Table 25
Lifetime of Subscribers (Months)[760]

	1Q07	2Q07	3Q07	4Q07	1Q08	2Q08	3Q08	4Q08	1Q09	2Q09	3Q09	4Q09
National Operators												
AT&T	59	63	59	59	59	63	59	63	63	67	71	71
Verizon Wireless	91	77	77	83	77	83	71	67	67	71	67	71
Sprint Nextel	43	48	43	42	37	48	45	45	45	48	40	42
T-Mobile	38	37	34	36	38	37	33	30	32	32	29	30
Regional & Other Operators												
US Cellular	59	48	45	48	56	53	48	50	53	45	45	48
Alltel	56	59	53	56	56	53	50	NAV	NAV	NAV	NAV	NAV
Centennial Cellular	45	56	43	42	43	50	37	40	45	45	36	NAV
Centennial PCS	37	42	42	38	42	40	38	36	34	34	30	NAV
Cincinnati Bell	29	28	28	29	30	27	25	23	29	31	29	29
Leap Wireless (Cricket)	29	23	19	24	28	26	23	26	30	23	19	21
MetroPCS	25	21	19	21	25	22	21	20	20	17	17	19

VII. INPUT AND DOWNSTREAM SEGMENTS OF THE MOBILE WIRELESS ECOSYSTEM

A. Input Segments

264. In the following sections, we consider key factors in the production of mobile wireless services. We examine whether and how such "upstream" or input segments, including spectrum, infrastructure and backhaul facilities, affect market performance. As we observe below, these critical input segments may affect competition in the provision of mobile wireless services.

1. Spectrum

265. In this section, we briefly describe the Commission's allocation and licensing of commercial wireless spectrum that is used for the provision of mobile voice, mobile broadband and other data services. We then provide an overview of the overall spectrum holdings among different providers. We also discuss the relative advantages of spectrum in different frequency bands for providing broadband service.

a. Availability of Mobile Wireless Services Spectrum

266. Access to spectrum is a precondition to the provision of mobile wireless services. Ensuring that sufficient spectrum is available for incumbent licensees, as well as for entities that need spectrum to enter the market, is critical for promoting competition, investment, and innovation. Incumbent licensees may need additional spectrum to increase their coverage or capacity as they grow

[760] *US Wireless 411 2Q09*; Commission estimates.

their subscriber bases and meet increasing demand, while new entrants need access to spectrum to enter the market and compete with established licensees. A number of commenters in this proceeding note the importance of promoting access to spectrum among providers to ensure that all mobile wireless consumers reap the benefits of competition.[761] Through the years, the Commission has increased the amount of spectrum available for the provision of mobile wireless services. This spectrum has been made available in different frequency bands, in different bandwidths and licensing areas.

267. As noted in the *National Broadband Plan*, making sufficient spectrum available to meet growing spectrum needs is integral to enabling network expansion and technology upgrades by providers.[762] In the absence of sufficient spectrum, network providers must turn to costly alternatives, such as cell splitting, often with diminishing returns.[763] Accordingly, the *National Broadband Plan* recommends that the Commission make 500 megahertz of spectrum newly available for broadband use within the next ten years, of which 300 megahertz between 225 MHz and 3.7 GHz should be made newly available for mobile use within five years.[764] Furthermore, on June 28, 2010, the President issued an Executive Memorandum calling for 500 megahertz of new spectrum to be made available for wireless broadband use in the next ten years,[765] which was further expanded on in the recent State of the Union address.[766] The need for new spectrum was also underscored by an October 2010 Commission staff technical paper.[767] According to the paper, the current spectrum forecast demonstrates that the amount of mobile data demanded by American consumers is likely to exceed the capacity of wireless networks in the near-term, and that meeting this demand by making additional spectrum available is likely to create significant value for the mobile economy. Specifically, the paper finds that mobile broadband growth is likely to outpace the ability of technology and network improvements to keep up by an estimated factor of three, leading to a spectrum deficit that is likely to approach 300 megahertz within the next five years.[768] The paper also finds that "releasing an additional 275 megahertz of spectrum saves approximately $120

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[761] *See* Cricket Reply at 9-12; Free Press and Media Access Project Comments at 15-17; MetroPCS Comments at 16-24; NTCA Comments at 4-6; RCA Comments at 7; RTG Comments at 8-9; Sprint Nextel Comments at 35 Letter from Russell H. Fox, Mintz Levin, to Marlene H. Dortch, Secretary, FCC, WT Docket No. 10-133 (filed Dec. 2, 2010) (*T-Mobile Dec. 2, 2010 Ex Parte Letter*) at 2-3; USCC Reply at 4-10.

[762] *National Broadband Plan,* at 77.

[763] *Id.*

[764] *National Broadband Plan,* at 75-76. The *National Broadband Plan* contemplates that the 300-megahertz spectrum goal can be met by making the following spectrum available: 20 megahertz of WCS spectrum; 60 megahertz of AWS 2/3 spectrum; the 10 megahertz 700 MHz D Block; 90 megahertz of MSS spectrum; and 120 megahertz of spectrum to be reallocated from the broadcast television bands. *See id.* at 84, Exhibit 5-E.

[765] Memorandum for the Heads of Executive Departments and Agencies, *Unleashing the Wireless Broadband Revolution,* (Presidential Memorandum), rel. June 28, 2010, 75 Fed. Reg. 38387, *available at* http://www.whitehouse.gov/the-press-office/presidential-memorandum-unleashing-wireless-broadband-revolution.

[766] *See* "President Obama Details Plan to Win the Future through Expanded Wireless Access", available at http://www.whitehouse.gov/the-press-office/2011/02/10/president-obama-details-plan-win-future-through-expanded-wireless-access, visited Feb. 10, 2011.

[767] *See* Federal Communications Commission Staff Technical Paper, *Mobile Broadband: The Benefits of Additional Spectrum*, Oct. 2010 (*FCC Mobile Broadband Paper*). In addition, on October 21, 2010, the Commission hosted a spectrum summit highlighting the need to make additional spectrum available for mobile broadband use and addressing potential ways to ensure America has the spectrum resources necessary to realize the full benefits of mobile broadband services. A video recording of the summit is available at http://reboot.fcc.gov/workshops/spectrum-summit.

[768] *FCC Mobile Broadband Paper,* at 17-19.

billion in capital expenses to accommodate mobile data demand."[769]

268. In October 2010, the Department of Commerce's National Telecommunications and Information Administration (NTIA) released two complementary reports describing efforts to make additional spectrum available for mobile and fixed broadband commercial use: a Ten-Year Plan and Timetable,[770] as well as a Fast Track Evaluation report identifying 115 megahertz of spectrum to be made available within five years.[771] The Ten-Year Plan and Timetable, developed in collaboration with the Commission and other Federal agencies, identifies over 2,200 megahertz of Federal and non-Federal spectrum that will be evaluated for potential opportunities for wireless broadband use.[772] It also describes the process for evaluating these candidate bands and the steps necessary to make the selected spectrum available for wireless broadband services.[773] In its Fast Track Evaluation report, NTIA examines four spectrum bands for potential reallocation within five years – 1675-1710 MHz, 1755-1780 MHz, 3500-3650 MHz, and 4200-4220/4380-4400 MHz – and recommends that various portions of these bands totaling 115 megahertz be made available for wireless broadband use within five years, contingent upon the allocation of resources for necessary reallocation activities.[774] NTIA has recently selected the 1755 – 1850 MHz spectrum band for a detailed evaluation of whether it can be repurposed for commercial mobile broadband use based on a variety of factors, including industry interest and its potential for commercial use within ten years.[775] In addition, a recent Presidential Memorandum directed NTIA, and encouraged the FCC, to collaborate to make available a total of 500 megahertz of federal and non-federal spectrum over the next ten years, suitable for both mobile and fixed wireless broadband use.[776]

269. Currently, mobile wireless operators primarily use licenses associated with three different frequency bands to provide mobile voice and, in most cases, mobile data services: Cellular (in the 850 MHz band), SMR (in the 800/900 MHz band), and broadband PCS (in the 1.9 GHz band). Over the past several years, additional spectrum bands have become available – BRS and EBS in the 2.5 GHz band,

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[769] *FCC Mobile Broadband Paper*, at 20. The paper notes that this value "is likely to be offset somewhat by the costs of acquiring and making use of new spectrum." *Id.* at 21.

[770] *See* Department of Commerce, *Plan and Timetable to Make Available 500 Megahertz of Spectrum for Wireless Broadband*, Oct. 2010, *available at* http://www.ntia.doc.gov/reports/2010/TenYearPlan_11152010.pdf. (*Plan and Timetable to Make Available 500 Megahertz of Spectrum for Wireless Broadband*).

[771] *See* Department of Commerce, *An Assessment of the Near-Term Viability of Accommodating Wireless Broadband Systems in the 1675-1710 MHz, 1755-1780 MHz, 3500-3650 MHz, and 4200-4220, 4380-4400 MHz Bands*, Oct. 2010, *available at* http://www.ntia.doc.gov/reports/2010/FastTrackEvaluation_11152010.pdf.

[772] *See Plan and Timetable to Make Available 500 Megahertz of Spectrum for Wireless Broadband.* Of the 2,200 megahertz of candidate spectrum that the Ten-Year Plan and Timetable identify, 28 percent is allocated exclusively for Federal use at present, 35 percent is allocated exclusively for commercial use, and 37 percent is shared by Federal and commercial users. The 2,200 megahertz includes 280 megahertz of commercial spectrum that the Commission recommended in the *National Broadband Plan* to be made available for mobile broadband use within five years.

[773] *See Plan and Timetable to Make Available 500 Megahertz of Spectrum for Wireless Broadband.*

[774] *See* Department of Commerce, *An Assessment of the Near-Term Viability of Accommodating Wireless Broadband Systems in the 1675-1710 MHz, 1755-1780 MHz, 3500-3650 MHz, and 4200-4220, 4380-4400 MHz Bands*, Oct. 2010, *available at* http://www.ntia.doc.gov/reports/2010/FastTrackEvaluation_11152010.pdf.

[775] *See NTIA Takes Next Step in 500 MHz Wireless Broadband Initiative*, Press Release, NTIA Jan 31. 2011, *available at* http://www.ntia.doc.gov/press/2011/500mhzstatement_02012011.html.

[776] The spectrum must be available to be licensed by the FCC for exclusive use or made available for shared access by commercial and Government users in order to enable licensed or unlicensed wireless broadband technologies to be deployed. "Presidential Memorandum: Unleashing the Wireless Broadband Revolution," June 28, 2010, *available at* http://www.whitehouse.gov/the-press-office/presidential-memorandum-unleashing-wireless-broadband-revolution.

AWS in the 1.7/2.1 GHz band, the 700 MHz band, and WCS in the 2.3 GHz band – which are beginning to enable the provision of additional competitive mobile voice and data services. By examining the history of the available frequency bands and associated service rules, it is possible to trace the growth of the mobile wireless industry and the introduction of new competition in the mobile wireless marketplace.[777]

(i) Frequency Bands

270. *Cellular.* The Commission began licensing Cellular spectrum in 1982, eventually making a total of 50 megahertz available. The band was divided into two blocks, licensed by Cellular Market Area (CMA). At the time of initial licensing, one of the two Cellular channel blocks in each market was awarded to a local incumbent wireline carrier, while the other block was awarded to another entity in order to promote competition. The Commission completed licensing the majority of Cellular operators in 1991. Cellular licensees provided the first widely-used mobile services.[778] Historically, they have held much of the share of mobile services provided in most markets across the country.

271. *SMR.* By the early 1990s, mobile voice services were also provided using approximately 20 megahertz of SMR spectrum in the 800 and 900 MHz bands. The Commission had established SMR in 1974 to provide for land mobile communications on a commercial basis. The Commission initially licensed SMR spectrum in non-contiguous bands, on a site-by-site basis.[779] The Commission has since licensed additional SMR spectrum on an EA basis, through the auction process. Although the primary use for SMR traditionally was dispatch services,[780] providers such as Nextel acquired significant amounts of SMR spectrum and were successful in launching mobile telephony services in the 1990s, competing with licensees using Cellular spectrum in the provision of mobile telephony services.[781]

272. *Broadband PCS.* Between 1995 and 1999, the Commission auctioned 120 megahertz of broadband PCS, in different bandwidths and licensing areas, in the 1850-1910 MHz and 1930-1990 MHz bands. More efficient digital wireless technologies had been developed, an advance over existing analog cellular networks. This newly available spectrum facilitated the growth and development of a more competitive mobile wireless marketplace. By 1998, 87 percent of the U.S. population (by Basic Trading Area) was covered by three or more providers, and 54 percent by five or more providers;[782] by 2009, 96 percent of the U.S. population (by census block) was covered by three or more providers, and 74 percent by five or more.[783] Between 1995 and 2008, the price per minute of mobile wireless service dropped 84 percent,[784] while the number of subscribers increased over 700 percent.[785] With increased competition

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[777] A more detailed description of spectrum available for mobile wireless service is provided in Appendix A. There are other bands – including 1670-1675 MHz and 901-902 MHz (Narrowband PCS) – that are licensed under the Commission's flexible Part 27 or Part 24 rules and can be used to provide CMRS. Appendix A also includes a discussion of the 3650-3700 MHz band, which can be used to provide wireless broadband service.

[778] See *Third Report*, 13 FCC Rcd at 19749, 19779, pp. 3, 29.

[779] The "900 MHz" SMR band refers to spectrum allocated in the 896-901 and 935-940 MHz bands; the "800 MHz" band refers to spectrum allocated in the 806-824 and 851-869 MHz bands. *See* 47 C.F.R. § 90.603; *see also* 47 C.F.R. § 90.7 (defining "specialized mobile radio system").

[780] Dispatch services allow two-way, real-time, voice communications between fixed units and mobile 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). *See Fifth Report*, 15 FCC Rcd at 17727-28, for a detailed discussion.

[781] Nextel and Sprint combined their spectrum holdings in a merger completed in 2005, becoming Sprint Nextel Corporation. *See* http://www.sprint.com/companyinfo/history/ (visited Oct. 27, 2010).

[782] *See Third Report*, 13 FCC Rcd at 19768, Table 3A.

[783] *See Fourteenth Report*, 25 FCC Rcd at 11448, Table 4.

[784] *See Id.* at 11532, Table 19.

came increased innovation: broadband PCS service providers offered new pricing plans, introduced smaller handsets with increased functionality, and facilitated mass market acceptance of mobile wireless service. Cumulative investment in the industry more than tripled from $19 billion to over $70 billion from 1994 to 2000,[786] and the number of cell sites more than quadrupled, from 18,000 to over 80,000.[787]

273. *BRS and EBS.* In 2004, the Commission adopted revisions to the rules and band plan governing BRS and EBS in the 2.5 GHz band that better facilitated the use of this spectrum, 73.5 megahertz of BRS and 112.5 megahertz of EBS, for mobile and fixed broadband services.[788] Since then, BRS and EBS licensees have been transitioning to the revised band plan, a process that is nearly complete. In 2008, Clearwire began deploying mobile broadband services using this spectrum in various markets across the country.[789]

274. *AWS.* In 2006, the Commission auctioned a total of 90 megahertz of AWS spectrum. Since 2008, several licensees, including T-Mobile and Leap, have deployed mobile wireless services using AWS spectrum across the country.[790] In the fourth quarter of 2010, MetroPCS and Cox Communications launched LTE and CDMA EV-DO networks, respectively, using their AWS licenses.[791] In addition, AT&T has announced that it plans to use both the AWS and 700 MHz spectrum bands for its LTE deployment.[792] Other major holders from the 2006 auction (*e.g.* Verizon Wireless and SpectrumCo) have not yet announced deployment plans for this spectrum.

275. *700 MHz.* The auctions of 700 MHz spectrum between 2002 and 2008, combined with the completion of the Digital Television transition in June 2009, have made an additional 74 megahertz of spectrum available for mobile and fixed commercial services.[793] Of this total, 58 megahertz is paired spectrum with sufficient channel widths to support mobile broadband. Beginning in December 2010, Verizon Wireless launched LTE services in this band.[794] In addition, AT&T has announced that it plans to deploy LTE in 2011-2013 using its 700 MHz and AWS spectrum, with its LTE network initially covering 75 million POPs by mid-2011.[795] In addition, AT&T announced in December 2010 that it has agreed to purchase licenses in the Lower 700 MHz D and E blocks from Qualcomm to deploy as a

(Continued from previous page)

[785] *See id.* at 11642, Table C-1.

[786] *CTIA Year-End 2008 Wireless Indices Report*, at 126.

[787] *Id.* at 150.

[788] On October 30, 2009, the Commission completed Auction 86, which offered 78 BRS licenses: 75 licenses covering various Basic Trading Areas (BTAs), including one partial BTA, and 3 licenses covering BRS service areas in the Gulf of Mexico. The Commission completed the auction. *See* "Auction of Broadband Radio Service Licenses Closes; Winning Bidders Announced for Auction 86," *Public Notice*, 24 FCC Rcd 13572 (2009).

[789] *See* Section IV.B.1, Service Provider Technology Deployments, *supra.*

[790] As of mid-2010, T-Mobile's HSPA network covered 212 million people, and its HSPA+ (21 Mbps) network covered 85 million people. *See* Section IV.B.1.a, Service Provider Technology Deployments, *supra.*

[791] *See* Sections IV.B.1, Service Provider Technology Deployments and III.E.1, Entry, *supra.*

[792] *See* Section IV.B.1.a, Service Provider Technology Deployments, *supra.*

[793] The 74 megahertz includes 4 megahertz of spectrum in the 700 MHz Guard Bands, which are not included in Table 26. Portions of the lower 700 MHz band were auctioned previously in Auctions 44, 49, and 60. *See Tenth Report*, 20 FCC Rcd at 15940, ¶ 80. The Digital Television transition ensured that the 700 MHz spectrum was cleared of broadcast use, and thus made available for commercial mobile services, no later than June 12, 2009.

[794] *See* Section IV.B.1.a, Service Provider Technology Deployments, *supra*, for a discussion of technological deployments in recently-licensed mobile wireless frequency bands.

[795] *Id.* AT&T expects to complete its LTE network deployment by 2013.

supplemental downlink for mobile broadband services.[796]

276. *Wireless Communications Service (WCS).* In May 2010, the Commission adopted final rules for WCS that modified the technical parameters governing the operation of WCS mobile and portable devices in 25 megahertz of spectrum in the 2.3 GHz band.[797] The revised rules will enable WCS licensees to offer mobile broadband services, while limiting the potential for harmful interference to incumbent Satellite Digital Audio Radio Service licensees operating in adjacent bands.[798]

Table 26
Spectrum Potentially Usable for Mobile Wireless Services[799]

Spectrum Band	Megahertz (Rounded)
Cellular	50
SMR*	26.5
Broadband PCS	120
AWS-1	90
700 MHz	70
2.5 GHz (includes BRS and EBS**)	74 (BRS) and 113 (EBS)
WCS	25
1.4 and 1.6 GHz	13
1910-15/1990-95 MHz***	10

* Including 19 megahertz of SMR spectrum and 7.5 megahertz of spectrum that is available for SMR as well as other services, *see* Appendix A, para. 4 on SMR spectrum
** BRS and EBS spectrum is calculated based on the post-transition band plan described in 47 C.F.R. §27.5(i)(2). EBS licenses must be held by educational institutions; however, EBS licensees can lease a significant portion of their spectrum to commercial operators.
*** Held by Sprint Nextel as a result of the 800 MHz Band Reconfiguration.

277. *Other Spectrum Bands.* Other spectrum bands that may later be used for the provision of mobile voice and broadband services include spectrum in the MSS spectrum bands, which are discussed above in Section III.B.4 of the *Report*.[800] The *National Broadband Plan* recommended that the Commission take steps to accelerate terrestrial broadband deployment in 90 megahertz of spectrum in the three MSS bands (the 2 GHz, the L-band, and the Big LEO band),[801] and the Commission has

[796] AT&T, *AT&T Agrees to Acquire Wireless Spectrum from Qualcomm,* Press Release, Dec. 20, 2010.

[797] *See* Amendment of Part 27 of the Commission's Rules to Govern the Operation of Wireless Communications Services in the 2.3 GHz Band, WT Docket No. 07-293, *Report and Order*, released May 20, 2010. The WCS band has a total of 30 MHz spectrum at 2305-2320 MHz and 2345-2360 MHz. *Id.* However, WCS mobile and portable devices are not permitted to operate in the 2.5-megahertz portions of the WCS C and D blocks closest to the SDARS band (*i.e.*, 2317.5-2320 and 2345-2347.5 MHz). *Id.*

[798] *See* Amendment of Part 27 of the Commission's Rules to Govern the Operation of Wireless Communications Services in the 2.3 GHz Band, WT Docket No. 07-293, *Report and Order*, released May 20, 2010.

[799] This table only includes the terrestrial, flexible use frequency bands discussed in this section of the *Report*. As discussed above and below, the Commission is taking steps to make additional MSS spectrum available for new investment in mobile broadband networks while also ensuring that the United States maintains robust MSS capabilities. *See* Section III.B.4, Mobile Satellite Service Providers, *supra*.

[800] *See* Section III.B.4, Mobile Satellite Service Providers, *supra*, for a discussion of MSS. Some of the service rules governing MSS bands are currently the subject of a rulemaking and notice of inquiry proceeding before the Commission. *See MSS NPRM* and *MSS NOI*.

[801] *See National Broadband Plan*, at 87.

commenced a proceeding and adopted a Report and Order.[802] LightSquared, for example, plans to offer LTE and satellite connectivity, on a wholesale basis, to other wireless network operators, cable operators, consumer electronics companies, and other technology companies, with coverage through its terrestrial network extending to at least 100 million U.S. POPs by the end of 2012.[803] Also potentially available for mobile wireless services are the 1.4 GHz band and the 1670-1675 MHz band.[804] These bands are not discussed further here because, as yet, services offered in these bands do not impact competition in mobile wireless services.

(ii) Facilitating Access to Spectrum Among Multiple Providers

278. In addition to increasing the availability of commercial mobile wireless spectrum, the Commission has had different policies relating to service and technical rules, licensing and assignment, and spectrum aggregation that have affected market entry. We discuss here several prominent Commission policies that have affected spectrum holdings over the past two decades.

279. *Flexible Use Policies.* Initially, the Commission's rules restricted the use of Cellular spectrum to analog service. More recently, the Commission has adopted a general policy of providing licensees with significant flexibility to decide which services to offer and what technologies to deploy on spectrum used for the provision of mobile wireless services. For example, licensees have the flexibility to deploy next-generation wireless technologies that allow them to offer high-speed mobile data services using their existing spectrum.[805]

280. *Spectrum Aggregation.* The Commission has adopted different policies through the years with regard to aggregation of commercial mobile spectrum. As mentioned above, when first licensing 50 megahertz of Cellular spectrum, the Commission required that two different Cellular licensees serve each local market in order to promote competition between mobile telephony providers. In 1994, as the Commission prepared to make an additional 120 megahertz of spectrum available through broadband PCS auctions, it adopted a CMRS spectrum cap as a means to preserve competitive opportunities in the mobile communications marketplace, retain incentives for innovation, and promote the efficient use of spectrum.[806] Under these CMRS spectrum aggregation limits, which were modified in 1999, no entity could control more than 45 megahertz out of 180 megahertz of Cellular, SMR, and broadband PCS spectrum in any given cellular market.[807] The Commission eliminated the spectrum cap beginning in

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[802] *See* Section III.B.4, Mobile Satellite Service Providers, *supra.*

[803] *See* Section IV.B.1.a, Service Provider Technology Deployments, *supra.*

[804] *See* Appendix A for additional discussion of the 1.4 GHz band and the 1670-1675 MHz band.

[805] 47 C.F.R § 24.3.

[806] Implementation of Sections 3(n) and 332 of the Communications Act, *Third Report and Order*, 9 FCC Rcd 7988, 7999, 8100-8110, ¶¶ 16, 238-265 (1994) (*CMRS Third Report and Order*). In adopting spectrum aggregation limits, the Commission was "recognizing the possibility that mobile service licensees might exert undue market power or inhibit market entry by other service providers if permitted to aggregate large amounts of spectrum." *Id.* at 8100 ¶ 239. It stated that if firms were to aggregate sufficient amounts of spectrum, it is possible that they could unilaterally or in combination exclude efficient competitors, reduce the quality of service available to the public, and increase prices to the detriment of consumers. *Id.* at 8104 ¶ 248. *See also* Amendment of the Commission's Rules Regarding Installment Payment Financing for Personal Communication Services (PCS) Licensees, WT Docket No. 97-82, *Sixth Report and Order and Order on* Reconsideration, 15 FCC Rcd. 16266, 16275 ¶ 15 (2000) (adopting auction eligibility restrictions to set aside some PCS licenses for small businesses to ensure that these businesses are provided with opportunities to enter the marketplace).

[807] *CMRS Third Report and Order*, 9 FCC Rcd at 8105-8110, ¶¶ 252-265. See also 1998 Biennial Regulatory Review, Spectrum Aggregation Limits for Wireless Telecommunications Carriers, WT Docket No. 98-205, Report and Order, 15 FCC Rcd 9219, 9254-57 ¶¶ 80-84 (2000). The CMRS spectrum cap only covered services that had spectrum of 5 megahertz or more (thus excluding narrowband CMRS) in order to ensure that providers using the spectrum could compete with one another. *CMRS Third Report and Order*, 9 FCC Rcd at 8105 ¶ 252. The *CMRS* (continued....)

2003, moving instead to a case-by-case market analysis of proposed merger transactions to address potential competitive concerns if providers sought to aggregate their spectrum holdings in particular markets.[808]

281. *Spectrum Screen.* In 2004, the Commission adopted a "spectrum screen" to assist in its analysis of potential competitive concerns raised by transactions in which providers were aggregating spectrum. This screen identified particular markets in which the spectrum aggregation exceeded a pre-determined amount of spectrum, set at approximately one-third of the critical spectrum input.[809] In those markets, the Commission conducted further analysis to determine whether sufficient spectrum capacity would be available to other providers to compete effectively. In markets where this would not be the case, the Commission required divestiture of spectrum.[810] For purposes of its competitive analysis, the Commission evaluated whether particular spectrum bands were available and "suitable" for mobile wireless services by determining whether the spectrum was capable of supporting mobile services given its physical properties and the state of the equipment technology, whether the spectrum was licensed with a mobile allocation and corresponding service rules, and whether the spectrum was committed to another use that effectively precluded its use for "mobile telephony" service.[811] At that time, the Commission included only Cellular, SMR,[812] and PCS spectrum in its "spectrum screen" analysis. Since then, however, that Commission periodically has modified its spectrum screen as additional spectrum – including 700 MHz,[813] AWS-1,[814] and BRS spectrum[815] – has become available.[816] The Commission also

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Third Report and Order calculated that PCS, Cellular, and SMR account for approximately 189 megahertz, which included 120 megahertz of broadband PCS spectrum, 50 megahertz of Cellular spectrum, and 19 megahertz of SMR spectrum. 9 FCC Rcd at 8108 ¶ 258. However, under the CMRS spectrum cap rules, no more than 10 megahertz of SMR spectrum could be attributed to any one licensee, making 180 megahertz the total pool of spectrum for the CMRS spectrum cap. *See* 47 C.F.R. § 20.6(b); 2000 Biennial Regulatory Review Spectrum Aggregation Limits for Commercial Mobile Radio Services, *Notice of Proposed Rulemaking*, 16 FCC Rcd 2763, 2764 ¶ 2 (2001); *CMRS Third Report and Order*, 9 FCC Rcd at 8113-14 ¶ 275. In 1999, the Commission raised the CMRS spectrum cap to 55 megahertz in rural market areas (RSAs). Biennial Regulatory Review, Spectrum Aggregation Limits for Wireless Telecommunications Carriers, *Report and Order*, 15 FCC Rcd 9219, 9256-57 (1999).

[808] *See* 2000 Biennial Regulatory Review – Spectrum Aggregation Limits for Commercial Mobile Radio Services, WT Docket No. 01-14, *Report and Order*, 16 FCC Rcd 22668, 22669-71 ¶¶ 2-6 (2001) (*Second Biennial Review Order*). The Commission also raised the spectrum cap to 55 megahertz in all markets during the sunset period. *Id.* at 22671 ¶ 6.

[809] Applications of AT&T Wireless Services, Inc. and Cingular Wireless Corporation For Consent to Transfer Control of Licenses and Authorizations, *Memorandum Opinion and Order*, 19 FCC Rcd 21522, 21568-69 ¶ 109 (2004).

[810] *Id.* at 21620-21 ¶ 255.

[811] *Id.* at 21534-35 ¶ 26.

[812] *See Ninth Report,* 19 FCC Rcd at 20633-34 ¶ 89 & n.197; *see also* Applications of Nextel Communications, Inc. and Sprint Corporation, WT Docket No. 05-63, *Memorandum Opinion and Order*, 20 FCC Rcd 13967, 13992 n.155; Applications of AT&T Wireless Services, Inc., Transferor, and Cingular Wireless, Corp., Transferee, *Memorandum Opinion and Order*, 19 FCC Rcd 21522, 21561 ¶ 81 (2004).

[813] *Id.* at ¶ 31.

[814] *Sprint Nextel-Clearwire Order*, 23 FCC Rcd at 17596-17600, ¶¶ 61-73. For purposes of this spectrum screen, AWS-1 is considered available in those markets where it has been cleared of governmental and non-governmental incumbent users such that it is available for the deployment of mobile wireless services. *See Sprint/Clearwire Order*, 23 FCC Rcd at 17599 ¶ 72.

[815] Most BRS spectrum is considered available in those markets where the transition of BRS spectrum to the new band plan has been completed. *Sprint/Clearwire Order*, 23 FCC Rcd at 17598-99 ¶ 70. EBS spectrum, which is licensed to educational institutions and can be leased to commercial operators, is not included in the Commission's spectrum screen when evaluating proposed transactions. The Commission has not to date included EBS spectrum in (continued....)

has recognized that the mobile services marketplace – including the product market – has evolved, and in 2008 revised its spectrum screen analysis by examining a combined product market for both mobile telephony services and mobile broadband services.[817]

282. *Secondary Market Transactions and Spectrum Leasing.* The Commission also has adopted secondary market policies to facilitate spectrum access. Subject to the Commission's approval, which includes review of spectrum aggregation for potential competitive harm, licensees may buy and sell licenses, in whole or in part (through partitioning and/or disaggregation), on the secondary market. In 2003, as part of its secondary market policies, the Commission adopted rules to permit mobile wireless licensees to lease all or a portion of their spectrum usage rights for any length of time within the license term, and over any geographic area encompassed by the license.[818] Further, the Commission's secondary markets policies allow licensees to enter into "dynamic" leasing arrangements, where the licensee and spectrum lessee can share use of the same spectrum through the use of cognitive radio technologies.[819] The Commission's secondary market policies allow existing licensees to obtain additional spectrum capacity and expand their coverage areas to better meet the needs of their customers, while also providing new entrants with additional opportunities to access to spectrum so that they can compete. The *National Broadband Plan* recommended that the Commission spur further development and deployment of opportunistic uses across more radio spectrum.[820] Consistent with that recommendation, in November 2010 the Commission released a Notice of Inquiry seeking comment on the variety of ways in which dynamic spectrum access radios and techniques can promote more intensive and efficient use of the radio spectrum, and the potential that these technological innovations have for enabling more effective management of spectrum through use of secondary market arrangements.[821]

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its spectrum screen. As noted in recent orders, the primary purpose of EBS is to further the educational mission of accredited public and private schools, colleges, and universities. Moreover, while EBS licensees are allowed to lease excess capacity to commercial operators, leased spectrum is subject to various special requirements designed to maintain the primary educational character of services provided. In addition, other elements of the EBS licensing regime, such as its solely site-specific character, with the absence of any licensee in various unassigned EBS "white spaces," complicate the use of this spectrum for commercial purposes. *See id.* at 17599-600 ¶ 71; *Verizon Wireless-Alltel Order*, 23 FCC Rcd at 17479 ¶ 67.

[816] As discussed above, in reviewing proposed merger transactions that involve spectrum aggregation, the Commission examines market participants' holdings of suitable spectrum to ensure that there is sufficient spectrum available to competitors.

[817] *See Verizon Wireless-Alltel Order*, 23 FCC Rcd at 17469-470, ¶¶ 45-47.

[818] *Ninth Report*, 19 FCC Rcd at 20631, ¶ 84.

[819] Promoting Efficient Use of Spectrum Through Elimination of Barriers to the Development of Secondary Markets, WT Docket No. 00-230, *Second Report and Order, Order on Reconsideration, and Second Further Notice of proposed Rulemaking*, 19 FCC Rcd 17503, 17547-49 ¶¶ 87-90 (2004) (*Secondary Markets Second R&O*); *700 MHz Second R&O*, 22 FCC Rcd at 15374-80, ¶¶ 231-248.

[820] *National Broadband Plan,* at 95-96.

[821] *See* Promoting More Efficient Use of Spectrum Through Dynamic Spectrum Use Technologies, ET Docket No. 10-237, *Notice of Inquiry*, FCC 10-198 (rel. Nov. 30, 2010), ¶ 2. The NOI first inquires into the current state of development of dynamic spectrum access technologies, including spectrum sensing and other dynamic spectrum sharing capabilities and techniques. The NOI also requests information on how the Commission can promote the development of these technologies, such as the establishment of dynamic access radio test-beds, and how these radios and spectrum management techniques may be deployed in the future for use on both a licensed and an unlicensed basis. In addition, the NOI seeks comment on whether there are additional steps the Commission should take to improve its "Spectrum Dashboard," how spectrum used through secondary market arrangements could employ dynamic spectrum access radios and techniques, and whether the database access model applicable to unlicensed Television Band Devices might be deployed in other spectrum bands. *Id.*

b. Current Spectrum Transactions

283. Aside from the larger, high profile transactions, there has been a recent increasing trend of smaller transactions involving applications to transfer or assign spectrum licenses involving national or regional service providers.[822] While some of these transactions include minimal network and customer assets as small providers exit, many transactions involve spectrum licenses only.[823] Some licensees transferring their spectrum licenses in these routine transactions are completely exiting while others are selling their licenses in certain geographic areas and retaining their remaining licenses in other geographic areas. For example, in 2010, AT&T filed an application to acquire PCS licenses from Von Donop Inlet PCS, LLC (Von Donop). This application included an assignment of spectrum in nine BTAs and encompassed 37 counties in eight states, and the sale left Von Donop with no wireless assets.[824] Other transactions involved the swap of spectrum licenses among service providers that retained some wireless assets post-transaction.

284. In 2009, all such transactions were spectrum licenses only. AT&T filed applications associated with 12 separate transactions through which it acquired PCS, AWS, and 700 MHz licenses in various geographical areas throughout the United States from licensees who had not yet built out these licenses.[825] Verizon Wireless also filed applications for eight transactions to acquire Cellular and PCS spectrum rights from licensees who had not yet built out these licenses.[826] Among the nationwide service providers, there were swap agreements involving PCS spectrum between T-Mobile and Sprint Nextel and between T-Mobile and Verizon Wireless.[827]

285. In the first ten months of 2010, these trends continued. AT&T filed applications for ten transactions to acquire Cellular, PCS, AWS-1, and 700 MHz licenses from small licensees, while Verizon Wireless filed applications for four transactions to acquire PCS and 700 MHz licenses from small licensees.[828] Also, in the first ten months of 2010, Sprint-Nextel filed to acquire PCS spectrum from Wirefree.[829] Additionally, three sets of swap applications were filed in the first ten months of 2010: AT&T and MetroPCS filed two sets of swap applications for AWS-1 licenses[830] and T-Mobile and Sprint

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[822] Transfer and assignment applications for CMRS spectrum are also regularly filed by smaller licensees, including licensees acquiring spectrum from one of the four nationwide service providers. Applications discussed herein reflect applications that the Commission has found acceptable for filing during 2009 and the first ten months of 2010.

[823] *See* Section III.E.2, Exit, *supra*.

[824] *See* ULS File No. 0004212012, consummated Oct. 29, 2010. *See also* Union Telephone Company which assigned 5 of its 18 lower 700 MHz licenses to AT&T in 2009. *See* ULS File No. 0003682956, consummated Apr. 15, 2009.

[825] *See* Public Notice, Wireless Telecommunications Bureau, Assignment of License Authorization Applications, Transfer of Control of Licensee Applications, and De Facto Transfer Lease Applications, and Designated Entity Reportable Eligibility Event Applications Accepted for Filing, 2009 ("*2009 Accepted for Filing PNs*").

[826] *2009 Accepted for Filing PNs*.

[827] Sprint/T-Mobile Swap Applications - *see* Public Notice, Wireless Telecommunications Bureau, Assignment of License Authorization Applications, Transfer of Control of Licensee Applications, and De Facto Transfer Lease Applications, and Designated Entity Reportable Eligibility Event Applications Accepted for Filing, ("WTB Accepted for Filing PN") rel. Aug. 19, 2009; Verizon Wireless/T-Mobile Swap Applications - *see* WTB Accepted for Filing PN, rel. Oct 21, 2009.

[828] *See* Public Notice, Wireless Telecommunications Bureau, Assignment of License Authorization Applications, Transfer of Control of Licensee Applications, and De Facto Transfer Lease Applications, and Designated Entity Reportable Eligibility Event Applications Accepted for Filing, 2010 ("2010 Accepted for Filing PNs").

[829] *See* WTB Accepted for Filing PN, rel. July 21, 2010.

[830] *See* WTB Accepted for Filing PN, rel. Mar. 3, 2010.

filed swap applications for PCS licenses.[831] During the first ten months of 2010, 13 out of the 16 transactions discussed above were spectrum-only.[832] The analyses of spectrum holdings below do not reflect the recent spectrum-only transactions described in this section.

c. Analysis of Spectrum Holdings Overall

286. Because access to spectrum is necessary for the provision of mobile wireless service, the different spectrum holdings of major providers potentially affect their ability to compete effectively. These spectrum holdings include licenses obtained when the spectrum was first licensed for mobile services, such as through the original Cellular assignments or through the auction process (*e.g.*, PCS, AWS, or 700 MHz spectrum), as well as spectrum obtained through various secondary market transactions. As the tables and charts below illustrate,[833] several wireless providers hold significant amounts of spectrum that is usually considered viable for mobile service, although SMR spectrum is not currently suitable for the provision of mobile broadband data services.[834]

287. Verizon Wireless and AT&T each hold significant amounts of 700 MHz, Cellular, broadband PCS, and AWS spectrum. Sprint Nextel has substantial holdings of PCS licenses, as well as the SMR spectrum acquired through its merger with Nextel in 2005. T-Mobile's spectrum holdings are in both the PCS and AWS bands.[835] Uniquely, the spectrum holdings of Clearwire, which is affiliated with Sprint Nextel,[836] fall in the 2.5 GHz band – where it holds the predominant amount of BRS spectrum, and has access to much of the EBS spectrum through spectrum leasing arrangements.[837] Regional provider US Cellular holds Cellular, PCS, and AWS licenses, while MetroPCS and Leap chiefly hold PCS and AWS spectrum. Finally, as the charts below reveal, smaller providers also hold Cellular, 700 MHz, PCS, and AWS licenses, primarily in the less populated parts of the United States.

288. Five providers together – Verizon Wireless, AT&T, T-Mobile, as well as Sprint Nextel and Clearwire – hold more than 80 percent of all spectrum, measured on a MHz-POPs basis, that is potentially usable for the provision of mobile wireless services (see Table 27). Table 28 shows megahertz holdings for each provider, weighted by population. Finally, Chart 38 is a graph of providers' spectrum holdings by frequency band, measured on a MHz-POPs basis.

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[831] *See* WTB Accepted for Filing PN, rel. Mar. 3, 2010.

[832] *See* Section III.E.2, Exit, *supra* for an analysis of the transactions that also involved customer transition issues and the exit of the associated firms.

[833] *See infra* Tables 27-28 and Charts 37-39. The data in these tables and charts generally reflect transactions consummated through September 30, 2010. The data reflect the sale of divestiture assets required as part of the Verizon Wireless-Alltel and AT&T-Centennial transactions. The data in these tables do not include MSS spectrum holdings. Nor do they include WCS spectrum holdings. WCS spectrum is currently licensed to several providers, including AT&T, Horizon Wi-Com, NextWave, NTELOS, Sprint Nextel, and Windstream. Additional information on WCS licensees can be accessed using the Spectrum Dashboard located on the Commission's website, *available at* www.fcc.gov/spectrumdashboard.

[834] *See* Para 290, *infra* (discussing limitations on the use of SMR spectrum for broadband service).

[835] SunCom Wireless License Company, LLC, a wholly owned subsidiary of T-Mobile, holds a Cellular license for CMA629-South Carolina 5-Georgetown (call sign KNKN557).

[836] *See* Section III.E.1, Entry, *supra*. Sprint Nextel holds a 54 percent interest in Clearwire, and has the ability to nominate seven of Clearwire's thirteen directors.

[837] As noted above, while EBS licensees may lease excess capacity to commercial operators, various elements of the EBS licensing regime complicate the use of EBS spectrum for commercial purposes. *See supra* note 815.

Table 27
Percentage Spectrum Holdings, Measured on a MHz-POPs Basis by Provider, by Frequency Band*

Licensee	700 MHz	Cellular (850 MHz)	SMR (800/900 MHz)	PCS (1.9 GHz)	AWS (1.7/2.1 GHz)	BRS (2.5 GHz)	EBS Leases (2.5 GHz)
Verizon Wireless	42.8%	47.7%	0.0%	15.1%	14.9%	0.0%	0.0%
AT&T	24.4%	43.6%	0.0%	26.1%	7.9%	0.0%	0.0%
Sprint Nextel	0.0%	0.0%	93.0%	26.8%	0.0%	0.0%	0.0%
Clearwire	0.0%	0.0%	0.0%	0.0%	0.0%	86.3%	62.0%**
T-Mobile	0.0%	0.0%***	0.0%	19.5%	27.4%	0.0%	0.0%
MetroPCS	0.5%	0.0%	0.0%	2.6%	9.2%	0.0%	0.0%
US Cellular	2.8%	4.4%	0.0%	1.8%	2.1%	0.0%	0.0%
Leap	0.0%	0.0%	0.0%	2.2%	8.7%	0.0%	0.0%
Other	29.5%	4.3%	7.0%	5.8%	29.8%	13.7%	38.0%
Grand Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

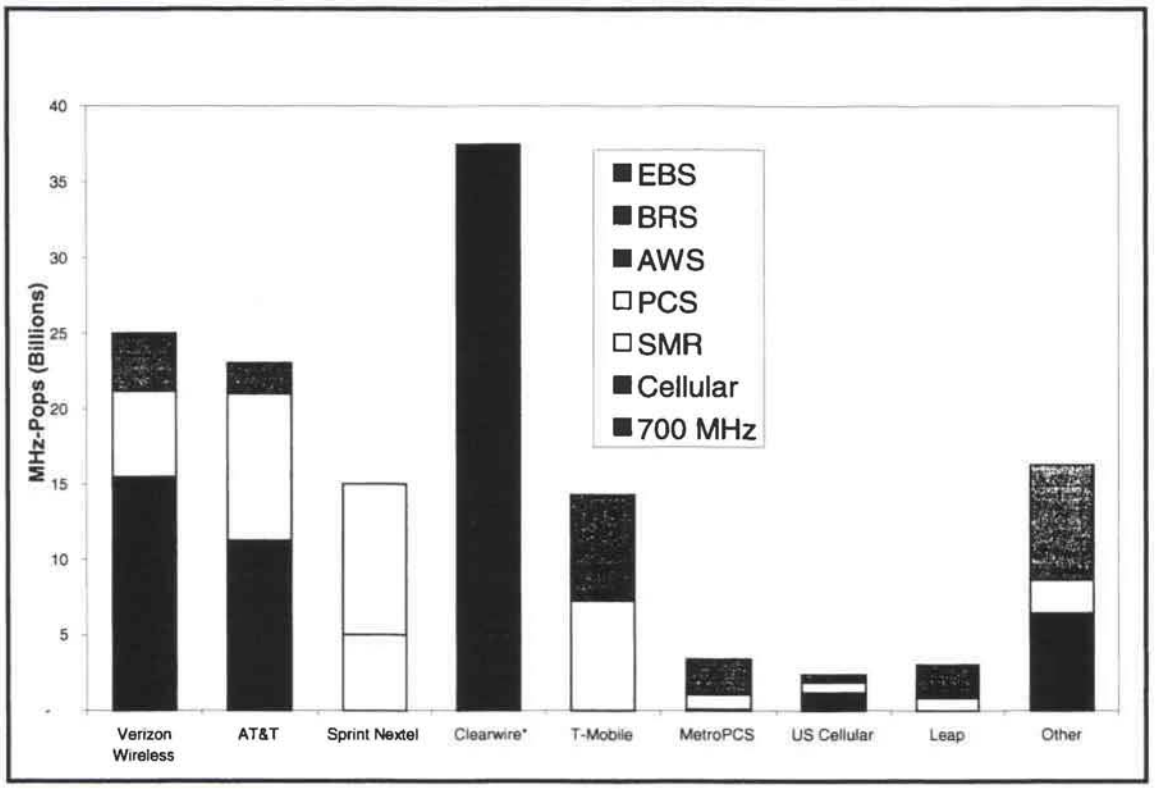
* These are estimates based on the available data.
** As noted above, while EBS licensees may lease excess capacity to commercial operators, various elements of the EBS licensing regime complicate the use of EBS spectrum for commercial purposes (*see* note 815).
*** SunCom Wireless License Company, LLC, a wholly owned subsidiary of T-Mobile, holds one Cellular license.

Table 28
Population-Weighted Average Megahertz Holdings* by Provider, by Frequency Band

Licensee	700 MHz	Cellular	SMR	PCS	AWS	BRS	EBS
Verizon Wireless	28.4	23.3	0.0	18.9	12.8	0.0	0.0
AT&T	16.2	21.3	0.0	32.5	6.8	0.0	0.0
Sprint Nextel	0.0	0.0	17.7	33.5	0.0	0.0	0.0
Clearwire	0.0	0.0	0.0	0.0	0.0	63.4	69.8
T-Mobile	0.0	0.0**	0.0	24.3	23.4	0.0	0.0
MetroPCS	0.3	0.0	0.0	3.2	7.9	0.0	0.0
US Cellular	1.8	2.1	0.0	2.3	1.8	0.0	0.0
Leap	0.0	0.0	0.0	2.8	7.4	0.0	0.0
Other	19.5	2.1	1.3	7.2	25.5	10.1	42.8

* Weighted average megahertz is the sum of the provider's MHz-POPs, divided by the U.S. population.
** SunCom Wireless License Company, LLC, a wholly owned subsidiary of T-Mobile, holds one Cellular license.

Chart 38
Mobile Wireless Provider Spectrum Holdings by Band, Weighted by Population



d. Analysis of Spectrum Holdings by Spectrum Characteristics

289. In addition to considering the quantity of spectrum to which providers have access, we also consider the characteristics of particular spectrum that is available for licensing and assignment. As discussed below, it has long been recognized throughout the mobile wireless industry that spectrum resources in different frequency bands can have widely disparate technical characteristics. Not only has the Commission recognized these differences in past proceedings, as discussed below, but regulators in other countries have also put forth policies taking these differences into account as additional spectrum becomes available.[838] As industry analysts, wireless providers, and others have noted, these different technical characteristics provide relative advantages for the deployment of spectrum in different frequency bands under certain circumstances. For instance, there is general consensus that the more favorable propagation characteristics of lower frequency spectrum allow for better coverage across larger geographic areas and inside buildings, while higher frequency spectrum may be well suited for adding capacity. Furthermore, some observers have noted important complementarities associated with a provider having access to spectrum in both the lower and higher frequency bands. We discuss below the technical differences between spectrum at lower and higher frequencies as well as the spectrum holdings of mobile wireless providers in both lower and higher frequency bands.

290. Two licensees may hold equal quantities of bandwidth but nevertheless hold very different spectrum assets. For example, as noted in the *National Broadband Plan*, broadband operations using SMR spectrum have not been shown to be viable pending completion of 800 MHz rebanding, given the interference protection provided to neighboring public safety operations.[839] In addition, the

[838] *See* footnote 336, *infra*.

[839] *See* National Broadband Plan, Chapter 5 n. 63; 47 CFR § 90.672.

commercial SMR spectrum in the 900 MHz band currently is interleaved with Business/Industrial/Land Transportation services, and thus is better suited for narrowband deployments.

291. In the United States, there are frequency bands suitable for mobile broadband services at very different frequencies: the 700 MHz and Cellular (850 MHz) bands fall below 1 GHz,[840] and the AWS, PCS, BRS, and EBS bands – at around 2 and 2.5 GHz – are well above 1 GHz. The different characteristics of these respective bands affect how they can be used to deliver mobile services to consumers. As discussed above, a number of commenters in this proceeding generally discuss the importance of access to spectrum to spur competition. In addition, several commenters note the particular importance of access to spectrum below 1 GHz.[841]

292. It is well established that lower frequency bands – such as the 700 MHz and Cellular bands – possess more favorable intrinsic spectrum propagation characteristics than spectrum in higher bands.[842] As a result, "low-band" spectrum can provide superior coverage over larger geographic areas, through adverse climates and terrain, and inside buildings and vehicles. Several commenters in this and related proceedings have noted the advantages of lower frequency spectrum for coverage in rural areas.[843] The Commission has also noted, in particular with respect to 700 MHz band spectrum, that lower frequency spectrum has "excellent propagation" characteristics that, in contrast to higher frequency bands such as PCS and AWS spectrum, "make it ideal for delivering advanced wireless services to rural areas."[844] In its consideration of mobile wireless competition issues, the DOJ has noted the differences

[840] In addition to the spectrum bands below 1 GHz authorized for licensed use, the Commission has recently taken steps to free up vacant spectrum between TV channels – called "white spaces" – for unlicensed use. *See* Unlicensed Operation in the TV Broadcast Bands, ET Docket No. 04-186, Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band, ET Docket No. 02-380, *Second Memorandum Opinion and Order*, FCC 10-174 (rel. Sept. 23, 2010) (*TVWS Second MO&O*).

[841] *See, e.g., T-Mobile Dec. 2, 2010 Ex Parte Letter* at 1-3, Attachment at 10-11. T-Mobile requests that the Commission "recognize the high value of spectrum below 1 GHz and the currently concentrated nature of the holdings in that band." *T-Mobile Dec. 2, 2010 Ex Parte Letter* at 1. T-Mobile also states that a mixture of low (below 1 GHz) and upper band spectrum is "important to building competitive high speed mobile broadband networks." *T-Mobile Dec. 2, 2010 Ex Parte Letter,* Attachment at 10-11. *See also* RCA Comments at 7 (asserting that "regional and rural carriers need near-term access to more ready to use, spectrum, particularly under 1 GHz"); Free Press and Media Access Project Comments at 16 (discussing the importance of greater access to spectrum, particularly below 1 GHz). Other commenters note that although spectrum below 1 GHz has superior propagation characteristics, providers with all types of spectrum continue to successfully deploy and upgrade their networks. *See* AT&T Comments at 25-26; Verizon Wireless Comments at 142-144.

[842] *See, e.g., 700 MHz Band Second R&O*, 22 FCC Rcd at 15349 ¶ 158, 15354-55 ¶ 176, 15400-401 ¶ 304 (recognizing the excellent propagation characteristics of 700 MHz band spectrum); *White Spaces Report and Order*, 23 FCC Rcd at 16807, 16820-21 ¶ 32 (propagation characteristics of the TV bands enable service at greater ranges than in the 2.4GHz band).

[843] *See, e.g., T-Mobile Dec. 2, 2010 Ex Parte Letter*, at 2, Attachment at 10-11 (lower frequency spectrum is advantageous in rural areas where topography and utility services can limit a provider's ability to "fill in" sites); Verizon Wireless Comments at 137 (stating that "[t]here is no dispute that lower band spectrum possesses propagation characteristics favorable for expanding coverage"); Letter from Joseph P. Marx, AT&T, to Marlene H. Dortch, Secretary, FCC, WT Docket No. 06-150 (filed Oct. 25, 2010), Attachment at 24; Letter from Kathleen O'Brien Ham, T-Mobile, to Marlene H. Dortch, Secretary, FCC, WT Docket No. 09-66 (filed Nov. 25, 2009) (*T-Mobile Nov. 25, 2009 Ex Parte Letter*), Attachment at 8-9; Letter from Kathleen O'Brien Ham, T-Mobile, to Marlene H. Dortch, Secretary, FCC, WT Docket No. 09-66 (filed Apr. 26, 2010) (*T-Mobile Apr. 26, 2010 Ex Parte Letter*); Letter from Tamara Preiss, Verizon Wireless, to Marlene H. Dortch, Secretary, FCC, WT Docket No. 09-66 (filed May 12, 2010) (*Verizon Wireless May 12, 2010 Ex Parte Letter*), at 2; Comcast Comments, GN Docket No. 09-157 (filed Sept. 30, 2009), at 9-12.

[844] *700 MHz Second R&O*, 22 FCC Rcd at 15349, ¶ 158. In the *TVWS Second MO&O*, the Commission noted that this particular spectrum has excellent propagation characteristics that allow signals to reach farther and penetrate walls and other structures. *Id.* at ¶ 1.

between the use of lower and higher frequency bands.[845] Furthermore, regulators in other countries have recognized the distinctive characteristics between lower and higher frequency bands. As lower frequency spectrum is becoming available for mobile services in other countries, some regulators have adopted or are considering policies intended to help facilitate the wider distribution of this newly available spectrum.[846]

293. More specifically, low-band spectrum can provide the same geographic coverage, at a lower cost, than higher-frequency bands, such as the 1.9 GHz PCS band, the 1.7/2.1 GHz AWS band, and the 2.5 GHz band.[847] A licensee that exclusively or primarily holds spectrum in a higher frequency range

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[845] *See* United States of America *et al.* v. Verizon Communications Inc. and ALLTEL Corporation, Competitive Impact Statement, Case No. 08-cv-1878, at 5-6 (filed Oct. 30, 2008), *available at* http://www.justice.gov/atr/cases/f238900/238947.pdf (". . . because of the characteristics of PCS spectrum, providers holding this type of spectrum generally have found it less attractive to build out in rural areas."); United States of America v. AT&T Inc. and Dobson Communications Corporation, Competitive Impact Statement, Case No. 1:07-cv-01952, at 5, 11, 13 (filed Oct. 30, 2007), *available at* http://www.justice.gov/atr/cases/f227300/227309.pdf (" . . . the propagation characteristics of [1900 MHz PCS] spectrum are such that signals extend to a significantly smaller area than do 800 MHz cellular signals. The relatively higher cost of building out 1900 MHz spectrum, combined with the relatively low population density of the areas in question, make it unlikely that competitors with 1900 MHz spectrum will build out their networks to reach the entire area served by" the two 800 MHz Cellular providers).

[846] For instance, in its auction of mobile spectrum conducted in April and May of 2010, Germany placed restrictions on the amount of sub-1GHz spectrum (in the 800 MHz band) that any mobile service provider could obtain, depending on how much sub-1 GHz spectrum a particular mobile provider already holds. *See Decision of the President's Chamber of the Federal Network Agency for Electricity, Gas, Telecommunications, Post, and Railway*, Oct. 16, 2009, at 6, 9 *available at* http://www.bundesnetzagentur.de/cae/servlet/contentblob/138364/publicationFile/3682/DecisionPresidentChamberTenor_ID17495pdf.pdf. The only participants in the auction were the four incumbent providers, with three of them – Deutsche Telekom, Vodafone, and O2 (Telefonica) – each acquiring 2 x 10 megahertz of 800 MHz band spectrum, while the fourth – E-Plus (KPN) – did not obtain any 800 MHz licenses. Michael Newlands, *Big Three Operators Happy with Low-Cost German Auction*, Policy Tracker, May 26, 2010. In March 2011, Ofcom in the United Kingdom (UK) proposed setting limits on the amounts of spectrum that bidders can win in its upcoming auction of spectrum in the 800 MHz and 2.6 GHz bands, and proposed establishing caps on total sub-1 GHz and overall mobile spectrum holdings of individual licensees. Under the proposal, Ofcom seeks to ensure that there are at least four companies that each have the minimum amount of spectrum "necessary to provide higher quality data services" as determined by five different spectrum holding combinations. In addition, Ofcom proposed to cap both total sub-1 GHz holdings and overall mobile spectrum holdings. *See Ofcom Prepares for 4G Mobile Auction*, Press Release, Ofcom, Mar. 22, 2011, *available at* http://media.ofcom.org.uk/2011/03/22/ofcom-prepares-for-4g-mobile-auction/; Ofcom, "Assessment of Future Mobile Competition and Proposals for the Award of 800 MHz and 2.6 GHz Spectrum and Related Issues," Mar. 22, 2011, *available at* http://stakeholders.ofcom.org.uk/consultations/combined-award/. The proposal was issued following a decision by the new coalition government of the UK in July 2010 to drop the previous government's spectrum cap requirements and grant Ofcom the responsibility for establishing any spectrum caps on 4G spectrum. David Meyer, *Government Sets Out 4G Spectrum Auction Plans*, ZDNet, July 28, 2010. On September 17, 2010, Irish Commission for Communications Regulation released a consultation paper proposing several options for spectrum cap for the 800 MHz band. *See* "Consultation Paper for 800 MHz, 900 MHz & 1800 MHz Spectrum Release," at 40-42, http://www.comreg.ie/_fileupload/publications/ComReg1071.pdf.

[847] *See* Section III.D, Entry and Exit Conditions, *supra* (a new entrant utilizing spectrum only in higher frequency bands may need to deploy more infrastructure, including cell sites, to cover the same land area and therefore incur higher cell site costs, compared to providers using lower band spectrum. One network cost study estimates that the total capital cost of deploying a single cell site, on average, can be upwards of $200,000). *See also* Peter Cramton, *700 MHz Device Flexibility Promotes Competition*, Aug. 9, 2010, at 2, *available at* http://www.cramton.umd.edu/papers2010-2014/cramton-700-mhz-device-flexibility-promotes-competition.pdf ("The 700 MHz and Cellular bands allow a region to be covered with many fewer cell sites and thus at much lower cost."); GSM World, *Impact of Spectrum Allocation*, http://www.gsmworld.com/our-work/public-policy/spectrum/digital-dividend/impact_of_spectrum_allocation.htm (visited Feb. 23, 2011) ("Operators need (continued....)

generally must construct more cell sites (at additional cost) than a licensee with primary holdings at a lower frequency in order to provide equivalent service coverage, particularly in rural areas. For example, T-Mobile estimates that build out of 700 MHz spectrum would require approximately 25 to 30 percent of the sites needed to build out a comparable geographic area using AWS-1 spectrum.[848] The National Institute of Standards and Technology (NIST) developed a propagation model comparing the 700 MHz, 1.9 GHz, and 2.4 GHz spectrum bands. It concluded that the favorable propagation characteristics meant that coverage using the same transmission power differed significantly, translating into the need for less infrastructure: while it required nine cells at 2.4 GHz and four cells at 1.9 GHz to span 100 meters squared, it was projected to require only one cell at 700 MHz.[849] Similarly, an analysis using the Okumura-Hata model shows that rural, suburban, and urban cell sizes at 700 MHz are more than three times larger than cells in the PCS band.[850]

294. In addition, many wireless providers, including Verizon Wireless and AT&T in other contexts, have recognized the relative advantages of deploying lower frequency spectrum in urban areas due to its superior in-building coverage characteristics.[851] For instance, in response to network issues stemming from its extensive introduction of smartphones, one of the key steps taken by AT&T to improve its network performance in large cities was modifying its network to put 3G traffic on its 850 MHz Cellular spectrum, which provided better in-building coverage than did its PCS spectrum.[852] In addition, according to one estimate from Verizon Wireless, spectrum in the 700 MHz and Cellular bands

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fewer cells at lower frequencies; 3G at 700 MHz needs about 30 percent of cells to offer the same coverage as 3G at 2100 MHz"); *Morgan Stanley Mobile Internet Report*, at 313-314 (lower spectrum allocations, such as 700 MHz spectrum, help lower capital expenditures by broadening reach); *T-Mobile Dec. 2, 2010 Ex Parte Letter* at 1-2 (cell sites using lower frequencies are capable of reaching more customers, which translates to lower capital costs); *T-Mobile Nov. 25, 2009 Ex Parte Letter*, Attachment at 8-9 (a network built using lower frequencies requires many fewer cell sites for the same coverage using higher frequencies).

[848] T-Mobile Comments, GN Docket No. 09-51 *et al.*, NBP PN #26, at 11 (filed Dec. 22, 2009).

[849] NIST, *700 MHz Band Channel Propagation Model*, http://www.nist.gov/itl/antd/emntg/700mhz.cfm (visited Apr. 29, 2010). *See T-Mobile Apr. 26, 2010 Ex Parte Letter* (stating that lower band spectrum is widely considered "beachfront" spectrum because of its propagation characteristics, and citing the NIST model).

[850] Okumura-Hata is a widely used RF propagation. *See* John S. Seybold, *Introduction to RF Propagation*, Wiley-Interscience, 2005.

[851] *See, e.g.*, Dan Mead, President and Chief Executive Officer, Verizon Wireless, News Conference at 2011 Consumer Electronics Show (Jan. 6, 2011), *available at* http://client.uvault.com/2491/010611/news/vod/start.php# (stating that 700 MHz spectrum is "the best spectrum for in-building coverage"); Lowell McAdam, President and Chief Operating Office, Verizon, Keynote Presentation at CTIA Enterprise & Applications Conference, Oct. 10, 2010, *available at* http://news.vzw.com/investor/20101006_transcript.pdf ("[with] 700 MHz, the in-building penetration is the best in the market"); John Stankey, President and CEO, AT&T Operations, Inc., Jan. 28, 2010 (Q4 2010 Earnings Call) (noting that 850 MHz Cellular spectrum is "very high quality with terrific propagation characteristics. It is very effective penetrating buildings...As customers make the shift to more data-intensive devices, we think this is important for the perceived quality of their overall experience"); *AT&T Invests Nearly $40 Million to Expand Wireless Capacity for Chicago's 3G Mobile Broadband Network*, Press Release, AT&T, Apr. 7, 2010 (discussing AT&T's deployment of 850 MHz spectrum, which can "better penetrate buildings," in the Chicago area in order to increase the coverage and capacity of its 3G network); *T-Mobile Dec. 2, 2010 Ex Parte Letter* at 2, Attachment at 10; Letter from Kathleen O'Brien Ham, T-Mobile, to Marlene H. Dortch, Secretary, FCC, WT Docket No. 09-66 (filed June 9, 2010) (*T-Mobile June 9, 2010 Ex Parte Letter*), at 3.

[852] AT&T, *What the 850 MHz Spectrum Can Do for You, available at* http://www.att.com/gen/press-room?pid=6209&cat=66&u=982 (AT&T videoblog discussing AT&T's use of an 850 MHz overlay in New York City to provide enhanced in-building coverage over 1900 MHz frequencies).

can provide in-building penetration approximately two to three times farther than that of spectrum in the PCS, AWS, and BRS bands.[853]

295. A comparison of spectrum prices for the recent auctions of AWS and 700 MHz spectrum (Auctions 66 and 73, respectively) suggests that providers may have placed a higher value on 700 MHz spectrum, at least in part, because of its relative advantages for coverage and in-building penetration. Although a number of factors in addition to frequency can impact the prices in a particular auction, including factors unrelated to technical characteristics of the spectrum, both auctions involved large quantities of paired spectrum with similar service rules in a relatively close timeframe, eliminating at least some of the other factors that could reduce the significance of the comparison.[854] In the 2008 auction of 700 MHz spectrum, the average price for the 700 MHz spectrum was $1.28 per MHz-pop, which was more than twice the average price of $0.54 per MHz-pop for AWS spectrum auctioned in 2006.[855]

296. Although higher-frequency spectrum does not provide the same level of coverage or in-building penetration as lower-frequency spectrum, in some instances, higher-frequency spectrum may be just as effective, or more effective, for providing significant capacity, or increasing capacity, within smaller geographic areas.[856] For instance, AT&T has noted that it cannot be assumed that lower frequency bands will require fewer cells or be more economical to deploy because other factors also affect propagation – including the presence of large buildings in urban areas or other physical impediments.[857] In addition, capacity enhancement technologies such as multiple-input and multiple-output (MIMO) may perform better at higher frequencies.[858] We also note that while spectral efficiency is the same for all spectrum bands when using a given technology (and bandwidth),[859] there currently is significantly more spectrum above 1 GHz that is potentially available for use (as shown by Table 26 above), and, in many parts of these higher bands, spectrum is licensed in larger contiguous blocks.[860]

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[853] *See* Barclays Capital, Lowell McAdam, President and CEO of Verizon Wireless, May 26, 2010, at 8, *available at* http://investor.verizon.com/news/20100526/20100526.pdf (showing the relative distances of building penetration for 700 MHz LTE, 800 MHz Cellular, 1900 MHz PCS, 2100 MHz AWS, and 2500 MHz BRS, when broadcast power is the same across the frequencies). According to Verizon Wireless, "[e]ach frequency has a different rate of energy decay, with higher frequencies decaying faster." *Id.*

[854] As observed by Verizon Wireless, auction prices depend on not only spectrum frequencies but also other factors such as when the spectrum would be available, service rules (including deployment schedule, block size, and market area of spectrum), potential interference from neighboring bands, market demand, and conditions in credit markets. *See* Verizon Wireless Comments at 146-147.

[855] *See generally* FCC, *Auction 66 – Advanced Wireless Services*, http://wireless.fcc.gov/auctions/default.htm?job=auction_summary&id=66.

[856] *T-Mobile Dec. 2, 2010 Ex Parte Letter* at 2; Verizon Wireless Comments at 137-140; *Verizon Wireless May 12, 2010 Ex Parte Letter* at 2-3; AT&T Comments at 25. *See also* Letter from Jeanine Poltronieri, AT&T, to Marlene H. Dortch, Secretary, FCC, WT Docket No. 09-66 (filed May 6, 2010) (*AT&T May 13, 2010 Ex Parte Letter*) at 2-3.

[857] AT&T Comments, Docket No. 09-66, at 81-83, stating that "in areas that are capacity limited, there is likely to be no difference in the number of cells required at 700 MHz vs. 2.5 GHz."

[858] Verizon Wireless Comments at 140-141 ("these advanced antenna systems are most effective if they are well separated, and shorter wavelengths allow more antennas to be used in close proximity while maintaining needed separation"); *Verizon Wireless May 12, 2010 Ex Parte Letter* at 3; *AT&T May 13, 2010 Ex Parte Letter* at 3. T-Mobile points out that, although it is more challenging to build MIMO systems on devices for lower frequency bands, for broadband type devices such as a modem or a router, it is still possible to implement MIMO in lower frequency bands. Moreover, T-Mobile states that MIMO is likely to provide only limited benefit in rural deployment where there are fewer multiple paths between a transmitter and a receiver. *T-Mobile June 9, 2010 Ex Parte Letter*, at 2-3.

[859] *AT&T May 13, 2010 Ex Parte Letter* at 2.

[860] *Id. at 3*; Verizon Wireless Comments at 139-140.

Larger blocks can enable operators to deploy wider channels and simplify device design. Thus, higher-frequency spectrum can be ideally suited for providing high capacity where it is needed, such as in high-traffic urban areas.[861]

297. Some observers have noted that there can be important complementarities that come with holding spectrum assets in different frequency bands, noting that combination of sub-1 GHz and higher frequency spectrum may be optimal.[862] For example, low frequency spectrum can be deployed ubiquitously with relatively few cell sites, providing a base layer of coverage that extends to wide areas in rural America. In addition, in urban areas, such spectrum can provide superior in-building coverage. In urban areas where traffic concentration is high, this base coverage layer may be complemented with a capacity layer using high frequency spectrum.[863] In this sense, to some degree, higher-frequency spectrum may be made more valuable by being combined with lower-frequency spectrum, and vice versa. Given these different spectrum characteristics, a licensee's particular mix of spectrum holdings may affect its ability to provide efficient mobile wireless services.

298. *Spectrum Holdings Below 1 GHz.* Three nationwide providers – Verizon Wireless, AT&T, and Sprint Nextel – hold licenses for CMRS/mobile broadband spectrum below 1 GHz, as do regional providers, such as US Cellular and Cellular South, MetroPCS, and several smaller companies, many of which have holdings in more rural areas of the country. T-Mobile, the fourth nationwide provider, holds one Cellular license in South Carolina.[864]

299. Of the sub-1 GHz spectrum, Verizon Wireless and AT&T each hold a significant amount of the available Cellular and 700 MHz spectrum, which is well suited for the provision of mobile broadband. Specifically, when measured on a licensed MHz-POP basis, Verizon Wireless holds 47.7 percent of the Cellular spectrum and 42.8 percent of the 700 MHz spectrum, while AT&T holds 43.6 percent of the Cellular spectrum and 24.4 percent of the 700 MHz band spectrum. Adding these two bands together, Verizon Wireless holds 45 percent of the licensed MHz-POPs of the combined Cellular and 700 MHz band spectrum, AT&T holds approximately 33 percent. US Cellular holds approximately 3 percent of these bands. Several other, smaller providers' combined holdings total less than five percent of the Cellular and not quite 30 percent of the 700 MHz spectrum. Sprint Nextel holds approximately 93 percent of the SMR spectrum.

300. As discussed in previous reports, providers have been utilizing Cellular spectrum for mobile voice and data services for many years, using CDMA-based and GSM-based technologies (which continue to evolve), while providers have been utilizing SMR spectrum to offer mobile voice and data services using iDEN-based technologies. Sprint Nextel, however, has announced that it intends to repurpose some of its 800 MHz SMR spectrum for CDMA service.[865] In recent years, providers have

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[861] *See* Alan Hadden, *Mobile Broadband — Where The Next Generation Leads Us*, Global Mobile Suppliers Association, Dec. 2009, *available at* http://www.gsacom.com/downloads/pdf/GSA_IEEE_articles1209.php4.

[862] *See, e.g., T-Mobile Dec. 2, 2010 Ex Parte Letter* at 1-3, Attachment at 10-11 (stating that a mixture of low (below 1 GHz) and upper band spectrum is "important to building competitive high speed mobile broadband networks"); Alan Hadden, *Mobile Broadband — Where The Next Generation Leads Us*, Global Mobile Suppliers Association, Dec. 2009, *available at* http://www.gsacom.com/downloads/pdf/GSA_IEEE_articles1209.php4.

[863] Alan Hadden, *Mobile Broadband — Where The Next Generation Leads Us*, Global Mobile Suppliers Association, Dec. 2009, *available at* http://www.gsacom.com/downloads/pdf/GSA_IEEE_articles1209.php4 ("A combination of higher spectrum (*e.g.*, 1.8 GHz, 2.1 GHz, 2.6 GHz) for the capacity layer, and sub-1 GHz spectrum for improved coverage in rural areas and for urban in-building, is considered optimal.")

[864] SunCom Wireless License Company, LLC, a wholly owned subsidiary of T-Mobile, holds a Cellular license for CMA629-South Carolina 5-Georgetown (call sign KNKN557).

[865] Sprint Nextel, *Sprint Announces Network Vision – A Cutting-Edge Network Evolution Plan With Partners Alcatel-Lucent, Ericsson and Samsung*, Press Release, Dec. 6, 2010.

been upgrading their Cellular-based networks from 2G and 2.5G technologies to mobile broadband technologies in most markets across the United States. As discussed earlier, SMR spectrum generally is not as suitable for broadband operations.[866] In addition, as described above in more detail, Verizon Wireless has recently launched LTE networks in 38 markets using 700 MHz paired spectrum blocks, and AT&T has announced plans to deploy LTE service using 700 MHz and AWS spectrum, with its initial LTE launch to cover around 75 million POPs by mid-2011.[867] In the past, deployment of networks in the 700 MHz unpaired spectrum blocks has generally been limited to mobile multichannel one-way video programming services.[868] However, in December 2010, Qualcomm announced that it expects its FLO TV network, which is operated in the 700 MHz unpaired spectrum bands, will be shut down in March 2011, and has entered into an agreement with AT&T for AT&T to acquire the licenses in these bands.[869]

301. *Spectrum Holdings Above 1 GHz.* All four nationwide providers hold spectrum above 1 GHz. Verizon Wireless, AT&T, and T-Mobile each hold a substantial number of PCS and AWS licenses, while Sprint Nextel holds significant amounts of PCS spectrum. In the PCS and AWS spectrum bands, no licensee holds more than 23 percent of the combined MHz-POPs for those two bands, with T-Mobile holding the most. Of the PCS and AWS spectrum held by nationwide providers, again based on MHz-POPs: Verizon Wireless holds approximately 15.1 percent of the PCS and 14.9 percent of the AWS spectrum; AT&T holds around 26.1 percent of the PCS and 7.9 percent of the AWS spectrum; Sprint Nextel approximately 26.8 percent of the PCS and none of the AWS; and T-Mobile approximately 19.5 percent of the PCS and approximately 27.4 percent of the AWS. US Cellular, MetroPCS, and Leap each hold some PCS and a somewhat higher percentage, relative to their PCS holdings, of the more recently auctioned AWS spectrum. Finally, other smaller providers hold approximately 5.8 percent of the PCS spectrum and nearly 30 percent of the AWS spectrum. Each of the nationwide providers, along with many others, offers mobile broadband and data services on networks using some of this spectrum. As of February 2011, MetroPCS has launched LTE in thirteen cities using its AWS spectrum.[870]

302. Finally, as noted above, Clearwire, in which Sprint Nextel holds a majority interest, holds a predominant amount of 2.5 GHz spectrum, comprised of the BRS and EBS spectrum, which is the highest frequency band potentially usable for the provision of mobile broadband service. As described earlier, Clearwire offers mobile broadband services using WiMAX technology and, as of November 2010, covers 82 million POPs in the United States. None of the other nationwide providers has any interests in BRS or EBS spectrum. Several smaller providers, including Xanadoo and Digital Bridge, are, like Clearwire, deploying WiMAX in their 2.5 GHz spectrum holdings.[871]

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[866] *See supra* ¶ 290.

[867] *See* Section IV.B.1, Service Provider Technology Deployments, *supra*.

[868] *See, e.g.*, MediaFLO, *Enabling the Wireless Ecosystem*, http://www.mediaflo.com/about_us.html (visited Oct. 27, 2010). *See also Statement from Qualcomm Regarding FLO TV*, PR Newswire, Oct. 5, 2010, *available at* http://www.prnewswire.com/news-releases/statement-from-qualcomm-regarding-flo-tv-104362108.html.

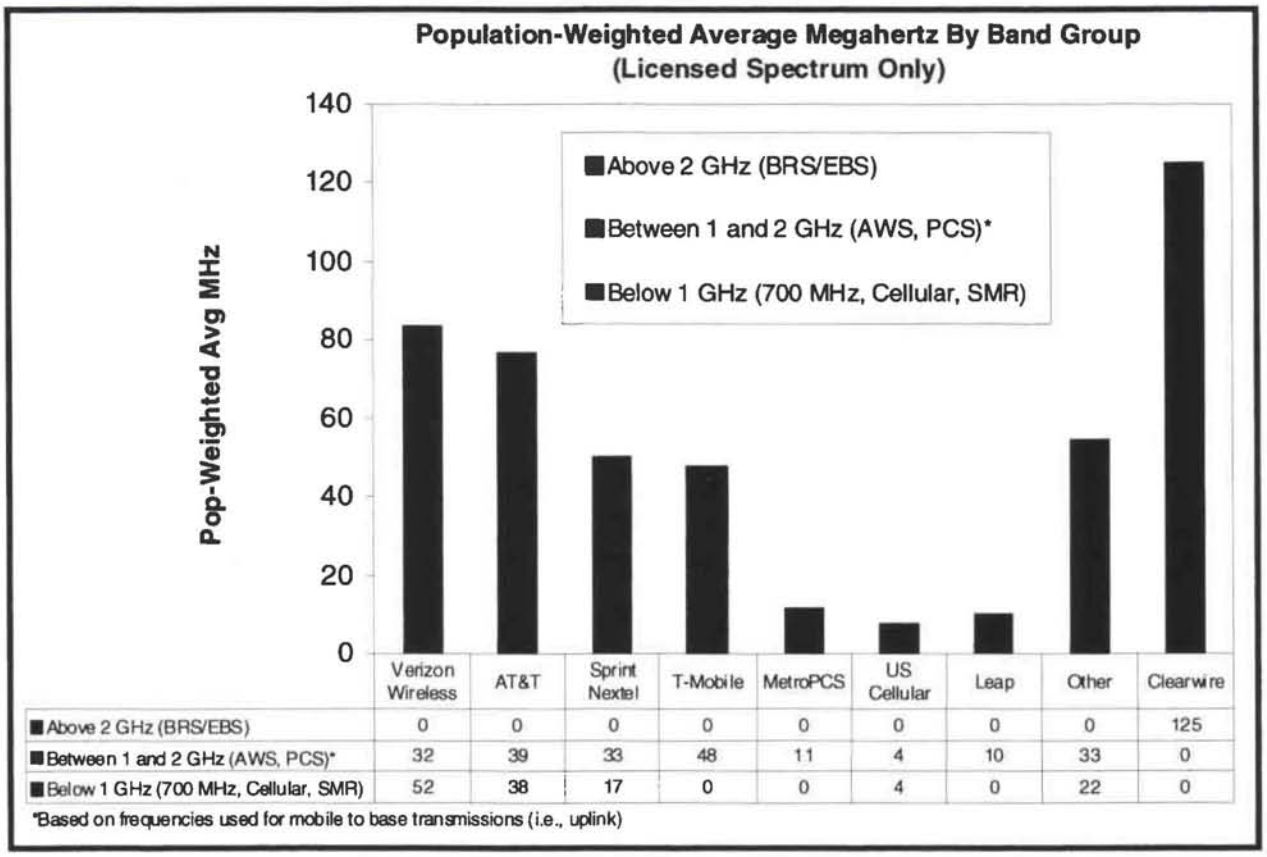
[869] *AT&T Agrees to Acquire Wireless Spectrum from Qualcomm*, Press Release, Qualcomm, Dec. 20, 2010. According to Qualcomm, the spectrum covers more than 300 million people nationwide: 12 megahertz of Lower 700 MHz D and E block spectrum covers more than 70 million people in five of the top 15 U.S. metropolitan areas – New York, Boston, Philadelphia, Los Angeles, and San Francisco; 6 megahertz of Lower 700 MHz D block spectrum covers more than 230 million people across the rest of the United States. *Id.* As part of its longer-term LTE plans, AT&T intends to deploy this spectrum as supplemental downlink, using carrier aggregation technology. *Id.*

[870] *Id.*

[871] Digital Bridge Communications, *About DBC: Bringing Broadband to Underserved or Rural Communities Nationwide*, http://www.digitalbridgecommunications.com/AboutDBC/tabid/84/Default.aspx (visited Nov. 30, 2010); Xanadoo Company, *About Xanadoo*, http://www.xanadoo.com/about.html (visited Nov. 30, 2010).

303. *Relative Distribution of Spectrum Holdings Below and Above 1 GHz.* Chart 39 shows the spectrum holdings of nationwide wireless providers by frequency. It provides a side-by-side comparison of each licensee's holdings – in terms of total population-weighted average megahertz – under 1 GHz, between 1 and 2 GHz, and above 2 GHz.

Chart 39
Population-Weighted Average Megahertz Under/Over 1 GHz (Licensed Spectrum Only)

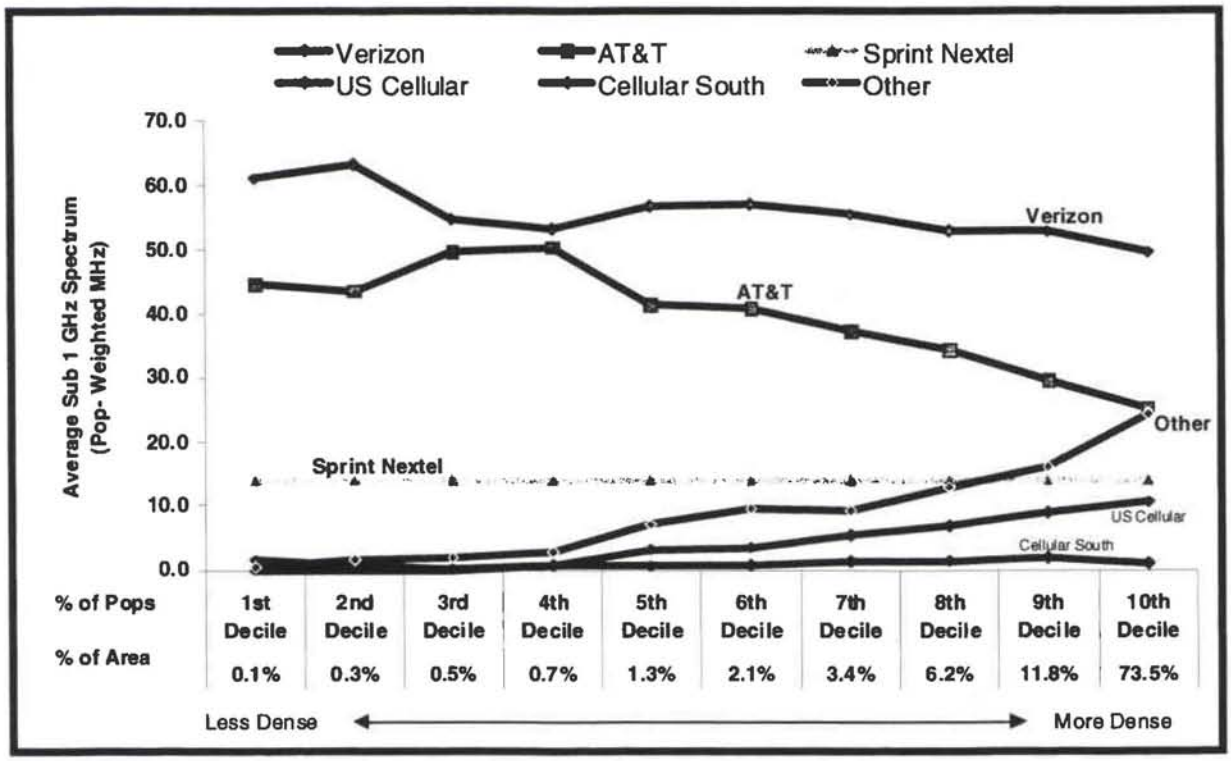


	Verizon Wireless	AT&T	Sprint Nextel	T-Mobile	MetroPCS	US Cellular	Leap	Other	Clearwire
Above 2 GHz (BRS/EBS)	0	0	0	0	0	0	0	0	125
Between 1 and 2 GHz (AWS, PCS)*	32	39	33	48	11	4	10	33	0
Below 1 GHz (700 MHz, Cellular, SMR)	52	38	17	0	0	4	0	22	0

*Based on frequencies used for mobile to base transmissions (i.e., uplink)

304. *Distribution of Spectrum by Population Density.* Chart 40 below shows how spectrum is nationally distributed by population density. Generally, as the population density decreases, the under-1 GHz spectrum holdings of the large providers decrease, and those of regional and smaller companies increase.

Chart 40
Average Under-1 GHz Spectrum by Population Density Deciles



e. Competitive Effects of Spectrum Holdings

305. The Commission's competition policies with respect to spectrum holdings have been designed to preserve competitive opportunities in the mobile wireless marketplace and retain incentives for efficiency and innovation. Its policies have evolved over the years as more and more spectrum has been made available for mobile services. These policies have also changed as the marketplace changes and technology evolves.

306. The mobile CMRS marketplace for mobile telephone services in 1995, when the *First Report* was issued, was very different from today's marketplace. Until 2007, the Commission's competition policies concerning the spectrum input market for mobile services focused on spectrum associated with three frequency bands – Cellular, SMR, and broadband PCS. These were the specific frequency bands that, until that time, the Commission had determined to be spectrum "suitable" for the provision of mobile services in the relevant product market, which the Commission had defined as the product market for "mobile telephony" services.[872] For purposes of its competitive analysis, the Commission has evaluated whether particular spectrum bands are "suitable" for mobile wireless services by determining whether the spectrum is capable of supporting mobile services given its physical properties and the state of the equipment technology, whether the spectrum is licensed with a mobile allocation and corresponding service rules, and whether the spectrum is committed to another use that effectively precludes its uses for mobile telephony.[873] Since the Commission first began applying a "spectrum screen" as part of its competitive analysis, the Commission has determined that additional

[872] *See AT&T-Dobson Order*, 22 FCC Rcd at 20311-312 ¶¶ 26-27 (2007).

[873] *Id.* at ¶ 26.

spectrum should be part of its spectrum input analysis – including 700 MHz,[874] AWS, and BRS spectrum[875] – and periodically has modified the spectrum screen as more spectrum has become available.[876] The Commission also has recognized that the mobile services marketplace – including the product market – has evolved. In 2008, the Commission revised its competition policies, no longer limiting its competitive analysis to examination of the mobile telephony product market. Given the increasing prevalence of mobile broadband services, the Commission began examining a combined product market for both mobile telephony services and mobile broadband services.[877]

307. As discussed above, spectrum resources in different frequency bands have distinguishing features that can make some frequency bands more valuable or better suited for particular purposes. For instance, given the superior propagation characteristics of spectrum under 1 GHz, particularly for providing coverage in rural areas and for penetrating buildings, providers whose spectrum assets include a greater amount of spectrum below 1 GHz spectrum may possess certain competitive advantages for providing robust coverage when compared to licensees whose portfolio is exclusively or primarily comprised of higher frequency spectrum. As discussed above, holding a mix of frequency ranges may be optimal from the perspective of providing the greatest service quality at low cost.

2. Infrastructure Facilities

a. Background

308. Infrastructure facilities are a major input into the provision of mobile wireless service. These facilities are comprised largely of cellular base stations and towers or other structures on which the base stations are situated. A base station generally consists of radio transceivers, antennas, coaxial cable, a regular and backup power supply, and other associated electronics. These base stations are generally placed atop a purpose-built communications tower, or on a tall building, water tower, or other structure providing sufficient height above the surrounding area.[878] The number of cell sites in use by wireless providers continues to grow in order to satisfy the increased demand created by new subscribers, accommodate additional airtime usage per subscriber largely caused by increased use of data services including broadband wireless and mobile Internet, expand geographic service area coverage and improve coverage in existing service areas, and accommodate newer technologies. According to CTIA, the total number of cell sites in use by CTIA's members was 247,081 as of December 31, 2009.[879] This represents an increase in the number of cell sites of 2.04 percent since December 31, 2008, 40.6 percent since December 31, 2004, and 51.6 percent since December 31, 2003.[880] According to *Above Ground Level*, a

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[874] *Id.* at ¶ 31.

[875] *Sprint Nextel-Clearwire Order*, 23 FCC Rcd at 17596-17600, ¶¶ 61-73. As discussed above, in reviewing proposed merger transactions that involve spectrum aggregation, the Commission examines market participants' holdings of suitable spectrum to ensure that there is sufficient spectrum available to competitors.

[876] *See id.*

[877] *See id.* at 17596 ¶ 61; *Verizon Wireless-ALLTEL Order*, 23 FCC Rcd at 17469-470, ¶¶ 45-47.

[878] An alternative to the use of tall structures for cell sites is distributed antenna systems (DAS). DAS are comprised of a relatively large network of small cells that are connected by fiber optic cable and can be placed on such locations as utility poles, buildings, or traffic signal poles, in geographic areas where either constructing towers is not feasible or wireless traffic demands are too great to be met with fewer, large cells. Because DAS sites are not visible beyond the immediate vicinity, they may be particularly desirable in areas with stringent siting regulations, such as historic districts. Providers of such networks include most of the major tower companies, as well as independent firms like NextG Networks, ExteNet, and Mobilitie.

[879] *See* CTIA, *Top Line 2009 Semi-Annual Wireless Industry Survey Results*, at 10 (2010), http://files.ctia.org/pdf/CTIA Survey Year End 2009.

[880] *Id.*

trade publication, there were a total of 266,623 cell sites in the United States as of April 1, 2010.[881] One analyst report indicated that of the 247,081 cell sites reported by CTIA, 207,946, or about 84 percent of these cell sites, were associated with the four major wireless providers.[882] For the four major wireless service providers, the percentage increase in the number of cell sites in use between the end of March 2009 and the end of March 2010 has been as follows: AT&T (4.1 percent), Sprint Nextel (0.6 percent), T-Mobile (6.5 percent), and Verizon Wireless (3.1 percent).[883]

b. Communications Tower Industry

309. The most visible cell sites are those that are situated on relatively tall communications towers. As noted above, cell sites may also be located on buildings, municipal water towers, and church steeples, and some cell sites are located inside buildings to fill indoor coverage gaps. In addition, cell sites may be located at the lower levels of taller towers built to support other communications services, such as broadcast or public safety. With the growth of cell sites required to meet the needs of wireless service providers and their subscribers, a communications tower industry has evolved. A typical communications tower can accommodate five to six tenants, though the current industry average of wireless tenants per tower is approximately 2.7.[884] This industry includes companies that own large numbers of towers on which they lease space to wireless service providers. In addition, there are a number of companies that help wireless service providers identify available tower or building space in needed geographic areas or, alternatively, arrange to construct towers where no appropriate facilities exist.[885]

310. Analyst reports about the communications tower industry indicate that the financial health of this industry is dependent to a large extent on the wireless service providers and whether or not they have the capital resources to expand service to new geographic areas or to enhance the quality of service in current service areas. Analysts seem to be optimistic that the expansion of new wireless providers into new areas,[886] together with the deployment of newer technologies by existing wireless service providers, bodes well for growth of the tower industry. Clearwire reportedly planned to deploy approximately 19,000 cell sites by the end of 2010, while Verizon Wireless reportedly would need to have in place a total of between 60,000 and 70,000 cell sites in order to accommodate its current needs and the deployment of its LTE network.[887] This projected level would represent an increase of between 17,400 and 27,400 cell sites from the 42,600 cell sites Verizon used as of March 31, 2010.[888] This growth potential, low churn, and the annuity-like revenue stream from long-term leases – which include standard annual price escalators of three to five percent – contribute to a favorable financial outlook for the tower

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[881] Clayton Funk and Jason Nicoly, *Trends and Forecasts for the Wireless Industry*, Above Ground Level, (July/Aug. 2010) at 40 (*Trends and Forecasts for the Wireless Industry*).

[882] Based on company reports and UBS estimates, AT&T utilized 52,370 cell sites, Sprint Nextel 66,450, T-Mobile 46,826, and Verizon Wireless 42,300 as of December 31, 2009. *US Wireless 411 1Q10*, at 54.

[883] *Id.*

[884] *See Trends and Forecasts for the Wireless Industry*, at 40.

[885] The eight largest tower companies in the United States by number of towers owned are: Crown Castle International (22,321), American Tower Corporation (20,594), AT&T Towers (10,792), SBA Communications (8,588), T-Mobile Towers (7,000), Global Tower Partners (3,700), Mobilitie L.L.C. (3,058), and TowerCo (3,000), Tracy Ford, *Top 10 Tower* Companies, RCR Wireless, Nov. 2, 2010.

[886] *Wireline & Wireless Telecom Services*, Bank of America/Merrill Lynch, Sept. 24, 2009, at 4.

[887] Presentation by Nadine Manjaro, ABI Research, *PCIA Wireless Infrastructure Show Debrief*, at 2009 Wireless Infrastructure Show, Oct. 1, 2009, *available at* http://www.rcrwireless.com/assets/pdf/PCIA_Wireless2009_Debrief.pdf.

[888] *US Wireless 411 1Q10*, at 54.

industry.[889] For example, American Tower reported that its revenue increased 11.1 percent between the first six-months of 2009 and the first six-months of 2010;[890] Crown Castle and SBA both reported increases in their revenues between second quarter 2009 and second quarter 2010 of 9 percent[891] and 13.5 percent,[892] respectively.

c. Barriers to Cell Site Deployment

311. Two significant constraints faced by wireless services providers that need to add or modify cell sites are obtaining the funds needed to finance the capital expenditure, and obtaining the necessary regulatory and zoning approvals from state and local authorities.[893]

312. Collocating base station equipment on an existing structure is often the most efficient and economical solution for existing and new wireless service providers that need new cell sites. PCIA estimates that the average cost to build a new tower is between $250,000 and $300,000, whereas the average deployment cost for a collocation is between $25,000 and $30,000.[894] Collocation is also commonly encouraged by zoning authorities to reduce the number of new communications towers.[895] Due to the high cost to construct new towers, and the often considerable delay to obtain approvals from state and local authorities, wireless service providers will typically look first for existing towers or other suitable structures for new cell sites. Collocation is particularly useful in areas in which it is difficult to find locations to construct new towers.

313. The issue of excessive delays in the zoning approval process was the subject of a Petition for Declaratory Ruling filed by CTIA in 2008. CTIA sought Commission assistance to alleviate unnecessary delays in the process of obtaining approval to construct a new cell site, or to modify an existing site.[896] The Commission solicited comments on the CTIA petition and, based on the evidence in that record, agreed that the lack of timely action on a significant number of cell site applications was impeding the ability of wireless providers to improve and expand their service offerings. On November 18, 2009, the Commission adopted a Declaratory Ruling which, among other things, defined presumptively reasonable time parameters for state or local zoning authorities to decide whether or not to approve a cell site application.[897]

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[889] *SBA Communications,* Bank of America/Merrill Lynch, Mar. 27, 2009, at 8.

[890] *American Tower Corporation Reports Second Quarter and First Half 2010 Financial Results*, Press Release, American Tower, Aug. 3, 2010, *available at* http://phx.corporate-ir.net/phoenix.zhtml?c=98586&p=irol-newsArticle_Print&ID=1455499&highlight=.

[891] *Crown Castle International Reports Second Quarter 2010 Results; Raises 2010 Outlook; Announces Agreement to Acquire NewPath Networks*, Press Release, Crown Castle, July 28, 2010, *available at* http://investor.crowncastle.com/phoenix.zhtml?c=107530&p=irol-newsArticle&ID=1453288&highlight=.

[892] *SBA Communications Corporation Reports 2nd Quarter 2010 Results; Provides 3rd Quarter and Updates Full Year 2010 Outlook*, Press Release, SBA, Aug. 2, 1010, *available at* http://ir.sbasite.com/releasedetail.cfm?ReleaseID=495570.

[893] There is no evidence that shortages of transmission equipment, including antennas, to install at cell sites act as a barrier to cell site deployment.

[894] *See* PCIA Comments at 7.

[895] *See, e.g.,* Guilford County, NC, *Development Ordinance on Cellular Tower Placement*, www.co.guilford.nc.us/planning_cms (visited Jan. 25, 2010).

[896] Petition for Declaratory Ruling to Clarify Provisions of Section 332(c)(7)(B) to Ensure Timely Siting Review and to Preempt under Section 253 State and Local Ordinances that Classify All Wireless Siting Proposals as Requiring a Variance, WT Docket No. 08-165, *Petition for Declaratory Ruling*, filed July 11, 2008.

[897] Petition for Declaratory Ruling to Clarify Provisions of Section 332(c)(7)(B) to Ensure Timely Siting Review and to Preempt Under Section 253 State and Local Ordinances that Classify All Wireless Siting Proposals as (continued....)

314. In its comments to the mobile wireless competition *Fifteenth Report Public Notice*, PCIA argues that many local jurisdictions continue to delay collocation application approval by subjecting these applications to the "same costly and time-consuming process" required of applications for new towers.[898] PCIA further notes that it is unclear to what extent the *Declaratory Ruling* has been effective in speeding approval of tower siting applications because applicants may conclude that it is more efficient in terms of time and money spent to agree to extend the application process than to seek judicial relief.[899] PCIA also notes that the infrastructure deployment process has been slowed by jurisdictions that enact moratoria on the siting of wireless infrastructure.[900] Finally, PCIA notes that some jurisdictions use municipal consultants to review wireless infrastructure siting applications.[901]

315. A recent report to Congress from GAO noted that there is public concern over the aesthetic, health, and safety effects of wireless infrastructure located in residential areas in particular.[902] These concerns have led a number of local jurisdictions to develop specific wireless infrastructure ordinances so that wireless service providers and tower companies are made aware of local concerns regarding wireless infrastructure.[903]

d. Competitive Effects of Infrastructure Costs and the Independent Communications Tower Industry

316. Infrastructure capital expenses for a new entrant can be higher than those for existing service providers. Infrastructure capital expenses per cell site vary depending primarily on whether the infrastructure is to be added to an existing cell site or entails building a completely new cell site. Additionally, a new entrant would need to construct a core network that includes such components as switches to connect its cell sites, gateways to access other networks, authentication capabilities, and back-office capabilities such as billing and customer service. The infrastructure operating expenses should be quite similar regardless of whether they are associated with an existing or new cell site for an existing wireless service provider, or a new cell site for a new wireless service provider.

317. When communications towers are owned by independent companies rather than wireless service providers, it may increase efficiency in the industry, ease entry, and enhance wireless service competition. Unlike wireless service providers that may have an economic incentive to forestall competition in a given area by restricting or delaying competitors' access to towers or antenna structures that they own, tower companies independent of wireless service providers have an incentive to maximize revenues by leasing space to as many service providers as possible. Therefore, it may be easier for wireless service providers to add cell sites on independently-owned towers in order to expand their geographic coverage area or to enhance service within a current coverage area. In addition, the ability of wireless service providers to lease space for new cell sites on established towers can ease and speed their entry into new geographic areas by eliminating the need to build a new tower. The use of existing towers

(Continued from previous page)
Requiring a Variance, *Declaratory Ruling*, WT Docket No. 08-165, 24 FCC Rcd 13994, 14021 ¶ 71 (2009); *Order on Reconsideration*, 25 FCC Rcd 11157 (2010); adopted Aug. 3, 2010, *petition for review pending*, City of Arlington, Texas v. FCC, No. 10-60039 (5th Cir., filed Jan. 12, 2010).

[898] *See* PCIA Comments at 9.

[899] *See* PCIA Comments at 9-10.

[900] *See* PCIA Comments at 12. These moratoria often apply to collocations as well as new wireless sites.

[901] *See* PCIA Comments at 13.

[902] *Enhanced Data Collection Could Help FCC Better Monitor Competition in the Wireless Industry*, U.S. Government Accountability Office (GAO), July 2010, at 36.

[903] *Id.* at 37. We note that state and local governments are preempted from regulating the siting of personal wireless service facilities based on the environmental effects of radio frequency emissions to the extent the facilities comply with the Commission's regulations concerning such emissions. *See* 42 U.S.C. § 332(c)(7).

also reduces the capital requirements for both new entrants and existing wireless service providers because they only need to finance the purchase and installation of the transmission equipment to be used at the cell site.

318. However, we note that, in many geographic areas, the most desirable positions for antennas on communications towers are occupied by existing tenants, leaving subsequent tenants with a choice of antenna positions that may not be optimal for their needs. Even with the reduced entry costs associated with an independent tower industry, tower siting costs and scarcity of desirable antenna positions may constitute significant entry barriers to new providers.[904]

3. Backhaul Facilities

a. Background

319. Backhaul connections are an integral component of a wireless service provider's network. Backhaul facilities link mobile providers' cell sites to wireline networks, carrying wireless voice and data traffic for routing and onward transmission. As wireless data services increase as a percentage of a mobile wireless provider's overall traffic, consuming vastly greater bandwidth, existing backhaul solutions are increasingly strained. Wireless providers must have access to sufficient backhaul, in terms of capacity and speed, to avoid creating a communications bottleneck.[905] As discussed above, estimates of average monthly backhaul costs range from hundreds of dollars (for a T1 line) to several thousand dollars per month.[906] Cell site backhaul capacity is forecast to increase fourfold between 2007 and 2011.[907]

320. Currently, there are three major technologies for backhaul transmission: copper lines, microwave (fixed wireless), and optical fiber.[908] Historically, copper circuits have been the predominant choice for backhaul traffic. The heavy reliance on copper transmission is diminishing. For example, one study estimated that 70.9 percent of backhaul traffic in 2009 would be carried via copper, 16.8 percent via fiber, and 12.3 percent via fixed wireless (including microwave).[909] In comparison, in 2005, 85.5 percent of backhaul traffic was carried via copper, 5.8 percent by fiber, and 8.7 percent by fixed wireless.[910] In other words, the incidence of copper as the medium for backhaul transmission is estimated to have decreased by nearly 15 percent over four years.

b. Competitive Landscape

321. Providers of backhaul services include incumbent local exchange carriers, independent wireline companies, cable providers, and independent wireless operators. Wireless providers may purchase special access services,[911] including DS1s and DS3s, from third parties for backhaul.[912]

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[904] *See* Section III.D, Entry and Exit Conditions, *supra*.

[905] Service providers must provide backhaul for increasing numbers of cell sites and ensure that the backhaul solutions they employ provide sufficient capacity to support increasing use of wireless data services.

[906] *See MSV 700 MHz Comments* (hundreds of a dollars for a T1 line to $2,000 for a DS3 connection); Space Data Corporation Comments, WT Docket No. 06-150, PS Docket No. 06-229, Exhibit A (filed June 20, 2008) (backhaul cost ranging from $2,500 to $6,000). *See* Section III.D, Entry and Exit Conditions, *supra*.

[907] SNL Kagan, Communications Industry News, June 26, 2008, at 1 (citing Infonetics Research Analyst, Michael Howard).

[908] Different protocols for data transmission (*e.g.*, TDM, Ethernet) can run over each type of physical facility.

[909] *Wireless Backhaul Market Study*, New Paradigm Resources, Oct. 2008.

[910] *Id.* This study estimated that as of mid-2009, there were about 530,000 backhaul lines, for 230,000 cell sites in the United States. *Id.*

[911] Special access services do not use local switches; instead they employ dedicated facilities that run directly between two designated locations. The Commission is examining the current state of competition for special access (continued....)