis Mobile Data Report*, at 104.

[517] Teletrac Inc., Form 10-Q, Sept. 30, 1999.

[518] *Id*.

[519] According to CellNet, utilities pay a marginal cost of approximately $1 per unit per month for AMR, in addition to the $50 per unit in initial build out costs. Traditional meter reading has a marginal cost of about 60 cents per unit per month, but does not provide a constant stream of detailed usage data or allow for advanced monitoring and two-way interactive services. *See* Denise Culver, *Wireless Telemetry Poised for Growth*, INTERACTIVE WEEK FROM ZDWIRE, Nov. 8, 1999, *available in* 1999 WL 14630415.

[520] *United Tech Gets Thermostat Provider Pact*, DOW JONES NEWS SERVICE, Jan. 7, 2000.

Telemetry can also be used to monitor HVAC systems, gas and oil pipelines, vending machines, alarm systems, parking meters, streetlights, smoke/fire detectors, factory process systems, and photocopiers. Wireless telemetry is also used to provide a variety of vehicle tracking and location services.

The wireless telemetry market has grown since the publication of the *Fourth Report*. In the past few years, utility deregulation has prompted the growing use of AMR systems, as they increase utilities' efficiency and quality of service while lowering their costs. For example, Kansas City Power & Light has reportedly saved 100,000 trips by repair crews to customers' homes because of AMR telemetry.[521]

Both non-CMRS and CMRS providers are players in the telemetry market. The two major non-CMRS providers are CellNet Data Systems, Inc. ("CellNet") and Itron, Inc ("Itron"). See Appendix C, Table 16 for an overview of their services. Schlumberger Resource Management Systems, which provides management services to energy and utility companies, completed its acquisition of CellNet in May 2000.[522] During 1999, CellNet increased its telemetry base from two million to three million units.[523] In addition to AMR, the company provides remote monitoring for photocopiers, vending machines, parking meters, and home security systems.[524] Itron focuses exclusively on providing AMR telemetry equipment and is the leader in that market. As of December 31 1999, Itron had shipped 15.4 million AMR units, a 14 percent increase from the previous year, to over 500 utilities.[525]

Most of the current CMRS telemetry providers are paging/messaging carriers, including WebLink, SkyTel, Motient, and BSWD. As mentioned earlier, many analysts and industry players believe that the telemetry market represents a significant business opportunity for paging/messaging carriers. GTE, Omnipoint, and Metricom also offer telemetry services, and Aeris and Cellemetry, while not CMRS providers themselves, use the cellular networks of CMRS providers to offer their telemetry products.[526]

Technological developments have aided the wireless telemetry industry during the past year. For example, Telemetrix Technologies Inc., a licensed broadband PCS operator and developer of broadband PCS-based telemetry and telecommunications technologies, created and patented a method of transmitting telemetry information using SMS transmissions.[527] Motorola also released its CreataLink 2

---

[521] Bill Richards, *Watch Closely: Wireless Monitoring of Machines May Be the Quiet Star of the Cordless Future*, THE WALL STREET JOURNAL, Sept. 20, 1999, *available in* 1999 WL-WSJA 20532168.

[522] *Schlumberger Announces Acquisition of Assets of CellNet Data Systems*, News Release, Schlumberger Limited, May 16, 2000. In order for CellNet to complete the merger, the company filed a prearranged Chapter 11 bankruptcy filing and received approval for the merger from the U.S. Bankruptcy Court on May 5, 2000. *Id.*

[523] *CellNet Installs Three Millionth Device into Wireless Network*, NETWORKS UPDATE, Dec. 1, 1999, *available in* 1999 WL 11391122; *More Than Two Million Devices Now Online in CellNet Data Systems Wireless Networks*, PR NEWSWIRE, Feb. 16, 1999.

[524] *More Than Two Million Devices Now Online in CellNet Data Systems Wireless Network*, PR NEWSWIRE, Feb. 16, 1999; Bill Richards, *Watch Closely: Wireless Monitoring of Machines May Be the Quiet Star of the Cordless Future*, THE WALL STREET JOURNAL, Sept. 20, 1999, *available in* 1999 WL-WSJA 20532168.

[525] *Itron Releases Fourth Quarter and Year-End Results for 1999*, News Release, Itron, Inc., Feb. 9, 2000.

[526] *See* Appendix C, Table 16, pp. C-20 - 21 for an overview of wireless telemetry services.

[527] *Telemetrix, Inc. Issued Patent No. 64014089 for a Method of Collected and Transmitting Data Using Existing PCS and Digital Wireless Networks*, PR NEWSWIRE, Jan. 21, 2000.

XT two-way telemetry transceiver, which is based on its ReFLEX two-way messaging protocol. The transceiver can be installed on and integrated into various types of equipment, and users can connect to the transceiver via a telephone, the Internet, or Motorola's PageWriter 2000.[528]

C. Dispatch

Dispatch services allow two-way, real-time, voice communications between mobile units and fixed units (*e.g.*, between a taxicab dispatch office and a taxi) or between two or more mobile units (*e.g.*, between a car and a truck). Typical users of dispatch services include service and delivery companies whose operations require their employees to communicate with each other on a private (one-to-one) or group (one-to-many) basis. Dispatch networks can also be designed to interconnect with the PSTN. Dispatch service is provided on both a CMRS and PMRS basis. It can be characterized as falling into three primary segments. First, "trunked dispatch" includes firms offering on a commercial basis both one-to-one and one-to-many calling services on trunked systems[529] employing either analog or digital network architectures. These services are provided primarily by carriers operating at 800 MHz, 900 MHz, and 220 MHz, but also by qualified private land mobile operators.[530] Note that as one part of trunked dispatch, some dispatch service offered in the 800 MHz and 900 MHz bands is referred to as Specialized Mobile Radio (SMR) service.[531] Second, "traditional dispatch" is non-interconnected, non-CMRS, dispatch service provided on a for profit basis.[532] Third, "private dispatch" refers to in-house systems operated by companies and state and local governments solely for their internal communications needs in support of their own business operations.[533] According to one analyst, there were approximately 16.2 million private dispatch users in the United States as of year-end 1999.[534] However, this report will limit

---

[528] *Motorola's CreataLink 2 XT Two-Way Data Transceiver Can Provide Wireless Communications between Devices and People*, CAMBRIDGE TELECOM REPORT, Sept. 13, 1999, *available in* 1999 WL 8104202.

[529] Trunking allows for the automatic sharing of multiple radio channels. Trunking is much more spectrally efficient because switching between multiple radio channels allows less blocking and it provides service to more radios per channel. On a 20-channel conventional system, for example, roughly 700-1,000 users can be served. In contrast, those 20 channels on a trunked, dispatch-type system can service between 2,000 and 2,500 users. International Mobile Telecommunications Association, *What is Commercial Trunked Radio?* (visited Feb. 8, 2000) < http://www.imta.org/ctr.html>

[530] These definitions are set forth in: *Applications of Various Subsidiaries and Affiliates of Geotek Communications, Inc., and Wilmington Trust Company or Hughes Electronics Corporation, and Applications of Wilmington Trust Company or Hughes Electronics Corporation and FCI 900, Inc., For Consent to Assignment of 900 MHz Specialized Mobile Radio Licenses*, 15 FCC Rcd 790 (WTB, 2000) ("*Geotek Order*"). This WTB Order alters terminology from, but otherwise employs the same market definitions as, the Bureau order: In re Applications of Pittencrieff Communications, Inc. Transferor and Nextel Communications, Memorandum Opinion and Order, 13 FCC Rcd 8935 (1997).

[531] *See* 47 C.F.R. § 90.7.

[532] Some dispatch services may be offered on a for-profit basis and may be classified as PMRS provided that these systems are not interconnected to the PSTN. *See First Report*, 10 FCC Rcd at 8861-8863.

[533] Some of these licensees also offer for profit dispatch services to other customers.

[534] *Strategis Dispatch Report*. Approximately 10 percent of those users are interconnected to the PSTN. *US Dispatch Market* (Conference Call Slides), The Strategis Group, Inc., Feb. 2, 2000, at 4.

its discussion of dispatch services primarily to trunked and traditional dispatch. In addition, because industry sources often provide data using a digital/analog distinction, we will sometimes use that breakdown for purposes of this report.[535]

1. Commercial Dispatch Market Structure and Performance

One analyst finds that in 1999 the commercial dispatch industry's total subscribership increased by 30 percent from 4.6 million in 1998 to 6.0 million,[536] and that of the 1999 total, approximately 1.6 million, or slightly more than 25 percent, were analog dispatch subscribers.[537] This total includes all Nextel subscribers. Nextel's primary service offering, however, is essentially a bundle of services in at least two markets, mobile voice and trunked dispatch. Thus, all Nextel subscribers should not be counted in the dispatch sector, and estimates of the dispatch sector that include all Nextel subscribers overstate the size and concentration of that sector. In addition, Nextel's Direct Connect® service option itself may be seen as providing more than trunked dispatch, because to some degree it is a substitute for mobile voice features such as speed dialing and conference calling. Thus, estimates of dispatch that employ some pro-ration of Nextel subscribers based on use of the Direct Connect® service option are inappropriate as well.[538]

While nationwide, summary measures are unavailable, it is nonetheless true that local trunked dispatch markets are generally concentrated.[539] However, firms providing this service face considerable competitive pressures because their customers possess numerous competitive options. For some trunked dispatch users, traditional dispatch services are likely to be a viable competitive alternative. For large users, owning and operating private, internal radio systems may be a competitive alternative. For some users, data dispatch service will constitute an effective alternative. And finally, as further discussed below, cellular and PCS firms are beginning to provide price/service plans that are similar to Nextel's mobile voice plus Direct Connect® service offering. Collectively, the various options available to consumers should promote competitive performance in trunked dispatch.[540]

Focusing on SMR providers without regard to the particular service markets involved, Nextel possesses by far the largest subscriber base. Using its iDEN technology, Nextel provided service to roughly 4.5 million digital subscribers at the end of 1999, 62 percent more than the 2.8 million it served at the end of 1998.[541] With 292,000 analog subscribers,[542] Nextel's share of the analog dispatch market continues to

---

[535] The Strategis Group estimates that 88 percent of digital subscribers are interconnected while only 15 percent of analog subscribers are. THE STRATEGIS GROUP, INC., PRIVATE RADIO MARKETS & USER TRENDS: 1999 (1999), at 131 *See also Strategis Dispatch Report* ("Strategis distinguishes between analog and digital SMR").

[536] *See* The Strategis Group, Inc., "Dispatch Service in a Competitive Market," Presentation at AMTEX'98 Conference & Exposition, Nov. 13, 1998: *Strategis Dispatch Report*.

[537] *See* Appendix D, Table 3, p. D-3.

[538] *Geotek Order*, at ¶¶ 27, 33.

[539] *Id*. at ¶ 33.

[540] *Id*. at ¶¶ 34-38.

[541] *See* Appendix D, Table 1, p. D-3.

decline, from 21 percent in 1998 to 18 percent in 1999, as a result of Nextel's continued efforts to convert its analog networks to digital networks (see *Analog Growth* and *Upper 800 MHz Band Relocation Progress* below).[543] The second largest dispatch operator in 1999 was Southern LINC, with around 200,000 digital subscribers. The third largest operator was Mobex, with 65,000 subscribers. Other significant operators include the Chadmoore Wireless Group, Inc., with 37,000 analog subscribers. In addition, there are a large number of small dispatch operators covering localized areas, with less than $5 million in annual revenues.[544]

2. Major Trends and Developments

a. Competition from the Mobile Telephony Sector

Non-SMR operators are now offering calling plans or services that attempt to provide or compete with what is considered the distinctive aspect of dispatch service: its group, or one-to-many, feature. A number of mobile telephony providers now offer plans that allow unlimited calling among members of a defined group, such as family-oriented price plans, or among all of an operator's subscribers in a defined area..[545] In September 1999, under the Cellular One brand name, SBC launched Cellular One to One, a service employing an Ericsson technology enabling subscribers to make conference calls with up to 30 different parties by dialing pre-programmed group numbers.[546]

b. Analog Subscribership

Analog subscribership declined slightly in 1999. This is again primarily due to Nextel's migration of its subscribers to its digital systems in the 800 MHz band. Analog subscriber growth was positive, however, in the non-800 MHz bands. While total analog subscribers in the 800 MHz band declined 4 percent in 1999, analog subscribership grew 4 percent in the 900 MHz, 39 percent in the 450 MHz, and 35 percent in the 220 MHz. As mentioned in the *Fourth Report*, this growth shows the continued demand for cheaper, dispatch-only service that is generally provided by analog operators.[547]

(Continued from previous page)

[542] *Id*. Nextel's existing analog SMR operations focus primarily on two-way radio service. Nextel Communications, Inc., Form 10-K405, Dec. 31, 1997, at 14.

[543] Nextel's analog subscribership has decreased from 583,000 at the end of 1997. *See Third Report*, 13 FCC Rcd at 19806 n.277. Nextel no longer provides a count of its analog subscribers.

[544] *Strategis Mobile Data Report*, at 72.

[545] *See* Section II.A.1.b, *supra*, for a further discussion of such plans. *See generally*, Lynnette Luna, *Group Calling Is Weapon In Wireless Wars*, RCR RADIO COMMUNICATIONS REPORT, June 28, 1999, *available in* 1999 WL 7791578.

[546] Ericsson's TDMA Pro product overlays dispatch capabilities onto existing mobile voice networks. Dispatch calls are routed to the server, which, in turn, simultaneously contacts members of predefined dispatch groups, eliminating the sequential calling delays characteristic of discount billing plans. *Ex Parte* Letter from Lauren H. Kravetz, Commercial Wireless Division, to Magalie Roman Salas, Secretary, Federal Communications Commission, filed Nov. 2, 1999, cited in *Geotek Order*.

[547] *See* Lynette Luna, *Analog Dispatch Still a Viable Growth Business, Say Operators*, RCR, Oct. 19, 1998, at 15-16. Chadmoore Wireless Group, Inc., for example, is building a nationwide analog SMR network. According to Chadmoore COO Jan Zwaik, "We want to remain analog . . . our vision is to provide cost-effective service." Lynette (continued….)

c. 220 MHz Service

Licensees authorized in the Phase II 220 MHz Service are permitted to provide voice, data, paging, and fixed communications.[548] On October 22, 1998, the Commission completed the Phase II 220 MHz auction,[549] raising $21 million.[550] A second auction of FCC-held licenses began on June 8, 1999, and closed on June 30, 1999.[551] The second auction offered a total of nine licenses in four Economic Area Groups ("EAGs") and 216 licenses in 87 Economic Areas ("EAs"). The number of licenses available in each EA ranged from one to five, while the number of licenses available in each EAG ranged from two to three. No nationwide licenses were available in this auction.[552] The auction raised over $1.9 million, almost all from the top five bidders.[553]

A supplier of 220 MHz equipment, Datamarine International, Inc. (selling its equipment through its wholly owned subsidiary, SEA, Inc.), expects the build-out of the 220 MHz band to increase demand for its products.[554] The company says it expects to ship large quantities of 220 MHz radios beginning in the third quarter of fiscal 2000.[555]

(Continued from previous page)
Luna, *Analog Dispatch Still a Viable Growth Business, Say Operators*, RCR, Oct. 19, 1998, at 15. The capital costs per subscriber associated with digital technology are substantially higher than those for analog systems. Chadmoore Wireless Group, Inc., Form 10QSB/A, filed Nov. 25, 1998. *Strategis Mobile Data Report*, at 72.

[548] Federal Communications Commission, *220 MHz Fact Sheet* (last modified Jan.7, 1999) <http://www.fcc.gov/wtb/auctions/220/220fact.html>.

[549] *See* Phase II 220 MHz Service Auction Closes: Winning Bidders in the Auction of 908 Phase II 220 MHz Service Licenses, *Public Notice*, DA 98-2143 (rel. Oct. 23, 1998).

[550] *See* Appendix A, Tables 1A and 1B, pp. A-2 - A-4 for a summary of the auction.

[551] Phase II 220 MHz Service Spectrum Auction Scheduled for June 8, 1999; Application Filing Deadline Set for May 10, 1999; Comment Sought on Reserve Prices or Minimum Opening Bids and Other Auction Procedures, *Public Notice*, DA 98-2386 (rel. Nov. 24, 1998). *See also* Phase II 220 MHz Service Spectrum Auction; Notice and Filing Requirements for Auction of Phase II 220 MHz Service Spectrum Scheduled for June 8, 1999, *Public Notice*, DA 99-474 (rel. Mar. 8, 1999); Phase II 220 MHZ Service Spectrum Auction Closes; Winning Bidders in the Auction of 225 Licenses in the Phase II 220 MHZ Service, *Public Notice*, DA 99-1287 (rel. July 1, 1999).

[552] Federal Communications Commission, *220 MHz Fact Sheet (Auction #24)* (visited Feb. 17, 2000) <http://www.fcc.gov/wtb/auctions/auc24/auc24fct.html>.

[553] *See* Appendix A for summaries of auction winners.

[554] Datamarine International Inc., Form 10-QSB, Feb. 15, 2000.

[555] *Id.*

d. Upper 800 MHz Band Relocation Progress

On December 8, 1997, the Commission completed an auction for the upper 200 channels in the 800 MHz SMR band.[556] The license holders from that auction are permitted to relocate incumbent licensees to comparable spectrum.[557] FCC rules provide for a one-year voluntary negotiation period, followed by a one-year mandatory negotiation period between incumbent licensees and the new EA licensees. Ultimately, the incumbent operators face forced relocation if the new licensee so desires. The voluntary negotiation period ended on December 4, 1999.[558]

The largest of the upper 800 MHz licensees, Nextel, has reported little conflict so far in its discussions of relocation with incumbents, with only ten licensees indicating they were not interested in discussing relocation voluntarily.[559] Of all the approximately 400 negotiations completed during the voluntary period, about two-thirds resulted in Nextel acquiring the licenses held by incumbents, and one-third resulted in the incumbents' systems being retuned to other frequencies. Those 800 Mhz licensees that have been relocated had their systems retuned almost exclusively within the 800 MHz band.[560] Nextel has indicated that it is more interested in moving systems than in purchasing them during the non-voluntary period.[561]

The Commission has scheduled two more 800 MHz SMR auctions in August and November 2000. In the SMR 800 MHz General Category auction 1,050 licenses will be available in the 851-854 MHz band, and in the SMR 800 MHz Lower 80 Channels auction 2,800 licenses will be available in the 856-860 band.[562]

---

[556] 800 MHz SMR Auction Closes, Winning Bidders In The Auction of 525 Specialized Mobile Radio Licenses, *Public Notice*, DA 97-2583 (rel. Dec. 9, 1997).

[557] 47 C.F.R. §90.699.

[558] Wireless Telecommunications Bureau Announces the Commencement of the Voluntary Negotiation Period for the Relocation of Incumbent Licensees in the 800 MHz Band, *Public Notice*, DA 98-2434 (rel. Dec. 4, 1998). License winners are required to contact the incumbents by March 4, 1999, to begin negotiations.

[559] Caron Carlson, *Pressures Growing For 800 MHz Incumbents*, WIRELESS WEEK Dec. 13, 1999, at 14-15. Nextel says that the total number of incumbents at stake is close to 1,000. *Id*.

[560] In July, the Commission granted 50 waivers permitting Nextel to utilize Part 90 PLMRS Business channels for CMRS operations for the purpose of relocation of upper 200 channel incumbent licensees. *Nextel Communications, Inc. Requests for Waiver of 47 C.F.R. §§ 90.617(c) and 90.619(b)*, Order, DA 98-2206 (rel. July 21, 1999).

[561] Caron Carlson, *Pressures Growing For 800 MHz Incumbents*, WIRELESS WEEK, Dec. 13, 1999, at 14-15. According to to Geoffrey Stearn, Nextel's director of corporate strategy, "As we get into the non-voluntary period, we're really de-emphasizing acquisition." Caron Carlson, *Pressures Growing For 800 MHz Incumbents*, WIRELESS WEEK, Dec. 13, 1999, at 14-15.

[562] Auction of Licenses for 800 MHz Specialized Mobile Radio (SMR) Service in the General Category Band (851-854 MHz) and Upper Band (861-865 MHz), *Public Notice*, DA00-1100 (rel. May 18, 2000); Auction of Licenses for 800 MHz Specialized Mobile Radio (SMR) Frequencies in the Lower 80 Channels, *Public Notice*, DA 00-1388 (rel. June 23, 2000). In the August auction three additional licenses will be available in the 800 MHz Upper Band (861-865 MHz). *See* Auction of Additional Licenses for 800 MHz Specialized Mobile Radio (SMR) Service To be Included in Auction No. 34 Scheduled for August 23, 2000, *Public Notice*, 15 FCC Rcd 7275 (2000).

e. Geotek Bankruptcy and Nextel

Geotek Communications, Inc. ("Geotek"), an SMR operator that used its own patented technology in the 900 MHz band to provide a range of telecommunications services to small- and medium-size businesses with mobile fleets of vehicles, filed for Chapter 11 bankruptcy protection on June 29, 1998.[563] Although it originally planned to reorganize, Geotek announced in October 1998 that it was shutting down its SMR operations.[564]

On February 12, 1999, Geotek's creditors selected Nextel to buy all 191 of its 900 MHz licenses[565] for $150 million, pending regulatory approval.[566] Four days later, Nextel and Geotek received permission for the transaction from the Delaware Bankruptcy Court.[567]

However, Nextel was subject to a 1995 Consent Decree it signed with the Department of Justice settling an antitrust lawsuit.[568] The Consent Decree limited the number of licenses Nextel could acquire in the

---

[563] Geotek Communications, Inc., Form 10-K, Dec. 31, 1996, at 2. In addition to traditional mobile telephone and one-to-many dispatch services, Geotek also offered a range of mobile messaging, mobile data and vehicle location services. Geotek Communications, Inc., Form 10-K, Dec. 31, 1996, at 3. As recently as January 1998, Geotek was operating in 11 markets and had 15,151 subscribers. *Geotek Reports Year End Subscriber Growth*, News Release, Geotek Communications, Inc., Feb. 5, 1998. By June 1998, however, Geotek had insufficient cash to fund operations. *Geotek to Cease Operations Later This Month*, WIRELESS TODAY, Oct. 2, 1998, *available in* 1998 WL 17661227.

[564] *Geotek to Cease Operations Later This Month*, WIRELESS TODAY, Oct. 2, 19982, 1998, *available in* 1998 WL 17661227.

[565] Geotek's licenses cover a potential market population of 200 million people and include a number of major metropolitan areas: Atlanta; Birmingham, Ala.; Boston; Charlotte, N.C.; Cincinnati, Ohio; Milwaukee, Wis.; New York City; Philadelphia; Portland, Ore.; Richmond, Va.; Washington, D.C.; Jacksonville and Miami, Fla.; San Antonio, Houston and Dallas, Texas; Spokane and Seattle, Wash.; and Tulsa and Oklahoma City, Okla. *Nextel To Acquire Geotek's Licenses For $150 Million*, COMMUNICATIONS TODAY, Feb. 16, 1999, *available in* 1999 WL 6503548; Federal Communications Commission, *Final Results for All Markets (Excel Ver. 4)* (visited Mar. 22, 1999)<http://www.fcc.gov/wtb/auctions/smr/7markets.xls>.

[566] *Nextel Requests Lift of Consent Decree to Buy Geotek's 191 900 MHz Licenses for $150 Million*, LAND MOBILE RADIO NEWS, Feb. 19, 1999, *available in* 1999 WL 6446839. Other bidders included Mobex Communications, Chadmoore Wireless Group, Industrial Communications & Electronics Inc., Southern Co., and FleetTalk Partners. Jeffrey Silva, *Geotek Bankruptcy Sale Reset for Tuesday*, RCR RADIO COMMUNICATIONS REPORT, Feb. 15, 1999, *available in* 1999 WL 7790238. Nextel agreed to pay $131 million for the licenses that were subject to the consent decree and $19 million for those not subject to the decree. Jeffrey Silva, *Nextel Sues To Lift Decree; Bank Ruptcy Judge Approves Geotek Spectrum Sale*, RCR RADIO COMMUNICATIONS REPORT, Feb. 22, 1999, *available in* 1999 WL 7790306.

[567] *Nextel Requests Lift of Consent Decree to Buy Geotek's 191 900 MHz Licenses for $150 Million*, LAND MOBILE RADIO NEWS, Feb. 19, 1999, *available in* 1999 WL 6446839.

[568] *See United States v. Motorola, Inc. and Nextel Communications, Inc.*, 1995 WL 866794 *3 (D.D.C. 1995) ("*United States v. Motorola")*. Specifically, the Consent Decree enjoins Nextel, *inter alia*, from holding or acquiring licenses for more than thirty 900 MHz channels in Boston, Massachusetts; Chicago, Illinois; Dallas and Houston, Texas; Denver, Colorado; Los Angeles and San Francisco, California; Miami and Orlando, Florida; New York, New York; Philadelphia, Pennsylvania; and Washington, D.C. In addition, Nextel is enjoined from holding or (continued….)

top 15 U.S. markets. The following day, Nextel filed suit in the U.S. District Court for the District of Columbia to lift the Consent Decree limiting its holdings in the 900 MHz band.

On March 5, 1999, Geotek filed applications jointly with its creditors seeking Commission consent to assign its licenses to its primary secured creditors, Wilmington Trust Company and Hughes Electronics Corporation (collectively, the "creditors").[569] On March 9, 1999, the creditors and FCI 900, Inc. ("FCI 900"), a wholly owned subsidiary of Nextel, filed applications with the Commission seeking consent to assign all of these licenses to FCI 900.

In June 1999, Nextel and DOJ reached a settlement that provided for the Consent Decree to terminate in October 2000. On December 16, 1999, the U.S. District Court for the District of Columbia accepted the settlement; as a result, the Consent Decree remains in effect until October 2000.[570] On December 17, 1999, Nextel requested that it be permitted to withdraw the applications to assign to FCI 900 the licenses covered by the Nextel Consent Decree.[571]

On January 14, 2000, the Wireless Telecommunications Bureau ("Bureau") granted applications for the assignment of licenses from the bankruptcy estate of Geotek to the creditors, the further assignment of licenses in markets not covered by the Consent Decree from the Creditors to FCI 900, and the request to withdraw the FCI 900 applications for the Consent Decree licenses.[572] On August 4, 2000, the Bureau granted consent for Neoworld License Holdings, Inc. ("Neoworld") to acquire from the creditors the former Geotek licenses that Nextel cannot acquire as long as the current Consent Decree with DOJ remains in force.[573]

III. CONCLUSION

Several key trends have marked the year since the release of the *Fourth Report*. First, during 1999 mobile telephone subscribership increased by 24 percent and average MOUs increased by 38 percent, while, according to the Bureau of Labor Statistics, the price of mobile telephone service fell by 11.3

(Continued from previous page)
acquiring licenses for more than ten 900 MHz channels in Detroit, Michigan and Seattle, Washington, and from acquiring additional channels in Atlanta, Georgia. Further, Nextel is prohibited from holding or acquiring, either directly or indirectly, more than a five percent ownership interest in any corporation or entity that owns, controls, or manages, directly or indirectly, 900 MHz channels in these cities and from entering into new management agreements for 900 MHz channels in these cities. *Id.*

[569] *See* Geotek Communications Seeks FCC Consent to Assign 900 MHz SMR Licenses, *Public Notice*, DA 99-1027 (rel. May 28, 1999).

[570] *United States v. Motorola*, Civil No. 94CV2331 (TFH) (D.D.C. Dec. 16, 1999) (Memorializing Order).

[571] *See* Letter to Terry Fishel, Deputy Chief, Licensing and Technical Analysis Branch, Wireless Telecommunications Bureau, Federal Communications Commission, from James Wheaten, Manager, Compliance, Nextel, dated February 17, 1999.

[572] *See Geotek Order*.

[573] *See* Applications of Neoworld License Holdings, Inc., Hughes Electronics Corporation, and Wilmington Trust Company, Liquidating Trustee, for Consent to Assignment of Licenses, *Order*, DA 00-1765 (rel. Aug. 4, 2000).

percent.[574] Second, the deployment of digital technology continued unabated. At the end of 1999, 51 percent of all mobile telephone subscribers used digital phones, and 80 percent of all mobile phones sold that year were digital.[575] Third, mobile telephony providers continued to build their nationwide footprints. Among the major carriers, achieving a national presence and a nationwide infrastructure are perceived as necessary to respond to consumer demands for seamless service at reasonable prices. Fourth, the rapid development of new mobile data technologies and applications for mobile data services may set the stage for the take-off of the mobile data sector in the coming years.

Between December 1998 and December 1999, five of the top 25 operators by subscribership combined with other carriers. Furthermore, since the end of 1999, five operators in the year-end 1999 top 25 have merged with other carriers, and the merger of a fourth is currently pending before the Commission. As was the case last year, the two most prominent mergers involved large regional operators attempting to create nationwide footprints in order to compete effectively with existing nationwide operators.

Some analysts predict that the current consolidation will intensify competition among nationwide wireless providers.[576] Their reasoning is that the cost savings made possible by operating large scale wireless networks will push these carriers to extend innovative pricing plans, such as DOR-type plans, to broader segments of the market.[577] If these predictions prove correct, the consolidations will benefit consumers by reinforcing the downward trend in prices.

Indeed, there is some evidence that the addition of new nationwide operators already may be contributing to decreasing prices. For example, according to one survey, prices declined by approximately eight percent during the last six months of 1999.[578] In addition, the biggest price declines came in price plans offering 150 minutes of talk time each month, which dropped by 12 percent over the last six months of 1999.[579] This may indicate that competition is continuing to make mobile telephone services more affordable for all Americans and not just those who can afford price plans that provide 500 or 1,000 minutes per month. While estimates of average MOUs show year over year increases, perhaps most interesting is that one analyst's estimates indicate that mobile telephone customers' share of total voice MOUs has increased from 3.2 percent in 1997, to 4.5 percent in 1998, and to 7.1 percent in 1999.[580]

Moreover, it is important to emphasize that, along with the process of consolidation across geographic areas, the mobile telephone sector continues to experience heightened competition within geographic

---

[574] *See* Section II.A.1.d, *supra*.

[575] *See* Section II.A.1.b, *supra*.

[576] Mary Mosquera, *Wireless Footprint Required For Competition*, TECHWEB, (visited Oct. 8, 1999) <http://www.techweb.com/wire/story/TWB19990930S0006>.

[577] *Id.*

[578] *Econ One News Release*.

[579] *Id.*

[580] *See* Paul Kagan Associates, Inc., *Wireless Share of Total U.S. Communications MOUs: 1997-2007*, WIRELESS MARKET STATS, Jan. 31, 1998, at 2 *and* Paul Kagan Associates, Inc., *Kagan Projections: Wireless Heading Towards One-Third Total U.S. Usage*, WIRELESS MARKET STATS, Oct. 27, 1999, at 5.

areas as a result of the expansion by broadband PCS carriers and Nextel. To date, 222 million people, or 88 percent of the total U.S. population, have three or more different operators (cellular, broadband PCS, and/or Nextel) offering mobile telephone service in the counties in which they live. Over 172 million people, or 69 percent of the U.S. population, live in areas with five or more mobile telephone operators competing to offer service. And 11 million people, or 4 percent of the population, can choose from among seven different mobile telephone operators.

Competition has also been instrumental in reshaping the mobile data and dispatch sectors. Paging operators, facing intense competition for a base of paging customers that has not changed substantially, plus heightened competition from cellular and broadband PCS operators, are diversifying their operations by offering customers a variety of more advanced mobile data services. Mobile telephone operators are joined by other wireless entities such as satellite, dedicated data, and hand held device providers in offering an impressive and ever-expanding variety of mobile data services. Similarly, the dispatch sector is also facing increased competition from both mobile telephone providers that are beginning to offer dispatch services, as well as new SMR licensees beginning to deploy their networks.

Finally, while analysts estimate that overall data traffic on mobile networks has remained low at around 2 percent,[581] the development of new mobile data technologies and applications has been proceeding rapidly. For example, CDMA operators are currently testing a network technology that will permit mobile telephone customers to access the Internet at speeds of up to ten times the current rate. Some operators intend to begin commercial service as early as 2001. Many analysts believe that these new wireless data technologies and applications will drive the growth of mobile data services and the expansion of overall wireless usage in the coming years.

IV. ADMINISTRATIVE MATTERS

This Fifth Report is issued pursuant to authority contained in Section 332 (c)(1)(C) of the Communications Act of 1934, as amended, 47 U.S.C. § 322 (c)(1)(C).

It is ORDERED that the Secretary shall send copies of this Report to the appropriate committees and subcommittees of the United States House of Representatives and the United States Senate.

FEDERAL COMMUNICATIONS COMMISSION

Magalie Roman Salas
Secretary

[581] Jonathan Collins, *Sprint's Aggressive Ad Campaign Could Fire Up Demand For Wireless Net Access Or Give It A Bum WAP*, TELE.COM, Feb. 21, 2000, *available in* 2000 WL 10907294.

APPENDIX A:
SPECTRUM AUCTIONS

Table of Contents

Table 1A: FCC Auctions Summary - Service Design

Auction Number and Name		Number of Licenses (1)	Geographic License Scheme (2)	Spectrum per license	Total Spectrum (in megahertz)	Service Description
1	**Nationwide Narrowband PCS**	11 (3)	Nationwide	11 blocks, 5 = 50/50 KHz, 3 = 50/12.5 KHz, 2 = 50 KHz	0.7875 MHz	Advanced paging/data
2	**Interactive Video and Data Service**	594	MSA	2 blocks of 500 kHz	1 MHz	Interactive data
3	**Regional Narrowband PCS**	30	Regional	6 blocks, 2 = 50/50 KHz, 4 = 50/12.5 KHz	0.45 MHz	Advanced paging/data
4	**A & B block Broadband PCS**	102 (4)	MTA	2 blocks of 30 MHz	60 MHz	Mobile voice and data
5/10/22	**C block Broadband PCS (5)**	493	BTA	1 block of 30 MHz or 2 blocks of 15 MHz	30 MHz	Mobile voice and data
6	**Multichannel Distribution Service**	493	BTA	Max of 13 channels of 6 MHz	78 MHz (6)	Wireless cable
7	**900 MHz Specialized Mobile Radio**	1020	MTA	20 blocks of 25 KHz	5 MHz	Mobile voice and data
8	**Digital Broadcast Service (7)**	1	Full US Coverage	500 MHz	437.5 MHz	Multichannel video
9	**Digital Broadcast Service (7)**	1	Partial US Coverage	Uses same spectrum as full coverage license	375 MHz	Multichannel video
11/22	**D, E, & F block Broadband PCS (8)**	1479	BTA	3 blocks of 10 MHz	30 MHz	Mobile voice and data
12	**Cellular Unserved**	14	MSA/RSA	2 blocks of 25 MHz	50 MHz	Mobile voice and data
13	**Interactive Video and Data Service**	981	MSA/RSA	2 blocks of 500 KHz	1 MHz	Interactive data
14	**Wireless Communications Service**	128	MEA/REAG	4 blocks, 2 = 10 MHz, 2 = 5 MHz	30 MHz	(9)
15	**Digital Audio Radio Service**	2	Full US Coverage	2 blocks of 12.5 MHz	25 MHz	Multichannel audio
16	**Upper 800 MHz Specialized Mobile Radio**	525	EA	3 blocks, 1 MHz, 3 MHz , and 6 MHz	**1**0 MHz	Mobile voice and data
17/23	**Local Multipoint Distribution Service**	986 (10)	BTA	2 blocks, 1150 MHz and 150 MHz	1300 MHz	Fixed voice, data and video
18/24	**220 MHz**	908	National, EAG, EA	13 blocks, 3 = 100 KHz, 5 = 100 KHz, 5 = 150 KHz	1.55 MHz	Voice, data, paging, fixed
19	**General Wireless Communications Service**	875	EA	5 blocks of 5 MHz	25 MHz	(11)
20	**VHF Public Coast**	42	Pub. Coast Station Areas	1 block between 350 and 500 KHz	350 to 500 kHz	Fixed and mobile
21	**Location and Monitoring Service**	528	EA	3 blocks, 2 = 6 MHz, 1 = 2.25 MHz	14.25 MHz	Mobile telemetry
25/27/28	**"Closed" Broadcast**	118	n/a	(12)	(12)	Broadcast TV and radio
26	**929 and 931 MHz Paging Service**	2,499	MEA	49 blocks of 20 kHz, 12 in 929 Band, 37 in 931 band.	790 kHz	Paging and messaging
30	**39 GHz**	2,450	EA	14 Blocks of 100 MHz	1400 MHz	Fixed (13)

Source: Federal Communications Commission

(1) This is the total number of licenses initially auctioned in each service. It does not take into account any partitioning and disaggregation activity. Some of these licenses may not have been granted.
(2) MTAs = Major Trading Areas, BTAs = Basic Trading Areas, MSAs = Metropolitan Statistical Areas, RSAs = Rural Service Areas, MEAs = Major Economic Areas, REAGs = Regional Economic Area Groups, EAs = Economic Areas.
(3) Includes one pioneer preference license.
(4) Includes three pioneer preference licenses.
(5) To date, three auctions have been completed that included C block PCS licenses, the original and two reauctions.
(6) To be precise, Multipoint Distribution Service (MDS) total spectrum should be 76 MHz because Channel 2 was originally 6 MHz only in the top 50 markets. In the rest of the markets, it was Channel 2A with 4 MHz. As noted in the MDS Auction Procedures, Terms, and Conditions:

"In 1992, the 2160-2162 MHz frequency was reallocated to emerging technologies, and thus, any subsequent MDS use of these 2 MHz will be secondary."
(7) There is a total of 500 MHz of DBS downlink spectrum available. The same spectrum can be reused at each of the eight U.S. DBS orbital slots. The figures in the table are (28/32) x500 and (24/32) x500, respectively, but they each refer to portions of the same 500 MHz of spectrum.
(8) To date, two auctions have been completed that included DEF block PCS licenses, the original and one reauction.
(9) WCS is permitted to implement a wide range of services, subject to FCC engineering requirements, including fixed, mobile, radio location, and broadcasting-satellite (sound) service.
(10) Cellularvision, Inc. has been granted a pioneer preference for a portion of the 1150 MHz New York BTA, of which 850 MHz was subsequently sold to Winstar Communications, Inc.
(11) GWCS may provide any fixed or mobile communications service except Broadcast services, Radiolocation services, and Satellite services on their assigned frequency. These include but are not limited to voice, video, and data transmission, private microwave, broadcast auxiliary, and ground-to-air voice and video.
(12) The “Closed” Broadcast auctions included a number of different licenses used for broadcast television and radio. The types of licenses included: AM Broadcast (10 kHz per license), FM Broadcast (200 kHz per license), FM Translator (200 kHz), TV Broadcast (6 MHz per license), Low Power TV (6 MHz per license), and TV Translator (6 MHz per license).
(13) Mobile communications are subject to the development of inter-licensee and inter-service interference criteria.

Table 1B: FCC Auctions Summary
Auction Results

	Auction Number(s) and Name	Total Winning Bids (1)	Bid Price (dollars per person per MHz)	Auction Duration			Number of Winning Bidders
				Began	Ended	# Rounds	
1	Nationwide Narrowband PCS	$650,306,674	$3.10	7/25/94	7/29/94	47	6
2	Interactive Video and Data Service	$213,892,375	$0.85	7/28/94	7/29/94	Oral Outcry	178
3	Regional Narrowband PCS	$392,706,797	$3.46	10/26/94	11/8/94	105	9
4	A & B block Broadband PCS	$7,721,184,171	$0.52	12/5/94	3/13/95	112	18
5/	C block Broadband PCS (2)	$10,071,708,841.50	$1.33	12/18/95	5/6/96	184	89
10/		$904,607,466.75	$1.94	7/3/96	7/16/96	25	7
22		$409,936,425.00	$0.15	3/23/99	4/15/99	78	57
6	Multichannel Distribution Service	$216,239,603	$0.067 (3)	11/13/95	3/28/96	181	67
7	900 MHz Specialized Mobile Radio	$204,267,144	$0.24 (3)	12/5/95	4/15/96	168	80
8	Digital Broadcast Service	$682,500,000	$0.0062	1/24/96	1/25/96	19	1
9	Digital Broadcast Service	$52,295,000	$0.0006	1/25/96	1/26/96	25	1
11/	D, E, & F block Broadband PCS (4)	$2,517,439,565	$0.33	8/26/96	1/14/97	276	125
22		$2,904,520	$0.10	3/23/99	4/15/99	78	6
12	Cellular Unserved	$1,842,533	n/a	1/13/97	1/21/97	36	10
13	Interactive Video and Data Service	(5)	(5)	(5)	(5)	(5)	(5)
14	Wireless Communications Service	$13,638,940	$0.0018	4/15/97	4/25/97	29	17
15	Digital Audio Radio Service	$173,234,888	$0.0274	4/1/97	4/2/97	25	2
16	Upper 800 MHz Specialized Mobile Radio	$96,232,060	$0.04	10/28/97	12/8/98	235	14
17/	Local Multipoint Distribution	$578,663,029	$0.0018	2/18/98	3/25/98	127	104
23	Service	$45,064,450		4/27/99	5/12/99	43	40
18/	220 MHz	$21,650,301	$0.06	9/15/98	10/22/98	173	44
24		$1,924,950		6/8/99	6/30/99	71	16
19	General Wireless Communications Service	(6)	(6)	(6)	(6)	(6)	(6)
20	VHF Public Coast	$7,459,200	$0.06 to $0.08	12/3/98	12/14/98	44	4
21	Location and Monitoring Service	$3,438,294	$0.001	2/23/99	3/5/99	54	4
25/	"Closed" Broadcast Auction	$57,820,350	(7)	9/28/99	10/8/99	35	91
27/		$172,250		10/6/99	10/8/99	15	1
28		$1,210,000		3/21/00	3/24/00	26	2
26	929 and 931 MHz Paging Service	$4,122,500	(8)	2/24/00	3/2/00	28	78
30	39 GHz	$410,649,085	$.0011 (9)	4/12/00	5/8/00	73	29

Source: Federal Communications Commission

Notes:
(1) Total Winning Bids includes high bids from the auction (net of any bidding credits) plus the price paid for any pioneer preference licenses.
(2) C block broadband PCS was auctioned in three auctions. Please note that because licenses are in more than one auction, simply summing together the figures for Total Winning Bids, Bid Price, and Number of Winning Bidders will result in over counting.

(3) Estimated to adjust for encumbered spectrum.
(4) DEF block broadband PCS was auctioned in two auctions. Please note that because licenses are in more than one auction, simply summing together the figures for Total Winning Bids, Bid Price, and Number of Winning Bidders will result in over counting.
(5) The second IVDS auction was postponed on January 29, 1997.
(6) The General Wireless Communications auction was postponed on April 24, 1998.
(7) Given the site-by-site nature of the broadcast licenses, calculations using POPs figures were not made.
(8) Given the highly encumbered nature of these licenses, calculations using POPs figures were not made.
(9) Using a 1999 US population estimate of 270 million. All others use 1990 population (253 million).

Table 2: "Closed" Broadcast Auction #25 Results

Bidder Name	Total High Bids	POPs	Net High Bids (1)
3 Angels Broadcasting Network, Inc.	2	n/a	$115,700
Abundant Life, Inc.	1	n/a	$571,350
American Media Investments, Inc.	1	n/a	$195,000
Amy M. Coco	1	n/a	$65,000
Anchor Broadcasting Limited Partnership	1	n/a	$136,500
Arizona Lotus Corp.	1	n/a	$5,055,000
Ashtabula B/Casting Corp., Inc.	1	n/a	$25,000
Atlantic Broadcasting Co., Inc.	1	n/a	$16,000
Betty Lutz	1	n/a	$269,100
Burbach Broadcasting Company	1	n/a	$143,000
C.D. Broadcasting, Inc.	1	n/a	$165,000
Catherine Joanna Flinn	1	n/a	$602,550
Channel 24 Corp.	1	n/a	$2,073,750
Chattahoochee Broadcast Associates	1	n/a	$15,600
Combined Communications Inc.	1	n/a	$488,000
Communications Systems, Inc.	1	n/a	$248,950
D/B/A Karnes City Airwave Company	1	n/a	$298,500
Danbeth Communications, Inc.	1	n/a	$2,842,450
David & Lynn Magnumfe	1	n/a	$162,000
David A. Rawley, Jr.	1	n/a	$118,500
DBM Entertainment Enterprises, Inc.	1	n/a	$115,050
Delta Blues Broadcasting	1	n/a	$68,250
Delta Radio, Inc.	2	n/a	$481,000
Diane C. Thoma	1	n/a	$133,250
Fairview Radio, Inc.	1	n/a	$2,110,550
FCC Held	3	n/a	$0
Frank K. Spain	1	n/a	$306,000
GALLATIN VALLEY WITNESS, INC.	1	n/a	$400,000
George S. Flinn, Jr.	6	n/a	$1,049,000
GREGORY D. GENTLING, JR.	1	n/a	$1,045,000
Harold J. Haley, Jr.	1	n/a	$154,700
Hubert N. Hoffman, Jr.	1	n/a	$656,000
Intermart Broadcasting Pocatello, Inc.	1	n/a	$955,000
Intermart Broadcasting Twin Falls, Inc.	1	n/a	$838,000
J. K. Whittimore	1	n/a	$121,000
Jon A. Le Duc	1	n/a	$190,450
Joseph W. & Donna M. Bollinger	1	n/a	$233,250
Kingfisher County Broadcasting, Inc.	1	n/a	$144,300
Klamath Basin Broadcasting	1	n/a	$84,500
KM Communications, Inc.	3	n/a	$821,000
KOB-TV, L.L.C.	1	n/a	$320,000
Lawrence A. Busse	1	n/a	$379,600
Liberty Productions, A Limited Partnership	1	n/a	$1,518,400
Lynn C Ketelsen	1	n/a	$42,750
Marc Scott Communications, Inc.	1	n/a	$253,500
Marcia T. Turner dba Turner Enterprises	1	n/a	$490,500
Margaret L Grap	1	n/a	$150,000
MAS Communications, Inc.	1	n/a	$10,400
Meredith Communications, L.C.	1	n/a	$750,000
Michael D. Law	1	n/a	$100,750
Michael F. and Bridget T. Andlaer	1	n/a	$115,050
Midwestern Broadcasting Company, Inc.	1	n/a	$864,000
Minnesota Christian Broadcasters, Inc.	1	n/a	$138,450
Mitchell Broadcasting Fremont, Inc.	1	n/a	$530,000
Mount Rushmore Broadcasting, Inc.	2	n/a	$511,000
MTD, Inc.	3	n/a	$585,000
Nancy L. Foster	1	n/a	$85,000
New Mexico Roswell 21, LLC	1	n/a	$495,300
Bidder Name	Total High Bids	POPs	Net High Bids (1)
Newman Communications Inc.	1	n/a	$642,750
Outlook Communications, Inc.	2	n/a	$2,035,500

Pacific Spanish Network, Inc.	1	n/a	$240,000
Pappas Telecasting of the Midlands, Inc.	1	n/a	$118,000
Paxson Communications LPTV, Inc.	1	n/a	$60,000
R & J Broadcasting	1	n/a	$117,000
Rainbow Radio of Livingston County	1	n/a	$547,300
Rapid Broadcasting Company	1	n/a	$1,059,000
Results Broadcasting of Shawano, Inc.	1	n/a	$16,000
Richard H. Heibel	1	n/a	$462,000
Richmond Broadcasting, Inc.	1	n/a	$1,189,500
Rob Allen Hauser	1	n/a	$16,250
Ronald K. Bishop	1	n/a	$1,021,800
Simmons Family, Inc.	2	n/a	$1,878,000
Southern Broadcasting Corporation	1	n/a	$478,000
Sun Valley Radio, Inc.	1	n/a	$63,000
Sunbrook Communications Inc.	1	n/a	$371,000
Ted W. Austin, Jr.	2	n/a	$772,500
Todd P. Robinson	3	n/a	$369,000
Todd Stuart Noordyk	1	n/a	$196,000
Trinity Broadcasting Network	2	n/a	$589,000
TSB II, Inc.	1	n/a	$1,561,000
Twenty-One Sound Communications Inc.	1	n/a	$105,750
Univision Television Group, Inc.	2	n/a	$381,000
Warrior Broadcasting Inc.	1	n/a	$138,450
WBCM Radio, Inc.	1	n/a	$150,000
Western Slope Communications LLC	1	n/a	$72,000
Wilber Johnson	1	n/a	$26,000
William Konopnicki	1	n/a	$1,900
William R. Reier, Jr.	1	n/a	$79,300
Winstar Broadcasting Corp.	5	n/a	$11,008,000
WKOB Communications, Inc.	1	n/a	$842,400
WLV-TV Inc.	2	n/a	$143,250
Woolstone Corporation	1	n/a	$216,750

Source: Federal Communications Commission
Notes: (1) As of the close of the auction.

Table 3: 929 and 931 MHz Paging Service Auction #26 Results

Bidder Name	Total High Bids	POPs	Net High Bids (1)
Metrocall USA, Inc.	145	1,175,537,620	$681,800
Vodafone AirTouch Licenses LLC	78	450,905,386	$277,600
WWC Paging Corporation	63	314,350,405	$448,000
MAP PAGING CO., INC.	53	562,119,338	$355,100
Trompex Corporation	51	252,556,989	$573,170
Emmerson Enterprises Inc.	48	285,718,673	$123,370
Southwestern Bell Mobile Systems, Inc.	42	200,503,381	$137,800
Teletouch Licenses, Inc.	32	111,346,366	$91,100
Electronic Engineering Co.	28	136,470,121	$91,500
Mobile Radio Communications, Inc.	26	56,199,062	$68,600
Betapage Communications, LLC	24	223,459,334	$77,220
TeleBEEPER of New Mexico, Inc.	23	109,445,980	$53,105
Heartland Communications	20	94,372,653	$60,900
Morris Communications, Inc.	18	77,229,654	$47,700
Golden Arrow Paging, Inc.	16	140,602,761	$80,250
Clear Paging, Inc.	15	70,042,206	$43,100
Link Two Communications Inc.	14	77,605,613	$79,300
Network Services,LLC	14	99,931,512	$44,400
Aquis Wireless Communications, Inc.	13	113,352,205	$59,300
Indiana Paging Network, Inc.	11	58,948,937	$26,325
SelectPath Holding, Inc.	10	36,236,473	$28,200
Cook Telecom, Inc.	9	34,281,567	$19,500
ProPage, Inc.	9	38,005,629	$34,200
RCC, Inc. d/b/a Radio Comm Company	9	34,787,381	$18,070
Bidder Name	Total High Bids	POPs	Net High Bids (1)
Robert J. Fetterman d.b.a. R.F. Communications	9	71,664,811	$27,105
TeleMaxx Communications LLC	9	45,696,051	$15,275
ADVANCED PAGING, INC.	8	41,957,282	$31,350

Kelley's Tele-Communications, Inc.	8	24,427,022	$15,000
Pass Word, Inc	8	22,325,400	$15,525
US Paging of Corpus	8	38,484,068	$21,710
Universal Talkware Corporation	8	42,511,917	$16,120
Sims Company, Inc.	7	19,880,946	$12,415
ADS Partners	6	18,655,230	$10,140
BCO, Incorporated	6	28,571,679	$17,475
L.P. Ganacias Enterprises, Inc.	6	3,669,538	$9,750
National Network Communications, Inc.	6	36,152,890	$14,495
Paging Systems, Inc.	6	69,497,276	$37,600
Priority Communications, Inc.	6	30,618,707	$12,600
Robert F. Ryder d/b/a Radio Paging Service	6	14,666,724	$10,010
TELEPHONE & TWO-WAY INC.	6	23,758,702	$9,750
Arthur Patrick	5	9,262,108	$13,000
Mobile Phone of Texas, Inc.	5	47,878,810	$18,975
Range Corporation	5	31,345,501	$10,400
Satellite Paging, Inc.	5	41,739,168	$17,290
1001 Lockwood, Inc.	4	17,923,822	$6,890
A. V. LAUTTAMUS COMMUNICATIONS, INC.	4	16,593,492	$6,500
Beeper Systems, Inc.	4	31,671,970	$19,175
IT&E Overseas, Inc.	4	705,988	$10,000
Nationwide Paging, Inc.	4	45,584,942	$19,275
Paging Dimensions, Inc.	4	38,207,573	$14,235
Pioneer Telephone Cooperative, Inc.	4	6,358,676	$10,000
Snider Communications Corporation	4	12,320,408	$7,500
Stephen P. Shirk	4	23,998,921	$15,300
ATS MOBILE TELEPHONE,INC.	3	6,010,265	$7,500
Alpha Display Paging, Inc.	3	8,599,872	$4,875
Robert R. Rule d/b/a Rule Communications	3	11,856,348	$4,875
TSR Wireless LLC	3	21,228,060	$13,900
Ameritel Paging, Inc.	2	9,268,022	$3,250
Bestcomm,LLC	2	14,683,862	$6,300
Charles P Oden Sr.	2	4,371,825	$4,290
Communications Properties, Inc.	2	6,160,204	$3,750
DAJ-JAJ-LLC	2	5,679,832	$3,250
EXPRESS MESSAGE CORPORATION	2	9,823,878	$3,445
General Telcourier, Inc.	2	3,552,683	$4,550
Micron Technology, Inc.	2	4,888,908	$5,000
Page Plus, Inc.	2	2,955,208	$3,750
Paging Source USA, Inc.	2	10,554,369	$3,975
Paging Systems Management, Inc.	2	4,447,402	$6,800
winsome paging inc.	2	36,969,336	$12,350
(800) Page-USA, Inc.	1	5,025,606	$2,175
DATAPAGE, INC.	1	8,672,944	$2,795
Gabriel Wireless, L.L.C.	1	9,575,762	$4,550
Omnicom Paging Plus, LLC	1	1,727,716	$1,625
Paul L. Valois	1	29,027,017	$11,700
Satellink Paging, LLC	1	2,002,283	$2,500
Telebeep, Inc.	1	1,638,440	$1,875
Texas Instruments Incorporated	1	9,575,762	$37,000
Two-Way Radio Co., Inc.	1	6,018,051	$1,950

Source: Federal Communications Commission
Notes: (1) As of the close of the auction.

Table 4: "Closed" Broadcast Auction #27 Results

Bidder Name	Total High Bids	POPs	Net High Bids (1)
Ramona Lee Hayes-Bell	1	n/a	$172.250

Source: Federal Communications Commission
Notes: (1) As of the close of the auction.

Table 5: Broadcast Auction #28 Results

Bidder Name	Total High Bids	POPs	Net High Bids (1)
KM Communications, Inc.	$316,000	n/a	$316,000
Valley Public Television, Inc.	$894,000	n/a	$894,000

Source: Federal Communications Commission
Notes: (1) As of the close of the auction.

Table 6: 39 GHz Auction #30 Results

Bidder Name	Total High Bids	POPs	Net High Bids (1)
WinStar Wireless Fiber Corp.	931	1,584,330,876	$161,423,900
Advanced Radio Telecom Corp.	352	766,888,483	$76,968,450
Hyperion Communications Long Haul, L.P.	177	260,962,368	$77,604,600
ZEPHYR WIRELESS, L.L.C.	140	96,244,310	$12,367,575
Atlantis Bidding Corp.	130	144,380,077	$21,803,775
Milkyway Multipoint, LLC	113	80,099,574	$1,518,270
TRW Inc.	100	35,617,649	$2,445,400
GigaTel Wireless, L.L.C.	60	61,446,401	$3,230,000
CT Communications, Inc	23	16,473,109	$852,500
PTPMS Communications, LLC	22	37,399,146	$1,461,330
Bachow 39 GHz, Inc.	21	21,436,414	$1,159,500
North Dakota Network Co.	11	1,613,494	$45,300
DCT Spirit, L.L.C.	11	14,719,224	$1,814,345
AT&T Wireless PCS, LLC	11	28,329,431	$9,861,000
Bala Equity IV, Inc.	10	27,043,965	$1,627,575
PVT Networks, Inc.	10	3,096,026	$56,940
NEXTBAND Communications, L.L.C.	10	31,036,304	$30,207,000
C & W Systems, Ltd.	8	6,067,210	$81,900
Switch 2000 L.L.C.	7	7,121,555	$354,900
Pinpoint Wireless, Inc.	7	1,636,759	$26,910
Tooker Fiber, LLC	4	6,752,355	$149,500
Valley Wireless, LP	4	1,528,380	$19,760
Cable & Communications Corporation	3	697,050	$12,150
Roseville PCS, Inc.	2	3,870,974	$4,624,000
Morgan Stanley Capital Group Inc.	2	2,316,124	$62,000
Sycamore Telephone Company	1	1,278,722	$20,150
Northern Arapaho Business Council	1	382,095	$5,655
David E Beyerle	1	798,826	$11,700
Telefonica Data Licensing, Inc.	1	3,623,846	$833,000

Source: Federal Communications Commission
Notes: (1) As of the close of the auction.

APPENDIX B:
MOBILE TELEPHONY

Table of Contents

Table 1: CTIA's Semi-Annual Mobile Telephone Industry Survey

Date	Estimated Subscribers	Total Six-Month Service Revenues (000s)	Roamer Services Revenues	Cell Sites	Employees	Cumulative Capital Investment (000s)	Average Local Monthly Bill
Jan 85	91,600	$178,085		346	1,404	$354,760	
June 85	203,600	$176,231		599	1,697	$588,751	
Dec 85	340,213	$306,197		913	2,727	$911,167	
June 86	500,000	$360,585		1,194	3,556	$1,140,163	
Dec 86	681,825	$462,467		1,531	4,334	$1,436,753	
June 87	883,778	$479,514		1,732	5,656	$1,724,348	
Dec 87	1,230,855	$672,005		2,305	7,147	$2,234,635	$96.83
June 88	1,608,697	$886,075		2,789	9,154	$2,589,589	$95.00
Dec 88	2,069,441	$1,073,473	$89,331	3,209	11,400	$3,274,105	$98.02
June 89	2,691,793	$1,406,463	$121,368	3,577	13,719	$3,675,473	$85.52
Dec 89	3,508,944	$1,934,132	$173,199	4,169	15,927	$4,480,141	$83.94
June 90	4,368,686	$2,126,362	$192,350	4,768	18,973	$5,211,765	$83.94
Dec 90	5,283,055	$2,422,458	$263,660	5,616	21,382	$6,281,596	$80.90
June 91	6,380,053	$2,653,505	$302,329	6,685	25,545	$7,429,739	$74.56
Dec 91	7,557,148	$3,055,017	$401,325	7,847	26,327	$8,671,544	$72.74
June 92	8,892,535	$3,633,285	$436,725	8,901	30,595	$9,276,139	$68.51
Dec 92	11,032,753	$4,189,441	$537,146	10,307	34,348	$11,262,070	$68.68
June 93	13,067,318	$4,819,259	$587,347	11,551	36,501	$12,775,967	$67.31
Dec 93	16,009,461	$6,072,906	$774,266	12,805	39,775	$13,946,406	$61.48
June 94	19,283,306	$6,519,030	$778,116	14,740	45,606	$16,107,920	$58.65
Dec 94	24,134,421	$7,710,890	$1,052,666	17,920	53,902	$18,938,677	$56.21
June 95	28,154,415	$8,740,352	$1,120,337	19,833	60,624	$21,709,286	$52.45
Dec 95	33,785,661	$10,331,614	$1,422,233	22,663	68,165	$24,080,466	$51.00
June 96	38,195,466	$11,194,247	$1,314,943	24,802	73,365	$26,707,046	$48.84
Dec 96	44,042,992	$12,440,724	$1,465,992	30,045	84,161	$32,573,522	$47.70
June 97	48,705,553	$13,134,551	$1,392,440	38,650	97,039	$37,454,294	$43.86
Dec 97	55,312,293	$14,351,082	$1,581,765	51,600	109,387	$46,057,911	$42.78
June 98	60,831,431	$15,286,660	$1,584,891	57,674	113,111	$50,178,812	$39.88
Dec 98	69,209,321	$17,846,515	$1,915,578	65,887	134,754	$60,542,774	$39.43
June 99	76,284,753	$19,368,304	$1,922,416	74,157	141,929	$66,782,827	$40.24
Dec 99	86,047,003	$20,650,185	$2,163,001	81,698	155,817	$71,264,865	$41.24

Source**:** Cellular Telecommunications Industry Association, *Semi-Annual Mobile Telephone Industry Survey* <.http://www.wow-com.com/wirelesssurvey/>.

Tables 2A - 2C: Mobile Telephone Industry Rollout Summary

Table 2A: Estimated Mobile Telephone Rollouts by Number of Launches by County

Total Number of Providers in a County	Number of Non-Cellular Providers (1) in a County	POPs Contained in Those Counties (2)	% of Total US POPs	Square Miles Contained in Those Counties	% of Total US Square Miles
3 or More	1 or More	222.2 million	87.8%	1,268,000	35.2%
4 or More	2 or More	202.0 million	79.8%	808,412	22.5%
5 or More	3 or More	173.3 million	68.5%	506,024	14.1%
6 or More	4 or More	87.4 million	34.6%	216,312	6.0%
7	5	11.1 million	4.4%	47,663	1.3%

Table 2B: Estimated Mobile Telephone Rollouts by Number of Launches by BTA

Total Number of Providers in a BTA	Number of Non-Cellular Providers (1) in a BTA	Number of BTAs	POPs Contained in Those BTAs (2)	% of Total US POPs
3 or More	1 or More	374	238.0 million	94.1%
4 or More	2 or More	267	225.6 million	89.2%
5 or More	3 or More	166	195.9 million	77.4%
6 or More	4 or More	94	104.2 million	41.2%
7 or More	5 or More	15	14.1 million	5.6%

Table 2C: County Quartiles with Estimated Rollout by at least 3 Mobile Telephone Providers

County Quartile Based on Population (2)	Total Number of Counties	Number of Counties with at least 3 Providers	Percent of Counties in Quartile with at least 3 Providers	POPs in Those Counties (2)	Percent of Quartile POPs with at least 3 Providers
1st Quartile	808	724	89.6%	200,245,115	96.6%
2nd Quartile	808	463	57.3%	16,505,721	58.7%
3rd Quartile	808	297	36.8%	4,945,232	38.6%
4th Quartile	809	104	12.9%	782,806	16.3%

Table 2D: BTA Quartiles with Estimated Rollout by at least 3 Mobile Telephone Providers

BTA Quartile Based on Population (2)	Total Number of BTAs	Number of BTAs with at least 3 Providers	Percent of BTAs in Quartile with at least 3 Providers	POPs in Those BTAs (2)	Percent of Quartile POPs with at least 3 Providers
1st Quartile	123	121	98.4%	191,195,674	99.5%
2nd Quartile	123	110	89.4%	29,957,146	89.7%
3rd Quartile	123	80	65.0%	11,771,075	66.3%
4th Quartile	124	63	50.8%	5,097,805	55.0%

Source: Federal Communications Commission estimates based on publicly available information.

Notes:
(1) For the analysis, non-cellular providers are defined as broadband PCS operators and Nextel Communications.
(2) POPs from the 1990 Census.

Table 3: Top 25 Mobile Telephone Operators by Subscribers
(in thousands)

Year-End 1998				Year-End 1999				*Pro Forma* Year-End 1999			
	Operator	Cell.	PCS	Total	Operator	Cell.	PCS	Total	Operator	Cell.	PCS	Total
1	AirTouch	7,915	0	7,915	SBC	9,651	1,500	11,151	Verizon Wireless	24,390	1,400	25,790
2	AT&T Wireless	6,635	563	7,198	AT&T Wireless	8,200	1,400	9,600	SBC-BellSouth (3)	14,988	1,500	16,488
3	SBC	5,924	846	6,770	Vodafone-AirT	9,133	0	9,133	AT&T Wireless	8,587	1,400	9,987
4	Bell Atlantic	6,201	0	6,201	Bell Atlantic	7,688	0	7,688	Sprint PCS	0	5,727	5,727
5	BellSouth	4,575	326	4,901	GTE	7,146	(1)	7,146	ALLTEL	5,019	(1)	5,019
6	GTE	4,817	(1)	4,817	Sprint PCS	0	5,727	5,727	Nextel	0	0	4,516
7	ALLTEL	4,009	(1)	4,009	BellSouth	5,337	(1)	5,337	US Cellular	2,602	0	2,602
8	Ameritech	3,577	(1)	3,577	ALLTEL	5,019	(1)	5,019	VoiceStream	0	2,204	2,204
9	Nextel	0	0	2,790	Nextel	0	0	4,516	Western Wireless	835	0	835
10	Sprint PCS	0	2,590	2,590	US Cellular	2,602	0	2,602	CenturyTel	707	(1)	707
11	US Cellular	2,183	0	2,183	PrimeCo	0	1,400	1,400	Dobson Comm.	660	0	660
12	Western Wirlss	660	322	983	Omnipoint	0	935	935	Powertel	0	546	546
13	PrimeCo	0	902	902	VoiceStream	0	846	846	Centennial	341	162	503
14	Comcast	815	0	815	Western Wirlss	835	0	835	US West	0	466	466
15	Vanguard	664	0	664	CenturyTel	707	(1)	707	Rural Cellular	452	14	466
16	CenturyTel.	624	0	624	Powertel	0	546	546	Price Comm.	454	0	454
17	Centennial	286	99	385	Centennial	341	162	503	PR Tel. Co. (2)	254	0	254
18	Price Comm.	382	0	382	US West	0	466	466	Triton PCS	0	195	195
19	Omnipoint	0	376	376	Dobson Comm.	445	0	445	Cincinnati Bell	0	162	162
20	CommNet	359	0	359	American	431	0	431	Midwest Wireless	150	0	150
21	Dobson Comm.	347	0	347	Price Comm.	454	0	454	Telecorp	0	142	142
22	American	334	0	334	Aerial	0	423	423	Cellcom (NE Comm. of WI.)	130	0	130
23	Powertel	29	295	324	CommNet	423	0	423	US Unwired	59	34	93
24	Aerial Comm.	0	312	312	PR Tel. Co. (2)	254	0	254	Bluegrass Cellular	75	0	75
25	Aliant Comm.	303	0	303	Rural Cellular	228	14	242	PCS One (4)	0	50	50

Sources: Except for Cellcom, Midwest Wireless, and Bluegrass Cellular, publicly available company documents such as operators' news releases and filings made with the Securities and Exchange Commission. Cellcom: Stefanie Scott, *Cell Phone Use Continues to Grow*, KRTBN KNIGHT-RIDDER TRIBUNE BUSINESS NEWS: THE POST-CRESCENT - APPLETON, WISCONSIN, Aug. 1, 1999 *available at* 1999 WL 22002935. Bluegrass: *PageMart Wireless and Bluegrass Cellular Join Forces to Expand Wireless Messaging Services to Central Kentucky*, News Release, PageMart Wireless, Inc., Oct. 6, 1997 (Bluegrass was reported as having 50,000 cellular customers in the fall of 1997, that figure was inflated by 50% to account for two years growth). Midwest Wireless: *Midwest Wireless Completes Acquisition in Iowa*, News Release, Midwest Wireless, Mar. 2, 2000.

Notes:
(1) Indicates that the operator has broadband PCS based systems but does not report those subscribers separately.
(2) Puerto Rico Telephone Co. Inc.'s subscribers are as of June 30, 1999.
(3) In the *Pro-Forma* columns, BellSouth's PCS customers are included with SBC-BellSouth's cellular customers, as BellSouth no longer reports its PCS customers separately.
(4) PCS One is a joint venture between a subsidiary of VoiceStream and D&E Communications, Inc.

Table 4: Foreign Holdings of U.S. Mobile Telephone Operators

Operator	Country	Subscribers (Brand name) (1)	Venture	Ownership (%)
SBC	France	6.4 million	Cegetel (owns 80% of cellular company Societe Francaise de Radiotelephone)	15 (through JV with Vivendi)
	Denmark	1.1 million	Tele Danmark	41.6
	Norway	720,000	NetCom	19.6 (controls 27.9% through investment in Tele Danmark)
	Belgium	1.9 million	Belgacom	17.5 (controls 24.4% through investment in Tele Danmark, which owns 16.5% of Belgacom)
	Switzerland	413,000	DiAx	40
	Hungary	867,000	MATAV	29.8
	South Africa	2.1 million (Vodacom)	Telkom SA(owns 50% of Vodacom)	18
	Canada	1.9 million (Bell Mobility)	Bell Canada	20
	Mexico	4.1 million	Telmex	9
	Taiwan	478,000	TransAsia Tele-communications	19.4
	Brazil	900,000	Algar Telecom Leste SA (ATL)	50 (stake is jointly owned with Telmex and can be increased to 50% in 2004)
AT&T	Canada	2.6 million	Rogers Cantel	17
	Colombia	466,000	Celumovil	14
	India	90,000	Birla Communications Ltd.	49
	Taiwan	1.425 million	FarEasTone	14
	Japan	8.1 million (J-Phone)	Japan Telecom	15
	Czech Republic	645,000	EuroTel Praha	24.5
	Slovakia	208,000	EuroTel Bratislava	24.5
	India	267,000 (BPL Mobile)	BPL Cellular	49
	Malaysia	630,000 (Maxis Mobile)	Maxis Communications	19
Verizon	Italy	6.2 million	Omnitel Pronto Italia	23.1
	Mexico	843,000	Iusacell	40.2
	Czech Republic	645,000	EuroTel Praha	24.5
	Slovakia	208,000	EuroTel Bratislava	24.5
	Greece	797,000	STET Hellas	20
	Indonesia	213,000	Excelcomindo	23.1
	Japan	3,137,800	Tu-Ka	0.8
	New Zealand	608,900	Telecom New Zealand	24.9
	Philippines	138,000 (Extelcom)	BayanTel (owns 46.6% stake in wireless provider Extelcom)	20
	Argentina	809,000	CTI Holdings	58
	Argentina	Expected to launch in 2000	GTE PCS	100
	Canada (British Columbia and Alberta)	1.1 million	TELUS	26.7
	Canada (Quebec)	37,000	Quebec Telephone	50.2
	Venezuela	1.2 million	CANTV	26.4
	Taiwan	3.1 million	Taiwan Cellular Corporation	13.5
	Dominican Republic	244,000	CODETEL	100

Operator	Country	Subscribers (Brand name) (1)	Venture	Ownership (%)
BellSouth	Uruguay	141,314	Abiatar	46
	Guatemala	Launch mid-2000	BellSouth Guatemala	60
	Nicaragua	51,022	Nicacell	49
	Ecuador	203,425	Otecel	89.4
	Panama	140,977	BellSouth Panama	43.7
	Brazil (Sao Paulo)	1,971,282	BCP	44.5
	Brazil (northeast)			46.8
	Brazil (central western & northern regions)	1 million	Tele Centro Oeste Celular	16.5
	Venezuela	2,833,667	Telcel	78.2
	Argentina	1,285,522	Movicom/ BellSouth	65
	Chile	403,119	BellSouth Chile	100
	Columbia	466,000	Celumovil	33.8
	Peru	318,953	Tele 2000	96.8
	Germany	4,089,294	E-Plus	22.5 (shares equal control of E-Plus with KPN through ownership in BellSouth GmbH)
	Denmark	827,992	SONOFON	46.5
	Israel	1,513,081	Cellcom	34.7
	India	24,664	SkyCell Communications	24.5
Nextel	Argentina	1.2456 million (includes all international subsidiaries and affiliates)	Ownership interests in international wireless companies are held through Nextel's substantially wholly owned subsidiary, Nextel International, Inc.	
	Brazil			
	Canada			
	Japan			
	Mexico			
	Peru			
	Philippines			
	Shanghai, PRC			

Sources: Publicly available company documents such as operators' news releases, Web sites, and filings made with the Securities and Exchange Commission; *DLJ Report*, at 76; and the following news articles: Doris Benavides, *Telmex Makes Analysts' Q1 Forecast*, INFOWORLD, May 15, 2000; *Canada: Rogers Units to Open Customer Center in Ottawa*, REUTERS ENGLISH NEWS SERVICE, May 11, 2000; *J-Phone Biz to Boost Japan Telecom Group Earnings in FY 2000*, JIJI PRESS ENGLISH NEWS SERVICE, May 18, 2000; *BellSouth Buys Brazil Celco Stake*, REUTERS, May 29, 2000; *Cellular Phone Carriers TCO, NBT Reach 1 Million Clients*, BRAZILIAN FINANCIAL WIRE, Apr. 5, 2000.

Notes:
(1) In most cases the data provided in the table reflect the number of subscribers as of year-end 1999, but some data are from earlier in 1999 while other data are more recent than year-end 1999.

Table 5: Estimated U.S Digital Mobile Telephone Subscribers

Technology	1997 Subscribers	1998 Subscribers	97/98 Percent Change	1999 Subscribers	98/99 Percent Change	Percent of Total Digital Subs
GSM Subs	1,200,000	2,700,000	125%	5,400,000	100%	12%
TDMA Subs	3,800,000	8,700,000	129%	18,300,000	110%	41%
CDMA Subs	1,400,000	6,400,000	357%	15,800,000	147%	36%
iDEN Subs	1,300,000	2,900,000	123%	4,800,000	65%	11%
Total Digital Subs	7,700,000	20,700,000	169%	44,300,000	114%	
Percent of Total	14%	30%	115%	52%	73%	
Analog Cellular Subs	47,600,000	48,500,000	2%	41,700,000	-14%	
Percent of Total	86%	70%	-19%	48%	-31%	
Total Mobile Phone Subs (1)	55,300,000	69,200,000	25%	86,000,000	24%	

Sources:
CDMA: 1997 and 1998 – Fourth Report, 14 FCC Rcd at 10223. 1999 - CDMA Development Group, *CDMA World Subscribers* (visited Feb. 14, 2000) < http://www.cdg.org/world/cdma_world_subscriber.html>. All of the figures were reported for North America as a whole and were adjusted for the United States by removing the CDMA subscriber totals of BCE Mobile Communications, Inc. and Clearnet Communications, Inc.
TDMA: 1997 and 1998 – Fourth Report, 14 FCC Rcd at 10223. 1999 - AT&T Corp., Form S-3, Feb. 2, 2000, at 68. The figures for all years were reported for North America as a whole and were adjusted for the United States by removing the TDMA subscriber totals of Rogers Cantel Mobile Communications, Inc.
GSM: 1997 and 1998 – Fourth Report, 14 FCC Rcd at 10223. *1999 – World's Fastest-Growing Wireless Digital Standard Provides North American GSM Customers Access to Global Network*, News Release, North American GSM Alliance, Mar. 31, 2000. The figures for all years were reported for North America as a whole and were adjusted for the United States by removing the GSM subscriber totals of Microcell Telecommunications, Inc.
iDEN: 1997 and 1998 – Fourth Report, 14 FCC Rcd at 10223. 1999 - The iDEN figures are the combined digital SMR subscriber totals for Nextel, Nextel Partners and Southern Company ("Southern"). The Southern figure is as of September 1999. Nextel: *Nextel Reports 1999 Results*, News Release, Nextel Communications, Inc., Feb. 22, 2000. Nextel Partners: Nextel Partners, Form S-1/A, Feb. 7, 2000, at 5. Southern: *Southern LINC Reaches 150,000 Customers*, News Release, Southern LINC, Sep. 7. 1999.

Notes:

(1) Total Mobile Phone Subs: Appendix B, Table 1, p. B-2.

Table 6: Quarterly Mobile Telephone Subscriber Growth
(in thousands)

	96Q4	97Q1	97Q2	97Q3	97Q4	98Q1	98Q2	98Q3	98Q4	99Q1	99Q2	99Q3	99Q4
Cellular													
SBC	4,398	4,623	4,781	4,890	5,068	5,090	5,188	5,234	5,924	6,142	6,275	7,210	9,651
Vodafone Airtouch	3,403	3,550	3,745	3,901	4,309	4,560	7,290	7,461	7,915	8,174	8,388	8,551	9,133
AT&T (1)	5,204	5,325	5,539	5,739	5,959	5,969	6,164	6,359	6,598	6,777	7,782	7,982	8,200
Bell Atlantic	4,410	4,634	4,875	5,064	5,356	5,483	5,707	5,914	6,201	6,391	6,606	6,873	7,688
GTE	3,749	4,009	4,151	4,286	4,487	4,545	4,631	4,685	4,817	4,892	5,027	5,196	7,146
ALLTEL	795	844	890	921	941	977	1,010	3,863	4,009	4,183	4,296	4,858	5,019
BellSouth	3,581	3,715	3,836	3,890	4,017	4,125	4,271	4,384	4,374	4,739	4,840	4,770	4,889
US Cellular	1,073	1,164	1,263	1,357	1,710	1,817	1,922	2,018	2,183	2,270	2,364	2,453	2,602
Western Wireless	324	351	390	426	520	547	583	620	660	696	738	774	835
CenturyTel	368	380	398	430	570	576	584	592	624	639	641	651	707
Price Comm.	280	311	326	337	310	327	347	364	382	389	418	434	454
Dobson Comm.	34	79	96	85	100	110	151	163	347	382	402	424	445
American Cellular	140	169	191	214	244	264	286	305	335	352	375	398	431
Commnet	230	244	257	275	290	307	320	336	359	373	388	403	423
Centennial	160	177	187	199	218	238	253	268	286	309	321	321	341
Rural Cellular	45	48	77	80	85	87	92	176	187	200	209	218	228
Ameritech	2,512	2,709	2,856	2,970	3,177	3,345	3,462	3,515	3,600	3,674	3,725	3,795	0
CCPR	159	167	176	182	196	212	234	265	302	333	362	375	0
Comcast	762	766	768	766	783	790	799	810	815	836	850	0	0
Vanguard	513	540	580	615	645	667	692	678	664	700	0	0	0
Aliant Comm.	147	154	161	170	183	271	281	290	303	308	316	0	0
Sygnet Wireless	107	114	121	130	143	148	157	167	0	0	0	0	0
360 Comm.	2,156	2,281	2,379	2,450	2,583	2,644	2,733	0	0	0	0	0	0
US West MG	1,873	1,984	2,073	2,200	2,374	2,424	0	0	0	0	0	0	0
	36,423	38,337	40,117	41,577	44,267	45,523	47,158	48,466	50,884	52,758	54,321	55,685	58,192
	3,203	1,914	1,780	1,460	2,603	1,256	1,635	1,266	2,147	1,874	1,438	1,174	2,507
Broadband PCS													
Sprint PCS (2)	1	192	347	570	887	1,114	1,370	1,750	2,586	3,350	3,967	4,687	5,727
SBC Comm.	10	27	137	287	365	446	568	670	846	1,008	1,180	1,300	1,500
PrimeCo	37	114	195	260	388	508	598	707	902	1,105	1,208	1,260	1,400
AT&T (1)			4	30	60	190	320	450	600	800	1,000	1,200	1,400
Omnipoint		16	42	80	141	190	255	274	376	478	594	698	935
VoiceStream	36	49	74	101	129	165	213	265	322	417	553	676	846
Powertel	15	35	45	66	119	157	181	229	295	338	382	438	546
US West					15	28	54	104	185	220	284	344	466
BellSouth (3)	31	49	65	77	88	105	129	158	211	266	315	365	448
Aerial Comm.			28	65	125	165	204	231	312	332	347	363	423
Triton PCS										44	78	130	195
Centennial		7	17	33	51	61	70	86	99	117	134	145	162
Cincinnati Bell							14	25	56	70	88	112	162
Telecorp										9	31	76	142
PCS One (4)									16	24	30	34	50
Intelos								7	12	19	24	31	43
Alamosa PCS												10	32
Tritel													25
Chase Telecomm.									4	5	9	12	16
Rural Cellular						0	1	2	5	8	9	11	14
Conestoga										4	6	7	10
APC/Sprint (2)	158	0	0	0	0	0	0	0	0	0	0	0	0
Total	288	488	955	1,569	2,367	3,128	3,977	4,957	6,826	8,613	10,239	11,899	14,542
Net Adds	145	200	466	614	798	761	848	980	1,870	1,753	1,626	1,660	2,643
Nextel Subs	300	423	624	947	1,271	1,642	2,042	2,417	2,790	3,153	3,593	4,051	4,516
Nextel Net Adds	72	123	202	322	324	371	401	375	373	420	449	467	474
Tot Net Adds	3,420	2,237	2,448	2,397	3,725	2,388	2,884	2,622	4,390	4,047	3,513	3,300	5,150
PCS/Nextel %	6.4%	14.4%	27.3%	39.1%	30.1%	47.4%	43.3%	51.7%	51.1%	53.7%	59.1%	64.4%	51.3%
Cellular %	93.6%	85.6%	72.7%	60.9%	69.9%	52.6%	56.7%	48.3%	48.9%	46.3%	40.9%	35.6%	48.6%

Sources: Except as noted, publicly available company documents such as news releases and filings made with the Securities and Exchange Commission.

Notes:
(1) AT&T's has reported broadband PCS subscriber totals for 97Q4, 98Q3, 98Q4, 99Q3, and 99Q4. The figures for AT&T's broadband PCS in the remaining quarters were estimated assuming average growth between the known data points, which were then netted against AT&T's reported total mobile telephone subscriber figures.
(2) APC/Sprint and Sprint PCS subscriber totals for 96Q4 are based on the average of estimates made by: Salomon Smith Barney, Paul Kagan Associates, Inc., and Merrill Lynch.
(3) BellSouth stopped reporting separate figures for its broadband PCS properties. The 1999 figures used here were estimated based on the average growth of the other broadband PCS operators on this list.
(4) PCS One is a joint venture between a subsidiary of VoiceStream and D&E Communications, Inc.

Table 7: Mobile Telephone Digital Coverage

Technology	Band	POPs in Those Areas (3)	% of Total POPs	Square Miles Contained in Those Counties	% of Total Square Miles
CDMA	Broadband PCS (1)	191.4 million	75.7%	786,000	21.8%
	Digital Cellular (2)	158.7 million	62.8%	626,000	17.4%
	Combined Total	204.3 million	80.8%	1,045,000	29.0%
TDMA	Broadband PCS (1)	81.3 million	32.1%	298,000	8.3%
	Digital Cellular (2)	175.7 million	69.5%	1,346,000	37.4%
	Combined Total	206.5 million	81.6%	1,492,000	41.4%
GSM	Broadband PCS (1)	165.3 million	65.3%	790,000	21.9%
iDEN	Digital SMR (1)	185.4 million	73.3%	730,000	20.3%

Source: Federal Communications Commission estimates based on publicly available information.

Notes:
(1) The areas used for broadband PCS and digital SMR are counties.
(2) The license areas used for digital cellular are MSAs and RSAs.
(3) The POPs are from the 1990 census.

Table 8: Broadband PCS Industry Growth

Operator	Technology Choice	Launch Date	Subscribers 12/31/95	Subscribers 12/31/96	Subscribers 12/31/97	Subscribers 12/31/98	Subscribers 12/31/99
APC/Sprint (1)	GSM	11/15/95	31,667	158,333	-	-	-
VoiceStream (formerly West. Wrlss)	GSM	2/28/96		35,500	128,600	322,400	845,700
BellSouth	GSM\TDMA	7/18/96		51,000	141,000	326,000	N/A
Powertel	GSM	10/15/96		14,892	118,757	295,295	546,364
SBC Communications (2)	GSM\TDMA	10/29/96		10,000	365,000	846,000	1,500,000
PrimeCo	CDMA	11/13/96		38,000	387,000	902,000	1,400,000
Omnipoint	GSM	11/14/96		N/A	141,000	375,500	935,000
Centennial Cellular (3)	CDMA	12/12/96		16,900	50,700	98,700	161,800
Sprint PCS (1) (4)	CDMA	12/16/96		1,333	887,000	2,586,000	5,727,000
GTE (5)	CDMA	2/18/97			N/A	N/A	N/A
Aerial Communications	GSM	3/27/97			125,000	311,900	423,000
Airadigm	GSM	5/3/97			N/A	N/A	N/A
AT&T	TDMA	6/5/97			60,000	600,000	1,400,000
Horizon PCS (7)	CDMA	8/29/97			N/A	N/A	N/A
US West Communications	CDMA	9/23/97			15,000	185,000	466,000
WirelessNorth	CDMA	10/1/97			N/A	N/A	N/A
Third Kentucky Cellular (8)	GSM	10/7/97			N/A	N/A	N/A
Intelos	CDMA	10/9/97			N/A	13,400	43,300
NPI Wireless	GSM	10/13/97			N/A	N/A	N/A
US Unwired (7)	CDMA	Nov-97			N/A	5,698	33,690
PCS One (9)	GSM	11/17/97			N/A	16,000	50,000
DIGIPH PCS	GSM	1/22/98				N/A	N/A
Poka Lambro	CDMA	Jan-98				N/A	N/A
Southeast Telephone	GSM	2/8/98				N/A	N/A
ALLTEL	CDMA	2/23/98				N/A	N/A
3 Rivers Wireless	CDMA	3/30/98				N/A	N/A
Hargrey Wireless	CDMA	4/1/98				N/A	N/A
Blackfoot Communications	CDMA	4/8/98				N/A	N/A
Rural Cellular (10)	GSM	4/21/98				5,129	14,198
Conestoga Enterprises	GSM	5/1/98				N/A	9,800
Cincinnati Bell (11)	TDMA	5/5/98				56,000	162,466
Via Wireless (7)	CDMA	7/15/98				N/A	N/A
Ameritech (5)	CDMA	7/21/98				N/A	N/A
Lifecom	CDMA	8/10/98				N/A	N/A
Century Telephone Enterprises	TDMA	8/12/98				N/A	N/A
Panhandle Telecomm. Systems	GSM	9/22/98				N/A	N/A
Chase Telecommunications	CDMA	9/23/98				3,500	22,000
Alaska Digitel	CDMA	10/26/98				N/A	N/A
Iowa Wireless Services (12)	GSM	11/6/98				N/A	N/A
Amica Wireless	CDMA	12/14/98				N/A	N/A
Cellular South	TDMA	1/20/99					N/A
Triton PCS (11)	TDMA	1/26/99					195,204
Telecorp (11)	TDMA	2/4/99					142,231
Southwest PCS (7)	CDMA	3/22/99					N/A
Industar (6)	TDMA	4/1/99					N/A
South Central (Utah) Comm.	CDMA	4/1/99					N/A
PinPoint Communications	GSM	2Q99					N/A
Pyxis Communications	CDMA	April 99					N/A
Roseville Communications	CDMA	6/11/99					N/A
ALAMOSA PCS (7)	CDMA	6/22/99					31,850
SOL Communications (12)	GSM	7/19/99					N/A
UBTA Communications	CDMA	9/16/99					N/A
Souris River Telecommunications	CDMA	9/20/99					N/A
Clearcomm	CDMA	9/23/99					N/A
Tritel (11)	TDMA	9/27/99					24,600
Airgate PCS (7)	CDMA	1/3/00					-

Sources: Except as noted below, all subscriber figures come from operators' news releases and filings made with the Securities and Exchange Commission.

Notes:

(1) APC/Sprint and Sprint PCS subscriber totals prior to 1998 are based on the average of estimates made by: Salomon Smith Barney, Paul Kagan Associates, Inc., and Merrill Lynch.
(2) SBC Communication's information includes the PCS operations added with the acquisition of Pacific Telesis. SBC launched its lone existing broadband PCS license in Tulsa on 5/22/97.
(3) Centennial Cellular's subscriber figures are as of November 30 of each year.
(4) Sprint PCS acquired APC/Sprint Spectrum on January 6, 1998. APC/Sprint Spectrum's 4th quarter 1997 subscribers are included with Sprint PCS.
(5) GTE and Ameritech reported their broadband PCS subscribers with their existing cellular operations.
(6) Due to technical problems with its original network, Industar shut down its original network and is working on deploying a newer, more robust network.
(7) Entered in affiliation agreements with Sprint PCS.
(8) Operates under the name Wireless 2000.
(9) PCS One is a joint venture between D&E Communications and a subsidiary of VoiceStream.
(10) Rural Cellular controls 51% of Wireless Alliance LLC, a joint venture between it and VoiceStream (formerly Aerial Communications).
(11) Joint Venture with AT&T.
(12) Joint Venture with VoiceStream.

Tables 9A - 9G: Broadband PCS Rollout Summary

Table 9A: Estimated Broadband PCS Rollouts by Number of Providers in a County

Number of PCS Providers in a County	POPs in Those Counties (1)	% of Total US POPs	Square Miles in Those Counties	% of Total US Counties
1 or More	217.3 million	85.9%	1,167,000	32.4%
2 or More	186.9 million	73.9%	641,000	17.8%
3 or More	95.3 million	37.7%	257,000	7.1%
4	11.9 million	4.7%	51,000	1.4%

Table 9B: Estimated Broadband PCS Rollouts by Number of Providers in a BTA

Number of PCS Providers in a BTA	Number of BTAs	POPs in Those BTAs (1)	% of Total US POPs
1 or More	352	234.3 million	92.7%
2 or More	245	210.4 million	83.2%
3 or More	109	114.4 million	45.2%
4	18	15.8 million	6.2%

Table 9C: Estimated Broadband PCS Rollouts by Technology by County

Technology	POPs in Those Counties (1)	% of Total US POPs	Square Miles in Those Counties	% of Total US Counties
CDMA (2)	191.4 million	75.7%	786,000	21.8%
GSM	165.3 million	65.3%	790,000	21.9%
TDMA	81.3 million	32.1%	298,000	8.3%

Table 9D: Estimated Broadband PCS Rollouts by Technology by BTA

Technology	Number of BTAs	POPs in Those BTAs (1)	% of Total US POPs
CDMA (2)	257	211,984,215	83.9%
GSM	250	180,888,064	71.6%
TDMA	126	97,511,255	38.6%

Table 9E: Estimated Broadband PCS Rollouts by Service Block by County

Service Block	POPs in Those Counties (1)	% of Total US POPs	Square Miles in Those Counties	% of Total US Counties
A	181.1 million	71.6%	676,000	18.8%
B	189.4 million	74.9%	714,000	19.8%
C (4)	36.5 million	14.4%	200,000	5.6%
D	95.9 million	37.9%	340,000	9.4%
E	61.2 million	24.2%	308,000	8.6%
F	39.3 million	15.5%	223,000	6.2%

Table 9F: Estimated Broadband PCS Rollouts by Service Block by BTA

Service Block	Number of BTAs (3)	POPs in Those BTAs (1)	% of Total US POPs
A	210	198,472,177	78.6%
B	250	209,357,087	82.9%
C (4)	83	37,926,975	15.0%
D	132	108,837,628	43.1%
E	96	68,165,625	27.0%
F	63	43,968,412	17.4%

Table 9G: Estimated Broadband PCS Rollout by County Quartile

County Quartile Based on Population	Number of Counties in Quartile	Number of Counties with PCS Rollout	Percent of Counties in Quartile with PCS Rollout	POPs in Counties (1) with PCS Rollout	Percent of Quartile POPs with PCS Rollout
1st Quartile	808	693	85.8%	197,166,387	95.1%
2nd Quartile	808	424	52.5%	15,097,410	53.7%
3rd Quartile	808	270	33.4%	4,472,002	34.9%
4th Quartile	809	97	12.0%	732,061	15.2%

Table 9H: Estimated Broadband PCS Rollout by BTA Quartile

BTA Quartile Based on Population	Number of BTAs in Quartile	Number of BTAs with PCS Rollout	Percent of BTAs in Quartile with PCS Rollout	POPs in BTAs (1) with PCS Rollout	Percent of Quartile POPs with PCS Rollout
1st Quartile	123	120	97.6%	190,662,794	99.2%
2nd Quartile	123	105	85.4%	28,635,344	85.8%
3rd Quartile	123	72	58.5%	10,561,590	59.5%
4th Quartile	124	55	44.4%	4,419,770	47.7%

Notes:
(1) POPs from 1990 Census.
(2) The CDMA coverage includes Sprint PCS' CDMA overlay in the Washington, DC and Baltimore, MD BTAs of the APC/Sprint Spectrum GSM-based network.
(3) There are several BTAs where a single operator controls multiple license blocks. This analysis assumes that they are all in use (except for AT&T's DEF block licenses). This was not done in the *Third Report*, making the numbers from Table 13C not comparable with the equivalent table in the *Third Report*.
(4) A number of licensee returned their C block licenses as a part of the June 1998 elections and switched to using licenses owned by Sprint PCS in the A or B blocks.

Table 10: Broadband PCS Spectrum Usage

Spectrum Used (MHz)	POPs in Those Counties	Percent of Total POPs
120	0	0.0%
110	4,590,000	1.81%
100	1,258,000	0.50%
95	1,193,000	0.47%
90	3,689,000	1.46%
85	201,000	0.08%
80	34,327,000	13.57%
75	7,464,000	2.95%
70	56,972,000	22.52%
65	373,000	0.15%
60	53,923,000	21.31%
55	649,000	0.26%
50	8,037,000	3.18%
45	3,203,000	1.27%
40	13,063,000	5.16%
35	973,000	0.38%
30	19,480,000	7.70%
25	777,000	0.31%
20	3,392,000	1.34%
15	439,000	0.17%
10	3,462,000	1.37%
0	35,523,000	14.04%

Table 11: Top 20 Mobile Telephone Resellers: 1998 and 1999

1998		1999	
Operator	**Resale Subscribers**	**Operator**	**Resale Subscribers**
MCI Worldcom	565,000	MCI Worldcom	950,000
Progressive Concepts	76,000	Progressive Concepts	77,500
Prime Matrix Wireless	72,000	CellNet Communications	55,000
Connecticut Telephone	70,000	Discount Cellular Inc.	46,079
CellNet Communications	65,000	Prime Matrix Wireless	46,000
Select Wireless	40,000	DCN Wireless/Robo Wireless	41,896
DCN Wireless/Robo Wireless	39,414	Select Wireless	40,000
Discount Cellular Inc.	24,831	Anything Wireless	28,000
Cellular Plus Systems	22,000	Fox Communications	26,000
Marathon Communications	21,000	Cellular Plus Systems	23,000
Phase 2 Cellular	20,000	Marathon Communications	20,000
Cellnet of Ohio Inc.	17,500	Cellnet of Ohio Inc.	17,650
SkyNet	15,677	SkyNet	17,609
CoreComm	15,031	Car Phones Express	14,863
The Mobile Phone Co.	13,000	The Mobile Phone Co.	11,500
One Source Communications	11,500	Pacific Cellular	10,500
Pacific Cellular	10,200	San Diego Wireless	10,162
Cellular Dynamics	10,000	Apex Wireless	8,500
Car Phones Express	10,000	Personal Cellular Service	3,700
San Diego Wireless Comm.	8,100	Phase 2 Cellular	3,500
Total	1,126,253		1,451,459
MCI WorldCom's Percentage of top 20	50.2%		65.5%

Sources:
1998: *RCR Top 20 Wireless Resellers*, RCR RADIO COMMUNICATIONS, Jan. 11, 1999, at 16.
1999: *RCR Top 20 Resellers*, RCR RADIO COMMUNICATIONS, Jan. 10, 2000, at 16.

Notes:
America One Communications, Inc. does not publicly report its resale subscribers.

APPENDIX C:
MOBILE DATA

Table of Contents

Table 1: Mobile Data Forecasts

I.Source	**Forecast**
Allied Business Intelligence	600 million WAP-enabled handsets shipped between now and 2005, accounting for 1/3 of all handsets.
Cahners In-Stat Group	784,000 wireless data business customers in 1999, 9 million by 2003, and in the overall market, 1.7 million subscribers in 1999 to 24 million by 2003.
Datacomm Research Inc.	350 million smart phones and PDAs shipped by 2003.
Dataquest	By 2003, 66.7 percent of all wireless data subscribers will use SMS and 19 percent of wireless data subscribers will be made up of two-way paging.
Dataquest	3 million U.S. wireless data users in 1999 and 36 million by 2003 (includes paging).
Dataquest	1.4 million wireless data subscribers in 1998. Expected to double by 1999 and 36 million by 2003, including more than $3 billion in revenue.
Frost & Sullivan	$56.3 million in smart phone revenues in 1998 and will reach $1.84 billion in 2005.
Gartner Group	40 percent of e-commerce transactions outside the U.S. will be done via mobile devices.
Gartner Group	More than 95 percent of mobile phones shipped in 2004 will be WAP-enabled.
Gartner Group	More than 75 percent of new handsets shipped in 2004 will be Bluetooth enabled.
IDC	By year end 1999, SMS achieved 11 percent penetration in Western Europe.
IDC	9 million U.S. subscribers capable of receiving SMS in 1998, by 2003, more than 68 million.
Jupiter Communications	1.1 million users of browser-enabled mobile phones this year to 79.4 million in 2003.
Killen & Associates	$37.5 billion in revenues for wireless Internet applications by 2002.
Ovum	21 million smart phones worldwide by end of 2000, 48 million by 2002 and 204 million by 2005.
Ovum	By 2004, smart phones and data-centric devices will comprise two-thirds of the estimated worldwide handset market.
Phone.com	By 2003, more than one-half of world's estimated one billion mobile phone subscribers will be connected to the Internet.
Strategy Analytics	95 percent of smart phones shipped to U.S. and Europe in 2003 will be WAP enabled and 70 percent will have Bluetooth technology.
Strategy Analytics	750 million wireless data users worldwide by 2010 – 75 percent penetration for U.S. and Western Europe.
The Strategis Group, Inc.	14.3 million wireless data users by 2003 with revenues of $3.8 million.
The Strategis Group, Inc.	$8 billion in U.S. by 2004 and $33.5 billion globally by 2004 (equipment and services). Subscriber revenue of $4.8 billion in 2003 and $5.8 billion in 2004.
Yankee Group	21.3 million mobile data users by the end of 2001 and 28 million by 2002, about 75 percent for e-mail.
Yankee Group	3 million wireless Internet users in 1999, by 2004 more than 50 million.

Sources: Brad Smith, *Wireless Data Markets Poised To Explode*, WIRELESS WEEK, Sept. 13, 1999, at 38-39; *Spyglass Inside Mobile Data – Market Statistics* (visited June 21, 2000) <http://webnotes.ostrech.com/mdexpert/stats.html>; Brad Smith, *How Steep Is Data Growth? Try A Hockey Stick Analogy*, WIRELESS WEEK, Nov. 1, 1999, at 26; Ed Lopez, *Wireless Data: Sell It Or Lose All*, WIRELESS WEEK, Dec. 13, 1999, at 12; Paul A. Greenberg, *Why Is Wireless Taking So Long?*, E-COMMERCE TIMES, Dec. 1, 1999, <wysiwyg://7/http://www.ecommercetimes.com/news/articles/991201-2.shtml>; Charles Mason, *What Have We Wrought?*, AMERICA'S NETWORK, July 1, 1999, *available in* 1999 WL 11825376; *Data-Enabled Wireless Handsets To Gain Huge Market Share, Research Group Ovum Says*, PCS WEEK, July 21, 1999, *available in* 1999 WL 7870989.

Table 2: 3G Spectrum Allocation Plans of European Countries

Country	Spectrum Allocated (MHz)	Number of Licenses	Assignment Method	Schedule	
				Auction/ Tender	Award of Licenses
Austria	145	4-6	Auction (with pre-qualification based on assessment of technical & economic abilities)	Nov. – Dec. 2000 (assessment from July to Sept. 2000)	Q4 2000/ Q1 2001 (14 days after auction ends)
Belgium	NA	4	Undecided but leaning toward auction	Sept. 2000	Dec. 2000
Denmark	155	5	Auction	NA	NA
Finland	140	4	Beauty contest	Jan.-Feb. 1999	March 1999
France	140	4	Beauty contest with entrance fee	Nov. or Dec. 2000	1st half of 2001
Germany	145	4-6	Auction	July- Aug. 2000	
Italy	125	5	Combination (prequalification beauty contest followed by competitive bids)	June-Sept. 2000	Nov. 2000
Ireland	140	4	Beauty contest		Apr.-May 2001
Netherlands	145	5	Auction	July 2000	Q3 2000
Norway	140	4	Beauty contest	Q3 2000	Oct./Nov. 2000
Portugal	140	4	Beauty contest	Q3 2000	Q1 2001
Spain	120	4	Beauty contest		March 2000
Sweden	140	4	Beauty contest	Sept. 2000	Nov. 2000
Switzerland	95 (1/1/02) 140(1/1/06)	4	Auction	Nov. 2000	
UK	140	5	Auction	Mar.-Apr. 2000	May 2000

Sources: Publicly available information such as Web sites of national regulatory authorities and the following publications: Dennis H. Leibowitz, *The Global Wireless Communications Industry*, Donaldson, Lufkin & Jenrette, Summer 2000, at 65; Maija Pesola, *3G Auctions: Country-By-Country Guide*, FINANCIAL TIMES, July 5, 2000.

Table 3: Contracts

Hardware Company	Carrier Company	Announcement	Geographic Location	Value	Summary
Ericsson	BellSouth Mobility	June 1999	United States	$750 Million	Ericsson is replacing BellSouth's TDMA infrastructure in order to facilitate migration to 3G EDGE technology.
Ericsson	Rogers Cantel	October 1999	Canada	$340 Million	The contract concentrates on evolving Cantel's 2G TDMA network into a 3G infrastructure.
Ericsson	NTT Mobile Communications Network Inc.	October 1999	Japan	N/A	Ericsson was selected to provide WCDMA mobile phones and base stations to NTT DoCoMo.
Nokia	Telefonica Moviles	November 1999	Spain	N/A	The companies have signed an agreement in which Nokia will provide the core network architecture based on GPRS technology.
Siemens AG & NEC Corp.	N/A	November 1999	Germany & Japan	$10 Million	The companies have formed a joint venture to address the market for radio infrastructure equipment for 3G mobile communications.
Nokia	Smart Communications	November 1999	Philippines	$150 Million	Nokia will supply and install base stations, switches and related equipment, including a WAP platform and GPRS nodes.
Nokia	Globe Telecom GMCR Inc.	November 1999	Philippines	$30 Million	Nokia will supply and install base stations, switches and related equipment, including a WAP platform and GPRS nodes.
QUALCOMM	Korea Telecom Freetel	November 1999	South Korea	$200 Million	QUALCOMM has agreed to invest in KT Freetel upon successful completion of technical and marketing trials of HDR.
Ericsson	Royal KPN NV	November 1999	United Kingdom	N/A	KPN has awarded Ericsson an order for the delivery of a test network for the deployment of GPRS technology on its existing GSM system.
Ericsson	Vodafone AirTouch	December 1999	United Kingdom, Greece, & Netherlands	N/A	Vodafone has appointed Ericsson as its supplier for GPRS technology. Commercial availability is anticipated in Fall of 2000.
Nokia	KG Telecom	December 1999	Taiwan	$250 Million	Nokia has been an awarded to evolve KG Telecom's existing infrastructure to a GPRS network solution.
Ericsson	Far EasTone Telecommunications	December 1999	Taiwan	N/A	Ericsson will provide the first commercial roll-out of GPRS in Taiwan and its surrounding islands.
Alcatel	Vodacom	January 2000	South Africa	N/A	Alcatel will provide an end-to-end GPRS system providing data and IP services.
Motorola	T-Mobil	January 2000	Germany	Mulit-Million	T-Mobil has chosen Motorola's GPRS core network system solution for implementation on a countrywide GSM communications network.
Motorola	Telsim	February 2000	Turkey	~1.5 Billion (over 3 yrs)	Telsim has selected Motorola to expand its current GSM system and implement a full trial overlay of GPRS technology.
Ericsson	Pacific Bell Wireless	February 2000	United States	Multi-Million	Pacific Bell has selected Ericsson to provide GPRS technology on its existing network.
Ericsson	Finnish 2G Ltd.	February 2000	Finland	N/A	First-ever agreement for a commercial end-to-end 3G system has been awarded to Ericsson by 2G ltd. Ericsson will integrate 2G's existing GSM network with 3G cpabiities.
3Com Corporation & Samsung Electronics	N/A	February 2000	N/A	N/A	The companies have agreed to jointly deliver CDMA2000 high-speed wireless networks to service providers worldwide.
Ericsson	Alands Mobiletelefon Ab	March 2000	Finland	N/A	Ericsson has been selected as the sole supplier of a fully integrated 3G system and GSM system based on GPRS technology.
Ericsson	Orange	March 2000	United Kingdom	$58 Million	Orange has selected Ericsson to provide a GPRS system including the IP-based core network infrastructure and new terminal devices.
Alcatel & Fujitsu	N/A	May 2000	Europe & Japan	N/A	The companies have entered into a joint venture to develop and manufacture next-generation mobile communications network equipment.

Source: The information provided above is illustrative of technology contracts and should not be considered an exhaustive list. Information is based on publicly available documents such as news releases and newspaper and periodical articles.

Table 4: Tests/Trials

Hardware Company	Carrier Company	Announcement	Geographic Location	Summary
Multiple	Multiple	April 2000	South Korea	CDMA Development Group, Bell Mobility, Nortel Networks, QUALCOMM, Samsung, and Sprint PCS announced they will bring deployment of CDMA 1x technology to Korea in late 2000.
N/A	E-Plus	February 2000	Germany	The company has begun testing of GPRS technology on its network to support connectivity with its cellular Internet service provider operation.
Ericsson	AT&T	October 1998	United States	Ericsson is beginning trials of 3G technologies using spectrum provided by AT&T Wireless Services.
	Omnipoint Communications (merged with VoiceStream)	February 1999	United States	Ericsson and Omnipoint Communication Services have signed the first agreement to provided GPRS in the United States. The companies agreed to conduct field trials of several GPRS applications in the Omnipoint PCS 1900 MHz network commencing in December, 1999.
	Telia	September 1999	Sweden	The companies have demonstrated live roaming between a commercially deployed GSM network and a 3G system.
	N/A	October 1999	Global	The company announced it will deliver GPRS systems to more than 45 operators in the Americas, Asia-Pacific, and Europe for GPRS field trials.
	Telexis Corporation	November 1999	Canada	Ericsson and Telexis have signed an agreement to test and demonstrate a Telexis wireless video monitoring application using WCDMA technology.
	Microcell Connexions	December 1999	Canada	The companies announced that they have begun testing 3G
	Telesystem International Wireless	April 2000	Brazil	The companies performed the first 3G call in Brazil, utilizing EDGE, a technology designed for migration of existing TDMA and GSM networks.
	ATL	April 2000	Brazil	The companies announced an agreement to evaluate migration of existing infrastructure to 3G wireless technologies. The agreement encompasses early studies of end-user behavior and usage, new business logic as well as technical requirements.
Lucent Technologies	AT&T	April 1999	United States	The companies have agreed to test 3G technologies such as EDGE and GPRS for future network evolutions.
	Telestra	May 1999	Australia	The companies announced that they will collaborate to assess the market for 3G wireless network architecture and the associated services through trials with selected customers. Trials are anticipated in June 2000 on CDMA 1XRTT technology.
	N/A	October 1999	United States	The company announced the successful completion of the first call on a prototype wideband radio platform designed to help network operators dramatically increase the calling capacity and data speeds utilizing TDMA technology. This achievement will allow for graceful evolution to 3G systems.
	Sprint PCS	October 1999	United States	Sprint and Lucent announced they will conduct a technology trial of 3G CDMA technology in the first half of 2000. The trial will focus on verifying the performance of the 3G 1X Radio Transmission Technology (RTT).
	Sprint PCS	June 2000	United States	Will test 1x Evolution (1xEV) technology which is based on HDR and incorporates 1xRTT.
	Symmetry Communications Systems	January 2000	United States	Symmetry and Lucent have agreed to collaborate on interoperability testing of 2.5G wireless network elements.

Hardware Company	Carrier Company	Announcement	Geographic Location	Summary
Lucent Technologies	Radio Design AB	April 2000	Sweden	The companies have announced plans to cooperatively support the introduction of 3G CDMA mobile networks to the Nordic Mobile Telephone 450 Market.
	QUALCOMM	April 2000	United States	The companies have collaborated on 3G wireless data technology, resulting in the first live transmissions of over-the-air data using cdma2000-1x technology.
Motorola	BT Cellnet	November 1999	United Kingdom	The companies announced the successful completion of the first live GPRS data transfer call over a live GSM network.
	N/A	February 2000	United States	The company announced the successful completion of a voice over Internet protocol (VoIP) call on top of a 3G high-speed packet data call at 384 Kbps.
Multiple	Multiple	November 1999	South Korea	SK Telecom, LG Information & Communication, Daewoo Telecom, Hyundai Electronics and 49 smaller firms in South Korea agreed to work together to develop a WCDMA system, with a trial system to be completed for IMT-2000 service in December 2000.
Nokia	Cable & Wireless HKT Mobile Services	February 2000	China (Hong Kong)	The companies have completed the first phase of trials on 3G mobile phone technology in Hong Kong. The trials are leading to commercial release late in 2001 or early in 2002.
	Vodafone New Zealand	February 2000	New Zealand	The companies have agreed to conduct a trial of GPRS and Wireless Application Protocol (WAP) systems.
Nortel Networks	British Telecommunications plc	January 1999	United Kingdom	The companies announced the trial of a prototype 3G/Universal Mobile Telecommunications System equipment and terminals with the purpose of further understanding the market and technology drivers for future mobile IP and voice services.
	N/A	February 1999	France	The company announced the successful completion of packet-switched, mobile video conference calls and high speed Web browsing at transmission rates up to 384 kilobits per second using WCDMA 3G radio technology.
	Sprint	April 1999	United States	The companies recently demonstrated high-speed data, voice and video applications using cdma2000 3G radio technology.
	France Telecom	June 1999	France	The companies announced France's first trial of a 3G UMTS mobile communications network.
	Bell Mobility	December 1999	United States	The companies announced plans for conducting trials of cdma2000 technology.
	Vodafone UK	December 1999	United Kingdom	The companies announced they are planning a trial in London, during early 2000, of WCDMA wireless radio and Internet Protocol networking technologies.
	N/A	March 2000	Canada	The company announced the completion of a series of 3G wireless calls, claiming the industry's first wireless packet data sessions using CDMA2000 1xRTT.
QUALCOMM	US West & Cisco Systems	February 1999	United States	The companies announced that they would conduct trials of High Data Rate (HDR) technology in order to deliver very high-speed Code Division Multiple Access (CDMA) wireless Internet access.
	Korea Telecom Freetel	January 2000	South Korea	The carrier is planning to launch a trial network of the 3G mobile communication service using CDMA2000. The network is planned for release in 2000 and will include a trial service of HDR packet data service developed by QUALCOMM.

Hardware Company	Carrier Company	Announcement	Geographic Location	Summary
QUALCOMM	Sprint PCS & Samsung Telecommunications America	March 2000	United States	The companies announced that they have successfully completed the first voice call by a carrier using 3G CDMA 1x technology in North America.
	Sprint PCS	May 2000	United States	The companies announced U.S. trials of a 3G CDMA 1x Multi-Carrier (MC) voice and data solutions began in April 2000.

Sources: The information provided above is illustrative of tests and trials and should not be considered an exhaustive list. Information is based on publicly available documents such as news releases and newspaper and periodical articles.

Table 5: Smartphones

Smart Phone/Model	Manufacturer	Price	Features	Notes
NeoPoint 1000	NeoPoint	$300.00	Web Browser; PDA functions; sync hardware and software; voice activated dialing; FAX capabilities.	Available through Sprint
NeoPoint 1600	NeoPoint	N/A	Same as above. This is the dual band version.	Available later this year
Nokia 8860	Nokia	$700.00	PDA functions (alarm, calendar, calculator, scheduler), dual band.	Available through AT&T
Nokia 8890	Nokia	N/A	Same as above. Also includes three language predictive text (for text messaging); photo messaging (incl downloading photos); currency converter, fax capable.	Available later this year
Nokia 7100	Nokia	N/A	WAP-compliant microbrowser, appointment calendar.	Available later this year
Nokia 8260	Nokia	N/A	Email and text messaging, appointment book with predictive text input.	Available later this year
MobileAccessT250	Mitsubishi	$199.99	Web Browser; PDA functions; FAX capabilities.	Available through AT&T
Ericsson R320	Ericsson	$99.99	Web browser, predictive text features.	Available through AT&T
QCP-2760	Qualcomm	$129.99	Mini-browser, dual band.	Available through Sprint
pdQ Smartphone	Qualcomm	$799.99	Mini-browser, PDA functions, digital band only.	Available through Sprint
i500plus	Motorola	$99.00	Smartphone, Web minibrowser, two-way radio technology.	Available through Nextel
i700plus	Motorola	$149.00	Smartphone, Web minibrowser, two-way radio technology.	Available through Nextel
i1000plus	Motorola	$199.00	Smartphone, Web minibrowser, two-way radio technology.	Available through Nextel
Timeport P8167	Motorola	$299.99	WAP-compliant microbrowser, FAX capabilities.	Available through Sprint
StarTAC ST7867W	Motorola	$229.99	PDA functions, Web minibrowser.	Available through Sprint
StarTAC ST7868W	Motorola	$249.99	PDA functions, Web minibrowser.	Available through Verizon Wireless
Talkabout T8167	Motorola	$249.99	WAP-compliant microbrowser, FAX capabilities.	Available through Sprint
CDM9000	Audiovox	$199.00	Web browser, dual band.	Available through Verizon Wireless

Sources: The information provided above is illustrative of the smartphones available and should not be considered an exhaustive list. Information is based on publicly available documents such as news releases, company Web sites, and newspaper and periodical articles.

Table 6: WAP-Enabled Handsets

Phone/Model	Manufacturer	Price	Features	Availability
Nokia 7110	Nokia	N/A	WAP-compliant browser, PDA functions	Available in Europe, Asia and Africa
Nokia 6210	Nokia	N/A	WAP-compliant browser, PDA functions	Available in Europe, Asia and Africa
Nokia 9110I	Nokia	N/A	WAP-compliant browser, keyboard, PDA functions, digital camera connectivity	Available in Europe, Asia and Africa
VIEW db @	Alcatel	$231.00	WAP-compliant browser	Targeted at European markets, launched March 2000
MobileAccessT250	Mitsubishi	$199.99	WAP-compliant browser; PDA functions; FAX capabilities	Available through AT&T
Ericsson R320	Ericsson	$99.99	WAP-compliant browser, predictive text features	Available through AT&T
Ericsson MC218	Ericsson	N/A	WAP-compliant browser, predictive text features	Targeted at European markets
Neopoint 1000	Neopoint	$299.99	WAP-compliant browser, PDA functions	Available through Sprint PCS
QCP-2760	Qualcomm	$129.99	WAP-compliant browser, FAX capabilities	Available through Sprint PCS
QCP-3035	Qualcomm	N/A	WAP-compliant browser, PDA functions	Launched March 2000
PdQ	Qualcomm	$799.99	WAP-compliant browser, PDA functions	Available through Sprint PCS
i500plus	Motorola	$99.00	WAP-compliant browser, two-way radio technology.	Available through Nextel
i700plus	Motorola	$149.00	WAP-compliant browser, two-way radio technology.	Available through Nextel
i1000plus	Motorola	$199.00	WAP-compliant browser, two-way radio technology.	Available through Nextel
Timeport P8167	Motorola	$299.99	WAP-compliant microbrowser, FAX capabilities.	Available through Sprint PCS
StarTAC ST7867W	Motorola	$229.99	WAP-compliant microbrowser, FAX capabilities.	Available through Sprint PCS
Talkabout T8167	Motorola	$249.99	WAP-compliant microbrowser, FAX capabilities.	Available through Sprint PCS
SGH-A110	Samsung	N/A	WAP-compliant browser	Available in Europe, being introduced in Asia now.
SCP-4000	Sanyo	$149.99	WAP-compliant browser	Available through Sprint PCS

Sources: The information provided above is illustrative of the WAP-enabled handsets and should not be considered an exhaustive list. Information is based on publicly available company documents such as news releases, company Web sites, and newspaper and periodical articles.

Table 7: Internet Access Services Provided by Mobile Telephone Operators

ISP	Cost per month	Notes
AT&T PocketNet	Free – existing customers (access to ~ 40 Web sites) $6.99 to $14.99 for additional services	Targeted for business and their mobile professionals.
GoAmerica	$9.95 for 25k $59.95 unlimited	Available to RIM, Novatel Wireless Minstrel II, Sierra Wireless AirCard 300, and RIM Wireless PC card (and recently to Handspring Visor).
MobileLogic Web	$70.00	Consists of a complete solution for wireless Web access - software, wireless Internet airtime, wireless data modem, and technical support. MobileLogic.Web software compresses and optimizes the Web page to deliver a faster transmission over the wireless link.
Nextel Online	From $14.95	Partnered w/ MSN Mobile. Allows Internet access via Nextel phone or utilize phone as a modem for full Web access.
OmniSky	$39.95 unlimited	Currently only available for the Palm V-series, but will be extended for Windows CE/Pocket PC, pagers, and WAP phones.
Palm.Net	From $9.99 limited vol. $44.99 unlimited	Available only to the Palm VII. Limited to e-mail and Web-clipping.
Ricochet	$29.00	Utilizes Microcell Radios and Wired Access Points in coverage areas (San Francisco Bay Area, Seattle, Washington D.C., major airports and selected corporate campuses across the United States). Requires use of a Metricom Mobile Modem.
Sprint PCS Wireless Web	From $9.95 with Sprint PCS plan	Calling plan minutes can be used for either calls or Internet.
Verizon Wireless	$6.95	Allows users to customize either the handset or through MyVWZ.com, Verizon's portal.
VoiceStream	$4.99	Allows limited Internet e-mail capacity and basic Web info in the form of text messages for stock quotes, sports scores, etc. Powered by InfoStream (Infospace).

Sources: The information provided above is illustrative of Internet access services provided by mobile telephone operators and should not be considered an exhaustive list. Information is based on publicly available company documents such as news releases, company Web sites, and newspaper and periodical articles.

Table 8: Wireless Portals Providers

Portal	Services	Comments
AirFlash.com	Offers location-specific information (current location pinpointed by wireless service provider) to consumers such as restaurants and stores. Also provides ability to conduct transactions (m-commerce). Transactions billed straight to the phone bill. Access through SMS, WAP, or automated, voice-based system.	Combination of AirFlash and Inktomi. Alliance with Excite@Home.
Amazon.com Anywhere (amazon.com/phone)	Offers access to Amazon.com shopping and search for entire product lines. Also provides product details, product reviews, and order information (supports international addresses). Provides a "gift click" feature that allows customers to easily select and send a gift by providing the recipient's e-mail address.	Partnered with Sprint PCS
AOL Anywhere (aol.com)	Using popular AOL content, brands and services, consumers will be able to use various wireless platforms to access AOL Mobile Messenger and Digital City Wireless.	In development and roll-out. AOL has partnered with Sprint PCS, Nokia, Motorola, Research in Motion, BellSouth and Arch Communications.
AvantGo.com	Offers a free interactive service aimed at providing personalized content and access to Internet channels. AvantGo users can access the entire Web directly from their mobile devices or they can select from over 350 content channels that have been optimized for the small screen.	Available for handhelds, and rolling out for WAP in the coming months.
BarPoint.com	This is a portal that provides barcode-based information to consumers. Offers UPC-based searches for books and audio books, DVDs and videos, music, and computer hardware and software. Also includes e-mail alerts for specials and news releases, as well as a Web Clipping Application for handhelds.	N/A
Bolt.com	Bolt targets 15 to 20 year olds, and its services are free to end users. Its "BoltEverywhere" service bottles its messaging applications (branded as BoltNotes, Bolt Tagbooks and BoltPolls) with personalized content such as horoscopes.	Has deals with AOL, Lycos, Hotmail and Yahoo!
BrowseNow (uswest.net) (uswestwireless.com)	Subscription cost of $9.95. Offers personalized content and bookmarks for subscribers through MyUSWEST, offers email, and provides account management self-service through MyDesk. Also includes a directory Yellow Pages and driving directions through USWESTDex.	Owned by US WEST and is primarily a value-added feature for US WEST Wireless ISP customers.
Excite@Home Wireless (www.home.net)	Services include access to personalized applications and content, including Excite Planner and Excite Inbox.	Currently available to Palm VII users. In conjunction with Airflash.com and AT&T PocketNet. In development.
InfoSpace.com	Offers a Personal Desktop Portal which includes Instant Messaging, Multi-Party private text chat and Buddy Lists that work with MSN Messenger Service and the user's personal address book.	This is the platform used by many other pure wireless portals. InfoSpace.com is a true portal geared for the desktop, but it does offer wireless capabilities.
Iobox.com	Offers mobile content and services such as Mobile Messaging, Mobile Organizer, Mobile Fun, Mobile news and Information, and m-Commerce.	Targeted primarily at European market. Utilizes Ztango.com platform.
IQorder.com	Offers a Universal Shopping Portal that provides access to the Internet to compare products and prices, locate the nearest store, and even place an order. Additional information includes manufacturer's part numbers, brief product descriptions, pricing and shipping, and availability.	N/A
MobileID.com	Provides a personalized wireless portal where the user is able to set up the exact content they wish to receive and how it will look on cell phones/PDAs supporting WAP. Each mobileID user receives a personalized Web address (Wap.username.mobileid.com/) and can direct access any POP3 e-mail account.	N/A
MSN Mobile (mobile.msn.com)	Offers consumers customized services through Mobile Alerts and Mobile Web. Mobile Web users can customize their accounts to better serve their individual needs either by accessing MSN Mobile via a wireless device or by visiting the MSN Mobile Web site. Using the Web site, users can customize what kind of information they wish to receive, as well as when they want to receive that information.	May be currently limited to Web-enabled phones from Nextel or AirTouch.
My.AirTouch.net	As part of AirTouch's Mobile Web, this portal provides customers with a free, personal home page with an e-mail account. Users are able to customize their preferences and content.	Owned by Vodaphone (Verizon Wireless) and powered by InfoSpace.com
My.USWEST..net	This portal offers news, weather, information and much more, personalized and available from a PC and/or a PCS phone.	Requires use of US WEST BrowseNow software/micro-browser. US WEST..net ISP customers cost is only $9.95/mo, all others $14.95/mo.
MyAladdin.com	Offers location-specific information (utilizing GPS chip/battery) to consumers such as driving direction, restaurants and stores. Utilizes intelligent agent technology to provide the most appropriate data and to update the user's profile. Also capable of push-based content such as flight information. Includes over-the-air wireless synchronization with both office databases and Internet content, as well as reverse look-up of incoming calls.	Created by NeoPoint, Inc.

Portal	Services	Comments
MyGoWeb.net	Allows the user to customize the content that is accessed by Go.Web as well as target URL addresses. Users may also access their e-mail accounts.	A service of the GoAmerica wISP for Blackberry/RIM, and Palm users.
MySAP.com	Provides a Marketplace for an open electronic hub that creates seamless inter-company relationships for buying, selling and collaborating within and across industries. It provides infrastructure, security, applications and personalized format, as well as added features such as delivery of news, content and directories.	Currently working with Nokia's WAP server technology for mobile access.
MyTimeport.com	Service offered on Motorola Web-enabled phones. Offers users online customer support, a personal organizer, bookmarked Internet sites, and e-mail.	Owned by Motorola.
MyVoiceStream.com	Basic Web info and notification such as stock quotes and sports scores. Allows access to the user's individual mobile phone account. Powered by InfoSpace.	Offered on VoiceStream services.
MyVZW.com	By customizing the information desired via MyVZW.com, users can receive updates on stock portfolios, comparison shop, book flights, and make restaurant reservations.	Offered on Verizon Wireless services.
MyWay.com	Provides a highly personalized Web portal with a wide variety of Internet content. Aggregates content and applications from more than 65 leading information partners. Also features best-of-breed applications from CMGI operating companies, including AltaVista Search, Engage, Tribal Voice, Vicinity, and KOZ.	Owned by CMGI, Inc and partnered with Phone.com, Inc.
OracleMobile.com	Offers personalization features such as quick alerts, service presets and location-based services. Oracle's portal will add services that allow callers to talk directly to the page and have the Web content read to them. Current portal includes news, stocks and entertainment information, as a free service over the wireless Web.	N/A
Uk.Orange.net	The service allows users to surf the Internet over a wireless connection or receive information services such as a news feed over their phones; It also includes a personal organizer, Internet searching and online billing.	N/A
Pawgo.com	Basic portal for WAP devices that provides access to news, weather, sports, entertainment and technology news, phone directories, maps and travel information. PAW stands for Personal Anywhere Web.	Content targeted at European market, but is adding more North American content.
SmartRay.com	Offers mobile content and services such as news and stock quotes. Offers a lifetime email account (username@smartray.com) and an event reminder service to assist with scheduling. Also provides a device manager application that allows account management across a spectrum of device types and for multiple devices by a single user. E-mail and portal content are user-centric and portable across devices.	Partnered with FlyteComm Corp (realtime flight data)
Zed (sonera.fi/english/mobileportal/)	Offers communication & time management, mobile commerce, Internet content, and access to corporate applications and intranet content. Also includes access to travel and directory services.	Owned by Sonera and mainly targeted toward the Finnish area, but also covers major EU countries.
Strategy.com	Allows customers to view and receive personalized information about finance, news, sports, weather, and entertainment. Subscribers create a "favorites" folder for quick retrieval of important information. Also offers alerts.	Owned by MicroStrategy Inc.
MyDOF (Telia.com)	MyDOF is a GSM subscription that is integrated with the Internet, and is aimed at people who want to use their mobile phones for more than just making phone calls. Telia's WAP portal MyDOF offers some of the most popular information and transaction services from the Internet, adapted for WAP telephones.	Swedish market. Platform provided by Oracle and Nokia. May still be in pilot and testing stage.
Thinkmobile.com	Provides a news and information portal for mobile computing and technology interests. WAP access capable.	Somewhat limited and not able to be personalized.
Web2PCS.com	Allows users to receive scheduled and customized information on their WAP enabled and SMS enabled PCS phone. Services include Entertainment, Quick Message, Email2PCS, PCS Alerts, Info Now and Wireless Instant Messaging. Future products such as Wireless Games, Wireless Calendar Synchronization and a WAP Search Engine will be released in 2000.	Member of Phone.com Alliance program.
Wirelessgames.com	Primarily offers a portal for games ranging from simple quiz and puzzle games, to more elaborate multi-user games. Will also eventually offer news and other information services	N/A
Yahoo! Mobile (mobile.yahoo.com)	Based upon the main Yahoo! Portal and offers customized Yahoo! To Go for content and services, including e-mail and mobile alerts. Also provides for mobile shopping and a free software library for PDA downloads.	Also partnered with Sprint PCS as their default "portal."
Yodlee.com	Yodlee delivers true anytime, anywhere access to personal account information. With Yodlee2Go, users can securely access real-time personal account information on their PDA or Web-enabled phone. Users can log in to Yodlee from a PDA or mobile phone and review investments, confirm a hotel address, check flight reservations, and retrieve email subjects.	N/A

Sources: The information provided above is illustrative of wireless portals and should not be considered an exhaustive list. Information is based on publicly available company documents such as news releases, company Web sites, and newspaper and periodical articles.

Table 9: 1996 – 1999 Paging/Messaging Industry Numbers

	Paging/ Messaging Units	Percent Growth	Revenues	Percent Growth	Average Monthly Revenue Per Unit
1996	38,500,000	19.94%	$4,360,000,000	13.57%	$9.48
1997	43,200,000	12.21%	$4,531,000,000	3.92%	$8.85
1998	45,100,000	4.40%	$4,457,000,000	-1.63%	$8.41
1999	45,800,000	1.55%	$4,426,000,000	-0.70%	$8.12

Sources: THE STRATEGIS GROUP, INC., THE STATE OF THE US PAGING INDUSTRY: 1999 (1999).

Table 10: 1996 – 1999 Number of Paging/Messaging Units by Publicly-Held Company

Company	1996	growth	1997	growth	1998	growth	1999
PageNet	8,551,574	19.33%	10,204,743	-3.33%	9,864,908	-8.86%	8,991,000
Arch (1)	7,695,000	-5.26%	7,290,000	1.18%	7,376,000	-6.45%	6,900,000
Metrocall (2)	4,576,148	16.50%	5,331,177	6.16%	5,659,550	4.74%	5,927,939
Vodafone AirTouch (3)	2,850,000	8.81%	3,101,000	10.35%	3,422,000	n/a	n/a
WebLink Wireless	1,851,445	35.75%	2,513,337	4.19%	2,618,527	1.70%	2,662,995
Ameritech (4)	1,140,000	31.58%	1,500,000	2.80%	1,542,000	n/a	n/a
SkyTel (5)	907,300	20.90%	1,096,900	29.62%	1,421,800	n/a	n/a
American Paging (6)	777,400	4.33%	811,100	n/a	n/a	n/a	n/a
Preferred Networks	362,481	25.47%	454,795	15.50%	525,274	0.07%	525,622
Teletouch	195,500	64.25%	321,100	8.91%	349,700	12.73%	394,200
Paging Partners (7)	83,000	81.93%	151,000	19.87%	181,000	n/a	n/a
Aquis Communications	n/a	n/a	n/a	n/a	n/a	n/a	375,000

Sources: Information is based on publicly available company information such as news releases and filings made with the Securities and Exchange Commission.

Notes:

(1) In June 1999, Arch completed its acquisition of MobileMedia. The Arch figures for 1996, 1997, and 1998 include MobileMedia subscribers.
(2) On December 30, 1997, Metrocall completed its acquisition of ProNet. The Metrocall figures for 1996 include ProNet subscribers. On October 2, 1998, Metrocall completed its acquisition of AT&T. Metrocall's figures for 1996 and 1997 include the AT&T subscribers.
(3) Vodafone AirTouch does not report paging subscribers.
(4) Ameritech was acquired by SBC in 1999, which does not report paging subscribers.
(5) SkyTel was acquired by Worldcom, Inc. which does not report paging subscribers.
(6) American Paging was acquired by TSR Wireless, LLC, a privately held company in 1998.
(7) Paging Partners was acquired by Aquis Communications on March 31, 1999.

Table 11: 1996 – 1999 Revenues by Publicly-Held Company

Company	1996	growth	1997	growth	1998	Growth	1999
PageNet	$822,487	16.84%	$960,976	8.85%	$1,046,027	n/a	$989,723
Arch (1)	$972,080	-4.92%	$924,233	-6.59%	$863,316	-25.66%	$641,824
Metrocall (2)	$247,101	17.10%	$289,364	60.60%	$464,724	31.30%	$610,187
Vodafone AirTouch (3)	$343,000	7.58%	$369,000	13.55%	$419,000	n/a	n/a
Weblink Wireless	$221,592	25.36%	$277,778	12.19%	$311,652	4.34%	$325,165
SkyTel (4)	$330,239	14.27%	$377,366	28.87%	$486,304	n/a	n/a
American Paging (5)	$104,187	-9.38%	$94,413	n/a	n/a	n/a	n/a
Preferred Networks	$11,734	52.67%	$17,914	9.23%	$19,567	n/a	$17,033
Teletouch	$31,725	30.46%	$41,389	9.11%	$45,159	13.24%	$51,138
Paging Partners (6)	$6,910	31.24%	$9,069	n/a	$9,902	n/a	n/a
Aquis Communications	n/a	n/a	n/a	n/a	n/a	n/a	$31,159

Sources: Information based on publicly available company documents such as news releases and filings made with the Securities and Exchange Commission.

Notes:

(1) The Arch figures are pro forma figures estimated to include MobileMedia's operations.
(2) The Metrocall figures are pro forma figures estimated to include ProNet's operations. AT&T did not separately report paging figures.
(3) Vodafone AirTouch does not report paging figures.
(4) SkyTel was acquired by Worldcom, Inc. which does not report paging figures.
(5) American Paging was acquired by TSR Wireless, LLC, a privately held company in 1998.
(6) Paging Partners was acquired by Aquis Communications on March 31, 1999.

Table 12: 1996 – 1999 EBITDA/Operating Cash Flow by Publicly-Held Company

Company	1996	growth	1997	growth	1998	growth	1999
PageNet	$256,837	20.52%	$309,550	7.56%	$332,939	n/a	$205,980
Arch (1)	$210,187	-0.02%	$210,148	21.46%	$255,245	4.33%	$266,300
Metrocall (2)	$52,561	19.11%	$62,607	95.36%	$122,311	27.96%	$156,513
Vodafone AirTouch (3)	$87,800	23.01%	$108,000	13.89%	$123,000	n/a	n/a
Weblink Wireless	$8,623	216.14%	$27,261	68.26%	$45,870	n/a	$45,387
SkyTel (4)	$12,780	447.93%	$70,026	85.96%	$130,218	n/a	n/a
American Paging (5)	($2,849)	n/a	($3,267)	n/a	n/a	n/a	n/a
Preferred Networks	($8,688)	n/a	($11,346)	n/a	($5,109)	n/a	($3,481)
Teletouch	$9,337	32.83%	$12,402	15.43%	$14,316	8.33%	$15,508
Paging Partners (6)	($1,500)	n/a	($47)	n/a	$578	n/a	n/a
Aquis Communications	n/a	n/a	n/a	n/a	n/a	n/a	$2,974

Sources: Information based on publicly available company documents such as news releases and filings made with the Securities and Exchange Commission.

Notes:

(1) The Arch figures are pro forma figures estimated to include MobileMedia's operations.
(2) The Metrocall figures are pro forma figures estimated to include ProNet's operations. AT&T did not separately report paging figures.
(3) Vodafone AirTouch does not report paging figures.
(4) SkyTel was acquired by Worldcom, Inc. which does not report paging figures.
(5) American Paging was acquired by TSR Wireless, LLC, a privately held company in 1998.
(6) Paging Partners was acquired by Aquis Communications on March 31, 1999.

Table 13: 1996 – 1999 EBITDA Margin/Operating Cash Flow Margin

Company	1996	growth	1997	growth	1998	growth	1999
PageNet	31.23%	3.15%	32.21%	-1.19%	31.83%	-34.61%	20.81%
Arch	21.62%	5.16%	22.74%	30.03%	29.57%	40.34%	41.49%
Metrocall	21.27%	1.72%	21.64%	21.64%	26.32%	-2.54%	25.65%
Vodafone AirTouch	25.60%	14.34%	29.27%	0.30%	29.36%	n/a	n/a
Weblink Wireless	3.89%	152.20%	9.81%	49.97%	14.72%	-5.16%	13.96%
SkyTel	3.87%	379.51%	18.56%	44.30%	26.78%	n/a	n/a
American Paging	-2.73%	n/a	-3.46%	n/a	n/a	n/a	n/a
Preferred Networks	-74.04%	n/a	-63.34%	n/a	-26.11%	n/a	-20.44%
Teletouch	29.43%	1.81%	29.96%	5.80%	31.70%	-4.34%	30.33%
Paging Partners	-21.71%	n/a	-0.52%	n/a	n/a	n/a	n/a
Aquis Communications	n/a	n/a	n/a	n/a	n/a	n/a	9.54%

Notes: EBITDA margin, or cash flow margin, equals the company's EBITDA divided by its total revenue. It is used as a measure of a company's efficiency and profitability.

Table 14: Advanced Messaging Services

ISP	Notes	Device	Cost	Monthly Cost
BSWD	Offers quick response time, interactive messaging. Ability to "chat" close to realtime with other system users. Special confirmation feature indicates messages are "delivered" and "read." Able to send and receive e-mail messages to and from the Internet.	RIM 950 Wireless Handheld™	$369.00	$9.95 to $69.95
AirTouch (Verizon)	Receive news, weather, stock reports, sports updates and more. Verizon Wireless Messaging Services allows dispatch of alpha messages for the user.	Motorola PF1500, ADVISOR Elite™; NEC MessageMaker Vue	$159.95; $79.95; $39.95	$9.95 to $24.95
PageNet	Offers mobile e-mail, customized profile to personalize messages, test messages up to 5,000 characters, and assured delivery where messages are stored when the unit is turned off or outside coverage areas.	Motorola PF1500, PageWriter 2000X; RIM 950	$185; $399.99; $399.99	from $23.00
SkyTel	Ability to send and receive complete e-mail messages of 2,000 characters. Offers guaranteed delivery for storage up to 72 hours and nationwide coverage.	Glenayre AccessMate; Motorola PageFinder; PF1500	$150; $150; $135 (w/ 1yr plan)	SkyWord Plus $24.95
		Glenayre AccessLink II; Motorola PageWriter 2000, 2000X	$195; $360; $395 (w/ 1 yr plan)	SkyWriter $24.95
		RIM 850	$395 (w/ 1 yr plan)	eLink $59.95
WebLink	With WebLink Wireless service, users are able to send instant messages to other wireless devices or to send e-mail to any Internet address.	Motorola T900, 2000X, PF1500; Glenayre AccessLink II™	$179.95; $399.95	$9.95 to $19.95
Motient	Offers ability to keep users connected to the office, desktop, family, and coworkers: eLink wireless email service. eLink lets users send and receive real-time email messages from virtually anywhere in the United States. It also acts as an inbox, information manager, pager, and calendar.	RIM 850	$359.00	$24.95 to $59.95
TSR Wireless	Offers capability to receive Web-based information and email. Every word message pager purchased at TSR Wireless comes equipped with it's own e-mail address to which the user can forward e-mail from a primary e-mail address, receive sports and weather updates, real-time stock quotes and other information feeds provided by TSR InfoBlasts.	Motorola Wordline, Advisor Elite, CP1250	$89.99; $110.95; $159.95	$151.00 (unlimited internet)

Sources: Information based on publicly available company documents such as news releases, company Web sites, and newspaper and periodical articles.

Table 15: Handheld Devices

Handheld/PDA	Manufacturer	Modem	Price
Palm VII	3COM	Integrated Wireless	$412
Palm III, V -series	3COM	Snap-on Module	$130 - $417
Cassiopeia -series	Casio	Compactflash Type II	$189 - $589
IPAQ Pocket PC 3600 *Aero* 1500, 2100, 8000	Compaq	PC Card Type II Compactflash Type II	$181 - $833
Visor	Handspring	Springboard Snap-on Modem Module	$149 - $249
EPlate (HPW-600ET)	Hitachi	PC Card Type II	$684
Jornada -series	HP	PC Card Type II Compactflash Type II	$385 - $694
Workpad -series	IBM	Snap-on Module (Z50 has PC Card II)	$279 - $398
MobilePro -series	NEC	PC Card Type II	$668 - $897
Nino -series Velo -series	Philips	Snap-on Module (PC Card Type II)	$149 - $428
Psion -series	Psion	PC Card Type II (external USB adapter)	$360 - $489
RIM 850/950/957 (marketed by RIM as Blackberry)	Research In Motion (RIM)	Integrated Wireless	$399
Mobilon -series	Sharp	PC Card Type II	$599 - $799
Clio	Vadem	PC Card Type II	$866

CompactFlash is the world's smallest removable mass storage device. First introduced in 1994 by SanDisk Corporation, CF™ cards weigh a half ounce and are the size of a matchbook. They provide complete PCMCIA-ATA functionality and compatibility. At 43mm (1.7") x 36mm (1.4") x 3.3mm (0.13"), the device's thickness is less than one-half of a current PCMCIA Type II card (PC Card). It is actually one-fourth the volume of a PCMCIA card. Compared to a 68-pin PCMCIA card, a CF card has 50 pins but still conforms to ATA specs. It can be easily slipped into a passive 68-pin Type II adapter card that fully meets PCMCIA electrical and mechanical interface specifications.

PC Card Type II: aka ***P**ersonal **C**omputer **M**emory **C**ard **I**nternational **A**ssociation,* and pronounced as separate letters, PCMCIA is an organization consisting of some 500 companies that has developed a standard for small, credit card-sized devices, called PC Cards. Originally designed for adding memory to portable computers, the PCMCIA standard has been expanded several times and is now suitable for many types of devices. There are in fact three types of PCMCIA cards. All three have the same rectangular size (85.6 by 54 millimeters), but different widths. Type II cards can be up to 5.5 mm thick. These cards are often used for modem and fax modem cards.

Sources: Company information is based on publicly available company documents such as news releases, company Web sites, and newspaper and periodical articles.

Table 16: Telemetry Services

Company	Status
CellNet Data Systems, Inc.	3 million units in service; 7.7 million meters under long term contract; signed agreements with PECO Energy(1), Northern States Power(2), Puget Sound Energy(3), and Cuivre River Electric Cooperative and Boone Electric Cooperative(4); also provides remote monitoring for photocopiers, vending machines, parking meters, and home security systems
Itron	offers AMR exclusively; had shipped 15.4 million AMR units at YE 1999 (14 percent increase from YE 1998) to over 500 utilities
Whisper Communications, Inc.	has agreements with Portland General Electric to connect 15,000 commercial and 20,000 residential meters, with Silicon Valley Power to connect 1,000 meters, and with Illinois Power to connect 1.1 million meters
WebLink Wireless Inc.	uses its narrowband PCS licenses for telemetry; plans to begin offering commercial services in Second Quarter 2000; has contracts to deploy environmental control, photocopier, and home security systems.
American Mobile Satellite Corp.	has agreement to provide AMR service to at least 55,000 of Enron's electric and gas meters by July 2001; developing other products including vending machine, traffic light, and ATM monitoring.
Omnipoint	Developing wireless AMR systems for GSM technology; created telemetry system for KeySpan Energy
Metricom	Offers AMR service called UtiliNet to utilities such as Southern California Edison
BellSouth Wireless Data	resells network to telemetry providers, such as alarm, billboard sign, and vending machine monitoring companies
GTE Wireless	resells network to telemetry providers; Global Data Wireless offers AMR services over GTE's network to Wisconsin Public Service, FirstEnergy, and Carolina Power & Light
Aeris's MicroBurst	leases the control channel of cellular networks from cellular carriers covering 98 percent of U.S.; 10,000 users; products include AMR, security system monitoring, equipment monitoring, vehicle location, and asset tracking.

Sources: Publicly available company documents such as news releases, company Web sites, and filings with the Securities and Exchange Commission. *PECO Energy and Schlumberger RMS Execute Agreement to Provide Metering Data Management Services Using a CellNet Data Systems Network*, PR NEWSWIRE, Oct. 13, 1999; *CellNet Data Systems to Expand Northern States Power Network by Approximately 800,000 Meters*, PR NEWSWIRE, Sept. 28, 1999; *1.3 Million Puget Sound Area Gas & Electric Meters to Go High-tech as Puget Sound Energy and CellNet Data Systems Extend Wireless Network*, PR NEWSWIRE, Sep. 21, 1999; *Network Meter Reading Not Just for Big Urban Utilities Anymore*, PR NEWSWIRE, Sep. 9, 1999; *WebLink Wireless Letter to Investors on Strategic Repositioning, Opportunities, Risks*, PR NEWSWIRE, Dec. 23, 1999; Tony Kontzer, *Electricity Meter Reading Joins Digital Era*, INVESTOR'S BUSINESS DAILY, Jul. 6, 1998; *American Mobile to Deliver Wireless Telemetry Applications through Partnerships with CA and cStar Technologies*, BUSINESS WIRE, July 19, 1999; *TransData and Omnipoint Technologies, Inc. to Develop and Market GSM-Based Wireless AMR and Telemetry Solutions for the Utility Industry*, PR NEWSWIRE, Sep. 27, 1999; Nancy Gohring, *Easy Money: Wireless Operators Take Another Look at Telemetry*, TELEPHONY, Sep. 13, 1999; *GTE and Global Data Wireless Help Utilities Compete through New Wireless Technologies the Remotely Read Meters across U.S. and Canada*, PR NEWSWIRE, Sep. 20, 1999; *Global Data Wireless Announces Contract with Wisconsin Public Service*, CANADA NEWSWIRE, Nov. 10, 1999; *Global Data Wireless Announces Contract with FirstEnergy*, CANADA NEWSWIRE, Dec. 22, 1999. *Global Data Wireless Announces Contract with Carolina Power and Light*, CANADA NEWSWIRE, Jan. 10, 2000; Antony Bruno, *Aeris Broadens Business Plans to Include Internet Apps*, RCR RADIO COMMUNICATIONS REPORT, Sep. 20, 1999; *Aeris.net Strengthens Wireless Data Messaging Coverage Areas with Illinois Valley Cellular and Rural Cellular Corp. Agreements*, PR NEWSWIRE, Nov. 2, 1999; Antony Bruno, *Aeris Broadens Business Plans to Include Internet Apps*, RCR RADIO COMMUNICATIONS REPORT, Sep. 20, 1999; *Aeris Communications Completes $29 Million Private Equity Investment; Changes Name to Aeris.net*, CANADA NEWSWIRE, Sep. 23, 1999.

Notes:
(1) The 15-year contract is for 2 million gas and electric meters, and CellNet plans to connect the first 5,000 meters by April 2000.

(2) This agreement, which covers residential and business electric and gas customers, expands a 1996 contract with Northern States Power from 1.2 million meters in Minneapolis-St. Paul, MN to 2 million meters across Minnesota, North Dakota, South Dakota, Wisconsin and Michigan.

(3) This agreement is also an expansion of an existing contract. Puget will expand CellNet's AMR service from 800,000 customers (500,000 have already been connected) in Seattle and Tacoma to 1.3 million customers in more rural areas across 95 percent of Puget's 11-county service territory.

(4) Cuivre River, which serves rural eastern Missouri, expanded its agreement with CellNet from 5,000 to 11,000 meters. Boone serves rural areas in the central part of the state and signed an agreement for 6,000-12,000 meters. Because rural utilities serve more dispersed customers over wider geographic areas, they have higher meter reading costs and greater cost savings from AMR.

APPENDIX D:
DISPATCH SERVICES

Table of Contents

Table 1: Major SMR Operators

Rank	SMR Provider	1998 Subscribers		1999 Subscribers	
		Total	Analog	Total	Analog
1	Nextel	3,143,900 (2)	354,000(2)	4,515,700 (digital only) (5)	292,000(1Q99)(6)
2	Southern LINC	100,000 (1)	N/A	200,000 (8)	0
3	Mobex	50,000 (1)	N/A	65,000 (7)	N/A
N/A	Chadmoore Wireless Group, Inc.	23,321 (3)	23,321 (3)	37,475 (3)	37,475 (3)
N/A	Securicor Wireless (formerly Intek Global Corp.)	11,400 (4)	N/A	N/A	N/A

(1) Jeffrey Silva, *Nextel Sues To Lift Decree; Bankruptcy Judge Approves Geotek Spectrum Sale*, RCR, Feb. 22, 1999.
(2) Nextel Communications, Inc., Form 10-K, Dec. 31, 1998, at 1.
(3) Chadmoore Wireless Group, Inc., *Item 6: Management's Discussion And Analysis Of Financial Condition And Results Of Operation*, Form 10-KSB, Dec. 31, 1999.
(4) Intek Global Corp., 10-Q, Feb. 12, 1999.
(5) Nextel, 4Q1999.
(6) Nextel, 1Q1999. Nextel has stopped reporting its analog subscribers
(7) *Dataradio Corporation and MOBEX Communications, Inc. Form Strategic Partnership*, Press Release, Oct. 20, 1999
(8) Southern Company, 1999 Annual Report.

Table 2: Analog Dispatch Average Revenue Per Unit

	Non-Trunked Dispatch - Analog	Trunked Dispatch - Analog
1996	$16.10	$49.40
1997	$16.30	$40.50
1998	$16.40	$38.70
1999	$16.90	$37.10

Sources:
- The Strategis Group, Inc., "Dispatch Service in a Competitive Market," Presentation at AMTEX'98 Conference & Exposition, Nov. 13, 1998; The Strategis Group, Inc., “US Dispatch Markets,” January, 2000.

Table 3: Analog Dispatch Subscriber Growth, By Band

Band	Subscribers YE 1998	Growth over 1997	Subscribers YE 1999	Growth Over 1998
800 MHz	1,453,020	-6%	1,402,164	-4%
900 MHz	147,750	2%	153,515	4%
450 MHz	22,000	273%	30,625	39%
220 MHz	30,000	43%	40,500	35%
All Analog bands	**1,652,770**		**1,626,804**	**-2%**

Sources:
- The Strategis Group, Inc., "Dispatch Service in a Competitive Market," Presentation at AMTEX'98 Conference & Exposition, Nov. 13, 1998; The Strategis Group, Inc., “US Dispatch Markets,” January, 2000.

APPENDIX E:
FIXED VOICE AND DATA SERVICES

As Congress and the Commission have looked for new ways to promote competition in the telecommunications industry, it has become clear that wireless licensees providing fixed wireless services have the potential to create facilities-based competition in numerous industries beyond the traditional mobile markets. While spectrum classified as CMRS is being utilized in this manner,[1] non-CMRS spectrum, including Multipoint Multichannel Distribution Service ("MMDS"), 24 GHz, Local Multipoint Distribution Service ("LMDS"), and 39 GHz, are also being used.

In this section, the Commission reviews the state of competition provided by fixed wireless operators for voice and data services in both residential and business markets. For discussion purposes, operators are trifurcated by spectrum bands - cellular/broadband PCS, 2 GHz to 4 GHz, and Upperband spectrum.

A. Fixed Wireless Access

In a fixed wireless access system, a provider attaches a radio transmitter to a customer's premises that communicates with a central antenna site. This antenna site acts as the gateway into the PSTN or the Internet. This technology functions as a replacement for the "last mile" of copper wire that has traditionally provided individual customers with telecommunications services, thus allowing a wireless provider to compete with a traditional wireline service provider. The "last mile" is also referred to as the "local loop"; thus, fixed wireless access is often referred to as "Wireless Local Loop," or "WLL" for short.

WLLs afford new entrants direct access to an individual customer's building, lessening the reliance on LECs. In addition to providing new competition in existing markets, fixed wireless systems have the potential to provide new services and expand capacity into areas considered too expensive to enter using available wireline technologies.

Lower Network Deployment Costs - Fixed wireless operators claim that their networks have a significantly lower cost structure than wireline systems for two primary reasons.[2] First, wireless networks are free of the installation and maintenance costs incurred with wires. Second, unlike a wireline network in which an entire market must be wired before initiating service, the capital expenditures of a wireless network can be incrementally incurred as more customers are added. Because of this lower cost structure, operators have been able to charge significantly lower prices than wireline competitors for business services. Teligent, for example, offers its subscribers a flat monthly rate that is up to a 30 percent discount compared to wireline providers.[3]

---

[1] "Licensees of cellular systems may use alternative cellular technologies and/or provide fixed services on a co-primary basis with their mobile offerings, including personal communications services . . . on the spectrum within their assigned channel block." 47 CFR § 22.902(d).

[2] According to WinStar, it can cost up to 85 percent less to provide phone service through the air than through a fiber network. Suzanne King, *Gaining a Foothold*, KANSAS CITY BUSINESS JOURNAL, Nov. 13, 1998.

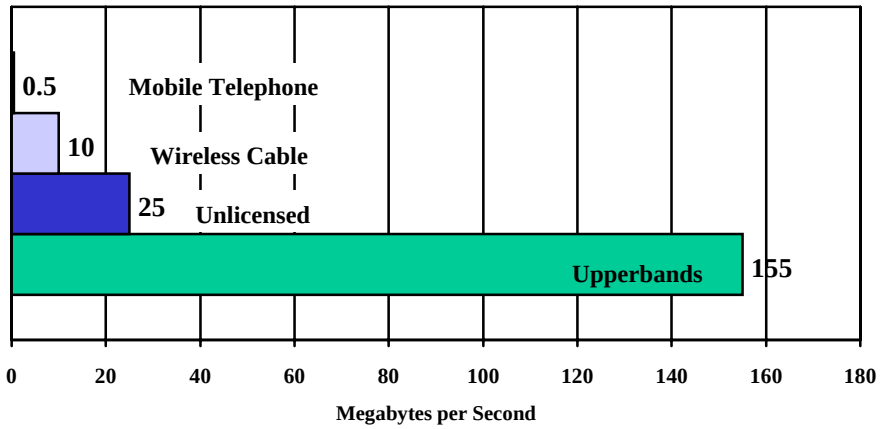
[3] Under a plan announced in 1998, to qualify for the maximum discount, customers switch their existing service -- local, long distance or Internet -- and sign up with Teligent for a minimum of one year. Teligent averages several representative bills from the customer's current carriers and deducts up to 30 percent. That figure becomes the customer's new flat monthly rate. Local and Internet service are unlimited. If customers wish to increase their long distance usage over current levels, they can purchase more service at what the company believes are attractive prices. *Teligent Launches Service In First Ten Markets, Vows To Start A Communications Revolution*, News release, Teligent, Inc., Oct. 27, 1998.

Underserved Markets - There are a number of market segments with low penetration by existing wireline systems. For example, only a small percentage of office buildings have wireline broadband access.[4] Fixed wireless operators can act as strategic partners with wireline CLECs that wish to extend their fiber networks more cheaply to such buildings. Many small and medium sized businesses, with volume too low for expensive fiber connections, are also potential customers.[5] In addition, wireless access has the potential to improve competition and broadband services for residential customers in both urban and rural markets.[6]

B. Broadband Access through Fixed Wireless

One of the great advantages of fixed wireless is its ability to provide broadband, or high-speed, services relatively cheaply and quickly in comparison with wireline technologies. While the term "broadband" has numerous meanings in common usage, the Commission has defined broadband as two-way speeds of 200 kbps and above.[7] Many fixed wireless operators provide such services, although such operators vary greatly, both in terms of technical capabilities and target markets.

Figure 1. Maximum Downstream Speeds Using WLL



[4] Estimates of this large market vary. Teligent estimates that fiber networks today reach only 3 percent of the 750,000 office buildings in the United States (although the company conditions that the 3 percent actually reach 35 percent of "fiber-addressable businesses"). Nancy Gohring, *Wireless Networks: Broadband Wireless Operators Build Their Case*, TELEPHONY, July 6, 1998. Roberta Woods, director of Wireless Market Research at Pioneer Consulting, claims that 99 percent of the estimated 4.6 million commercial buildings in the United States are not served by fiber. Charles Mason, *LMDS: Huge Niche Technology*, AMERICA'S NETWORK, Sept. 1, 1998, *available in* 1998 WL 15871129.

[5] Robertson Stephens estimates that there are 8 million small and medium-sized businesses in the United States. Jim Friedland and Amy Roth, *Broadband Wireless Access: Beyond the Reach of Fiber*, Robertson Stephens Telecom Services Research, Feb. 18, 2000, at 1. Lehman Brothers estimates that mid-sized businesses use 25 to 35 million access lines. Tim Luke, *Introducing the Broadband Wireless Equipment Market*, Lehman Brothers, Aug. 5, 1999, at 6.

[6] Inquiry Concerning The Deployment Of Advanced Telecommunications Capability To All Americans In A Reasonable And Timely Fashion, And Possible Steps To Accelerate Such Deployment Pursuant To Section 706 Of The Telecommunications Act Of 1996, *Report*, 14 FCC Rcd 2398, 2422.

[7] *Id.* at 2406.

C. Service Providers

1. Cellular (800 MHz) / Broadband PCS (1900 MHz)

In the United States, the current WLL in these bands is still in an early stage of development, is currently targeted at low-use/residential subscribers, and is secondary to the mobile products of service providers. A number of cellular and broadband PCS operators have considered the possibility of using their licenses to provide WLL services, but few operators have taken major steps to provide fixed services, and even fewer offer broadband services. The primary exception is AT&T's Project Angel, discussed below. The other operators are simply using their existing cellular or PCS infrastructure to offer Plain Old Telephone Service ("POTS"), but no service at higher speeds.[8]

a. AT&T Digital Broadband – After years of development,[9] AT&T has committed itself to widespread deployment of its fixed wireless access system, originally dubbed "Project Angel." AT&T says it will use its fixed wireless system to reach homes and small businesses in markets not covered by its "broadband properties,"[10] namely its cable systems or arrangements with cable operators, which cover about 50 percent of U.S. markets.[11] Estimated to cost about $750 per customer (and expected to drop to $500 in five years), the system uses broadband PCS spectrum[12] to transmit signals between an antenna at customers' premises and AT&T's network.[13] The system permits four voice channels, data rates up to 512 kbps, and "always-on" Internet access.[14] The service is expected to be capable of speeds of one Mbps by the end of 2000.[15]

In early 2000, AT&T was serving 200 customers with a Digital Broadband trial system in Dallas, TX.[16] In March 2000, AT&T began offering service commercially to residential customers in Fort Worth, TX.[17] By mid-July 2000, AT&T was serving approximately 2,800 customers using 6,000 lines in the Dallas-

---

[8] Centennial Communications has been operating a WLL system in Puerto Rico since 1997 using its broadband PCS spectrum. Its offering involves restricting the use of a mobile phone to one location, and many of its WLL customers use their handsets for their primary telecommunications line. *Bringing Local Loop to Puerto Rico*, WIRELESS BUSINESS & TECHNOLOGY, Jan. 1998, at 27; Elizabeth V. Mooney, *Wireless Is Foundation To Launch Other Services*, RCR RADIO COMMUNICATIONS REPORT, Nov. 8, 1999. WWC is operating fixed wireless systems in Nevada and North Dakota using its cellular licenses. *See Fourth Report*. *See also* the WLL offerings of Hargray Wireless (visited Feb. 23, 2000) <http://www.hargraywireless.com/products/plans.html>.

[9] *See Fourth Report*, Appendix F.

[10] AT&T Corp., Form S-3, Feb. 2, 2000, at 60.

[11] Monica Alleven, *AT&T Talks Up Growth*, WIRELESS WEEK, Dec. 13, 1999, at 8.

[12] AT&T also plans to use its Wireless Communication Service ("WCS") licenses for this service. AT&T Corp., Form S-3, Feb. 2, 2000, at 53. *See* Appendix F, Map 12, p. F-13.

[13] Monica Alleven, *AT&T Talks Up Growth*, WIRELESS WEEK, Dec. 13, 1999, at 8.

[14] *AT&T Wireless to Offer Residential Broadband Service in Four New Cities*, News Release, AT&T Corp., July 19, 2000.

[15] *Id.*

[16] AT&T Corp., Form S-3, Feb. 2, 2000, at 60. For accounts of subscribers' experiences, *see* Nicole Harris, *AT&T's High Wireless Act: Can It Deliver the Web and a Dial Tone*, WALL STREET JOURNAL, Mar. 2, 2000, *available in* 2000 WL-WSJ 3020074.

[17] *AT&T "Cuts The Cord" To Provide Services Into Homes; Debuts Nation's First Wireless Local Communications Company*, News Release, AT&T Corp., Mar. 22, 2000.

Fort Worth area.[18] The company has announced plans to rollout service in four additional cities, starting with San Diego, and claims to be on track to have 1.5 million fixed wireless subscribers by year-end 2000.[19]

b. Cellular ETC Efforts - Wireline local exchange carriers offer residential service discounted by the receipt of universal service funds.[20] In order to receive funding, a fixed wireless operator, like all carriers, has to be designated an "Eligible Telecommunications Carrier" ("ETC") by the state in which it plans to operate.[21] A few mobile telephony operators have been granted ETC status and have become eligible for universal service funds, including Sprint PCS in California and Arkansas, United States Cellular Corp. in Washington, and Centennial Communications in Puerto Rico.[22]

2. 2 GHz to 4 GHz

Commercial and trial services in these bands, primarily by wireless cable licensees, target both business and residential customers.

a. Wireless Cable

(i) Overview

MMDS, also called wireless cable,[23] has become a new vehicle for offering high-speed Internet access and broadband services to residential and small office/home office ("SOHO") customers. Most notably, during the past year WorldCom and Sprint acquired MMDS licenses covering 60 million households and began rolling out MMDS high-speed Internet access in six cities.[24] As of May 2000, the companies were

---

[18] Doug Abrahms and Mary Greczyn, *Wireless Sales Soar: AT&T Earnings Up But Long Distance Revenues Are Flat*, COMMUNIATIONS DAILY, July, 26, 2000.

[19] *Id*. The other cities include Anchorage, Houston, and Los Angeles. Of these, San Diego will be last in which Broadband PCS spectrum is used. To maximize PCS spectrum use for mobile wireless, AT&T plans to use WCS spectrum for the other fixed wireless markets that will be rolled out in 2000. *Id*.

[20] According to Western Wireless Chairman and CEO John Stanton, "If our competitor has the subsidies and we do not, then we can't compete on equal footing." *Western Wireless Breaks ETC Barrier For Wireless Providers*, COMMUNICATIONS TODAY, Oct. 5, 1999, *available in* 1999 WL 28525915.

[21] 47 U.S.C. 214(e)(2).

[22] See *Universal Service: Contribution Factors and Quarterly Administrative Filings*, Quarterly Administrative Filings, 2Q, High Cost & Low Income, Schools & Libraries, and Rural Health Care, Exhibit 4 (visited Feb. 24, 2000) <http://www.fcc.gov/ccb/universal_service/quarterly_filings/2000q2/exhibit4.xls>. Western Wireless has applied for ETC status in 13 states, but withdrew its application for Montana. South Dakota rejected Western Wireless's application, and Wyoming said it did not have jurisdiction to rule on the issue. *Western Wireless Petitions FCC*, RCR RADIO COMMUNICATIONS REPORT, June 28, 1999, *available in* 1999 WL 7791576; Heather Forsgren Weaver, *Kansas, Washington Grant ETC Status To Wireless*, RCR RADIO COMMUNICATIONS REPORT, Feb. 14, 2000, *available in* 2000 WL 9540070.

[23] What is commonly referred to as MMDS or wireless cable spectrum includes 33 different 6-MHz channels in the 2.1-2.2 GHz and 2.5-2.7 GHz spectrum bands. These channels include the Multipoint Distribution Service ("MDS"), Multichannel Multipoint Distribution Service ("MMDS"), and Instructional Television Fixed Service ("ITFS") channels. Wireless cable operators generally use the MMDS and MDS channels and lease excess capacity from ITFS operators, and often control different amounts of spectrum in different markets.

[24] *See MCI WorldCom Announces 'Fixed Wireless' Service Trials*, PR NEWSWIRE, Mar. 7, 2000; *Sprint Rolls Out Wireless DSL in Phoenix*, COMMUNICATIONS DAILY, May 9, 2000, *available in* 2000 WL 4695243; Paul Kagan Associates, Inc., WIRELESS/PRIVATE CABLE INVESTOR, Mar. 9, 2000, at 1. In one of the markets, Sprint is offering

planning to offer the service in 100 markets by the end of 2001.[25] In addition to WorldCom and Sprint, nine independent wireless cable companies currently offer high-speed Internet access via MMDS in 11 markets.[26] These markets include rural areas, such as Sioux Falls, SD and Cache Valley, UT. In at least five of those markets, the service is being offered on a two-way basis. One analyst estimated there were 12,000 MMDS Internet access subscribers at the end of 1999,[27] and the market for this service is expected to grow substantially over the next 3 to 5 years.[28]

MMDS companies were originally licensed to provide analog television programming to homes using the 2 GHz spectrum band. However, many wireless cable operators had difficulty competing with wireline cable and direct-to-home satellite companies, which had significantly higher channel capacities. Therefore, in 1997 and 1998, wireless cable companies began refocusing their business operations on offering high-speed Internet access instead of television programming. In September 1998, the Commission issued an order authorizing the use of MMDS spectrum for two-way services.[29]

(ii) Major Operators

WorldCom. At the writing of the *Fourth Report*, WorldCom had acquired CAI Wireless Systems, Inc. and CS Wireless Systems, Inc.[30] Since then, WorldCom has acquired two additional companies, Wireless One[31] and PrimeOne Tele-TV.[32] WorldCom's MMDS licenses cover 45 million households in 78 markets.

---

service on a commercial basis. In the other five markets, WorldCom and Sprint are running service trials. *See* Section I.A.1.a(ii), *infra*, for a further discussion of WorldCom and Sprint's MMDS plans.

[25] *MCI WorldCom Announces 'Fixed Wireless' Service Trials*, PR NEWSWIRE, Mar. 7, 2000.

[26] See Table E-1, p. E-19 for an overview of MMDS Internet offerings.

[27] Andrew Backover, *Cable, DSL and Wireless Vie for Market Leadership*, DENVER POST, Jan. 24, 2000, *available in* 2000 WL 4450560 (citing the Strategis Group).

[28] The Strategis Group predicts there will be 1.2 million residential and 300,000 business MMDS broadband subscribers by 2003. *U.S. Wireless Broadband: LMDS, MMDS and Unlicensed Spectrum* (Conference Call Slides), Peter Jarich and James Mendelson, The Strategis Group Inc., Feb. 17, 2000.

[29] *See* Amendment of Parts 21 and 74 to Enable Multipoint Distribution Service and Instructional Television Fixed Service Licensees to Engage in Fixed Two-Way Transmission, *Report and Order*, MM Docket No. 97-217, 13 FCC Rcd 19112 (1998), *recon.*, 14 FCC Rcd 12764 (1999), *further recon. pending*. This Order established a framework for allowing MMDS operators to offer, quickly and easily, two-way high speed Internet access, as well as other two-way broadband services, such as telephony, video conferencing, and distance learning. Mike Farrell, *Wireless Ops Hope Two-Way Ruling Helps*, MULTICHANNEL NEWS, Sept. 28, 1998, at 3, 32; Annual Assessment of the Status of Competition in Markets for the Delivery of Video Programming, *Fifth Annual Report*, FCC 98-335 (rel. Dec. 23, 1998). Prior to the Order, MMDS operators sought developmental authority from the Commission to provide Internet access and used a wireline return path or upstream connection.

[30] WorldCom, Inc., *CAI Wireless Information* (visited Jan. 27, 2000) <http://www.wcom.com/about_the_company/investor_relations/mergers+acquisitions/CAI_wireless/>.

[31] *Wireless One Completes Reorganization, Becoming MCI WorldCom Subsidiary*, PR NEWSWIRE, Dec. 10, 1999. WorldCom also acquired Wireless One's 50% interest in Wireless One of North Carolina, LLC, which owns MMDS and WCS licenses in 13 North Carolina markets. *Id. See* Section I.A.1.c, page E-10, *infra*, for a discussion of WCS spectrum.

[32] *MCIW's Wireless Cable Plans Cover Wholesaling, Small Business*, COMMUNICATIONS DAILY, July 14, 1999.

WorldCom began implementing its plans to offer fixed wireless high-speed Internet access and other broadband services to residential and SOHO customers, particularly customers that are beyond the reach of wireline DSL, during the spring of 2000.[33] As of May 2000, WorldCom was running trials in Baton Rouge, LA; Jackson, MS; and Memphis, TN.[34] WorldCom is charging its residential trial customers $39.95 per month for two-way speeds of 310 kbps and businesses $300-$600 per month for speeds of 128 kbps to 8 Mbps.[35] WorldCom has also announced it will run MMDS trials in Boston and Dallas during the summer of 2000.[36] In addition to its commercial rollout plans, WorldCom announced in April 2000 that it would begin using MMDS to deliver high-speed Internet access to schools, libraries, and community centers in four rural communities – Raleigh, NC; Houma, LA; Dothan, AL; and Hattiesburg, MS – by August 2000.[37] WorldCom and Sprint announced plans to merge with each other in October 1999, but called off the merger in July 2000 after the U.S. Department of Justice filed a suit to block it.[38]

Sprint. In 1999, Sprint acquired People's Choice TV and American Telecasting.[39] Since then, Sprint has acquired WBS America LLC,[40] Transworld Telecommunications Inc., Videotron USA,[41] Wireless Cable of Florida, Inc., and Nashville Wireless Cable JV.[42] Sprint's MMDS licenses cover over 30 million households in 83 markets.

---

[33] Bernie Ebbers, Merger Speech, National Press Club, Jan. 12, 2000, (visited Jan. 21, 2000) <http://www.worldcom-merger.com/press_room/ebbers_npc_speech.htm>.

[34] In these three markets, Wireless One had previously offered two-way high-speed Internet access on a limited basis using both MMDS and WCS spectrum, and WorldCom is also using both types of spectrum in its trials. See *Fourth Report* at F-17; Paul Kagan Associates, Inc., WIRELESS/PRIVATE CABLE INVESTOR, Mar. 9, 2000, at 1. In Jackson, WorldCom is also testing wireless LAN technology in a 300-unit apartment complex. Paul Kagan Associates, Inc., WIRELESS/PRIVATE CABLE INVESTOR, Mar. 9, 2000, at 1.

[35] Paul Kagan Associates, Inc., WIRELESS/PRIVATE CABLE INVESTOR, Mar. 9, 2000, at 1. WorldCom has stated that its capital expenditures for rolling out MMDS services are approximately $2000 per square mile. *Telephony*, COMMUNICATIONS DAILY, Mar. 8, 2000.

[36] *MCI WorldCom to Test Fixed Wireless Service in Boston,* News Release, WorldCom, Inc. Mar. 27, 2000; *MCI WorldCom Adds Dallas to 'Fixed Wireless' Service Trials*, News Release, WorldCom, Inc., Apr. 5, 2000. In Dallas, WorldCom will also be using WCS spectrum in its service trials. *Mexico-U.S. Talks Heat Up on DARS Interference Concerns,* AUDIO WEEK, Apr. 24, 2000.

[37] *MCI WorldCom's Wireless Internet to Help Bridge the Digital Divide*, News Release, WorldCom, Inc., Apr. 26, 2000.

[38] *MCI WorldCom and Sprint Create Pre-Eminent Global Communications Company for 21st Century*, News Release, Sprint Communications Company LP, Oct. 5, 1999; *Justice Department Sues to Block WorldCom's Acquisition of Sprint*, News Release, U.S. Department of Justice, June 27, 2000.

[39] Sprint bought People's Choice TV and American Telecasting. *Sprint Closes Acquisition of American Telecasting, Inc.*, News Release, Sprint Communications Company, LP, Sept. 23, 1999.

[40] *Sprint Completes Purchase of Videotron USA and Operating Units of WBS America, LLC*, News Release, Sprint Communications Company, LP, Oct. 26, 1999.

[41] *Sprint Completes Purchase of Videotron USA and Operating Units of WBS America, LLC*, News Release, Sprint Communications Company, LP, Oct. 26, 1999. Videotron USA was the wireless broadband subsidiary of Le Groupe Videotron Ltee, a Canadian company. *Sprint Agrees to Acquire Videotron USA and Transworld Telecommunications Inc.*, News Release, Sprint Communications Company LP, May 3, 1999.

[42] *Sprint Completes Purchase of Videotron USA and Operating Units of WBS America, LLC*, News Release, Sprint Communications Company, LP, Oct. 26, 1999.

As of May 2000, Sprint had launched commercial MMDS Internet service in Phoenix[43] and was running trials in Detroit, MI and San Francisco, CA.[44] Sprint's residential service in Phoenix costs $39.95 per month for speeds of 1 to 2 Mbps and covers 85 percent of area households.[45] Sprint has stated that it plans to launch MMDS in 10-20 markets by the end of 2000 and to incorporate the technology into its existing ION service.[46]

Nucentrix. Nucentrix Broadband Services, Inc. ("Nucentrix," formerly Heartland Wireless Systems, Inc.) is the only large wireless cable company that has not been acquired by WorldCom or Sprint. Nucentrix emerged from bankruptcy in April 1999 with a business plan focused on offering high-speed Internet access instead of furthering its television programming operations.[47] Nucentrix currently offers two-way Internet access service in Austin and Sherman-Denison, TX,[48] and plans to launch the service in up to 40 markets by the end of 2001.[49] Nucentrix holds licenses that cover 87 small and medium markets in the central United States.[50]

Other Operators. In addition to the three companies discussed above, several small independent MMDS licensees have also turned to offering high-speed Internet access in the markets they serve. For example, Wireless First, Inc., an MMDS operator in Traverse City, MI, offers high-speed Internet access to homes and SOHOs in five counties on the Upper Peninsula of Michigan.[51] And Alaska Wireless Cable offers the service on two-way basis in Fairbanks, Alaska.[52] Worldwide Wireless Systems, Inc., a wholly-owned subsidiary of New England Wireless, Inc. located in Bellows Falls, VT, plans to rollout two-way service there and in 12 other markets.[53]

---

[43] *Sprint Rolls Out Wireless DSL in Phoenix*, COMMUNICATIONS DAILY, May 9, 2000.

[44] Paul Kagan Associates, Inc., WIRELESS/PRIVATE CABLE INVESTOR, Mar. 9, 2000, at 1. In Phoenix and Detroit, People's Choice TV, which Sprint acquired in the spring of 1999, had previously offered two-way high-speed Internet access on a limited basis. *See Fourth Report*, 14 FCC Rcd at 10271.

[45] *Sprint Rolls Out Wireless DSL in Phoenix*, COMMUNICATIONS DAILY, May 9, 2000.

[46] Nancy Gohring, *All Chips on MMDS*, TELEPHONY, Dec. 20, 1999. Sprint began offering its ION package of voice and high-speed data services to high-end residential customers in Denver, Kansas City, and Seattle during the second half of 1999. Fred Dawson, *Sprint's ION Launches Hit Cable, Telcos*, MULTICHANNEL NEWS, Nov. 29, 1999. The package includes 2200 minutes of distance-free domestic calls per month on four phone lines, advanced calling features, and unlimited Internet access at speeds of one Mbps for $159.99.

[47] *See Fourth Report*, 14 FCC Rcd at 10260.

[48] *Nucentrix Broadband Networks Announces Effectiveness of Shelf*, BUSINESS WIRE, Dec. 17, 1999.

[49] Fred Dawson, *Broadband Wireless Gets to the (Multi)Point*, INTERACTIVE WEEK FROM ZDWIRE, Mar. 13, 2000, *available in* 2000 WL 4065337.

[50] *Nucentrix Broadband Networks Announces Effectiveness of Shelf*, BUSINESS WIRE, Dec. 17, 1999.

[51] *Regional Wireless Operators Select Hybrid Networks' 2-Way Today Solution To Launch Multiple Markets*, PR NEWSWIRE, Jan. 10, 2000.

[52] *Regional Wireless Operators Select Hybrid Networks' 2-Way Today Solution to Launch Multiple Markets*, PR NEWSWIRE, Jan. 10, 2000.

[53] *Regional Wireless Operators Select Hybrid Networks' 2-Way Today Solution to Launch Multiple Markets*, PR NEWSWIRE, Jan. 10, 2000.

At least four Internet access companies, including IJNT.net, SkyLynx, AirNet, and US Interactive, offer high-speed Internet access using owned or leased MMDS spectrum in at least six markets. Both IJNT.net and SkyLynx use MMDS in conjunction with unlicensed spectrum[54] and offer traditional dial-up Internet access as well high-speed service.[55]

(iii) Technology

As noted earlier, wireless cable or MMDS spectrum includes 33 different 6-MHz channels on the 2 GHz band. However, wireless cable operators control different amounts of spectrum in different markets, and many lease unused channels from ITFS operators for both video programming and broadband services. The downstream Internet speeds reported by MMDS operators range from 750 kbps to 11 Mbps, and MMDS Internet systems can be designed in point-to-point or point-to-multipoint configurations.

Wireless cable transmissions have a greater radius than upperband fixed wireless service, generally 35 miles versus three to five miles for upperband services. This is partly due to the fact that MMDS signals are less attenuated by rain and other severe weather conditions.[56] MMDS's larger radius makes the service well-suited for not only residential customers, but customers in rural, underserved, and unserved areas as well. One drawback of MMDS has been that it requires a direct line of sight from the transmitter to the receiver at the customer's end. Recent technological developments, discussed below, may help to overcome this restriction, however.

While different providers use different types of equipment, the following is a general description of how MMDS operators provide two-way broadband services. First, data from the Internet is sent to an MMDS operator's point of presence, where it travels through a downstream router and then to a transmitter on a microwave tower or the roof of a tall building, where it is broadcast to subscribers in the service area.[57] Each subscriber has a rooftop antenna that receives and sends data and a transverter that converts data into a useable format. The transverter feeds downstream data through inside wiring to a cable modem and then to the user's PC, with an Ethernet connection between the cable modem and the PC. The upstream connection sends data through the reverse path.[58]

In the past year, MMDS has emerged as another vehicle, in addition to cable and DSL, for providing high-speed Internet access to residential customers. As MMDS carriers have shifted their focus from television programming to two-way high-speed Internet access, equipment vendors have begun to do the same. Many have begun to devote more of their resources to producing MMDS Internet systems, and have begun vying for contracts with WorldCom and Sprint in response to their rollouts and trials of MMDS.[59] WorldCom announced in March 2000 that it would test equipment made by ADC Telecommunications Inc., Cisco Systems ("Cisco"), Motorola, Nortel Networks Corp., and Lucent

---

[54] *See* Section I.A.1.b, page E-10, *infra*, for a discussion of unlicensed spectrum.

[55] IJNT.net, Inc. Form 10KSB/A, Dec. 31, 1999; SkyLynx Communications, Inc., Form 10KSB, Dec. 31, 1999.

[56] SpeedChoice, *Data over Wireless – a Primer* (visited Jan. 24, 2000) <http://www.speedchoice.com/technol…rTechnology/dataOverWireless4.html>.

[57] Keith Ross, *Gearing Up for Two-Way Wireless*, PRIVATE CABLE & WIRELESS CABLE, Oct. 1998; NextNet, Inc., *Technology* (visited Jan. 20, 2000) <http://www.nextnetworks.com/products_tech_bottom.html>.

[58] Keith Ross, *Gearing Up for Two-Way Wireless*, PRIVATE CABLE & WIRELESS CABLE, Oct. 1998.

[59] Nancy Gohring, *Sprint Gears Up for MMDS: Equipment Vendors Spar for Contracts*, TELEPHONY, Nov. 29, 1999, *available in* 1999 WL 11172548.

Technologies, Inc. in its five MMDS trials.[60] Sprint completed a significant investment in the leading manufacturer of wireless cable modems, Hybrid Networks, Inc. ("Hybrid") in August 1999. As part of the deal, Sprint agreed to purchase $10 million worth of equipment from the company for use in its MMDS network.[61] Hybrid's equipment is deployed in over 44 North American markets.[62] In April 2000, Verizon Communications, Inc. ("Verizon," formerly Bell Atlantic Corp.) also made a significant investment in Radix Wireless, Inc., a fixed wireless equipment company. Verizon plans to use fixed wireless technology designed by Radix to rollout high-speed Internet access at DSL speeds.[63]

During the past year, both entrepreneurs and established companies have made technological breakthroughs that allow two-way Internet access to be offered via MMDS and that overcome some of the problems associated with that offering. For example, in December 1999, Cisco released a cellularization technology for MMDS and unlicensed spectrum called VOFDM (Vector Orthogonal Frequency Division Multiplexing).[64] VOFDM captures signals as they bounce off buildings and other objects and redirects them to end-user transceivers, therefore eliminating the need for a fixed line-of-sight between a transmitter and a receiver.[65] In February 2000, Nucentrix announced that it would run field trials of Cisco's VOFDM equipment in Austin and Amarillo, TX during 2000 and that it plans to deploy the technology in at least 20 markets by the end of 2001.[66] WorldCom will also test VOFDM in its Dallas trial.[67] Sprint believes VOFDM will be used in combination with other technologies and in niche markets with line-of-sight problems.[68]

Other technological developments include an antenna technology released by Wireless Online that enhances the coverage, quality, and capacity of MMDS networks.[69] A start-up called NextNet, Inc. has also developed an end-to-end MMDS system with a desktop CPE unit that requires no rooftop antenna and no inside wiring connections.[70]

---

[60] Paul Kagan Associates, Inc., WIRELESS/PRIVATE CABLE INVESTOR, Mar. 9, 2000, at 1.

[61] *Sprint Purchases $11 Million of Convertible Debentures in Wireless Equipment Manufacturer Hybrid Networks, Inc.*, News Release, Sprint Communications Company LP, Aug. 31, 1999.

[62] *Regional Wireless Operators Select Hybrid Networks' 2-Way Today Solution to Launch Multiple Markets*, PR NEWSWIRE, Jan. 10, 2000.

[63] It is unclear which spectrum band Bell Atlantic and Radix plan to use. *Bell Atlantic Invests in Fixed Wireless Company As Part of DSL Deployment Strategy*, News Release, Bell Atlantic, Apr. 3, 2000.

[64] Cliff Edwards, *Cisco Hopes Advances New Wireless Technology for Internet*, AP NEWSWIRES, Dec. 2, 1999.

[65] *Id*.

[66] *Nucentrix Broadband Networks and Cisco to Deliver First VOFDM-Based Wireless Broadband Internet Services*, News Release, Nucentrix Broadband Networks, Feb. 4, 2000.

[67] *MCI WorldCom Adds Dallas to 'Fixed Wireless' Service Trials*, News Release, WorldCom, Inc., Apr. 5, 2000.

[68] Nancy Gohring, *Sprint Gears Up for MMDS: Equipment Vendors Spar for Contracts*, TELEPHONY, Nov. 29, 1999, *available in* 1999 WL 11172548.

[69] *Wireless OnLine Adds Vice President of Product Management*, PR NEWSWIRE, Jan. 5, 2000.

[70] NextNet, Inc., *Products* (visited Jan. 20, 2000) <http://www.nextnetworks.com/products_prod_bottom.html>.

b. Unlicensed Spectrum (2 and 5 GHz)

A handful of companies across the United States use unlicensed spectrum in the 2 GHz and 5 GHz spread spectrum bands to offer high-speed Internet access and other broadband services. According to one analyst, the maximum downstream speed of unlicensed spectrum is approximately 25 Mbps,[71] while the speeds reported by operators range from 500 kbps to as high as 100 Mbps.

As of April 2000, at least 11 companies were providing these services in 23 markets.[72] Two of these companies, SkyLynx and IJNT.net, use unlicensed spectrum in conjunction with MMDS spectrum. Many of the unlicensed operators are small start-ups, and some are traditional ISPs that have added fixed wireless service for customers who demand high-speed access. For example, PSINet, a leading wireline business ISP, launched a high-speed fixed wireless service called InterSky in six cities during 1999.[73] Two established CMRS companies, US WEST, Inc. ("US WEST,"which was acquired by Qwest Communications International, Inc. on June 30, 2000) and Metricom, entered the unlicensed fixed wireless market during the past year. US WEST announced in 1999 that it planned to run a trial of fixed wireless broadband service in Denver using equipment made by Adaptive Broadband.[74] And Metricom, which received a significant investment from WorldCom during 1999, will begin marketing its wireless modem to home PC users for fixed, in addition to mobile use.[75] One analyst predicts the company will have three million home PC subscribers by 2007.[76]

Other companies, such as BreezeCOM and RadioLAN,[77] use unlicensed spectrum to offer wireless WAN/LAN and wireless PBX services to businesses, schools, and hospitals.

c. WCS (2.3 GHz)

In addition to AT&T's use of WCS spectrum in its Project Angel, mentioned above, several other operators have begun to use WCS for Internet access. WorldCom is using WCS spectrum that it acquired from wireless cable companies (in conjunction with MMDS spectrum) to test fixed wireless high-speed Internet access in Baton Rouge, LA; Jackson, MS; Memphis, TN; and Dallas, TX.[78] BellSouth will also

---

[71] *U.S. Wireless Broadband: LMDS, MMDS and Unlicensed Spectrum* (Conference Call Slides), Peter Jarich and James Mendelson, The Strategis Group Inc., Feb. 17, 2000.

[72] *See* Appendix F, Map 7, p. F-8 for an overview of the cities where high-speed, fixed wireless Internet access is offered with unlicensed spectrum.

[73] The service costs $395 per month for speeds of 512 kbps to 2 Mbps and includes a wireless LAN system. The initial rollout cities were Ft. Myers and Naples, FL; Knoxville, Nashville, and Memphis, TN; and Mobile, AL, and PSINet was targeting businesses without access to other types of high-speed Internet access. *PSINet to Launch Low-Cost Wireless Internet Service in 50 New Markets*, News Release, PSINet Inc., Feb. 2, 1999; *PSINet and Cisco Team for PSINet InterSky Business-Grade Wireless Internet Service*, News Release, PSINet Inc., May 10, 1999.

[74] *Adaptive Broadband and U S West Sign Master Purchase Agreement for AB-Access Broadband Wireless Data Networking Units*, BUSINESS WIRE, Oct. 18, 1999.

[75] John M. Bensche and Jennifer A. Cooke, *Metricom, Inc.: More Subs, More Revenue, More Cash Flow, More Upside!*, Lehman Brothers, Inc., Feb. 8, 2000.

[76] *Id*.

[77] BreezeCOM, *About BreezeCOM* (visited August 8, 2000) <http://www.breezecom.com/AboutBreezeCOM/overview.htm>; RadioLAN, *About RadioLAN* (visited August 8, 2000) < http://www.radiolan.com/about.html>.

[78] Paul Kagan Associates, Inc., WIRELESS/PRIVATE CABLE INVESTOR, Mar. 9, 2000, at 1; *Mexico-U.S. Talks Heat Up on DARS Interference Concerns*, AUDIO WEEK, Apr. 24, 2000, *available in* 2000 WL 4551820.

begin testing one-way high-speed Internet access using its WCS spectrum in Houma, LA in 2000 at a downstream speed of 1.5 Mbps.[79] If trials are successful, BellSouth reports it will upgrade the system to two-way service.[80]

3. Upperbands (24 to 39 GHz)

The largest commercial deployment of fixed wireless systems has occurred in the "upperbands" of the spectrum, in the 24 GHz, 28 GHz (LMDS), and 39 GHz ranges.[81] The most significant operators in these bands, Teligent, Inc. ("Teligent") and WinStar Communications, Inc. ("WinStar"), are concentrating on business customers. These operators are either capable now or planning to offer subscribers a variety of one- and two-way broadband services, such as video programming distribution, video teleconferencing, and wireless local loop telephony, as well as Internet access and other high-speed data transmission services.

a. Recent Developments

(i) Auctions

On May 12, 1999, the second auction of LMDS licenses closed, raising $45 million (in net high bids): the Commission sold 121 A Block (1150 MHz) and 40 B Block (150 MHz) licenses.[82]

On May 8, 2000, the Federal Communications Commission completed the auction of 2,450 licenses for services in the 39 GHz band, raising (in net high bids) a total of $410,649,085 for the U.S. Treasury.[83] In this auction, 29 winning bidders won a total of 2,173 licenses.[84] A number of existing upperband licensees won licenses in the auction, including Winstar, Advanced Radio Telecom, Inc. ("ART"), and NEXTLINK Communications, Inc. ("Nextlink").[85] Licensees in the 39 GHz band may provide fixed communications including point-to-point and point-to-multipoint communications. Mobile communications are subject to the development of inter-licensee and inter-service interference criteria.[86]

---

[79] *BellSouth Launching Trial to Cross Digital Divide*, WIRELESS TODAY, Dec. 10, 1999, *available in* 1999 WL 6692433; *Mexico-U.S. Talks Heat Up on DARS Interference Concerns*, AUDIO WEEK, Apr. 24, 2000, *available in* 2000 WL 4551820.

[80] *BellSouth Launching Trial to Cross Digital Divide*, WIRELESS TODAY, Dec. 10, 1999, *available in* 1999 WL 6692433.

[81] 24 GHz spans 24.25 - 25.25 GHz; LMDS spans 27.5 - 31.3 GHz; 39 GHz spans 38.6 - 40.0 GHz. 39 GHz is often referred to as 38 GHz.

[82] FCC, *Auction #23 Local Multi-Point Distribution Service (LMDS) ReAuction - Charts: Top 10 Markets In Each Block* (visited Mar. 7, 2000) < http://www.fcc.gov/wtb/auctions/auc23/23press1.pdf>.

[83] 39 GHz Band Auction Closes, *Public Notice*, DA 00-1035 (rel. May 10, 2000). Fourteen 100 megahertz licenses (paired 50 megahertz channel blocks) were offered in each of 172 Economic Areas (EAs) and 3 EA-like areas, covering the United States, the Northern Mariana Islands, Guam, American Samoa, the United States Virgin Islands and Puerto Rico. Auction Of Licenses For Fixed Point-To-Point Microwave Services In The 38.6 To 40.0 GHz (39 GHz) Band Scheduled For April 11, 2000, *Public Notice*, DA 99-2624 (rel. Nov. 23, 1999).

[84] 39 GHz Band Auction Closes, *Public Notice*, DA 00-1035 (rel. May 10, 2000). 227 licenses were retained by the FCC. *Id.*

[85] Bidding under NEXTBAND Communications, L.L.C.

[86] FCC, *39 GHz Fact Sheet* (visited Feb. 24, 2000) <http://www.fcc.gov/wtb/auctions/39ghz/39ghfact.html>.

The Commission also has issued proposed rules for the auctioning of spectrum at 24 GHz.[87]

(ii) Investments

Upperband operators have received significant investments over the past year.[88] In September 1999, Qwest and a group of technology investment funds finalized a $251 million equity investment in ART.[89] In November 1999, Teligent announced that it raised $500 million in new capital from an investment group led by Microsoft Corporation and Hicks, Muse, Tate & Furst Inc., enabling Teligent to finance its core operations into 2001 and begin an international expansion.[90] In December 1999, Winstar Communications received a $900 million investment from Microsoft and several investment firms to expand its network, products and services.[91] Also in December 1999, investment firm Forstmann Little & Co. agreed to invest $850 million in Nextlink giving the firm an 8% diluted stake in the company. Nextlink said it would use the funds to expand networks and services, to introduce new technologies and to fund its business plan.[92]

b. Major Operators

Teligent and WinStar are in a more advanced stage of deployment than the other upperband operators, most of which appear not to have moved beyond the development and pilot testing stage as of the end of 1999. Accordingly, significant data on deployment (subscribers, lines installed, revenue) is available primarily for Teligent and Winstar.

Teligent. Teligent provides a bundle of broadband fixed wireless telecommunication services to small and medium sized businesses using its 24 GHz licenses. Teligent offers local, long distance, and Internet access and data speeds ranging from 64 kbps to 155 Mbps (OC-3).[93] Over the past year, Teligent completed its plan to rollout service in 40 US markets,[94] covering more than 100 million people.[95] Teligent's licenses cover 74 markets nationwide and the company plans to enter all these markets by the

---

[87] Amendments to Parts 1, 2 and 101of the Commission's Rules To License Fixed Services at 24 GHz, *Notice Of Proposed Rulemaking,* FCC 99-333 (rel. Nov. 10, 1999).

[88] This is representative of the success telecom companies in general have had recently in raising money. According to Goldman Sachs, communications companies raised 88 percent of the $9.5 billion in the world-wide high-yield bond issuance of the first two months of 2000, up from 45 percent in the same period in 1999. Paul M. Sherer, *Junk Bonds Throw Money Into Telecom Firms,* WALL STREET JOURNAL, Feb. 23, 2000, at C1.

[89] COMMUNICATIONS DAILY, Sept. 13, 1999.

[90] *Teligent 3Q99 Report Shows $10.3M in Revenues*, WIRELESSNOW, Nov. 11, 1999. In June, 1999, AT&T's Liberty Media Group purchased Associated Group for $3 billion. Associated has a 41% stake in Teligent. *AT&T Gearing Up For Fixed Wireless Plans*, COMMUNICATIONS DAILY, Dec. 22, 1999, *available in* 1999 WL 7581032.

[91] *Winstar Gets $900 Million Investment From Microsoft and Other Companies*, DOW JONES NEWSWIRES, Dec. 15, 1999.

[92] *Nextlink Secures $850M Infusion*, WIRELESSNOW, Dec. 10, 1999.

[93] Teligent (visited Mar. 6, 2000) <http://www.teligent.com/>; Teligent, Form 10-K, Dec. 31, 1999, at 3.

[94] *See* Appendix F, Map 8, p. F-9.

[95] *Teligent Reports $31 Million In 1999 Revenue; Expands Reach To Four Continents,* News Release, Teligent, Mar. 6, 2000.

end of 2001.[96] At year end 1999, Teligent's customer base had grown to more than 15,000, up more than 12 fold from the 1,176 customers installed at the end of 1998.[97] In the fourth quarter of 1999, Teligent installed nearly 90,000 lines, [98] bringing its total installed lines to 166,000.[99] Teligent has access to more than 7,500 buildings through leases and options, and 2,500 of those are "on-net"(*i.e.*, have been connected to Teligent's network).[100] Of the 2500 on-net, 1000 had fixed wireless installations.[101]

In February 2000, Teligent and wireline CLEC ICG Communications, Inc. ("ICG") announced a swap stock valued at $81 million. According to a Teligent spokesperson, the agreement provided an opportunity for the companies to examine the synergies between wireline and wireless operations, with ICG having the ability to provide Teligent with wireline network capacity for backhaul operations and wiring buildings.[102]

WinStar. WinStar uses its 28 GHz and 39 GHz licenses to provide a package of WLL services, which it collectively calls "Wireless Fiber." WinStar sells local, long distance, high-speed data, Internet access, and information services to business customers and resells its networks to other telecommunications carriers using both its wireless and extensive fiber networks.[103] WinStar offers customers speeds up to 155 Mbps using its wireless spectrum.[104] WinStar's wireless network expanded to 60 domestic markets in 1999, up from 30 at the end of 1998.[105] WinStar finished the year with 23,000 "Core Customers," 618,000 access lines, and access rights to more than 8,000 buildings.[106] Over 34 percent of those lines are "on-net."[107] For lines added in the fourth quarter, 57 percent were on-net.[108] In February 2000, WinStar sold its 12 percent stake in ART.[109]

---

[96] *Teligent Reports Third Quarter Financial Results, Completes Launch of First 15 Markets*, News Release, Teligent, Nov. 11, 1998.

[97] *Teligent Reports $31 Million In 1999 Revenue; Expands Reach To Four Continents*, News Release, Teligent, Mar. 6, 2000.

[98] *Id.*

[99] Teligent had a total of 76,000 lines installed at the end of the third quarter 1999. *Teligent Reports Third Quarter Revenue Of $10.3M; Tops 1999 Target Of 75,000 Installed Lines*, News Release, Teligent, Nov. 9, 1999.

[100] *Teligent Reports $31 Million In 1999 Revenue; Expands Reach To Four Continents*, News Release, Teligent, Mar. 6, 2000.

[101] *Id.*

[102] COMMUNICATIONS DAILY, Feb. 29, 2000.

[103] These other carriers include CLECs, Competitive Access Providers ("CAPs"), inter-exchange carriers ("IXCs"), LECs, and Internet Service Providers ("ISPs").

[104] WinStar Communications, Inc., Form 10-K405, Dec. 31, 1999, at 3.

[105] *WinStar Reports Fourth Quarter Results; Revenue, Gross Margin and EBITDA Continue Sharp Improvement*, News Release, WinStar, Feb. 10, 2000. *See* Appendix F, Map 10, p. F-11.

[106] *Id.*

[107] *Id.*

[108] *Id.* In New York, fourth quarter new lines additions were 84 percent on-net. *Id.*

[109] *WinStar Sells its 12% stake in Advanced Radio Telecom*, THE SEATTLE TIMES, Feb. 7, 2000.

WinStar won the most licenses (931) in the 39 GHz auction and spent the most money, $161 million, almost 40 percent of the total.[110]

Nextlink. Nextlink is an LMDS licensee and CLEC currently operating 32 facilities-based networks providing local and long distance services in 49 markets across the United States.[111] In 1999, Nextlink expanded its LMDS holdings by buying out Nextel's interest in jointly-held Nextband Communications, LLC ("Nextband")[112] and by acquiring WNP Communications, Inc. ("WNP").[113] The company plans to use the spectrum as a complement to its fiber networks.[114] In December 1999, Nextlink completed its first generation broadband wireless field tests and announced the availability of wireless commercial services to a limited group of customers in Los Angeles, CA and Dallas, TX.[115] In July 2000, Nextlink announcing that commercial broadband service was now available in Chicago, Philadelphia, Newark, Los Angeles and Dallas.[116] The company plans to have service available in Boston, St. Louis, Washington D.C., San Francisco, Cleveland, Sacramento, Seattle and Memphis by the end of the third quarter 2000 and fully expects to reach its goal of serving 25 markets via broadband wireless by year-end.[117]

In June 1999, Nextlink agreed to purchase two million shares of SPEEDUS.COM, Inc. ("SPEEDUS.COM") and to pay $20 million for 150 MHz of its LMDS spectrum in New York City.[118] SPEEDUS.COM, the first operational LMDS provider,[119] offers high-speed Internet access, up to 48 Mbps downstream, to business and residential users in Manhattan, Brooklyn, and Queens, NY. In

---

[110] FCC, *FCC "Closed" 39 GHz Auction #30* (visited May 17, 2000) <http://www.fcc.gov/wtb/auctions/39ghz/30press1.pdf >.

[111] Nextlink, *NEXTLINK Communications, Inc. Fact Sheet*, Dec. 31, 1999. *See* Appendix F, Map 9, p. F-10.

[112] Nextlink and Nextel each owned 50 percent of Nextband, which purchased 42 licenses in the LMDS auction. This aquisition will make Nextlink the sole owner of Nextband.

[113] *NEXTLINK Communications To Acquire WNP Communications for $695 Million*, News Release, Nextlink, Jan. 14, 1999. On March 30, 1999, the FCC approved the assignment of WNP's licenses to Nextlink. Wireless Telecommunications Bureau Public Safety and Private Wireless Division Grants Consent to Assign Authorizations of WNP Communications, Inc. and PCO Aquisition Corp., *Public Notice*, DA 99-610 (rel. Mar. 30, 1999); *Nextlink Closes WNP Acquisition; Becomes Largest Holder of Fixed Wireless Spectrum in North America*, News Release, Nextlink, Apr. 27, 1999. WNP was the largest bidder in the LMDS auction, having acquired 40 licenses covering 114 million POPs.

[114] *McCaw's Big-Picture Strategy Comes into Clearer Focus as Nextel Chief Consolidates Domestic LMDS Holdings*, PCS WEEK, Jan. 27, 1999, *available in* 1999 WL 7870838; *McCaw Aims to Consolidate Domestic LMDS Spectrum Holdings*, COMMUNICATIONS TODAY, Jan. 15, 1999, *available in* 1999 WL 6503237.

[115] *NEXTLINK Beats Line Count, Revenue And EBITDA Expectations In 4Q*, News Release, Nextlink, Feb. 15, 2000.

[116] *NEXTLINK Beats Second Quarter Analyst Revenue and Line Installation Estimates*, Nextlink, July 26, 2000.

[117] *Id.*

[118] SPEEDUS.COM, Inc., *SPEEDUS.COM, Inc. and Nextlink Sign $40 Million Pact, Nextlink Agrees to Purchase Two Million Shares at $10 Per Share*, News Release, SPEEDUS.COM, Inc., June 14, 1999.

[119] In January 1999, CellularVision USA, Inc. completed its name change to SPEEDUS.COM, Inc. *SpeedUs.com New Name For CellularVision; SpeedUs.com: A New Broadcast ISP For Super High-Speed Internet In New York*, News Release, SPEEDUS.COM, Jan. 6, 1999.

November 1999, Nextlink also bought a 15 percent stake in LMDS license holder HighSpeed.Com L.L.C. ("HighSpeed.Com") and 300 MHz of HighSpeed.Com's LMDS spectrum in Denver, CO for $18.7 million.[120]

Touch America. Touch America is the wholly owned telecommunications subsidiary of Montana Power Company, and provides both wireline and wireless voice and data services to other carriers, as well as directly to its own customers. In 1998, Touch America acquired 24 LMDS licenses that cover significant portions of the inland Pacific Northwest, northern and central Rocky Mountain regions and the northern Plains states. In February 1999, Touch America announced that it would build a high-speed broadband wireless telecommunications network directly linking large data customers in 30 cities to Touch America's fiber optic network.[121]

By late 1999, Touch America had successfully tested its high-speed LMDS network in Billings and Butte, MT and had launched commercial operation in both cities.[122] Touch America offers voice and data services on its LMDS network with speeds up to 10 Mbps, and is targeting the service at business and government customers. Major customers include the Billings and Butte public school districts. Touch America anticipates spending $15 million to build its initial LMDS footprint in 25 cities.[123]

In March 2000, Montana Power announced that it would divest its energy businesses and focus exclusively on telecommunications.[124] In June 2000, Touch America completed the acquisition of Qwest Communication's long-distance business in the 14-state territory of US WEST.[125]

HighSpeed.Com. Privately-held Highspeed.Com was the successful bidder on 28 LMDS licenses in the western United States. The licenses, covering 12 million Pops, include much of the states of Washington, Oregon, Idaho, Hawaii, Colorado and Nevada as well as a large part of the Central Valley of California.[126] HighSpeed.Com has begun offering service using its LMDS licenses in Walla Walla, WA; Bend, OR; Bakersfield, CA and Boise, ID.[127]

ART. ART holds over 350 39 GHz licenses. These licenses cover 210 U.S. markets, with a population of over 186 million, allowing the company to provide between 100 and 500 MHz of transmission capacity in

---

[120] *NEXTLINK And Highspeed.Com Form Strategic Alliance*, News Release, Highspeed.Com, Nov. 16, 1999. *See* further discussion below.

[121] *Touch America to Enter Wireless Communications Business*, News Release, Touch America, Feb. 18, 1999.

[122] *Touch America Launches Wireless, High-Speed Broadband LMDS Commercial Service*, News Release, Touch America, Sept. 21, 1999; *Touch America Launches Wireless, High-Speed Broadband LMDS Service in Butte*, News Release, Touch America, Nov. 5, 1999.

[123] *Id.*

[124] *Montana Power to Divest Energy Businesses, Company to Become Touch America*, News Release, Touch America, Mar. 28, 2000.

[125] *Touch America Completes Acquisition of Qwest Communications' 14-State Long Distance Business*, News Release, Touch America, June 30, 2000. The sale was required by the Telecommunications Act of 1996 to comply with restrictions that currently prohibit regional bell operating companies or their affiliates from providing long distance services in their local service region.

[126] Highspeed.Com, *Welcome to Highspeed.Com* (visited Mar. 8, 2000) <www.highspeed.com>.

[127] Phone conversation with HighSpeed.Com President and CFO Thomas P. Sawatzki, Apr. 25, 2000.

90 of the top 100 U.S. markets.[128] First a "wholesale carriers' carrier," then an ISP to "end-user customers,"[129] ART has since modified its business strategy to provide "high speed broadband IP services to businesses."[130] ART provides access for businesses to its wide area network at 10 Mbps and 100 Mbps speeds.[131] The company also provides 155 Mbps speeds for data center and other high capacity bandwidth applications.[132]

In September 1999, ART began offering "100 Mbps Internet access service" to businesses in the San Jose area.[133] Since then, ART has launched networks in Los Angeles, Washington, D.C., Houston, Seattle, and Phoenix, and plans to deploy service in Boston, Dallas, New York, and San Diego by the end of 2000.[134] ART has plans to rollout a total of 40 markets over the next few years.[135]

ART has signed a number of master leases and individual building license agreements that give the company access to more than 4,400 commercial buildings in the United States.[136] In June 1999, Qwest Communications International Inc. ("Qwest") purchased a 19 percent stake in ART. Qwest plans to use ART's broadband metropolitan networks as part of its local broadband access strategy to extend its high-speed Internet network to the end user.[137]

In March 2000, ART entered into a binding letter of intent to acquire 366 39 GHz licenses from Broadstream Communications Corporation and its affiliates ("Broadstream") and also entered into agreements to acquire all 14 of the 39 GHz licenses of Bachow Communications Incorporated ("Bachow").[138]

---

[128] *Advanced Radio Telecom Corp. Announces Operating Results for Fourth Quarter 1998*, News Release, ART, Jan. 12, 1999; Advanced Radio Telecom, Inc., Form 10-K, Dec. 31, 1999, at 5. *See* Appendix F, Map 11, p. F-12.

[129] ART had begun offering a variety of broadband Internet services to business customers in Seattle, WA, Portland, OR, and Phoenix, AZ, in 1998. *Advanced Radio Telecom Reports 1999 Fourth Quarter, Year End Results*, News Release, Advanced Radio Telecom, Inc., Feb. 16, 2000.

[130] Advanced Radio Telecom, Inc., Form 10-K, Dec. 31, 1999, at 2.

[131] *Advanced Radio Telecom Launches Broadband Wireless IP Network in Phoenix*, News Release, Advanced Radio Telecom, Inc., June 30, 2000.

[132] *Id.*

[133] Advanced Radio Telecom, Inc., Form 10-K, Dec. 31, 1999, at 2.

[134] *Advanced Radio Telecom to Deploy Broadband Wireless Internet Protocol Networks in 10 Markets in 2000*, News Release, Advanced Radio Telecom, Inc., Jan. 5, 2000; *Advanced Radio Telecom Launches Broadband Wireless IP Network in Phoenix*, News Release, Advanced Radio Telecom, Inc., June 30, 2000.

[135] *Advanced Radio Telecom to Deploy Broadband Wireless Internet Protocol Networks in 10 Markets in 2000*, News Release, Advanced Radio Telecom, Inc., Jan. 5, 2000.

[136] *Advanced Radio Telecom Adds 800 Commercial Buildings to Access Portfolio via Agreement with RREEF*, News Release, Advanced Radio Telecom, Inc., Feb. 15, 2000.

[137] *Advanced Radio Telecom to Deploy Broadband Wireless Internet Protocol Networks in 10 Markets in 2000*, News Release, Advanced Radio Telecom, Inc., Jan. 5, 2000.

[138] *Advanced Radio Telecom Signs Binding LOI for Major Spectrum Acquisition*, News Release, Advanced Radio Telecom, Inc., Mar. 29, 2000; *Advanced Radio Telecom to Acquire 15 Additional 39 GHz Licenses in Major Markets*, News Release, Advanced Radio Telecom, Inc., Mar. 29, 2000. The 14 licenses to be acquired from Bachow cover a population of approximately 37 million, bringing ART's U.S. license coverage to over 370 million

AT&T. AT&T has 39 GHz licenses in 156 geographic areas covering a total population of approximately 220 million, including more than 80 of the largest 100 metropolitan markets.[139] AT&T obtained the licenses through its acquisition of Teleport Communications Group, Inc. ("TCG"), completed in July 1998.[140] AT&T has released little public information concerning how the company is currently using its licenses,[141] and how, or if, it plans to use them for its fixed wireless system.[142] AT&T also owns 22 LMDS licenses that it obtained through the acquisition of Vanguard Cellular Systems, Inc., in May 1999.[143]

c. Technology

All wireless services that operate above 10 GHz face significant signal losses from atmospheric gasses, most notably from precipitation (*i.e.*, rain, snow, fog). However, by adjusting factors such as cell size and transmission power, the networks can be engineered to the standard level of reliability in telecommunications network, 99.999 percent.[144] Because of this atmospheric degradation, the range of individual transmitters above 10 MHz is limited compared to wireless systems at lower frequencies. The maximum range most often cited by operators is approximately 3 to 5 miles. Moreover, since they behave much more like visible light than cellular or PCS signals when obstacles such as terrain, buildings, and vegetation are encountered, upperband signals also require a clear line-of-sight between transmitters and receivers.

Upperband operators currently use a mix of point-to-point (PTP) and point-to-multipoint (PTMP) transmission technologies to link their customers to their central hubs. In a PTP network, at the hub, there is a single transmitting dish for each building or customer on the network. In a PTMP network, multiple buildings or customers can be serviced by a single special transmitter at the hub.

---

channel pops. *Advanced Radio Telecom to Acquire 15 Additional 39 GHz Licenses in Major Markets*, News Release, Advanced Radio Telecom, Inc., Mar. 29, 2000. The 366 Broadstream licenses cover a population of approximately 258 million, including 37 of the top 50 markets in the United States. *Advanced Radio Telecom Signs Binding LOI for Major Spectrum Acquisition*, News Release, Advanced Radio Telecom, Inc., Mar. 29, 2000. 104 of the licenses to be acquired from Broadsteam are subject to put and call agreements conditioned on license renewal. *Advanced Radio Telecom Signs Binding LOI for Major Spectrum Acquisition*, News Release, Advanced Radio Telecom, Inc., Mar. 29, 2000.

[139] AT&T Corp., Prospectus of AT&T Wireless Group Tracking Stock, Mar. 28, 2000. *See* also Appendix F, Map 12, p. F-13.

[140] *AT&T Completes TCG Merger; TCG Now Core of AT&T Local Services Network Unit*, News Release, AT&T Corp., July 23, 1998.

[141] According to one analyst, at the end of 1999, AT&T had 400-600 buildings connected via fixed wireless and that number should reach 800 by the end of 2000. AT&T also uses its 39 GHz spectrum to connect its cellular base stations in a number of markets. Jim Friedland and Amy Roth, *Broadband Wireless Access: Beyond the Reach of Fiber*, Telecom Services Research, Robertson Stephens, Feb. 18, 2000.

[142] In early 1999, AT&T said it planned to expand TCG's wireless local loop bypass business. Bill Menezes, *MCI WorldCom Discovers Fixed Wireless*, WIRELESS WEEK, Feb. 8, 1999, at 25.

[143] AT&T Corp., Form 10-K, Dec. 31, 1999, at 1.

[144] This level of reliability is also known as "five 9's."

PTMP has a number of advantages over PTP.[145] PTMP allows for the cost of the hub site antenna to be allocated over numerous customer building sites, rather than just one, and reduces the capital expenditures necessary to bring service to a particular building.[146] In addition, the use of PTMP allows fixed wireless operators to allocate and share network capacity on an as-needed basis and supply customers with bandwidth-on-demand to address their dynamic capacity needs.[147]

The incumbent 39 GHz licensees, which were the first to be operating in the upperband, have traditionally used PTP systems, but are currently beginning to test and deploy PTMP systems as well. WinStar, for example, deployed PTMP technologies in six U.S. markets in 1999, with plans further deployment throughout 2000.[148] The company is integrating Siemens/P-Com and Hughes PMP equipment into its network.[149] Other operators are trying to implement PTMP. Nextlink has had success with its PTMP technical trials, but believes that equipment costs may be too high at present to justify a significant deployment of PTMP equipment until more cost-effective, 2nd generation equipment becomes commercially available over the next 12 months.[150] Nextlink expects to be using PTMP commercially by early 2001.[151] The company with the most extensive PTMP network is probably Teligent, with 25 percent of its fixed wireless traffic transmitted using PTMP.[152]

[145] Fixed wireless equipment maker P-Com believes that PTP technology offers a better solution than PTMP for customer requirements above 45 Mbps. John Hodulik, Broadband Wireless Conference Call Series # 4 with P-Com, PaineWebber, Apr. 12, 2000.

[146] WinStar Communications, Inc., Form 10-K405, Dec. 31, 1999, at 3-4.

[147] *Id.*

[148] *Winstar Reports Fourth Quarter Results; Revenue, Gross Margin and EBITDA Continue Sharp Improvement*, News Release, Winstar Communications, Inc., Feb. 10, 2000.

[149] *Id.*

[150] *Nextlink Communications, Inc.*, Equity Research, Credit Suisse First Boston, Feb 18, 2000.

[151] *Broadband Wireless Access: Beyond the Reach of Fiber*, Robertson Stephens, Feb. 18, 2000, at 7.

[152] *Id.*

Table E-1: MMDS Internet Access Offerings

Company	Location	Direction	Maximum Downstream Speed
Alaska Wireless Cable	Fairbanks, AK	Two-way	N/A
Cache Valley AIRNET	Cache Valley, UT	Two-way	5 Mbps
IJNT.net, Inc.	Salt Lake City, UT Beaumont, TX	One-way	10 Mbps
Nucentrix Broadband Networks, Inc.	Austin, TX Sherman, TX	Two-way	1.54 Mbps
Sioux Valley Wireless	Sioux Falls, SD	Two-way	4 Mbps
SkyLynx Communications	Fresno, CA Sarasota, FL	Two-way (in conjunction with unlicensed)	11 Mbps
Sprint	Phoenix, AZ	Two-way	2 Mbps
	Detroit, MI San Francisco, CA	Two-way (trial)	2 Mbps
U.S. Interactive dba AccelerNet	Houston, TX	One-way	10 Mbps
Wireless First	Traverse City, MI	Two-way	N/A
WorldCom	Baton Rouge, LA Jackson, MI Memphis, TN	Two-way (trial)	310 kbps (residential) 8 Mbps (business)

Table E-2: LMDS Launches

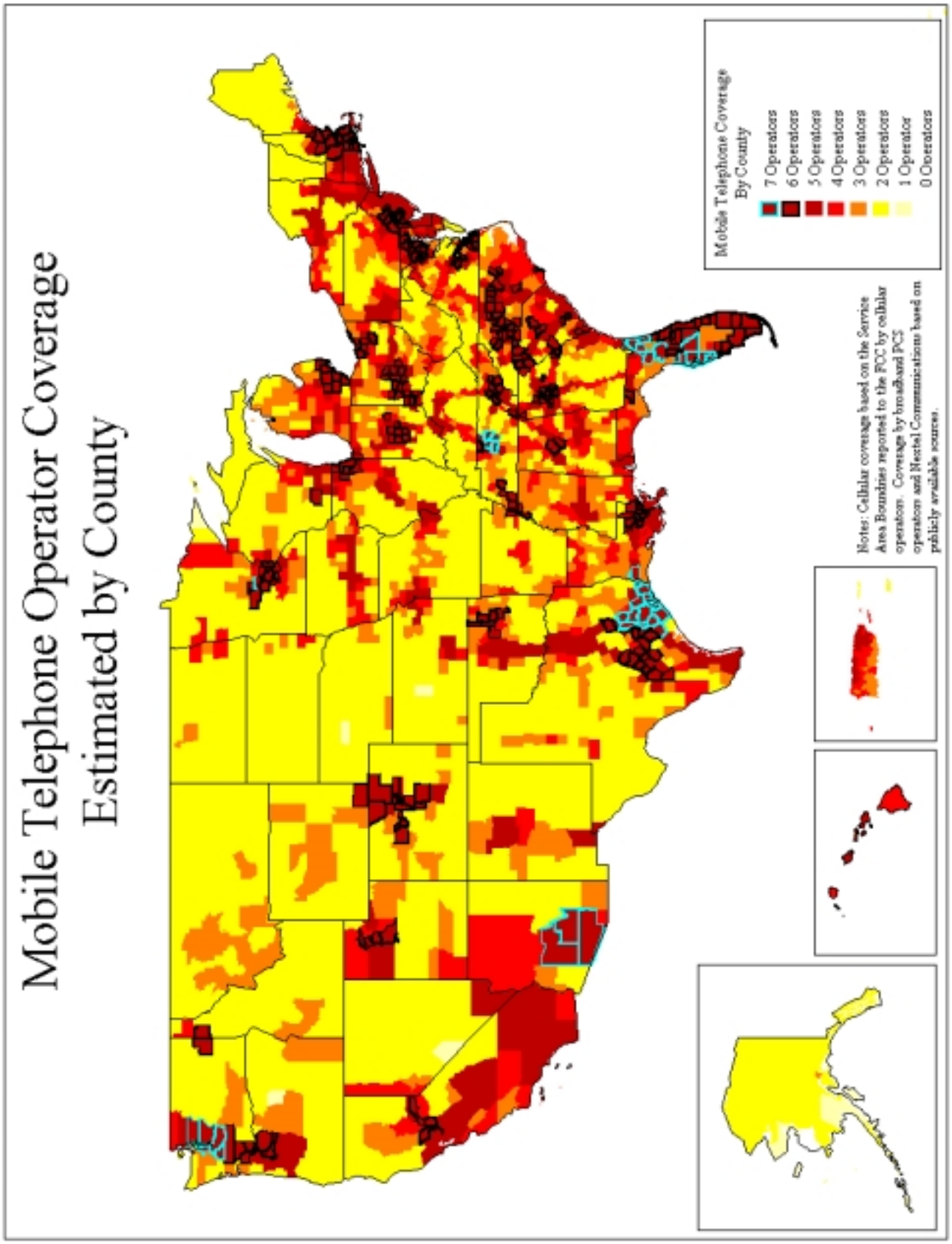
Carrier	Service Location	Equipment Vendor	Type of Service
NextLink	Dallas, Los Angeles	Ericsson (Mini-Link Broad Access system), SpectraPoint Wireless, Wavetrace, Digital Microwave	Launched commercial service after field tests
Winstar	Holds 9 LMDS A-block licenses, including the San Francisco-Oakland BTA	Wavetrace	LMDS service rollout scheduled for 2000.
South Central Telecom	Medicine Lodge, KS	Newbridge Networks	Telemedicine, distance learning, and leased line services
Formus Communications	Denver	Wavetrace	Testing LMDS equipment for deployment in Europe, Latin America, New Zealand
Virginia Tech University	Blacksburg,VA	Wavetrace	Acquired 4 LMDS licenses at auction. Use LMDS to provide two-way high-speed data, voice, and video from an on-campus to three off-campus office buildings
Touch America (telecom subsidiary of Montana Power)	Billings, Butte, MT	Nortel Networks	Full voice and data service to business and government
SpeedUS.com (formerly CellularVision)	New York metro	SpeedUS.com developed its LMDS network from CellularVision's patented technology	Facilities-based high-speed Internet service
Central Texas Communications	San Angelo, Brownwood, Goldthwaite, TX	Newbridge Networks	LMDS system is functioning, but has no customers. Scheduled to launch service by year-end 2000
PVT Networks, subsidiary of Penasco Valley Telephone	Artesia, N.M.		Testing LMDS. Scheduled to launch commercial service by end of second quarter 2000
US Unwired	Lake Charles, LA	SpectraPoint Wireless	LMDS voice and data trials
Liberty Cellular	Salinas, KS		Trial service started in mid-1999.
Home Telephone, Inc.	Charleston, SC	Newbridge Networks	LMDS trials
HighSpeed.Com	Walla Walla, WA	Spectrapoint Wireless	CLEC voice and data
Prime	New Castle, PA	Alcatel USA	Market test
Frazier/King Media	Irving, TX	Spectrapoint Wireless	LMDS demonstration to deliver voice, data, and video services to residences and businesses

Source: Rulemaking to Amend Parts 1, 2, 21, and 25 of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, to Reallocate the 29.5-30.0 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Serviceand for Fixed Satellite Services, *Third Report and Order and Memorandum Opinion and Order*, FCC 00-223, Appendix B, released June 27, 2000.

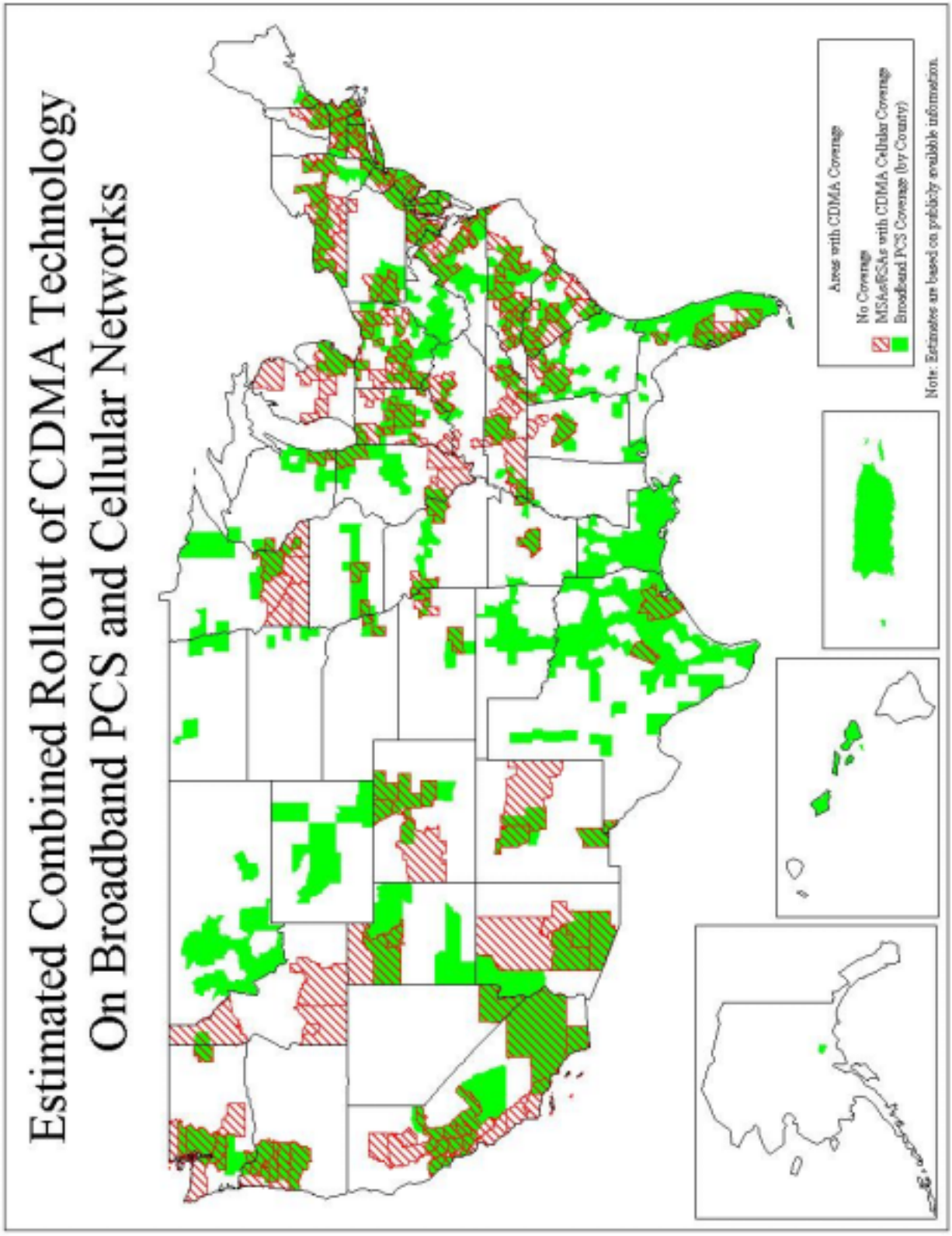
APPENDIX F:
MAPS

Table of Contents

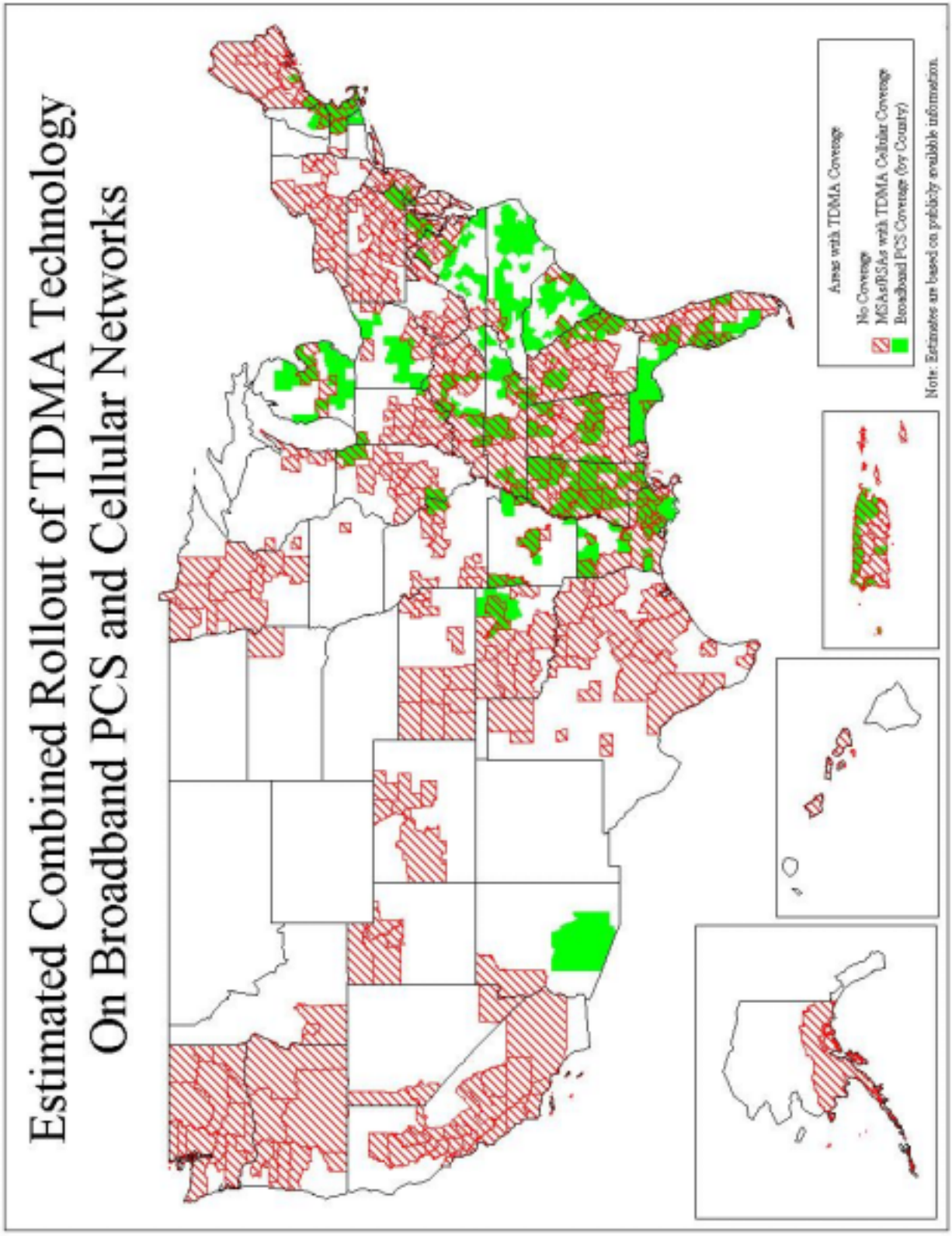
Map 1


Mobile Telephone Operator Coverage
Estimated by County
Mobile Telephone Coverage
By County
7 Operators
6 Operators
5 Operators
4 Operators
3 Operators
2 Operators
1 Operator
0 Operators
Notes: Cellular coverage based on the Service
Area Boundaries reported to the FCC by cellular
operators. Coverage by broadband PCS
operators and Nextel Communications based on
publicly available sources.

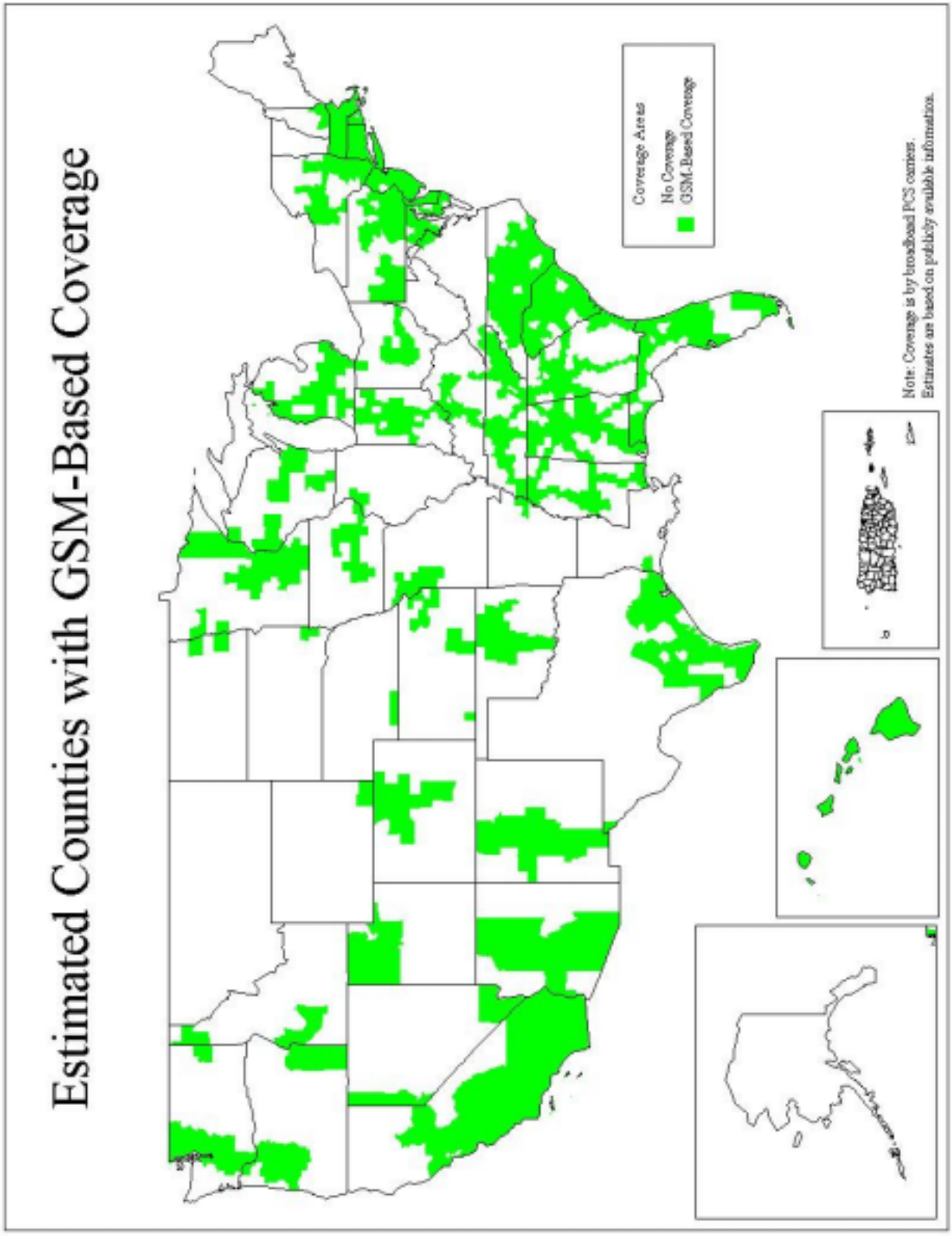
Map 2


Estimated Combined Rollout of CDMA Technology
On Broadband PCS and Cellular Networks
Areas with CDMA Coverage
No Coverage
MSAs/RSAs with CDMA Cellular Coverage
Broadband PCS Coverage (by County)
Note: Estimates are based on publicly available information.

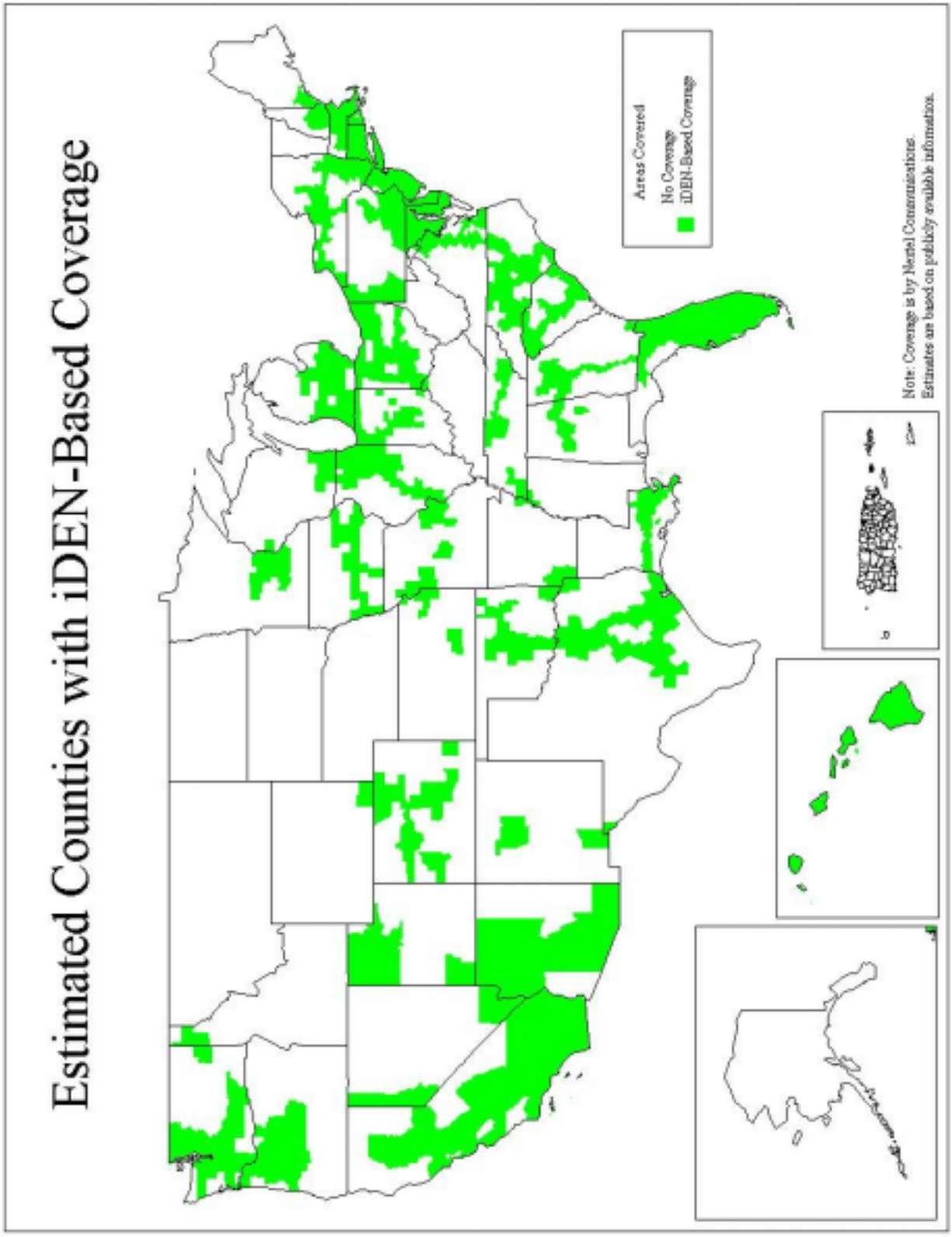
Map 3


Estimated Combined Rollout of TDMA Technology
On Broadband PCS and Cellular Networks
Areas with TDMA Coverage
No Coverage
MSAs/RSAs with TDMA Cellular Coverage
Broadband PCS Coverage (by County)
Note: Estimates are based on publicly available information.

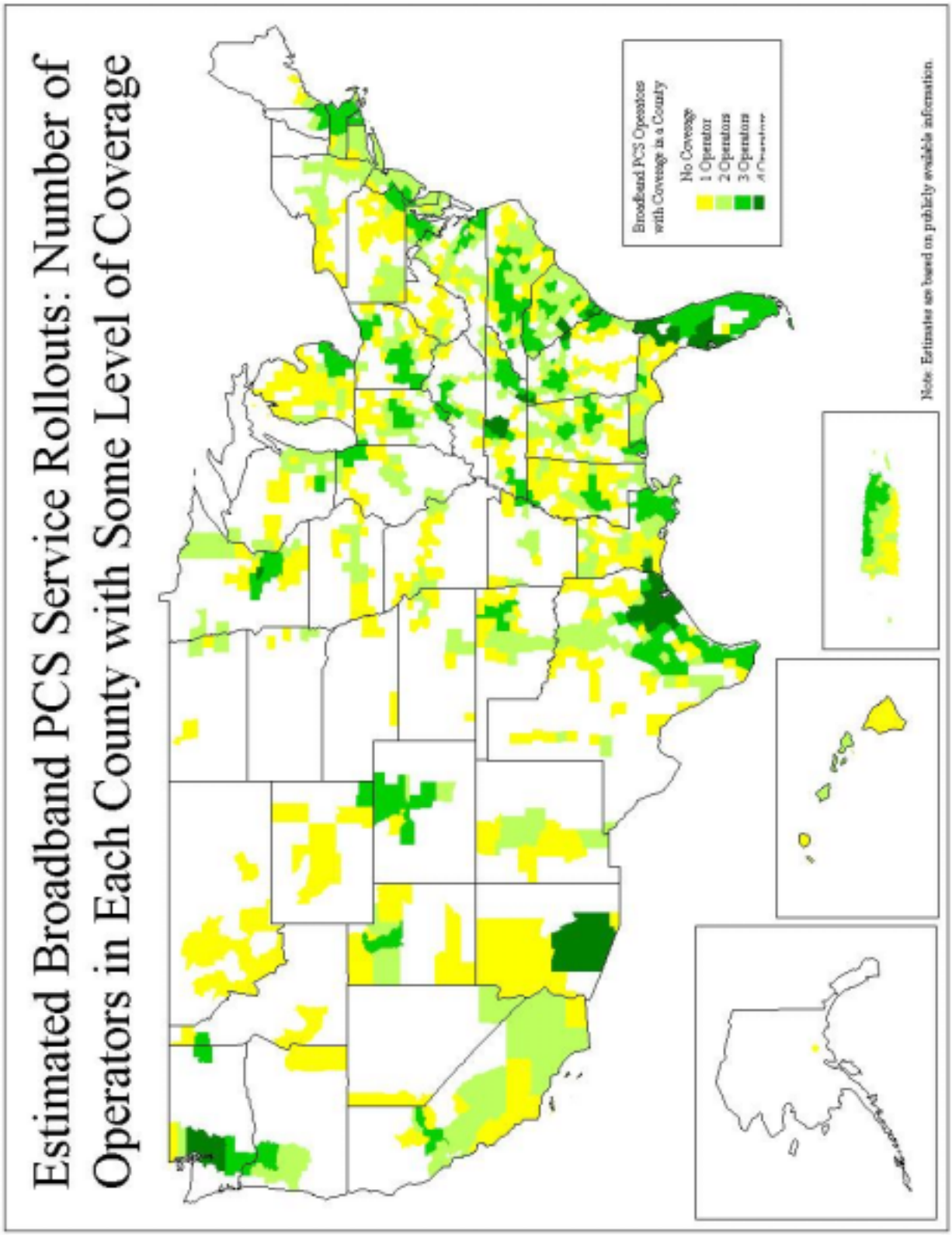
Map 4


Estimated Counties with GSM-Based Coverage
Coverage Areas
No Coverage
GSM-Based Coverage
Note: Coverage is by broadband PCS carriers.
Estimates are based on publicly available information.

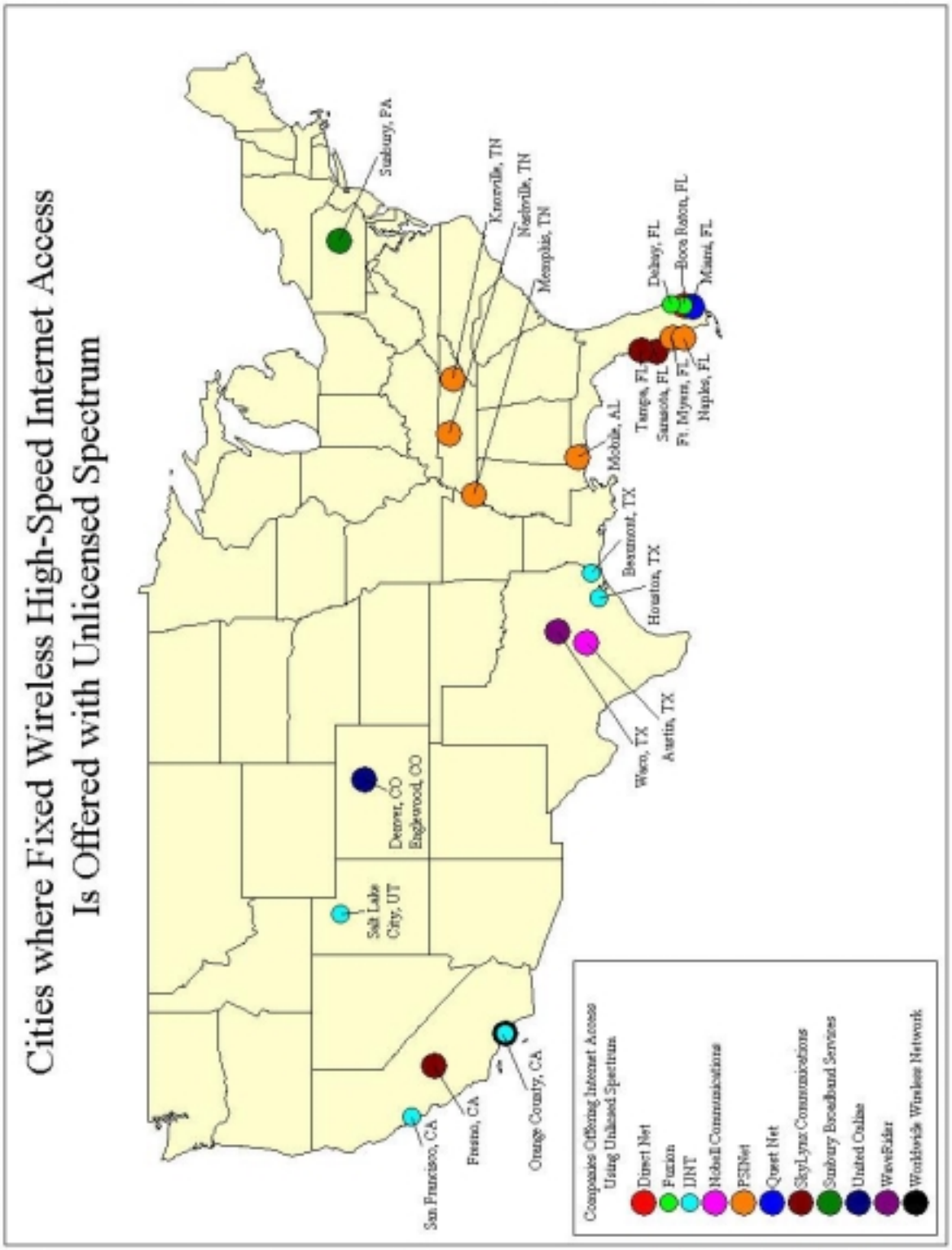
Map 5


Estimated Counties with iDEN-Based Coverage
Areas Covered
No Coverage
iDEN-Based Coverage
Note: Coverage is by Nextel Communications.
Estimates are based on publicly available information.

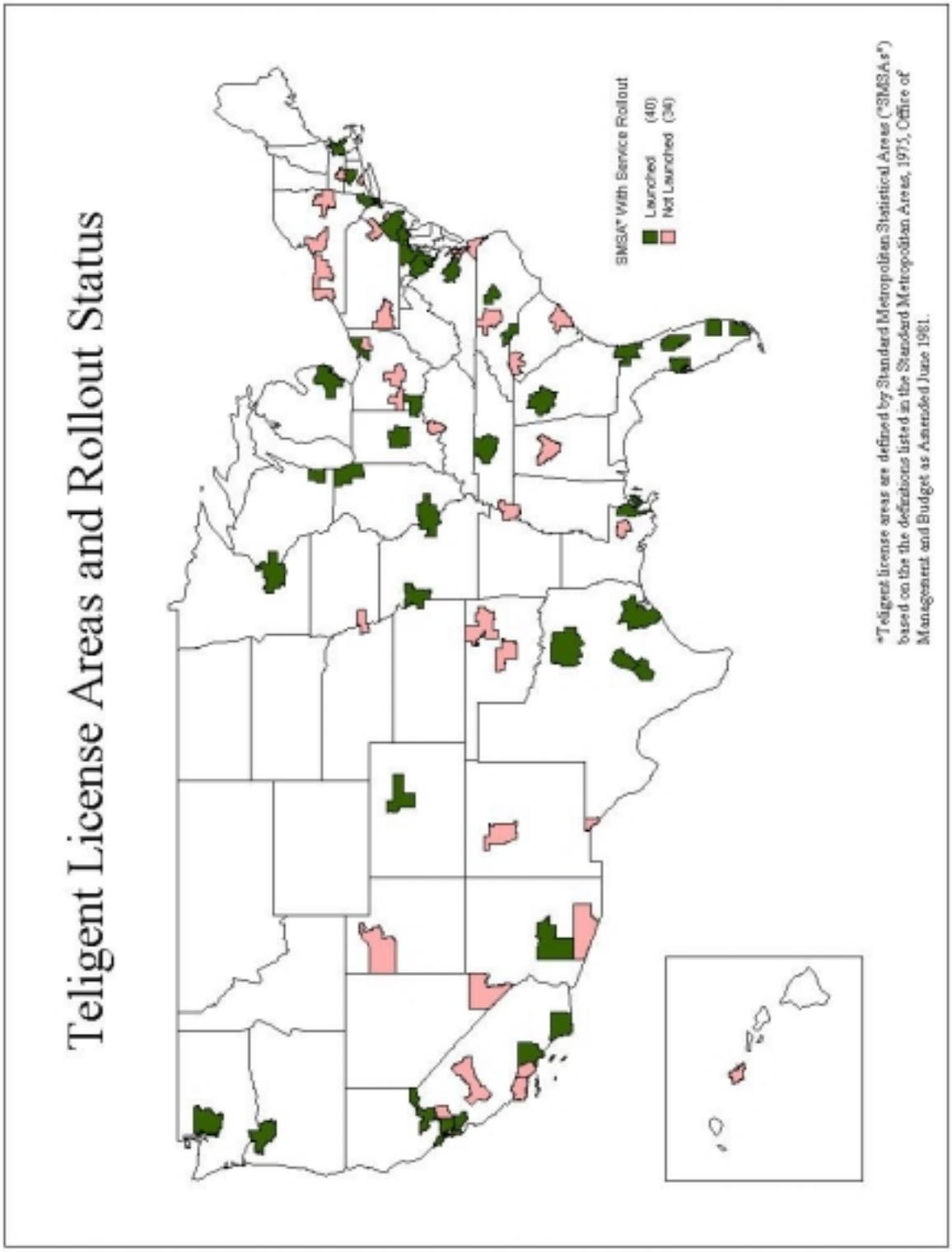
Map 6


Estimated Broadband PCS Service Rollouts: Number of Operators in Each County with Some Level of Coverage
Broadband PCS Operators with Coverage in a County
No Coverage
1 Operator
2 Operators
3 Operators
Note: Estimates are based on publicly available information.

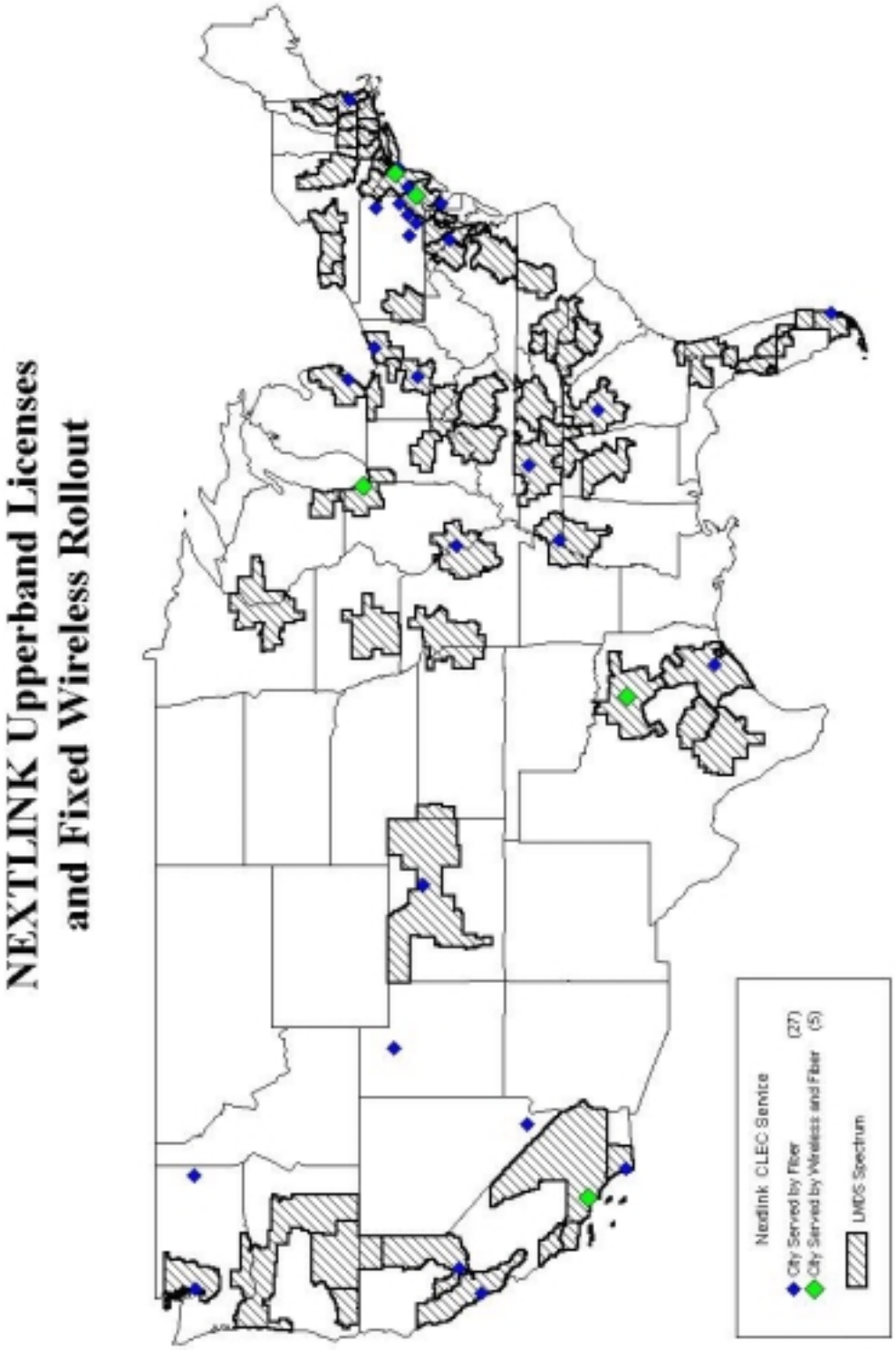
Map 7


Cities where Fixed Wireless High-Speed Internet Access Is Offered with Unlicensed Spectrum
Sunbury, PA
Knoxville, TN
Nashville, TN
Memphis, TN
Delray, FL
Boca Raton, FL
Miami, FL
Tampa, FL
Sarasota, FL
Ft. Myers, FL
Naples, FL
Mobile, AL
Beaumont, TX
Houston, TX
Waco, TX
Austin, TX
Denver, CO
Englewood, CO
Salt Lake City, UT
San Francisco, CA
Fresno, CA
Orange County, CA
Composites Offering Internet Access Using Unlicensed Spectrum
Direct Net
Fusion
UNT
Nobell Communications
PSINet
Qwest Net
SkyLynx Communications
Sunbury Broadband Services
United Online
WaveRider
Worldwide Wireless Network

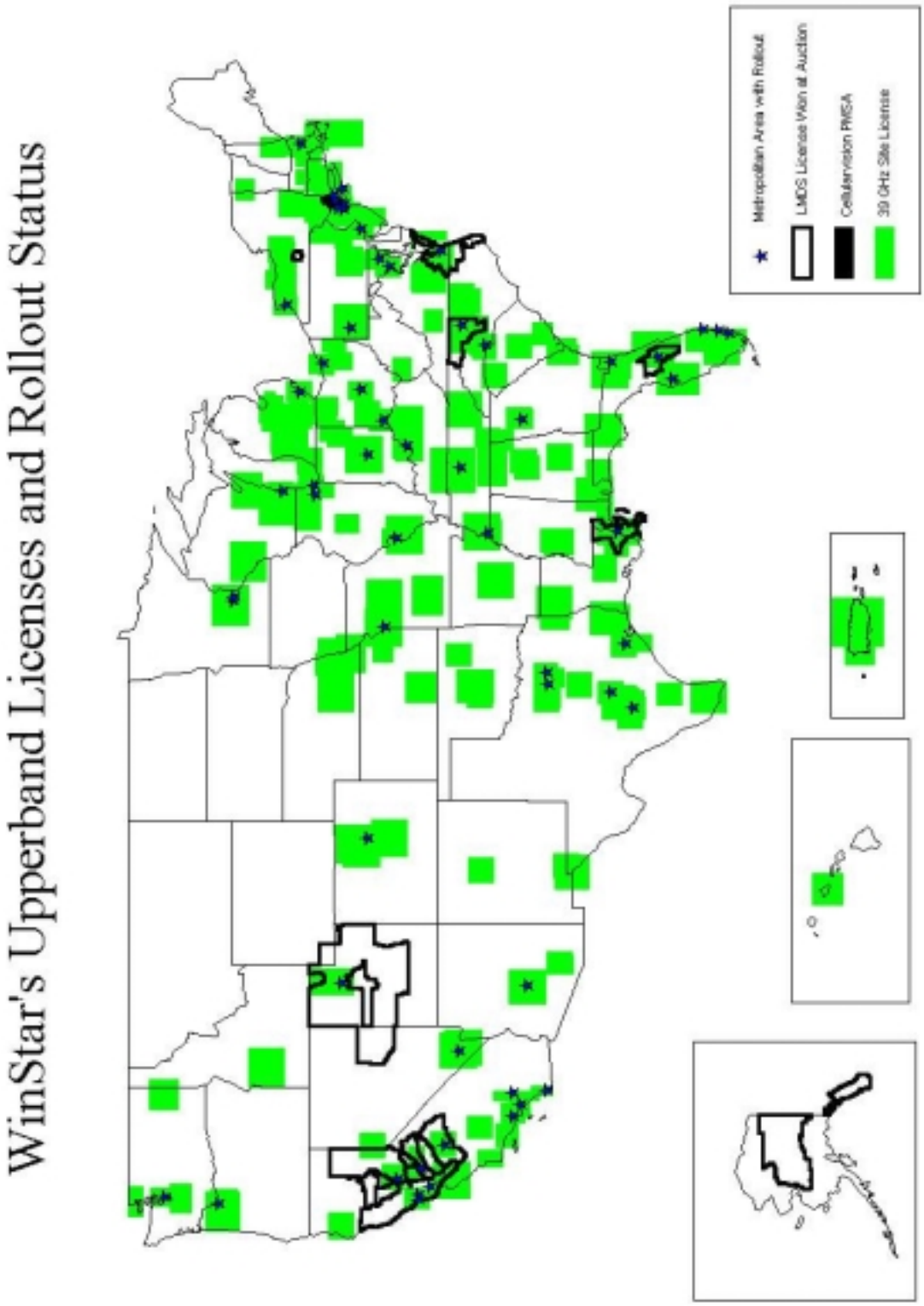
Map 8


Teligent License Areas and Rollout Status
SMSA* With Service Rollout
Launched (40)
Not Launched (34)
*Teligent license areas are defined by Standard Metropolitan Statistical Areas ("SMSAs") based on the the definitions listed in the Standard Metropolitan Areas, 1975, Office of Management and Budget as Amended June 1981.

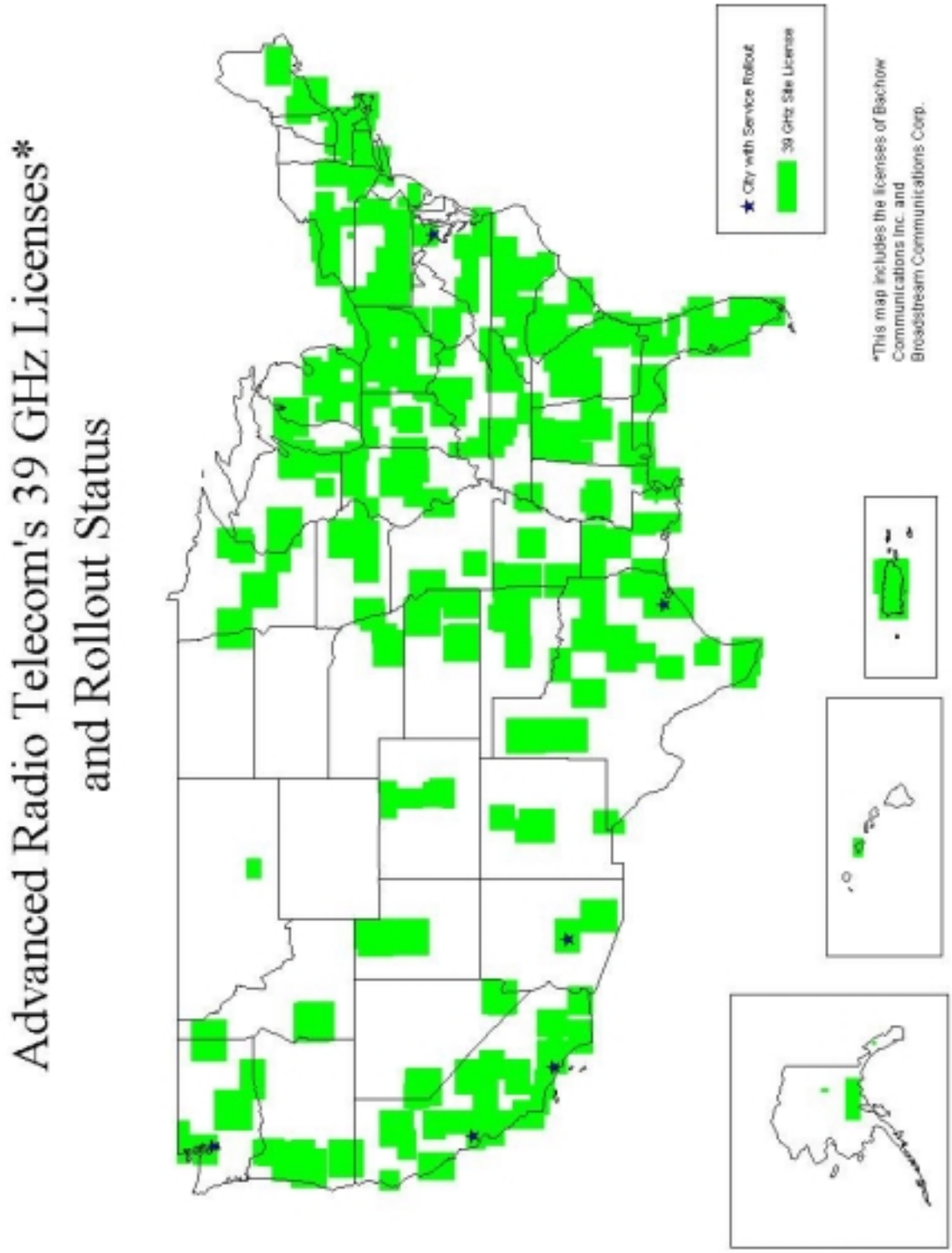
Map 9


NEXTLINK Upperband Licenses
and Fixed Wireless Rollout
Nextlink CLEC Service
City Served by Fiber (27)
City Served by Wireless and Fiber (5)
LMDS Spectrum

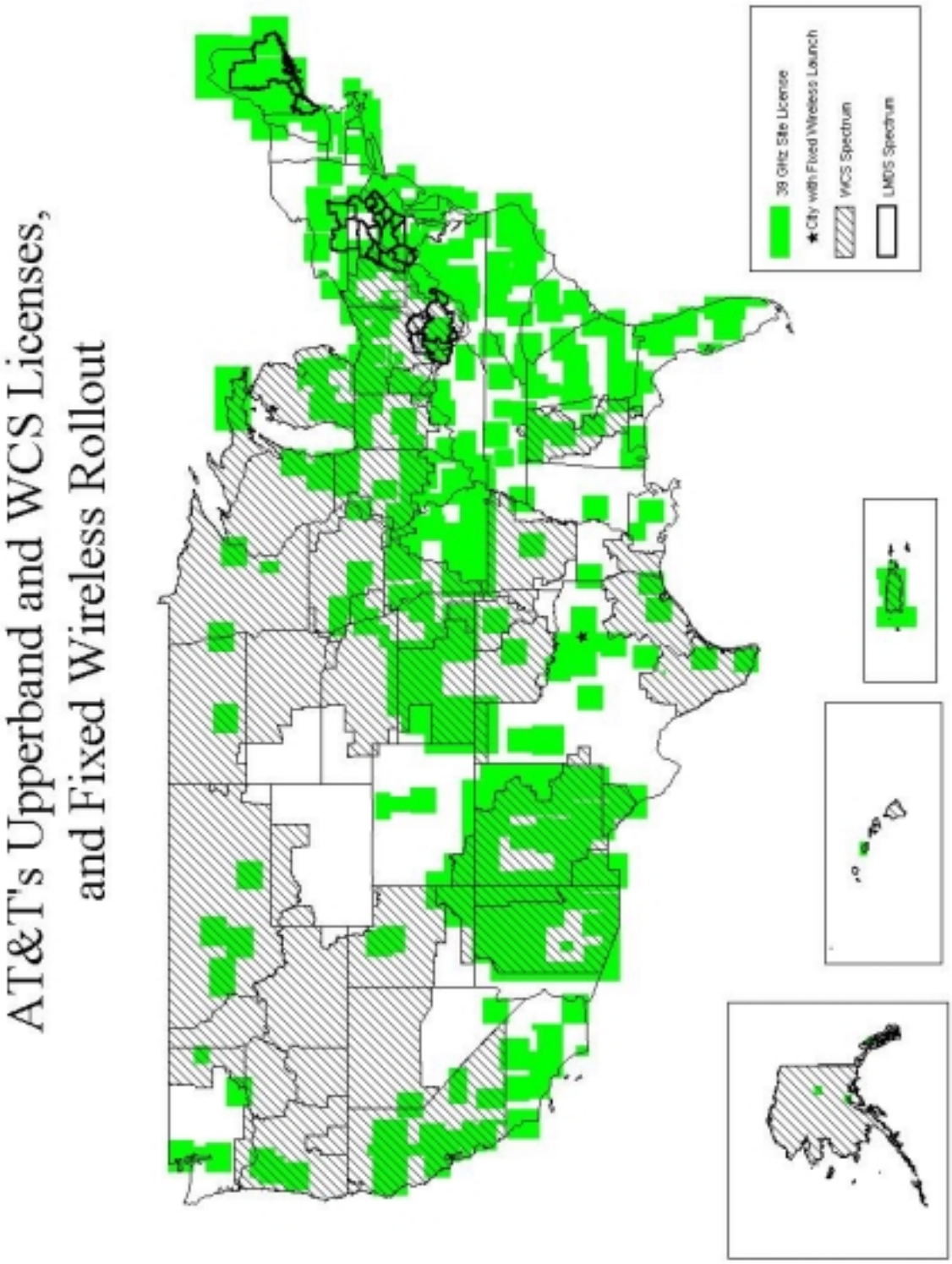
Map 10


WinStar's Upperband Licenses and Rollout Status
Metropolitan Area with Rollout
LMDS License Won at Auction
Cellularvision PMSA
39 GHz Site License

Map 11


Advanced Radio Telecom's 39 GHz Licenses*
and Rollout Status
City with Service Rollout
39 GHz Site License
*This map includes the licenses of Bachow Communications Inc. and Broadstream Communications Corp.

Map 12


AT&T's Upperband and WCS Licenses,
and Fixed Wireless Rollout
39 GHz Site License
City with Fixed Wireless Launch
WCS Spectrum
LMDS Spectrum

APPENDIX G:
CELLULAR LICENSE OWNERSHIP

Below are the cellular licenses owned by a selection of mobile telephone operators. This information was gathered from either public sources, such as filings with the Securities and Exchange Commission and operators' Web sites, or through contacts with the operators themselves. Some of this information may no longer be accurate due to mergers, acquisitions, and exchanges, some of which are noted. When available, the following information is provided for each license:

MSA/RSA Name: The market name for a license.
MSA/RSA Number: The market's number. Markets 1 through 306 are Metropolitan Statistical Areas ("MSAs"). Markets 308 through 724 are Rural Service Areas ("RSAs"). Market 307 is for the Gulf of Mexico.
Frequency Block: For each market, there are two 25 MHz licenses. They are referred to as A block (or non-wireline) and B block (or wireline).
Submarket: For various reasons, the licenses for some markets have been further subdivided (referred to as either Submarkets 1, 2, 3, etc. or A, B, C, etc).
As of Date: The date on which a license was owned by an operator. Unless the operator provided a specific "as of date," the date was assumed to be: the period for which a filing was made with the Securities and Exchange Commission, the date a World Wide Web site was visited, the date a list was provided by an operator, or the date an acquisition or exchange was completed.
% Owned: Percentage of license the operator claimed to control.
POPs: The population covered by license as reported by the operator based on 1998 POPs. Even in the cases where an RSA has been partitioned into submarkets, the population of the entire RSA is listed.
Net POPs: Equals POPs multiplied by the percentage ownership.

ALLTEL

MSA/RSA Name	MSA/RSA Number	Freq. Block	Sub Market	% Owned	As of Date	1998 POPs	Net POPs
Chicago, IL	3	B	1	5.0000%	12/31/98	7,766,679	388,334
Houston, TX	10	B	1	11.1100%	12/31/98	4,138,280	459,763
St. Louis, MO-IL	11	B	1	2.0000%	12/31/98	2,481,272	49,625
Cleveland, OH	16	B	1	100.0000%	4/3/00	1,837,282	1,837,282
Tampa-St. Petersburg, FL	22	B	1	100.0000%	4/3/00	2,129,332	2,129,332
Cincinnati, OH-KY-IN	23	B	1	1.2016%	12/31/98	1,530,386	18,389
Kansas City, MO-KS	24	B	1	19.0000%	12/31/98	1,587,406	301,607
Phoenix, AZ	26	A	1	100.0000%	4/3/00	2,784,075	2,784,075
Columbus, OH	31	B	1	1.2016%	12/31/98	1,332,708	16,014
Hartford-New Britain-Bristol, CT	32	B	1	0.1485%	12/31/98	1,110,065	1,648
Dayton, OH	40	B	1	1.2016%	12/31/98	846,407	10,170
Bridgeport-Stamford-Norwalk-Danbury, CT	42	B	1	0.1485%	12/31/98	838,362	1,245
Norfolk-Virginia Beach-Portsmouth, VA/NC	43	A	1	100.0000%	12/31/98	1,026,706	1,026,706
Greensboro-Winston-Salem-High Point, NC	47	B	1	80.5817%	12/31/98	1,016,137	818,820
Toledo, OH-MI	48	B	1	85.1000%	12/31/98	794,417	676,049
New Haven-West Haven-Waterbury-Meriden, CT	49	B	1	0.1485%	12/31/98	793,504	1,178
Akron, OH	52	B	1	100.0000%	4/3/00	688,952	688,952
Gary-Hammond-East Chicago, IN	54	B	1	5.0000%	12/31/98	624,049	31,202
Richmond, VA	59	A	1	50.0620%	1/1/99	828,032	414,529
Charlotte-Gastonia, NC	61	B	1	100.0000%	12/31/98	925,112	925,112
New Brunswick-Perth Amboy-Sayreville, NJ	62	B	1	10.0000%	12/31/98	716,176	71,618
Springfield-Chicopee-Holyoke, MA	63	B	1	0.1485%	12/31/98	588,993	875
Omaha, NE-IA	65	B	1	100.0000%	1/1/99	650,753	650,753
Youngstown-Warren, OH	66	B	1	96.8630%	12/31/98	480,231	465,166

Greenville-Spartanburg, SC	67	B	1	100.0000%	4/3/00	708,390	708,390
Long Branch-Asbury Park, NJ	70	B	1	10.0000%	12/31/98	603,434	60,343
Raleigh-Durham, NC	71	B	1	92.0228%	12/31/98	883,142	812,692
Austin, TX	75	B	1	0.8200%	12/31/98	1,023,072	8,389
Tuscon, AZ	77	A	1	100.0000%	4/3/00	790,755	790,755
El Paso, TX	81	A	1	100.0000%	4/3/00	703,127	703,127
Mobile, AL	83	B	1	100.0000%	4/3/00	532,257	532,257
Johnson City-Kingsport-Bristol, TN-VA	85	B	1	100.0000%	12/31/98	462,345	462,345
Albuquerque, NM	86	A	1	100.0000%	4/3/00	614,007	614,007
Canton, OH	87	B	1	100.0000%	4/3/00	402,207	402,207
Chattanooga, TN-GA	88	B	1	8.1200%	12/31/98	460,650	37,405
Wichita, KS	89	B	1	40.0000%	12/31/98	509,982	203,993
Charleston-North Charleston, SC	90	B	1	75.0000%	12/31/98	541,159	405,869
Little Rock-North Little Rock, AR	92	B	1	64.0000%	12/31/98	556,295	356,029
Columbia, SC	95	B	1	53.6000%	12/31/98	512,316	274,601
Beaumont-Port Arthur, TX	101	B	1	11.1100%	12/31/98	375,564	41,725
Newport News-Hampton, VA	104	A	1	100.0000%	12/31/98	477,112	477,112
Jackson, MS	106	B	1	26.7460%	12/31/98	429,614	114,905
Augusta, GA/SC	108	B	1	100.0000%	12/31/98	438,268	438,268
Huntington-Ashland, WV/KY/OH	110	B	1	100.0000%	12/31/98	313,922	313,922
Lakeland-Winter Haven, FL	114	B	1	100.0000%	4/3/00	452,584	452,584
Reading, PA	118	B	1	10.0000%	12/31/98	355,956	35,596
Pensacola, FL	127	B	1	100.0000%	4/3/00	399,625	399,625
Lorain-Elyria, OH	136	B	1	100.0000%	4/3/00	282,149	282,149
Melbourne-Titusville-Palm Bay, FL	137	B	1	25.0000%	12/31/98	466,093	116,523
Montgomery, AL	139	B	1	100.0000%	12/31/98	321,781	321,781
Charleston, WV	140	B	1	100.0000%	12/31/98	253,175	253,175
Daytona Beach, FL	146	B	1	25.0000%	12/31/98	423,409	105,852
Fayetteville, NC	149	B	1	92.0228%	12/31/98	284,629	261,924
New London-Norwich, CT	154	B	1	0.1485%	12/31/98	245,740	365
Savannah, GA	155	B	1	100.0000%	12/31/98	285,508	285,508
Lima, OH	158	B	1	85.1000%	12/31/98	219,697	186,962
Killeen-Temple, TX	160	B	1	100.0000%	12/31/98	301,449	301,449
Springfield, MO	163	B	1	100.0000%	12/31/98	275,755	275,755
Fort Myers, FL Counties - Lee	164	B	1	100.0000%	4/3/00	392,895	392,895
Fort Smith, AK-OK	165	B	1	100.0000%	12/31/98	240,609	240,609
Hickory, NC	166	B	1	100.0000%	12/31/98	246,512	246,512
Sarasota, FL	167	B	1	100.0000%	4/3/00	303,400	303,400
Tallahassee, FL	168	B	1	100.0000%	12/31/98	279,673	279,673
Galveston-Texas City, TX	170	B	1	11.1100%	12/31/98	245,556	27,281
Lincoln, NE	172	B	1	100.0000%	12/31/98	235,589	235,589
Wheeling, WV-OH	178	B	1	100.0000%	12/31/98	152,903	152,903
Fayetteville-Springdale, AK	182	B	1	89.9000%	12/31/98	272,616	245,082
Gainesville, FL	192	B	1	100.0000%	12/31/98	223,439	223,439
Waco, TX	194	B	1	100.0000%	12/31/98	203,446	203,446
Steubenville-Weirton, OH-WV	199	B	1	100.0000%	12/31/98	134,535	134,535
Parkersburg-Marietta, OH-WV	200	B	1	100.0000%	12/31/98	155,850	155,850
Lynchburg, VA	203	B	1	100.0000%	12/31/98	158,984	158,984
Longview-Marshall, TX	206	B	1	60.0000%	12/31/98	173,103	103,862
Bradenton, FL	211	B	1	100.0000%	4/3/00	239,682	239,682
Wilmington, NC	218	B	1	100.0000%	12/31/98	218,248	218,248
Anderson, SC	227	B	1	100.0000%	4/3/00	160,791	160,791
Mansfield, OH	231	B	1	100.0000%	12/31/98	127,342	127,342
Petersburg-Colonial Heights-Hopewell, VA	235	A	1	79.0783%	12/31/98	129,000	102,011
Tyler, TX	237	B	1	60.0000%	12/31/98	168,783	101,270
Ocala, FL	245	B	1	100.0000%	12/31/98	241,513	241,513
Dothan, AL	246	B	1	100.0000%	4/1/99	134,749	134,749
Charlottesville, VA	256	B	1	100.0000%	12/31/98	149,190	149,190
Jacksonville, NC	258	B	1	100.0000%	12/31/98	142,358	142,358
Albany, GA	261	B	1	100.0000%	12/31/98	118,076	118,076
Danville, VA	262	B	1	100.0000%	12/31/98	108,252	108,252
Florence, SC	264	B	1	53.6000%	12/31/98	124,904	66,949
Fort Walton Beach, FL	265	B	1	100.0000%	12/31/98	169,289	169,289
Kankakee, IL	273	B	1	5.0000%	12/31/98	102,107	5,105
St. Joseph, MO	275	B	1	49.0000%	12/31/98	97,338	47,696
Burlington, NC	280	B	1	92.0228%	12/31/98	119,397	109,872
Panama City, FL	283	B	1	100.0000%	12/31/98	146,999	146,999
Las Cruces, NM	285	A	1	76.3000%	4/3/00	169,165	129,073
Lawrence, KS	301	B	1	19.0000%	12/31/98	93,137	17,696
Aurora-Elgin, IL	303	B	1	5.0000%	12/31/98	51,817	2,591
Joliet, IL	304	B	1	5.0000%	12/31/98	36,686	1,834
Alabama 4 – Bibb	310	B	1	100.0000%	12/31/98	141,731	141,731
Alabama 5 – Cleburne	311	B	2	100.0000%	12/31/98	213,811	213,811
Alabama 6 – Washington	312	B	1	100.0000%	12/31/98	120,857	120,857
Alabama 7 – Butler	313	B	1	100.0000%	12/31/98	168,759	168,759
Alabama 8 – Lee	314	B	1	100.0000%	12/31/98	177,437	177,437
Arizona 2 – Coconino	319	A	1	100.0000%	4/3/00	262,682	262,682
Arizona 5 – Gila	322	A	1	100.0000%	4/3/00	195,903	195,903
Arkansas 1 – Madison	324	B	1	51.0000%	12/31/98	75,810	38,663
Arkansas 1 – Madison	324	B	2	51.0000%	12/31/98	75,810	38,663

Arkansas 2 – Marion	325	B	2	51.0000%	12/31/98	94,229	48,057
Arkansas 4 – Clay	327	B	1	55.4500%	12/31/98	206,300	114,393
Arkansas 5 – Cross	328	B	1	55.4500%	12/31/98	118,482	65,698
Arkansas 6 – Cleburne	329	B	1	55.4500%	12/31/98	105,747	58,637
Arkansas 7 – Pope	330	B	1	55.4500%	12/31/98	116,279	64,477
Arkansas 8 – Franklin	331	B	1	51.0000%	12/31/98	70,194	35,799
Arkansas 9 – Polk	332	B	1	100.0000%	12/31/98	67,256	67,256
Arkansas 10 – Garland	333	B	1	55.4500%	12/31/98	159,901	88,665
California 2 – Modoc	337	B	1	25.0000%	12/31/98	63,053	15,763
Colorado 6 - San Miguel	353	A	1	100.0000%	3/31/99	74,717	74,717
Connecticut 1 – Litchfield	357	B	1	0.1485%	12/31/98	181,277	269
Connecticut 2 – Windham	358	B	1	0.1485%	12/31/98	105,121	156
Florida 1 – Collier	360	B	1	61.6000%	4/3/00	228,793	140,936
Florida 2 – Glades	361	B	1	100.0000%	4/3/00	214,011	214,011
Florida 3 – Hardee	362	B	1	100.0000%	4/3/00	180,765	180,765
Florida 4 – Citrus	363	B	1	100.0000%	4/3/00	483,928	483,928
Florida 4 – Citrus	363	B	2	25.0000%	12/31/98	483,928	120,982
Florida 4 – Citrus	363	B	3	100.0000%	12/31/98	483,928	483,928
Florida 5 – Putnam	364	B	1	25.0000%	12/31/98	117,874	29,469
Florida 5 – Putnam	364	B	2	100.0000%	12/31/98	117,874	117,874
Florida 6 – Dixie	365	B	1	100.0000%	12/31/98	58,546	58,546
Florida 7 – Hamilton	366	B	1	100.0000%	12/31/98	110,695	110,695
Florida 8 – Jefferson	367	B	1	100.0000%	12/31/98	55,778	55,778
Florida 8 – Jefferson	367	B	2	100.0000%	12/31/98	55,778	55,778
Florida 9 – Calhoun	368	B	1	51.0000%	12/31/98	42,734	21,794
Florida 10 – Walton	369	B	1	100.0000%	12/31/98	121,984	121,984
Florida 11 – Monroe	370	B	2	100.0000%	4/3/00	81,203	81,203
Georgia 1 – Whitfield	371	B	1	25.5400%	12/31/98	237,794	60,733
Georgia 2 – Dawson	372	B	1	38.7000%	12/31/98	313,406	121,288
Georgia 2 – Dawson	372	B	2	35.0000%	12/31/98	313,406	109,692
Georgia 4 – Jasper	374	B	3	35.0000%	12/31/98	129,794	45,428
Georgia 7 – Hancock	377	B	2	100.0000%	12/31/98	134,061	134,061
Georgia 8 – Warren	378	B	1	33.3300%	12/31/98	158,788	52,924
Georgia 9 – Marion	379	B	2	100.0000%		118,965	118,965
Georgia 9 – Marion	379	B	3	100.0000%	12/31/98	118,965	118,965
Georgia 10 – Bleckley	380	B	1	100.0000%	12/31/98	151,920	151,920
Georgia 10 – Bleckley	380	B	2	100.0000%		151,920	151,920
Georgia 11 – Toombs	381	B	1	100.0000%	12/31/98	155,791	155,791
Georgia 12 – Liberty	382	B	1	41.6660%	12/31/98	217,965	90,817
Georgia 13 – Early	383	B		100.0000%	12/31/98	149,785	149,785
Georgia 14 – Worth	384	B	1	100.0000%		255,094	255,094
Illinois 2 – Bureau	395	B	2	40.0000%	12/31/98	255,746	102,298
Iowa 1 – Mills	412	B	1			62,907	
Iowa 1 – Mills	412	B	1	9.2000%	12/31/98	62,907	5,787
Iowa 14 – Kossuth	425	B	1	5.5600%	12/31/98	106,514	5,922
Iowa 15 – Dickinson	426	B	1	6.6700%	12/31/98	82,903	5,530
Iowa 16 – Lyon	427	B	1	8.3300%	12/31/98	103,198	8,596
Kansas 1 – Cheyenne	428	B	1	3.0700%	9/1/99	27,044	830
Kansas 2 – Norton	429	B	1	3.0700%	9/1/99	29,996	921
Kansas 3 – Jewell	430	B	1	3.0700%	9/1/99	51,813	1,591
Kansas 4 – Marshall	431	B	1	3.0700%	9/1/99	128,814	3,955
Kansas 5 – Brown	432	B	1	3.0700%	9/1/99	119,263	3,661
Kansas 6 – Wallace	433	B	1	3.0700%	9/1/99	19,472	598
Kansas 7 – Trego	434	B	1	3.0700%	9/1/99	79,248	2,433
Kansas 8 – Ellsworth	435	B	1	3.0700%	9/1/99	130,227	3,998
Kansas 9 – Morris	436	B	1	3.0700%	9/1/99	57,829	1,775
Kansas 10 – Franklin	437	B	1	3.0700%	9/1/99	111,078	3,410
Kansas 11 – Hamilton	438	B	1	3.0700%	9/1/99	86,082	2,643
Kansas 12 – Hodgeman	439	B	1	3.0700%	9/1/99	43,971	1,350
Kansas 13 – Edwards	440	B	1	3.0700%	9/1/99	28,836	885
Kansas 14 – Reno	441	B	1	3.0700%	9/1/99	175,907	5,400
Kansas 15 – Elk	442	A	1	3.0700%	9/1/99	153,720	4,719
Massachusetts 1 - Franklin	470	B	1	0.1485%	12/31/98	70,597	105
Mississippi 3 – Bolivar	495	B	2	26.7460%	12/31/98	158,256	42,327
Mississippi 4 – Yalobusha	496	B	2	26.7460%	12/31/98	127,528	34,109
Mississippi 5 – Washington	497	B	2	26.7460%	12/31/98	159,801	42,740
Mississippi 6 – Montgomery	498	B	1	26.7460%	12/31/98	183,013	48,949
Mississippi 7 – Leake	499	B	1	26.7460%	12/31/98	180,260	48,212
Mississippi 8 – Claiborne	500	B	2	26.7460%	12/31/98	155,250	41,523
Mississippi 9 – Copiah	501	B	1	26.7460%	12/31/98	121,950	32,617
Mississippi 10 – Smith	502	B	2	26.7460%	12/31/98	152,830	40,876
Missouri 1 – Atchison	504	B	1	31.2200%	12/31/98	42,563	13,288
Missouri 2 – Harrison	505	B	1	50.0000%	12/31/98	34,620	17,310
Missouri 3 – Schuyler	506	B	1	100.0000%	12/31/98	55,564	55,564
Missouri 4 - De Kalb	507	B	1	47.5000%	12/31/98	71,247	33,842
Missouri 8 – Callaway	511	B	1	30.0000%	12/31/98	110,667	33,200
Missouri 9 – Bates	512	B	1	19.6000%	12/31/98	78,733	15,432
Missouri 9 – Bates	512	B	2	100.0000%	12/31/98	78,733	78,733
Missouri 10 – Benton	513	B	1	100.0000%	12/31/98	100,384	100,384
Missouri 13 – Washington	516	B	1	2.0000%	12/31/98	95,986	1,920

Missouri 14 – Barton	517	B	1	85.7000%	12/31/98	106,099	90,927
Missouri 15 – Stone	518	B	1	71.0000%	12/31/98	119,406	84,778
Missouri 16 – Laclede	519	B	1	100.0000%	12/31/98	102,072	102,072
Missouri 18 – Perry	521	B	1	2.0000%	12/31/98	119,777	2,396
Missouri 19 – Stoddard	522	B	1	2.0000%	12/31/98	198,427	3,969
Nebraska 1 – Sioux	533	B	1	100.0000%	12/31/98	89,918	89,918
Nebraska 2 – Cherry	534	B	1	100.0000%	12/31/98	30,165	30,165
Nebraska 3 – Knox	535	B	1	100.0000%	12/31/98	115,633	115,633
Nebraska 4 – Grant	536	B	1	100.0000%	12/31/98	34,745	34,745
Nebraska 5 – Boone	537	B	1	100.0000%	12/31/98	147,531	147,531
Nebraska 6 – Keith	538	B	1	100.0000%	12/31/98	109,130	109,130
Nebraska 7 – Hall	539	B	1	100.0000%	12/31/98	92,133	92,133
Nebraska 8 – Chase	540	B	1	100.0000%	12/31/98	57,347	57,347
Nebraska 9 – Adams	541	B	1	100.0000%	12/31/98	80,406	80,406
Nebraska 10 – Cass	542	B	1	100.0000%	12/31/98	86,751	86,751
New Mexico 1 – San Juan	553	A	1	100.0000%	12/31/98	264,430	264,430
New Mexico 2 – Colfax	554	A	1	100.0000%	12/31/98	23,342	23,342
New Mexico 4 – Santa Fe	556	A	1	100.0000%	12/31/98	266,097	266,097
New Mexico 5 – Grant	557	A	1	100.0000%	12/31/98	61,892	61,892
North Carolina 2 – Yancey	566	B	2	100.0000%	12/31/98	164,241	164,241
North Carolina 4 – Henderson	568	B	2	50.0000%	12/31/98	349,393	174,697
North Carolina 4 – Henderson	568	B	3	100.0000%	12/31/98	349,393	349,393
North Carolina 5 – Anson	569	B	1	50.0000%	12/31/98	130,457	65,229
North Carolina 5 – Anson	569	B	2	100.0000%	12/31/98	130,457	130,457
North Carolina 6 – Chatham	570	B	1	100.0000%	12/31/98	166,128	166,128
North Carolina 7 – Rockingham	571	B	1	100.0000%	12/31/98	294,004	294,004
North Carolina 7 – Rockingham	571	B	2	100.0000%	12/31/98	294,004	294,004
North Carolina 8 – Northampton	572	B	1	100.0000%	12/31/98	291,972	291,972
North Carolina 9 – Camden	573	B	1	100.0000%	12/31/98	120,643	120,643
North Carolina 10 – Harnett	574	B	1	100.0000%	12/31/98	301,200	301,200
North Carolina 11 – Hoke	575	B	1	100.0000%	12/31/98	229,364	229,364
North Carolina 12 – Sampson	576	B	1	100.0000%	12/31/98	134,941	134,941
North Carolina 13 – Greene	577	B	1	100.0000%	12/31/98	247,338	247,338
North Carolina 14 – Pitt	578	B	1	100.0000%	12/31/98	249,266	249,266
North Carolina 15 – Cabarrus	579	B	1	100.0000%	12/31/98	446,987	446,987
North Carolina 15 – Cabarrus	579	B	2	50.0000%	12/31/98	446,987	223,494
Ohio 1 – Williams	585	B	1	100.0000%	12/31/98	127,826	127,826
Ohio 2 – Sandusky	586	B	1	67.4710%	12/31/98	260,887	176,023
Ohio 2 – Sandusky	586	B	2	100.0000%	4/3/00	260,887	260,887
Ohio 3 – Ashtabula	587	B	1	50.0000%	4/3/00	103,300	51,650
Ohio 5 – Hancock	589	B	1	68.3491%	12/31/98	235,464	160,938
Ohio 6 – Morrow	590	B		82.4742%	12/31/98	457,990	377,724
Ohio 7 – Tuscarawas	591	B	2	100.0000%	12/31/98	257,869	257,869
Ohio 10 – Perry	594	B	2	100.0000%	12/31/98	175,484	175,484
Ohio 11 – Columbiana	595	B	1	100.0000%	12/31/98	111,521	111,521
Oklahoma 4 – Nowata	599	B	1	77.7800%	12/31/98	196,523	152,856
South Carolina 1 – Oconee	625	B	1	100.0000%	12/31/98	64,059	64,059
South Carolina 2 – Laurens	626	B	1	50.0000%	12/31/98	232,539	116,270
South Carolina 3 – Cherokee	627	B	1	50.0000%	12/31/98	136,460	68,230
South Carolina 4 – Chesterfield	628	B	1	50.0000%	12/31/98	215,375	107,688
South Carolina 5 – Georgetown	629	B	1	50.0000%	12/31/98	263,099	131,550
South Carolina 6 – Clarendon	630	B	1	50.0000%	12/31/98	195,461	97,731
South Carolina 7 – Calhoun	631	B	1	50.0000%	12/31/98	151,640	75,820
South Carolina 8 – Hampton	632	B	1	50.0000%	12/31/98	182,518	91,259
South Carolina 9 – Lancaster	633	B	1	50.0000%	12/31/98	213,200	106,600
Tennessee 4 – Hamblen	646	B	1	100.0000%	12/31/98	274,517	274,517
Tennessee 8 – Johnson	650	B	1	100.0000%	12/31/98	16,755	16,755
Texas 7 – Fanni	658	B	1	25.0000%	12/31/98	374,211	93,553
Texas 7 – Fanni	658	B	2	97.5000%	12/31/98	374,211	364,856
Texas 8 – Gaines	659	B	1	14.2860%	12/31/98	136,170	19,453
Texas 8 – Gaines	659	B	2	14.2860%	12/31/98	136,170	19,453
Texas 9 – Runnels	660	B	1	15.3800%	12/31/98	186,658	28,708
Texas 9 – Runnels	660	B	3	100.0000%	12/31/98	186,658	186,658
Texas 9 – Runnels	660	B	4	15.3800%	12/31/98	186,658	28,708
Texas 10 – Navarro	661	B	1	25.0000%	12/31/98	317,225	79,306
Texas 10 – Navarro	661	B	2	100.0000%	12/31/98	317,225	317,225
Texas 10 – Navarro	661	B	3	25.0000%	12/31/98	317,225	79,306
Texas 10 – Navarro	661	B	4	100.0000%	12/31/98	317,225	317,225
Texas 11 – Cherokee	662	B	1	18.0000%	12/31/98	286,850	51,633
Texas 11 – Cherokee	662	B	2	46.0000%	12/31/98	286,850	131,951
Texas 15 – Concho	666	B	1	100.0000%	12/31/98	184,002	184,002
Texas 16 – Burleson	667	B	1	9.6000%	12/31/98	334,553	32,117
Texas 17 – Newton	668	B	1	17.0210%	12/31/98	264,833	45,077
Utah 6 – Piute	678	B	1	20.0000%	12/31/98	27,964	5,593
Virginia 1 – Lee	681	B	1	100.0000%	12/31/98	141,441	141,441
Virginia 2 – Tazewell	682	B	1	71.2600%	12/31/98	135,521	96,572
Virginia 4 – Bedford	684	B	2	100.0000%	12/31/98	178,022	178,022
Virginia 6 – Highland	686	B	2	100.0000%	12/31/98	216,746	216,746
Virginia 7 – Buckingham	687	B	2	100.0000%	12/31/98	90,640	90,640
Virginia 8 – Amelia	688	A	1	100.0000%	12/31/98	85,172	85,172

Virginia 9 – Greensville	689	A	1	100.0000%	12/31/98	88,538	88,538
Virginia 10 – Frederick	690	B	2	33.0000%	12/31/98	239,823	79,142
Virginia 11 – Madison	691	B	2	100.0000%	12/31/98	288,296	288,296
West Virginia 6 – Lincoln	706	B	1	100.0000%	12/31/98	178,612	178,612

AT&T Wireless

MSA/RSA Name	MSA/RSA Number	Freq. Block	Sub Market	% Owned	As of Date	1998 POPs	Net POPs
New York, NY-NJ/Nassau-Suffolk, NY/Newark, Jersey City and Paterson-Clifton-Passaic, NJ	1	A	1	98.3350%	11/22/99	15,261,373	15,007,271
Los Angeles-Long Beach/Anaheim-Santa Ana-Garden Grove/Riverside-San Bernardino-Ontario, CA	2	A	1	55.6150%	11/22/99	15,049,306	8,369,672
San Francisco-Oakland, CA	7	A	1	97.0000%	11/22/99	4,001,831	3,881,776
Dallas-Forth Worth, TX	9	A	1	100.0000%	11/22/99	4,706,948	4,706,948
Houston, TX	10	A	1	55.6150%	11/22/99	4,138,280	2,301,504
Miami-Fort Lauderdale-Hollywood, FL	12	A	1	100.0000%	11/22/99	3,655,844	3,655,844
Pittsburgh, PA	13	A	1	82.1500%	11/22/99	2,030,521	1,668,073
Minneapolis-St. Paul, MN-WI	15	A	1	100.0000%	11/22/99	2,705,116	2,705,116
San Diego, CA	18	A	1	100.0000%	12/31/98	2,780,592	2,780,592
Denver-Boulder, CO	19	A	1	100.0000%	11/22/99	2,210,104	2,210,104
Seattle-Everett, WA	20	A	1	100.0000%	11/22/99	2,242,659	2,242,659
Tampa-St. Petersburg, FL	22	A	1	100.0000%	11/22/99	2,129,332	2,129,332
San Jose, CA	27	A	1	50.0000%	11/22/99	1,641,215	820,608
Portland, OR-WA	30	A	1	100.0000%	11/22/99	1,692,454	1,692,454
San Antonio, TX	33	A	1	100.0000%	11/22/99	1,506,915	1,506,915
Sacramento, CA	35	A	1	100.0000%	11/22/99	1,527,310	1,527,310
Salt Lake City-Ogden, UT	39	A	1	100.0000%	11/22/99	1,301,096	1,301,096
Oklahoma City, OK	45	A	1	100.0000%	11/22/99	1,008,029	1,008,029
Honolulu, HI	50	A	1	100.0000%	11/22/99	872,478	872,478
Jacksonville, FL	51	A	1	100.0000%	11/22/99	1,065,787	1,065,787
Northeast Pennsylvania, PA	56	A	1	100.0000%	11/22/99	647,805	647,805
Tulsa, OK	57	A	1	100.0000%	11/22/99	814,544	814,544
Allentown-Bethlehem-Easton, PA-NJ	58	A	1	100.0000%	11/22/99	715,477	715,477
Orlando, FL	60	A	1	100.0000%	11/22/99	1,302,362	1,302,362
West Palm Beach-Boca Raton, FL	72	A	1	100.0000%	11/22/99	1,032,625	1,032,625
Oxnard-Simi Valley-Ventura, CA	73	A	1	100.0000%	11/22/99	731,967	731,967
Fresno, CA	74	A	1	100.0000%	11/22/99	755,730	755,730
Austin, TX	75	A	1	100.0000%	11/22/99	1,023,072	1,023,072
Tacoma, WA	82	A	1	100.0000%	11/22/99	676,505	676,505
Harrisburg, PA	84	A	1	100.0000%	11/22/99	498,597	498,597
Las Vegas, NV	93	A	1	100.0000%	11/22/99	1,162,129	1,162,129
Bakersfield, CA	97	A	1	100.0000%	11/22/99	631,459	631,459
York, PA	99	A	1	100.0000%	11/22/99	459,792	459,792
Shreveport, Louisiana	100	A	1	100.0000%	11/22/99	378,641	378,641
Lancaster, PA	105	A	1	100.0000%	11/22/99	456,414	456,414
Stockton, CA	107	A	1	100.0000%	11/22/99	550,445	550,445
Spokane, WA	109	A	1	100.0000%	11/22/99	408,669	408,669
Huntington-Ashland, WV/KY/OH	110	A	1	100.0000%	11/22/99	313,922	313,922
Vallejo-Fairfield-Napa, CA	111	A	1	50.0000%	11/22/99	496,703	248,352
Lakeland-Winter Haven, FL	114	A	1	100.0000%	11/22/99	452,584	452,584
Colorado Springs, CO	117	A	1	100.0000%	11/22/99	510,984	510,984
Reading, PA	118	A	1	100.0000%	11/22/99	355,956	355,956
Binghamton, NY	122	A	1	100.0000%	11/22/99	291,166	291,166
Santa Rosa-Petaluma, CA	123	A	1	52.0800%	11/22/99	433,304	225,665
Santa Barbara-Santa Maria-Lompoc, CA	124	A	1	93.0000%	11/22/99	389,502	362,237
Salinas-Seaside-Monterey, CA	126	A	1	53.0800%	11/22/99	365,605	194,063
Manchester-Nashua, NH	133	A	1	2.4800%	11/22/99	363,031	9,003
Eugene-Springfield, OR	135	A	1	100.0000%	11/22/99	314,068	314,068
Melbourne-Titusville-Palm Bay, FL	137	A	1	94.7500%	11/22/99	466,093	441,623
Charleston, WV	140	A	1	100.0000%	11/22/99	253,175	253,175
Duluth, MN-WI	141	A	1	50.0000%	12/31/98	236,464	118,232
Modesto, CA	142	A	1	100.0000%	11/22/99	426,460	426,460
Johnstown, PA	143	A	1	100.0000%	11/22/99	236,347	236,347
Orange County, NY	144	A	1	50.0000%		329,220	164,610
Daytona Beach, FL	146	A	1	100.0000%	11/22/99	423,409	423,409
Salem, OR	148	A	1	95.8900%	11/22/99	330,101	316,534
Visalia-Tulare-Porterville, CA	150	A	1	96.1100%	11/22/99	355,240	341,421
Poughkeepsie, NY	151	A	1	50.0000%	12/31/98	265,317	132,659
Portland, ME	152	A	1	100.0000%	11/22/99	289,361	289,361
Portsmouth-Dover-Rochester, NH-ME	156	A	1	100.0000%	11/22/99	283,815	283,815
Provo-Orem, UT	159	A	1	95.6300%	11/22/99	335,635	320,968
Killeen-Temple, TX	160	A	1	100.0000%	11/22/99	301,449	301,449
Springfield, MO	163	A	1	100.0000%	11/22/99	275,755	275,755
Sarasota, FL	167	A	1	94.6900%	11/22/99	303,400	287,289
Galveston-Texas City, TX	170	A	1	49.6800%	11/22/99	245,556	121,992
Reno, NV	171	A	1	93.0800%	11/22/99	313,660	291,955

Santa Cruz, CA	175	A	1	11.6400%	11/22/99	242,994	28,285
Wheeling, WV-OH	178	A	1	96.5400%	11/22/99	152,903	147,613
Topeka, KS	179	A	1	10.7800%	11/22/99	200,730	21,639
Muskegon, MI	181	A	1	7.9100%	11/22/99	191,581	15,154
Terre Haute, IN	185	A	1	0.4500%	11/22/99	167,898	756
Anchorage, AK	187	A	1	93.5700%	11/22/99	254,982	238,587
Racine, WI	189	A	1	3.4000%	11/22/99	186,119	6,328
Boise City, ID	190	A	1	99.0600%	11/22/99	275,687	273,096
Yakima, WA	191	A	1	96.1300%	11/22/99	218,062	209,623
Waco, TX	194	A	1	100.0000%	11/22/99	203,446	203,446
St. Cloud, MN	198	A	1	77.9500%	11/22/99	222,613	173,527
Steubenville-Weirton, OH-WV	199	A	1	100.0000%	11/22/99	134,535	134,535
Parkersburg-Marietta, OH-WV	200	A	1	100.0000%	11/22/99	155,850	155,850
Longview-Marshall, TX	206	A	1	100.0000%	11/22/99	173,103	173,103
Fort Pierce, FL	208	A	1	100.0000%	11/22/99	295,118	295,118
Fort Collins-Loveland, CO	210	A	1	96.2500%	11/22/99	231,221	222,550
Bradenton, FL	211	A	1	95.2400%	11/22/99	239,682	228,273
Bremerton, WA	212	A	1	98.3500%	11/22/99	232,623	228,785
Pittsfield, MA	213	A	1	23.7500%	11/22/99	133,038	31,597
Richland-Kennewick-Pasco, WA	214	A	1	100.0000%	11/22/99	182,709	182,709
Chico	215	A	1	100.0000%	11/22/99	194,597	194,597
Monroe, LA	219	A	1	100.0000%	11/22/99	146,979	146,979
Elkhart-Goshen, IN	223	A	1	0.3300%	11/22/99	172,310	569
Bangor, ME	224	A	1	5.3100%	11/22/99	142,323	7,557
Altoona, PA	225	A	1	100.0000%	11/22/99	130,615	130,615
Medford, OR	229	A	1	95.5600%	11/22/99	173,123	165,436
Eau Claire, WI	232	A	1	50.0000%	12/31/98	143,861	71,931
Wichita Falls, TX	233	A	1	100.0000%	11/22/99	139,471	139,471
Athens, GA	234	A	1	7.1400%	11/22/99	176,320	12,589
Petersburg-Colonial Heights-Hopewell, VA	235	A	1	12.4400%	11/22/99	129,000	16,048
Muncie, IN	236	A	1	0.3700%	11/22/99	116,828	432
Tyler, TX	237	A	1	100.0000%	11/22/99	168,783	168,783
Joplin, MO	239	A	1	100.0000%	11/22/99	148,684	148,684
Texarkana, TX – Texarkana, AR	240	A	1	94.2000%	11/22/99	136,572	128,651
Olympia, WA	242	A	1	94.1500%	11/22/99	202,255	190,423
Greeley, CO	243	A	1	95.1900%	11/22/99	159,429	151,760
Ocala, FL	245	A	1	92.0700%	11/22/99	241,513	222,361
Williamsport, PA	251	A	1	100.0000%	11/22/99	117,308	117,308
Pascagoula, MS	252	A	1	4.0000%		130,910	5,236
Redding, CA	254	A	1	94.1900%	11/22/99	164,349	154,800
State College, PA	259	A	1	100.0000%	11/22/99	132,700	132,700
Lawton, OK	260	A	1	100.0000%	11/22/99	113,508	113,508
Wausau, WI	263	A	1	50.0000%	12/31/98	123,223	61,612
Bellingham, WA	270	A	1	96.1800%	11/22/99	156,830	150,839
Yuba City, CA	274	A	1	96.5000%	11/22/99	137,043	132,246
St. Joseph, MO	275	A	1	10.9900%		97,338	10,697
Sheboygan, WI	277	A	1	1.2400%	11/22/99	110,170	1,366
Lewiston-Auburn, ME	279	A	1	4.8300%	11/22/99	101,280	4,892
Bloomington, IN	282	A	1	1.3200%	11/22/99	115,130	1,520
Elmira, NY	284	A	1	100.0000%	11/22/99	92,021	92,021
Dubuque, IA	286	A	1	2.0600%	11/22/99	87,806	1,809
Rochester, MN	288	A	1	94.8800%	11/22/99	116,702	110,727
La Crosse, WI	290	A	1	1.4100%	11/22/99	102,565	1,446
Pine Bluff, AK	291	A	1	47.9000%	11/22/99	81,556	39,065
Sherman-Denison, TX	292	A	1	100.0000%	11/22/99	102,815	102,815
Alton-Granite City, IL	305	A	1	50.0000%		21,373	10,687
Alaska 2 – Bethel	316	A	1	100.0000%	11/22/99	158,753	158,753
Arkansas 1 – Madison	324	A	1	50.0000%	11/22/99	75,810	37,905
Arkansas 2 – Marion	325	A	1	50.0000%	11/22/99	94,229	47,115
Arkansas 3 – Sharp	326	A	1	50.0000%	11/22/99	102,936	51,468
Arkansas 4 – Clay	327	A	1	50.0000%	11/22/99	206,300	103,150
Arkansas 5 – Cross	328	A	1	50.0000%	11/22/99	118,482	59,241
Arkansas 6 – Cleburne	329	A	1	50.0000%	11/22/99	105,747	52,874
Arkansas 7 – Pope	330	A	1	50.0000%	11/22/99	116,279	58,140
Arkansas 8 – Franklin	331	A	1	50.0000%	11/22/99	70,194	35,097
Arkansas 10 – Garland	333	A	1	50.0000%	11/22/99	159,901	79,951
Arkansas 12 – Ouachita	335	A	1	50.0000%	11/22/99	185,087	92,544
California 3 – Alpine	338	A	1	100.0000%	11/22/99	143,498	143,498
California 8 – Tehama	343	A	1	100.0000%	11/22/99	98,879	98,879
California 10 – Sierra	345	A	1	100.0000%	11/22/99	94,714	94,714
California 11 - El Dorado	346	A	1	100.0000%	11/22/99	158,502	158,502
California 12 – Kings	347	A	1	100.0000%	11/22/99	118,866	118,866
Colorado 3 – Garfield	350	A	1	100.0000%	11/22/99	296,742	296,742
Connecticut 1 – Litchfield	357	A	1	100.0000%	11/22/99	181,277	181,277
Florida 2 – Glades	361	A	2	100.0000%	11/22/99	214,011	214,011
Florida 4 – Citrus	363	A	1	85.0000%	11/22/99	483,928	411,339
Florida 5 – Putnam	364	A	2	100.0000%	11/22/99	117,874	117,874
Hawaii 2 – Maui	386	A	1	100.0000%	11/22/99	120,785	120,785
Hawaii 3 – Hawaii	387	A	1	100.0000%	12/31/98	143,135	143,135
Idaho 1 – Boundary	388	A	1	100.0000%	11/22/99	251,625	251,625

Idaho 4 – Elmore	391	A	1	100.0000%	11/22/99	155,716	155,716
Kentucky 4 – Spencer	446	A	1	50.0000%	12/31/98	250,884	125,442
Kentucky 5 – Barren	447	A	1	50.0000%	12/31/98	159,099	79,550
Kentucky 6 – Madison	448	A	1	50.0000%	12/31/98	267,723	133,862
Kentucky 8 – Mason	450	A	1	50.0000%	12/31/98	121,142	60,571
Louisiana 1 – Claiborne	454	A	1	100.0000%	11/22/99	111,848	111,848
Louisiana 2 – Morehouse	455	A	1	100.0000%	11/22/99	115,219	115,219
Louisiana 3 - De Soto	456	A	2	100.0000%	11/22/99	146,932	146,932
Maine 4 – Washington	466	A	1	100.0000%	11/22/99	85,434	85,434
Michigan 1 – Gogebic	472	A	1	50.0000%	12/31/98	197,174	98,587
Minnesota 2 - Lake of the Woods	483	A	2	50.0000%	12/31/98	64,189	32,095
Minnesota 3 – Koochiching	484	A	1	50.0000%	12/31/98	59,395	29,698
Minnesota 4 – Lake	485	A	1	50.0000%	12/31/98	15,358	7,679
Minnesota 5 – Wilkin	486	A	1	50.0000%	12/31/98	207,720	103,860
Minnesota 6 – Hubbard	487	A	1	50.0000%	12/31/98	259,847	129,924
Minnesota 6 – Hubbard	487	A	2	100.0000%	11/22/99	259,847	259,847
Minnesota 11 – Goodhue	492	A	1	100.0000%		206,468	206,468
Missouri 14 – Barton	517	A	1	100.0000%	11/22/99	106,099	106,099
Nevada 3 – Storey	545	A	1	100.0000%	11/22/99	119,477	119,477
New Jersey 1 – Hunterdon	550	A	1	100.0000%	11/22/99	122,428	122,428
New York 5 – Otsego	563	A	1	50.0000%	12/31/98	374,774	187,387
New York 6 – Columbia	564	A	1	50.0000%	12/31/98	111,028	55,514
Ohio 7 – Tuscarawas	591	A	1	50.0000%	12/31/98	257,869	128,935
Ohio 9 – Ross	593	A	1	100.0000%	11/22/99	249,588	249,588
Ohio 10 – Perry	594	A	1	50.0000%	11/22/99	175,484	87,742
Oklahoma 3 – Grant	598	A	1	100.0000%	11/22/99	207,339	207,339
Oklahoma 4 – Nowata	599	A	1	100.0000%		196,523	196,523
Oklahoma 5 – Roger Mills	600	A	1	100.0000%	11/22/99	58,042	58,042
Oregon 1 – Clatsop	606	A	1	100.0000%	11/22/99	186,281	186,281
Oregon 2 – Hood River	607	A	1	92.3200%	11/22/99	74,602	68,873
Pennsylvania 5 – Wayne	616	A	1	100.0000%	11/22/99	85,398	85,398
Pennsylvania 8 – Union	619	A	1	100.0000%	11/22/99	403,256	403,256
Pennsylvania 9 – Greene	620	A	1	50.0000%	12/31/98	185,589	92,795
Pennsylvania 10 – Bedford	621	A	2	100.0000%	11/22/99	191,873	191,873
Pennsylvania 11 – Huntingdon	622	A	1	100.0000%	11/22/99	113,661	113,661
Pennsylvania 12 – Lebanon	623	A	1	100.0000%	11/22/99	117,434	117,434
Tennessee 4 – Hamblen	646	A	1	50.0000%	12/31/98	274,517	137,259
Texas 6 – Jack	657	A	1	100.0000%	11/22/99	84,562	84,562
Texas 11 – Cherokee	662	A	1	100.0000%	11/22/99	286,850	286,850
Utah 1 – Box Elder	673	A	1	100.0000%	11/22/99	130,732	130,732
Utah 2 – Morgan	674	A	1	100.0000%	11/22/99	47,035	47,035
Washington 1 – Clallam	693	A	1	100.0000%	11/22/99	272,570	272,570
Washington 5 – Kittitas	697	A	1	100.0000%	11/22/99	127,317	127,317
Washington 6 – Pacific	698	A	1	100.0000%	11/22/99	184,396	184,396
Washington 7 – Skamania	699	A	1	92.3200%	11/22/99	29,100	26,865
West Virginia 1 – Mason	701	A	1	100.0000%	11/22/99	77,123	77,123
West Virginia 2 – Wetzel	702	A	1	50.0000%	12/31/98	77,979	38,990
West Virginia 3 – Monongalia	703	A	1	50.0000%	12/31/98	266,003	133,002
West Virginia 6 – Lincoln	706	A	1	100.0000%	11/22/99	178,612	178,612
Wisconsin 1 – Burnett	708	A	1	50.0000%	12/31/98	112,725	56,363
Wisconsin 2 – Bayfield	709	A	2	50.0000%	12/31/98	85,150	42,575
Wisconsin 3 – Vilas	710	A	1	50.0000%	12/31/98	141,299	70,650
Wisconsin 4 – Marinette	711	A	1	50.0000%	12/31/98	120,582	60,291
Wisconsin 5 – Pierce	712	A	1	50.0000%	12/31/98	95,999	48,000
Wisconsin 6 – Trempealeau	713	A	2	50.0000%	12/31/98	116,883	58,442

BellSouth

MSA/RSA Name	MSA/RSA Number	Freq. Block	Sub Market	% Owned	As of Date	1998 POPs	Net POPs
Los Angeles-Long Beach/Anaheim-Santa Ana-Garden Grove/Riverside-San Bernardino-Ontario, CA	2	A	1	44.3850%	12/31/98	15,049,306	6,679,634
Houston, TX	10	A	1	44.3850%	12/31/98	4,138,280	1,836,776
Miami-Fort Lauderdale-Hollywood, FL	12	B	1	100.0000%	12/31/98	3,655,844	3,655,844
Pittsburgh, PA	13	B	1	3.6000%	12/31/98	2,030,521	73,099
Atlanta, GA	17	B	1	100.0000%	12/31/98	3,406,269	3,406,269
Indianapolis, IN	28	A	1	100.0000%	12/31/98	1,387,834	1,387,834
New Orleans, LA	29	B	1	100.0000%	12/31/98	1,171,481	1,171,481
Memphis, TN-AR-MS	36	B	1	93.8600%	12/31/98	1,062,970	997,704
Louisville, KY-IN	37	B	1	100.0000%	12/31/98	941,598	941,598
Birmingham, AL	41	B	1	100.0000%	12/31/98	933,269	933,269
Nashville-Davidson, TN	46	B	1	100.0000%	12/31/98	1,156,225	1,156,225
Jacksonville, FL	51	B	1	85.7600%	12/31/98	1,065,787	914,019
Gary-Hammond-East Chicago, IN	54	A	1	33.3300%	12/31/98	624,049	207,996
Richmond, VA	59	A	1	49.9000%	1/1/99	828,032	413,188
Orlando, FL	60	B	1	75.4600%	12/31/98	1,302,362	982,762

West Palm Beach-Boca Raton, FL	72	B	1	100.0000%	12/31/98	1,032,625	1,032,625
Baton Rouge, LA	80	B	1	100.0000%	12/31/98	575,129	575,129
Mobile, AL	83	A	1	100.0000%	7/31/99	532,257	532,257
Chattanooga, TN-GA	88	B	1	62.7000%	12/31/98	460,650	288,828
Columbia, SC	95	B	1	46.4200%	12/31/98	512,316	237,817
Shreveport, Louisiana	100	B	1	9.0000%	12/31/98	378,641	34,078
Jackson, MS	106	B	1	73.2600%	12/31/98	429,614	314,735
Lexington-Fayette, KY	116	B	1	100.0000%	12/31/98	383,143	383,143
Evansville, IN/KY	119	A	1	100.0000%	12/31/98	322,906	322,906
Huntsville, AL	120	B	1	100.0000%	12/31/98	420,774	420,774
Melbourne-Titusville-Palm Bay, FL	137	B	1	75.4600%	12/31/98	466,093	351,714
Macon-Warner Robins, GA	138	B	1	100.0000%	12/31/98	319,502	319,502
Daytona Beach, FL	146	B	1	75.4600%	12/31/98	423,409	319,504
Galveston-Texas City, TX	170	A	1	38.7700%	6/1/99	245,556	95,202
Lafayette, LA	174	B	1	51.0000%	12/31/98	234,181	119,432
Terre Haute, IN	185	A	1	92.8500%	12/31/98	167,898	155,893
Clarksville-Hopkinsville, TN/KY	209	B	1	100.0000%	12/31/98	199,758	199,758
Anderson, IN	217	A	1	100.0000%	12/31/98	131,360	131,360
Monroe, LA	219	B	1	9.0000%	12/31/98	146,979	13,228
Tuscaloosa, AL	222	B	1	100.0000%	12/31/98	160,768	160,768
Florence, AL	226	B	1	100.0000%	12/31/98	137,271	137,271
Athens, GA	234	B	1	100.0000%	12/31/98	176,320	176,320
Muncie, IN	236	A	1	93.1000%	12/31/98	116,828	108,767
Lafayette, IN	247	A	1	100.0000%	12/31/98	139,005	139,005
Anniston, AL	249	B	1	100.0000%	12/31/98	117,018	117,018
Florence, SC	264	B	1	46.4200%	12/31/98	124,904	57,980
Kokomo, IN	271	A	1	9.0400%	12/31/98	100,176	9,056
Gadsden, AL	272	B	1	100.0000%	12/31/98	103,975	103,975
Bloomington, IN	282	A	1	94.1800%	12/31/98	115,130	108,429
Bryan-College Station, TX	287	A	1	100.0000%	4/1/99	133,407	133,407
Owensboro, KY	293	A	1	100.0000%	12/31/98	91,139	91,139
Alabama 1 – Franklin	307	B	1	100.0000%	12/31/98	348,901	348,901
Alabama 1 – Franklin	307	B	2	80.0000%	12/31/98	348,901	279,121
Alabama 1 – Franklin	307	B	5	100.0000%	12/31/98	348,901	348,901
Alabama 2 – Jackson	308	B	1	100.0000%	12/31/98	131,616	131,616
Alabama 3 – Lamar	309	B	1	100.0000%	12/31/98	136,638	136,638
Alabama 5 – Cleburne	311	B	1	100.0000%	12/31/98	213,811	213,811
Alabama 6 – Washington	312	A	1	100.0000%	12/31/98	120,857	120,857
Florida 1 – Collier	360	B	2	100.0000%	12/31/98	228,793	228,793
Florida 2 – Glades	361	B	2	71.5000%	12/31/98	214,011	153,018
Florida 2 – Glades	361	B	3	100.0000%	12/31/98	214,011	214,011
Florida 4 – Citrus	363	B	2	75.4600%	12/31/98	483,928	365,172
Florida 5 – Putnam	364	B	1	75.4600%	12/31/98	117,874	88,948
Florida 5 – Putnam	364	B	3	85.7600%	12/31/98	117,874	101,089
Florida 11 – Monroe	370	B	1	100.0000%	12/31/98	81,203	81,203
Georgia 1 – Whitfield	371	B	1	74.4600%	12/31/98	237,794	177,061
Georgia 2 – Dawson	372	B	1	61.2300%	12/31/98	313,406	191,898
Georgia 2 – Dawson	372	B	2	35.0000%	12/31/98	313,406	109,692
Georgia 2 – Dawson	372	B	3	100.0000%	12/31/98	313,406	313,406
Georgia 3 – Chattooga	373	B	1	75.0000%	12/31/98	216,235	162,176
Georgia 4 – Jasper	374	B	1	100.0000%	12/31/98	129,794	129,794
Georgia 4 – Jasper	374	B	3	35.0000%	12/31/98	129,794	45,428
Georgia 5 – Haralson	375	B	1	100.0000%	12/31/98	261,567	261,567
Georgia 6 – Spalding	376	B	5	100.0000%	12/31/98	203,032	203,032
Georgia 6 – Spalding	376	B	4	100.0000%	12/31/98	203,032	203,032
Georgia 7 – Hancock	377	B	1	100.0000%	12/31/98	134,061	134,061
Indiana 5 – Warren	407	A	1	100.0000%	12/31/98	123,849	123,849
Indiana 7 – Owen	409	A	1	100.0000%	12/31/98	225,643	225,643
Indiana 8 – Brown	410	A	1	100.0000%		264,986	264,986
Indiana 9 – Decatur	411	A	1	100.0000%	12/31/98	149,277	149,277
Kentucky 1 – Fulton	443	A	1	100.0000%	12/31/98	190,694	190,694
Kentucky 2 – Union	444	A	1	100.0000%	12/31/98	129,194	129,194
Kentucky 3 – Meade	445	A	1	100.0000%	12/31/98	323,926	323,926
Kentucky 6 – Madison	448	B	2	100.0000%	12/31/98	267,723	267,723
Kentucky 7 – Trimble	449	B	1	100.0000%	12/31/98	177,071	177,071
Kentucky 7 – Trimble	449	B	3	100.0000%	12/31/98	177,071	177,071
Kentucky 8 – Mason	450	B	1	100.0000%	12/31/98	121,142	121,142
Kentucky 9 – Elliott	451	A	1	100.0000%	12/31/98	201,249	201,249
Kentucky 10 – Powell	452	A	1	100.0000%	12/31/98	153,141	153,141
Kentucky 11 – Clay	453	A	1	100.0000%	12/31/98	168,292	168,292
Louisiana 1 – Claiborne	454	B	1	9.0000%	12/31/98	111,848	10,066
Louisiana 2 – Morehouse	455	B	1	9.0000%	12/31/98	115,219	10,370
Louisiana 3 - De Soto	456	B	2	9.0000%	12/31/98	146,932	13,224
Louisiana 5 – Beauregard	458	B	2	35.0000%	12/31/98	388,669	136,034
Louisiana 6 – Iberville	459	B	2	51.0000%	12/31/98	184,516	94,103
Louisiana 6 – Iberville	459	B	1	35.0000%	12/31/98	184,516	64,581
Louisiana 7 – West Feliciana	460	B	1	66.7000%	12/31/98	183,915	122,671
Louisiana 8 – St. James	461	B	1	50.0000%	12/31/98	111,671	55,836
Louisiana 9 – Plaquemines	462	B	1	100.0000%	12/31/98	26,293	26,293
Mississippi 1 – Tunica	493	B	1	93.8700%	12/31/98	173,216	162,598

Mississippi 2 – Benton	494	B	1	100.0000%	12/31/98	249,770	249,770
Mississippi 3 – Bolivar	495	B	2	73.2600%	12/31/98	158,256	115,938
Mississippi 4 – Yalobusha	496	B	2	73.2600%	12/31/98	127,528	93,427
Mississippi 4 – Yalobusha	496	B	1	100.0000%	12/31/98	127,528	127,528
Mississippi 5 – Washington	497	B	2	73.2600%	12/31/98	159,801	117,070
Mississippi 6 – Montgomery	498	B	1	73.2600%	12/31/98	183,013	134,075
Mississippi 7 – Leake	499	B	1	73.2600%	12/31/98	180,260	132,058
Mississippi 8 – Claiborne	500	B	2	73.2600%	12/31/98	155,250	113,736
Mississippi 9 – Copiah	501	B	1	73.2600%	12/31/98	121,950	89,341
Mississippi 10 – Smith	502	B	2	73.2600%	12/31/98	152,830	111,963
Tennessee 1 – Lake	643	B	4	100.0000%	12/31/98	308,431	308,431
Tennessee 1 – Lake	643	B	1	93.8700%	12/31/98	308,431	289,524
Tennessee 5 – Fayette	647	B	2	100.0000%	12/31/98	354,553	354,553
Tennessee 5 – Fayette	647	B	3	100.0000%	12/31/98	354,553	354,553
Tennessee 5 – Fayette	647	B	1	93.8700%	12/31/98	354,553	332,819
Tennessee 6 – Giles	648	B	1	100.0000%	12/31/98	162,182	162,182
Tennessee 7 – Bledsoe	649	B	1	100.0000%	12/31/98	266,926	266,926
Tennessee 7 – Bledsoe	649	B	2	100.0000%	12/31/98	266,926	266,926
Tennessee 9 – Maury	651	B	1	100.0000%	12/31/98	69,633	69,633
Texas 17 – Newton	668	A	1	100.0000%	4/1/99	264,833	264,833
Texas 21 – Chambers	672	A	1	38.7700%	6/1/99	23,743	9,205

Note: BellSouth and SBC have announced a merger of their wireless assets.

Centennial Cellular

MSA/RSA Name	MSA/RSA Number	Freq. Block	Sub Market	% Owned	As of Date	1998 POPs	Net POPs
San Francisco-Oakland, CA	7	B	1	2.8700%	7/31/99	4,001,831	114,853
San Jose, CA	27	B	1	2.8700%	7/31/99	1,641,215	47,103
Sacramento, CA	35	B	1	23.4700%	7/31/99	1,527,310	358,460
Fort Wayne, IN	96	A	1	100.0000%	7/31/99	443,932	443,932
Beaumont-Port Arthur, TX	101	A	1	100.0000%	7/31/99	375,564	375,564
Stockton, CA	107	B	1	23.4700%	7/31/99	550,445	129,189
Vallejo-Fairfield-Napa, CA	111	B	1	2.8700%	7/31/99	496,703	14,255
Santa Rosa-Petaluma, CA	123	B	1	2.8700%	7/31/99	433,304	12,436
Salinas-Seaside-Monterey, CA	126	B	1	2.8700%	7/31/99	365,605	10,493
South Bend-Mishawaka, IN	129	A	1	100.0000%	7/31/99	303,532	303,532
Kalamazoo, MI	132	A	1	100.0000%	7/31/99	305,326	305,326
Modesto, CA	142	B	1	23.4700%	7/31/99	426,460	100,090
Reno, NV	171	B	1	23.4700%	7/31/99	313,660	73,616
Lafayette, LA	174	A	1	94.5000%	7/31/99	234,181	221,301
Santa Cruz, CA	175	B	1	2.8700%	7/31/99	242,994	6,974
Battle Creek, MI	177	A	1	100.0000%	7/31/99	195,540	195,540
Benton Harbor, MI	193	A	1	100.0000%	7/31/99	160,245	160,245
Lake Charles, LA	197	A	1	100.0000%	7/31/99	180,330	180,330
Alexandria, LA	205	A	1	93.2000%	7/31/99	145,753	135,842
Jackson, MI	207	A	1	100.0000%	7/31/99	156,157	156,157
Chico	215	B	1	23.4700%	7/31/99	194,597	45,672
Elkhart-Goshen, IN	223	A	1	91.7000%	7/31/99	172,310	158,008
Redding, CA	254	B	1	23.4700%	7/31/99	164,349	38,573
Kokomo, IN	271	A	1			100,176	
Yuba City, CA	274	B	1	23.4700%	7/31/99	137,043	32,164
Arizona 4 – Yuma	321	A	1	100.0000%	7/31/99	147,139	147,139
California 1 - Del Norte	336	B	1	6.8800%	7/31/99	206,423	14,202
California 2 – Modoc	337	B	1	25.0000%	7/31/99	63,053	15,763
California 7 – Imperial	342	A	1	100.0000%	7/31/99	144,051	144,051
California 8 – Tehama	343	B	1	23.4700%	7/31/99	98,879	23,207
California 10 – Sierra	345	B	1	23.4700%	7/31/99	94,714	22,229
Indiana 1 – Newton	403	A	1	100.0000%	7/31/99	216,018	216,018
Indiana 2 – Kosciusko	404	A	1	100.0000%	7/31/99	178,767	178,767
Indiana 3 – Huntington	405	A	1	100.0000%	7/31/99	145,468	145,468
Indiana 4 – Miami	406	A	1	100.0000%	7/31/99	180,610	180,610
Indiana 6 – Randolph	408	A	1	100.0000%	7/31/99	221,073	221,073
Louisiana 2 – Morehouse	455	A	1	100.0000%	7/31/99	115,219	115,219
Louisiana 3 – De Soto	456	A	1	100.0000%	7/31/99	146,932	146,932
Louisiana 4 – Caldwell	457	A	1	100.0000%	7/31/99	73,552	73,552
Louisiana 5 – Beauregard	458	A	1	100.0000%	7/31/99	388,669	388,669
Louisiana 6 – Iberville	459	A	1	100.0000%	7/31/99	184,516	184,516
Louisiana 7 – West Feliciana	460	A	1	100.0000%	7/31/99	183,915	183,915
Michigan 6 – Roscommon	477	A	1	100.0000%	7/31/99	141,095	141,095
Michigan 7 – Newaygo	478	A	1	100.0000%	7/31/99	244,501	244,501
Michigan 8 – Allegan	479	A	1	100.0000%	11/23/99	101,662	101,662
Michigan 9 – Cass	480	A	1	100.0000%	7/31/99	299,579	299,579
Mississippi 8 – Claiborne	500	A	1	100.0000%	7/31/99	155,250	155,250
Mississippi 9 – Copiah	501	A	1	100.0000%	7/31/99	121,950	121,950

Nevada 3 – Storey	545	B	1	23.4700%	7/31/99	119,477	28,041
Ohio 1 – Williams	585	A	1	100.0000%	7/31/99	127,826	127,826
Pennsylvania 6 – Lawrence	617	B	2	14.2900%	7/31/99	380,694	54,401

CenturyTel

MSA/RSA Name	MSA/RSA Number	Freq. Block	Sub Market	% Owned	As of Date	1998 POPs	Net POPs
Detroit/Ann Arbor, MI	5	B	1	3.2000%	12/31/98	4,779,588	152,947
Dallas-Forth Worth, TX	9	B	1	0.5000%	12/31/98	4,706,948	23,535
Milwaukee, WI	21	B	1	17.9600%	12/31/98	1,459,805	262,181
Grand Rapids, MI	64	B	1	97.0000%	12/31/98	769,523	746,437
Flint, MI	68	B	1	3.2000%	12/31/98	508,653	16,277
Austin, TX	75	B	1	35.0000%	12/31/98	1,023,072	358,075
Lansing-East Lansing, MI	78	B	1	97.0000%	12/31/98	511,383	496,042
Little Rock-North Little Rock, AR	92	B	1	36.0000%	12/31/98	556,295	200,266
Saginaw-Bay City-Midland, MI	94	B	1	91.7000%	12/31/98	401,991	368,626
Shreveport, Louisiana	100	B	1	87.0000%	12/31/98	378,641	329,418
Jackson, MS	106	A	1	90.2200%	12/31/98	429,614	387,598
Madison, WI	113	B	1	9.7800%	12/31/98	424,586	41,525
Appleton-Oskosh-Neenah, WI	125	B	1	98.8500%	12/31/98	344,464	340,503
Kalamazoo, MI	132	B	1	97.0000%	12/31/98	305,326	296,166
Biloxi-Gulfport, MS	173	A	1	96.4500%	12/31/98	231,474	223,257
Lafayette, LA	174	B	1	49.0000%	12/31/98	234,181	114,749
Battle Creek, MI	177	B	1	97.0000%	12/31/98	195,540	189,674
Muskegon, MI	181	B	1	97.0000%	12/31/98	191,581	185,834
Benton Harbor, MI	193	B	1	97.0000%	12/31/98	160,245	155,438
Alexandria, LA	205	B	1	100.0000%	12/31/98	145,753	145,753
Jackson, MI	207	B	1	97.0000%	12/31/98	156,157	151,472
Monroe, LA	219	B	1	87.0000%	12/31/98	146,979	127,872
Eau Claire, WI	232	B	1	55.5000%	12/31/98	143,861	79,843
Texarkana, TX – Texarkana, AR	240	B	1	89.0000%	12/31/98	136,572	121,549
Pascagoula, MS	252	A	1	89.2200%	12/31/98	130,910	116,798
La Crosse, WI	290	B	1	95.0000%	12/31/98	102,565	97,437
Pine Bluff, AK	291	B	1	100.0000%	12/31/98	81,556	81,556
Sherman-Denison, TX	292	B	1	0.5000%	12/31/98	102,815	514
Arkansas 2 – Marion	325	B	1	82.0000%	12/31/98	94,229	77,268
Arkansas 3 – Sharp	326	B	1	82.0000%	12/31/98	102,936	84,408
Arkansas 11 – Hempstead	334	B	1	89.0000%	12/31/98	66,133	58,858
Arkansas 12 – Ouachita	335	B	1	80.0000%	12/31/98	185,087	148,070
Louisiana 1 – Claiborne	454	B	1	87.0000%	12/31/98	111,848	97,308
Louisiana 2 – Morehouse	455	B	1	87.0000%	12/31/98	115,219	100,241
Louisiana 3 – De Soto	456	B	2	87.0000%	12/31/98	146,932	127,831
Louisiana 4 – Caldwell	457	B	1	100.0000%	12/31/98	73,552	73,552
Michigan 1 – Gogebic	472	B	1	100.0000%	12/31/98	197,174	197,174
Michigan 2 – Alger	473	B	1	100.0000%	12/31/98	113,344	113,344
Michigan 3 – Emmet	474	B	1	42.8400%	12/31/98	164,337	70,402
Michigan 4 – Cheboygan	475	B	1	100.0000%	12/31/98	134,847	134,847
Michigan 5 – Manistee	476	B	1	42.8400%	12/31/98	160,758	68,869
Michigan 6 – Roscommon	477	B	1	98.0000%	12/31/98	141,095	138,273
Michigan 7 – Newaygo	478	B	1	56.0700%	12/31/98	244,501	137,092
Michigan 8 – Allegan	479	B	1	97.0000%	12/31/98	101,662	98,612
Michigan 9 – Cass	480	B	1	43.3800%	12/31/98	299,579	129,957
Michigan 10 – Tuscola	481	B	1	26.0000%	12/31/98	136,459	35,479
Mississippi 2 – Benton	494	A	1	100.0000%	12/31/98	249,770	249,770
Mississippi 5 – Washington	497	A	1	100.0000%		159,801	159,801
Mississippi 6 – Montgomery	498	A	1	100.0000%	12/31/98	183,013	183,013
Mississippi 7 – Leake	499	A	1	100.0000%	12/31/98	180,260	180,260
Texas 7 – Fanni	658	B	6	89.0000%	12/31/98	374,211	333,048
Texas 16 – Burleson	667	B	1	9.6000%	12/31/98	334,553	32,117
Washington 5 – Kittitas	697	B	1	8.4700%	12/31/98	127,317	10,784
Washington 8 – Whitman	700	B	1	7.3600%	12/31/98	120,939	8,901
Wisconsin 1 – Burnett	708	B	1	42.2100%	12/31/98	112,725	47,581
Wisconsin 2 – Bayfield	709	B	1	99.0000%	12/31/98	85,150	84,299
Wisconsin 3 – Vilas	710	B	1	42.8600%	12/31/98	141,299	60,561
Wisconsin 4 – Marinette	711	B	1	25.0000%	12/31/98	120,582	30,146
Wisconsin 6 – Trempealeau	713	B	1	57.1400%	12/31/98	116,883	66,787
Wisconsin 7 – Wood	714	B	1	22.7000%	12/31/98	289,795	65,783
Wisconsin 8 – Vernon	715	B	1	84.0000%	12/31/98	236,606	198,749
Wisconsin 10 – Door	717	B	1	22.5000%	12/31/98	129,245	29,080

CFW Communications

MSA/RSA Name	MSA/RSA Number	Freq. Block	Sub Market	% Owned	As of Date	1998 POPs	Net POPs
Virginia 5 – Bath	685	B	1	21.9800%	12/31/98	61,441	13,505
Virginia 6 – Highland	686	B	1	84.1100%	12/31/98	216,746	182,305

Convergys

MSA/RSA Name	MSA/RSA Number	Freq. Block	Sub Market	% Owned	As of Date	1998 POPs	Net POPs
Cincinnati, OH-KY-IN	23	B	1	45.0000%	12/31/98	1,530,386	688,674
Columbus, OH	31	B	1	45.0000%	12/31/98	1,332,708	599,719
Dayton, OH	40	B	1	45.0000%	12/31/98	846,407	380,883
Hamilton-Middletown, OH	145	B	1	45.0000%	12/31/98	330,428	148,693
Springfield, OH	180	B	1	45.0000%	12/31/98	183,523	82,585
Kentucky 7 – Trimble	449	B	2	45.0000%	12/31/98	177,071	79,682
Ohio 4 – Mercer	588	B	1	45.0000%	12/31/98	228,533	102,840
Ohio 7 – Tuscarawas	591	B	1	45.0000%	12/31/98	257,869	116,041
Ohio 8 – Clinton	592	B	1	45.0000%	12/31/98	178,218	80,198
Ohio 10 – Perry	594	B	1	45.0000%	12/31/98	175,484	78,968

Dobson Communications

MSA/RSA Name	MSA/RSA Number	Freq. Block	Sub Market	% Owned	As of Date	1998 POPs	Net POPs
Eau Claire, WI	232	A	1	48.0000%		143,861	69,053
Wausau, WI	263	A	1	47.9500%		123,223	59,085
Youngstown-Warren, OH	66	A	1	100.0000%	6/30/99	480,231	480,231
Erie, PA	130	A	1	100.0000%	6/30/99	276,401	276,401
Duluth, MN-WI	141	A	1	50.0000%		236,464	118,232
Orange County, NY	144	A	1	50.0000%	12/31/98	329,220	164,610
Poughkeepsie, NY	151	A	1	47.8000%		265,317	126,822
Santa Cruz, CA	175	A	1	87.3000%	6/30/99	242,994	212,134
Sharon, PA	238	A	1	100.0000%	6/30/99	121,938	121,938
Hagerstown, MD	257	A	1	100.0000%	6/30/99	127,352	127,352
Cumberland, MD-WV	269	A	1	100.0000%	6/30/99	98,070	98,070
Enid, OK	302	A	1	100.0000%	6/30/99	56,859	56,859
Alton-Granite City, IL	305	A	1	43.5000%		21,373	9,297
Alaska 1 - Wade Hampton	315	A	1	100.0000%	2/18/00	125,620	125,620
Alaska 3 – Haines	317	A	1			71,886	
Arizona 1 – Mohave	318	A	1			130,618	
Arizona 5 – Gila	322	B	1	75.0000%	6/30/99	195,903	146,927
California 4 – Madera	339	A	1	100.0000%	6/30/99	361,252	361,252
California 7 – Imperial	342	B	1	100.0000%	6/30/99	144,051	144,051
Kansas 5 – Brown	432	A	1	100.0000%	6/30/99	119,263	119,263
Kentucky 4 – Spencer	446	A	1	50.0000%		250,884	125,442
Kentucky 5 – Barren	447	A	1	50.0000%		159,099	79,550
Kentucky 6 – Madison	448	A	1	50.0000%		267,723	133,862
Kentucky 8 – Mason	450	A	1	50.0000%		121,142	60,571
Maryland 1 – Garrett	467	A	1	100.0000%	6/30/99	29,238	29,238
Maryland 2 – Kent	468	A	1	100.0000%	6/30/99	456,653	456,653
Maryland 3 – Frederick	469	A	1	100.0000%	6/30/99	186,777	186,777
Michigan 1 – Gogebic	472	A	1	50.0000%		197,174	98,587
Michigan 3 – Emmet	474	A	1	100.0000%		164,337	164,337
Michigan 10 – Tuscola	481	A	1	100.0000%	3/6/00	136,459	136,459
Minnesota 2 – Lake of the Woods	483	A	2	50.0000%		64,189	32,095
Minnesota 3 – Koochiching	484	A	1	50.0000%		59,395	29,698
Minnesota 4 – Lake	485	A	1	50.0000%		15,358	7,679
Minnesota 5 – Wilkin	486	A	1	50.0000%		207,720	103,860
Minnesota 6 – Hubbard	487	A	1	50.0000%		259,847	129,924
Missouri 1 – Atchison	504	A	1	100.0000%	6/30/99	42,563	42,563
Missouri 4 – De Kalb	507	A	1	100.0000%	6/30/99	71,247	71,247
Missouri 5 – Linn	508	A	2	100.0000%	6/30/99	68,533	68,533
New York 3 – Chautauqua	561	A	1	100.0000%	6/30/99	476,839	476,839
New York 5 – Otsego	563	A	1	50.0000%		374,774	187,387
New York 6 – Columbia	564	A	1	50.0000%		111,028	55,514
Ohio 2 – Sandusky	586	A	1	100.0000%	6/30/99	260,887	260,887
Ohio 7 – Tuscarawas	591	A	1	50.0000%		257,869	128,935
Ohio 10 – Perry	594	A	1	50.0000%	12/31/98	175,484	87,742
Ohio 11 – Columbiana	595	A	1	100.0000%	6/30/99	111,521	111,521

Oklahoma 2 – Harper	597	A	1	100.0000%	6/30/99	48,679	48,679
Oklahoma 3 – Grant	598	B	1	5.0000%	12/31/98	207,339	10,367
Oklahoma 5 – Roger Mills	600	B	1	64.4000%	6/30/99	58,042	37,379
Oklahoma 7 – Beckham	602	B	1	64.4000%	6/30/99	128,753	82,917
Pennsylvania 1 – Crawford	612	A	1	100.0000%	6/30/99	196,171	196,171
Pennsylvania 2 – McKean	613	A	2	100.0000%	6/30/99	86,660	86,660
Pennsylvania 6 – Lawrence	617	A	1	100.0000%	6/30/99	380,694	380,694
Pennsylvania 7 – Jefferson	618	A	1	100.0000%	6/30/99	215,569	215,569
Pennsylvania 9 – Greene	620	A	1	50.0000%		185,589	92,795
Pennsylvania 10 – Bedford	621	A	1	100.0000%	6/30/99	191,873	191,873
Tennessee 4 – Hamblen	646	A	1	50.0000%		274,517	137,259
Texas 2 – Hansford	653	B	1	61.0000%	6/30/99	90,557	55,240
Texas 9 – Runnels	660	A	1	100.0000%		186,658	186,658
Texas 10 – Navarro	661	A	1	100.0000%	6/30/99	317,225	317,225
Texas 16 – Burleson	667	A	1	100.0000%	6/30/99	334,553	334,553
West Virginia 2 – Wetzel	702	A	1	50.0000%		77,979	38,990
West Virginia 3 – Monongalia	703	A	1	50.0000%		266,003	133,002
Wisconsin 1 – Burnett	708	A	1	50.0000%		112,725	56,363
Wisconsin 2 – Bayfield	709	A	2	50.0000%		85,150	42,575
Wisconsin 3 – Vilas	710	A	1	50.0000%		141,299	70,650
Wisconsin 4 – Marinette	711	A	1	50.0000%		120,582	60,291
Wisconsin 5 – Pierce	712	A	1	50.0000%		95,999	48,000
Wisconsin 6 – Trempealeau	713	A	2	50.0000%		116,883	58,442

Hickory Tech

MSA/RSA Name	MSA/RSA Number	Freq. Block	Sub Market	% Owned	As of Date	1998 POPs	Net POPs
Minnesota 10 – Le Sueur	491	A	1	100.0000%	12/31/98	230,935	230,935

Midwest Wireless

MSA/RSA Name	MSA/RSA Number	Freq. Block	Sub Market	% Owned	As of Date	1998 POPs	Net POPs
Rochester, MN	288	B	1	100.0000%	12/31/98	116,702	116,702
Iowa 6 – Iowa	417	B	1	100.0000%	3/2/00	156,100	156,100
Iowa 13 – Mitchell	424	B	1	50.0000%	3/2/00	66,188	33,094
Iowa 14 – Kossuth	425	B	1	13.2800%	3/2/00	106,514	14,145
Iowa 15 – Dickinson	426	B	1	49.1400%	3/2/00	82,903	40,739
Iowa 16 – Lyon	427	B	2			103,198	
Minnesota 7 – Chippewa	488	B	1	100.0000%	12/31/98	170,987	170,987
Minnesota 8 – Lac qui Parle	489	B	1	100.0000%	12/31/98	66,725	66,725
Minnesota 9 – Pipestone	490	B	1	100.0000%	12/31/98	132,729	132,729
Minnesota 10 – Le Sueur	491	B	1	100.0000%	12/31/98	230,935	230,935
Minnesota 11 – Goodhue	492	B	1	100.0000%	12/31/98	206,468	206,468
Wisconsin 5 – Pierce	712	B	1	100.0000%	3/17/00	95,999	95,999

Northeast Communications of Wisconsin

MSA/RSA Name	MSA/RSA Number	Freq. Block	Sub Market	% Owned	As of Date	1998 POPs	Net POPs
Green Bay, WI	186	B	1	67.0000%		215,373	144,300
Wausau, WI	263	B	1	71.7600%	11/1/98	123,223	88,425
Iowa 3 – Monroe	414	B	1	55.0000%	5/5/99	90,478	49,763
Iowa 11 – Hardin	422	B	1	20.0000%		112,534	22,507
Iowa 12 – Winneshiek	423	B	1	90.0000%	5/5/99	115,174	103,657
Wisconsin 4 – Marinette	711	B	1	25.0000%	5/5/99	120,582	30,146
Wisconsin 10 – Door	717	B	1	54.3500%	5/5/99	129,245	70,245

Price Communications

MSA/RSA Name	MSA/RSA Number	Freq. Block	Sub Market	% Owned	As of Date	1998 POPs	Net POPs
Augusta, GA/SC	108	A	1	100.0000%	9/30/99	438,268	438,268
Macon-Warner Robins, GA	138	A	1	99.6000%	9/30/99	319,502	318,224
Montgomery, AL	139	A	1	94.6000%	9/30/99	321,781	304,405

Columbus, GA-AL	153	A	1	99.1000%	9/30/99	249,818	247,570
Savannah, GA	155	A	1	98.5000%	9/30/99	285,508	281,225
Dothan, AL	246	A	1	95.0000%	9/30/99	134,749	128,012
Albany, GA	261	A	1	96.8000%	9/30/99	118,076	114,298
Panama City, FL	283	A	1	92.0000%	9/30/99	146,999	135,239
Alabama 5 – Cleburne	311	A	3	100.0000%		213,811	213,811
Alabama 8 – Lee	314	A	1	100.0000%	9/30/99	177,437	177,437
Georgia 6 – Spalding	376	A	1	96.5000%	9/30/99	203,032	195,926
Georgia 7 – Hancock	377	A	1	100.0000%	9/30/99	134,061	134,061
Georgia 8 – Warren	378	A	1	100.0000%	9/30/99	158,788	158,788
Georgia 9 – Marion	379	A	1	100.0000%	9/30/99	118,965	118,965
Georgia 10 – Bleckley	380	A	1	100.0000%	9/30/99	151,920	151,920
Georgia 12 – Liberty	382	A	1	100.0000%	9/30/99	217,965	217,965
Georgia 13 – Early	383	A	1	96.8000%	9/30/99	149,785	144,992

Public Service Communications

MSA/RSA Name	MSA/RSA Number	Freq. Block	Sub Market	% Owned	As of Date	1998 POPs	Net POPs
Columbus, GA-AL	153	B	1			249,818	
Alabama 5 – Cleburne	311	B	3	100.0000%	12/31/98	213,811	213,811
Alabama 8 – Lee	314	B	2	100.0000%	12/31/98	177,437	177,437
Georgia 5 – Haralson	375	B	2	100.0000%	12/31/98	261,567	261,567
Georgia 6 – Spalding	376	B	1	100.0000%	12/31/98	203,032	203,032
Georgia 6 – Spalding	376	B	2	100.0000%	12/31/98	203,032	203,032
Georgia 6 – Spalding	376	B	3			203,032	
Georgia 9 – Marion	379	B	1			118,965	

Roseville Communications

MSA/RSA Name	MSA/RSA Number	Freq. Block	Sub Market	% Owned	As of Date	1998 POPs	Net POPs
Sacramento, CA	35	B	1	23.5000%	12/31/98	1,527,310	358,918
Stockton, CA	107	B	1	23.5000%	12/31/98	550,445	129,355
Modesto, CA	142	B	1	23.5000%	12/31/98	426,460	100,218
Reno, NV	171	B	1	23.5000%	12/31/98	313,660	73,710
Chico	215	B	1	23.5000%	12/31/98	194,597	45,730
Yuba City, CA	274	B	1	23.5000%	12/31/98	137,043	32,205
California 8 – Tehama	343	B	1	23.5000%	12/31/98	98,879	23,237
California 10 – Sierra	345	B	1	23.5000%	12/31/98	94,714	22,258
Nevada 3 – Storey	545	B	1	23.5000%	12/31/98	119,477	28,077

Rural Cellular

MSA/RSA Name	MSA/RSA Number	Freq. Block	Sub Market	% Owned	As of Date	1998 POPs	Net POPs
Bangor, ME	224	B	1	100.0000%	6/30/99	142,323	142,323
Burlington, VT	248	A	1	100.0000%	6/30/99	148,878	148,878
Alabama 3 – Lamar	309	A	1	100.0000%	9/30/99	136,638	136,638
Alabama 4 – Bibb	310	A	1	100.0000%	9/30/99	141,731	141,731
Alabama 7 – Butler	313	A	2	100.0000%	9/30/99	168,759	168,759
Kansas 1 – Cheyenne	428	A	1	100.0000%	9/30/99	27,044	27,044
Kansas 2 – Norton	429	A	1	100.0000%	9/30/99	29,996	29,996
Kansas 6 – Wallace	433	A	1	100.0000%	9/30/99	19,472	19,472
Kansas 7 – Trego	434	A	1	100.0000%	9/30/99	79,248	79,248
Kansas 11 – Hamilton	438	A	1	100.0000%	9/30/99	86,082	86,082
Kansas 12 – Hodgeman	439	A	1	100.0000%	9/30/99	43,971	43,971
Kansas 13 – Edwards	440	A	1	100.0000%	9/30/99	28,836	28,836
Maine 1 – Oxford	463	B	1	100.0000%	6/30/99	82,606	82,606
Maine 2 – Somerset	464	B	1	100.0000%	6/30/99	146,747	146,747
Maine 3 – Kennebec	465	B	1	100.0000%	6/30/99	221,334	221,334
Massachusetts 1 – Franklin	470	A	1	100.0000%	6/30/99	70,597	70,597
Minnesota 1 – Kittson	482	B	1	100.0000%	6/30/99	49,587	49,587
Minnesota 2 – Lake of the Woods	483	B	1	100.0000%	6/30/99	64,189	64,189
Minnesota 3 – Koochiching	484	B	1	100.0000%	6/30/99	59,395	59,395
Minnesota 5 – Wilkin	486	B	1	100.0000%	6/30/99	207,720	207,720
Minnesota 6 – Hubbard	487	B	1	100.0000%	6/30/99	259,847	259,847
Mississippi 1 – Tunica	493	A	1	100.0000%	9/30/99	173,216	173,216
Mississippi 3 – Bolivar	495	A	1	100.0000%	9/30/99	158,256	158,256

Mississippi 4 – Yalobusha	496	A	1	100.0000%	9/30/99	127,528	127,528
New Hampshire 1 - Coos	548	A	1	100.0000%	6/30/99	223,007	223,007
New York 2 – Franklin	560	A	1	100.0000%	6/30/99	224,207	224,207
Oregon 3 – Umatilla	608	A	1	100.0000%	9/30/99	150,757	150,757
Oregon 4 – Lincoln	609	A	1	100.0000%	9/30/99	227,587	227,587
Oregon 6 – Crook	611	A	1	100.0000%	9/30/99	200,411	200,411
South Dakota 4 – Marshall	637	B	1	100.0000%	6/30/99	68,452	68,452
Vermont 1 – Franklin	679	A	1	100.0000%	6/30/99	210,251	210,251
Vermont 2 – Addison	680	A	1	100.0000%	6/30/99	231,754	231,754
Washington 2 – Okanogan	694	A	1	100.0000%	9/30/99	131,920	131,920
Washington 3 – Ferry	695	A	1	100.0000%	9/30/99	58,160	58,160
Washington 8 – Whitman	700	A	1	100.0000%	9/30/99	120,939	120,939

SBC Communications

MSA/RSA Name	MSA/RSA Number	Freq. Block	Sub Market	% Owned	As of Date	1998 POPs	Net POPs
Chicago, IL	3	A	1	100.0000%	12/31/98	7,766,679	7,766,679
Philadelphia, PA	4	A	1	100.0000%	12/31/98	4,881,650	4,881,650
Detroit/Ann Arbor, MI	5	B	1	95.4230%	12/31/98	4,779,588	4,560,826
Boston-Lowell-Brockton-Lawrence-Haverhill, MA-NH	6	A	1	100.0000%	12/31/98	4,146,082	4,146,082
Washington, DC-MD-VA	8	A	1	90.0000%	12/31/98	3,963,144	3,566,830
Dallas-Forth Worth, TX	9	B	1	82.5000%	12/31/98	4,706,948	3,883,232
St. Louis, MO-IL	11	B	1	98.0000%	12/31/98	2,481,272	2,431,647
Baltimore, MD	14	A	1	90.0000%	12/31/98	2,444,280	2,199,852
Milwaukee, WI	21	B	1	79.0750%	12/31/98	1,459,805	1,154,341
Cincinnati, OH-KY-IN	23	B	1	52.7930%	12/31/98	1,530,386	807,937
Kansas City, MO-KS	24	B	1	81.0000%	12/31/98	1,587,406	1,285,799
Buffalo, NY	25	A	1	100.0000%	12/31/98	1,152,541	1,152,541
New Orleans, LA	29	A	1	100.0000%		1,171,481	1,171,481
Columbus, OH	31	B	1	52.7930%	12/31/98	1,332,708	703,577
Hartford-New Britain-Bristol, CT	32	B	1	99.5000%	12/31/98	1,110,065	1,104,515
San Antonio, TX	33	B	1	70.0000%	12/31/98	1,506,915	1,054,841
Rochester, NY	34	A	1	100.0000%	12/31/98	1,021,229	1,021,229
Providence-Warwick-Pawtucket, RI	38	A	1	100.0000%	12/31/98	905,612	905,612
Dayton, OH	40	B	1	52.7930%	12/31/98	846,407	446,844
Bridgeport-Stamford-Norwalk-Danbury, CT	42	B	1	99.5000%	12/31/98	838,362	834,170
Albany-Schenectady-Troy, NY	44	A	1	100.0000%	12/31/98	839,166	839,166
Oklahoma City, OK	45	B	1	62.0000%	12/31/98	1,008,029	624,978
New Haven-West Haven-Waterbury-Meriden, CT	49	B	1	99.5000%	12/31/98	793,504	789,536
Syracuse, NY	53	A	1	100.0000%	12/31/98	653,376	653,376
Gary-Hammond-East Chicago, IN	54	A	1	66.7000%	12/31/98	624,049	416,241
Worchester-Fitchburg-Leominster, MA	55	A	1	95.3000%	12/31/98	731,881	697,483
New Brunswick-Perth Amboy-Sayreville, NJ	62	A	1	100.0000%	12/31/98	716,176	716,176
Springfield-Chicopee-Holyoke, MA	63	B	1	99.5000%	12/31/98	588,993	586,048
Flint, MI	68	B	1	95.4230%	12/31/98	508,653	485,372
Wilmington, DE-NJ-MD	69	A	1	100.0000%	12/31/98	630,241	630,241
Long Branch-Asbury Park, NJ	70	A	1	100.0000%	12/31/98	603,434	603,434
New Bedford-Fall River, MA	76	A	1	100.0000%	12/31/98	517,543	517,543
Baton Rouge, LA	80	A	1	85.0000%		575,129	488,860
Wichita, KS	89	B	1	60.0000%	12/31/98	509,982	305,989
San Juan-Caguas, PR	91	A	1	100.0000%	12/31/98	2,289,855	2,289,855
Little Rock-North Little Rock, AR	92	A	1	100.0000%	12/31/98	556,295	556,295
Corpus Christi, TX	112	B	1	100.0000%	12/31/98	387,733	387,733
Madison, WI	113	B	1	64.6810%	12/31/98	424,586	274,626
Utica-Rome, NY	115	A	1	100.0000%	12/31/98	294,677	294,677
Trenton, NJ	121	A	1	87.2000%	12/31/98	331,629	289,180
McAllen-Edinburg-Mission, TX	128	B	1	77.5000%	12/31/98	522,204	404,708
Atlantic City, NJ	134	A	1	97.4000%	12/31/98	336,116	327,377
Hamilton-Middletown, OH	145	B	1	52.7930%	12/31/98	330,428	174,443
Ponce, PR	147	A	1	100.0000%	12/31/98	281,886	281,886
New London-Norwich, CT	154	B	1	99.5000%	12/31/98	245,740	244,511
Lubbock, TX Counties - Lubbock	161	B	1	71.0000%	12/31/98	229,475	162,927
Brownsville-Harlingen, TX	162	B	1	77.5000%	12/31/98	326,449	252,998
Fort Smith, AK-OK	165	A	1	100.0000%	12/31/98	240,609	240,609
Mayaguez, PR	169	A	1	100.0000%	12/31/98	256,076	256,076
Springfield, IL	176	A	1	96.7000%	12/31/98	203,847	197,120
Topeka, KS	179	B	1	77.0000%	12/31/98	200,730	154,562
Springfield, OH	180	B	1	52.7930%	12/31/98	183,523	96,887
Fayetteville-Springdale, AK	182	A	1	100.0000%	12/31/98	272,616	272,616
Houma-Thibodaux, LA	184	A	1	95.0000%		193,858	184,165
Amarillo, TX	188	B	1	71.0000%	12/31/98	208,607	148,111
Racine, WI	189	B	1	79.0750%	12/31/98	186,119	147,174
Champaign-Urbana-Rantoul, IL	196	A	1	98.3000%	12/31/98	167,788	164,936
Arecibo, PR	202	A	1	100.0000%	12/31/98	188,384	188,384
Aguadilla, PR	204	A	1	99.0100%	12/31/98	173,903	172,181

Pittsfield, MA	213	B	1	99.5000%	12/31/98	133,038	132,373
Janesville-Beloit, WI	216	B	1	64.6810%	12/31/98	150,736	97,498
Abilene, TX	220	B	1	71.0000%	12/31/98	153,481	108,972
Vineland-Millville-Bridgeton, NJ	228	A	1	94.6000%	12/31/98	140,341	132,763
Decatur, IL	230	A	1	99.0000%	12/31/98	113,772	112,634
Kenosha, WI	244	B	1	79.0750%	12/31/98	144,339	114,136
Bloomington-Normal, IL	250	A	1	96.0000%	12/31/98	142,652	136,946
Odessa, TX	255	B	1	71.0000%	12/31/98	125,729	89,268
Glens Falls, NY	266	A	1	100.0000%	12/31/98	121,742	121,742
St. Joseph, MO	275	B	1	51.0000%	12/31/98	97,338	49,642
Sheboygan, WI	277	B	1	79.0750%	12/31/98	110,170	87,117
Columbia, MO	278	A	1	100.0000%	12/31/98	129,098	129,098
Laredo, TX	281	B	1	55.5000%	12/31/98	188,166	104,432
Pine Bluff, AK	291	A	1	49.1300%	12/31/98	81,556	40,068
Sherman-Denison, TX	292	B	1	82.5000%	12/31/98	102,815	84,822
Midland, TX	295	B	1	71.0000%	12/31/98	119,647	84,949
Lawrence, KS	301	B	1	81.0000%	12/31/98	93,137	75,441
Aurora-Elgin, IL	303	A	1	83.4000%	12/31/98	51,817	43,215
Joliet, IL	304	A	1	85.3000%	12/31/98	36,686	31,293
Arkansas 1 – Madison	324	A	1	50.0000%	12/31/98	75,810	37,905
Arkansas 2 – Marion	325	A	1	50.0000%	12/31/98	94,229	47,115
Arkansas 3 – Sharp	326	A	1	50.0000%	12/31/98	102,936	51,468
Arkansas 4 – Clay	327	A	1	50.0000%	12/31/98	206,300	103,150
Arkansas 5 – Cross	328	A	1	50.0000%	12/31/98	118,482	59,241
Arkansas 6 – Cleburne	329	A	1	50.0000%	12/31/98	105,747	52,874
Arkansas 7 – Pope	330	A	1	50.0000%	12/31/98	116,279	58,140
Arkansas 8 – Franklin	331	A	1	50.0000%	12/31/98	70,194	35,097
Arkansas 10 – Garland	333	A	1	50.0000%	12/31/98	159,901	79,951
Arkansas 12 – Ouachita	335	A	1	50.0000%	12/31/98	185,087	92,544
Connecticut 1 – Litchfield	357	B	1	99.5000%	12/31/98	181,277	180,371
Connecticut 2 – Windham	358	B	1	99.5000%	12/31/98	105,121	104,595
Delaware 1 – Kent	359	A	1	50.0000%	12/31/98	260,796	130,398
Hawaii 1 – Kauai	385	A	1	100.0000%	12/31/98	56,603	56,603
Illinois 2 – Bureau	395	A	1	100.0000%	12/31/98	255,746	255,746
Illinois 4 – Adams	397	A	1	55.5000%	12/31/98	214,892	119,265
Illinois 5 – Mason	398	A	1	100.0000%	12/31/98	95,732	95,732
Illinois 6 – Montgomery	399	A	1	55.5000%	12/31/98	201,881	112,044
Kansas 5 – Brown	432	B	2	100.0000%	12/31/98	119,263	119,263
Kentucky 7 – Trimble	449	B	2	52.7930%	12/31/98	177,071	93,481
Massachusetts 1 – Franklin	470	B	1	99.5000%	12/31/98	70,597	70,244
Massachusetts 2 – Barnstable	471	A	1	100.0000%	12/31/98	230,150	230,150
Michigan 5 – Manistee	476	B	1	11.1900%		160,758	17,989
Missouri 7 – Saline	510	A	1	100.0000%	12/31/98	165,839	165,839
Missouri 8 – Callaway	511	B	1	60.0000%	12/31/98	110,667	66,400
Missouri 9 – Bates	512	B	1	50.4000%	12/31/98	78,733	39,681
Missouri 10 – Benton	513	A	1	100.0000%	12/31/98	100,384	100,384
Missouri 11 – Moniteau	514	B	1	50.0000%	12/31/98	150,741	75,371
Missouri 12 – Maries	515	B	1	50.0000%	12/31/98	121,840	60,920
Missouri 13 – Washington	516	B	1	98.0000%	12/31/98	95,986	94,066
Missouri 17 – Shannon	520	B	1	98.0000%	12/31/98	56,370	55,243
Missouri 18 – Perry	521	B	1	98.0000%	12/31/98	119,777	117,381
Missouri 19 – Stoddard	522	B	1	98.0000%	12/31/98	198,427	194,458
New Jersey 2 – Ocean	551	A	1	100.0000%	12/31/98	489,819	489,819
New York 1 – Jefferson	559	A	1	100.0000%	12/31/98	252,232	252,232
New York 4 – Yates	562	A	1	100.0000%	12/31/98	351,639	351,639
Ohio 4 – Mercer	588	B	1	52.7930%	12/31/98	228,533	120,649
Ohio 7 – Tuscarawas	591	B	1	52.7930%	12/31/98	257,869	136,137
Ohio 8 – Clinton	592	B	1	52.7930%	12/31/98	178,218	94,087
Ohio 10 – Perry	594	B	1	52.7930%	12/31/98	175,484	92,643
Oklahoma 3 – Grant	598	B	1	74.0000%	12/31/98	207,339	153,431
Oklahoma 9 – Garvin	604	B	1	60.0000%	12/31/98	203,617	122,170
Rhode Island 1 – Newport	624	A	1	100.0000%	12/31/98	82,868	82,868
Texas 6 – Jack	657	B	1	49.5000%	12/31/98	84,562	41,858
Texas 7 – Fanni	658	B	1	50.0000%	12/31/98	374,211	187,106
Texas 9 – Runnels	660	B	1	35.6000%	12/31/98	186,658	66,450
Texas 9 – Runnels	660	B	4	84.6000%	12/31/98	186,658	157,913
Texas 10 – Navarro	661	B	1	75.0000%	12/31/98	317,225	237,919
Texas 18 – Edwards	669	B	1	34.0000%	12/31/98	224,996	76,499
Texas 19 – Atascosa	670	B	1	33.3000%	12/31/98	232,216	77,328
Texas 20 – Wilson	671	B	1	50.0000%	12/31/98	149,571	74,786
Virginia 10 – Frederick	690	A	1	90.0000%	12/31/98	239,823	215,841
Virginia 11 – Madison	691	A	1	90.0000%	12/31/98	288,296	259,466
Virginia 12 – Caroline	692	A	1	90.0000%	12/31/98	179,203	161,283
West Virginia 4 – Grant	704	A	1	90.0000%	12/31/98	176,008	158,407
Wisconsin 9 – Columbia	716	B	1	71.8780%	12/31/98	388,006	278,891
Wisconsin 9 – Columbia	716	B	2	71.8780%	12/31/98	388,006	278,891
Puerto Rico 1 – Rincon	723	A	1	100.0000%	12/31/98	12,213	12,213
Puerto Rico 2 – Adjuntas	724	A	1	100.0000%	12/31/98	269,059	269,059
Puerto Rico 3 – Ciales	725	A	1	100.0000%	12/31/98	115,037	115,037
Puerto Rico 4 – Aibonito	726	A	1	100.0000%	12/31/98	259,361	259,361

Puerto Rico 6 – Vieques	728	A	1	100.0000%	12/31/98	8,602	8,602
Puerto Rico 7 – Culebra	729	A	1	100.0000%	12/31/98	1,542	1,542
Virgin Islands 1 – St.Thomas Island	730	A	1	100.0000%	12/31/98	38,780	38,780
Virgin Islands 2 – St. Croix Island	731	A	1	100.0000%	12/31/98	63,220	63,220

Note: BellSouth and SBC have announced a merger of their wireless assets.

Shenandoah Telecommunications

MSA/RSA Name	MSA/RSA Number	Freq. Block	Sub Market	% Owned	As of Date	1998 POPs	Net POPs
Virginia 6 – Highland	686	B	1	11.3700%	5/1/99	216,746	24,644
Virginia 10 – Frederick	690	B	2	66.0000%	12/31/98	239,823	158,283

Souris River Telecommunications Cooperative

MSA/RSA Name	MSA/RSA Number	Freq. Block	Sub Market	% Owned	As of Date	1998 POPs	Net POPs
North Dakota 1 – Divide	580	B	1	16.0840%		102,605	16,503
North Dakota 2 – Bottineau	581	B	1	31.5000%		59,186	18,644
North Dakota 5 – Kidder	584	B	1	19.3550%		47,492	9,192

Triton PCS

MSA/RSA Name	MSA/RSA Number	Freq. Block	Sub Market	% Owned	As of Date	1998 POPs	Net POPs
South Carolina 5 – Georgetown	629	A	1	100.0000%	12/31/98	263,099	263,099

US Cellular

MSA/RSA Name	MSA/RSA Number	Freq. Block	Sub Market	% Owned	As of Date	1998 POPs	Net POPs
Los Angeles-Long Beach/Anaheim-Santa Ana-Garden Grove/Riverside-San Bernardino-Ontario, CA	2	B	1	5.5000%	12/31/98	15,049,306	827,712
Milwaukee, WI	21	A	1	100.0000%	12/31/98	1,459,805	1,459,805
Oklahoma City, OK	45	B	1	14.6000%	12/31/98	1,008,029	147,172
Tulsa, OK	57	B	1	55.0600%	12/31/98	814,544	448,488
Allentown-Bethlehem-Easton, PA-NJ	58	B	1	8.1200%	12/31/98	715,477	58,097
Oxnard-Simi Valley-Ventura, CA	73	B	1	5.5000%	12/31/98	731,967	40,258
Knoxville, TN	79	B	1	96.0300%	12/31/98	555,517	533,463
Davenport-Rock Island-Moline, IA/IL	98	A	1	97.3700%	12/31/98	357,813	348,403
Des Moines, IA	102	A	1	100.0000%	12/31/98	436,922	436,922
Peoria, IL	103	A	1	100.0000%	12/31/98	344,779	344,779
Corpus Christi, TX	112	A	1	100.0000%	12/31/98	387,733	387,733
Madison, WI	113	A	1	92.5000%	12/31/98	424,586	392,742
Appleton-Oskosh-Neenah, WI	125	A	1	100.0000%	12/31/98	344,464	344,464
McAllen-Edinburg-Mission, TX	128	A	1	26.2000%	12/31/98	522,204	136,817
Rockford, IL	131	A	1	100.0000%	12/31/98	306,376	306,376
Manchester-Nashua, NH	133	A	1	92.7000%	12/31/98	363,031	336,530
Portsmouth-Dover-Rochester, NH-ME	156	B	1	40.0000%	12/31/98	283,815	113,526
Roanoke, VA	157	A	1	100.0000%	12/31/98	232,710	232,710
Tallahassee, FL	168	A	1	100.0000%	12/31/98	279,673	279,673
Asheville, NC	183	B	1	100.0000%	12/31/98	213,629	213,629
Green Bay, WI	186	A	1	99.0100%	12/31/98	215,373	213,241
Racine, WI	189	A	1	89.8200%	12/31/98	186,119	167,172
Yakima, WA	191	B	1	58.5400%	12/31/98	218,062	127,653
Gainesville, FL	192	A	1	100.0000%	12/31/98	223,439	223,439
Cedar Rapids, IA	195	A	1	96.0000%	12/31/98	182,651	175,345
Waterloo-Cedar Falls, IA	201	A	1	93.0300%	12/31/98	144,532	134,458
Lynchburg, VA	203	A	1	100.0000%	12/31/98	158,984	158,984
Fort Pierce, FL	208	B	1	100.0000%	12/31/98	295,118	295,118
Richland-Kennewick-Pasco, WA	214	B	1	100.0000%	12/31/98	182,709	182,709
Janesville-Beloit, WI	216	A	1	92.4300%	12/31/98	150,736	139,325
Wilmington, NC	218	A	1	96.5100%	12/31/98	218,248	210,631
Bangor, ME	224	A	1	91.8800%	12/31/98	142,323	130,766
Medford, OR	229	B	1	100.0000%	12/31/98	173,123	173,123

Wichita Falls, TX	233	B	1	70.4500%	12/31/98	139,471	98,257
Joplin, MO	239	B	1	100.0000%	12/31/98	148,684	148,684
Kenosha, WI	244	A	1	99.3200%	12/31/98	144,339	143,357
Charlottesville, VA	256	A	1	95.3700%	12/31/98	149,190	142,283
Hagerstown, MD	257	B	1	100.0000%	12/31/98	127,352	127,352
Jacksonville, NC	258	A	1	96.4800%	12/31/98	142,358	137,347
Lawton, OK	260	B	1	70.4500%	12/31/98	113,508	79,966
Cumberland, MD-WV	269	B	1	100.0000%	12/31/98	98,070	98,070
Sheboygan, WI	277	A	1	86.7600%	12/31/98	110,170	95,583
Columbia, MO	278	B	1	100.0000%	12/31/98	129,098	129,098
Lewiston-Auburn, ME	279	A	1	83.6300%	12/31/98	101,280	84,700
Laredo, TX	281	A	1	93.7400%	12/31/98	188,166	176,387
Dubuque, IA	286	A	1	95.5100%	12/31/98	87,806	83,864
La Crosse, WI	290	A	1	95.1100%	12/31/98	102,565	97,550
Iowa City, IA	296	A	1	100.0000%	12/31/98	102,724	102,724
Victoria, TX	300	A	1	100.0000%	12/31/98	82,650	82,650
Alton-Granite City, IL	305	B	1	100.0000%	12/31/98	21,373	21,373
California 1 – Del Norte	336	A	1	100.0000%	12/31/98	206,423	206,423
California 2 – Modoc	337	A	1	100.0000%	12/31/98	63,053	63,053
California 9 – Mendocino	344	A	1	100.0000%	12/31/98	138,881	138,881
Florida 5 – Putnam	364	A	1	100.0000%	12/31/98	117,874	117,874
Florida 6 – Dixie	365	A	1	100.0000%	12/31/98	58,546	58,546
Florida 8 – Jefferson	367	A	1	100.0000%	12/31/98	55,778	55,778
Florida 9 – Calhoun	368	A	1	100.0000%	12/31/98	42,734	42,734
Florida 10 – Walton	369	A	1	100.0000%	12/31/98	121,984	121,984
Georgia 11 – Toombs	381	A	1	100.0000%	12/31/98	155,791	155,791
Georgia 14 – Worth	384	A	1	100.0000%	12/31/98	255,094	255,094
Idaho 5 – Butte	392	A	1	100.0000%	12/31/98	160,290	160,290
Idaho 6 – Clark	393	A	1	100.0000%	12/31/98	295,734	295,734
Illinois 1 – Jo Daviess	394	A	1	100.0000%	12/31/98	317,684	317,684
Illinois 3 – Mercer	396	A	1	100.0000%	12/31/98	201,974	201,974
Illinois 4 – Adams	397	B	2	100.0000%	12/31/98	214,892	214,892
Indiana 4 – Miami	406	B	1	28.5700%	12/31/98	180,610	51,600
Indiana 5 – Warren	407	B	1	33.3300%	12/31/98	123,849	41,279
Iowa 1 – Mills	412	A	1	100.0000%	12/31/98	62,907	62,907
Iowa 2 – Union	413	A	1	100.0000%	12/31/98	50,301	50,301
Iowa 3 – Monroe	414	A	1	49.0000%	12/31/98	90,478	44,334
Iowa 4 – Muscatine	415	A	1	100.0000%	12/31/98	153,462	153,462
Iowa 5 – Jackson	416	A	1	100.0000%	12/31/98	108,301	108,301
Iowa 6 – Iowa	417	A	1	100.0000%	12/31/98	156,100	156,100
Iowa 7 – Audubon	418	A	1	100.0000%	12/31/98	54,882	54,882
Iowa 9 – Ida	420	B	1	16.6700%	12/31/98	62,992	10,501
Iowa 10 – Humbolt	421	A	1	100.0000%	12/31/98	180,543	180,543
Iowa 11 – Hardin	422	A	1	100.0000%	12/31/98	112,534	112,534
Iowa 12 – Winneshiek	423	A	1	24.5000%	12/31/98	115,174	28,218
Iowa 13 – Mitchell	424	A	1	100.0000%	12/31/98	66,188	66,188
Iowa 14 – Kossuth	425	A	1	100.0000%	12/31/98	106,514	106,514
Iowa 16 – Lyon	427	A	1	100.0000%	12/31/98	103,198	103,198
Kansas 15 – Elk	442	B	1	75.0000%	12/31/98	153,720	115,290
Maine 1 – Oxford	463	A	1	100.0000%	12/31/98	82,606	82,606
Maine 2 – Somerset	464	A	1	100.0000%	12/31/98	146,747	146,747
Maine 3 – Kennebec	465	A	1	100.0000%	12/31/98	221,334	221,334
Maine 4 – Washington	466	B	1	100.0000%	12/31/98	85,434	85,434
Maryland 1 – Garrett	467	B	1	100.0000%	12/31/98	29,238	29,238
Missouri 3 – Schuyler	506	A	1	100.0000%	12/31/98	55,564	55,564
Missouri 5 – Linn	508	A	1	100.0000%	12/31/98	68,533	68,533
Missouri 6 – Marion	509	B	1	100.0000%	12/31/98	85,525	85,525
Missouri 11 – Moniteau	514	A	1	100.0000%	12/31/98	150,741	150,741
Missouri 13 – Washington	516	A	1	100.0000%	12/31/98	95,986	95,986
Missouri 15 – Stone	518	A	1	100.0000%	12/31/98	119,406	119,406
Missouri 16 – Laclede	519	A	1	100.0000%	12/31/98	102,072	102,072
Missouri 17 – Shannon	520	A	1	100.0000%	12/31/98	56,370	56,370
New Hampshire 1 – Coos	548	B	1	100.0000%	12/31/98	223,007	223,007
New Hampshire 2 – Carroll	549	A	1	100.0000%	12/31/98	219,208	219,208
New York 1 – Jefferson	559	B	1	60.0000%	12/31/98	252,232	151,339
North Carolina 2 – Yancey	566	B	3	100.0000%	12/31/98	164,241	164,241
North Carolina 3 – Ashe	567	A	1	100.0000%	12/31/98	163,756	163,756
North Carolina 4 – Henderson	568	B	1	100.0000%	12/31/98	349,393	349,393
North Carolina 6 – Chatham	570	A	1	81.2000%	12/31/98	166,128	134,896
North Carolina 7 – Rockingham	571	A	1	100.0000%	12/31/98	294,004	294,004
North Carolina 8 – Northampton	572	A	1	100.0000%	12/31/98	291,972	291,972
North Carolina 9 – Camden	573	A	1	100.0000%	12/31/98	120,643	120,643
North Carolina 10 – Harnett	574	A	1	100.0000%	12/31/98	301,200	301,200
North Carolina 11 – Hoke	575	A	1	100.0000%	12/31/98	229,364	229,364
North Carolina 12 – Sampson	576	A	1	100.0000%	12/31/98	134,941	134,941
North Carolina 13 – Greene	577	A	1	100.0000%	12/31/98	247,338	247,338
North Carolina 14 – Pitt	578	A	1	100.0000%	12/31/98	249,266	249,266
Ohio 9 – Ross	593	B	1	49.0000%	12/31/98	249,588	122,298
Oklahoma 4 – Nowata	599	B	2	55.0600%	12/31/98	196,523	108,206
Oklahoma 6 – Seminole	601	A	1	55.0600%	12/31/98	220,965	121,663

Oklahoma 7 – Beckham	602	B	2	70.4500%	12/31/98	128,753	90,706
Oklahoma 8 – Jackson	603	B	1	70.4500%	12/31/98	94,972	66,908
Oklahoma 9 – Garvin	604	A	1	100.0000%	12/31/98	203,617	203,617
Oklahoma 10 – Haskell	605	A	1	100.0000%	12/31/98	83,133	83,133
Oregon 2 - Hood River	607	B	1	65.5500%	12/31/98	74,602	48,902
Oregon 3 – Umatilla	608	B	1	76.3900%	12/31/98	150,757	115,163
Oregon 5 – Coos	610	A	1	100.0000%	12/31/98	259,533	259,533
Oregon 6 – Crook	611	B	1	100.0000%	12/31/98	200,411	200,411
Pennsylvania 10 – Bedford	621	B	2	100.0000%	12/31/98	191,873	191,873
South Carolina 4 – Chesterfield	628	A	1	100.0000%	12/31/98	215,375	215,375
Tennessee 3 – Macon	645	B	1	16.6700%	12/31/98	349,106	58,196
Tennessee 4 – Hamblen	646	B	2	100.0000%	12/31/98	274,517	274,517
Tennessee 7 – Bledsoe	649	B	3	96.0300%	12/31/98	266,926	256,329
Texas 4 – Briscoe	655	B	2	70.4500%	12/31/98	41,573	29,288
Texas 5 – Hardeman	656	B	1	70.4500%	12/31/98	75,434	53,143
Texas 18 – Edwards	669	A	1	100.0000%	12/31/98	224,996	224,996
Texas 19 – Atascosa	670	A	1	100.0000%	12/31/98	232,216	232,216
Texas 20 – Wilson	671	A	1	100.0000%	12/31/98	149,571	149,571
Vermont 2 – Addison	680	B	2	100.0000%	12/31/98	231,754	231,754
Virginia 2 – Tazewell	682	A	1	100.0000%	12/31/98	135,521	135,521
Virginia 3 – Giles	683	A	1	100.0000%	12/31/98	201,798	201,798
Virginia 4 – Bedford	684	A	1	100.0000%	12/31/98	178,022	178,022
Virginia 5 – Bath	685	A	1	100.0000%	12/31/98	61,441	61,441
Virginia 7 – Buckingham	687	A	1	100.0000%	12/31/98	90,640	90,640
Washington 4 – Grays Harbor	696	A	1	100.0000%	12/31/98	117,606	117,606
Washington 5 – Kittitas	697	B	1	85.2000%	12/31/98	127,317	108,474
Washington 6 – Pacific	698	B	1	100.0000%	12/31/98	184,396	184,396
Washington 7 – Skamania	699	B	1	65.5500%	12/31/98	29,100	19,075
West Virginia 3 – Monongalia	703	B	1	100.0000%	12/31/98	266,003	266,003
West Virginia 4 – Grant	704	B	1	100.0000%	12/31/98	176,008	176,008
West Virginia 5 – Tucker	705	B	1	100.0000%	12/31/98	130,623	130,623
West Virginia 7 – Raleigh	707	B	1	100.0000%	12/31/98	252,524	252,524
Wisconsin 5 – Pierce	712	A	2	100.0000%	12/31/98	95,999	95,999
Wisconsin 6 – Trempealeau	713	A	1	100.0000%	12/31/98	116,883	116,883
Wisconsin 7 – Wood	714	A	1	100.0000%	12/31/98	289,795	289,795
Wisconsin 8 – Vernon	715	A	1	100.0000%	12/31/98	236,606	236,606
Wisconsin 9 – Columbia	716	A	1	100.0000%	12/31/98	388,006	388,006
Wisconsin 10 – Door	717	A	1	100.0000%	12/31/98	129,245	129,245

US Unwired

MSA/RSA Name	MSA/RSA Number	Freq. Block	Sub Market	% Owned	As of Date	1998 POPs	Net POPs
Lake Charles, LA	197	B	1	100.0000%	12/7/99	180,330	180,330
Louisiana 3 – De Soto	456	B	1	100.0000%	12/7/99	146,932	146,932
Louisiana 5 – Beauregard	458	B	1	100.0000%	12/7/99	388,669	388,669
Texas 21 – Chambers	672	B	1	25.0000%	12/7/99	23,743	5,936

Verizon Wireless

MSA/RSA Name	MSA/RSA Number	Freq. Block	Sub Market	% Owned	As of Date	1998 POPs	Net POPs
New York, NY-NJ/Nassau-Suffolk, NY/Newark, Jersey City and Paterson-Clifton-Passaic, NJ	1	B	1	100.0000%	4/3/00	15,261,373	15,261,373
Los Angeles-Long Beach/Anaheim-Santa Ana-Garden Grove/Riverside-San Bernardino-Ontario, CA	2	B	1	94.5000%	6/30/99	15,049,306	14,221,594
Chicago, IL	3	B	1	95.0000%	10/8/99	7,766,679	7,378,345
Philadelphia, PA	4	B	1	100.0000%	6/30/99	4,881,650	4,881,650
Detroit/Ann Arbor, MI	5	A	1	100.0000%	6/30/99	4,779,588	4,779,588
Boston-Lowell-Brockton-Lawrence-Haverhill, MA-NH	6	B	1	100.0000%	6/30/99	4,146,082	4,146,082
San Francisco-Oakland, CA	7	B	1	97.1300%	12/31/98	4,001,831	3,886,978
Washington, DC-MD-VA	8	B	1	100.0000%	6/30/99	3,963,144	3,963,144
Houston, TX	10	B	1	83.5700%	12/31/98	4,138,280	3,458,361
St. Louis, MO-IL	11	A	1	85.0000%	10/8/99	2,481,272	2,109,081
Pittsburgh, PA	13	B	1	92.8000%	4/3/00	2,030,521	1,884,323
Baltimore, MD	14	B	1	100.0000%	6/30/99	2,444,280	2,444,280
Minneapolis-St. Paul, MN-WI	15	B	1	100.0000%	4/3/00	2,705,116	2,705,116
Cleveland, OH	16	A	1	100.0000%	4/3/00	1,837,282	1,837,282
Atlanta, GA	17	A	1	100.0000%	4/3/00	3,406,269	3,406,269
San Diego, CA	18	B	1	100.0000%	4/3/00	2,780,592	2,780,592
Denver-Boulder, CO	19	B	1	100.0000%	4/3/00	2,210,104	2,210,104
Seattle-Everett, WA	20	B	1	100.0000%	4/3/00	2,242,659	2,242,659
Cincinnati, OH-KY-IN	23	A	1	100.0000%	6/30/99	1,530,386	1,530,386

Kansas City, MO-KS	24	A	1	100.0000%	4/3/00	1,587,406	1,587,406
Buffalo, NY	25	B	1	100.0000%	6/30/99	1,152,541	1,152,541
Phoenix, AZ	26	B	1	100.0000%	4/3/00	2,784,075	2,784,075
San Jose, CA	27	B	1	97.1000%	12/31/98	1,641,215	1,593,620
Indianapolis, IN	28	B	1	94.8400%	12/31/98	1,387,834	1,316,222
Portland, OR-WA	30	B	1	100.0000%	4/3/00	1,692,454	1,692,454
Columbus, OH	31	A	1	100.0000%	6/30/98	1,332,708	1,332,708
Hartford-New Britain-Bristol, CT	32	A	1	100.0000%	6/30/99	1,110,065	1,110,065
Rochester, NY	34	B	1	100.0000%	4/3/00	1,021,229	1,021,229
Sacramento, CA	35	B	1	50.8600%	4/3/00	1,527,310	776,790
Memphis, TN-AR-MS	36	A	1	100.0000%	12/31/98	1,062,970	1,062,970
Louisville, KY-IN	37	A	1	100.0000%	12/31/98	941,598	941,598
Providence-Warwick-Pawtucket, RI	38	B	1	100.0000%	6/30/99	905,612	905,612
Salt Lake City-Ogden, UT	39	B	1	100.0000%	4/3/00	1,301,096	1,301,096
Dayton, OH	40	A	1	100.0000%	6/30/98	846,407	846,407
Birmingham, AL	41	A	1	100.0000%	12/31/98	933,269	933,269
Bridgeport-Stamford-Norwalk-Danbury, CT	42	A	1	100.0000%	6/30/99	838,362	838,362
Norfolk-Virginia Beach-Portsmouth, VA/NC	43	B	1	100.0000%	12/31/98	1,026,706	1,026,706
Albany-Schenectady-Troy, NY	44	B	1	100.0000%	6/30/99	839,166	839,166
Nashville-Davidson, TN	46	A	1	100.0000%	12/31/98	1,156,225	1,156,225
Greensboro-Winston-Salem-High Point, NC	47	A	1	100.0000%	12/31/98	1,016,137	1,016,137
Toledo, OH-MI	48	A	1	100.0000%	6/30/98	794,417	794,417
New Haven-West Haven-Waterbury-Meriden, CT	49	A	1	100.0000%	6/30/99	793,504	793,504
Honolulu, HI	50	B	1	100.0000%	12/31/98	872,478	872,478
Akron, OH	52	A	1	100.0000%	6/30/98	688,952	688,952
Syracuse, NY	53	B	1	100.0000%	4/3/00	653,376	653,376
Gary-Hammond-East Chicago, IN	54	B	1	95.0000%	10/8/99	624,049	592,847
Worchester-Fitchburg-Leominster, MA	55	B	1	100.0000%	6/30/99	731,881	731,881
Northeast Pennsylvania, PA	56	B	1	83.9700%	4/3/00	647,805	543,962
Allentown-Bethlehem-Easton, PA-NJ	58	B	1	73.8800%	4/3/00	715,477	528,594
Richmond, VA	59	B	1	100.0000%	12/31/98	828,032	828,032
Charlotte-Gastonia, NC	61	A	1	100.0000%	6/30/99	925,112	925,112
New Brunswick-Perth Amboy-Sayreville, NJ	62	B	1	90.0000%	6/30/99	716,176	644,558
Springfield-Chicopee-Holyoke, MA	63	A	1	100.0000%	6/30/99	588,993	588,993
Grand Rapids, MI	64	A	1	100.0000%	6/30/98	769,523	769,523
Omaha, NE-IA	65	A	1	93.7500%	4/3/00	650,753	610,081
Greenville-Spartanburg, SC	67	A	1	100.0000%	6/30/99	708,390	708,390
Flint, MI	68	A	1	100.0000%	6/30/98	508,653	508,653
Wilmington, DE-NJ-MD	69	B	1	100.0000%	6/30/99	630,241	630,241
Long Branch-Asbury Park, NJ	70	B	1	90.0000%	6/30/99	603,434	543,091
Raleigh-Durham, NC	71	A	1	100.0000%	12/31/98	883,142	883,142
Oxnard-Simi Valley-Ventura, CA	73	B	1	94.5000%	4/3/00	731,967	691,709
Fresno, CA	74	B	1	98.1000%	6/30/98	755,730	741,371
New Bedford-Fall River, MA	76	B	1	100.0000%	6/30/99	517,543	517,543
Tuscon, AZ	77	B	1	100.0000%	4/3/00	790,755	790,755
Lansing-East Lansing, MI	78	A	1	100.0000%	6/30/98	511,383	511,383
Knoxville, TN	79	A	1	94.1200%	12/31/98	555,517	522,853
El Paso, TX	81	B	1	100.0000%	12/31/98	703,127	703,127
Tacoma, WA	82	B	1	100.0000%	6/30/98	676,505	676,505
Harrisburg, PA	84	B	1	100.0000%	4/3/00	498,597	498,597
Johnson City-Kingsport-Bristol, TN-VA	85	A	1	100.0000%	12/31/98	462,345	462,345
Albuquerque, NM	86	B	1	100.0000%	4/3/00	614,007	614,007
Canton, OH	87	A	1	100.0000%	6/30/98	402,207	402,207
Chattanooga, TN-GA	88	A	1	100.0000%	12/31/98	460,650	460,650
Wichita, KS	89	A	1	100.0000%	4/3/00	509,982	509,982
Charleston-North Charleston, SC	90	A	1	100.0000%	12/31/98	541,159	541,159
San Juan-Caguas, PR	91	B	1	40.0000%		2,289,855	915,942
Las Vegas, NV	93	B	1	100.0000%	4/3/00	1,162,129	1,162,129
Saginaw-Bay City-Midland, MI	94	A	1	100.0000%	6/30/98	401,991	401,991
Columbia, SC	95	A	1	100.0000%	6/30/99	512,316	512,316
Fort Wayne, IN	96	B	1	90.0000%	4/3/00	443,932	399,539
Bakersfield, CA	97	B	1	98.1000%	12/31/98	631,459	619,461
Davenport-Rock Island-Moline, IA/IL	98	B	1	100.0000%	12/31/98	357,813	357,813
York, PA	99	B	1	100.0000%	4/3/00	459,792	459,792
Beaumont-Port Arthur, TX	101	B	1	83.5700%	12/31/98	375,564	313,859
Des Moines, IA	102	B	1	80.0000%	4/3/00	436,922	349,538
Peoria, IL	103	B	1	100.0000%	4/3/00	344,779	344,779
Newport News-Hampton, VA	104	B	1	100.0000%	12/31/98	477,112	477,112
Lancaster, PA	105	B	1	100.0000%	4/3/00	456,414	456,414
Stockton, CA	107	B	1	50.8600%	6/30/98	550,445	279,956
Spokane, WA	109	B	1	100.0000%	4/3/00	408,669	408,669
Vallejo-Fairfield-Napa, CA	111	B	1	97.1300%	12/31/98	496,703	482,448
Utica-Rome, NY	115	B	1	100.0000%	6/30/99	294,677	294,677
Lexington-Fayette, KY	116	A	1	100.0000%	12/31/98	383,143	383,143
Colorado Springs, CO	117	B	1	100.0000%	4/3/00	510,984	510,984
Reading, PA	118	B	1	90.0000%	6/30/99	355,956	320,360
Evansville, IN/KY	119	B	1	100.0000%	12/31/98	322,906	322,906
Huntsville, AL	120	A	1	100.0000%	12/31/98	420,774	420,774
Trenton, NJ	121	B	1	100.0000%	6/30/99	331,629	331,629
Binghamton, NY	122	B	1	100.0000%	6/30/99	291,166	291,166

Santa Rosa-Petaluma, CA	123	B	1	97.1000%	12/31/98	433,304	420,738
Santa Barbara-Santa Maria-Lompoc, CA	124	B	1	100.0000%	6/30/98	389,502	389,502
Salinas-Seaside-Monterey, CA	126	B	1	97.1300%	12/31/98	365,605	355,112
South Bend-Mishawaka, IN	129	B	1	100.0000%	4/3/00	303,532	303,532
Erie, PA	130	B	1	96.5000%	4/3/00	276,401	266,727
Rockford, IL	131	B	1	59.6000%	12/31/98	306,376	182,600
Manchester-Nashua, NH	133	B	1	100.0000%	6/30/99	363,031	363,031
Atlantic City, NJ	134	B	1	100.0000%	6/30/99	336,116	336,116
Eugene-Springfield, OR	135	B	1	100.0000%	4/3/00	314,068	314,068
Lorain-Elyria, OH	136	A	1	100.0000%	6/30/98	282,149	282,149
Duluth, MN-WI	141	B	1	100.0000%	4/3/00	236,464	236,464
Modesto, CA	142	B	1	50.8600%	6/30/98	426,460	216,898
Johnstown, PA	143	B	1	100.0000%	4/3/00	236,347	236,347
Orange County, NY	144	B	1	85.0000%	6/30/99	329,220	279,837
Hamilton-Middletown, OH	145	A	1	99.6000%	4/3/00	330,428	329,106
Ponce, PR	147	B	1	40.0000%		281,886	112,754
Salem, OR	148	B	1	100.0000%	4/3/00	330,101	330,101
Fayetteville, NC	149	A	1	99.4700%	12/31/98	284,629	283,120
Visalia-Tulare-Porterville, CA	150	B	1	98.1000%	6/30/98	355,240	348,490
Poughkeepsie, NY	151	B	1	85.0000%	6/30/99	265,317	225,519
Portland, ME	152	B	1	100.0000%	11/16/99	289,361	289,361
New London-Norwich, CT	154	A	1	100.0000%	6/30/99	245,740	245,740
Roanoke, VA	157	B	1	100.0000%	12/31/98	232,710	232,710
Lima, OH	158	A	1	100.0000%	6/30/98	219,697	219,697
Provo-Orem, UT	159	B	1	100.0000%	4/3/00	335,635	335,635
Hickory, NC	166	A	1	100.0000%	6/30/99	246,512	246,512
Mayaguez, PR	169	B	1	40.0000%		256,076	102,430
Galveston-Texas City, TX	170	B	1	83.5700%	12/31/98	245,556	205,211
Reno, NV	171	B	1	50.8600%	6/30/98	313,660	159,527
Santa Cruz, CA	175	B	1	97.1300%	12/31/98	242,994	236,020
Springfield, IL	176	B	1	72.6500%	6/30/98	203,847	148,095
Topeka, KS	179	A	1	78.0100%	4/3/00	200,730	156,589
Springfield, OH	180	A	1	89.2300%	4/3/00	183,523	163,758
Muskegon, MI	181	A	1	79.4100%	4/3/00	191,581	152,134
Asheville, NC	183	A	1	100.0000%	6/30/99	213,629	213,629
Terre Haute, IN	185	B	1	93.0000%	12/31/98	167,898	156,145
Boise City, ID	190	B	1	100.0000%	4/3/00	275,687	275,687
Cedar Rapids, IA	195	B	1	100.0000%	4/3/00	182,651	182,651
Champaign-Urbana-Rantoul, IL	196	B	1	72.6500%	6/30/98	167,788	121,898
Waterloo-Cedar Falls, IA	201	B	1	88.5417%	4/3/00	144,532	127,971
Arecibo, PR	202	B	1	40.0000%		188,384	75,354
Aguadilla, PR	204	B	1	40.0000%		173,903	69,561
Clarksville-Hopkinsville, TN/KY	209	A	1	100.0000%	12/31/98	199,758	199,758
Fort Collins-Loveland, CO	210	B	1	100.0000%	4/3/00	231,221	231,221
Bremerton, WA	212	B	1	100.0000%	6/30/98	232,623	232,623
Pittsfield, MA	213	A	1	70.9200%	6/30/99	133,038	94,351
Chico	215	B	1	50.8600%	6/30/98	194,597	98,972
Anderson, IN	217	B	1	94.8400%	12/31/98	131,360	124,582
Fargo-Moorehead, ND-MN	221	B	1	100.0000%	4/3/00	168,431	168,431
Tuscaloosa, AL	222	A	1	93.5100%	12/31/98	160,768	150,334
Elkhart-Goshen, IN	223	B	1	100.0000%	4/3/00	172,310	172,310
Altoona, PA	225	B	1	100.0000%	4/3/00	130,615	130,615
Florence, AL	226	A	1	93.1000%	12/31/98	137,271	127,799
Anderson, SC	227	A	1	97.0000%	6/30/99	160,791	155,967
Vineland-Millville-Bridgeton, NJ	228	B	1	100.0000%	6/30/99	140,341	140,341
Decatur, IL	230	B	1	72.6500%	6/30/98	113,772	82,655
Mansfield, OH	231	A	1	100.0000%	6/30/98	127,342	127,342
Athens, GA	234	A	1	86.8400%	4/3/00	176,320	153,116
Petersburg-Colonial Heights-Hopewell, VA	235	B	1	100.0000%	12/31/98	129,000	129,000
Muncie, IN	236	B	1	94.8400%	12/31/98	116,828	110,800
Sharon, PA	238	B	1	96.8600%	4/3/00	121,938	118,109
Pueblo, CO	241	B	1	73.9900%	4/3/00	134,867	99,788
Olympia, WA	242	B	1	100.0000%	4/3/00	202,255	202,255
Greeley, CO	243	B	1	100.0000%	4/3/00	159,429	159,429
Lafayette, IN	247	B	1	94.8400%	12/31/98	139,005	131,832
Burlington, VT	248	B	1	100.0000%	6/30/99	148,878	148,878
Anniston, AL	249	A	1	100.0000%	12/31/98	117,018	117,018
Bloomington-Normal, IL	250	B	1	72.6500%	6/30/98	142,652	103,637
Williamsport, PA	251	B	1	100.0000%	4/3/00	117,308	117,308
Sioux City, IA-NE	253	B	1	74.5000%	4/3/00	120,464	89,746
Redding, CA	254	B	1	50.3900%	4/3/00	164,349	82,815
State College, PA	259	B	1	100.0000%	4/3/00	132,700	132,700
Danville, VA	262	A	1	95.8100%	12/31/98	108,252	103,716
Florence, SC	264	A	1	100.0000%	12/31/98	124,904	124,904
Glens Falls, NY	266	B	1	100.0000%	6/30/99	121,742	121,742
Sioux Falls, SD	267	B	1	100.0000%	4/3/00	143,011	143,011
Billings, MT	268	B	1	91.6300%	12/14/99	126,158	115,599
Bellingham, WA	270	B	1	100.0000%	4/3/00	156,830	156,830
Kokomo, IN	271	B	1	94.8400%	12/31/98	100,176	95,007
Gadsden, AL	272	A	1	90.0000%	12/31/98	103,975	93,578

Kankakee, IL	273	B	1	95.0000%	10/8/99	102,107	97,002
Yuba City, CA	274	B	1	50.8600%	6/30/98	137,043	69,700
St. Joseph, MO	275	A	1	87.0000%	4/3/00	97,338	84,684
Grand Forks, ND-MN	276	B	1	100.0000%	4/3/00	97,823	97,823
Lewiston-Auburn, ME	279	B	1	100.0000%	11/16/99	101,280	101,280
Burlington, NC	280	A	1	100.0000%	12/31/98	119,397	119,397
Bloomington, IN	282	B	1	94.8400%	12/31/98	115,130	109,189
Elmira, NY	284	B	1	100.0000%	6/30/99	92,021	92,021
Las Cruces, NM	285	B	1	100.0000%	12/31/98	169,165	169,165
Dubuque, IA	286	B	1	85.0000%	4/3/00	87,806	74,635
Bryan-College Station, TX	287	B	1	100.0000%	12/31/98	133,407	133,407
Rapid City, SD	289	B	1	100.0000%	12/14/99	109,613	109,613
Owensboro, KY	293	B	1	100.0000%	12/31/98	91,139	91,139
Iowa City, IA	296	B	1	100.0000%	4/3/00	102,724	102,724
Great Falls, MT	297	B	1	91.6300%	4/3/00	78,983	72,372
Bismarck, ND	298	B	1	51.0000%	4/3/00	91,442	46,635
Casper, WY	299	B	1	100.0000%	4/3/00	63,341	63,341
Lawrence, KS	301	A	1	100.0000%	4/3/00	93,137	93,137
Aurora-Elgin, IL	303	B	1	95.0000%	10/8/99	51,817	49,226
Joliet, IL	304	B	1	95.0000%	10/8/99	36,686	34,852
Alabama 1 – Franklin	307	A	1		10/1/98	348,901	
Alabama 1 – Franklin	307	A	2		10/1/98	348,901	
Alabama 1 – Franklin	307	A	3		10/1/98	348,901	
Alabama 2 – Jackson	308	A	1	100.0000%	10/1/98	131,616	131,616
Alaska 2 – Bethel	316	B	2	50.0000%	9/8/97	158,753	79,377
Arizona 1 – Mohave	318	B	1	33.3300%	6/30/98	130,618	43,535
Arizona 2 – Coconino	319	B	1	100.0000%	4/3/00	262,682	262,682
Arizona 3 – Navajo	320	B	1	100.0000%	4/3/00	165,779	165,779
Arizona 4 – Yuma	321	B	1	100.0000%	4/3/00	147,139	147,139
Arizona 6 – Graham	323	B	2	100.0000%	4/3/00	191,680	191,680
California 1 – Del Norte	336	B	1	22.4800%	6/30/98	206,423	46,404
California 2 – Modoc	337	B	1	25.0000%	6/30/98	63,053	15,763
California 3 – Alpine	338	B	1	27.7300%		143,498	39,792
California 4 – Madera	339	B	1	50.0000%	10/1/98	361,252	180,626
California 5 – San Luis Obispo	340	B	1	100.0000%	6/30/98	234,366	234,366
California 6 – Mono	341	B	1	100.0000%	10/1/98	28,413	28,413
California 8 – Tehama	343	B	1	49.8800%	6/30/98	98,879	49,321
California 9 – Mendocino	344	B	1	100.0000%	10/1/98	138,881	138,881
California 10 – Sierra	345	B	1	49.8800%	6/30/98	94,714	47,243
California 12 – Kings	347	B	1	92.0000%	10/1/98	118,866	109,357
Colorado 1 – Moffat	348	A	1	100.0000%	12/14/99	47,899	47,899
Colorado 2 – Logan	349	B	1	61.7500%	4/3/00	63,814	39,405
Colorado 3 – Garfield	350	B	1	100.0000%	4/3/00	296,742	296,742
Colorado 4 – Park	351	B	1	61.7500%	4/3/00	82,218	50,770
Colorado 5 – Elbert	352	B	1	66.0000%	4/3/00	33,988	22,432
Colorado 6 – San Miguel	353	B	1	100.0000%	12/14/99	74,717	74,717
Colorado 7 – Saguache	354	B	1	69.4000%	4/3/00	49,756	34,531
Colorado 8 – Kiowa	355	B	1	100.0000%	4/3/00	45,840	45,840
Colorado 9 – Costilla	356	B	1	49.0000%	4/3/00	29,392	14,402
Connecticut 2 – Windham	358	A	1	100.0000%	6/30/99	105,121	105,121
Delaware 1 – Kent	359	B	1	100.0000%	6/30/99	260,796	260,796
Georgia 2 – Dawson	372	A	1	100.0000%	6/30/99	313,406	313,406
Georgia 3 – Chattooga	373	A	1	100.0000%	4/3/00	216,235	216,235
Georgia 4 – Jasper	374	A	1	100.0000%	4/3/00	129,794	129,794
Hawaii 1 – Kauai	385	B	1	100.0000%	10/1/98	56,603	56,603
Hawaii 2 – Maui	386	B	1	100.0000%	10/1/98	120,785	120,785
Hawaii 3 – Hawaii	387	B	1	100.0000%	10/1/98	143,135	143,135
Idaho 1 – Boundary	388	B	1	75.0000%	4/3/00	251,625	188,719
Idaho 2 – Idaho	389	B	1	100.0000%	4/3/00	72,381	72,381
Idaho 3 – Lemhi	390	B	1	100.0000%	4/3/00	17,251	17,251
Idaho 4 – Elmore	391	B	1	100.0000%	4/3/00	155,716	155,716
Idaho 5 – Butte	392	B	1	100.0000%	12/14/99	160,290	160,290
Idaho 5 – Butte	392	B	2	100.0000%	4/3/00	160,290	160,290
Idaho 6 – Clark	393	B	1	91.6400%	4/3/00	295,734	271,011
Illinois 1 - Jo Daviess	394	B	1	91.5000%	10/1/98	317,684	290,681
Illinois 2 – Bureau	395	B	1	40.0000%	9/8/97	255,746	102,298
Illinois 2 – Bureau	395	B	3	14.5300%	6/30/98	255,746	37,160
Illinois 3 – Mercer	396	B	1	100.0000%	4/3/00	201,974	201,974
Illinois 4 – Adams	397	B	1	60.1300%	6/30/98	214,892	129,215
Illinois 5 – Mason	398	B	1	100.0000%	4/3/00	95,732	95,732
Illinois 5 – Mason	398	B	2	72.6500%	10/8/99	95,732	69,549
Illinois 6 – Montgomery	399	B	1	44.5400%	6/30/98	201,881	89,918
Illinois 7 – Vermilion	400	B	1	44.5400%	6/30/98	234,133	104,283
Illinois 9 – Clay	402	B	1		9/8/97	149,924	
Indiana 1 – Newton	403	B	1	40.0000%	10/1/98	216,018	86,407
Indiana 1 – Newton	403	B	2	95.0000%	10/8/99	216,018	205,217
Indiana 2 – Kosciusko	404	B	1	75.0000%	4/3/00	178,767	134,075
Indiana 3 – Huntington	405	B	1	40.0000%	4/3/00	145,468	58,187
Indiana 6 – Randolph	408	B	1	43.7500%	10/1/98	221,073	96,719
Indiana 7 – Owen	409	B	1	38.1000%	10/1/98	225,643	85,970

Indiana 8 – Brown	410	B	1	38.1000%	10/1/98	264,986	100,960
Indiana 9 – Decatur	411	B	1	38.1000%	10/1/98	149,277	56,875
Iowa 1 – Mills	412	B	1	7.6200%	6/30/98	62,907	4,794
Iowa 2 – Union	413	B	1	49.5000%	4/3/00	50,301	24,899
Iowa 4 – Muscatine	415	B	1	48.2100%	10/1/98	153,462	73,984
Iowa 5 – Jackson	416	B	1	100.0000%	4/3/00	108,301	108,301
Iowa 7 – Audubon	418	B	1	14.1400%	4/3/00	54,882	7,760
Iowa 8 – Monona	419	B	1	44.9200%	4/3/00	54,898	24,660
Iowa 9 – Ida	420	A	1	100.0000%	4/3/00	62,992	62,992
Iowa 16 – Lyon	427	B	1	49.1700%	3/2/00	103,198	50,742
Kentucky 1 – Fulton	443	B	1	50.0000%	10/1/98	190,694	95,347
Kentucky 2 – Union	444	B	1	100.0000%	10/1/98	129,194	129,194
Kentucky 7 – Trimble	449	A	1	100.0000%	10/1/98	177,071	177,071
Maryland 2 – Kent	468	B	1	100.0000%	6/30/99	456,653	456,653
Maryland 3 – Frederick	469	B	1	100.0000%	6/30/99	186,777	186,777
Massachusetts 2 – Barnstable	471	B	1	100.0000%	6/30/99	230,150	230,150
Minnesota 4 – Lake	485	B	1	100.0000%	4/3/00	15,358	15,358
Missouri 8 – Callaway	511	A	1	100.0000%	10/8/99	110,667	110,667
Missouri 9 – Bates	512	B	1	14.7000%	12/14/99	78,733	11,574
Missouri 12 – Maries	515	A	1	100.0000%	10/8/99	121,840	121,840
Missouri 18 – Perry	521	A	1	100.0000%	10/8/99	119,777	119,777
Missouri 19 – Stoddard	522	A	1	100.0000%	10/8/99	198,427	198,427
Montana 1 – Lincoln	523	B	1	91.6300%	12/14/99	151,635	138,943
Montana 1 – Lincoln	523	B	2	91.6300%	12/14/99	151,635	138,943
Montana 2 – Toole	524	B	1	91.6300%	12/14/99	36,758	33,681
Montana 4 – Daniels	526	B	1	91.6300%	12/14/99	39,323	36,032
Montana 5 – Mineral	527	B	1	91.6300%	12/14/99	191,215	175,210
Montana 6 – Deer Lodge	528	B	1	91.6300%	12/14/99	65,242	59,781
Montana 7 – Fergus	529	B	1	91.6300%	12/14/99	29,892	27,390
Montana 8 – Beaverhead	530	B	1	91.6300%	12/14/99	94,171	86,289
Montana 9 – Carbon	531	B	1	91.6300%	4/3/00	32,995	30,233
Montana 10 – Prairie	532	B	1	91.6300%	12/14/99	19,672	18,025
Nevada 2 – Lander	544	B	1	100.0000%	4/3/00	55,065	55,065
Nevada 3 – Storey	545	B	1	49.8800%	6/30/98	119,477	59,595
Nevada 4 – Mineral	546	B	1	50.0000%	4/3/00	35,397	17,699
Nevada 5 – White Pine	547	B	1	100.0000%	4/3/00	14,298	14,298
New Hampshire 2 – Carroll	549	B	1	100.0000%	6/30/99	219,208	219,208
New Jersey 1 – Hunterdon	550	B	1	100.0000%	6/30/99	122,428	122,428
New Jersey 2 – Ocean	551	B	1	100.0000%	6/30/99	489,819	489,819
New Jersey 3 – Sussex	552	B	1	100.0000%	6/30/99	143,030	143,030
New Mexico 1 – San Juan	553	B	1	100.0000%	4/3/00	264,430	264,430
New Mexico 1 – San Juan	553	B	2	58.3600%	12/14/99	264,430	154,321
New Mexico 3 – Catron	555	B	1	78.9200%	12/14/99	94,829	74,839
New Mexico 4 – Santa Fe	556	B	2	100.0000%	4/3/00	266,097	266,097
New Mexico 5 – Grant	557	B	1	59.3300%	12/14/99	61,892	36,721
New Mexico 6 – Lincoln	558	B	1	71.4000%	10/1/98	243,169	173,623
New Mexico 6 – Lincoln	558	B	2	12.5000%	9/8/97	243,169	30,396
New York 1 – Jefferson	559	B	1	40.0000%	6/30/99	252,232	100,893
New York 2 – Franklin	560	B	1	42.9000%	6/30/99	224,207	96,185
New York 3 – Chautauqua	561	B	1	100.0000%	6/30/99	476,839	476,839
New York 4 – Yates	562	B	1	100.0000%	6/30/99	351,639	351,639
New York 5 – Otsego	563	B	1	100.0000%	6/30/99	374,774	374,774
New York 6 – Columbia	564	B	1	100.0000%	9/9/99	111,028	111,028
North Carolina 1 – Cherokee	565	A	1	100.0000%	6/30/99	189,731	189,731
North Carolina 2 – Yancey	566	A	1	100.0000%	6/30/99	164,241	164,241
North Carolina 4 – Henderson	568	A	1	100.0000%	6/30/99	349,393	349,393
North Carolina 5 – Anson	569	A	1	100.0000%	6/30/99	130,457	130,457
North Carolina 15 – Cabarrus	579	A	1		10/1/98	446,987	
North Dakota 1 – Divide	580	B	1	53.3600%	4/3/00	102,605	54,750
North Dakota 2 – Bottineau	581	B	1	65.0600%	4/3/00	59,186	38,506
North Dakota 3 – Barnes	582	B	1	56.8600%	4/3/00	90,248	51,315
North Dakota 4 – McKenzie	583	B	1	49.0000%	4/3/00	63,570	31,149
North Dakota 5 – Kidder	584	B	1	61.7500%	4/3/00	47,492	29,326
Ohio 3 – Ashtabula	587	A	1	100.0000%	6/30/98	103,300	103,300
Ohio 4 – Mercer	588	A	1	100.0000%	6/30/98	228,533	228,533
Ohio 6 – Morrow	590	A		100.0000%	6/30/98	457,990	457,990
Ohio 8 – Clinton	592	A	1	100.0000%	6/30/98	178,218	178,218
Oregon 1 – Clatsop	606	B	1	100.0000%	4/3/00	186,281	186,281
Oregon 4 – Lincoln	609	B	1	100.0000%	4/3/00	227,587	227,587
Pennsylvania 1 – Crawford	612	B	1	80.0000%	4/3/00	196,171	156,937
Pennsylvania 2 – McKean	613	B	1	100.0000%	6/30/99	86,660	86,660
Pennsylvania 3 – Potter	614	B	1	100.0000%	4/3/00	95,790	95,790
Pennsylvania 3 – Potter	614	B	2	100.0000%	4/3/00	95,790	95,790
Pennsylvania 4 – Bradford	615	B	1	100.0000%	4/3/00	97,715	97,715
Pennsylvania 4 – Bradford	615	B	2	100.0000%	4/3/00	97,715	97,715
Pennsylvania 5 – Wayne	616	B	1	40.0000%	4/3/00	85,398	34,159
Pennsylvania 6 – Lawrence	617	B	1	57.1300%	4/3/00	380,694	217,490
Pennsylvania 6 – Lawrence	617	B	2	51.1300%	6/30/99	380,694	194,649
Pennsylvania 7 – Jefferson	618	B	1	100.0000%	6/30/99	215,569	215,569
Pennsylvania 8 – Union	619	B	1	100.0000%	4/3/00	403,256	403,256

Pennsylvania 9 – Greene	620	B	1	100.0000%	6/30/99	185,589	185,589
Pennsylvania 10 – Bedford	621	B	1	100.0000%	4/3/00	191,873	191,873
Pennsylvania 11 – Huntingdon	622	B	1	100.0000%	4/3/00	113,661	113,661
Pennsylvania 11 – Huntingdon	622	B	2	100.0000%	6/30/99	113,661	113,661
Pennsylvania 12 – Lebanon	623	B	1	100.0000%	4/3/00	117,434	117,434
Rhode Island 1 – Newport	624	B	1	100.0000%	6/30/99	82,868	82,868
South Carolina 1 – Oconee	625	A	1	100.0000%	6/30/99	64,059	64,059
South Carolina 2 – Laurens	626	A	1	100.0000%	6/30/99	232,539	232,539
South Carolina 3 – Cherokee	627	A	1	100.0000%	6/30/99	136,460	136,460
South Carolina 6 – Clarendon	630	A	1	100.0000%	10/1/98	195,461	195,461
South Carolina 7 – Calhoun	631	A	1	100.0000%	10/1/98	151,640	151,640
South Carolina 7 – Calhoun	631	A	2			151,640	
South Carolina 8 – Hampton	632	A	1	100.0000%	6/30/99	182,518	182,518
South Carolina 9 – Lancaster	633	A	1	100.0000%	6/30/99	213,200	213,200
South Dakota 1 – Harding	634	B	1	100.0000%	12/14/99	36,508	36,508
South Dakota 2 – Corson	635	B	1	100.0000%	12/14/99	22,543	22,543
South Dakota 3 – McPherson	636	B	1	100.0000%	12/14/99	52,483	52,483
South Dakota 5 – Custer	638	B	1	100.0000%	12/14/99	26,246	26,246
South Dakota 5 – Custer	638	B	2	100.0000%	12/14/99	26,246	26,246
South Dakota 6 – Haakon	639	B	1	100.0000%	12/14/99	39,523	39,523
South Dakota 6 – Haakon	639	B	2	100.0000%	12/14/99	39,523	39,523
South Dakota 7 – Sully	640	B	1	100.0000%	4/3/00	65,978	65,978
South Dakota 8 – Kingsbury	641	B	1	100.0000%	4/3/00	72,067	72,067
South Dakota 9 – Hanson	642	B	1	100.0000%	4/3/00	101,747	101,747
Tennessee 1 – Lake	643	A	1	100.0000%	10/1/98	308,431	308,431
Tennessee 2 – Cannon	644	A	1	100.0000%	10/1/98	168,294	168,294
Tennessee 3 – Macon	645	A	1	100.0000%	10/1/98	349,106	349,106
Tennessee 5 – Fayette	647	A	1	100.0000%	10/1/98	354,553	354,553
Tennessee 6 – Giles	648	A	1	100.0000%	10/1/98	162,182	162,182
Tennessee 7 – Bledsoe	649	A	1	100.0000%	10/1/98	266,926	266,926
Tennessee 9 – Maury	651	A	1	100.0000%	10/1/98	69,633	69,633
Texas 17 – Newton	668	B	1	31.9100%	10/1/98	264,833	84,508
Texas 21 – Chambers	672	B	1	75.0000%	10/1/98	23,743	17,807
Utah 1 - Box Elder	673	B	1	100.0000%	4/3/00	130,732	130,732
Utah 2 – Morgan	674	B	1	66.6700%	4/3/00	47,035	31,358
Utah 3 – Juab	675	B	1	100.0000%	12/14/99	59,725	59,725
Utah 4 – Beaver	676	B	1	100.0000%	12/14/99	116,670	116,670
Utah 5 – Carbon	677	B	3	100.0000%	12/14/99	80,901	80,901
Utah 6 – Piute	678	B	1	80.0000%	12/14/99	27,964	22,371
Vermont 1 – Franklin	679	B	1	100.0000%	6/30/99	210,251	210,251
Vermont 2 – Addison	680	B	1	100.0000%	6/30/99	231,754	231,754
Virginia 1 – Lee	681	A	1	100.0000%	6/30/99	141,441	141,441
Virginia 2 – Tazewell	682	B	1	4.9900%	6/30/99	135,521	6,762
Virginia 3 – Giles	683	B	1	100.0000%	10/1/98	201,798	201,798
Virginia 4 – Bedford	684	B	1	100.0000%	10/1/98	178,022	178,022
Virginia 5 – Bath	685	B	1	77.0000%	10/1/98	61,441	47,310
Virginia 6 – Highland	686	B	1		9/8/97	216,746	
Virginia 7 – Buckingham	687	B	1	100.0000%	10/1/98	90,640	90,640
Virginia 8 – Amelia	688	B	1	95.0000%	10/1/98	85,172	80,913
Virginia 9 – Greensville	689	B	1	95.0000%	10/1/98	88,538	84,111
Virginia 10 – Frederick	690	B	1	100.0000%	6/30/99	239,823	239,823
Virginia 10 – Frederick	690	B	2	1.0000%		239,823	2,398
Virginia 11 – Madison	691	B	1	95.0000%	10/1/98	288,296	273,881
Virginia 11 – Madison	691	B	3	100.0000%	6/30/99	288,296	288,296
Virginia 12 – Caroline	692	B	1	100.0000%	10/1/98	179,203	179,203
Virginia 12 – Caroline	692	B	2	100.0000%	6/30/99	179,203	179,203
Washington 1 – Clallam	693	B	1	100.0000%	6/30/98	272,570	272,570
Washington 2 – Okanogan	694	B	1	100.0000%	4/3/00	131,920	131,920
Washington 3 – Ferry	695	B	1	100.0000%	4/3/00	58,160	58,160
Washington 4 – Grays Harbor	696	B	1	37.5000%	4/3/00	117,606	44,102
West Virginia 1 – Mason	701	B	1	100.0000%	6/30/99	77,123	77,123
West Virginia 2 – Wetzel	702	B	1	100.0000%	6/30/99	77,979	77,979
Wyoming 1 – Park	718	B	1	66.0000%	4/3/00	50,558	33,368
Wyoming 2 – Sheridan	719	B	1	100.0000%	12/14/99	76,755	76,755
Wyoming 3 – Lincoln	720	A	1	100.0000%	12/14/99	145,641	145,641
Wyoming 4 – Niobrara	721	B	1	100.0000%	4/3/00	132,275	132,275
Wyoming 5 – Converse	722	B	1	100.0000%	4/3/00	12,337	12,337
Puerto Rico 1 – Rincon	723	B	1	40.0000%		12,213	4,885
Puerto Rico 2 – Adjuntas	724	B	1	40.0000%		269,059	107,624
Puerto Rico 3 – Ciales	725	B	1	40.0000%		115,037	46,015
Puerto Rico 4 – Aibonito	726	B	1	40.0000%		259,361	103,744
Puerto Rico 5 – Ceiba	727	B	1	40.0000%		39,765	15,906
Puerto Rico 6 – Vieques	728	B	1	40.0000%		8,602	3,441
Puerto Rico 7 – Culebra	729	B	1	40.0000%		1,542	617

Note: Additional licenses once held by Bell Atlantic, AirTouch, PrimeCo, and GTE are (as of this writing) being held by a trustee appointed by the Department of Justice. These licenses will eventually be sold to other companies.

Western Wireless

MSA/RSA Name	MSA/RSA Number	Freq. Block	Sub Market	% Owned	As of Date	1998 POPs	Net POPs
McAllen-Edinburg-Mission, TX	128	A	1	69.5000%	6/1/99	522,204	362,932
Lubbock, TX Counties – Lubbock	161	A	1	100.0000%	12/31/98	229,475	229,475
Brownsville-Harlingen, TX	162	A	1	78.7400%	6/1/99	326,449	257,046
Lincoln, NE	172	A	1	100.0000%	12/31/98	235,589	235,589
Abilene, TX	220	A	1	100.0000%	12/31/98	153,481	153,481
Fargo-Moorehead, ND-MN	221	A	1	100.0000%	12/31/98	168,431	168,431
Pueblo, CO	241	A	1	100.0000%	12/31/98	134,867	134,867
Sioux City, IA-NE	253	A	1	100.0000%	12/31/98	120,464	120,464
Odessa, TX	255	A	1	96.0000%	12/31/98	125,729	120,700
Sioux Falls, SD	267	A	1	99.0000%	12/31/98	143,011	141,581
Billings, MT	268	A	1	97.9000%	12/31/98	126,158	123,509
Grand Forks, ND-MN	276	A	1	100.0000%	12/31/98	97,823	97,823
Rapid City, SD	289	A	1	100.0000%	12/31/98	109,613	109,613
San Angelo, TX	294	A	1	100.0000%	12/31/98	102,775	102,775
Midland, TX	295	A	1	96.0000%	12/31/98	119,647	114,861
Great Falls, MT	297	A	1	100.0000%	12/31/98	78,983	78,983
Bismarck, ND	298	A	1	100.0000%	12/31/98	91,442	91,442
Casper, WY	299	A	1	100.0000%	12/31/98	63,341	63,341
Arizona 6 – Graham	323	A	1			191,680	
Arkansas 11 – Hempstead	334	A	1		11/10/99	66,133	
California 6 – Mono	341	A	1	100.0000%	12/31/98	28,413	28,413
Colorado 4 – Park	351	A	1	100.0000%	12/31/98	82,218	82,218
Colorado 5 – Elbert	352	A	1	100.0000%	12/31/98	33,988	33,988
Colorado 7 – Saguache	354	A	1	100.0000%	12/31/98	49,756	49,756
Colorado 8 – Kiowa	355	A	1	100.0000%	12/31/98	45,840	45,840
Colorado 9 – Costilla	356	A	1	100.0000%	12/31/98	29,392	29,392
Idaho 2 – Idaho	389	A	1	100.0000%	12/31/98	72,381	72,381
Idaho 3 – Lemhi	390	A	2	100.0000%		17,251	17,251
Idaho 3 – Lemhi	390	A	4	100.0000%		17,251	17,251
Iowa 8 – Monona	419	A	1	100.0000%	12/31/98	54,898	54,898
Kansas 3 – Jewell	430	A	1	100.0000%	12/31/98	51,813	51,813
Kansas 4 – Marshall	431	A	1	100.0000%	12/31/98	128,814	128,814
Kansas 8 – Ellsworth	435	A	1	100.0000%	12/31/98	130,227	130,227
Kansas 9 – Morris	436	A	1	100.0000%	12/31/98	57,829	57,829
Kansas 10 – Franklin	437	A	1	100.0000%	12/31/98	111,078	111,078
Kansas 14 – Reno	441	A	1	100.0000%	12/31/98	175,907	175,907
Minnesota 1 – Kittson	482	A	1	100.0000%	12/31/98	49,587	49,587
Minnesota 2 - Lake of the Woods	483	A	1	100.0000%	12/31/98	64,189	64,189
Minnesota 7 – Chippewa	488	A	1	100.0000%	12/31/98	170,987	170,987
Minnesota 8 – Lac qui Parle	489	A	1	100.0000%	12/31/98	66,725	66,725
Minnesota 9 – Pipestone	490	A	1	100.0000%	12/31/98	132,729	132,729
Missouri 9 – Bates	512	A	1	100.0000%	12/31/98	78,733	78,733
Montana 1 – Lincoln	523	A	1	100.0000%	12/31/98	151,635	151,635
Montana 2 – Toole	524	A	1	100.0000%	12/31/98	36,758	36,758
Montana 3 – Phillips	525	A	1	100.0000%	12/31/98	14,409	14,409
Montana 4 – Daniels	526	A	1	100.0000%	12/31/98	39,323	39,323
Montana 5 – Mineral	527	A	1	100.0000%	12/31/98	191,215	191,215
Montana 6 - Deer Lodge	528	A	1	100.0000%	12/31/98	65,242	65,242
Montana 7 – Fergus	529	A	1	100.0000%	12/31/98	29,892	29,892
Montana 8 – Beaverhead	530	A	1	100.0000%	12/31/98	94,171	94,171
Montana 9 – Carbon	531	A	1	100.0000%	12/31/98	32,995	32,995
Montana 10 – Prairie	532	A	1	100.0000%	12/31/98	19,672	19,672
Nebraska 2 – Cherry	534	A	1	100.0000%	12/31/98	30,165	30,165
Nebraska 3 – Knox	535	A	1	100.0000%	12/31/98	115,633	115,633
Nebraska 4 – Grant	536	A	1	100.0000%	12/31/98	34,745	34,745
Nebraska 5 – Boone	537	A	1	100.0000%	12/31/98	147,531	147,531
Nebraska 6 – Keith	538	A	1	100.0000%	12/31/98	109,130	109,130
Nebraska 7 – Hall	539	A	1	100.0000%	12/31/98	92,133	92,133
Nebraska 8 – Chase	540	A	1	100.0000%	12/31/98	57,347	57,347
Nebraska 9 – Adams	541	A	1	100.0000%	12/31/98	80,406	80,406
Nebraska 10 – Cass	542	A	1	100.0000%	12/31/98	86,751	86,751
Nevada 1 – Humboldt	543	A	1	100.0000%	12/31/98	46,872	46,872
Nevada 2 – Lander	544	A	1	100.0000%	12/31/98	55,065	55,065
Nevada 4 – Mineral	546	A	1	100.0000%	12/31/98	35,397	35,397
Nevada 5 – White Pine	547	A	1	100.0000%	12/31/98	14,298	14,298
New Mexico 6 – Lincoln	558	A	1	100.0000%	12/31/98	243,169	243,169
North Dakota 1 – Divide	580	A	1	100.0000%	12/31/98	102,605	102,605
North Dakota 2 – Bottineau	581	A	1	100.0000%	12/31/98	59,186	59,186
North Dakota 3 – Barnes	582	A	2	100.0000%		90,248	90,248
North Dakota 4 – McKenzie	583	A	1	100.0000%	12/31/98	63,570	63,570
North Dakota 5 – Kidder	584	A	1	100.0000%	12/31/98	47,492	47,492
Oklahoma 1 – Cimarron	596	A	1	100.0000%	2/4/99	27,655	27,655
Oklahoma 7 – Beckham	602	A	1	100.0000%	12/31/98	128,753	128,753
Oklahoma 8 – Jackson	603	A	1	100.0000%	12/31/98	94,972	94,972

South Dakota 1 – Harding	634	A	1	100.0000%	12/31/98	36,508	36,508
South Dakota 2 – Corson	635	A	1	100.0000%	12/31/98	22,543	22,543
South Dakota 3 – McPherson	636	A	1	100.0000%	12/31/98	52,483	52,483
South Dakota 4 – Marshall	637	A	1	100.0000%	12/31/98	68,452	68,452
South Dakota 5 – Custer	638	A	1	100.0000%	2/1/99	26,246	26,246
South Dakota 6 – Haakon	639	A	1	100.0000%	12/31/98	39,523	39,523
South Dakota 7 – Sully	640	A	1	100.0000%	12/31/98	65,978	65,978
South Dakota 8 – Kingsbury	641	A	1	100.0000%	12/31/98	72,067	72,067
South Dakota 9 – Hanson	642	A	1	100.0000%	12/31/98	101,747	101,747
Texas 1 – Dallam	652	A	1	100.0000%	12/31/98	55,468	55,468
Texas 2 – Hansford	653	A	1	100.0000%	12/31/98	90,557	90,557
Texas 3 – Parmer	654	A	1	100.0000%	12/31/98	140,655	140,655
Texas 4 – Briscoe	655	A	1	100.0000%	12/31/98	41,573	41,573
Texas 5 – Hardeman	656	A	1	100.0000%	12/31/98	75,434	75,434
Texas 7 – Fanni	658	A	1		10/1/99	374,211	
Texas 8 – Gaines	659	A	1	100.0000%	12/31/98	136,170	136,170
Texas 12 – Hudspeth	663	A	1	100.0000%	12/31/98	26,185	26,185
Texas 13 – Reeves	664	A	1	100.0000%	12/31/98	31,662	31,662
Texas 14 – Loving	665	A	1	100.0000%	12/31/98	46,129	46,129
Utah 3 – Juab	675	A	1	100.0000%	12/31/98	59,725	59,725
Utah 4 – Beaver	676	A	1	100.0000%	12/31/98	116,670	116,670
Utah 5 – Carbon	677	A	1		1/5/00	80,901	
Utah 6 – Piute	678	A	1	100.0000%	12/31/98	27,964	27,964
Wyoming 1 – Park	718	A	1	100.0000%		50,558	50,558
Wyoming 2 – Sheridan	719	A	1	100.0000%	12/31/98	76,755	76,755
Wyoming 4 – Niobrara	721	A	1	100.0000%	2/4/99	132,275	132,275
Wyoming 5 – Converse	722	A	1	100.0000%	12/31/98	12,337	12,337