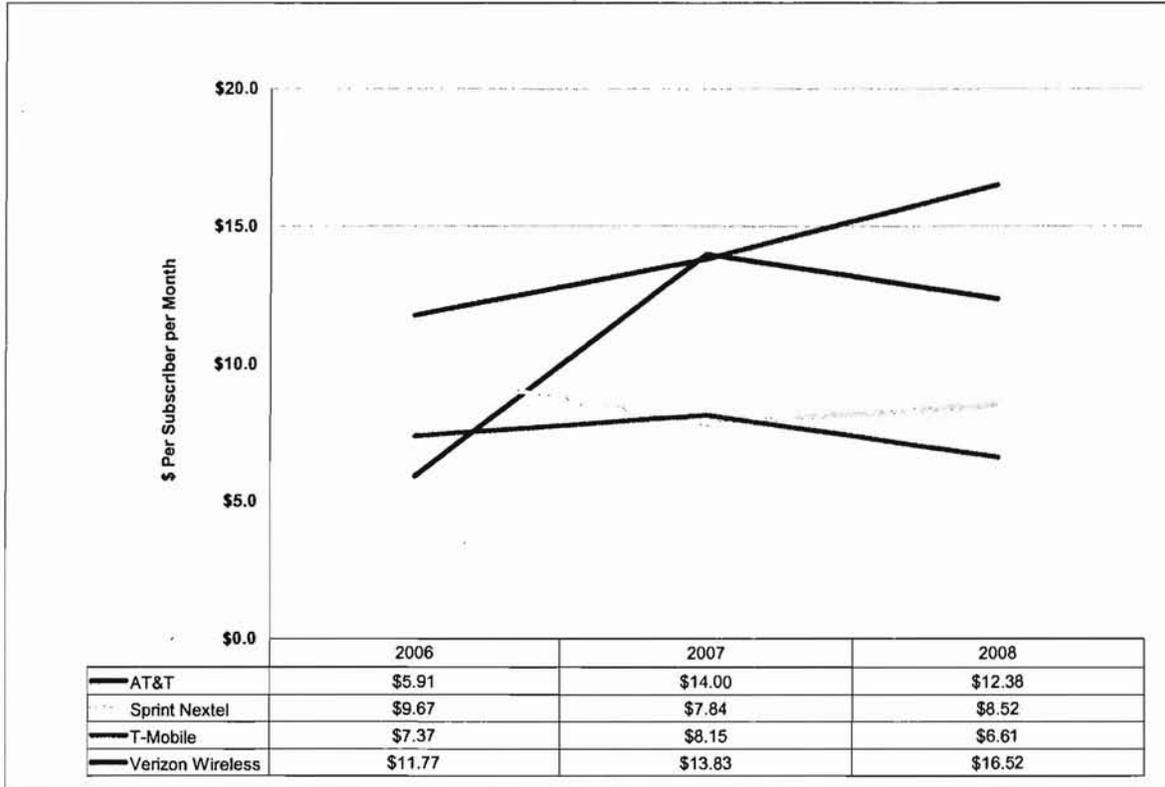
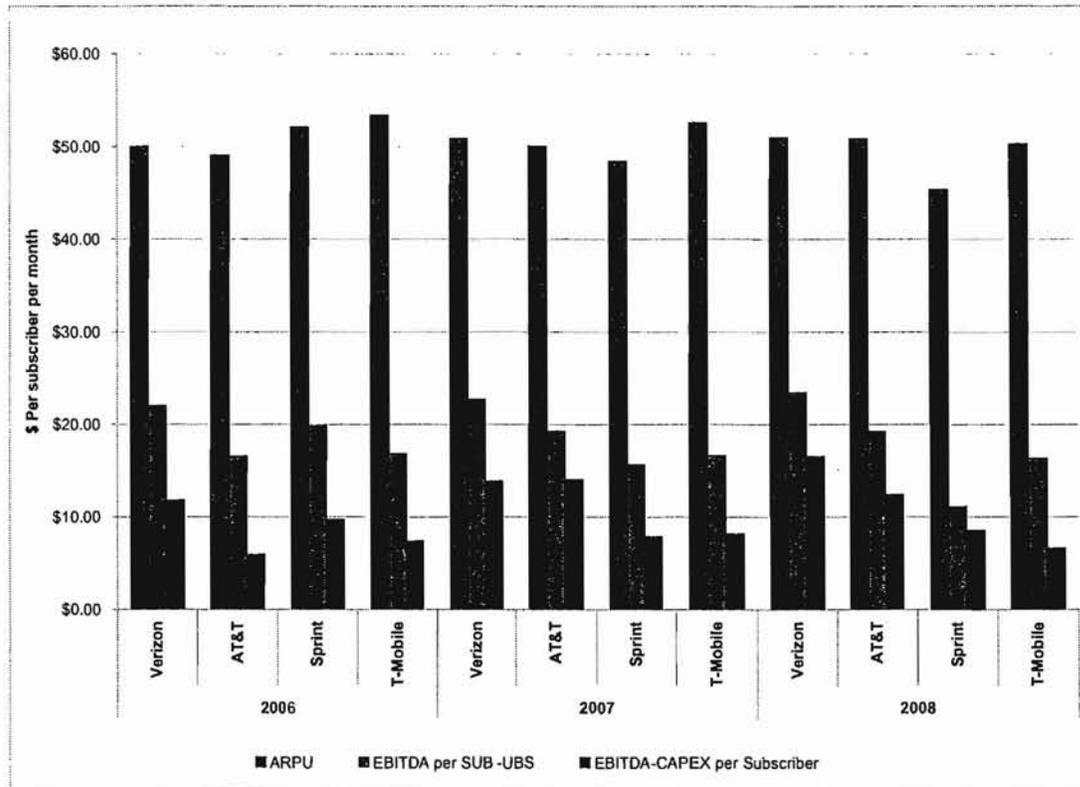


Chart 35
EBITDA minus CAPEX per Subscriber per Month (Selected Providers)⁶²⁴



⁶²⁴ UBS, *US Wireless 411 Reports*, 2006 – 2009

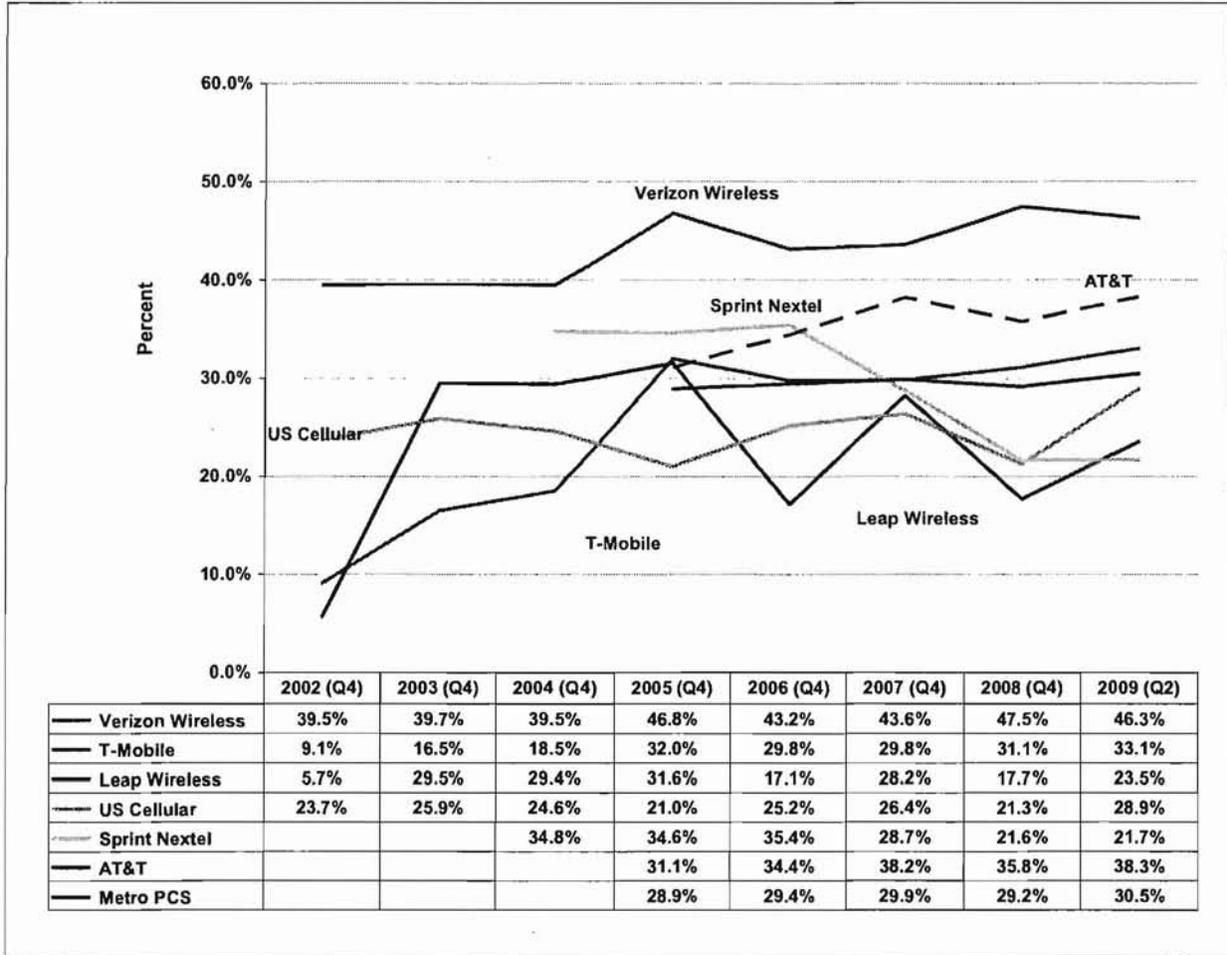
Chart 36
Comparison of ARPU, EBITDA, and EBITDA minus CAPEX⁶²⁵



221. EBITDA as a percentage of service revenue, also called EBITDA margin, appears in Chart 37 and provides another indicator of mobile wireless segment profitability. Standardizing EBITDA by service revenues facilitates cross-provider comparisons. In 2008, the difference between the provider with the highest EBITDA margin (Verizon Wireless) and the provider with the lowest (Leap) was 29.6 percent. Since 2007, the two largest national providers were the only providers with EBITDA margins greater than 35 percent. Verizon Wireless has remained in a band between 43 percent and 48 percent since 2005, increasing in 2008 relative to 2007. AT&T has remained between 31 percent and 39 percent, decreasing in 2008 relative to 2007. Between 2004 and 2008, Sprint Nextel declined from nearly 35 percent to approximately 22 percent. Since 2005, T-Mobile and MetroPCS remained between 28 percent and 33 percent.

⁶²⁵ UBS, *US Wireless 411 Reports*, 2006 – 2009

Chart 37
Reported EBITDA Margins: 2002 – 2009 (Selected Providers)⁶²⁶



I. Network Quality

222. A semi-annual study conducted by J.D. Power measures wireless call quality performance in terms of the number of problems per 100 calls (PP100), where a lower score reflects fewer problems and higher wireless call quality performance.⁶²⁷ Prior to the 2009 study, the number of reported wireless call quality problems for the industry overall declined for three consecutive reporting periods and then remained relatively stable from 2007 to 2008 at 15 problems per 100 calls, the lowest

⁶²⁶ UBS, *US Wireless 411 Reports*, 2006 – 2009. Data is for the fourth quarter, except for 2009, which is second quarter data.

⁶²⁷ *J.D. Power and Associates Reports: The Gap in Call Quality Performance Among Carriers Narrows As Competition Intensifies Across the Wireless Service Industry*, Press Release, J.D. Power, Mar. 18, 2009 (“*Gap in Call Quality Performance Among Carriers Narrows*”); J.D. Power, *2009 Wireless Call Quality Volume 1*, available at <http://jdpower.com/telecom/articles/2009-Wireless-Call-Quality-Volume-1> (*2009 Wireless Call Quality Volume 1*). The study measures wireless call quality based on seven customer-reported problem areas that impact overall carrier performance: dropped calls; static/interference; failed connection on first try; voice distortion; echoes; no immediate voicemail notification; and no immediate text message notification. The *2009 Wireless Call Quality Volume 1* is based on responses from 27,754 wireless customers. The study was fielded between July and December 2009.

level in the history of the study.⁶²⁸ The J.D. Power 2009 Wireless Call Quality Performance Study (Volume 1) indicates that network quality for the industry overall has held steady since the 2008 study, with the number of problems reported by consumers remaining virtually unchanged at 15 problems per 100 calls.⁶²⁹

223. The same study further indicates that, while overall industry performance has remained the same, the gap in call quality performance among the major providers included in the study has closed significantly as compared with previous years.⁶³⁰ In particular, while call quality performance among wireless providers still varies at the regional level, the gap between the highest- and lowest-ranked providers for the overall industry has narrowed from eight problems per 100 calls in the 2008 Volume 2 study to only five problems per 100 calls in the 2009 Volume 1 study.⁶³¹ According to J.D. Power, this trend toward greater parity is primarily the result of decreases in reported problems by customers of AT&T and Sprint Nextel and slight increases in reported problems by customers of both Verizon Wireless and Alltel.⁶³² Based on these findings, J.D. Power concludes that there is now less differentiation between the better-performing providers and those that struggle with network quality performance, compared with previous studies.⁶³³ Nevertheless, despite experiencing a slight increase in reported problems, Verizon Wireless remains the industry leader in network performance overall.⁶³⁴

224. One challenge facing service providers is ensuring that bandwidth consumption by data-intensive smartphone users does not degrade the quality of service for those users and other mobile wireless subscribers on the network.⁶³⁵ Reports suggest that iPhone users have experienced service quality problems on AT&T's broadband network, including dropped calls, delayed text and voice messages, and slow download speeds, particularly during periods of peak use in dense urban areas with higher concentrations of iPhone users.⁶³⁶ According to reports, the deterioration in service quality is due in part to the popularity of the iPhone and the challenges associated with architecting a network to keep up with the increased demand for data services.⁶³⁷ As detailed above, AT&T is devoting the majority of its capital spending to various measures aimed at upgrading and expanding the capacity of its 3G network in order to fix these problems and meet the rising demands on the network from bandwidth-heavy data

⁶²⁸ *Thirteenth Report*, 24 FCC Rcd at 6286-6287, ¶¶ 214-216.

⁶²⁹ *2009 Wireless Call Quality Volume 1*.

⁶³⁰ *Id.*

⁶³¹ *Gap in Call Quality Performance Among Carriers Narrows*.

⁶³² *2009 Wireless Call Quality Volume 1*.

⁶³³ *Id.*

⁶³⁴ *Id.*

⁶³⁵ Tom Kaneshige, *AT&T iPhone Users Irate at Idea of Usage-Based Pricing*, PCWORLD, Dec. 14, 2009. As discussed above, iPhone and other smartphone users are responsible for a significant portion of data traffic and consume significantly more bandwidth than average mobile wireless subscribers. See Section V.D.3, Mobile Data Traffic (Non-Messaging), *supra*.

⁶³⁶ Jenna Wortham, *Customers Angered as iPhones Overload AT&T*, NEW YORK TIMES, Sept. 3, 2009; Jared Newman, *Network Woes? Hate the iPhone, Not AT&T*, PCWORLD, Sept. 4, 2009. Service quality problems are reported to be particularly pronounced in the cities of New York and San Francisco, where Piper Jaffray analyst Gene Munster estimates that AT&T's network "shoulders as much as 20 percent of all the iPhone users in the United States." Jenna Wortham, *Customers Angered as iPhones Overload AT&T*, NEW YORK TIMES, Sept. 3, 2009.

⁶³⁷ *Wireless Service and Handset Pricing – Pressure Building*, at 2; Jenna Wortham, *Customers Angered as iPhones Overload AT&T*, NEW YORK TIMES, Sept. 3, 2009.

applications.⁶³⁸ Although reports have focused on the quality of service on AT&T's network, rival service providers may confront the same network challenges as smartphone penetration increases.

J. Economic Impact of Mobile Wireless Services

225. Wireless industry contributions to the U.S. economy include investment, job creation, and increased productivity. According to CTIA, wireless services delivered close to \$100 billion in "value added" contributions to the U.S. GDP in 2007.⁶³⁹ In addition, one study estimates that during the fifteen years between 1992 and 2007, economic contributions from wireless services grew faster than the rest of the U.S. economy, averaging over 16 percent annual growth compared to approximately 3 percent for the remainder of the economy.⁶⁴⁰ However, the same study also reveals that the average annual growth rate for economic contributions from wireless services decreased to 11.2 percent for the period from 2002 to 2007, down from 19.1 percent for the period between 1997 and 2002.⁶⁴¹

226. As discussed above, mobile wireless service providers have invested heavily in network deployment and equipment, including mobile broadband networks. According to one recent study, there is a multiplier effect for investment in mobile wireless broadband networks, with a seven-to-tenfold increase in GDP compared to the initial investment.⁶⁴² As the authors explain, investment in wireless broadband infrastructure is similar to building a roadway in that it "not only generates jobs and income for the builders of the road, but provides opportunities for others to create new businesses and homes along the roadway."⁶⁴³ As a result, while investment in mobile wireless infrastructure increases the availability, capacity, speed, and reliability of services, it also provides indirect benefits, such as creating new businesses and sources of revenue, enhancing health care and public safety services, and helping consumers reach goods, services, jobs, and educational opportunities.⁶⁴⁴ Moving forward, new investment in mobile broadband infrastructure may offer additional opportunities for investment and economic growth in both the wireless sector and economy as a whole.

227. Investment and growth in the wireless sector in recent years has also spurred job creation and generated additional economic benefits through increased productivity. For instance, wireless providers directly employ more than 268,000 people, a number that has grown about six percent year-over-year for the last four years.⁶⁴⁵ Beyond direct employment by wireless providers, CTIA claims that approximately 2.4 million American jobs are either directly or indirectly dependent upon the U.S.

⁶³⁸ See Section IV.B.1, Network Coverage and Technology Upgrades, *supra*. *Wireless Service and Handset Pricing – Pressure Building*, at 2; Jenna Wortham, *Customers Angered as iPhones Overload AT&T*, NEW YORK TIMES, Sept. 3, 2009.

⁶³⁹ Letter from Christopher Guttman-McCabe, CTIA, to Chairman Julius Genachowski, *et al.*, FCC, GN Docket No. 09-51, WT Docket Nos. 08-165, 09-66 (filed July 9, 2009) at 2.

⁶⁴⁰ *Id.* at Attach., Harold Furchtgott-Roth, *The Wireless Sector: A Key to Economic Growth in America* (Jan. 2009) at 1.

⁶⁴¹ Letter from Christopher Guttman-McCabe, CTIA, to Chairman Julius Genachowski, *et al.*, FCC, GN Docket No. 09-51, WT Docket Nos. 08-165, 09-66 (filed July 9, 2009), Attach., Harold Furchtgott-Roth, *The Wireless Sector: A Key to Economic Growth in America* (Jan. 2009) at 27, Table 11.

⁶⁴² Alan Pearce and Michael S. Pagano, *Accelerated Wireless Broadband Infrastructure Deployment: The Impact on GDP and Employment*, 18 MEDIA L. & POL'Y, Spring 2009, at 12, 15.

⁶⁴³ *Id.* at 13.

⁶⁴⁴ *Id.* at 15-18.

⁶⁴⁵ Letter from Christopher Guttman-McCabe, CTIA, to Chairman Julius Genachowski, *et al.*, FCC, GN Docket No. 09-51, WT Docket Nos. 08-165, 09-66 (filed July 9, 2009) at 18, citing *CTIA Mid-Year 2009 Wireless Indices Report*.

wireless industry.⁶⁴⁶ In addition, one study predicts that the U.S. wireless industry may create two to three million new jobs between 2005 and 2015.⁶⁴⁷ Wireless services also create opportunities for increased productivity in American businesses, with one study projecting that productivity gains from the deployment and use of wireless broadband services could generate nearly \$860 billion in additional GDP between 2005 and 2016.⁶⁴⁸

⁶⁴⁶ Letter from Christopher Guttman-McCabe, CTIA, to Chairman Julius Genachowski, *et al.*, FCC, GN Docket No. 09-51, WT Docket Nos. 08-165, 09-66 (filed July 9, 2009) at 18.

⁶⁴⁷ Roger Entner and David Lewin, Ovum, *The Impact of the U.S. Wireless Telecom Industry on the U.S. Economy – A Study for CTIA-The Wireless Association*, Sept. 2005, at 3, 30.

⁶⁴⁸ Roger Entner, Ovum, *The Increasingly Important Impact of Wireless Broadband Technology and Services on the U.S. Economy: A Follow Up to the 2005 Ovum Report on the Impact of the U.S. Wireless Telecom Industry on the U.S. Economy – A Study for CTIA-The Wireless Association*, 2008, at 4, 10.

VI. MOBILE WIRELESS SERVICES: CONSUMER BEHAVIOR

228. Consumer behavior in response to price increases and adverse changes in service is an important indicator of the level of competition in the mobile wireless services industry. If consumers are sufficiently well-informed to take prices and other non-price factors into account, they are in a better position to choose the provider that offers the best terms. If enough consumers have the ability and propensity to switch service providers in response to a change in price or non-price factors, then mobile wireless service providers will have an incentive to compete vigorously to gain customers and retain their current customers. Consumers will be more effective in constraining wireless service provider behavior when the transaction costs they incur in choosing and switching providers are low. Transaction costs depend on, among other factors, subscribers' access to and ability to use information, and economic and non-economic barriers to switching providers.

A. Consumer Switching Costs

229. In the context of mobile wireless services, consumer switching costs are costs that a consumer incurs when past investment specific to her current service provider must be duplicated for a new service provider. First, there is the information cost associated with the consumer's need to obtain sufficiently detailed information about the offerings of other service providers. Second, wireless service consumers that have entered into multi-month service subscriptions with their service providers may be liable for early termination fees (ETF) if they choose to prematurely terminate their contracts. Third, there are the costs associated with obtaining a new wireless handset or unlocking the old handset when changing service providers. A potentially related handset change cost is the cost of reacquiring applications purchased for their current handset that may not be transferrable to a new handset.

230. A reasonable proxy to determine whether switching costs are high enough to prevent consumers from making changes is churn. As discussed below, churn refers to the percentage of current customers an operator loses over a given period of time, *i.e.*, a company's gross loss of customers during that time period. By examining the magnitude and trend over time of service provider churn, we can quantify the degree to which consumers have both the desire and the ability to change service providers to better meet their mobile wireless service needs.⁶⁴⁹

1. Access to Information on Mobile Wireless Services

231. In order to make informed decisions, consumers need detailed information about the availability, quality, and features of mobile wireless services. Obtaining such information requires the expenditure of time and, in some cases, money on the part of the wireless service consumer. A number of third parties – such as *Consumer Reports*, trade associations, marketing and consulting firms, and several web sites – provide consumers with an overview and comparison of the mobile wireless services available in their area.⁶⁵⁰ In addition, J.D. Power's web site posts the results of its annual wireless user surveys, which rate wireless service providers by region based on overall customer satisfaction, call quality, and customer service.⁶⁵¹

⁶⁴⁹ Churn only measures consumers that have left a particular service provider; it does not measure consumers that wanted to switch, but were unable to do so.

⁶⁵⁰ See *Thirteenth Report*, 24 FCC Rcd at 6270, ¶ 178; CTIA PN Comments at 36-37; CTIA NOI Comments at 67-69.

⁶⁵¹ J.D. Power, *Wireless*, www.jdpower.com (visited Jan. 14, 2010). For example, according to the J.D. Power 2009 Wireless Consumer Smartphone Customer Satisfaction Study, Apple ranks highest in customer satisfaction with smartphone manufacturers, while LG ranks highest among traditional mobile phone users. *Id.* In addition, several websites, such as billshrink.com, myrateplan.com, reviews.cnet.com/cell-phone-buying-guide, and prepaidreviews.com, provide consumers with free and user-friendly means to identify the best wireless service to meet their needs. BillShrink states in recent comments to the Commission that the public needs increased access to service coverage maps, dropped call data, service plan and pricing transparency, service contract detail, and explicit (continued....)

232. Implementation of initial trial periods in multi-month service subscriptions is a policy that may alleviate a “buyer’s regret” problem. Some wireless service providers have implemented formal procedures to permit consumers to use their service on a trial basis for periods ranging from 14 to 30 days, consistent with one of the elements of CTIA’s Consumer Code.⁶⁵²

233. The Commission continues to receive consumer complaints about various aspects of mobile wireless service. As GAO notes in a November 2009 report about mobile wireless service, about 84 percent of adult wireless users are very or somewhat satisfied with their wireless service, but approximately ten percent are very or somewhat dissatisfied.⁶⁵³ The *GAO Report* also notes that 19 states have rules or regulations governing wireless service.⁶⁵⁴ The Commission is working to address the issues raised in the *GAO Report* by improving consumer access to needed information and coordinating with states to more efficiently and effectively respond to consumer complaints about mobile wireless services. In August 2009, the Commission initiated a *Notice of Inquiry* proceeding seeking comment on consumer information, disclosure, and truth-in-billing practices for services it regulates.⁶⁵⁵ The Commission now has a record that was created in response to that inquiry, which will help determine whether or not additional regulatory actions may be needed to ensure that consumers have sufficient information to make informed decisions about a mobile wireless service provider.⁶⁵⁶ In addition, in May 2010, the FCC’s Consumer and Governmental Affairs Bureau sought comment on the feasibility of instituting usage alerts and cut-off mechanisms that would provide mobile wireless consumers with a way to monitor their voice, text, and data usage, as well as the various charges they may incur in connection with such usage.⁶⁵⁷

2. Early Termination Fees (ETFs)

234. The practice of assessing ETFs against postpaid subscribers when they cancel their wireless service agreement or plan before the expiration of its term represents probably the largest quantifiable cost to consumers who wish to switch service providers. According to information obtained by the Commission from Telogical Systems, these charges are the same nationwide and range from \$175 to \$350 per phone number among the four nationwide mobile wireless service providers.⁶⁵⁸ Additional

(Continued from previous page) _____

information about additional charges on wireless bills such as taxes and various fees. See, e.g. BillShrink.com Comments to CG Docket No. 09-158, Oct. 13, 2009, at 1.

⁶⁵² See CTIA, *Consumer Code for Wireless Service*, <http://files.ctia.org/pdf/ConsumerCode.pdf> (visited Apr. 28, 2010). The ability of consumers to terminate a wireless service contract within 14 days is also one of a number of provisions of the Assurance of Voluntary Compliance agreed to by AT&T (then Cingular), Sprint Nextel, and Verizon Wireless with the attorneys general of 32 states on June 25, 2004. See <http://www.nasuca.org/archive/CINGULAR%20AVC%FINAL%20VERSION.pdf>, visited Mar. 15, 2010.

⁶⁵³ *FCC Needs to Improve Oversight of Wireless Phone Service*, GAO Report, Nov. 2009, at 8. (*GAO Report*)

⁶⁵⁴ *Id.* at 27-8. The states that have rules or regulations that apply to wireless carriers are: Alaska, Arizona, California, Colorado, Connecticut, Hawaii, Indiana, Iowa, Louisiana, Massachusetts, Mississippi, Montana, Nebraska, New Mexico, North Dakota, Ohio, Rhode Island, South Dakota, and West Virginia.

⁶⁵⁵ Consumer Information and Disclosure, Truth-in-Billing and Billing Format, IP-Enabled Services, CG Docket No. 09-158, *Notice of Inquiry*, 24 FCC Rcd 11380 (2009).

⁶⁵⁶ *Id.*

⁶⁵⁷ See “Comment Sought on Measures Designed to Assist U.S. Wireless Consumers to Avoid ‘Bill Shock,’” CG Docket No. 09-158, *Public Notice*, DA 10-803 (CGB rel. May 11, 2010). Similar usage alerts and notification mechanisms were adopted by the European Union in June 2009. *Id.*

⁶⁵⁸ An exception is the new Google Nexus One handset. Those who terminate their contracts for this T-Mobile Google phone will be charged \$350, \$200 by T-Mobile as an early service termination fee, and \$150 by Google as an equipment recovery fee within the first 120 days of service. Amy Schatz, *Google Lowers Nexus One Termination Fee*, WALL STREET JOURNAL, Feb. 8, 2010, available at <http://online.wsj.com/article/SB10001424052748703615904575053641103601412.html>.

ETFs may be imposed by certain authorized agents or third-party vendors.⁶⁵⁹

235. As discussed in previous *Reports*, all four nationwide providers have implemented policies to pro-rate ETFs over the course of the contract term, and pro-rated ETFs lower the costs to consumers who switch service providers by progressively reducing the fee they pay to cancel their service early.⁶⁶⁰ However, the Consumer and Governmental Affairs Bureau (CGB) and the Wireless Telecommunications Bureau (WTB) have sought information from certain mobile wireless providers regarding their assessment of ETFs, especially in connection with advanced devices and smartphones, and the impact such ETFs have on consumers' ability to switch providers. Specifically, on December 4, 2009, the CGB and WTB requested information from Verizon Wireless regarding its assessment of a \$350 early termination fee for advanced devices. CGB and WTB asked, among other things, why the provider decided to increase the ETF for smartphones from \$175 to \$350, how it defines a device as an "advanced device," and how consumers receive information about the ETF.⁶⁶¹ Verizon Wireless responded to the CGB and WTB on December 18, 2009, stating in part that the "higher [ETF] associated with advanced devices reflects the higher costs associated with offering those devices to consumers at attractive prices, the costs and risks of investing in the broadband network to support these devices, and other costs and risks."⁶⁶²

236. Subsequently, on January 26, 2010, the Chiefs of CGB and WTB sent letters to four mobile wireless service providers – Verizon Wireless, Sprint Nextel, AT&T, and T-Mobile – as well as Google, asking each company to detail how it determines and assesses the ETFs, as well as how it notifies consumers about ETFs.⁶⁶³ The letters noted that "[o]ur discussions with wireless companies since December indicate that there is no standard framework for structuring and applying ETFs throughout the wireless industry," noting that the ETFs are substantial (and in some cases are increasing) and have an important impact on consumers' ability to switch providers.⁶⁶⁴ CGB and WTB also stated that it is essential that consumers fully understand what they are signing up for – both in the short term and over the life of the contract – when they accept a service plan with an early termination fee.⁶⁶⁵ In light of those concerns, the Bureaus requested, among other things, that each wireless company provide a

⁶⁵⁹ See, e.g., Verizon Wireless, *Service Agreement*, http://www.verizonwireless.com/b2c/globalText?textName=CUSTOMER_AGREEMENT&jspName=footer/customerAgreement.jsp (visited Jan. 14, 2010)

⁶⁶⁰ See *Thirteenth Report*, 24 FCC Rcd at 6272-73, ¶ 185; CTIA PN Comments at 29-30; CTIA NOI Comments at 43.

⁶⁶¹ *WTB ETF Letter to Verizon Wireless*, n. 239.

⁶⁶² Letter from Kathleen Grillo, Senior Vice President, Federal Regulatory Affairs, Verizon, to Ruth Milkman, Chief, Wireless Telecommunications Bureau, FCC, and Mark Stone, Acting Chief, Consumer and Government Affairs Bureau, FCC, WT Docket No. 05-194, CG Docket No. 09-158 (Dec. 18, 2009).

⁶⁶³ See, e.g., Letter from Joel Gurin, Chief, Consumer and Government Affairs Bureau, and Ruth Milkman, Chief, Wireless Telecommunications Bureau, FCC, to Kathleen Grillo, Senior Vice President, Federal Regulatory Affairs, Verizon, DA 10-136 (Jan. 26, 2010); Letter from Joel Gurin, Chief, Consumer and Government Affairs Bureau, and Ruth Milkman, Chief, Wireless Telecommunications Bureau, FCC, to Robert W. Quinn, Jr., Esq., Senior Vice President-Federal Regulatory, AT&T Services, Inc., DA 10-132 (Jan. 26, 2010); Letter from Joel Gurin, Chief, Consumer and Government Affairs Bureau, and Ruth Milkman, Chief, Wireless Telecommunications Bureau, FCC, to Thomas J. Sugrue, Vice President, Government Affairs, T-Mobile, DA 10-135 (Jan. 26, 2010); Letter from Joel Gurin, Chief, Consumer and Government Affairs Bureau, and Ruth Milkman, Chief, Wireless Telecommunications Bureau, FCC, to Vonya B. McCann, Esq., Senior Vice President, Government Affairs, Sprint Nextel Corporation, DA 10-137 (Jan. 26, 2010); and Letter from Joel Gurin, Chief, Consumer and Government Affairs Bureau, and Ruth Milkman, Chief, Wireless Telecommunications Bureau, FCC, to Richard S. Whitt, Esq., Washington Telecom and Media Counsel, Google, Inc., DA 10-133 (Jan. 26, 2010).

⁶⁶⁴ *Id.*

⁶⁶⁵ *Id.*

description of how it set up its ETFs, the rationales for the fees, and what options consumers have to learn about the fees and manage their obligations.⁶⁶⁶ All of the five companies responded by February 23, 2010, describing their practices regarding disclosure of ETFs to consumers and stating generally that they give consumers adequate notice about the applicable ETFs that apply; that ETFs allow them to subsidize handset purchases — including purchases of smartphones — for customers; and that wireless providers normally recover those subsidies over the life of a contract, but cannot do so when a customer ends a contract early.⁶⁶⁷

237. Some providers offer service plans that do not have ETFs. For example, in addition to its multi-month plans with ETFs, Verizon Wireless also offers a month-to-month agreement with all of its nationwide pricing plans that allows customers to terminate their plans at the end of any month without paying an ETF.⁶⁶⁸ Customers who choose Verizon Wireless's new month-to-month option either purchase new devices from Verizon Wireless at the full retail price, or procure their own CDMA devices.⁶⁶⁹ Another way that consumers can avoid ETFs entirely is to purchase mobile wireless service on a prepaid basis, instead of agreeing to enter into a long-term service contract.⁶⁷⁰ In addition, the five largest mobile wireless service providers have all implemented various policies that allow subscribers to change elements of their service contracts without triggering the start of a new contract term, thus reducing the likelihood these subscribers will be affected by an ETF.⁶⁷¹

238. The emergence of a secondary market segment for mobile wireless service contracts may also help promote competition by facilitating consumers' ability to switch service providers. In most cases, wireless service providers allow customers to get out of their contracts without paying an ETF by transferring the remaining contract term to someone else who meets the provider's credit requirements.⁶⁷² A number of websites exist to facilitate transfers of mobile wireless contracts under these provisions.⁶⁷³ In particular, the websites help mobile wireless customers avoid paying penalties for early termination by

⁶⁶⁶ Letter from Kathleen Grillo, Senior Vice President, Federal Regulatory Affairs, Verizon, to Joel Gurin, Chief, Consumer and Government Affairs Bureau, and Ruth Milkman, Chief, Wireless Telecommunications Bureau, FCC, CG Docket No. 09-158 (Feb. 23, 2010); Letter from Robert W. Quinn, Jr., Esq., Senior Vice President-Federal Regulatory, AT&T Services, Inc., dated Feb. 23, 2010 in CG Docket No. 09-158 to Joel Gurin, Chief, Consumer and Government Affairs Bureau, and Ruth Milkman, Chief, Wireless Telecommunications Bureau, FCC; Letter from Thomas J. Sugrue, Vice President, Government Affairs, T-Mobile, dated Feb. 23, 2010 in CG Docket No. 09-158 to Joel Gurin, Chief, Consumer and Government Affairs Bureau, and Ruth Milkman, Chief, Wireless Telecommunications Bureau, FCC; Letter from Vonya B. McCann, Esq., Senior Vice President, Government Affairs, Sprint Nextel Corporation, dated Feb. 23, 2010 in CG Docket No. 09-158 to Joel Gurin, Chief, Consumer and Government Affairs Bureau, and Ruth Milkman, Chief, Wireless Telecommunications Bureau, FCC; and Letter from Richard S. Whitt, Esq., Washington Telecom and Media Counsel, Google, Inc., dated Feb. 23, 2010 in CG Docket No. 09-158 to Joel Gurin, Chief, Consumer and Government Affairs Bureau, and Ruth Milkman, Chief, Wireless Telecommunications Bureau, FCC.

⁶⁶⁷ *Id.*

⁶⁶⁸ *No Contract Required – New Month-to-Month Agreement Gives Verizon Wireless Customers Even More Freedom*, Press Release, Verizon Wireless, Sept. 22, 2008.

⁶⁶⁹ *Id.*

⁶⁷⁰ See Section IV.A.2, Prepaid Service, *supra*.

⁶⁷¹ See Section IV.A, Price Rivalry: Developments in Mobile Service Pricing Plans, *supra*.

⁶⁷² Lauren Tara Lacapra, *Breaking Free of a Cellular Contract*, WALL STREET JOURNAL, Nov. 30, 2006, at D1 (*Breaking Free of a Cellular Contract*) (noting that this “loophole” in mobile phone contracts is available “to nearly all customers with long-term plans”).

⁶⁷³ Several web-based services that are available include: cellswapper (available at www.cellswapper.com, visited Jan. 12, 2010); trademycellular (available at www.trademycellular.com, visited Jan. 12, 2010); celltradeusa (available at www.celltradeusa.com, visited Jan. 12, 2010); and cashmoneylife (available at www.cashmoneylife.com, visited Jan. 12, 2010).

putting them in touch with people seeking a mobile wireless contract. Although these sites charge existing mobile wireless customers a range of fees to transfer or cancel a mobile wireless service contract, the fees to transfer a contract through these web sites generally are much lower than the ETFs customers would otherwise have to pay.⁶⁷⁴ As an additional enticement to potential contract buyers, many contract sellers offer to transfer their mobile handsets free of charge.⁶⁷⁵ In addition to a possible free handset, other potential advantages to contract buyers include avoiding a service activation fee and obtaining a shorter contract than if they had contracted directly with a mobile wireless service provider. Finally, at least one wireless service provider, Cellular South, offers to pay the ETF to entice a consumer to move to its network, thus eliminating the ETF as a cost of switching.⁶⁷⁶

3. Handsets, Handset Locking, and Handset Applications

239. Another potential cost of switching to a new service provider is the cost of replacing the handset when a consumer wishes to change from one wireless service provider to another that employs a different air interface. Even if both providers employ the same underlying air interface, handset replacement may be necessary because there is also the fact that many handset models are produced to the specifications of a single wireless service provider to enable certain functionalities unique to that service provider.

240. In addition, most handsets sold in the United States are “locked,” meaning that they normally will operate only on a single wireless network. Locking can prevent a consumer from taking a handset from one service provider to another, unless the handset is reprogrammed.⁶⁷⁷ The ability of a consumer to unlock a handset varies depending on the service provider. For example, GSM operators have different policies regarding handset unlocking. Whereas T-Mobile will provide an “unlock code” after the subscriber account has been active at least 90 days so that the same handset can be used on another operator’s GSM network,⁶⁷⁸ AT&T only releases unlock codes to subscribers under certain circumstances, and will not do so at all for iPhones.⁶⁷⁹ CDMA handsets are more difficult to unlock because they do not use a removable Subscriber Identification Module (SIM) card and must be reprogrammed by CDMA provider in order to be unlocked.⁶⁸⁰

241. Another increasingly important switching cost associated with smartphones is the stranding of mobile applications purchased for a particular handset that cannot be transferred to or used on a new handset. Mobile applications are typically tied to a single mobile wireless operating system. As a result, if a consumer with a smartphone were to contemplate switching either to a new service provider or to new handset using a different operating system with the same service provider, she would likely consider the cost associated with reacquiring applications purchased for use on the current handset that

⁶⁷⁴ See *Breaking Free of a Cellular Contract*.

⁶⁷⁵ *Id.*

⁶⁷⁶ See Cellular South, *Three Reasons to Switch to Cellular South*, <https://www.cellularsouth.com/switchnow/index.html> (visited Jan. 14, 2010).

⁶⁷⁷ Some handset manufacturers directly sell unlocked handsets in their Internet shops and through non-provider retailers. See, e.g., the manufacturer Internet shops selling unlocked handsets at <http://www.motorola.com/Consumers/US-EN/Home>, <http://www.nokiausa.com/> and https://www.google.com/phone/choose?locale=en_US&s7e=. See also, Section VII.B.1, Mobile Wireless Handsets/Devices and Operating Systems, *infra*.

⁶⁷⁸ See T-Mobile, *SIM Cards and Unlocking Your Phone*, http://search.t-mobile.com/inquirapp/ui.jsp?ui_mode=question&question_box=unlock (visited Apr. 28, 2010).

⁶⁷⁹ See AT&T, *Answer Center – What is the Unlock Code for My Phone?*, <http://www.wireless.att.com/answer-center/main.jsp?solutionId=55002&t=solutionTab> (visited Apr. 28, 2010).

⁶⁸⁰ See Cell Phone Forums, *Unlocking a CDMA Phone*, <http://cellphoneforums.net/general-cell-phone-forum/t206579-unlocking-cdma-phone.html> (visited 3/8/2010).

could not be used on the new handset.

4. Number Portability

242. Local number portability (LNP) refers to the ability of users of telecommunications services to retain, at the same location, existing telecommunications numbers when switching from one telecommunications carrier to another.⁶⁸¹ Subscribers can port numbers between two mobile wireless service providers (intra-modal porting) or between a mobile wireless provider and wireline carrier (inter-modal porting).⁶⁸²

243. Prior to the Commission's actions to require local number portability, the cost and inconvenience to consumers of changing to a new telephone number was considered a significant barrier to switching, reducing the likelihood a consumer would move to a new service provider and thus impeding competition. Now that consumers can retain their telephone numbers within a given geographic area, this switching cost has been significantly reduced as a consideration in determining whether or not to change mobile wireless service providers. In fact, the average number of wireless subscribers per month porting their phone number from one mobile wireless provider to another has been steadily increasing over the past few years to approximately 1.2 million per month in 2008.⁶⁸³

B. Churn as a Measure of Consumer Switching Costs

244. Churn refers to the percentage of current customers an operator loses over a given period of time, *i.e.*, a company's gross loss of customers during that time period.⁶⁸⁴ Mobile wireless service providers usually express churn in terms of a percent of their subscribers per month. For example, an operator might report an average monthly churn of two percent, which is equivalent to the loss of about 24 percent of its current customers per year.

245. Most providers report churn rates for postpaid subscribers of between 1.5 percent and 3.3 percent per month (see Chart 38).⁶⁸⁵ Churn rates had been decreasing for a number of years; however, the trend has shown a slight increase over the last few quarters, with the nationwide providers averaging a monthly churn rate of two percent in the fourth quarter of 2008.⁶⁸⁶ Prepaid subscriber churn is typically significantly higher, over four percent per month, as seen in the graph of "comparative churn" below. Churn is a significant expense for the mobile wireless industry. The magnitude of this expense can be estimated by multiplying the number of subscribers lost by the average cost to acquire a new subscriber. For example, using data for the end of 2008, AT&T lost an estimated 1.2 million subscribers per month, multiplied by its estimated average cost to acquire a new subscriber of \$528.93, yielding an estimated cost

⁶⁸¹ 47 C.F.R. § 52.21(l).

⁶⁸² Under the Commission's rules and orders, covered mobile wireless providers operating in the 100 largest MSAs were required to begin providing number portability by November 24, 2003. Mobile wireless providers outside of the top 100 MSAs were required to be LNP-capable by May 24, 2004. 47 C.F.R. § 52.31(a); Verizon Wireless's Petition for Partial Forbearance From Commercial Mobile Radio Services Number Portability Obligation and Telephone Number Portability, *Memorandum Opinion and Order*, 17 FCC Rcd 14972, 14986, ¶ 31 (2002). In an October 2007 ruling, the Commission also expanded local number portability to VoIP, among other things. Telephone Number Requirements for IP-Enabled Services Providers, *Report and Order, Declaratory Ruling, Order on Remand, and Notice of Proposed Rulemaking*, 22 FCC Rcd 19531 (2007).

⁶⁸³ Craig Stroup and John Vu, *Numbering Resource Utilization in the United States*, FCC, Sept. 2009, at 35 (*March 2009 NRUF Report*).

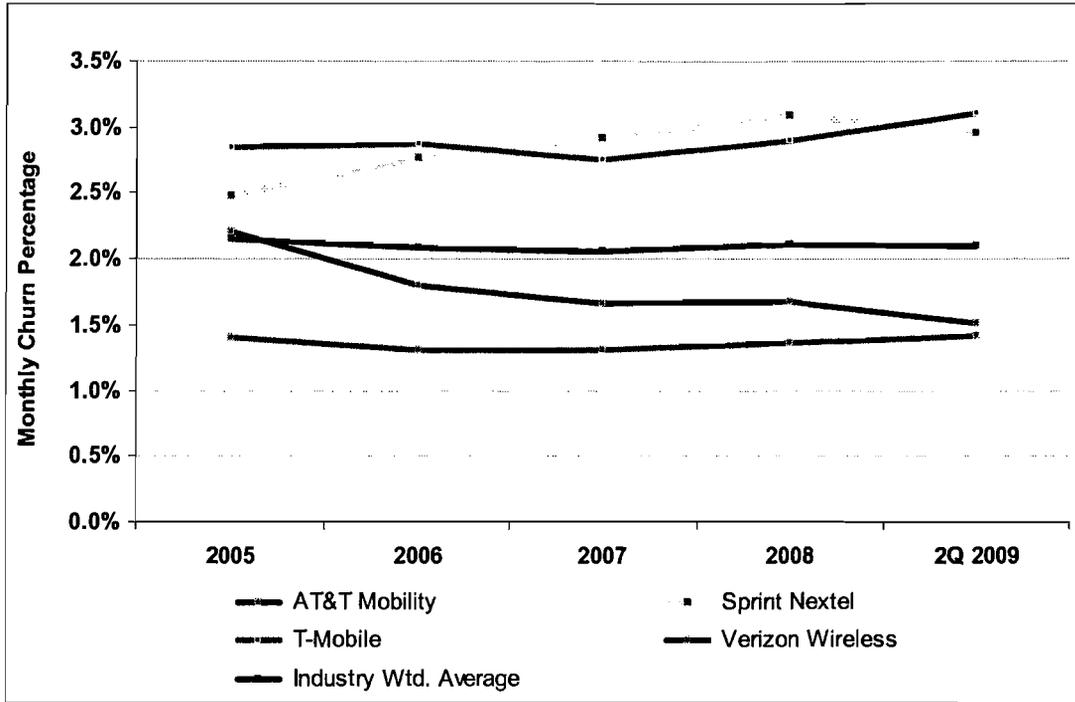
⁶⁸⁴ CTIA defines it as "a measure of the number of subscribers disconnecting from service during the period." *CTIA Mid-Year 2009 Wireless Indices Report*, at 70.

⁶⁸⁵ *US Wireless 411 3Q09*, at 20 (Table 16: Monthly Churn). See also, CTIA NOI Comments at 69.

⁶⁸⁶ *US Wireless 411 3Q09*, at 6. See also *Eleventh Report*, 21 FCC Rcd 10947 at 11005, ¶ 145 for reasons for the earlier decline.

to replace the 1.2 million lost subscribers in a month of almost \$652 million.⁶⁸⁷

Chart 38
Blended Churn Reported by Four Nationwide Service Providers⁶⁸⁸



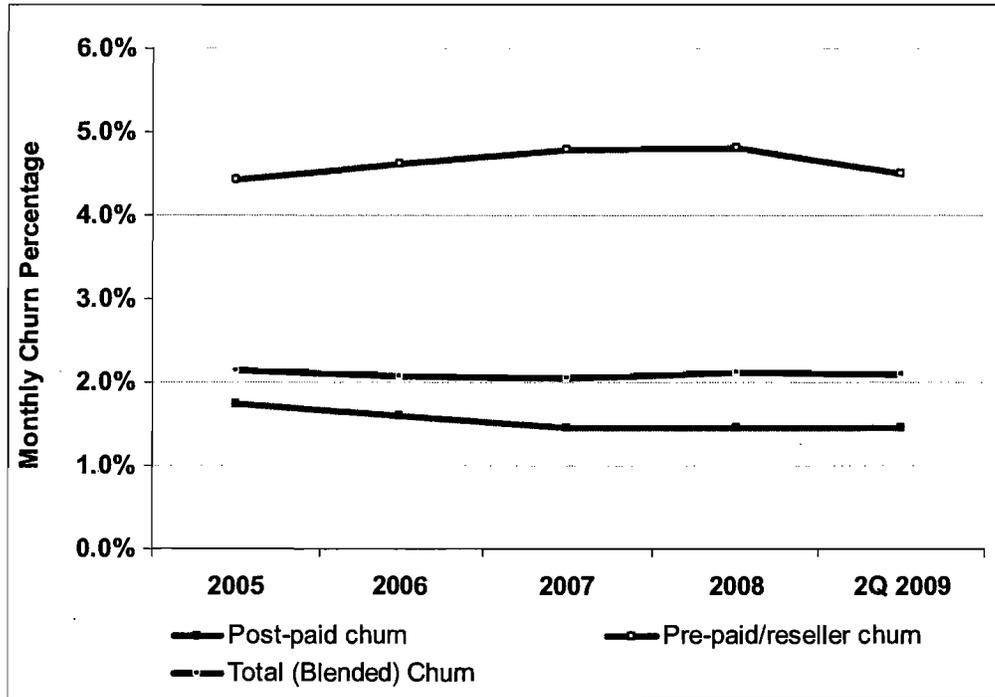
246. *Comparative Churn.* Many service providers report churn for postpaid subscribers separately from prepaid subscribers. As can be seen in the following graph of comparative churn rates, prepaid subscribers are more likely than a post paid subscriber to terminate a relationship with a wireless service provider because they are not constrained by a contract.⁶⁸⁹ Chart 39 helps to illustrate the trends in churn for different subscriber types.

⁶⁸⁷ *Wireline & Wireless Telecom Services*, Bank of America/Merrill Lynch, Mar. 26, 2009, at 14.

⁶⁸⁸ Data provided by Bernstein Research. Annual churn is an average for each of the four quarters. Verizon Wireless is combined with Alltel.

⁶⁸⁹ *Leap Wireless & Metro PCS: Low Cost Prepaid Wireless...A Survival Story; Initiating Coverage at Outperform*, Bernstein Research, Dec 14, 2009.

Chart 39
Comparative Churn⁶⁹⁰



247. *Subscriber Lifetime.* Based on industry and reported service provider churn, one can also calculate the number of months an average subscriber is expected to remain a customer of a particular wireless service provider. This measure is referred to as the subscriber lifetime, and is calculated by dividing one by the monthly churn rate. Subscriber lifetime can also be used to derive ancillary subscriber metrics (such as Total Lifetime Revenue per user, and Lifetime revenues for voice and data revenues). As indicated by Table 23, the national weighted average lifetime of a subscriber to one of the four national providers has recently ranged between 48 and 56 months.⁶⁹¹ The lifetime of subscribers to prepaid service providers, such as Leap and MetroPCS, is significantly lower at a range of 19 to 30 months for Leap and 17 to 25 months for Metro PCS, reflecting the higher churn rates experienced by these companies.⁶⁹²

⁶⁹⁰ Data provided by Bernstein Research. Annual churn is an average for each of the four quarters. Verizon Wireless is combined with Alltel.

⁶⁹¹ Calculation of Monthly Lifetime is based on Blended Churn, thus postpaid and prepaid churn calculations would provide different measures.

⁶⁹² *Id.*

Table 23
Lifetime of Subscribers (Months)⁶⁹³

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

248. Churn can serve as a reasonable proxy to measure whether or not consumer switching costs are detrimental to competition among mobile wireless service providers.⁶⁹⁴ Churn rates indicate that approximately one quarter of customers switch their service providers each year, thereby providing some indication that some customers are not locked in, although all consumers may incur costs when switching service providers.

⁶⁹³ *US Wireless 411 2Q09*; Commission estimates.

⁶⁹⁴ Mercatus NOI Comments at 11.

VII. INPUT AND DOWNSTREAM SEGMENTS OF THE MOBILE WIRELESS ECOSYSTEM

A. Input Segments

249. In the following sections, we consider key factors of production of 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 service.

1. Spectrum

250. 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, and mobile broadband and other data services. We then provide an overview of the overall spectrum holdings among different providers. We also discuss how spectrum in different frequency bands can affect an operator’s ability to provide broadband service.

a. Availability of Mobile Wireless Services Spectrum

251. Access to spectrum is a precondition to the provision of mobile wireless service. 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 their subscriber bases and meet increasing demand, while new entrants need access to spectrum to enter the market and compete with established licensees. 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.

252. 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/EBS in the 2.5 GHz band, AWS in the 1.7/2.1 GHz band, and the 700 MHz band – which are beginning to enable the provision of additional and competitive voice and mobile data services.⁶⁹⁵ 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.⁶⁹⁶

(i) Frequency Bands

253. *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.⁶⁹⁷ Historically, they have held much of the share of mobile services provided in most markets across the country.

254. *SMR.* By the early 1990s, mobile voice services were also provided using approximately

⁶⁹⁵ A more detailed description of spectrum available for mobile wireless service is provided in Appendix A. There are other bands – including 2.3 GHz (WCS), 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.

⁶⁹⁶ Appendix A of this Report provides a more detailed discussion of these frequency bands.

⁶⁹⁷ See *Third Report*, 13 FCC Rcd at 19749, 19779, pp. 3, 29.

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.⁶⁹⁸ 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,⁶⁹⁹ providers such as Nextel acquired significant amounts of SMR spectrum and were successful in launching mobile telephony services in the 1990s, which competed with licensees using cellular spectrum in the provision of mobile telephony services.⁷⁰⁰

255. *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, representing an advancement 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 served by three or more providers, and 54 percent by five or more providers;⁷⁰¹ by 2008, 96 percent of the U.S. population (by census block) was served by three or more providers, and 65 percent by five or more.⁷⁰² Between 1995 and 2008, the price per minute of mobile wireless service dropped 84 percent,⁷⁰³ while the number of subscribers increased over 700 percent.⁷⁰⁴ With increased competition 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. This heightened competition and investment was fueled by the great investment made by the mobile industry during this timeframe: cumulative investment in the industry more than tripled from \$19 billion to over \$70 billion from 1994 to 2000,⁷⁰⁵ and the number of cell sites more than quadrupled, from 18,000 to over 80,000.⁷⁰⁶

256. *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 restructured this band to facilitate the use of this spectrum, totaling approximately 194 megahertz, for mobile and fixed broadband services.⁷⁰⁷ 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

⁶⁹⁸ 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”).

⁶⁹⁹ 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.

⁷⁰⁰ 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 Mar. 8, 2010).

⁷⁰¹ See *Third Report*, 13 FCC Rcd at 19768, p. B-4, Table 3A (1998).

⁷⁰² See *Thirteenth Report*, 24 FCC Rcd at 6210, ¶ 40, Table 1.

⁷⁰³ See *id.* at 6277, ¶ 193, Table 12 (2009).

⁷⁰⁴ See *id.* at 6314, Table A-1 (2009).

⁷⁰⁵ *CTIA Year-End 2008 Wireless Indices Report*, at 126.

⁷⁰⁶ *Id.* at 150.

⁷⁰⁷ Since the release of the *Thirteenth Report*, 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 on October 30, 2009. See “Auction of Broadband Radio Service Licenses Closes; Winning Bidders Announced for Auction 86,” *Public Notice*, 24 FCC Rcd 13572 (2009).

markets across the country.⁷⁰⁸

257. *AWS*. In 2006, the Commission auctioned a total of 90 megahertz of AWS spectrum. Since 2008, several licensees (*e.g.*, T-Mobile, MetroPCS, and Leap) have begun to deploy AWS services across the country.⁷⁰⁹ Several other major holders from the 2006 auction (*e.g.*, Verizon Wireless, AT&T, and SpectrumCo) have not yet announced deployment plans for this spectrum.

258. *700 MHz*. The auctions of 700 MHz spectrum in 2003 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.⁷¹⁰ Of this total, 58 megahertz is paired spectrum with sufficient channel widths to support mobile broadband. Beginning in 2010, Verizon Wireless, AT&T, and other licensees of 700 MHz spectrum are expected to begin rolling out services for mobile broadband in this band.⁷¹¹

259. *Other Spectrum Bands*. Other spectrum bands that are potentially available for the provision of mobile voice and broadband services include spectrum in the Wireless Communications Service (WCS) in the 2.3 GHz band, the 1.4 GHz band, and the 1670-1675 MHz band,⁷¹² as well as MSS spectrum.⁷¹³ These bands are not discussed further here because, as yet, services offered in these bands do not impact competition in mobile wireless services.

⁷⁰⁸ See Section IV.B.1.a, Service Provider Technology Deployments, *supra*.

⁷⁰⁹ As mentioned in the *Thirteenth Report*, T-Mobile had launched HSPA service, using its AWS spectrum, in 13 major U.S. markets as of September 2008. As of August 2009, T-Mobile's HSPA network covered 121 million people in 176 cities, with anticipated coverage of 200 million people in an additional 100 cities by the end of 2009. MetroPCS has announced that it plans to begin deploying LTE beginning in the second half of 2010 using its AWS spectrum licenses. See Section IV.B.1.a, Service Provider Technology Deployments, *supra*.

⁷¹⁰ The 74 megahertz includes 4 megahertz of spectrum in the 700 MHz Guard Bands, which are not included in Table 24. 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.

⁷¹¹ See Section IV.B.1.a, Service Provider Technology Deployments, *supra*, for a discussion of technological deployments in recently-licensed mobile wireless frequency bands.

⁷¹² See Appendix A for additional discussion of WCS, the 1.4 GHz band, and the 1670-1675 MHz band.

⁷¹³ See Section III.B.4, Mobile Satellite Service Providers, *supra*, for a discussion of MSS.

Table 24
Flexible Use Spectrum Usable for Mobile Wireless Services⁷¹⁴

Spectrum Band	Megahertz (Rounded)
Cellular	50
SMR*	19
Broadband PCS	120
AWS-1	90
700 MHz	70
BRS/EBS**	194
WCS	20
1.4 and 1.6 GHz	13
1910-15/1990-95 MHz***	10

* Includes post-800 MHz Band Reconfiguration ESMR spectrum at 817-824 MHz and 862-869 MHz.

**BRS/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.

(ii) Facilitating Access to Spectrum Among Multiple Providers

260. 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.

261. *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.⁷¹⁵

262. *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.⁷¹⁶ Under these CMRS spectrum aggregation limits, which were modified in 1999, no entity could control more than 45 megahertz of Cellular, SMR, and broadband PCS spectrum (which altogether

⁷¹⁴ This table only includes the terrestrial, flexible use frequency bands discussed in this section of the *Report*.

⁷¹⁵ 47 C.F.R § 24.3.

⁷¹⁶ 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.

totaled approximately 190 megahertz) in any given cellular market.⁷¹⁷ The Commission eliminated the spectrum cap beginning in 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.⁷¹⁸

263. *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.⁷¹⁹ 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.⁷²⁰ As additional spectrum has become available in recent years, the Commission has continued to revise its policies for analyzing spectrum aggregation, including modifications to its spectrum screen, as it seeks to ensure competition in the provision of mobile wireless services.⁷²¹

264. *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.⁷²² Further, the Commission’s secondary markets policies also 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.⁷²³ The Commission’s secondary market policies allow existing licensees to obtain

⁷¹⁷ *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. For the purposes of calculating spectrum holdings under the CMRS cap, the Commission counted SMR spectrum as 10 megahertz. *Id.* 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).

⁷¹⁸ 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.

⁷¹⁹ 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).

⁷²⁰ *Id.* at 21620-21, ¶ 255.

⁷²¹ See, e.g., *AT&T-Dobson Order*, 22 FCC Rcd at 20311, ¶¶ 26-30; *Verizon Wireless-ALLTEL Order*, 23 FCC Rcd at 17473, ¶ 53; *Sprint Nextel-Clearwire Order*, 23 FCC Rcd at 17591, ¶ 53.

⁷²² *Ninth Report*, 19 FCC Rcd at 20631, ¶ 84.

⁷²³ 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*); Service Rules for the 698-746, 747-762 and 777-792 MHz Bands; Implementing a Nationwide, Broadband, Interoperable (continued....)

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.

b. Analysis of Spectrum Holdings Overall

265. Because spectrum is a key input to the provision of mobile wireless service, the different spectrum holdings of major providers potentially affect their ability to compete. 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, several wireless providers hold significant amounts of spectrum that is usually considered viable for mobile service.⁷²⁴

266. Verizon Wireless and AT&T each hold significant amounts of 700 MHz, Cellular, broadband PCS, and AWS spectrum. Sprint Nextel holds SMR spectrum, acquired through its merger with Nextel in 2005, as well as substantial holdings of PCS licenses. T-Mobile's spectrum holdings are in both the PCS and AWS bands.⁷²⁵ Regional provider US Cellular holds Cellular, PCS, and AWS licenses, while MetroPCS and Leap chiefly hold PCS and AWS spectrum. Unlike the rest, Clearwire, which is affiliated with Sprint Nextel,⁷²⁶ has holdings in the 2.5 GHz band, where it holds the predominant amount of BRS spectrum, and has access to much EBS spectrum through leasing arrangements. Finally, as the charts below reveal, smaller providers also hold Cellular, 700 MHz, PCS, and AWS licenses in parts of the United States.

267. Table 25 reveals that five providers together – Verizon Wireless, AT&T, T-Mobile, as well as Sprint Nextel and Clearwire – hold more than 80 percent of all of the spectrum, measured on a MHz-POPs basis, that is suitable for the provision of mobile wireless services. Table 26 shows megahertz holdings for each provider, weighted by population. Finally, Chart 40 is a graph of providers' spectrum holdings by frequency band, measured on a MHz-POPs basis.

(Continued from previous page) _____

Public Safety Network in the 700 MHz Band, WT Docket Nos. 06-150, PS Docket No. 06-229, *Second Report and Order*, 22 FCC Rcd 15289, 15374-80 ¶¶ 231-248 (2007).

⁷²⁴ See *infra* Tables 25-26 and Charts 40-41. The data in these tables and charts generally reflect transactions through 2009. They include the AT&T/Centennial transaction as well as the divestitures required as part of the Verizon Wireless-Alltel transaction. With respect to the Verizon Wireless-Alltel divestitures, licenses that were divested have been included in the "Other" category.

⁷²⁵ T-Mobile holds a very small amount of spectrum below 1 GHz.

⁷²⁶ See Section III.E.1, Entry, *supra*.

Table 25
Percentage Spectrum Holdings, Measured on a MHz-POPs Basis
by Provider, by Frequency Band*
(Providers Listed by Number of Subscribers as of 2Q 2009)

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	42.7%	48.5%	0.0%	15.4%	15.0%	0.0%	0.0%
AT&T	24.3%	42.3%	0.0%	25.9%	11.2%	0.0%	0.0%
Sprint Nextel	0.0%	0.0%	93.0%*	26.8%	0.0%	0.0%	0.0%
T-Mobile	0.0%	0.0%**	0.0%	19.7%	27.5%	0.0%	0.0%
MetroPCS	0.5%	0.0%	0.0%	2.6%	5.9%	0.0%	0.0%
US Cellular	2.7%	4.3%	0.0%	1.8%	2.0%	0.0%	0.0%
Leap	0.0%	0.0%	0.0%	2.3%	8.8%	0.0%	0.0%
Other	29.8%	4.9%	7.0%*	5.5%	29.6%	13.7%*	38.0%*
Clearwire	0.0%	0.0%	0.0%	0.0%	0.0%	86.3%*	62.0%*
Grand Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

* These are estimates based on the available data.

** T-Mobile holds a very small amount of Cellular spectrum.

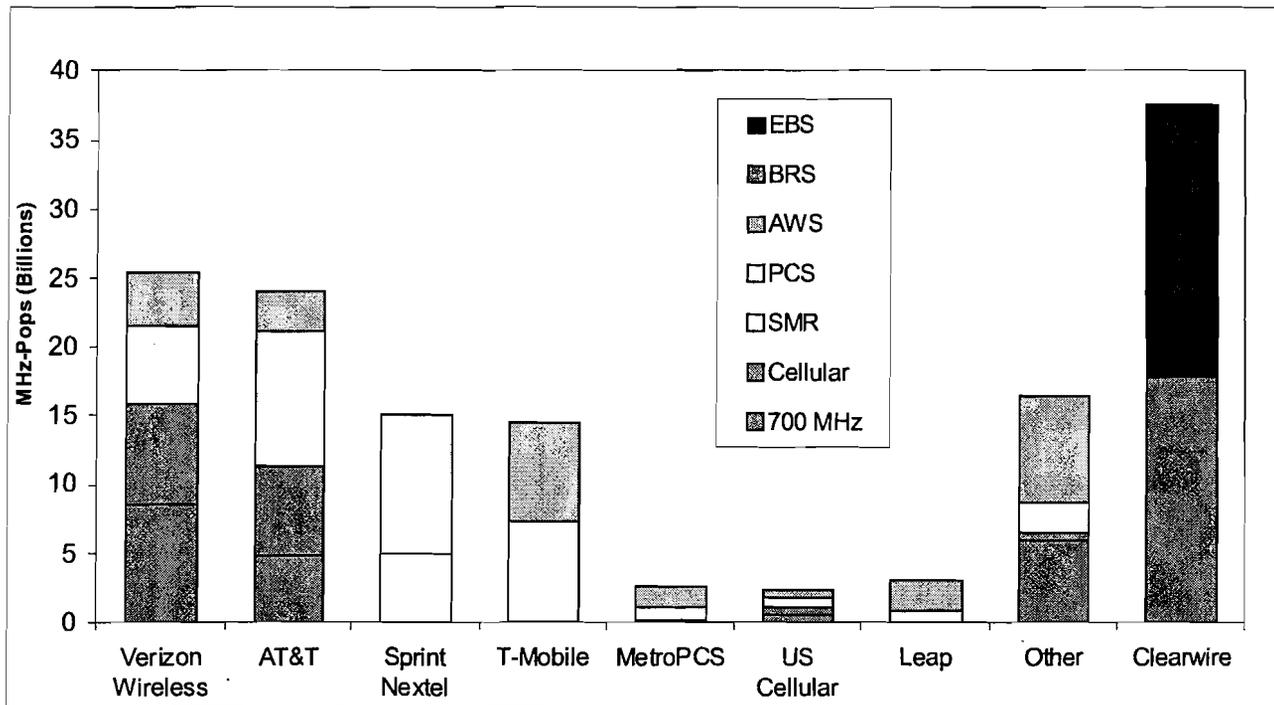
Table 26
Population-Weighted Average Megahertz Holdings*
by Provider, by Frequency Band
(Providers Listed by Number of Subscribers as of 2Q 2009)

Licensee	700 MHz	Cellular	SMR	PCS	AWS	BRS	EBS
Verizon Wireless	29.9	24.3	0.0	20.0	13.5	0.0	0.0
AT&T	17.0	21.2	0.0	33.7	10.1	0.0	0.0
Sprint Nextel	0.0	0.0	17.7	34.8	0.0	0.0	0.0
T-Mobile	0.0	0.0**	0.0	25.6	24.8	0.0	0.0
MetroPCS	0.4	0.0	0.0	3.4	5.3	0.0	0.0
US Cellular	1.9	2.2	0.0	2.3	1.8	0.0	0.0
Leap	0.0	0.0	0.0	3.0	7.9	0.0	0.0
Other	20.9	2.5	1.3	7.2	26.6	10.1	42.8
Clearwire	0.0	0.0	0.0	0.0	0.0	63.4	69.8

* Weighted average megahertz is the sum of the provider's MHz-POPs, divided by the U.S. population.

** T-Mobile holds a very small amount of Cellular spectrum.

Chart 40
Mobile Wireless Provider Spectrum Holdings by Band
Weighted by Population



c. Analysis of Spectrum Holdings by Spectrum Characteristics

268. 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. Two licensees may hold equal quantities of bandwidth but nevertheless hold very different spectrum assets. As discussed below, it has long been recognized that spectrum resources in different frequency bands can have widely disparate technical characteristics. In particular, 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,⁷²⁷ and the AWS, PCS, and BRS/EBS bands – at around 2 and 2.5 GHz – are well above 1 GHz. The different propagation characteristics of these bands impact how they can be used to deliver mobile services to consumers. Bidders in recent auctions in the United States also appear to have recognized these differences, which helps explain the significantly different prices per MHz-POP in the AWS-1 and 700 MHz auctions. There may be important complementarities associated with a provider having access to spectrum in both the lower and higher frequency bands. Not only has the Commission recognized these differences in past proceedings, but regulators in other countries have also adopted policies taking these differences into account as additional spectrum becomes available.

269. Lower frequency bands – such as the 700 MHz and Cellular bands – possess more

⁷²⁷ Although SMR spectrum also falls below 1 GHz, broadband operations using this spectrum have not been shown to be viable pending completion of 800 MHz rebanding, as noted in the National Broadband Plan, given the interference protection provided to neighboring public safety operations per 47 CFR § 90.672. See National Broadband Plan, Chapter 5 n. 63. In addition, the commercial SMR spectrum in the 900 MHz band currently is interleaved with Business/Industrial/Land Transportation services, and thus is best suited for narrowband deployments.

favorable intrinsic spectrum propagation characteristics than spectrum in higher bands.⁷²⁸ “Low-band” spectrum can provide superior coverage over larger geographic areas, through adverse climate and terrain, and inside buildings and vehicles. As the Commission has noted in the 700 MHz band proceeding, this lower frequency spectrum had “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.”⁷²⁹ Several commenters in this and related proceedings also have noted the advantages of lower frequency spectrum for coverage and penetration.⁷³⁰ In its consideration of mobile wireless competition issues, DOJ has noted the differences between the use of lower and higher frequency bands.⁷³¹ Regulators in other countries also 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 are adopting policies intended to help facilitate the wider distribution of this newly available spectrum.⁷³² Low-band spectrum is sometimes referred to as “beachfront” spectrum given its superior propagation features.⁷³³

⁷²⁸ See, e.g., Service Rules for the 698-746, 747-762, and 777-792 MHz Bands, WT Docket No. 06-150, 22 FCC Rcd 15289, 15349 ¶ 158, 15354-55 ¶ 176, 15400-401 ¶ 304 (2007) (*700 MHz Band Second R&O*) (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).

⁷²⁹ See, e.g., *700 MHz Band Second R&O*, 22 FCC Rcd at 15349, ¶ 158.

⁷³⁰ See, e.g., NTELOS comments at 9 (Cellular and 700 MHz licenses are the “optimum spectrum ranges for delivering mobile services”); 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.

⁷³¹ 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).

⁷³² For instance, in its auction of mobile spectrum that began in April of 2010, Germany has 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. In March 2010, the United Kingdom (UK) Government similarly proposed a spectrum cap for the upcoming auction of sub-1 GHz spectrum (in the 800 MHz band). Draft Statutory Instruments, *The Wireless Telegraphy Act 2006 (Directions to OFCOM)*, Mar. 2010, at 5, available at http://www.opsi.gov.uk/si/si2010/draft/pdf/ukdsi_9780111497319_en.pdf. The UK Government also proposed that there be a spectrum cap on total mobile services spectrum that any provider could hold.

⁷³³ See, e.g., *T-Mobile April 26, 2010 Ex Parte Letter* (stating that lower band spectrum is widely considered “beachfront” spectrum because of its propagation characteristics).

270. Low-band spectrum can enable the same level of service, 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 BRS/EBS band.⁷³⁴ A licensee that exclusively or primarily holds spectrum in a higher frequency range 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.⁷³⁵ 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.⁷³⁶ 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.⁷³⁷

271. The higher value that many providers have placed on low-band spectrum with respect to the provision of mobile service – especially mobile broadband service – is demonstrated by a comparison of market valuations. The recent auctions of AWS and 700 MHz spectrum (Auctions 66 and 73, respectively) provide a basis for comparison, as both auctions involved large quantities of paired spectrum in a relatively close timeframe. In the 2008 auction of 700 MHz spectrum, the average price for the 700 MHz spectrum was \$1.28 per MHz-pop.⁷³⁸ This unit price was more than twice the average price of \$0.54 per MHz-pop for AWS spectrum auctioned in 2006.⁷³⁹

272. Conversely, higher-frequency spectrum may be particularly effective for providing significant capacity, or increasing capacity, within a smaller geographic area.⁷⁴⁰ In certain situations, higher frequency bands can achieve greater improvements in capacity. For instance, capacity

⁷³⁴ See, e.g., *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). See also, *Morgan Stanley Mobile Internet Report*, at 313-314 (lower spectrum allocations, such as 700 MHz spectrum, help lower capital expenditures by broadening reach); John Stankey, President and CEO, AT&T Operations, Inc., January 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”).

⁷³⁵ While propagation characteristics are important with regard to coverage in urban areas, especially in-building coverage, site spacing in these areas can also be driven by the need for capacity. AT&T, for instance, notes 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. It states 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.” AT&T NOI Comments at 81-83.

⁷³⁶ 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).

⁷³⁷ Okumura-Hata is a widely used RF propagation. See John S. Seybold, *Introduction to RF Propagation*, Wiley-Interscience, 2005.

⁷³⁸ See generally FCC, *Auction 73 – 700 MHz Band*, http://wireless.fcc.gov/auctions/default.htm?job=auction_summary&id=73.

⁷³⁹ See generally FCC, *Auction 66 – Advanced Wireless Services*, http://wireless.fcc.gov/auctions/default.htm?job=auction_summary&id=66.

⁷⁴⁰ *Verizon Wireless May 12, 2010 Ex Parte Letter* at 2-3. 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.

enhancement technologies such as MIMO may perform better at higher frequencies.⁷⁴¹ In addition, while spectral efficiency is the same for all spectrum bands when using a given technology (and bandwidth),⁷⁴² there currently is significantly more spectrum above 1 GHz that is potentially available for use (as shown by Table 24, above). Further, in many parts of these higher bands, spectrum is licensed in larger contiguous blocks,⁷⁴³ which 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.⁷⁴⁴

273. Some analysts also have observed 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. 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 as well as deep into buildings in urban areas. However, in urban areas where traffic concentration is high, this base coverage layer may be complemented with a capacity layer using high frequency spectrum.⁷⁴⁵ In this sense, higher-frequency spectrum is 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.

274. *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, has very few spectrum licenses below 1 GHz.

275. Of the sub-1 GHz spectrum, Verizon Wireless and AT&T each hold a significant amount of the Cellular and 700 MHz spectrum, while Sprint Nextel holds the majority of SMR spectrum (see Table 25). Specifically, when measured on a licensed MHz-POP basis, Verizon Wireless holds 48.5 percent of the Cellular spectrum and 42.7 percent of the 700 MHz spectrum, and AT&T holds 42.3 percent of the Cellular spectrum and 24.3 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 33 percent, and US Cellular holds approximately 5 percent. Several other, smaller providers' combined holdings total less than four percent of the Cellular but nearly a third of the 700 MHz spectrum. Meanwhile, Sprint Nextel holds nearly all of the SMR spectrum.

276. 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. In recent years, providers have been upgrading their Cellular-based networks from 2G and 2.5G technologies to 3G technologies in most markets across the United States. As discussed earlier, SMR spectrum generally is not as suitable for broadband operations.⁷⁴⁶ Deployment of networks in the 700 MHz unpaired spectrum blocks have generally be limited, to date, to

⁷⁴¹ *Verizon Wireless May 12, 2010 Ex Parte Letter at 3; AT&T May 13, 2010 Ex Parte Letter at 3.*

⁷⁴² *AT&T May 13, 2010 Ex Parte Letter at 2.*

⁷⁴³ *Id. at 3.*

⁷⁴⁴ 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.

⁷⁴⁵ *Id.* (“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”).

⁷⁴⁶ See Para 254, *supra*.