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

In the Matter of	)	
Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993	)	WT Docket No. 13-135
Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, Including Commercial Mobile Services	)	

SEVENTEENTH REPORT

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By the Chief, Wireless Telecommunications Bureau:

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I. INTRODUCTION

1. In this Seventeenth Mobile Wireless Competition Report (*Report*), the Federal Communications Commission (Commission or FCC) fulfills its obligation, pursuant to Section 332(c)(1)(C) of the Communications Act, to report annually to the Congress on the state of competition in mobile services. Competition in mobile wireless services is a cornerstone of the Commission's mission and essential for driving innovation, investment, and consumer benefits. In recent years, mobile wireless services have gone from a luxury to a convenience to an absolutely central part of Americans' daily lives. Increasing numbers of users now have multiple devices connected to mobile networks. Handsets are no longer used just for voice communication, email, social networking, and web browsing, but increasingly as hubs for entertainment, mobile commerce, and to connect other personal devices such as smart watches and fitness monitors. These developments have helped make mobile wireless one of the most important sectors in the national economy.

2. Following on the *Sixteenth Report*, released in March 2013, which provided an analysis of market conditions and developments during 2010, 2011, and 2012,[1] this *Report* presents data and analysis covering 2013 and the first half of 2014, to the extent data are available.[2] The analysis focuses on "competitive market conditions with respect to commercial mobile services," as required by the Act.[3] While like the *Sixteenth Report*, this *Report* presents a multitude of industry data on various aspects of mobile wireless competition,[4] it employs a more data-centric model, with a more concise analysis along with a greater use of Tables and Charts in accessible data formats. For instance, we are providing the charts and tables in the *Report* and its Appendices, as well as much of the underlying data, on a dedicated website[5] that we intend to update before the release of the next Report as new data becomes available.

3. Similar to previous reports, the analysis in this *Report* is based on a consumer-oriented view of mobile services, with a focus on specific product categories regardless of their regulatory classification. Thus, our analysis of commercial mobile radio services (CMRS) is integrated into an analysis of all mobile wireless services, including not only voice, but also messaging and broadband.[6] Because consumers increasingly view various mobile voice, messaging, and data services as interchangeable with one another, no matter their regulatory classification, service providers are competing for customers using CMRS services as well as non-CMRS services. As a result, the Commission has indicated that it is important to consider potential substitutes when analyzing the competitive landscape for these services, and to evaluate the mobile wireless industry as a whole, rather than just focusing on the provision of CMRS services.[7] This *Report* analyzes competition across the entire

[1] Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993, Annual Report and Analysis of Competitive Market Conditions with Respect to Commercial Mobile Services, *Sixteenth Report*, 28 FCC Rcd at 3836 (2013) (*Sixteenth Report*).

[2] For instance, much data are only published as year-end numbers and are publicly available only in middle of the following year. For example, all CTIA data are yearend 2013, and this is available in their annual report published in July 2014. For these data, we are able to present only 2013 numbers with no mid-year updates. As more data becomes available, we plan to provide web updates rather than wait until release of the next Competition Report.

[3] 47 U.S.C. § 332(c)(1)(C),.

[4] 47 U.S.C. § 332(c)(1)(C). As with previous *Reports*, this *Report* does not address the merits of any license transfer applications that are currently pending before the Commission or that may be filed in the future, which will be decided based on the record collected in each proceeding.

[5] fcc.gov/wireless-competition-report

[6] *See* Section II, Introduction, *infra*.

[7] *See Sixteenth Report at* 28 FCC Rcd at 3836 (2013) at ¶*31*. As the Commission has concluded, paraphrasing the Department of Justice/Federal Trade Commission guidelines on merger review, "When one product is a reasonable substitute for the other in the eyes of consumers, it is to be included in the relevant product market even though the products themselves are not identical." Application of Echostar Communications Corporation, General Motors Corporation, and Hughes

mobile wireless marketplace, including key market segments such as spectrum and infrastructure. This *Report*, like the previous three *Reports*, adopts an approach similar to the earliest reports, but undertakes an expanded and more detailed competitive analysis of the entire mobile wireless ecosystem.

4. Congress enacted the requirement in 1993 that the Commission report annually on "competitive market conditions with respect to commercial mobile services."[8] At the same time, it created the statutory classification of "commercial mobile services" to promote the consistent regulation of mobile radio services that are similar in nature,[9] and established the promotion of competition as a fundamental goal for CMRS policy formation and regulation.[10] In particular, the statute requiring the annual report on CMRS competition states:

> The Commission shall review competitive market conditions with respect to commercial mobile services and shall include in its annual report an analysis of those conditions. Such analysis shall include an identification of the number of competitors in various commercial mobile services, an analysis of whether or not there is effective competition, an analysis of whether any of such competitors have a dominant share of the market for such services, and a statement of whether additional providers or classes of providers in those services would be likely to enhance competition.[11]

5. This *Report* complies with the statutory requirements for analyzing competitive market conditions with respect to commercial mobile services by employing an analysis founded upon an expanded view of the mobile wireless services marketplace and an examination of competition across the entire mobile wireless ecosystem. We analyze competitive rivalry in the mobile wireless industry, and the benefits received by consumers. This competitive analysis also identifies areas where competition is strong, as well as areas that could benefit from increased competition.

6. Consistent with the Commission's first seven *Reports*, and the *Fourteenth* and subsequent *Reports*, this *Seventeenth Report* does not reach an overall conclusion or formal finding regarding whether or not the CMRS marketplace was effectively competitive, but provides an analysis and description of the CMRS industry's competitive metrics and trends.[12] Given the complexity of the various inter-related segments and services within the mobile wireless ecosystem, we refrain from providing any single conclusion because such an assessment would be incomplete and possibly misleading in light of the variations and complexities we observe. Rather, the *Report* focuses on presenting the best data available on competition throughout this sector of the economy, both at the regional and national level, and highlighting several key trends in the mobile wireless industry. We note that there is no definition of "effective competition" widely accepted by economists or

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Electronics Corporation (Transferors) and Echostar Communications Corporation (Transferee), *Hearing Designation Order*, 17 FCC Rcd 20559, 20606 ¶ 106 (2002).

[8] 47 U.S.C. § 332(c)(1)(C). As noted in previous *Reports*, any individual proceeding in which the Commission defines relevant product and geographic markets, such as an application for approval of a license transfer, may present facts pointing to narrower or broader markets than any used, suggested, or implied in this *Report*. *See, e.g.*, Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993, Annual Report and Analysis of Competitive Market Conditions with Respect to Commercial Mobile Services, *Twelfth Report*, 23 FCC Rcd 2241, 2250 ¶ 3 n. 5 (2008) (*Twelfth Report*).

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

[10] 47 U.S.C. § 332 (a)(3).

[11] 47 U.S.C. § 332 (c)(1)(C).

[12] This is in contrast to the *Eighth* through the *Thirteenth Reports*, which included a specific finding that there was effective competition in the CMRS market without defining the term "effective competition." *See, e.g.*, *Thirteenth Report*, 24 FCC Rcd 6185.

competition policy authorities such as the U.S. Department of Justice (DOJ).[13] The approach taken in this *Report* is consistent with the policy of the DOJ.

7. This *Report* first provides an analysis of the overall competitive dynamics of the industry, describing the various types of entities and their positions *vis a vis* one another across indices such as market share and various financial indicators.[14] The *Report* then presents a broad overview of trends and developments in the mobile marketplace that have taken place since the *Sixteenth Report*, such as subscribership growth, adoption and deployment of technologies, and usage trends. While most of the developments have been along a continuum of previously noted trends, the ongoing deployment and adoption of LTE networks and the technologies they have enabled, has had a particularly profound effect throughout the mobile wireless marketplace during the period under review.

8. The *Report* then turns to an analysis of key inputs necessary for provision of mobile service, such as spectrum resources and network infrastructure. Spectrum, in particular, is the single most important input that wireless providers need for the provision of service and is a finite and scarce resource. The *Report* examines how the distribution of spectrum in the various bands affects competition. The *Report* next examines developments in the ways providers compete for and attract subscribers through pricing innovations, such as the decreased reliance on traditional handset subsidies and term contracts. As part of this analysis, the analysis looks at the differences between pre and postpaid market segments as well as ways in which those segments are converging. Finally, the *Report* analyzes competitive rivalry in non-price factors, such as coverage, service quality and speed of providers' service offerings.

9. In addition to providing analysis of market conditions, various sections of the *Report* highlight Commission policies and actions designed to enhance competition -- for example, by making more spectrum available to existing mobile service providers and potential new entrants through competitive bidding such as the upcoming AWS-3 and incentive auctions. We also revised our transaction review process and spectrum screen to ensure that multiple providers in each market have access to sufficient spectrum to compete effectively.[15] The Commission's policies have been guided by the goal of promoting and preserving competition, which in turn has facilitated the ability of consumers to make choices among numerous service providers and leads to lower prices, improved quality, and increased innovation.[16]

II. COMPETITIVE DYNAMICS WITHIN THE INDUSTRY

10. As part of our analysis of competition in the mobile wireless services industry, we begin by discussing some of the various competitive dynamics within the industry.[17] Providers of mobile wireless services

[13] *See Ex Parte* Submission of the United States Department of Justice, GN Docket No. 09-51 at 11 (filed Jan. 4, 2010). The DOJ states, "[t]he operative question in competition policy is whether there are policy levers that can be used to produce superior outcomes, not whether the market resembles the textbook model of perfect competition."

[14] . Dollar figures stated in this *Report* have not been adjusted for inflation (*i.e.*, they are nominal dollars) unless stated otherwise.

[15] *See* In The Matter Of Policies Regarding Mobile Spectrum Holdings Expanding The Economic And Innovation Opportunities Of Spectrum Through Incentive Auctions, WT Docket No. 12-269, *Report and Order (Mobile Spectrum Holdings Report and Order)*, 29 FCC Rcd 6133

[16] *See Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6144¶ 17, and at 6193¶ 143. Our public interest evaluation necessarily encompasses the "broad aims of the Communications Act," which include, among other things, a deeply rooted preference for preserving and enhancing competition in relevant markets, accelerating private sector deployment of advanced services, and generally managing the spectrum in the public interest. *See, e.g.*, *AT&T WCS Order*, 27 FCC Rcd at 16464 ¶ 11; *AT&T-Centennial Order*, 24 FCC Rcd at 13928 ¶ 28;.

[17] We discuss in more detail in Sections IV and V below additional aspects in the competitive dynamics of the industry when we discuss elements of price and non-price rivalry.

offer an array of mobile voice and data services, including interconnected mobile voice services, text and multimedia messaging, and mobile broadband Internet access services. Mobile wireless services also include machine-to-machine connections for fleet management systems, smart grid devices, vehicle tracking, home security systems, and other telematics services. This section presents information and data on all mobile wireless services as well as on individual services and segments where appropriate and when the data are available.[18]

A. Service Providers

1. Facilities-Based Providers

11. Facilities-based mobile wireless service providers offer mobile voice, messaging, and/or data services primarily using their own network facilities, although coverage areas usually are supplemented through roaming agreements.[19] Facilities-based providers can operate nationwide, multi-regional, regional, or local networks. Some data and messaging services offered by facilities-based providers rely only on Internet Protocol (IP)-based, packet-switched networks, but most mobile voice services continue to connect to the Public Switched Telephone Network (PSTN) and rely on North American Numbering Plan telephone numbers.

12. *Nationwide Service Providers*. As of year-end 2013, there were four facilities-based mobile wireless service providers in the United States that industry observers typically describe as "nationwide." These providers include AT&T,[20] Sprint,[21] T-Mobile,[22] and Verizon Wireless.[23] Although none of these four providers has a network that covers the entire land area or population of the United States, each has a network that covers a significant portion of both, and therefore these four providers will be referred to as "nationwide providers" throughout this *Report*.[24] Each of the four nationwide service providers has a mobile wireless network that covers in excess of 99 percent of the U.S. population.[25]

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[18] See *Sixteenth Report, 28 FCC Rcd at 3836* at ¶ 20 - 22

[19] Fixed wireless services are currently not included in our analysis of mobile wireless services.

[20] AT&T Mobility is the successor of Cingular, a joint venture formed in October 2000 between Southwestern Bell (SWB) and Bell South. In 2005, SWB subsidiary that included SWB's interest in Cingular merged with AT&T Corp. In 2006, AT&T acquired Bell South and therefore 100% ownership of Cingular. As of December 31, 2013, AT&T Mobility served more than 110 million subscribers." *See* AT&T Inc., SEC Form 10-K, filed Feb. 21, 2014, at 2.

[21] Sprint Nextel was created by the merger in 2005 of Sprint Corp. and Nextel Communications, Inc. *See* Tenth Report, 20 FCC Rcd at 15931 ¶ 60. On July 5, 2013, the FCC released an order approving the acquisition of Sprint by SoftBank Corp., and Sprint's acquisition of 100 percent of Clearwire's stock. *See Softbank-Sprint-Clearwires Order*, 28 FCC Rcd at 9643-44 ¶ 1-4.

[22] T-Mobile traces its roots to May 2001,when Deutsche Telekom AG (DT) acquired in a deal worth $24 billion two US providers -- VoiceStream Wireless (formerly a division of Western Wireless that had recently acquired regional GSM providers Aerial Communications in the Midwest and Omnipoint in the Northeast), and Southern regional provider Powertel. In September 2002, they were re-branded nationally with the T-Mobile name, conforming to the brand under which DT provided mobile services overseas. *See* http://www.celtnet.org.uk/telecos/T-mobile.php Most recently, on March 12, 2013, the FCC released an order approving the application of Deutsche Telekom, T-Mobile, and MetroPCS, which resulted in the creation of T-Mobile USA as a wholly-owned subsidiary of Deutsche Telekom . See T-Mobile-MetroPCS Order, 28 FCC Rcd at 2323-24 ¶ 1-2.

[23] As of December 31, 2013, Verizon owned a controlling 55% interest in Verizon Wireless and Vodafone owned the remaining 45%. *See* Verizon Communications, Inc., SEC Form 10-K, filed Feb. 27, 2014, at 2. On February 21, 2014, Verizon completed its acquisition of Vodafone's 45 percent indirect interest in Verizon Wireless, so that Verizon now owns 100 percent of Verizon Wireless. *See* http://newscenter.verizon.com/corporate/news-articles/2014/02-21-acquisition-of-vodafone-stake-in-vzw-complete/

[24] All four nationwide have spectrum in CONUS and in HI and AK.

[25] Thus, a nationwide network covers a sufficiently large percentage of the population such that it would be inappropriate to categorize it as a regional network.

13. All nationwide providers provide service directly to consumers and businesses and also provide machine-to-machine (M2M) services. Later in the *Report*, detailed data and analysis are provided on the retail voice and broadband service provided by these companies. However, there are limited statistics on M2M communications. The research firm "Current Analysis" estimates that AT&T had approximately 14.7 million M2M connections, Verizon Wireless had between 7 and 9 million connections, and both Sprint and T-Mobile had 3.3 million connections. M2M has gained significant interest in the past few years as providers continue to provide connectivity between devices, sensors, monitors, etc. and their networks. The new "Internet of Things" (IoT) is seen by some commentators as promising the next major opportunity for providing interconnection and advanced connect among devices. Many industries such as healthcare, are transforming to use M2M networks to connect their numerous smart devices and machines. While M2M resides mostly in the Enterprises space, more and more providers are launching services for the home market.

14. *Multi-Regional, Regional, and Local Service Providers*. US Cellular is a multi-regional service provider that has developed wireless networks and customer service operations covering five geographic market areas in portions of 23 states that collectively represent a total population of 31.8 million as of December 31, 2013."[26] US Cellular relies on roaming agreements with nationwide facilities-based providers, as well as other smaller providers, to supply service to its customers in areas not covered by its networks. C-Spire and Ntelos are two other regional providers with substantial market presence in certain parts of the country. There are also dozens of regional and local facilities-based providers throughout the continental United States, Alaska, and Hawaii that typically provide service in a single geographical area, many of them rural areas.[27]

2. Resale and MVNO Providers

15. Resellers and mobile virtual network operators (MVNOs) do not own any network facilities but instead purchase mobile wireless services wholesale from facilities-based providers and resell these services to consumers.[28] An agreement between an MVNO and a facilities-based provider may be more likely to occur when the MVNO has better access to some market segments than the host facilities-based provider, possibly due to its brand reputation, distribution network, marketing strategies, or business model.[29] MVNOs often increase the range of services offered by the host facilities-based provider by targeting specific market segments, including segments previously not served by the hosting facilities-based provider.[30] Hence, the relationship between an MVNO and its hosting facilities-based provider can be a mutually beneficial strategic partnership.[31] In 2013, the

[26] United States Cellular Corp., SEC Form 10-K for the fiscal year ended December 31, 2013 at 1.

[27] Some regional facilities based providers include, but are not limited to, Alaska Communications, Big River Broadband, Bluegrass Cellular, Cellcom, Choice Wireless, GCI Wireless, People's Wireless, Pioneer, West Central Wireless.

[28] According to one service provider, "MVNOs execute a contract with [the facilities-based provider] to buy wireless service from [the facilities-based provider] to resell under their own brand to customers and perform all marketing, billing, collections and customer service for the customers they activate. MVNOs establish and maintain the relationship with its customers. MVNOs own the relationship with their customers and establish their own calling plans and pricing." *See* Verizon Wireless, *Authorized Retailers and MVNOs*, http://www.verizonwireless.com/b2c/aboutUs/reseller/authorizedAgentIndex.jsp (visited June. 23, 2014).

[29] *See* P. Kalmus and L. Wiethaus, *On the Competitive Effects of Mobile Virtual Network Operators*, Telecommunications Policy, Vol. 34, 2010 at 263, 266, 268.

[30] *See* P. Kalmus and L. Wiethaus, *On the Competitive Effects of Mobile Virtual Network Operators*, Telecommunications Policy, Vol. 34, 2010, at 268 (*On the Competitive Effects of Mobile Virtual Network Operators). See* A. Banerjee and C. Dippon, *Voluntary Relationships Among Mobile Network Operators and Mobile Virtual Network Operators: An Economic Explanation*, Information Economics and Policy, Vol. 21, 2009, at 72 (*Voluntary Relationships Among Mobile Network Operators and Mobile Virtual Network Operators: An Economic Explanation*).

[31] *See* The Yankee Group, Jason Armitage, *Yankee Group's 2011 Predictions: 4G Fuels the Decade of Disruption*, at 7 (stating, "[I]t's critical the MVNO does not compete to any meaningful degree with the host.")

largest MVNO was TracFone Wireless (TracFone).[32]

16. Unlike facilities-based providers, MVNOs do not engage in non-price rivalry by creating capacity through network investments, network upgrades, or network coverage. MVNOs may target their service and product offerings at specific demographic, lifestyle, and market niches, including consumers who are low income, are relatively price sensitive, do not want to commit to multi-year subscription contracts, have low usage needs, or do not want to buy a bundle that contains unwanted data services. Following widespread industry practices, the Commission generally attributes the subscribers of MVNOs to their host facilities-based providers, including when it calculates market concentration metrics.

3. Other Providers

17. *Narrowband Data Providers.* Narrowband data and paging services comprise a specialized market segment of the mobile wireless industry. These services include two-way messaging, as well as machine-to-machine and other telemetry communications, and are consumed primarily by businesses, government users, and other institutions. According to XXXX licensing databases, there is approximately seven megahertz of spectrum allocated to narrowband and paging services, and there are hundreds of licensees for these services, including private individuals, firms, and local and state governments.

18. *Mobile Satellite Service Providers.* Mobile Satellite Services (MSS) providers offer satellite-based communications to mobile devices. Traditionally, MSS has involved voice and narrowband data services. MSS services are generally targeted at users who require service in remote areas, in disaster response situations, or other places where terrestrial mobile wireless network access may be limited.[33] Examples of MSS customers include the oil industry, maritime users, public safety agencies, and other government/military operations.

B. Connections, Net Additions, Churn

1. Subscribers and Total Connections, and Net Additions

19. In the period since the *Sixteenth Report*, the U.S. mobile wireless services industry experienced continued strong growth, with total wireless connections up by 10 million in 2013.[34] Of the four nationwide facilities-based providers, AT&T and Verizon Wireless maintained the largest market shares throughout 2013.[35] T-Mobile had the largest quarterly increases in market share during this time period. While Sprint steadily lost subscribers in the first three quarters of 2013, it rebounded slightly in the final quarter of the year.[36]

20. This *Report* uses several data sources to estimate the number of mobile wireless subscribers and connections. One source, the Numbering Resource Utilization Forecast (NRUF), tracks the quantity of phone numbers that have been assigned to mobile wireless devices.[37] Based on NRUF data, it appears that the number

[32] Some MVNO companies that currently provide service include Straight Talk, H2O Wireless, Ultra Mobile, Net10, LycaMobile, Spot Mobile, Telcel America, GIV Mobile, Simple Mobile, Red Pocket, Pure Talk, PagePlus, Ting, iWireless, Voyager, FreedomPop, ROK Mobile, Tracfone, See sprint/?utm_source=GeneralUsers&utm_campaign=41e3559dd9-c:tec,mdad:07-29&utm_medium=email&utm_term=0_1dd83065c6-41e3559dd9-98996217
http://gigaom.com/2014/07/28/unlock-phone-att-verizon-tmobile

[33] *See Thirteenth Report*, 24 FCC Rcd at 6301 ¶ 247.

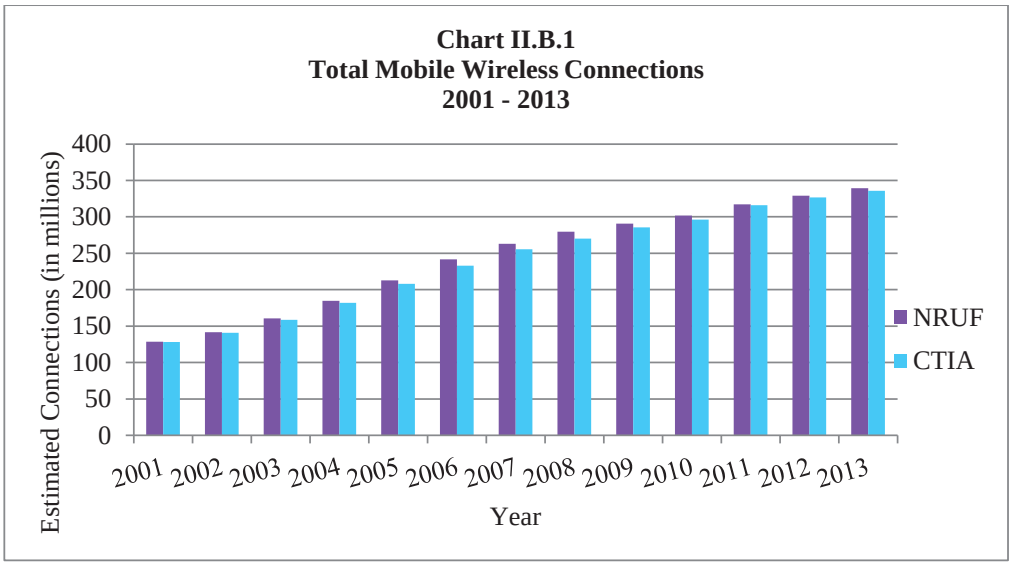
[34] NRUF, Dec 2013.

[35] *UBS Investment Research. US Wireless 411 v51 4Q13.* Figure 21

[36] *UBS Investment Research. US Wireless 411 v51 4Q13,* Figure 24

[37] When all mobile wireless devices were assigned telephone numbers and subscribers generally carried one mobile device for making voice calls, NRUF provided reasonably accurate measures of subscribership. Now, however, consumers are more likely to use more than one mobile device that have been assigned telephone numbers – particularly non-voice devices, such as Internet access devices (e.g., wireless modem cards, netbooks, and mobile Wi-Fi hotspots), e-readers, tablets, and telematics systems. In addition, certain mobile broadband providers do not assign telephone numbers to at least some of the devices on their networks. Therefore, NRUF is becoming less useful in measuring the number of individual subscribers.

of mobile wireless connections in 2013 were 335.7 million. Connections grew three percent during 2013, from 329.2 million at the end of 2012, to 339.2 million at the end of 2013. CTIA also estimated the total number of mobile wireless connections based on its own industry survey,[38] and found that the number of connections grew by three percent during the same period, from 326.5 million at the end of 2012, to 335.7 million at the end of 2013.[39] This information is presented in Chart II.B.1.



Note. Based on data from NRUF, CTIA (CTIA Year-End 2013 Wireless Indices Report, Table 6). Latest available data.

21. Chart II.B.2 presents data on total connections by service segment. The postpaid segment accounts for more than 60 percent of the total connections over the reported period, while the prepaid connections have grown from approximately 15 to 20 percent of the total connections. Wholesale connections and connected devices are a small but growing portion of the total connections.[40]

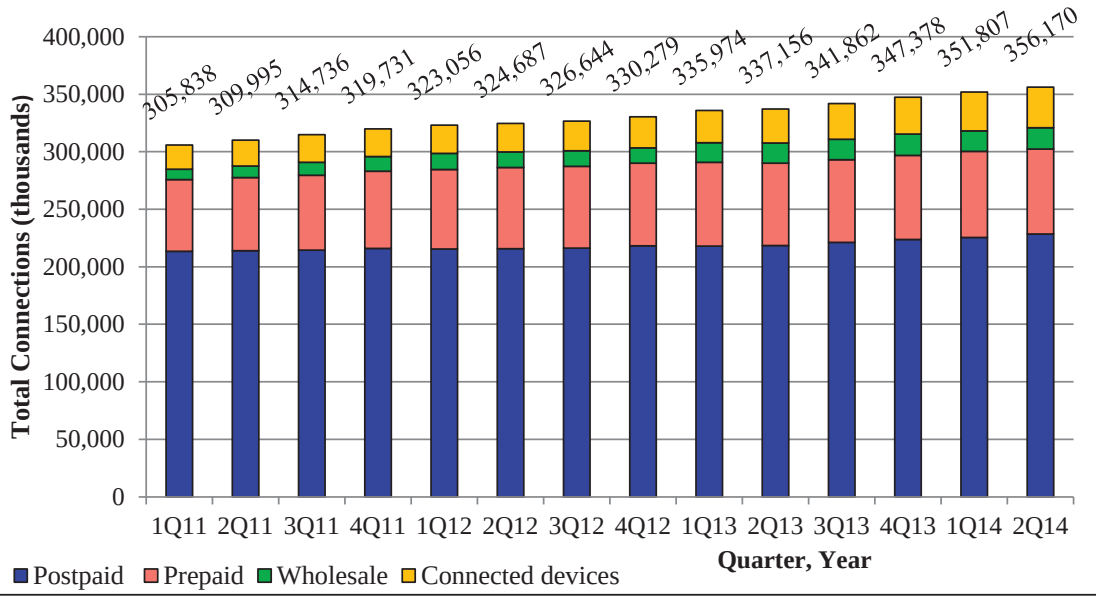
Instead, it is providing more of an estimate of the number of mobile wireless connections or connected devices. In addition, it will become a less accurate measure of connected devices to the extent that more devices are sold that do not use telephone numbers.

[38] CTIA states that "the terms subscriber, subscriptions, and connections are being used interchangeably" in their report and survey. *See* CTIA Wireless Industry Indices at p. 7.

[39] See Appendix Table II.B.i for detailed data.

[40] See Appendix Table II.B.ii for detailed data.

Chart II.B.2
Qualrterly Total Mobile Wireless Connections by Service Segment
2011-1st Half 2014



Source: *UBS Investment Research. US Wireless 411 Version 51.* Figure 17: *US Wireless 411 Version 54.*

22. Table II.B.1 presents data on total connections of the larger individual providers Based on the 2014 data, it appears that AT&T and Verizon Wireless account for roughly two-thirds of the estimated connections, with Sprint and T-Mobile together accounting for slightly less than a third. Regional providers accounted for approximately 3 percent of the total mobile wireless connections.

Table II.B.1
Estimated Total Connections for Publicly Traded Facilities–Based Mobile Wireless Service Providers (In thousands)
2011- 1st Half 2014

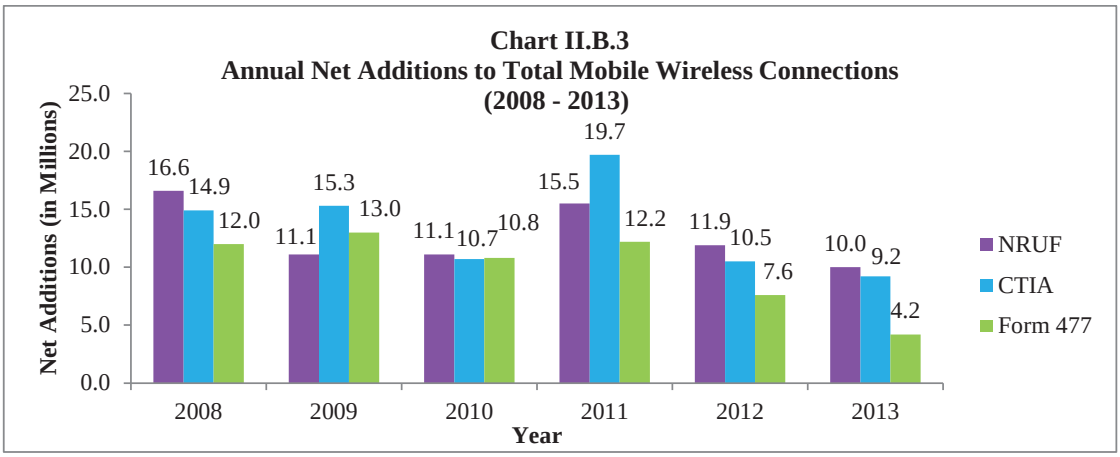
Nationwide Providers	2011	2012	2013	1st Half 2014
Verizon Wireless	108,667	116,570	125,535	129, 615
A&T	103,247	106,965	110,276	116,542
Sprint	55,021	55,626	54,622	54,080
T-Mobile	30,756	30,299	46,684	50,545
Nationwide Provider Total	297,691	309,460	337,117	350,782
Regional Providers	**2011**	**2012**	**2013**	**2nd Q 2014**
US Cellular	5,891	5,798	4,774	4,653
Metro PCS	9,347	8,887		
Leap Wireless	5,934	5,297	4,551	
NTELOS	415	440	465	458
Cincinnati Bell	459	398	340	277
Regional Provider Total	22,046	20,820	10,130	5,388
Total Estimated Connections	319,736	330,279	347,247	356,170

Note: *UBS Wireless 411 Report. Version 51 2014 Q1,* Table 21, pp.14. *UBS Wireless 411 Version 54.* Total

estimated connections figure includes data only for the providers reported in the table. Annual numbers are end of the year, 1st half 2014 numbers are end of 2nd quarter 2014.

2. Subscribers and Net Additions

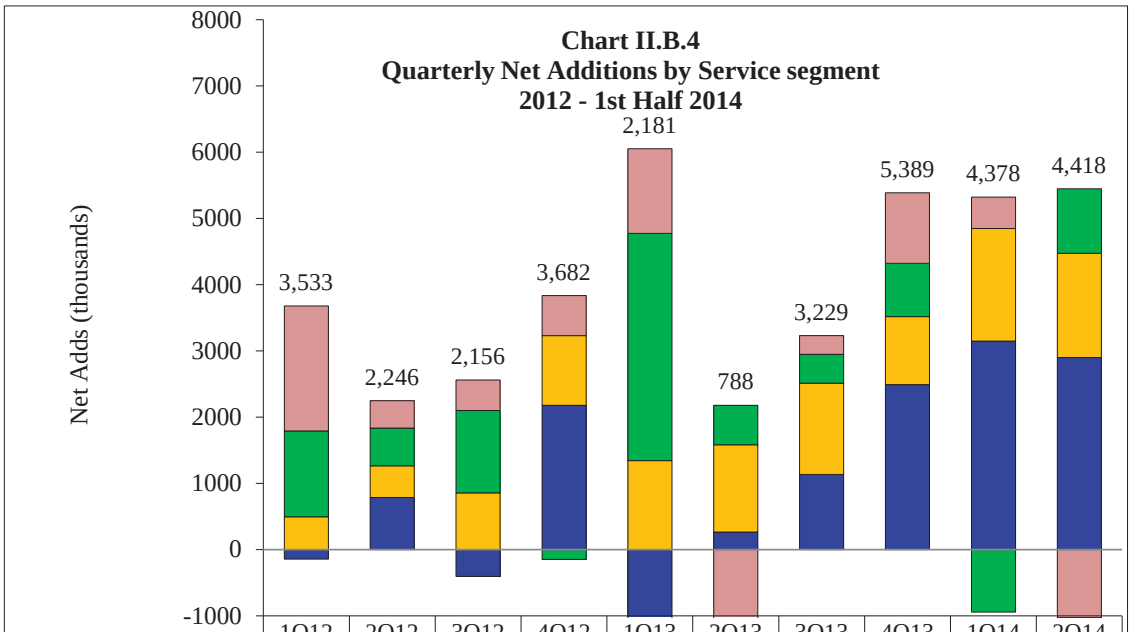
23. Net additions for 2013 totaled 10.0 million based on NRUF data, and 9.2 million based on CTIA data. The Commission is also able to use data reported by service providers on Form 477 to estimate the number of mobile voice subscribers and mobile internet subscribers. Form 477 data generally show a lower number of subscriber additions than NRUF data. Between 2011 and 2013, annual net subscriber additions amounted to 12.2 million, 7.6 million, and 4.2 million, respectively. This information, along with NRUF and CTIA data, is presented in Chart II.B.3.



Source: NRUF, CTIA (CTIA Year-End 2013 Wireless Indices Report Table 6), Form 477. Latest available data.

24. In 2012, quarterly net additions varied by service segment, with connected device adds seeing significant growth. In the fourth quarter of 2012, wholesale additions dropped substantially, while postpaid adds showed significant increase. The net number of connected device additions was consistently higher than prepaid additions during through the first half of 2014, with the second quarter of 2013 and 2014 showing negative prepaid additions. Postpaid net additions fell dramatically in the first quarter of 2013, but climbed for the remainder of the year and showed significant growth in the first half of 2014. This information is presented in Chart II.B.4.[41]

[41] See Appendix Table II.B.iii for detailed data.

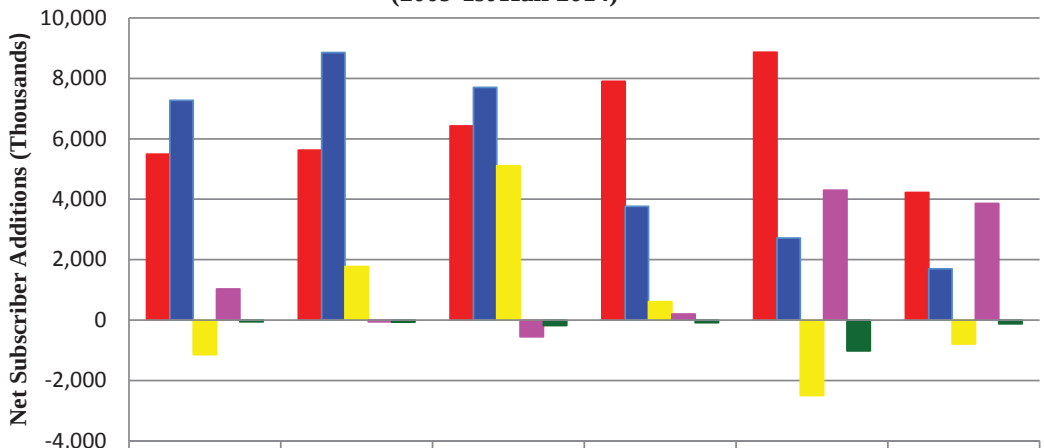


	1Q12	2Q12	3Q12	4Q12	1Q13	2Q13	3Q13	4Q13	1Q14	2Q14
Total	3,533	2,246	2,156	3,682	2,181	788	3,229	5,389	4,378	4,418
Prepaid	1,891	414	462	603	1,278	-1,391	280	1,069	472	-1,029
Wholesale	1,296	568	1,244	-151	3,431	598	436	802	-945	975
Connected Devices	493	480	854	1,053	1,344	1,318	1,381	1,026	1,703	1,574
Postpaid	-147	784	-405	2,177	-3,872	263	1,132	2,492	3,147	2,899

Source: *UBS Investment Research. UBS Wireless 411 Version 54.* Figure 16: UBS categorizes Tracfone customers as prepaid, not wholesale.

25. From 2009 through 2011, AT&T had the largest number of net additions, partly through acquisitions and partly through organic growth. Verizon Wireless had the largest number in 2012, accumulating the most net additions in 2012 and 2013. T-Mobile hovered between third and last place from 2009 to 2012. In 2013, however, T-Mobile experienced a surge in customer growth, moving past AT&T to accumulate the second most net additions for the year, as well as in the first half of 2014. The significant subscriber growth Sprint experienced during 2010 and 2011 slowed significantly in 2012, and Sprint lost customers in 2013. US Cellular lost subscribers every year from 2009 through the first half of 2014. These trends are displayed in Chart II.B.5.

Chart II.B.5
Annual Net Additions by Service Provider
(2009-1st Half 2014)



	2009	2010	2011	2012	2013	1st Half 2014
Verizon	5,486	5,627	6,421	7,903	8,868	4220
AT&T	7,278	8,853	7,699	3,764	2,721	1696
Sprint	-1,141	1,777	5,111	605	-2,500	-796
T-Mobile	1,032	-56	-549	204	4,300	3861
US Cellular	-55	-69	-186	-88	-1,024	-121

Source: *UBS Investment Research. UBS Wireless 411 Version 51.* Figure 14: *UBS Wireless 411 Version 54.*

3. Churn

26. Churn measures the number of connections that are disconnected from mobile wireless service during a given period time period, and is usually expressed as a percentage. Churn is calculated by dividing the aggregate number of wireless subscriber connections who canceled service during a period by the total number of wireless subscriber connections at the beginning of that period. The churn rate for the period is equal to the average of the churn rate for each month of that period, *e.g.*, the three months in a quarter or the twelve months for an annual churn rate. Thus a monthly churn rate of 1 percent averaged over the three month reporting period would also be reported as 1 percent. Providers publish their monthly churn rate information as part of their quarterly filings with the SEC.

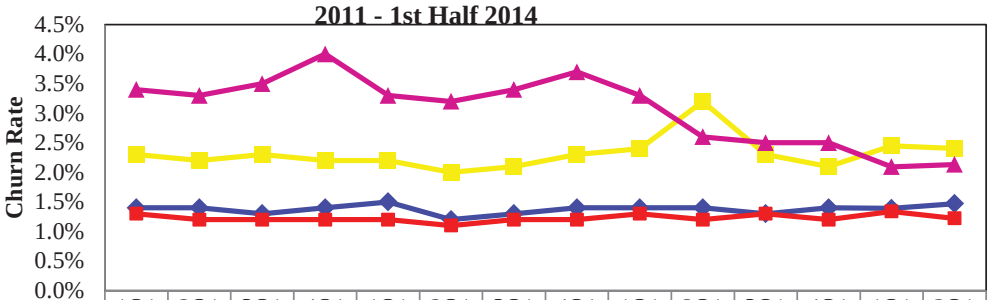
27. A service provider's churn rate depends on many factors, including the distribution of its customers between postpaid and prepaid service plans, customer satisfaction with their service provider, service provider switching costs, and competition. As an example, if a service provider has an average monthly churn rate of 2 percent in each month of a year, the service provider would lose approximately 24 percent of its customer base over the course of the year.

28. Churn rates of the nationwide facilities-based service providers, measured in the second quarter of 2014, ranged from 1.2 percent for Verizon Wireless and 1.5 percent for AT&T, up to 2.1 percent for T-Mobile and 2.4 percent for Sprint. These data are presented in Chart II.B.6. The average industry quarterly churn rates have ranged from 1.9 percent to 3.0 percent since 2010.[42] Churn rates for prepaid connections are typically significantly higher than churn rates for postpaid connections, because prepaid customers, unconstrained by a

[42] *UBS Investment Research. US Wireless 411 v51 Q1 2014.* Figure 14: U.S. Wireless Industry Model.

multi-month or multi-year service contract, are more likely than postpaid customers to terminate a relationship with a wireless service provider.

Chart II.B.6
Quarterly Churn Rate for Nationwide Mobile Wireless Providers
2011 - 1st Half 2014



	1Q11	2Q11	3Q11	4Q11	1Q12	2Q12	3Q12	4Q12	1Q13	2Q13	3Q13	4Q13	1Q14	2Q14
AT&T	1.4%	1.4%	1.3%	1.4%	1.5%	1.2%	1.3%	1.4%	1.4%	1.4%	1.3%	1.4%	1.4%	1.5%
Verizon Wireless	1.3%	1.2%	1.2%	1.2%	1.2%	1.1%	1.2%	1.2%	1.3%	1.2%	1.3%	1.2%	1.3%	1.2%
Sprint	2.3%	2.2%	2.3%	2.2%	2.2%	2.0%	2.1%	2.3%	2.4%	3.2%	2.3%	2.1%	2.4%	2.4%
T-Mobile	3.4%	3.3%	3.5%	4.0%	3.3%	3.2%	3.4%	3.7%	3.3%	2.6%	2.5%	2.5%	2.1%	2.1%

Source: *UBS Investment Research. US Wireless 411 Version 49*, Table 16; *US Wireless 411 Version 51*, Figure 28; *US Wireless 411 Version 54.*

C. Market Shares and Concentration

29. Revenues and connections or subscribers are key metrics that are used to measure the size of a company. In turn, the relative size of a company compared to the total size of the industry determines market share. The revenue data are presented in Table II.C.1 below.

Table II.C.1
Service Revenues for Facilities–Based Mobile Wireless Service Providers (In millions of dollars)
2005-1st Half 2014

National	2005	2006	2007	2008	2009	2010	2011	2012	2013	1H2014
Verizon	28,131	32,796	38,016	49,717	52,046	55,629	59,157	63,733	69,033	36,065
AT&T	30,665	33,788	38,678	44,249	48,563	53,510	56,726	59,186	61,552	30,535
Sprint	28,631	31,918	32,106	28,435	25,832	25,894	27,390	29,086	29,263	14,337
T-Mobile	12,308	14,511	16,891	19,242	18,926	18,689	18,481	17,213	20,535	10,821
Nextel	1,695	468								
Regional	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**1H2014**
US Cellular	2,832	2,445	3,679	3,940	3,926	3,913	4,054	4,099	3,595	1,697
Metro PCS	872	1,291	1,919	2,437	3,130	3,690	4,428	4,540		
Leap (Cricket)	769	956	1,396	1,709	2,171	2,413	2,829	2,947	2,631	
NTELOS	264	302	357	392	400	383	395	424	467	226
Cincinnati Bell	215	236	267	291	284	269	252	225	185	80
Alltel	6,485	7,030	7,984							
Centennial	395	433	484	524	408					
CentennialPCS	363	339	294	320	236					
Dobson	1,117	1,202	1,030							

Rural Cellular	511	539	608	327						
SunCom	739	755	649							

Note: *UBS Investment Research. - UBS Wireless 411 Report. Version 51*, Table 31. *UBS Wireless 411 Report Version 54*, MetroPCS was acquired by T-Mobile in March 2013 and Leap (Cricket) was acquired by AT&T in March of 2014.

30. Market share is usually calculated as the percentage of an industry or market's total revenues earned (or number of customers served) by a particular company over a specified time period.[43] In general, market share increases and decreases can be a sign of the relative competitiveness of a company's products or services. Nationwide service provider market shares by service revenues are shown in Table II.C.2 below. This table provides market share estimates of the largest facilities-based service providers based on revenues. The four nationwide service providers accounted for about 96 percent of the nation's mobile wireless service revenue in 2013, up from 91.5 percent in 2012. The service revenues of Verizon Wireless and AT&T accounted for about 70 percent of total service revenue in 2013.

Table II.C.2
Market Shares for Facilities-Based Mobile Wireless Providers
Based on Service Revenues 2011 – 2013[44]

Nationwide Service Providers	**2011**	**2012**	**2013**
Verizon Wireless	33.8%	34.4%	36.5%
AT&T	32.4%	32.0%	32.5%
Sprint	15.6%	15.7%	15.5%
T-Mobile	10.6%	9.3%	10.9%
Total National Service Provider Market Share	92.4%	91.5%	95.3%
Regional Service Providers	**2011**	**2012**	**2013**
US Cellular	2.3%	2.2%	1.9%
Metro PCS	2.5%	2.5%	
Leap Wireless	1.6%	1.6%	1.4%
NTELOS	0.2%	0.2%	0.2%
Cincinnati Bell	0.1%	0.1%	0.1%
Other	0.7%	1.9%	1.0%
Total Regional Service Provider Market Share	7.6%	8.5%	4.7%

Note: Data based on Table II.C.1, *infra* ,*UBS Wireless 411 Report. Version 51 2014 Q1*, Table 31, pp.19 *UBS Wireless 411 Report. Version 54* and CTIA total service revenue figures. For 2011, the data are also from the *Sixteenth Competition Report* Table 11 and 12.

31. Market concentration can be measured by the number of competitors in the marketplace, or by the share of subscribers, sales or revenues attributable to each competitor. High market concentration levels in a given market may raise some concern that the market is not competitive. However, an analysis of other factors, such as prices, entry conditions, and non-price rivalry, may find that a market with high concentration levels is competitive.

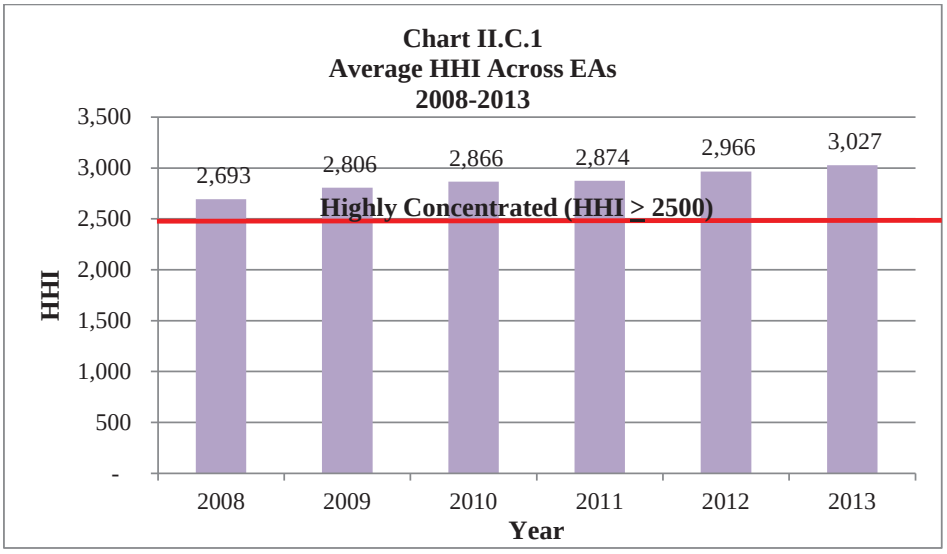
32. The Herfindahl-Hirschman Index (HHI), which is employed by the Commission to measure

[43] Markets as discussed in this *Report* are independent of markets determined in the context of transactions. In prior transactions, the Commission has found that the relevant geographic markets for certain wireless transactions generally are "local" and have used CMAs (cellular marketing areas) as the local geographic market. In addition, it has also evaluated a transaction's competitive effects at the national level where a transaction exhibits certain national characteristics that provide cause for concern. See *AT&T-Leap Order*, 29 FCC Rcd at 2735 ¶ 27.

[44] We do not report mid-year market shares.

market concentration, is a widely-accepted measure of concentration in competition analysis. The HHI is calculated by summing the squared market shares of all firms in any given market. In this *Report*, we calculate HHIs by EA (economic areas), to maintain continuity with past *Reports* and to ensure that we do not compromise the confidential information found in the NRUF data.[45] The Commission generally estimates HHIs on a narrower geographic area than the EA to evaluate the competitive consequences of transactions.[46]

33. At the end of 2013, the weighted average of the HHI (weighted by population across the 172 Economic Areas in the United States) for the mobile wireless services industry was 3,027, a small increase from 2,966 at the end of 2012, which in turn was an increase from 2,874 at the end of 2011.[47] As in previous years, the most recent increases in the weighted average of HHIs reflect continued industry consolidation, such as the 2013 merger of T-Mobile and MetroPCS. Average HHIs across EAs are presented in Chart II.C.1[48] At the end of 2013, the value of the HHI for individual Economic Areas (EAs) ranged from a low of 2,237 in EA 63 (Milwaukee-Racine WI) to a high of 6,689 in EA 146 (Missoula MT).



Source: NRUF and 2010 census data, EAs defined as in 1995. The latest NRUF data available is 2013.

[45] By contrast, in wireless transactions, the Commission has analyzed competitive effects on "local" geographic markets using CMAs (cellular marketing areas). See *AT&T-Leap Order*, 29 FCC Rcd at 2735 ¶ 27. *See also* note 43 *supra*.

[46] Antitrust authorities in the United States generally classify markets into three types: Unconcentrated (HHI < 1500), Moderately Concentrated (1500 < HHI < 2500), and Highly Concentrated (HHI > 2500). *See Horizontal Merger Guidelines*, U.S. Department of Justice and the Federal Trade Commission, http://www.justice.gov/atr/public/guidelines/hmg-2010.pdf . The Commission's HHI screen flags markets for further competitive review if the HHI is 2800 with a change from the pre to the post transaction HHI of 100 or greater or a change of 250 or greater regardless of the initial HHI. See Applications of AT&T Wireless Services, Inc., Transferor, and Cingular Wireless Corp., Transferee, Memorandum Opinion and Order, 19 FCC Rcd 21522 (2004); Applications of AT&T Inc. and Cellco Partnership d/b/a Verizon Wireless for Consent to Assign or Transfer Control of Licenses and Authorizations and Modify a Spectrum Leasing Arrangement, WT Docket No. 09-104, Memorandum Opinion and Order, 25 FCC Rcd 8704 (2010).

[47] Data are based on 2010 census data. EAs defined as in 1995.

[48] EA level data are presented in Appendix Table II.C.i

D. Financial Indicators

1. Revenue and ARPU

34. Total service revenues of the wireless providers, as reported by the CTIA, include monthly service fees, usage-related charges, activation charges, vertical services (voice mail, enhanced calling features, and other services), out-collect roaming revenues, and data service revenues.[49] In 2013, total wireless service revenue was $189 billion. It has grown steadily over the last twenty years, although the pace has tended to fluctuate over the last five years. Revenue increased by 2.3 percent in 2013.[50] As reported earlier in Table II.C.1, company-specific revenues reported by the providers during this time indicate that Verizon Wireless and AT&T had the highest service revenues, followed by Sprint, and then T-Mobile.[51]

35. Given the longstanding variation in terms of plan characteristics and pricing for mobile voice and data, average price metrics have been necessary and useful tools to compare broad trends in pricing, even though average metrics have always had their limitations.[52] Previous *Reports* have reported average price metrics, including the per-minute price of voice service, the average revenue per text message, the average revenue per megabyte, and the average revenue per unit (ARPU).[53] As detailed in the *Sixteenth Report,*[54] however, in the second half of 2012 Verizon and AT&T launched their shared data plans that bundled unlimited voice and texting with a data allowance for a single flat monthly fee, starting a shift toward shared data plans by wireless service providers. Beginning with its report of 2012 data, CTIA discontinued separately tracking and reporting wireless data service revenues.[55] As a result of these changes, estimates of the unit price of wireless voice and data revenues are increasingly unreliable and difficult to come by, and the Commission is no longer able to report from the CTIA data an average revenue per text message, an average revenue per megabyte, or an average voice revenue per minute.

36. Similarly, the ARPU metric, which has commonly been used in the industry as an overall pricing indicator and which remains the best such measure currently used by industry and financial analysts, has come under increasing pressure, especially as a measure for comparisons across different providers. Consistent estimation of ARPU has become more difficult due to the growing prevalence of shared data plans, family and group plans, and other types of bundling, along with the increasing number of accounts with multiple devices, with each device potentially subject to a different pricing model. We note that ARPU is not consistently reported by different providers. For instance, AT&T, Sprint and T-Mobile report ARPU, while Verizon Wireless provides its reporting based on ARPA (Average Revenue per Account), which accounts for the multiple devices that may be associated to a single account. CTIA's Wireless Industry Indices no longer report an "average local

[49] See *CTIA Year-End 2013 Wireless Indices Report,* at 70-72.

[50] Revenue increased by 3.0 percent, 4.9 percent, 6.2 percent, 9.0 percent, and 2.3 percent in 2009, 2010, 2011, 2012, and 2013, respectively. See Appendix Table II.D.i for details.

[51] Detailed service provider service revenues are shown in Appendix Table II.C.i.

[52] Different mobile wireless providers have offered a variety of pricing plans for their voice and data services, with service often offered under multi-part pricing schemes and with differing non-price terms and features, such as early termination fees and the consequences of reaching usage limits. As discussed in previous reports, it is therefore difficult to identify sources of information that track actual mobile wireless service prices in a comprehensive and consistent manner. Additionally, data on subscribership is not available at the plan level, and any average price comparison implicitly assumes uniform subscribership of all plans.

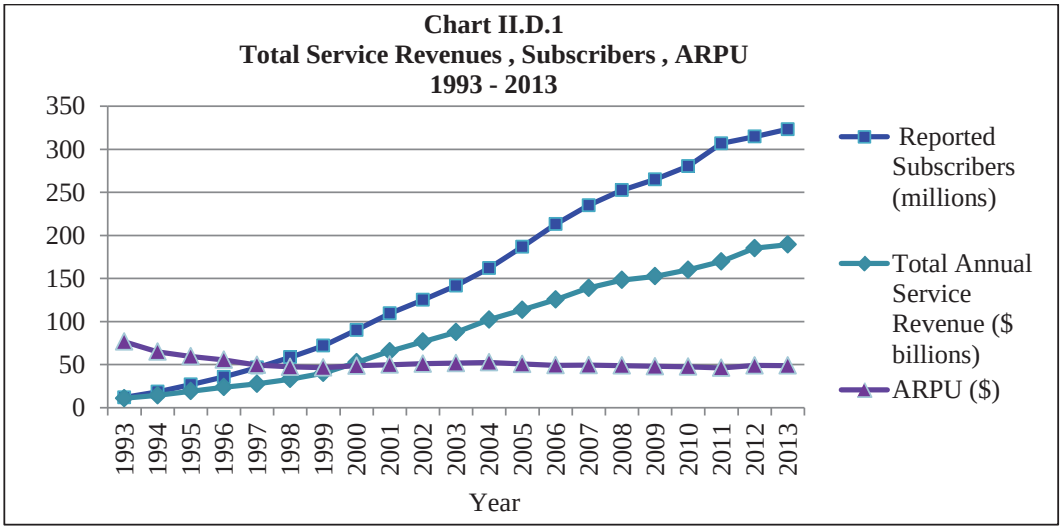
[53] Industry and financial analysts have used company reported ARPU as a fair proxy of the amount of revenue generated per subscriber on a monthly basis

[54] *Sixteenth Report*, 28 FCC Rcd at 3836, ¶144-146

[55] See *CTIA Year-End 2013 Wireless Indices Report,* at 85-90 for a detailed discussion.

monthly bill" consistently reported by providers that was used to estimate ARPU.[56] To account for these shortcomings, industry and financial analysts have had to make additional assumptions and begun to estimate a new, normalized version of ARPU, dividing overall reported service revenues by the average number of subscribers for the period.

37. In its year-end 2013 annual report, CTIA reported an industry average measure of ARPU, specifically "Average Revenue per Reported (subscriber) Unit",[57] which is based "upon total revenues divided by the average total reported active units per survey period, divided by the number of months in the survey period," i.e., an annualized monthly ARPU. The total service revenues used in this ARPU calculation includes roaming revenues, usage fees, access and other connection fees. Thus all revenues, including those from roamers in a provider's market, are attributed to the subscriber base of the provider.[58] According to CTIA, from December 2012 to December 2013, the average revenue per active unit (ARPU) in 2013 was $48.79 based on annual revenues and average active revenue-generating subscriber units. Total wireless industry service revenues for 2013 equaled $189.12 billion, up from $185 billion for 2012 as a whole. Total reported prepaid revenues for 2013 equaled $22.4 billion, down 5 percent from $23.7 billion reported for 2012.[59] Chart II.D.1 below shows the total service revenue, subscribers and ARPU for the past 20 years. It appears that based on nominal dollars, the average industry ARPU appears to be fairly stable, while revenues and subscribership has increased.



Note: Based on CTIA Year-End 2013 Wireless Indices Report, Table 27. Latest available data.

2. Average Revenue per Unit (ARPU) by Provider

38. There is considerable variation in ARPU amongst the various national and regional wireless

[56] CTIA's Indices Report provides discussion of some of the alternative methods of calculating ARPU. For example, the report indicates that a Yankee Group study on ARPU had found that the majority of major providers used nine to ten separate revenue components in their calculation. As noted in the Indices Report, consistency of reporting is critical to accurately compare the data over time. *CTIA Year End 2013 Wireless Indices Report, at 85 – 90.*

[57] See *Infra* Footnote 22.

[58] This ARPU is not equal to the 'average bill' for a household, or consumer, as it is not equal to an 'account' which may cover several different devices, such as multiple phones (under a family plan) or multiple devices (including phones and tablets, wireless broadband modems, or other adjunct devices covered by a customer's service plan). It assigns overall service revenue across all revenue generating devices. See *CTIA Year-End 2013 Wireless Indices Report*, at 2.

[59] See Appendix Table II.D.i

providers, despite the overall stable numbers. From Table II.D.1 below we find that between the fourth quarter of 2011 and the fourth quarter of 2013, AT&T's ARPU was fairly stable, Verizon Wireless experienced a slight increase in ARPU, and T-Mobile showed a steady decline in ARPU. Regional providers such as US Cellular experienced a slight decrease in ARPU during this time.

Table II.D.1
ARPU Estimates of Publicly Traded Facilities-Based Mobile Wireless Providers
4th Quarter 2011 – 2nd Quarter 2014

Nationwide Providers	4Q11	4Q12	4Q13	2Q 14
AT&T	$ 47.04	$ 46.94	$ 47.58	$ 43.91
Verizon Wireless	$ 46.55	$ 47.57	$ 47.50	$ 46.96
Sprint	$ 43.08	$ 43.37	$ 44.83	$ 43.55
T-Mobile	$ 44.29	$ 40.24	$ 36.91	$ 36.17
Regional/Rural Providers	**4Q11**	**4Q12**	**4Q13**	
US Cellular	$ 49.74	$ 50.89	$ 50.21	$ 53.27
MetroPCS	$ 40.55	$ 40.86		
Leap Wireless	$ 42.39	$ 40.69	$ 45.55	
NTELOS	$ 48.57	$ 52.78	$ 54.11	$ 52.21
Cincinnati Bell	$ 43.26	$ 43.28	$ 41.35	$ 42.81

Source: *UBS Investment Research. UBS Wireless 411 v. 51* Figure 36, *UBS Wireless 411 Report Version 54*.

39. As a consequence of the shift to shared data plans by the two largest wireless service providers, estimates of the unit price of wireless voice and data revenues are increasingly unreliable and difficult to come by, as discussed in earlier paragraphs. In addition, we note that the available estimates do not fully reflect the prices of all relevant mobile broadband services offered by U.S. wireless service providers, and therefore are subject to certain caveats depending on the methodology used in the particular analyst report. Acknowledging these limitations, we present some analyst estimates of ARPU and the unit price of mobile wireless broadband services. As seen in Table II.D.1, on average, the combined ARPU for voice, text and data has been fairly stable for most nationwide providers, with the exception of T-Mobile, which shows a steady decline in ARPU over the reported period.

3. Wireless Telephone Services CPI

40. The Consumer Price index (CPI) is a measure of the average change over time in the prices paid by urban consumers for a fixed market basket of consumer goods and services. The basket of goods includes over 200 categories, such as food and beverages, housing, apparel, transportation, medical care, recreation, education, and communications. The CPI allows consumers to compare the price of the basket of goods and services this month with the price of the same basket a month or a year ago. As documented in previous *Reports*, two different pricing indicators – the Wireless Telephone Services CPI and the per-minute price of voice service – show that mobile wireless prices have declined significantly since the launch of PCS service in the mid-1990s. However, given the shift in mobile voice service plans away from a defined number of monthly minutes[60], there is no simple way to calculate a per-minute price for such service, so this discussion focuses on the CPI.

41. The wireless telephone services' component of the CPI (Wireless Telephone Services CPI) is published by the U.S. Department of Labor's Bureau of Labor Statistics (BLS) on a national basis.[61] From 2011

[60] See Section II.D.1 *infra*

[61] Starting in December 1997, the basket included a category for cellular/wireless telephone services. All CPI figures discussed above were taken from BLS databases found at http://www.bls.gov. The index used in this analysis, the CPI for All Urban Consumers (CPI-U), represents about 87 percent of the total U.S. population. *See* Bureau of Labor Statistics, *Consumer Price Index: Frequently Asked Questions*, http://www.bls.gov/cpi/cpifaq.htm (visited June 16, 2014). The Cellular

to 2012, the annual Wireless Telephone Services CPI decreased by 1.2 percent while the overall CPI increased by 2.1 percent and the Telephone Services CPI was approximately unchanged.[62] From 2012 to 2013, the annual Wireless Telephone Services CPI decreased by 1.6 percent while the overall CPI increased by 1.5 percent and the Telephone Services CPI was unchanged. The Wireless Telephone Services CPI has steadily declined since 2010 following an unchanged Wireless Telephone Services CPI in 2009 and a series of much smaller declines in the period from 2002 to 2008. Since December 1997, the Wireless Telephone Services CPI has declined nearly 43 percent while the overall CPI has increased by 34 percent.

4. Profitability Metrics

42. One measure of competition is the relative profitability of competitors within the wireless market. It is also informative to compare the profitability of the wireless industry with other industries. In the absence of the data necessary to estimate economic profits, accounting profits can instead be estimated using various metrics available to wireless industry observers. One such metric, based on company data reported to the Securities and Exchange Commission, is EBITDA (Earnings before Interest, Taxes, Debt, and Amortization). EBITDA equals accounting profits before deducting interest expenses, corporate income taxes, depreciation, and amortization. In 2014, out of the nationwide facilities-based providers, EBITDA per subscriber ranged from a low of $6.13 (US Cellular) to a high of $24.19 (Verizon Wireless). These numbers are presented in Table II.D.2.

Table II.D.2
Annual EBITDA per Subscriber ($/month), 2011 – 1st half 2014

Top 5 Mobile Wireless Service Providers	2011	2012	2013	1st Half 2014
Verizon Wireless	20.85	22.21	23.56	24.19
AT&T	18.49	18.64	19.55	19.67
Sprint	6.84	6.11	7.53	11.13
T-Mobile	13.17	12.09	10.08	8.64
US Cellular	11.88	11.51	7.34	6.13

Source: *UBS Investment Research*. *UBS Wireless 411 Version 51*, Fig 47; *UBS Wireless 411 Version 54*. Annual figures calculated by taking the average of each quarter for each year.

43. A second indicator of mobile wireless segment profitability is EBITDA margin[63], which expresses EBITDA as a percentage of service revenue. Standardizing EBITDA by service revenues facilitates cross-provider comparisons. The EBITDA margin of a number of the publicly reported mobile providers for the past several years is shown in Chart II.D.1. In the fourth quarter of 2013, the EBITDA margin of the top four nationwide providers ranged from 47.0 percent (Verizon Wireless), to 14.4 percent (Sprint). The EBITDA margin of Verizon Wireless has remained above 40 percent since the fourth quarter of 2005.[64] AT&T's EBITDA margin has fluctuated since 2009, dropping below 30.0 percent in 2011, then rising above the 40 percent mark in late 2012 and in mid- 2103.[65] The other providers' EBITDA margins were all substantially lower in the second quarter of 2013.

CPI includes charges from all telephone companies that supply "cellular telephone services," which are defined as "domestic personal consumer phone services where the telephone instrument is portable and it sends/receives signals for calls by wireless transmission." This measure does not include business calls, telephone equipment rentals, portable radios, and pagers. While the CPI-U is urban-oriented, it does include expenditure patterns of some of the rural population. Information submitted by companies for the CPI is provided on a voluntary basis. *See Sixteenth Report, 28 FCC Rcd at 3836* at ¶ 263.

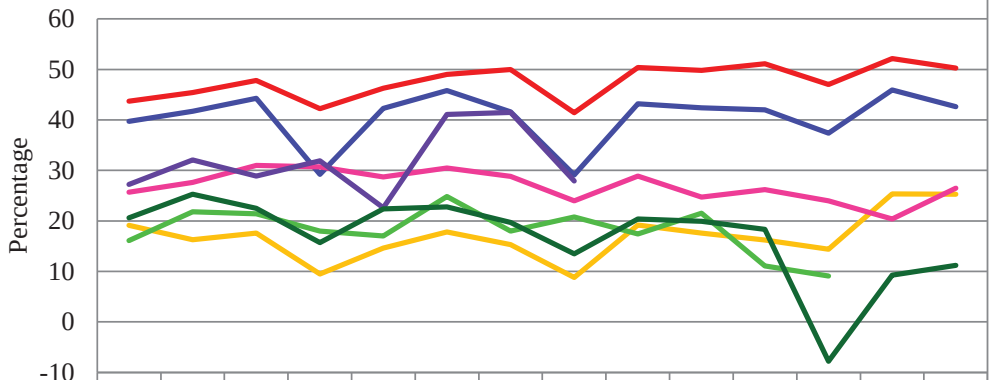
[62] For details, see Appendix Table II.D.ii,

[63] It is equal to earnings before interest, tax, depreciation and amortization (EBITDA) divided by total revenue. Because EBITDA excludes depreciation and amortization, EBITDA margin can provide a cleaner view of a company's core profitability.

[64] UBS, *US Wireless 411 Reports*, 2002 – 2014.

[65] *Id*.

Chart II.D.1
Reported EBITDA Margins (in %) for Selected Publicly Traded Facilities-Based Wireless Providers
2011 - 1st Half 2014



	1Q 11	2Q 11	3Q 11	4Q 11	1Q 12	2Q 12	3Q 12	4Q 12	1Q 13	2Q 13	3Q 13	4Q 13	1Q 14	2Q 14
Verizon Wireless	43.7	45.4	47.8	42.2	46.3	49	50	41.4	50.4	49.8	51.1	47	52.1	50.2
AT&T	39.7	41.7	44.3	29.2	42.3	45.8	41.6	29.1	43.2	42.4	42	37.4	45.9	42.6
Sprint	19.1	16.3	17.6	9.5	14.6	17.8	15.3	8.8	19.2	17.6	16.2	14.4	25.3	25.3
T-Mobile	25.7	27.6	31	30.7	28.7	30.5	28.8	24	28.9	24.7	26.2	24	20.3	26.4
Metro PCS	27.2	32.1	28.9	31.9	22.6	41.1	41.5	27.9						
Leap (Cricket)	16.1	21.8	21.4	18	17	24.8	18	20.8	17.4	21.5	11.1	9.1		
US Cellular	20.6	25.3	22.5	15.7	22.4	22.8	19.7	13.5	20.4	19.9	18.3	-7.8	9.27	11.1

Source: *UBS Investment Research UBS Wireless 411 Version 51*, Fig 46; *UBS Wireless 411 Version 54.*

III. OVERALL MOBILE WIRELESS INDUSTRY METRICS

44. In this section, we discuss the current market trends in the mobile wireless marketplace and provide additional analysis highlighting specific changes that have occurred over the last year. Specifically, this section examines such indices as numbers of connections and distribution of subscribers by geography and by demographics. It analyzes the extent of voice and broadband coverage, including by number of available providers, and a comparison of rural to non-rural markets. We will also discuss developments in wireless devices, intermodal developments such as wireless-wireline substitution and wireless-only households, and consumers' access to information about their available choices in the marketplace.

A. Network Coverage

45. The analysis in this section is based on U.S. census blocks[66] overlaid on provider coverage maps provided to the Commission through a contract with Mosaik Solutions, an independent consulting firm that tracks

[66] A census block is the smallest geographic unit for which the Census Bureau tabulates decennial census data. There are 11,166,336 blocks designated in the 2010 Census, and they range in population from zero to several hundred. *See* U.S. Census Bureau, *2010 Census Summary File 1 – 2010 Census of Population and Housing, Technical Documentation*, Mar. 2010, at 2-1, *available at* http://www.census.gov/prod/cen2010/doc/sf1.pdf#page=504.

coverage footprints of mobile voice and mobile data networks.[67] If the center point, or centroid, of a census block is within the coverage boundary of a map provided by Mosaik, then we consider the census block to be "covered" by that provider and/or technology.[68] We then aggregate the population and land area of the covered census blocks. These coverage estimates represent deployment of mobile networks and do not indicate the extent to which providers actually offer service to residents in the covered areas. While recognizing that this analysis likely overstates the coverage experienced by consumers because of limitations in Mosaik data,[69] we find that this analysis is useful because it provides a general baseline that can be compared over time across network technologies, and providers.

1. Overall Network Coverage

46. We first estimate the percentage of the U.S. population, land area, and road miles covered by a certain number of facilities-based mobile wireless service providers.[70] We then present estimated mobile broadband coverage, using the same categories. For purposes of this Report, mobile wireless coverage represents either mobile voice or mobile broadband coverage, and "mobile broadband" includes coverage and services offered using the following 3G and 4G technologies: EVDO, EVDO Rev A, WCDMA/HSPA, HSPA+, LTE, and mobile WiMAX.[71] Finally, we note the data underlying these estimates measure mobile network "coverage," and not the number of network providers affirmatively offering service to any or all residents in those locations.

a. Mobile Wireless Coverage

47. As of January 2014, 99.9 percent of the total U.S. population lived in census blocks that were covered by at least one facilities-based mobile wireless provider, as shown in Chart III.A.1. The percentage of the population living in a census block with mobile wireless coverage by at least one or two providers has not changed significantly since January 2012,[72] while the percentage of the population living in a census block with coverage by at least three or four providers has fallen slightly during this time.[73] However, the percentage of the population living in a census block covered by at least five providers fell sharply to 22.8 percent in January 2014,

[67] Mosaik provides data to the FCC under contract on facilities-based providers in the form of coverage boundary maps based on the coverage boundaries provided to them by mobile wireless network operators. *See* Mosaik, About Us, http://www.mosaik.com/about-us/ (visited July. 7, 2014).

[68] The Centroid Method overlays the geographic polygons showing wireless coverage onto a map of census blocks. The Centroid Method codes a census block as covered if the calculated center point (the "centroid") of the census block is within the coverage polygon. If a centroid is covered, then all of the population and land area in the corresponding census block is coded as covered as well. We also note that in some cases the calculated center point may lay outside of the boundaries of a census block. In these cases, the centroid will be identified as the point inside the census block nearest to the calculated center point.

[69] This analysis likely overstates the coverage actually experienced by consumers, because Mosaik reports advertised coverage as reported to it by many wireless service providers, each of which uses a different definition or determination of coverage. The data does not expressly account for factors such as signal strength, bit rate, or in-building coverage, and may convey a false sense of consistency across geographic areas and service providers but nonetheless are useful for benchmarking mobile network deployment across the United States, especially over time. National Broadband Plan, at 39 (Chapter 4). We also recognize that an analysis of coverage at the nationwide level provides only a general benchmark. A nationwide average will mask regional disparities in coverage and create an overall picture that does not capture variances across the country.

[70] Also see Appendix Table III.A.i and III.A.ii

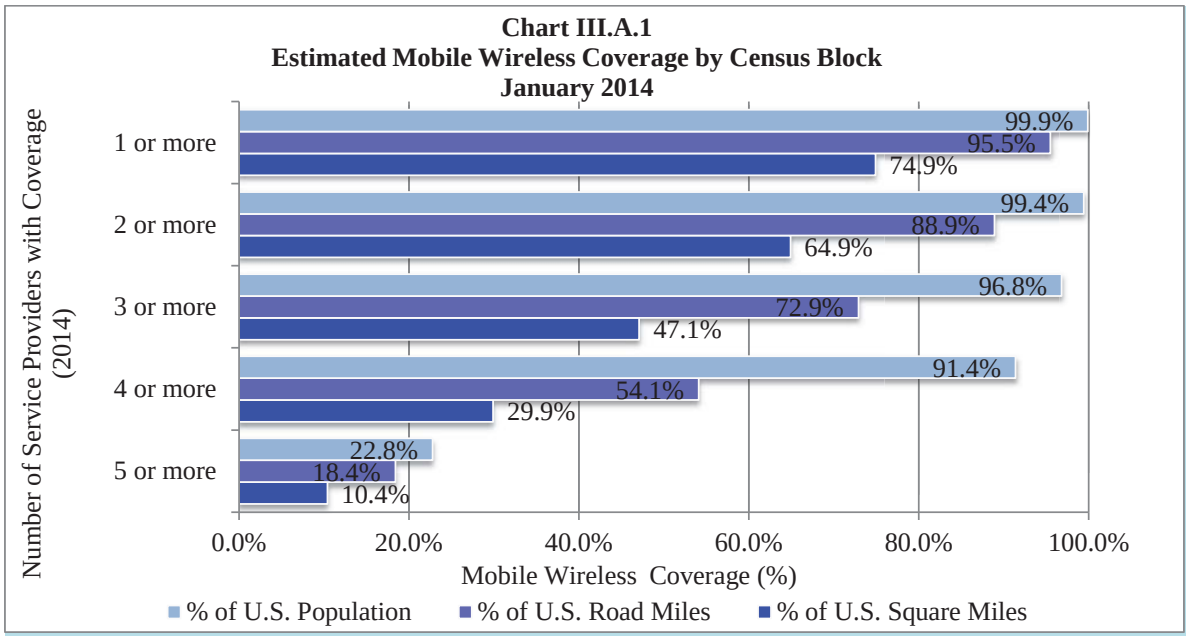
[71] The Commission has used alternative definitions of mobile broadband in different contexts. For the 706 Report (Broadband Progress Report), it has used both a speed threshold based on the SBI data and a technology threshold based on the Mosaik data to define mobile broadband. See *Eighth Broadband Progress Report, FCC Rcd 12-90A1* at 10366 ¶¶ 37 – 40.

[72] *Sixteenth Report*, 28 FCC Rcd at ¶ 45

[73] *Sixteenth Report*, 28 FCC Rcd at 3836, Table 4¶ 44 - 47

from 79.6 percent in January 2012. We note that the number of providers in a census block does not necessarily reflect the number of network provider choices available to a particular individual or household residing in those areas.[74]

48. Chart III. A.1 also presents the approximate percentage of the U.S. land area and road miles covered by a certain number of mobile wireless providers. While more than 90 percent of the U.S. population lived in census blocks with coverage by at least four mobile voice providers in January 2014, these census blocks accounted for only approximately 29.9 percent of the total land area of the United States, and approximately 54.1 percent of U.S. road miles. Furthermore, while 0.1 percent of the U.S. population lived in census blocks that received no mobile wireless coverage, approximately 25 percent of the U.S. land area and 5 percent of U.S. road miles were not covered.



Note: Based on January 2014 Mosaik Data and 2010 Census Data. The number of providers in a census block represent network coverage, which does not necessarily reflect the number of choices available to a particular individual or household, Coverage calculations based on Mosaik data, while useful for measuring developments in mobile wireless coverage, have certain limitations that likely overstate the extent of mobile wireless coverage.

49. In this *Report*, we have included a provider if it has market share above a particular threshold, and have made estimates based on two alternative thresholds. Specifically, to estimate the number of providers serving a CMA, we include a provider if it has a greater than two percent market share (alternatively, a five percent market share which provides greater assurance of a meaningful choice for consumers) of mobile wireless connections based on NRUF data at the CMA level. Table III.A.1 presents the data for December 2013. Since the

[74] The percentages of population located in census blocks with zero, one, two, or three or more mobile wireless or mobile broadband providers represent network coverage, which does not necessarily mean that they offered service to residents in the census block. In addition, we emphasize that a provider reporting mobile wireless or mobile broadband coverage in a particular census block may not provide coverage everywhere in the census block. For both these reasons, the number of providers in a census block does not necessarily reflect the number of choices available to a particular individual or household, and does not purport to measure competition. In addition, calculations based on Mosaik data on coverage, while useful for measuring developments in mobile wireless coverage, have certain limitations that likely overstate the extent of mobile wireless and mobile broadband coverage.

Sixteenth Report,[75] the percentage of CMAs with three or more providers have remained essentially unchanged from 29.3to 29.7 percent.[76] CMAs with 4 or more providers have increased from 34.4 percent to 43.7 percent, while there has been a decrease in the number of CMAs with at least five providers based on the five percent threshold primarily due to increased industry consolidation as discussed above.

Table III.A.1
Estimated Mobile Wireless Providers Offering Service by CMA, Excluding Territories
December 2013

	Two Percent Market Share Threshold		Five Percent Market Share Threshold	
Number of Providers Offering Service Anywhere in a CMA	**Number of CMAs**	**Total CMAs (percent)**	**Number of CMAs**	**Total CMAs (percent)**
Total for U.S., excluding territories	*716*	*100.0%*	*716*	*100.0%*
1 provider	0	0.0%	2	0.3%
2 providers	62	8.7%	139	19.4%
3 providers	148	20.7%	213	29.7%
4 providers	358	50.0%	313	43.7%
5 or more providers	148	20.7%	49	6.8%

Source: Based on December 2013 NRUF data. Just as is the case for census blocks, the number of providers in a CMA represents network coverage, which does not necessarily reflect the number of choices available to a particular individual or household.

b. Mobile Broadband Coverage

50. Chart III.A.2 presents mobile wireless broadband coverage as of January 2014.[77] As discussed in an earlier section, for purposes of this Report, "mobile broadband" includes coverage and services offered using the following 3G and 4G technologies: EVDO, EVDO Rev A, WCDMA/HSPA, HSPA+, LTE, and mobile WiMAX.[78] Mobile broadband coverage has generally increased since the *Sixteenth Report*.[79] While this increase was small overall, there was significant expansion of specific broadband technologies, especially LTE, during this time.[80] Despite the general increase in broadband coverage, the percentage of the U.S. population living in areas with five or more broadband providers fell to 11.8 percent in January 2014, compared to 52.9 percent in January 2012.

51. Mobile wireless broadband deployment focuses on high population centers. While more than 80 percent of the U.S. population lived in census blocks with coverage by at least four mobile service providers in January 2014, these census blocks only accounted for 35.3 percent of road miles, and 15.7 percent of the total land area of the United States. Furthermore, while 0.3 percent of the U.S. population lived in census blocks that received no mobile wireless broadband coverage, 7.3 percent of U.S. road miles and 20.8 percent of the U.S. land area were not covered.

[75] See *Sixteenth Report* ¶ 50.

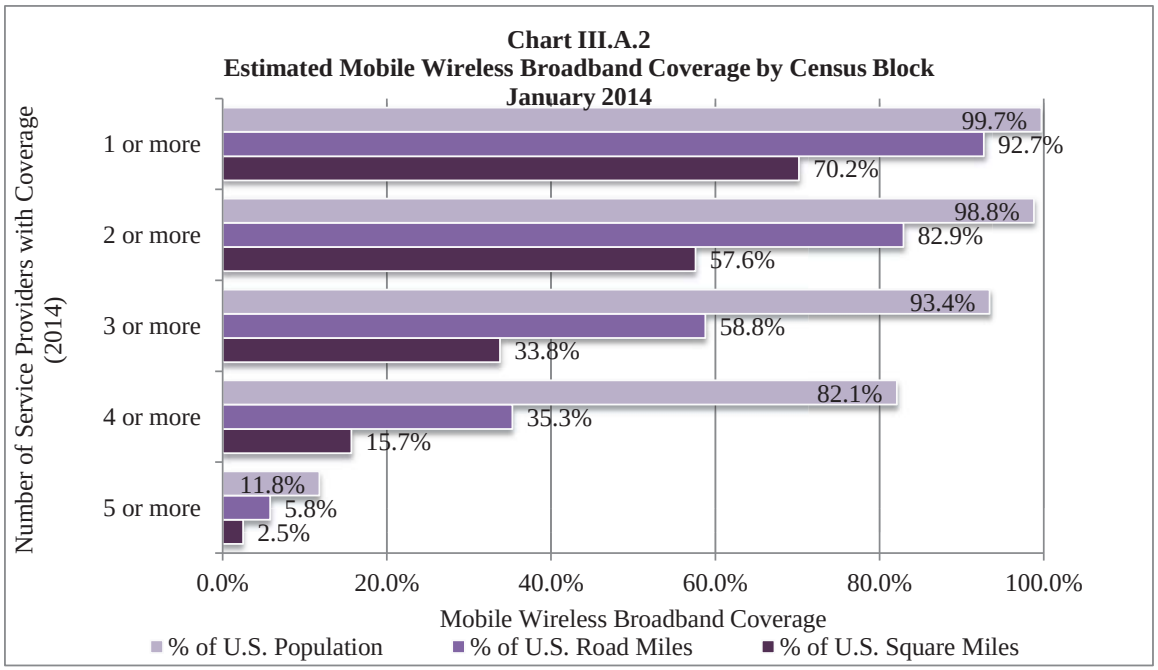
[76] See Appendix Table III.A.iii for December 2011 data. Because NRUF includes data on the number of telephone numbers that have been assigned to end-user devices by mobile wireless providers, this analysis does not include providers whose data-only devices are not assigned a mobile telephone number. *See also* Section V.A, and Customers, *infra*.

[77] Also see Appendix Table III.A.iv and III.A.v.

[78] See Footnote 70 *infra*.

[79] See *Sixteenth Report*, 28 FCC Red at 3836, ¶48

[80] This is discussed in more detail in section VI.B of this *Report*, and in Table VI.B.1, below



Note: Based on January 2014 Mosaik Data and 2010 Census Data. The number of providers in a census block represent network coverage, which does not necessarily reflect the number of choices available to a particular individual or household, Coverage calculations based on Mosaik data, while useful for measuring developments in mobile wireless coverage, have certain limitations that likely overstate the extent of mobile wireless coverage.

c. Urban/Rural Comparisons

52. Since the release of the *Sixth Report*,[81] the Commission has also evaluated competition in rural areas. The Communications Act does not include a statutory definition of what constitutes a rural area.[82] Since its 2004 *Report and Order* concerning deployment of wireless services in rural areas, the Commission has used a "baseline" definition of rural as a county with a population density of 100 persons or fewer per square mile.[83] We

[81] *Sixth Report*, 16 FCC Rcd at 13350.

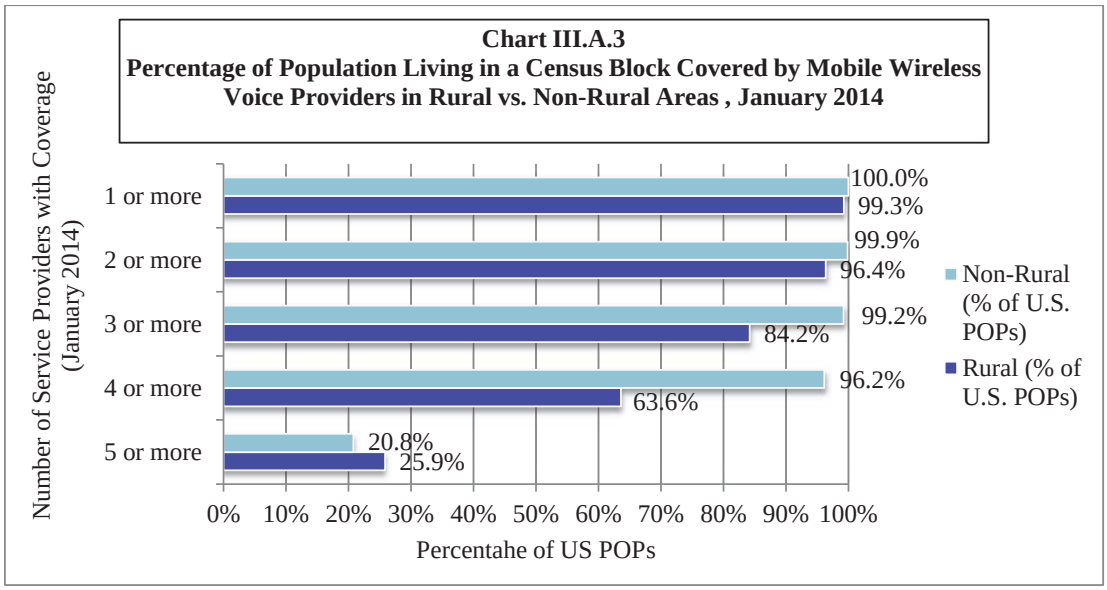
[82] The federal government has multiple ways of defining rural, reflecting the multiple purposes for which the definitions are used. *See Eighth Report*, 18 FCC Rcd at 14834; Facilitating the Provision of Spectrum-Based Service to Rural Areas and Promoting Opportunities for Rural Telephone Companies to Provide Spectrum-Based Services, *See also Notice of Proposed Rulemaking*, 18 FCC Rcd 20802, 20808-11 (2003). The Commission has used Rural Services Areas (RSAs) as a proxy for rural areas for certain purposes, such as the former cellular cross-interest rule and the former CMRS spectrum cap, stating that "other market designations used by the Commission for CMRS, such as [EAs], combine urbanized and rural areas, while MSAs and RSAs are defined expressly to distinguish between rural and urban areas." *See* 1998 Biennial Regulatory Review, Spectrum Aggregation Limits for Wireless Telecommunications Carriers, *Report and Order*, 15 FCC Rcd 9219, 9256 ¶ 84, n.203 (1999).

[83] Facilitating the Provision of Spectrum-Based Services to Rural Areas and Promoting Opportunities for Rural Telephone Companies To Provide Spectrum-Based Services, *Report and Order*, 19 FCC Rcd. 19078, 19087-88 (2004) ("We recognize, however, that the application of a single, comprehensive definition for 'rural area' may not be appropriate for all purposes. . . . Rather than establish the 100 persons per square mile or less designation as a uniform definition to be applied in all cases, we instead believe that it is more appropriate to treat this definition as a presumption that will apply for current or future Commission wireless radio service rules, policies and analyses for which the term 'rural area' has not been expressly defined. By doing so, we maintain continuity with respect to existing definitions of 'rural' that have been tailored to apply to specific policies, while also providing a practical guideline").

use this same definition to analyze service availability in rural areas in this *Report*. By this definition, roughly 59 million people, or 19 percent of the U.S. population, live in rural counties, based on 2010 US Census data. These counties comprise 3.1 million square miles, or 86 percent of the geographic area of the United States.[84] Approximately 81 percent of the U.S. population lives on 15 percent of the land, while 19 percent live on the remaining 85 percent of the land.[85]

(i) Mobile Wireless Network Coverage

53. As seen in Chart III.A.3, 100 percent of the non-rural population lived in census blocks that were covered by at least one provider in January 2014, compared to 99.3 percent of the rural population.[86] The percentage of the population living in census blocks covered by at least two providers was also similar for rural and non-rural areas. As with mobile wireless coverage, the gap between rural and non-rural mobile broadband coverage jumps when we consider coverage by at least three or more providers. However, a higher percentage of the rural population lives in census blocks that were covered by at least five providers, with 25.9 percent of the rural population live in census blocks covered by at least five providers, compared to 20.8 percent of the non-rural population.[87] While the percentage of rural and non-rural populations living in census blocks covered by at least one, at least two, at least three, and at least four providers has not changed significantly since January 2012, the percentage of the population living in census blocks with at least five providers has again decreased since January 2012.[88]



Source: Based on January 2014 Mosaik Data and 2010 Census Data. The number of providers in a census block represent network coverage, which does not necessarily reflect the number of choices available to a particular individual or household, Coverage calculations based on Mosaik data, while useful for measuring developments in mobile wireless coverage, have

[84] Based on 2010 Census data. Includes the population of Puerto Rico.

[85] *Id*

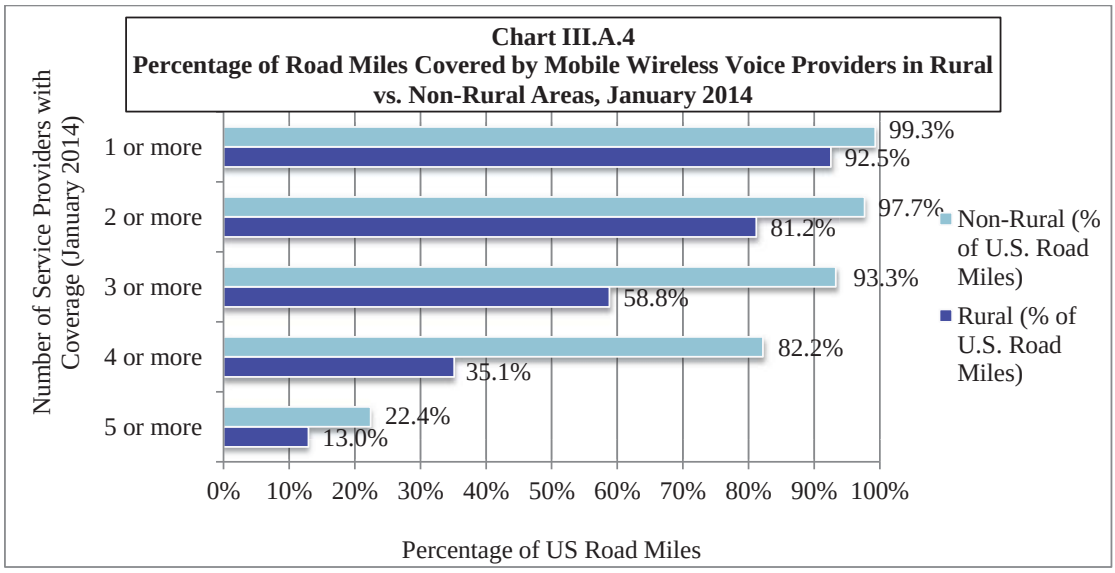
[86] Also see Appendix Tables III.A.iv and III.A.v

[87] This is largely a result of T-Mobile's acquisition of MetroPCS and AT&T's acquisition of Leap Wireless. Because the acquired providers had a larger presence in non-rural areas, the effect of the consolidation was more pronounced in those areas.

[88] *Sixteenth Report*, 28 FCC Rcd at 3836, Table 55 and 57

certain limitations that likely overstate the extent of mobile wireless coverage

54. Chart III.A.4 presents mobile wireless coverage of rural and non-rural road miles in January 2014.[89] The changes in road mile coverage since January 2012 are similar to the trends in population coverage over the same time period.



Source: Based on January 2014 Mosaik Data and 2010 Census Data. The number of providers in a census block represent network coverage, which does not necessarily reflect the number of choices available to a particular individual or household, Coverage calculations based on Mosaik data, while useful for measuring developments in mobile wireless coverage, have certain limitations that likely overstate the extent of mobile wireless coverage.

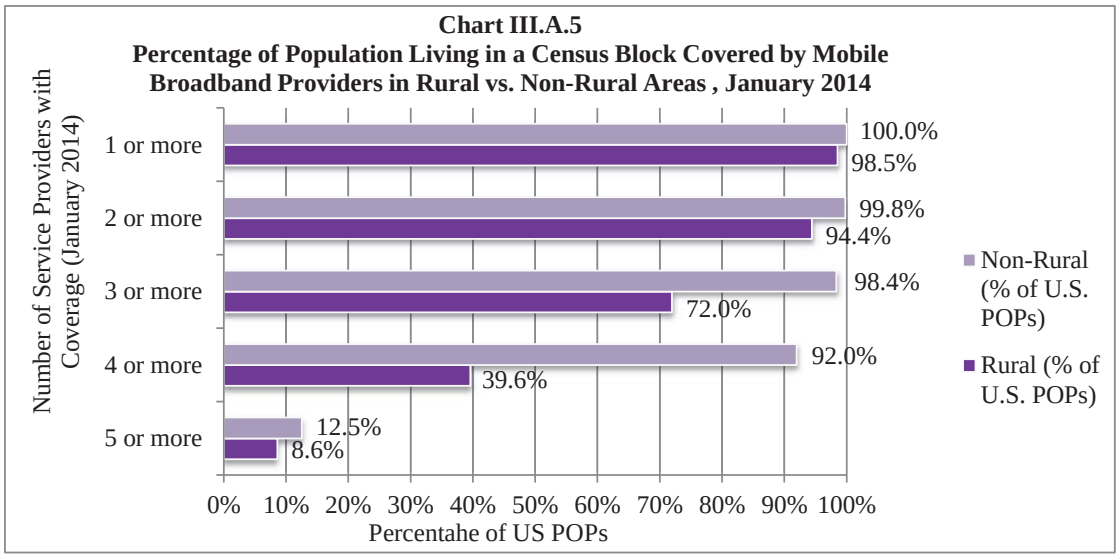
(ii) Mobile Broadband Network Coverage

55. As seen in Chart III.A.5, approximately 100 percent of the non-rural population lived in census blocks that were covered by at least one provider in January 2014, compared to 98.5 percent of the rural population.[90] The percentage of the population living in census blocks covered by at least two providers was also similar for rural and non-rural areas. The gap between rural and non-rural coverage jumps when we consider coverage by at least three or more providers, narrowing again when we consider the percentage of the population living in census blocks covered by at least five providers. The percentage of rural residents living in census blocks with at least one available mobile broadband provider did not change significantly between January 2012 and January 2014.[91] During the same time period, the percentage of rural residents living in census blocks with at least two, at least three, or at least four available mobile broadband providers increased by 8.4 percent, 13.6 percent, and 9.9 percent, respectively. Meanwhile, the percentage of rural residents living in census blocks with at least five available mobile broadband providers fell only slightly, from 10.3 percent to 8.6 percent The percentage of non-rural residents living in census blocks with at least one, two, three, or four available mobile broadband providers increased only slightly during this time, while the percentage of non-rural residents living in census blocks with at least five broadband providers dropped significantly, from 62.8 percent to 12.5 percent, largely reflecting the acquisitions of MetroPCS and Leap/Cricket by T-Mobile and AT&T, respectively.

[89] Also see Appendix Tables III.A.vi and III.A.vii

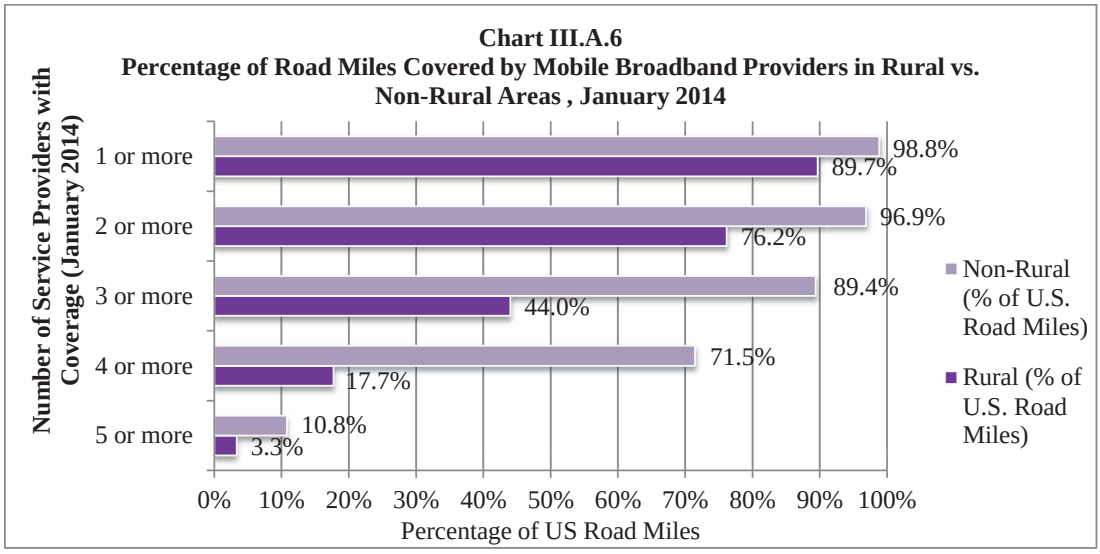
[90] Also see Appendix Tables III.A.viii and III.A.ix

[91] *Sixteenth Report*, 28 FCC Rcd at 3836, Tables 55 and 57, ¶385-387



Source: Based on January 2014 Mosaik Data and 2010 Census Data. The number of providers in a census block represent network coverage, which does not necessarily reflect the number of choices available to a particular individual or household, Coverage calculations based on Mosaik data, while useful for measuring developments in mobile wireless coverage, have certain limitations that likely overstate the extent of mobile wireless coverage

56. Chart III.A.6 presents mobile broadband coverage of rural and non-rural road miles in January 2014.[92] The percentage of rural road miles with mobile broadband coverage increased across the board between January 2012 and January 2014. The percentage of non-rural roads covered by at least one, at least two, at least three, and at least four providers increased, however the percentage of non-rural roads covered by at least five providers fell dramatically from 40.5 percent to 10.8 percent between January 2012 and January 2014.



Source: Based on January 2014 Mosaik Data and 2010 Census Data. The number of providers in a census block represent network coverage, which does not necessarily reflect the number of choices available to a particular individual or household, Coverage calculations based on Mosaik data, while useful for measuring developments in mobile wireless coverage, have

[92] Also see Appendix Tables III.A.viii and II.A.ix

certain limitations that likely overstate the extent of mobile wireless coverage.

2. Network Coverage and Roaming

57. Service providers often use roaming services to enhance their coverage. They offer their customers coverage outside of their network coverage areas through roaming arrangements with other providers. Roaming arrangements between mobile wireless service providers allow customers of one mobile wireless provider to automatically receive service from other providers' networks when they are in areas that are covered by their roaming partners' networks but not their own network. Smaller providers that rely on roaming arrangements to offer nationwide coverage to their customers often include the price of nationwide roaming services in the plans' monthly fees instead of billing for roaming on a usage basis. In contrast to the purchase of capacity wholesale from other service providers to provide resale or MVNO services, a provider uses roaming services to market extended coverage to consumers residing within the provider's network coverage area, not to acquire customers where a provider does not have network coverage. A detailed discussion is provided in Section VI.B, which discusses non-price rivalry between providers.

3. Network Coverage by Technology

58. The Commission has adopted flexible licensing policies, and does not mandate any particular technology or network standard for commercial mobile wireless licensees. Mobile wireless service providers choose their own network technologies and services and abide by certain technical parameters designed to avoid radiofrequency interference with adjacent licensees. As a result of this approach, over the past 15 years U.S. service providers have deployed a variety of digital network technologies with divergent technology migration paths. Previously, two main technology migration paths have been the CDMA and GSM paths.[93] There has not been any significant change in CDMA or GSM/TDM coverage since the *Sixteenth Report*, and each technology covers over 99 percent of the population. Sprint's iDEN network was shut down on July 2013, and the percentage of the population that is covered by this technology accordingly fell from 90.0 percent in January 2012, to 4.9 percent in January 2014 with service being provided by small providers in a few markets.[94] The evolution of mobile network technologies is now converging on LTE, as all of the major service providers are deploying or planning to deploy LTE technology.[95]

59. During the time period covered by this *Report*, the four nationwide facilities-based mobile wireless service providers, as well as other mobile providers continued to upgrade and expand their networks with advanced 3G and 4G technologies that allow for faster mobile broadband connection speeds.[96] LTE, in particular, has been growing in importance over the past few years, as it can provide faster speeds and improved user experience. Each provider is extending its LTE footprint in order to better compete in the mobile wireless marketplace. According to Verizon Wireless, about 69 percent of total data traffic was over the 4G/LTE network in.[97] As of January 2014, 98.5 percent of the population lived in census blocks that were covered by an LTE

[93] See Appendix Chart III.A.i. Of the top four nationwide mobile wireless providers, AT&T and T-Mobile have deployed technologies on the GSM migration path, while Verizon Wireless and Sprint have deployed technologies on the CDMA migration path. Sprint has shut down its iDEN network.

[94] Appendix Table III.A.viii presents mobile wireless network coverage by technology type in terms of population, land area, and road miles, as of January 2014

[95] See section VII.B.3 for a more detailed discussion of service provider network deployments.

[96] For purposes of this *Report*, the term "broadband" – when referring to mobile broadband networks, coverage, providers, or services – includes the 3G and 4G network technologies: HSPA, EV-DO, LTE, and mobile WiMAX. The Commission may include other combinations of mobile network technologies when referring to "mobile broadband" in other contexts. *See, e.g., Eighth Broadband Progress Report* at Table 15.

[97] VZ – Q4 2013 Verizon Earnings Conference Call, January 21, 2014

network, compared to 67.5 percent of the population in January 2012.[98] WCDMA/HSPA/HSPA+ coverage also increased during this time, increasing from 93.1 percent of the population in January 2012 to 97.7 percent of the population in January 2014 as shown in Table III.A.2.

Table III.A.2
Estimated Mobile Wireless Data/Broadband Network Coverage by Census Block, Jan. 2014[99]

Technology		POPs in Covered Blocks (Thousands)	% of Total POPs	Square Miles Contained in Those Blocks (Thousands)	% of Total Square Miles	Road Miles Contained in Those Blocks (Thousands)	% of Total U.S. Road Miles
2.5G	CDMA 1xRTT	310,365	99.3%	2,532	66.6%	6,117	89.7%
	GPRS/EDGE	310,396	99.3%	2,507	65.9%	6,082	89.2%
	Total 2.5G Mobile Data Network Coverage	***311,962***	***99.8%***	***2,788***	***73.3%***	***6,460***	***94.7%***
3G/ 4G	WCDMA/HSPA/ HSPA+	305,138	97.7%	2,121	55.8%	5,421	79.5%
	EV-DO/EV-DO Rev. A	310,024	99.2%	2,434	64.0%	6,001	88.0%
	Mobile WiMAX	105,486	33.8%	44	1.2%	419	6.1%
	LTE	307,736	98.5%	2,067	54.4%	5,475	80.3%
	Total Mobile Broadband Coverage (3G/4G)	***311,492***	***99.7%***	***2,669***	***70.2%***	***6,322***	***92.7%***

Note: Based on January 2014 Mosaik Data and 2010 Census Data. Calculations based on Mosaik data on coverage, while useful for measuring developments in mobile wireless coverage, have certain limitations that likely overstate the extent of mobile broadband coverage. The number of providers in a census block reflect network coverage, which does not necessarily reflect the number of choices available to a particular individual or household

4. Network Coverage by Income Levels

60. We also analyze how the number of facilities-based mobile wireless providers that have coverage in a census tract varies based on median household income levels.[100] The analysis is based on mobile wireless and

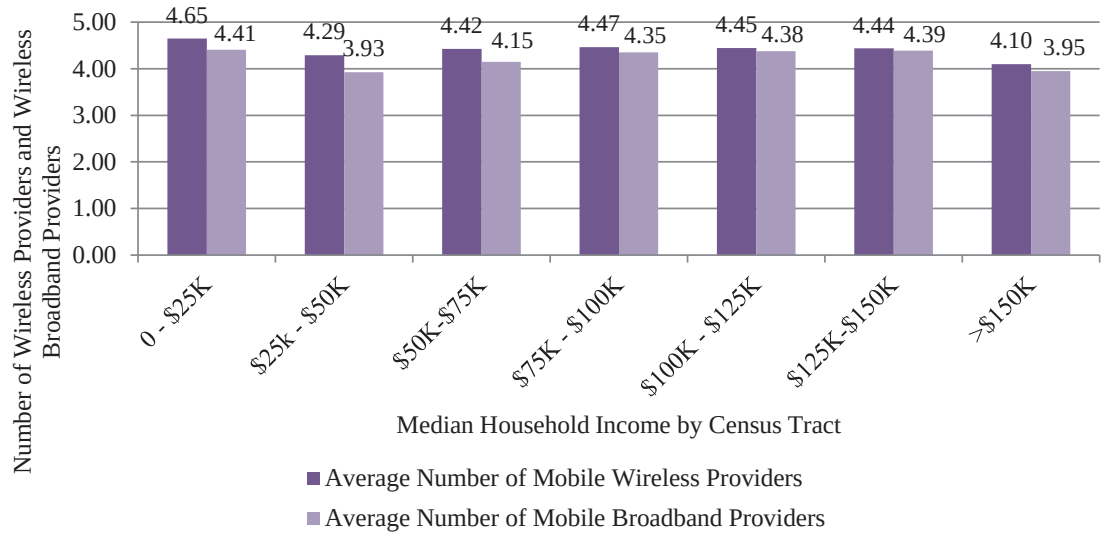
[98] The analysis of mobile wireless network coverage in this section is based on U.S. census blocks overlaid on provider coverage maps provided to the Commission through a contract with Mosaik Solutions, described above. Also see CR 16 table 31

[99] Includes Federal lands. Commission estimates based on census block analysis of Mosaik CoverageRight coverage maps, January 2014. Population data are from the 2010 Census, and the square miles include the United States and Puerto Rico.

[100] The percentages of population located in census tracts where zero, one, two, or three or more mobile wireless or mobile broadband providers represent network coverage, which does not necessarily mean that they offered service to residents in the census block. In addition, we emphasize that a provider reporting mobile wireless or broadband coverage in a particular census tract may not provide coverage everywhere in the census tract. For both these reasons, the number of providers in a census tract, or by income level does not necessarily reflect the number of choices available to a particular individual or household at a certain income level, and does not purport to measure competition. In addition, calculations based on Mosaik data on coverage, while useful for measuring developments in mobile wireless coverage, have certain limitations that likely overstate the extent of mobile wireless and mobile broadband coverage.

mobile broadband coverage data reported by Mosaik[101] and the median household income levels in each of the country's 74,000 census tracts based on United States Census Bureau's American Community Survey (ACS).[102] Chart III.A.7 below shows that, as of January 2014, the average number of mobile wireless providers in census tracts with median household income less than $25,000 was 4.65, compared to 4.10 in census tracts with median household income of more than $150,000. The average number of mobile broadband providers in census tracts with median household income less than $25,000 was 4.41, compared to 3.95 in census tracts with median household income of more than $150,000. Chart III.A.8 compares the number of mobile broadband providers by income level for August 2010, January 2012, and January 2014.[103]

Chart III.A.7
Average Number of Mobile Wireless Providers and Mobile Broadband Providers in Census Tracts by Median Household Income
January 2014

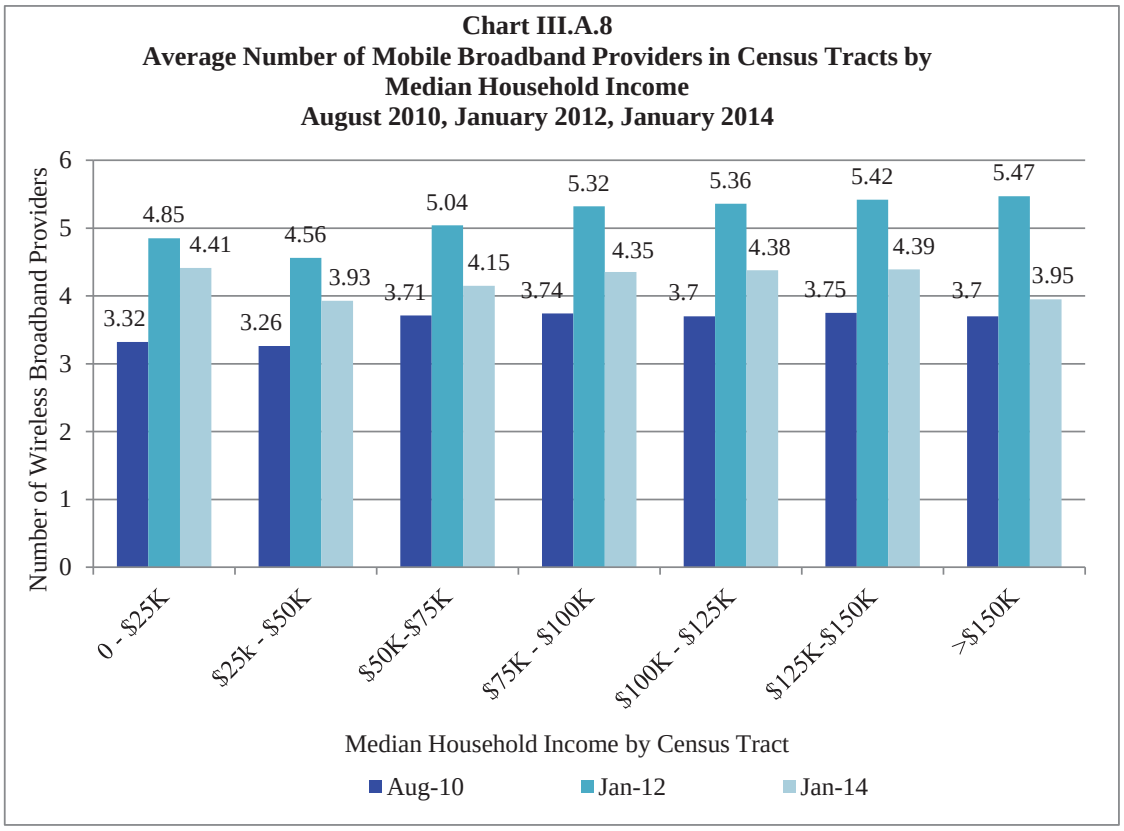


Source: Data on median household income by census tract are based on United States Census Bureau's American Community Survey 2009-2013 (ACS). Data on number of providers are from Mosaik, January 2014. The number of mobile wireless or mobile broadband providers in a census tract represents network coverage, which does not necessarily mean that they offered service to any or all the residents in the census tract. In addition, we emphasize that a provider reporting mobile wireless or broadband coverage in a particular census tract may not provide coverage everywhere in the tract.

[101] Data on numbers of mobile wireless providers and mobile broadband providers are based on Mosaik database, January 2014. We note that the calculations based on Mosaik data on coverage, while useful for measuring developments in mobile wireless coverage, have certain limitations that likely overstate the extent of mobile wireless and mobile broadband coverage.

[102] Data on median household income are based on United States Census Bureau's American Community Survey 2009-2013 (ACS). The analysis is done on a census tract, rather than census block, basis because the smallest geographic area for which median household income data is available is census tracts. These data do not allow for an analysis of adoption rates for mobile wireless or mobile broadband services.

[103] *See Sixteenth Mobile Wireless Competition Report*, 28 FCC Rcd ¶ 297, for the August 2010 and January 2012 data.



Source: Current data on median household income by census tract are based on United States Census Bureau's American Community Survey 2009-2013 (ACS). Current data on number of providers are from Mosaik, January 2014. August 2010 and January 2012 data are from the *Sixteenth Competition Report* (Chart 41). The number of mobile wireless or mobile broadband providers in a census tract represents network coverage, which does not necessarily mean that they offered service to any or all the residents in the census tract. In addition, we emphasize that a provider reporting mobile wireless or broadband coverage in a particular census tract may not provide coverage everywhere in the tract.

5. Commission Actions Related to Coverage, Technology and Roaming

61. When competing mobile wireless service providers deploy compatible network technologies, greater economies of scale in the production of both end-user devices and network infrastructure equipment can result, lowering the unit cost of handsets, chipsets, and other network equipment. This, in turn, may promote more rapid adoption of mobile wireless services, a greater variety of handsets, and more price competition. In October, 2013, the Commission adopted a Report and Order and Order of Proposed Modification to effectuate a voluntary industry agreement and thereby provide for interoperable LTE service in the Lower 700 MHz band. Since that time, the Commission has adopted specific interoperability requirements for the AWS-3 band, as well as for the 600 MHz Band.[104]

[104] *See* Amendment of the Commission's Rules with Regard to Commercial Operations in the 1695-1710 MHz, 1755-1780 MHz, and 2155-2180 MHz Bands, GN Docket No. 13-185, *Report and Order*, 29 FCC Rcd. 4610, ¶¶ 225-231 Rel. March 31, 2014, (AWS-3 Report and Order) and *Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*, GN Docket No. 12-268, *Report and Order*, 29 FCC Rcd. 6567, ¶¶ 731-737 Rel. June 2, 2014 (Incentive Auctions Report and Order).

62. In order to encourage mobile network deployment into unserved or underserved areas, the Commission adopted rules creating the Mobility Fund in November 2011.[105] The Mobility Fund uses Universal Service Fund reserves to support the deployment of current- or future-generation mobile network technologies that provide mobile voice and Internet services.[106] For Mobility Fund Phase I, the Commission will provide up to $300 million in one-time support payments, plus up to $50 million dedicated to Tribal lands, that were awarded through reverse auctions,.[107] The Commission is currently exploring whether to retarget Mobility Fund Phase II ongoing support to ensure the continued deployment and preservation of 4G LTE mobile broadband service and preservation of mobile voice and broadband service in areas that otherwise would not have such service through marketplace forces.[108]

63. In recent years, the Commission has taken actions to facilitate roaming arrangements.[109] In 2007, for instance, it clarified that automatic voice roaming is a common carrier obligation for CMRS providers.[110] In April 2010, the Commission adopted the *Roaming Order on Reconsideration*, which eliminates the home roaming exclusion and establishes the same general obligation to provide automatic voice roaming, regardless of whether the provider requesting roaming holds spectrum in an area.[111] In April 2011, the Commission issued the *Data Roaming Order*.[112] The *Data Roaming Order* requires facilities-based providers of commercial mobile data services, whether or not such providers also offer CMRS, to offer data roaming arrangements to other mobile data service providers on commercially reasonable terms and conditions, subject to certain limitations.[113]

64. Several commenters in the current record contend that it is still difficult to negotiate roaming agreements with larger, nationwide providers.[114] A recent survey by NTCA of its membership, which consists exclusively of small, rural providers, asked participants to categorize their experience in negotiating data roaming and in-market roaming agreements with other providers. Of the respondents, 69 percent categorized it as moderately to extremely difficult, 27 percent as moderately to relatively easy, and four percent as extremely easy. In addition, 52 percent of those respondents who have a reciprocal roaming agreement with

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[105] Connect America Fund, A National Broadband Plan for Our Future, Establishing Just and Reasonable Rates for Local Exchange Carriers, High-Cost Universal Service Support, Developing an Unified Intercarrier Compensation Regime, Federal-State Joint Board on Universal Service, Lifeline and Link-Up, Universal Service Reform – Mobility Fund, *Report and Order and Further Notice of Proposed Rulemaking*, 26 FCC Rcd 17663 (2011). *See* Section IX, Urban-Rural Comparisons, *infra.*

[106] *Id*

[107] *Auction 901 Closing Public Notice*. Mobility Fund Phase I disbursements were authorized beginning April 2013 and are anticipated to continue through 2016. *Mobility Fund Phase I Support Authorized for Seven Winning Bidders; Defaults on Two Auction 901 Winning Bids Determined*, AU Docket No. 12-25, Public Notice, 28 FCC Rcd 5599. *Tribal Mobility Fund Phase I Auction Closes Winning Bidders Announced for Auction 902*, Public Notice, released February 28, 2014, XX FCC Rcd Commission.

[108] *See* In the matter of Connect America Fund Universal Service Reform – Mobility Fund, ETC Annual Reports and Certifications, Establishing Just and Reasonable Rates for Local Exchange Carriers, Developing an Unified Intercarrier Compensation Regime, WC Docket No. 10-90, *Further Notice of Proposed Rulemaking*, (rel. June 10, 2014).

[109] *Sixteenth Report*, 28 FCC Rcd at 3837 ¶ 209.

[110] *See* Roaming Obligations of Commercial Mobile Radio Service Providers, *Report and Order and Further Notice of Proposed Rulemaking*, 22 FCC Rcd 15817, 15828 ¶ 27 (2007) (*2007 Roaming Order and FNPRM*) ("[W]e recognize that automatic roaming benefits mobile telephony subscribers by promoting seamless CMRS service around the country, and reducing inconsistent coverage and service qualities.")

[111] *Roaming Order on Reconsideration*, 25 FCC Rcd at 4182 ¶ 2.

[112] *Data Roaming Order*, 26 FCC Rcd 5411.

[113] *Id.* at 5418-5428 ¶ 13-31.

[114] *See. e.g.* CCA Comments at 17.

another provider indicated that they pay about as much as they themselves are paid, while 33 percent pay more and 14 percent pay less.[115]

65. On May 27, 2014, T-Mobile USA, Inc. ("T-Mobile") filed a petition for an expedited declaratory ruling that would provide guidance on the criteria used for determining whether the terms of a data roaming agreement meet the "commercially reasonable" standard set forth in the Commission's data roaming rule.[116] The data roaming rule requires facilities-based providers of commercial mobile data services to offer roaming arrangements to other such providers on "commercially reasonable terms and conditions."[117] T-Mobile contends that providers need this guidance to evaluate the commercial reasonableness of terms offered in individual negotiations and to reach agreements. The Commission released a Public Notice on June 10, 2014 seeking comment on the petition.[118]

B. Connections and Subscribers

1. Connections and Subscribers by Geography

66. To better understand the number of connections across geographic areas, for this *Report*, we have estimated penetration rates,[119] using NRUF subscriber data,[120] at the level of the 172 Economic Areas (EAs)[121] of the United States, each of which is an aggregation of a differing number of counties. We use EAs as the geographic unit for measuring the level of concentration in the mobile wireless services marketplace in order to maintain continuity with past *Reports* and to ensure that we do not compromise the confidential information contained in the NRUF data.[122] Regional penetration rates for the 172 EAs range from 85 percent in La Crosse, WI-MN to 188 percent in Grand Island, NE.[123] The nationwide penetration rate based on NRUF data now exceeds 100 percent, meaning that the number of connected devices exceeds the population, and the penetration

[115] NTCA *2012 Wireless Survey Report*, September 2012, at 3. *See* http://www.ntca.org/images/stories/Documents/Advocacy/SurveyReports/2012ntcawirelesssurveyreport.pdf

[116] Petition for Expedited Declaratory Ruling of T-Mobile USA, Inc., WT Docket No. 05-265, filed May 27, 2014.

[117] 47 C.F.R. § 20.12(e).

[118] Wireless Telecommunications Bureau Seeks Comment on Petition for Expedited Declaratory Ruling by T-Mobile USA, Inc. Regarding Data Roaming Obligations, WT Docket No. 05-265, *Public Notice*, DA 14-798 (WTB rel. June 10, 2014).

[119] The penetration rate is defined as the number of mobile wireless connections per 100 people.

[120] NRUF subscriber data indicate the number of assigned phone numbers that a wireless provider has in a particular wireline rate center (there are approximately 18,000 rate centers in the country). Rate centers are geographic areas used by local exchange carriers for a variety of reasons, including the determination of toll rates. *See* HARRY NEWTON, NEWTON'S TELECOM DICTIONARY: 19TH EXPANDED & UPDATED EDITION 660 (July 2003). All mobile wireless providers must report to the Commission the quantity of their phone numbers that have been assigned to end users, thereby permitting the Commission to calculate the total number of mobile wireless subscribers. For purposes of geographical analysis, the rate center data can be associated with a geographic point, and all of those points that fall within a county boundary can be aggregated together and associated with much larger geographic areas based on counties. We note that the aggregation to larger geographic areas reduces the level of inaccuracy inherent in combining non-coterminous areas such as rate center areas and counties.

[121] EAs are geographic areas defined by the U.S. Department of Commerce that define geographic markets using data on commuting patterns. . We recognize that EAs may be broader or narrower than other geographic markets employed in the Commission's analyses. For example, the Commission typically has used smaller geographic areas, such as CMAs, in its analysis of mobile wireless transactions. *See, e.g.*, *Sprint Nextel-Clearwire Order*, 23 FCC Rcd at 17591 ¶¶ 51-52; *Verizon Wireless-Alltel Order*, 23 FCC Rcd at 17472-73 ¶ 52.

[122] See Section II.D *infra*.

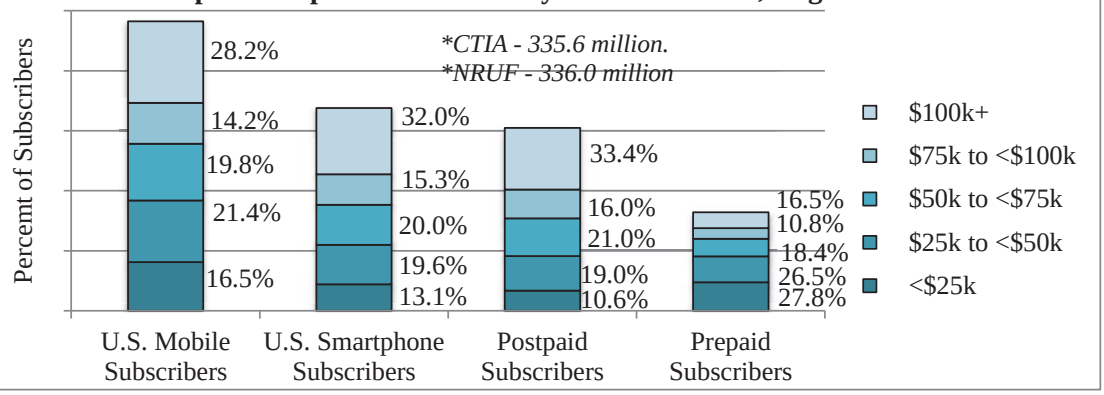
[123] See Appendix Table III.B.i

rate in 82 of the 172 EAs was at least 100 percent at the end of 2013.[124]

2. Connections and Subscribers by Demographics

67. Several socio-economic and demographic factors such as household income and age are correlated with overall mobile wireless subscription rates as well as smartphone subscription rates. Based on August 2014 survey data from ComScore Mobilens,[125] Chart III.B.1 shows that mobile wireless subscribers overall, and smartphone subscribers in particular, are in higher income brackets. For example, 24.7 percent of the population live in households with an annual income of less than $25,000, but only 16.5 percent of mobile wireless users and 13.1 percent of smartphone users are in this bracket. Conversely, 22.0 percent of the population live in households with an annual income over $100,000, but 28.2 percent of mobile wireless subscribers and 32 percent of smartphone subscribers are in this income bracket. The chart also shows that income may also be correlated with the choice of a prepaid plan or a postpaid plan: more postpaid users are in a higher income bracket, while the converse is true for prepaid subscribers.

Chart III.B.1
Total Mobile Subscribers, Smartphone Subscribers, and Prepaid/Postpaid Subscribers by Income Bracket, August 2014



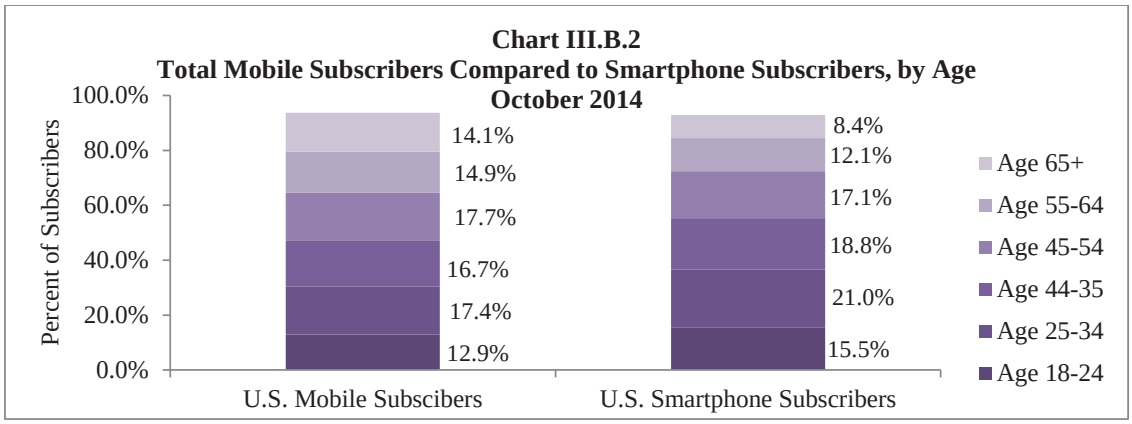
Source: ComScore, MobiLens Audience Profile August 2014 3-month survey data averages and U.S. Census Bureau 2012 Population Reports.

68. The ComScore data also allows the presentation of the composition of mobile users by age. The age distribution of mobile wireless subscribers and of smartphone subscribers is shown in Chart III.B.2. While the general adoption of mobile wireless devices is fairly evenly distributed among various age groups, smartphone adoption is more concentrated in younger age groups. For example, adults ages 18-44 comprise 47 percent of all mobile wireless subscribers, but make up over 55 percent of smartphone users, while adults over the age of 55

[124] According to the Bureau of the Census, the combined population of the 50 states, the District of Columbia, and Puerto Rico, as of July 1, 2011, was estimated to be 311.6 million. *See* U.S. Census Bureau, http://www.census.gov/popest/data/national/totals/2011/index.html (visited June 17, 2011). As noted in the *Fifteenth Report*, if NRUF is used to calculate a mobile wireless penetration rate (of a population), that penetration rate is overstated in terms of the number of individuals who have more than one mobile wireless device.

[125] Survey data based on ComScore MobiLens, March 2014. ComScore MobilLens U.S. data are derived from a monthly survey of over 13,000 respondents ages 13 and older who are recruited to represent U.S. Census demographics. The total universe size is estimated from data provided by CTIA and comScore's monthly subscriber studies. Race data are found at the US Census Bureau State and County Quick Facts 2013 website, at http://quickfacts.census.gov/qfd/states/00000.html. Income data are found in the "Income, Poverty, and Health Insurance Coverage in the United States: 2012 Current Population Reports. United States Census Bureau". Issued September 2013, Table A-1: Households by Total Money Income, Race, and Hispanic Origin of Householder, at http://www.census.gov/prod/2013pubs/p60-245.pdf

represent over 29 percent of all mobile wireless subscribers, but only 21 percent of smartphone subscribers.[126]



Source: ComScore MobiLens, 3 Month Average, October 2014

C. Consumers and Mobile Wireless

69. In today's connected world, consumers are faced with a wide variety of choices in mobile service plans, devices and applications. But fundamental to these options is the choice of a mobile service provider. Consumers choose a service provider or switch between providers for varying reasons, including price, availability of family plans, network quality, free/unlimited in-network calling, billing/payment options/credit, reputation/recommendation, previous experience with the provider, customer service, mobile data services, specific phone offerings, and bundling mobile phone services with other services or other unspecified reasons. In the past, contract length, handset exclusivity, lack of interoperability were some factors that were highlighted as barriers to switching. Recently, the advent of no-contract plans, such as those discussed in Section V, newer premium models such as the new iPhone versions being available to more providers, and the FCC 700 MHz interoperability Order, may have eased some of the switching barriers, and somewhat reduced switching cost. However, even now, switching is not free of costs. When mobile wireless customers wish to switch service providers, they may incur some switching costs including: search costs; early termination fees (ETFs); handset purchase; and implicit costs such as brand loyalty.

1. Usage

70. According to CTIA, reported annual MOUs increased 13.8 percent, reaching over 2.6 trillion. Average billable minutes of use (MOUs), a measure of monthly mobile voice usage per connection, also increased significantly in 2013.[127] This follows a decline in average MOUs, which leveled out in 2012. As seen in Chart III.C.1, between 2012 and 2013, average monthly MOUs, excluding most data-only devices, increased by 10.5 percent, compared with a previous year-over-year decline of 0.4 percent from 2011 to 2012 and 6.3 percent decline from 2010 to 2011. According to CTIA research staff, this may be due in part to improved reporting, provider participation and possible volume increases in usage, the 2013 MOUs show a significant increase in MOUs reported to CTIA.[128]

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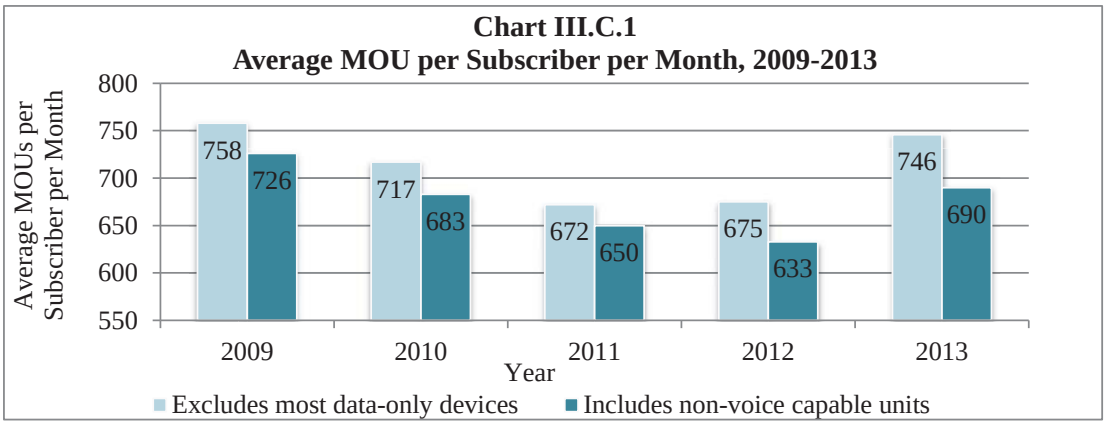
[127] CTIA Wireless Industry Indices Year-End 2013 at page 129, Table 43.

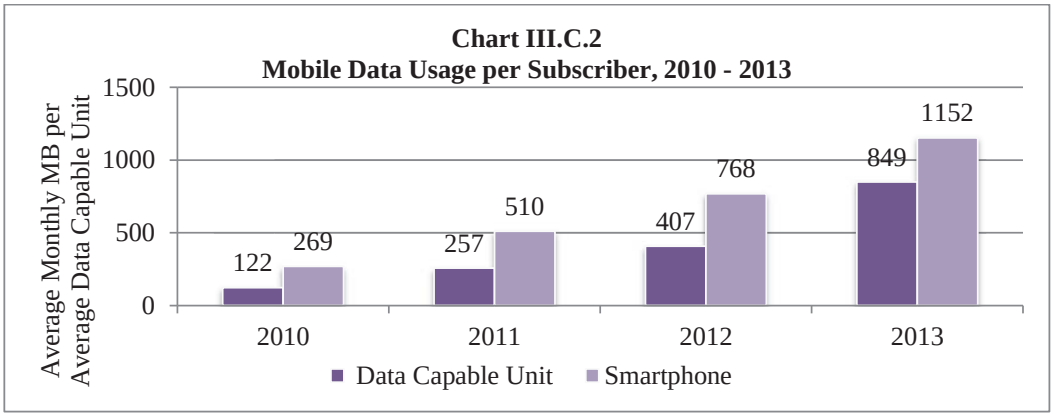
[128] CTIA Wireless Industry Indices Year-End 2013 at page 135. Telephone Conversation between FCC staff and CTIA Research October 2014.



Source: CTIA Wireless Industry Indices Year-End 2013. Latest available data.

71. However, voice usage does not tell the entire mobile use story. Cisco projects that mobile data will grow at an annual rate of 50 percent from 2013 to 2018[129] while Ericsson—a network infrastructure provider—projects mobile data growth of 38 percent per year between 2013 and 2019.[130] This trend is due to multiple factors including increased adoption of smartphones and tablets, growth in streaming video, and the development of faster networks.

72. CTIA reported that SMS and text messaging traffic amounted to over 153.3 billion for the December 2013 period. According to the CTIA survey, average monthly data usage per subscriber in 2013 averaged 1.2 GB per month increasing 50 percent over 2012. Chart III.C.2 provides average data usage per subscriber for 2010 to 2013 comparing the amount of data usage between data-capable devices and smartphones.



Source: CTIA Wireless Industry Indices Year-End 2013, Chart 32 Indices. Latest available data.

73. Other research organizations such as NPD indicates that according to 2013 data, average mobile data usage rangles between 550 MB and 1.4 GB.[131] According to GSMA, LTE users use twice as much data as non-LTE users , which translates to about 1.5 GB of data per month on average.[132] Total wireless data traffic

[129] *Cisco Visual Networking Index: Forecast and Methodology, 2013-2018*, (June 10, 2014).

[130] *Cisco Visual Networking Index*; Ericsson, *Ericsson Mobility Report; On the Pulse Of the Networked Society* (June 2014).

[131] http://www.fiercewireless.com/special-reports/average-android-ios-smartphone-data-use-across-tier-1-wireless-carriers-thr-1

[132] GSMA Report, *The Mobile Economy*, 2014. http://www.gsmamobileeconomy.com/GSMA_ME_Report_2014_R2_WEB.pdf

reported by the providers to CTIA amounted to 3.23 trillion MB for 2013 up 120 percent from 1.47 trillion MB in 2012.[133] For the third quarter of 2014, Mobidia reports that LTE continues to drive data usage with the average 3G smartphone subscriber using less than half the data of and LTE subscriber, who average monthly data usage is around 2 GB.[134]

74. According to the Pew Research Internet Project, 81 percent of cellphone users use their cellphone to send or receive text messages; 60 percent access the Internet; 52 percent send or receive email; 50 percent download apps; 49 percent get directions, recommendations, or other location-based information; 48 percent listen to music; 21 percent participate in a video call or video chat; and 8 percent check-in or share location.[135] Not only has the variety of uses changed, but socially acceptable times to use mobile devices have also changed. For example, 70 percent of mobile device users reported having, within the previous 24 hours, used a mobile device while eating.[136]

2. Handsets

75. *Smartphone Penetration*. Smartphone use has continued to increase over the last two years. The Pew Research Internet Project estimates that as of January 2014, 90 percent of all American adults had a cell phone, and 58 percent had a smartphone.[137] Chart III.C.3 presents a more detailed analysis. According to ComScore's dataset, 72 percent of all mobile subscribers had a smartphone in September 2014,, compared to 51 percent in September 2012.[138] These numbers increase when we consider only subscribers who purchased a phone recently. For instance, 85 percent of subscribers purchasing a new phone in September 2014 were smartphone users, up from 67 percent in September 2012.

[133] CTIA Indices at page 11

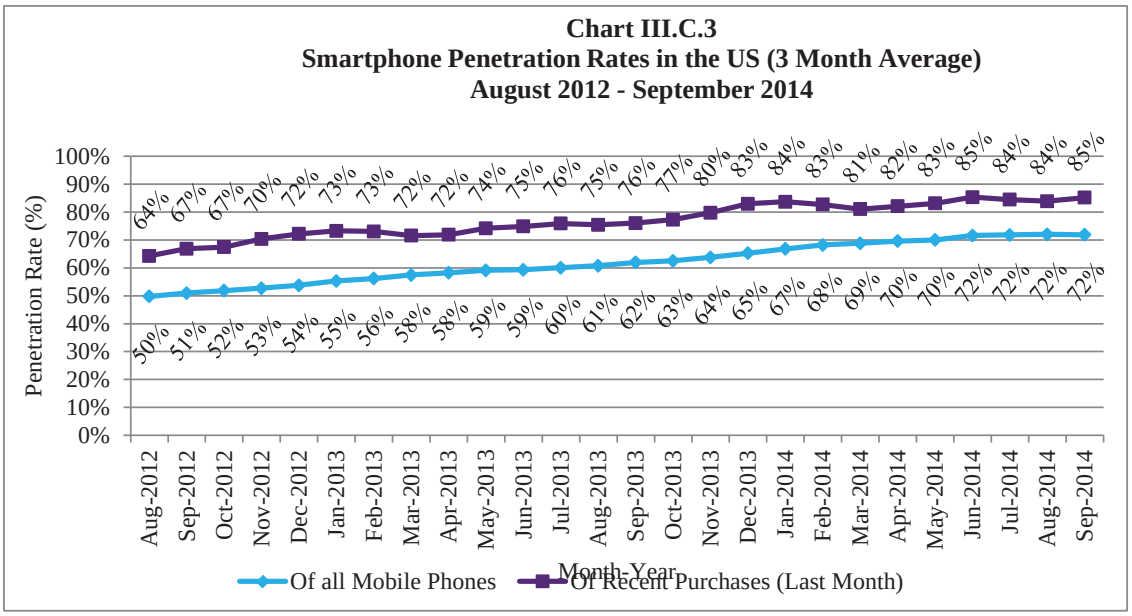
[134] Mobidia LTE Data Usage, November 2014, http://www.mobidia.com/blog

[135] http://pewinternet.org/Reports/2013/Cell-Activities.aspx

[136] Citrix Mobile Device Survey, January 2014.

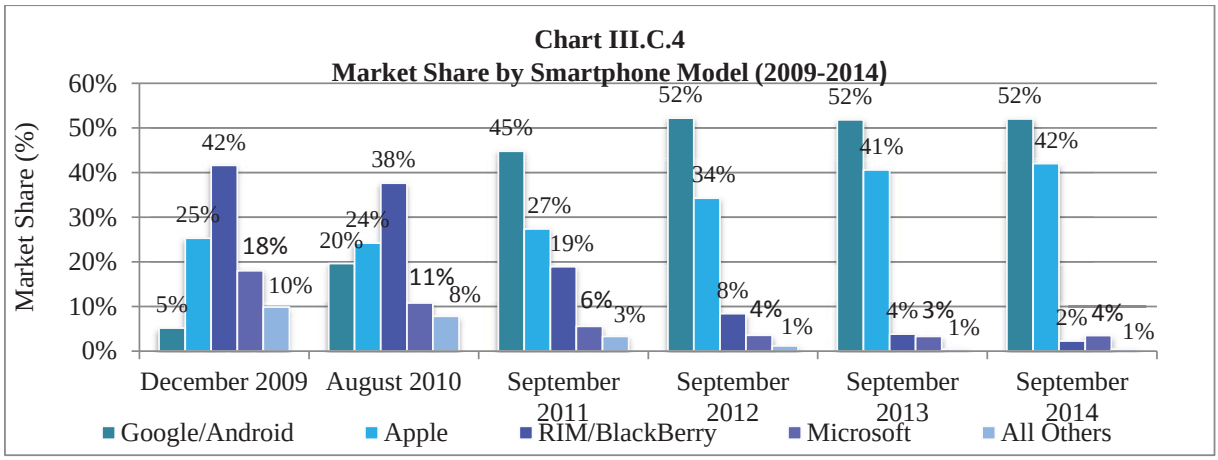
[137] Pew Research Internet Project, *Cell Phone and Smartphone Ownership Demographics*, Jan. 2014, available at http://www.pewinternet.org/data-trend/mobile/cell-phone-and-smartphone-ownership-demographics/

[138] ComScore, MobiLens Trend, 3 month averages from August 2012 to November 2013.



Note: ComScore, MobiLens Audience Profile, 3 month averages from August 2012 to September 2014.

76. *Share of Smartphones by Operating System*. The operating system of a smartphone is a major determining factor of the smartphone's ability to support mobile applications and Internet-based services. As seen in Chart III.C.4[139], Apple's iOS and Google's Android continued to dominate the market for mobile operating systems.[140] In September 2014 Android's share of the market was 52 percent, and it retained over half of the smartphone operating system market. In second place, Apple's iOS held 42 percent of the market in September 2014, up from 34.3 percent in September 2012. RIM (Research in Motion)/Blackberry (2 percent), Microsoft (4 percent), and other firms (1 percent) comprised the remainder of the market.



Note: Based on ComScore MobiLens 3-month survey data averages

[139] ComScore, MobiLens Trend. comScore MobilLens U.S. data are derived from a monthly survey of over 13,000 respondents ages 13 and older who are recruited to represent U.S. Census demographics. The total universe size is estimated from data provided by CTIA and comScore's monthly subscriber studies.

[140] Also see Appendix Table III.C.i

3. Mobile Applications

77. The increasing use of smartphones has spawned a mobile applications ecosystem. Major categories include: web searching, news and information, e-mail and messaging, games, social networking, location-based services, photo sharing, music and video streaming, VoIP, and mobile commerce (including mobile payments, mobile banking, and mobile shopping). Thousands of niche applications have been designed for specific uses, hobbies, interests, and industries by various third-party application developers. The number of mobile applications launched and the number of applications downloaded by consumers have grown significantly over the past three years. There are two main application stores—the Apple App Store and Google Play. As of year end 2013, based on revenues, the Apple App Store had a 62 percent market share, while Google Play had a 38 percent market share.[141]

78. Additionally, mobile commerce is playing a growing role in the U.S. economy.[142] As of November 2013, approximately 36 percent of U.S. bank account holders have used mobile banking services more than once in the past 30 days.[143] Mobile banking allows consumers to check account balances, pay bills, and transfer funds on a variety of mobile devices.[144] Many banks offer consumers text banking, access to accounts via the mobile web, mobile banking applications, and mobile deposits for use on several platforms and devices.[145] In addition, many mobile wireless handsets and devices can be used to make on-the-spot payments at physical retail locations with a technology commonly known as "Tap and Pay." Mobile payments technologies include SMS, operator billing, the mobile Internet, mobile wallets, and Near Field Communications (NFC).[146] As of, February 2014, approximately 87 percent of smartphone and tablet owners say they use these devices for shopping activities.[147]

79. Most mobile applications are available for download through mobile web browsers or through mobile application stores, such as the Apple's App Store or Google Play. Once an application is installed on a mobile device, the application may or may not require a mobile broadband connection to function. In addition, many applications for smartphones and other devices such as tablets are pre-installed on mobile operating systems. As see in Chart III.C.5, as of July 2014, Android users were able to choose between 1.3 million apps.

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[141] *Top Global Apps – January 2014*, http://www.distimo.com/blog/2014_02_top-global-apps-january-2014/, (visited 5/22/2014).

[142] Matthew B. Gross, Jeanne M. Hogarth, and Maximilian D Schmeiser, *Consumers and Mobile Financial Services*, Federal Reserve Board, Division of Consumer and Community Affairs, March 2012. Penny Crosman, *Contactless Mobile Pay Transactions Seen Nearing 10B by 2016*, Mar. 6, 2012.

[143] Nielsenwire, The Nielsen Company, *Multiplying Mobile: How Multicultural Consumers are Leading Smartphone Adoption*, March 4, 2014. Neilsen Newswire, The Nielsen Company, *The Evolution of Modern Banking*, March 19, 2014.

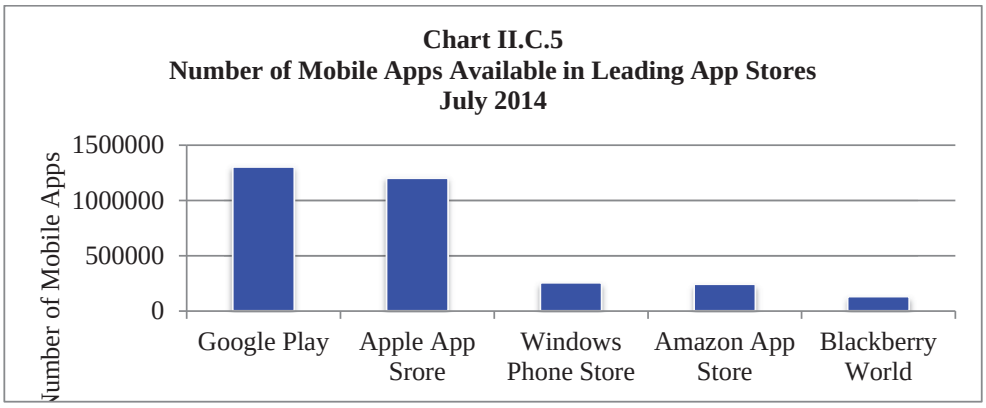
[144] International Business Times, Mobile Banking on the Rise, Aug. 15, 2012, *available at* http://www.ibtimes.com/articles/373841/20120815/mobile-banking-united-states-bank-account-holders.htm (visited April 16, 2014).

[145] *See generally* Bank of America, *Mobile Banking*. http://www.bankofamerica.com/onlinebanking/index.cfm?template=mobile_banking (visited April 16, 2014); Chase, *Chase Mobile Banking*, https://www.chase.com/index.jsp?pg_name=ccpmapp/shared/assets/page/Chase_Mobile_Banking (visited April 16, 2014); Citibank, *Citi Mobile Banking*, https://online.citibank.com/US/JRS/pands/detail.do?ID=CitiMobile (visited April 16, 2014).

[146] International Business Times, Mobile Banking on the Rise, Aug. 15, 2012, available at http://www.ibtimes.com/articles/373841/20120815/mobile-banking-united-states-bank-account-holders.htm (visited April 16, 2014); Ovum, *Mapping Mobile Payments*, April 2012, at 2.

[147] Nielsenwire, The Nielsen Company, *Shopping Lists: How Mobile Helps Consumers Tick All the Boxes*, February 20, 2014.

Apple's App Store remained the second-largest app store with 1.2 million available.[148]



Note: Data from Statistica.com, Latest available data.

80. Mobile applications are available in a broad range of categories and include web searching, social media, and gaming. As shown in Chart III.C.6, the applications that were accessed by the highest percentage of smartphone users in April 2014 were email, weather, and social networking apps.[149] However, other apps continue to grow in popularity. Analysts predict that industry-focused mobile applications marketplaces will develop, focusing for example on professional healthcare or education, among other industries.[150]

81. Mobile applications generate revenue through contracts for application developers, e-commerce sales, in-application advertising, and application store sales.[151] Estimates from Vision Mobile and Developer Economy indicate that the total worth of the global mobile applications marketplace ranged from $60 billion to $70 billion in 2013.[152]

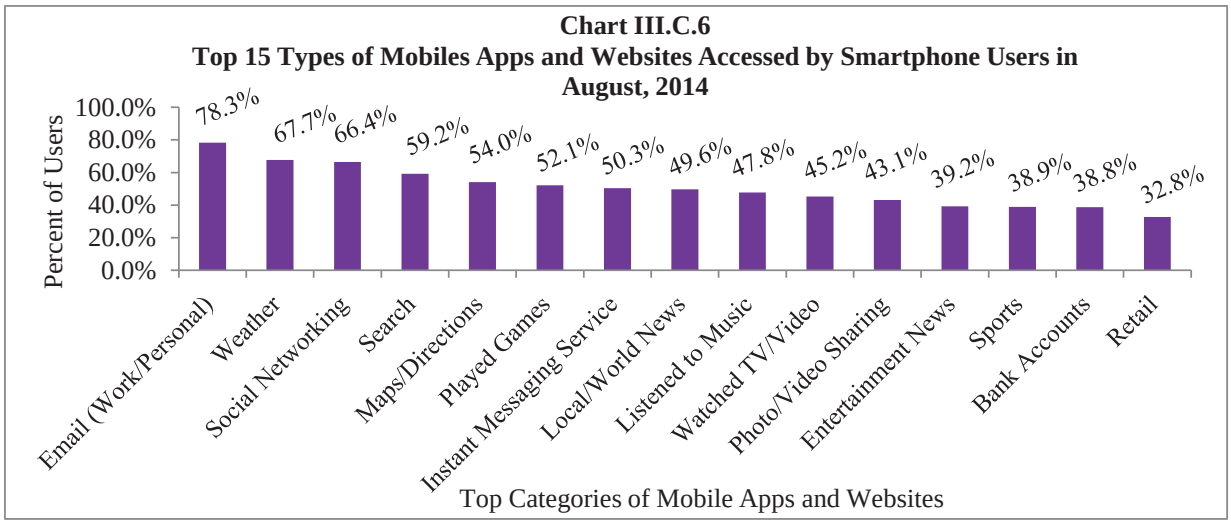
[148] See http://www.statista.com/statistics/276623/number-of-apps-available-in-leading-app-stores/

[149] *See* ComScore, MobiLens. 3 month average survey data, April 2014.

[150] *See* Vision Mobile, Business and Productivity Apps, March 2014.

[151] *See* Vision Mobile, Business and Productivity Apps, March 2014.

[152] *See* Developer Economics, State of the Developer Nation, February 2014. *See also*, Vision Mobile, Business and Productivity Apps, March 2014.



Note: Based on ComScore MobiLens 3-month survey data averages, August 2014

4. Consumer Access to Information

82. Through the *Consumer Code for Wireless Service*, CTIA and the service providers that are its signatories voluntarily commit to providing consumers with information to assist them in the selection of a mobile wireless service provider.[153] Signatories to CTIA's Consumer Code commit to disclose rates, additional taxes, fees, surcharges, and terms of service; provide coverage maps; and make customer service readily accessible. In July 2010, CTIA updated the Consumer Code to require providers to ensure disclosure of data allowances offered in a service plan, whether there are any prohibitions on data service usage, and whether there are network management practices that will have a material impact on the customer's wireless data experience.[154] The Consumer Code also states that prepaid service providers must disclose the period of time during which any prepaid balance is available for use.[155] 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.[156]

83. *Bill Shock*. In October 2011, CTIA revised its Consumer Code to require that its participating providers provide four types of alerts (data, voice, text, international roaming) by April 17, 2013, and at least two out of the four types of alerts by October 17, 2012.[157] The member providers agreeing to this plan account for service to 97 percent of U.S. wireless customers and all customers are included unless they opt out. In order to

[153] *See* CTIA, *Consumer Code for Wireless Service*, *available at* http://files.ctia.org/pdf/ConsumerCode.pdf (visited Oct. 16, 2012). (*Consumer Code for Wireless Service*).

[154] *See* CTIA Comments at 46; CTIA, *CTIA-The Wireless Association® Announces Updates to Its 'Consumer Code for Wireless Service,'* Press Release, July 28, 2010, *available at* http://www.ctia.org/media/press/body.cfm/prid/1992 (visited Oct. 16, 2012).

[155] *Id.*

[156] *See* CTIA Comments at 44-45; *See* also *Consumer Code for Wireless Service*. 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.

[157] *See* http://www.fcc.gov/blog/new-fcc-website-help-consumers-beat-%E2%80%98bill-shock%E2%80%99 (visited Oct. 16, 2012). *See also* CTIA Consumer Code, http://www.ctia.org/content/index.cfm/AID/10352 (visited Nov. 1, 2012).

further facilitate the adoption of such alerts, the Commission has established a web site where consumers can determine which providers are implementing the voluntary commitments.[158]

84. *Open Internet Rules*. The rules on Internet openness adopted by the Commission in December 2010 require both fixed and mobile broadband Internet providers to "publicly disclose accurate information regarding the network management practices, performance, and commercial terms of its broadband Internet access services sufficient for consumers to make informed choices regarding use of such services."[159] In providing guidance regarding effective disclosure models in that Order, the Commission indicated that among the types of information that might be included in an effective disclosure are pricing terms such as monthly prices, usage-based fees, and fees for early termination or additional network services.[160] The Commission also adopted anti-blocking requirements for fixed and mobile providers and an anti-discrimination rule for fixed providers.[161]

85. Verizon challenged the open Internet rules in the D.C. Circuit and the court ruled on Verizon's challenge in January, 2014.[162] The court rejected Verizon's challenge to the transparency rule, but struck down the anti-blocking and anti-discrimination rules. The court remanded the case to the Commission for further proceedings. In May, 2014, the Commission issued a NPRM responding to the court's remand, and proposed to adopt new rules consistent with the court's opinion.[163] Among its proposals, the Commission tentatively concluded that it should enhance the transparency rule to improve its effectiveness and require broadband providers to more specifically tailor disclosures to the needs of affected parties.[164]

5. Intermodal Developments

86. We here provide the latest information from the CDC National Health Interview Survey on wireless-only households. Preliminary results from CDC's July - December 2013 National Health Interview Survey indicate that the number of American homes with only wireless telephones continues to grow. As shown in Chart III.C.7 the percentage of U.S. adults and children living in households with landlines, with or without wireless, has fallen steadily over the past few years.[165] The percentage of wireless-only households has continued to increase for both groups, and the percentage of households without phones has not changed significantly.[166] However, a significant percentage of homes with both landline and wireless phone access received all or almost all calls on wireless telephones despite also having a landline telephone.[167] SNL Kagan, estimates that phone cord cutting will continue to grow over the next decade, driving wireless-only households to 60.9 percent of all

[158] *See* http://www.fcc.gov/encyclopedia/bill-shock-wireless-usage-alerts-consumers (visited Oct. 16, 2012).

[159] *Open Internet Order* at ¶ 54.

[160] *Open Internet Order* at ¶ 56.

[161] 47 C.F.R. § 8.5.

[162] *Verizon v. FCC*, 740 F.3d 623 (D.C. Cir. 2014).

[163] *Protecting and Promoting the Open Internet*, GN Docket No. 14-28, Notice of Proposed Rulemaking, 29 FCC Rcd 5561 (2014).

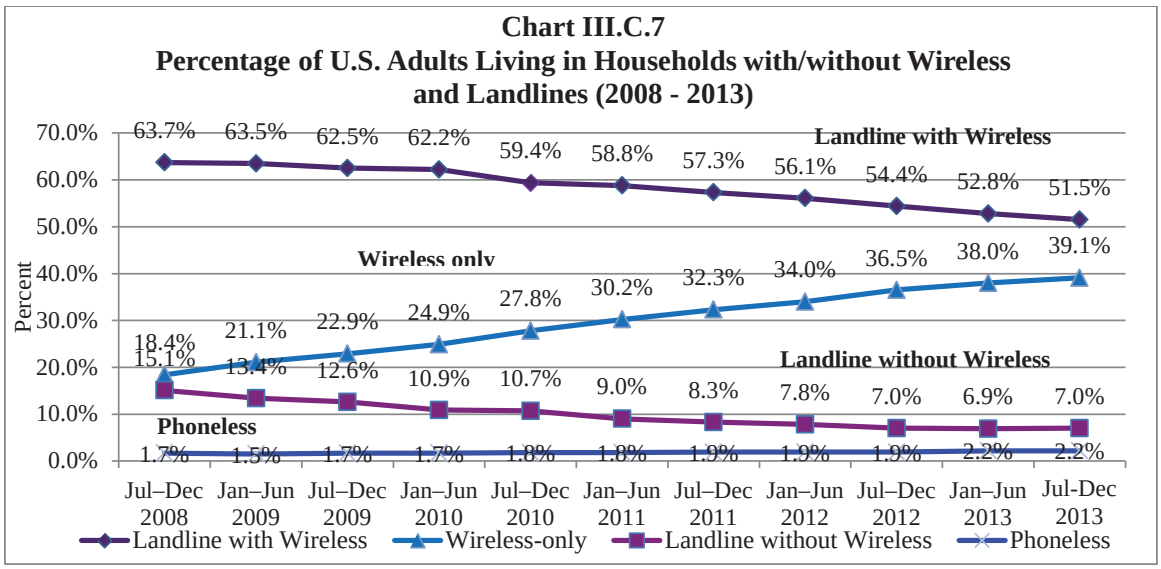
[164] *Id*. at 5586, ¶¶ 67-68.

[165] Also see Appendix Tables III.C.ii and III.C.iii

[166] Stephen J. Blumberg and Julian V. Luke, Wireless Substitution: Early Release of Estimates from the National Health Interview Survey, January-June 2013, National Center for Health Statistics, Centers for Disease Control, December 2014, available at http://www.cdc.gov/nchs/data/nhis/earlyrelease/wireless201312.pdf

[167] Stephen J. Blumberg and Julian V. Luke, Wireless Substitution: Early Release of Estimates from the National Health Interview Survey, January-June 2013, National Center for Health Statistics, Centers for Disease Control, December 2013, available at http://www.cdc.gov/nchs/data/nhis/earlyrelease/wireless201312.pdf

households by the end of 2024.[168]



Source: Data from CDC/NCHS National Health Interview Surveys, Jan-June 2012 and Jan-June 2013. Latest available data. Adults are aged 18 and over, children are under age 18.

IV. INPUT MARKETS

87. Mobile wireless service providers employ a combination of inputs to provide mobile wireless services to their customers. These inputs include electromagnetic spectrum to transmit signals between base stations and end users' devices, as well as non-spectrum inputs such as cellular base stations and towers to carry transmissions. Backhaul, which routes voice and data traffic from base stations for onward transmission and may use spectrum or wireline resources, is an additional input required for the provision of mobile service.

A. Spectrum

88. This section highlights the role that spectrum plays as an input in the provision of mobile wireless services, summarizes the Commission's policies to facilitate the use of commercial wireless spectrum, and provides summary information on service providers' current spectrum holdings.

1. Importance of Spectrum for the Provision of Mobile Wireless Services

89. As the Commission has recently found, spectrum is a critical input in the provision of mobile wireless services, including mobile broadband, as it affects if and when existing service providers and potential entrants will be able to expand capacity or deploy networks.[169] 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 incumbent licensees.[170]

90. Spectrum bands vary in their propagation characteristics, which has implications for spectrum use and deployment. Service providers deploy their spectrum bands differently depending on the nature of the

[168] SNL Kagan (cite)

[169] *See* Policies Regarding Mobile Spectrum Holdings; Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions, WT Docket No. 12-269; Docket No. 12-268, *Report and Order*, FCC 14-63, at ¶ 2 (re. Jun. 2, 2014) ("*Mobile Spectrum Holdings Report and Order*"); *Sixteenth Report*, 28 FCC Rcd at 3836 ¶ 85.

[170] *Sixteenth Mobile Wireless Competition Report*, 28 FCC Rcd 3769 ¶ 86.

service, geography, density, or other factors in their network build-out.[171] Spectrum below 1 GHz ("low-band spectrum") has distinct propagation advantages for network deployment over long distances, while also reaching deep into buildings and urban canyons. Spectrum above 1 GHz ("high-band spectrum") is more plentiful and possesses certain technical advantages allowing for the transmission of large amounts of information. In this sense, spectrum below 1 GHz may be thought of as "coverage" spectrum, and spectrum above 1 GHz may be thought of as "capacity" spectrum.[172] There is significantly less low-band spectrum than high-band spectrum that is suitable and available for the provision of mobile telephony/broadband services.[173]

91. Rising consumer demand for mobile broadband is increasing service providers' need for spectrum at an unprecedented rate.[174] As service providers deploy next-generation mobile networks, the engineering properties and deployment capabilities of the mix of particular spectrum bands in their spectrum holdings have become increasingly important, particularly as multi-band phones allow users to take advantage of the different properties of different spectrum bands.[175] Service providers need access to spectrum that can provide both coverage and in-building penetration, as well as spectrum that can provide the increased throughput for mobile broadband applications.[176] A service provider holding a mix of low- and high-band spectrum licenses has greater flexibility and is better able to optimize its network costs for a given quality level.[177]

92. As the Commission has found, robust competition depends critically upon the availability of spectrum as a necessary input in the provision of mobile wireless services.[178] For robust competition to exist and persist, multiple competing service providers must have access to a sufficient mix of low- and high-band spectrum to be able to enter a marketplace or expand output rapidly in response to any price increase or reduction in quality, or other change that would harm consumer welfare.[179] In particular, without access to low-band spectrum, service providers would have to rely on alternative, less cost-effective methods to increase rural and in-building coverage to serve additional customers, such as adding towers, splitting cells, or acquiring roaming rights on other networks.[180] In that regard, spectrum acquisition can be valuable in furthering a service provider's competitive

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[171] *See Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6149-6154 ¶ 31-40; *Sixteenth Report*, 28 FCC Rcd at 3789-3793 ¶ 119-127.

[172] *See Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6135 ¶ 3; *Sixteenth Mobile Wireless Competition Report*, 28 FCC Rcd at 3789, 3792 ¶ 121, 126.

[173] *Sixteenth Mobile Wireless Competition Report*, 28 FCC Rcd at 3789, 3792 ¶ 121, 126.

[174] *See Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6134 ¶ 2.

[175] *See Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6144 ¶ 18; *Sixteenth Mobile Wireless Competition Report*, 28 FCC Rcd at XXXX ¶ 127.

[176] *See Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6157 ¶ 47;*Sixteenth Mobile Wireless Competition Report*, 28 FCC Rcd at XXXX ¶ 127.

[177] *See Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6163-6164 ¶ 59*; Sixteenth Mobile Wireless Competition Report*, 28 FCC Rcd at 3789, 3792-93, 3796 ¶¶ 119, 127, 135.

[178] *See Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6134 ¶ 1; *Verizon Wireless-SpectrumCo Order*, 27 FCC Rcd at 10716 ¶ 47; *AT&T-Qualcomm Order*, 26 FCC Rcd at 17601-02 ¶ 30; *Verizon Wireless-ALLTEL Order*, 23 FCC Rcd at 17481-82 ¶ 75; *Cingular-AT&T Wireless Order*, 19 FCC Rcd at 21569 ¶ 109.

[179] *Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6143, 6163-6164 ¶¶ 17, 59. *See also AT&T WCS Order*, 27 FCC Rcd at 16467 ¶ 20; *Verizon Wireless-SpectrumCo Order*, 27 FCC Rcd at 10716 ¶ 48; *AT&T-Qualcomm Order*, 26 FCC Rcd at 17601-02 ¶ 30.

[180] *See Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6164 ¶ 60. While other cost-related factors exist, ensuring that multiple providers are able to access a sufficient amount of low-band spectrum is a threshold requirement for extending and improving service in both rural and urban areas. *See Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6135 ¶ 3.

position as well as reducing opportunities available to its rivals.[181]

2. Facilitating Access to Spectrum

93. Recognizing the importance of spectrum in the provision of mobile wireless services, Congress, through the Communications Act, requires the Commission to implement spectrum policies that promote competition, innovation, and the efficient use of spectrum to best serve the public interest, convenience and necessity.[182] Consistent with the Commission's statutory mandate, the Commission has established policies to make spectrum available to existing mobile service providers and potential new entrants through initial licensing, primarily by competitive bidding, and through secondary market transactions.[183] The Commission's spectrum policies have been guided by the goal of promoting and preserving competition, which in turn enables consumers to make choices among numerous service providers and leads to lower prices, improved quality, and increased innovation.[184] The Commission generally has provided 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, which has permitted an evolution to next-generation wireless technologies and services using the licensees' existing spectrum.

a. Auctions

94. Since 1994, the Commission has conducted various auctions of spectrum licenses.[185] These auctions are open to any eligible entity that submits an application and upfront payment, and is found to be a qualified bidder by the Commission.[186] The *Sixteenth Report* discusses auctions for the various frequency bands which are potentially suitable for the provision of mobile telephony/broadband service.[187] Additionally, the Commission's auction website provides detailed information regarding ongoing, completed, and planned auctions.[188]

95. To meet rising the consumer demand discussed above, the Commission is making substantially more spectrum available for the provision of mobile wireless services. In early 2014, the Commission auctioned the 10 megahertz of H Block in the 1.9 GHz Band, in which Dish Network won all 176 licenses.[189] The auction

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[181] *See Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6164, 6165 ¶¶ 60, 62.

[182] *See 4*7 U.S.C. § 309(j)(3)(B).

[183] *See*, 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, ; 700 MHz Second R&O, 22 FCC Rcd at 15374-80, ¶¶ 231-248

[184] *See Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6144 ¶ 17. Our public interest evaluation necessarily encompasses the "broad aims of the Communications Act," which include, among other things, a deeply rooted preference for preserving and enhancing competition in relevant markets, accelerating private sector deployment of advanced services, and generally managing the spectrum in the public interest. *See, e.g.*, *AT&T WCS Order*, 27 FCC Rcd at 16464 ¶ 11; *AT&T-Centennial Order*, 24 FCC Rcd at 13928 ¶ 28; *Verizon Wireless-ALLTEL Order*, 23 FCC Rcd at 17461 ¶ 27; *Sprint-Clearwire Order*, 23 FCC Rcd at 17580 ¶ 20.

[185] *See* Auction 1 in FCC Auctions Home, Auctions, http://wireless.fcc.gov/auctions/default.htm?job=auctions_home (visited Jul. 03, 2014).

[186] *See* Federal Communications Commission, About Auctions, http://wireless.fcc.gov/auctions/default.htm?job=about_auctions (visited Mar. 27, 2014).

[187] *See Sixteenth Report*, 28 FCC Rcd at 3773-3778 ¶ 92-100.

[188] *See* Federal Communications Commission, Auctions Home, http://wireless.fcc.gov/auctions/default.htm?job=auctions_home (visited Mar. 27, 2014).

[189] *See Auction of H Block Licenses in the 1915-1920 MHz and 1995-2000 MHz Bands Closes; Winning Bidder Announced for Auction 96*, 29 FCC Rcd at 2044 (Re. Feb. 28, 2014); Service Rules for Advanced Wireless Services in the 2000-2020 MHz and 2180-2200 MHz Bands, WT Docket No. 12-70, Fixed and Mobile Services in the Mobile Satellite Service Bands at

for Advanced Wireless Services-3 ("AWS-3"), which commenced on November 13, 2014, and is ongoing as of the release of this report, will award 65 megahertz of high-band spectrum to the winning bidders.[190] In addition, the planned 600 MHz Incentive Auction will auction significant amounts of low-band spectrum in a broadcast television spectrum incentive auction. Pursuant to the Spectrum Act, the Commission will allow broadcasters to voluntarily participate in a "reverse auction" of the UHF spectrum, which would then be made available in a "forward auction" for licenses with flexible use service rules. It is expected that the 600 MHz Band will be used to provide robust mobile broadband service, given that its technical characteristics and rules are similar to those for the 700 MHz Band, which is the home today of much of the current LTE mobile broadband service.[191]

96. In the *Mobile Spectrum Holdings Report and Order*, the Commission concluded that, in lieu of a post-auction application of the spectrum screen to the initial licensing of spectrum to winning bidders, the Commission would determine whether a band-specific mobile spectrum holding limit is necessary, and if so, would establish an *ex ante* application of that limit to the competitive bidding for that band.[192] With respect to the Incentive Auction, the Commission established a market-based spectrum reserve of up to 30 megahertz in each license area that is designed to ensure against excessive concentration in holdings of low-band spectrum while including safeguards to ensure that all bidders bear a fair share of the cost of the Incentive Auction.[193] The Commission declined to adopt band-specific mobile spectrum holding limits for AWS-3, emphasizing the availability of a substantial amount of comparable high-band spectrum to competitors and the significant existing holdings of multiple providers of comparable spectrum.[194]

b. Secondary Markets

97. Subject to the Commission's approval, licensees may assign and exchange licenses, in whole or in part (through partitioning and/or disaggregation), on the secondary market.[195] In reviewing proposed acquisitions of spectrum through secondary market transactions, the Commission uses an initial screen to help identify for case-by-case review local markets where changes in spectrum holdings resulting from the transaction may be of particular concern.[196] As set out in various transactions orders, however, the Commission has not

1525-1559 MHz and 1626.5-1660.5 MHz, 1610-1626.5 MHz and 2483.5-2500 MHz, and 2000-2020 MHz and 2180-2200 MHz, ET Docket No. 10-142, Service Rules for Advanced Wireless Services in the 1915-1920 MHz, 1995-2000 MHz, 2020-2025 MHz and 2175-2180 MHz Bands, WT Docket No. 04-356, *Report and Order and Order of Proposed Modification*, FCC 12-151 (rel. Dec. 17, 2012) *(AWS-4 Report and Order).*

[190] *See* Amendment of the Commission's Rules with Regard to Commercial Operations in the 1695-1710 MHz, 1755-1780 MHz, and 2155-2180 MHz Bands, GN Docket No. 13-185, Report and Order, GN 13-185 (re. Mar. 31, 2014) *(AWS-3 Report and Order). See also* Auction of Advanced Wireless Services (AWS-3) Licenses Scheduled for November 13, 2014, AU-Docket No. 14-78, *Public Notice*, (rel. July 23, 2014).

[191] *See generally* Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions, GN Docket No. 12-268, FCC 14-50, Report and Order (May 15, 2014).

[192] *See Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6192 ¶ 139 (replacing policies previously articulated in 2008 in Union Telephone Company and Cellco Partnership d/b/a Verizon Wireless Applications for 700 MHz Band Licenses, Auction No. 73, Order, 23 FCC Rcd 16787, 16791, 16796 ¶¶ 9, 18 (2008)). See Section IV.A.2.b *infra*

[193] *See Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6193-6219 ¶¶ 146-217.

[194] *See Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6220-6221 ¶¶ 222-224.

[195] As part of its secondary market policies, the Commission also permits 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. For a more comprehensive overview of the Commission's secondary market policies, *see Sixteenth Report*, 28 FCC Rcd at 3782-3783 ¶¶ 108-110.

[196] *See, e.g., Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6221-6222 ¶ 225; *Alaska Wireless Order*, 28 FCC Rcd at 10449-50 ¶ 38; *Verizon Wireless-SpectrumCo Order*, 27 FCC Rcd at 10719 ¶ 59; *AT&T-Qualcomm Order*, 26 FCC Rcd at 17602 ¶ 31; *AT&T-Centennial Order*, 24 FCC Rcd at 13938 ¶ 50. For transactions that result in the acquisition of wireless business units and customers or change the number of firms in any market, the Commission also applies an initial

limited its consideration of potential competitive harms solely to markets identified by its initial screen, if it encounters other factors that may bear on the public interest inquiry.[197]

98. The Commission includes in its initial screen spectrum that it finds is suitable and available for the provision of mobile telephony/broadband services. Suitability is based upon whether the spectrum band at issue is capable of supporting mobile service given its physical properties and the state of 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 the relevant mobile services.[198] With respect to availability, the Commission considers particular spectrum to be a relevant input if it is fairly certain that it will meet the criteria for suitable spectrum in the near term.[199]

99. In the past decade, in the context of its review of secondary market transactions, the Commission periodically determined that additional spectrum was suitable and available, and therefore subject to inclusion in the spectrum screen used in its competitive review—including 700 MHz,[200] AWS-1,[201] BRS,[202] and WCS.[203] Recently, in the *Mobile Spectrum Holdings Report and Order*, the Commission updated the spectrum screen by adding 151 megahertz of spectrum in total from the AWS-4 (2.0/2.2 GHz), H Block (1.9 GHz), BRS, and EBS bands.[204] It also designated for future inclusion in the spectrum screen, the amount of 600 MHz Band spectrum that would be made available through the upcoming Incentive Auction, and the 65 megahertz of AWS-3 spectrum as it becomes available on a market by market basis.[205] Furthermore, the Commission subtracted 12.5 megahertz of SMR, and 10 megahertz that was the Upper 700 MHz D Block.[206] Spectrum currently included in the screen is as follows:

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screen based on the size of the post-transaction HHI and the change in the HHI. *See, e.g., Cingular-AT&T Wireless Order*, 19 FCC Rcd at 21564-65 ¶ 96.

[197] *See, e.g., Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6221-6222 ¶ 225; *SoftBank-Sprint Order*, 28 FCC Rcd at 9656 ¶ 35; *AT&T WCS Order*, 27 FCC Rcd at 16467 ¶ 21; *Verizon Wireless-SpectrumCo Order*, 27 FCC Rcd at 10716 ¶ 48; *AT&T-Qualcomm Order*, 26 FCC Rcd at 17610-11 ¶¶ 49-50.

[198] *See, e.g., Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6169 ¶ 71; *AT&T-WCS Order*, 27 FCC Rcd at 16469-16970 ¶ 29 and n. 81.

[199] *Id.*

[200] *See AT&T-Dobson Order*, 22 FCC Rcd 20295, 20307-08 ¶ 17.

[201] *See Sprint Nextel-Clearwire Order*, 23 FCC Rcd 17570, 17599 ¶ 72.

[202] Most BRS spectrum is considered available in those markets where the transition of BRS spectrum to the new band plan has been completed. *Sprint Nextel-Clearwire Order*, 23 FCC Rcd at 17598-99 ¶ 70; Amendment of Part 27 of the Commission's Rules to Govern the Operation of Wireless Communications Services in the 2.3 GHz Band, *Report and Order*, 25 FCC Rcd 11710, 11711 ¶ 1 (2010).

[203] *See AT&T-WCS Order*, 27 FCC Rcd at 16470-16471 ¶ 31; *WCS Order on Reconsideration*, 27 FCC Rcd at 13688 ¶ 88.

[204] *See Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6172-6187 ¶¶ 82-125.

[205] *See Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6171-6172, 6176-6179 ¶¶ 76-81, 94-102.

[206] *See Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6187-6190 ¶¶ 126-134.

Table IV.A.1
Spectrum Included in the Spectrum Screen

Spectrum Band	Megahertz
700 MHz	70
Cellular	50
SMR (Specialized Mobile Radio Service)	14
Broadband PCS	130
AWS-1[a]	90
H-Block	10
AWS-4	40
WCS	20
BRS[b] (Broadband Radio Service)	67.5
EBS (Educational Broadband Service)	89
Total Amount of Spectrum	580.5

[a] AWS-1 is not attributable in markets where Federal Government users have not been relocated.
[b] BRS is not attributable in markets where previous BRS licensees have not been transitioned.

100. For those markets identified by the spectrum screen, or where the Commission encounters other factors that may bear on the public interest inquiry, [207] the Commission conducts further competitive review to determine whether the transaction would result in an increased incentive or ability for the assignee or transferee to behave in an anticompetitive manner. The case-by-case analysis considers variables that are important in predicting the incentives and ability of service providers to successfully reduce competition on price or non-price terms, and transaction-specific public interest benefits that may mitigate or outweigh any public interest harms that might arise from the transaction.[208] In addition, the *Mobile Spectrum Holdings Report and Order* found that considering additional below-1-GHz spectrum concentration as an enhanced factor in the Commission's review of secondary market transactions will help ensure that further concentration of such spectrum will not have adverse competitive effects either in particular local markets or on a broader regional or national level. The Commission can condition approval of a transaction on the divestiture of licenses or certain other commitments in markets where necessary to find an application serves the public interest.[209]

101. Since the *Sixteenth Report*, a number of transactions involving the transfer of spectrum licenses, as well as, in certain cases, network infrastructure and other assets, have been filed with the Commission. Major transactions have included the transfer of control and assignments of various spectrum licenses of Atlantic Tele-Network, Inc.[210] as well as Leap Wireless[211] to AT&T; the transfer of control and assignments of various

[207] For example, the Commission also considered whether harms in numerous local markets may result in nationwide harms and has considered potential harms from concentration in a particular band with an important ecosystem and from concentration of below-1-GHz spectrum. *See, e.g., Verizon Wireless-SpectrumCo Order*, 27 FCC Rcd at 10722, 10727, at ¶¶ 64, 76; *AT&T-Qualcomm Order*, 26 FCC Rcd at 17610-11 ¶ 49.

[208] *See Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6239 ¶285; *AT&T-Leap Order*, 29 FCC Rcd at 2767-68 ¶¶ 75-76; *SoftBank-Sprint Order*, 28 FCC Rcd at 9650, ¶ 23; *Verizon Wireless-SpectrumCo Order*, 27 FCC Rcd at 10724-27 ¶¶70-78; *Verizon Wireless-Alltel Order*, 23 FCC Rcd at 17460 ¶ 26. [check cite] For a description of some relevant competitive variables, see *Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6237-6238 ¶¶ 279-280 (citing various transactions orders).

[209] *See, e.g., AT&T-Leap Order*, 29 FCC Rcd at 2743-2744 ¶ 16; *SoftBank-Sprint Order*, 28 FCC Rcd at 9652 ¶ 25; *Verizon Wireless-SpectrumCo Order*, 27 FCC Rcd at 10711 ¶ 30*; Verizon Wireless-ALLTEL Order*, 23 FCC Rcd at 17462 ¶ 29; *AT&T-Cingular Order*, 19 FCC Rcd 21522, 21545, ¶ 43. For a general discussion of public interest conditions imposed by the FCC in certain wireless transactions granted in 2013 and 2014, *see* Baker, A., Brennan, T., Erb, J., Nayeem, O., Yankelevich, A., 2014. "Economics at the FCC, 2013-2014." Mimeo. FCC, Washington, DC. (*Baker, et al.*, (2014)).

[210] *See generally, AT&T-ATN Order*, 28 FCC Rcd at 13670. *See also, Baker, et al.*, (2014).

spectrum licenses of Sprint and Clearwire to Softbank Corp.;[212] the joint venture between GCI and ACS Wireless;[213] and the assignment and lease of licenses between AT&T, Verizon Wireless, and Grain Spectrum.[214] Among the smaller transactions that have occurred in the past couple of years are a number in which a nationwide provider acquired spectrum or other assets from a small or regional licensee. Not including spectrum swaps or the major transactions above, from September 2012 through June 2014 the Commission approved approximately 120 applications filed by the four nationwide providers to acquire PCS, AWS-1, Cellular, and/or 700 MHz licenses from a non-nationwide licensee – approximately 90 applications by AT&T, approximately 20 by Verizon Wireless, three by Sprint, and seven by T-Mobile.

c. Additional Spectrum Initiatives

102. Another Commission initiative that could potentially make more spectrum available that would facilitate the provision of mobile wireless service is the 3.5 GHz Band proceeding. The Commission has there proposed to create a three-tier shared access authorization framework in the 3550-3650 MHz Band, with the goal of facilitating the use of small cell broadband technologies on a shared basis with incumbent federal and non-federal users of the band. The 3.5 GHz band is envisioned as an "innovation band" that would enable the exploration of new technologies and spectrum sharing with a focus on relatively low powered applications.[215] Under the proposal, access to and use of the band would be managed by a spectrum access system incorporating a geo-location enabled dynamic database.[216] The three proposed tiers are: Incumbent Access, Priority Access, and General Authorized Access (GAA).[217] The proposed rules would implement a framework to authorize a variety of small cell and other broadband uses of the 3.5 GHz Band via the establishment of a Citizen Broadband Radio Service to be divided into Priority Access and GAA tiers of service.[218]

103. On April 1, 2014, the Commission adopted a Report and Order modifying the rules governing the operation of Unlicensed National Information Infrastructure (U-NII) devices operating in the 5 GHz band.[219] The new rules will make 100 megahertz of spectrum more accessible for use in homes and congested spaces like convention centers, parks, and airports and increase the potential for more unlicensed spectrum innovation. This will facilitate the provision of mobile broadband by augmenting commercial cellular networks and allowing for increased offloading to Wi-Fi networks. U-NII devices play an important role in meeting public demand for

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[211] *See generally, AT&T-Leap Order*, 29 FCC Rcd at 2735. *See also, Baker, et al.*, (2014).

[212] *See generally, SoftBank-Sprint Order*, 28 FCC Rcd at 9642.

[213] *See generally, Alaska Wireless Order*, 28 FCC Rcd at 10433. *See also, Baker, et al.*, (2014).

[214] *See generally, AT&T-Verizon Wireless-Grain Order*, 28 FCC Rcd at 12878.

[215] *Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550 – 3650 MHz Band, GN Docket No. 12-354, Further Notice of Proposed Rulemaking, FCC 14-49*, 29 FCC Rcd 4273*(2014)* ("*3.5 GHz FNPRM*"). The FNPRM also included a supplemental proposal to incorporate the 3650-3700 MHz band into the proposed Citizens Broadband Radio Service authorization framework.

[216] *Id.*

[217] Incumbent Access users would include authorized federal and grandfathered Fixed Satellite Service users currently operating in the 3.5 GHz Band. These users would be protected from harmful interference from Priority Access and GAA users. Priority Access Licenses would be subject to competitive bidding and would be entitled to protection from harmful interference from other Priority Access Licensees and GAA users. The GAA tier would be licensed-by-rule to permit open, flexible access to the band for the widest possible group of potential users. GAA users would have no expectation of protection from harmful interference.

[218] *3.5 GHz FNPRM*, 29 FCC Rcd 4275, ¶ 3.

[219] *See, Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band, Report and Order*, ET Docket No. 13-49, 29 FCC Rcd. 4127, (2014)

wireless broadband service. Currently U-NII devices operate in 555 megahertz of spectrum in the 5 GHz band, and are used for Wi-Fi and other high-speed wireless connections. The new rules removed the restriction on indoor-only use and increase the permissible power which will provide more robust access in the 5.150-5.250 GHz band. This in turn will allow U-NII devices to better integrate with other unlicensed portions of the 5 GHz band to offer faster speeds and reduce congestion at crowded Wi-Fi hot spots such as airports and convention centers.

3. Analysis of Spectrum Holdings

104. Table IV.A.2 (Percentage Spectrum Holdings, by Provider, by Frequency Band) and Table IV.A.3 (Population-Weighted Average Megahertz Holdings by Provider, by Frequency Band) below present spectrum holdings by service provider including all spectrum bands considered suitable and available following the release of the *Mobile Spectrum Holdings Report and Order*.[220] Table IV.A.3 shows megahertz holdings for each provider, weighted by population. Chart IV.A.1 is a graph of providers' spectrum holdings by frequency band, measured on a MHz-POPs basis. As of June 2014, Verizon Wireless, AT&T, Sprint, and T-Mobile, together, hold close to 80 percent of all spectrum suitable and available for the provision of mobile wireless services, measured on a MHz-POPs basis.[221] This is the same percentage as reported in the *Sixteenth Report*, but represents, in absolute terms, an increase in the total spectrum holdings of the nationwide service providers since the *Sixteenth Report*, given the increase in the spectrum included in the spectrum screen following the *Mobile Spectrum Holdings Report and Order*.[222]

Table IV.A.2
Percentage Spectrum Holdings, Measured on a MHz-POPs Basis by Licensee, by Frequency Band*

	700 MHz	Cell.	SMR	PCS	H Block	AWS-1	AWS-4	WCS	BRS	EBS
Spectrum	**70 MHz**	**50 MHz**	**14 MHz**	**130 MHz**	**10 MHz**	**90 MHz**	**40 MHz**	**20 MHz**	**67.5 MHz**	**112.5 MHz*** **
Verizon Wireless	31.0%	48.0%	0.0%	16.2%	0.0%	38.6%	0.0%	0.0%	0.0%	0.0%
AT&T	40.6%	44.6%	0.0%	29.1%	0.0%	15.8%	0.0%	91.1%	0.0%	0.0%
Sprint	0.0%	0.0%	96.5%	28.0%	0.0%	0.0%	0.0%	8.6%	86.8%	69.8%
T-Mobile	8.6%	0.1%	0.0%	21.7%	0.0%	40.9%	0.0%	0.0%	0.0%	0.0%
US Cellular	3.6%	4.2%	0.0%	1.6%	0.0%	0.6%	0.0%	0.0%	0.0%	0.0%
DISH**	6.6%	0.0%	0.0%	0.0%	100%	0.0%	100%	0.0%	0.0%	0.0%
Other* **	9.7%	3.1%	3.5%	3.5%	0.0%	4.2%	0.0%	0.3%	13.2%	30.2%

[220] *See Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6135 ¶ 4.

[221] The holdings presented in this section include all transactions consummated as of early June, 2014, plus the assignment of AWS-1 licenses from Aloha to AT&T, which was consented to by the Commission in July 2014. *See* Application of AT&T Mobility Spectrum LLC and Aloha Partners II, L.P. For Consent to Assign Advanced Wireless Services A, B and C Block Licenses, ULS File No. 0006065982; *Order*, DA 14-1034. The holdings do not reflect other transactions consummated after June 2014, but, with one exception, these smaller transactions have minimal impacts on the numbers. The exception was the assignment of WCS A and B Block licenses from Sprint to AT&T, which represented 8.65 percent of total MHz-POPs of WCS (*AT&T and Sprint Seek FCC Consent to the Assignment of WCS Licenses*, 29 FCC Rcd 5879), resulting in AT&T holding essentially all of the WCS spectrum . Other smaller transactions include, but are not limited to, the exit of Cincinnati Bell and concurrent assignments and leases of spectrum to and between Grain Spectrum and Verizon Wireless (*Cellco Partnership D/B/A Verizon Wireless, Cincinnati Bell Wireless, LLC, Grain Spectrum III, LLC and Grain Spectrum IV, LLC Seek FCC Consent to the Assignment of AWS, PCS, and Lower 700 MHz Band A Block Licenses, etc.*, 29 FCC Rcd 5368), the assignment of 700 MHz A-Block spectrum from Actel to T-Mobile (ULS File No. 0006402872).

[222] *Sixteenth Report*, 28 FCC Rcd at 3787 ¶ 118.

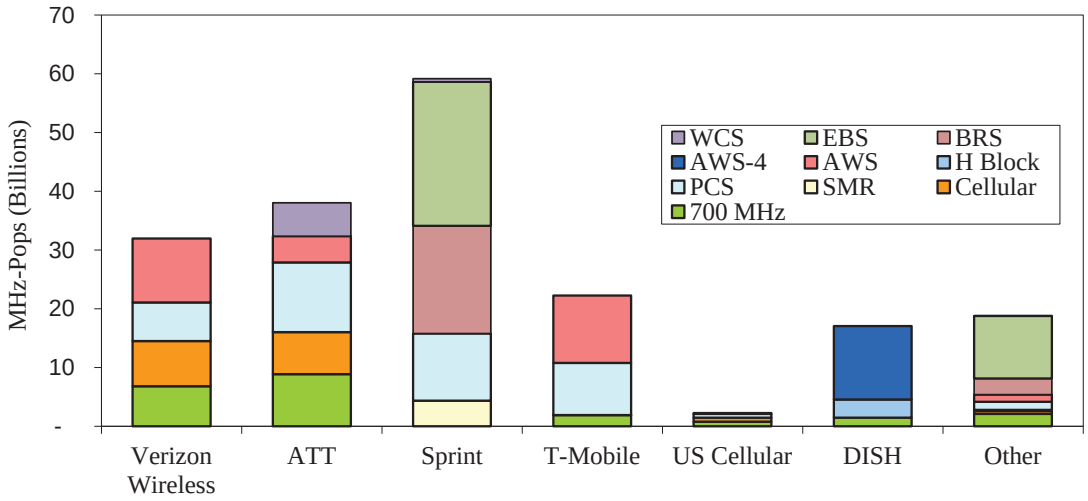
* Estimates include all transactions consummated as of the beginning of June, 2014. Abbreviations for spectrum bands: Cell. (Cellular); SMR (Specialized Mobile Radio Service), BRS (Broadband radio Service), EBS (Educational Broadband service).
** Dish Network Corporation currently does not provide mobile service.
*** In the application of the spectrum screen in secondary market transactions, 89 megahertz of EBS spectrum is included.

Table IV.A.3
Population-Weighted Average Megahertz Holdings
by Licensee, by Frequency Band*

	700 MHz	Cell.	SMR	PCS	H Block	AWS-1	AWS-4	WCS	BRS	EBS
Spectrum Counted	**70 MHz**	**50 MHz**	**14 MHz**	**130 MHz**	**10 MHz**	**90 MHz**	**40 MHz**	**20 MHz**	**67.5 MHz**	**112.5 MHz*** **
Verizon Wireless	21.7	24.6	0.0	21.1	0.0	34.7	0.0	0.0	0.0	0.0
AT&T	28.4	22.8	0.0	38.0	0.0	14.2	0.0	18.3	0.0	0.0
Sprint	0.0	0.0	13.9	36.6	0.0	0.0	0.0	1.7	58.6	78.5
T-Mobile	6.0	0.0	0.0	28.3	0.0	36.8	0.0	0.0	0.0	0.0
US Cellular	2.5	2.2	0.0	2.1	0.0	0.5	0.0	0.0	0.0	0.0
DISH**	4.6	0.0	0.0	0.0	10.0	0.0	40.0	0.0	0.0	0.0
Other* **	6.8	1.6	0.5	4.5	0.0	3.8	0.0	0.1	8.9	34.0

* Estimates in Table IV.A.3 include all transactions consummated as of the beginning of June, 2014.
** Dish Network Corporation currently does not provide mobile service.
*** In the application of the spectrum screen in secondary market transactions, 89 megahertz of EBS spectrum is included.

Chart IV.A.1
Mobile Wireless Provider Spectrum Holdings by Band
Weighted by Population
June 2014

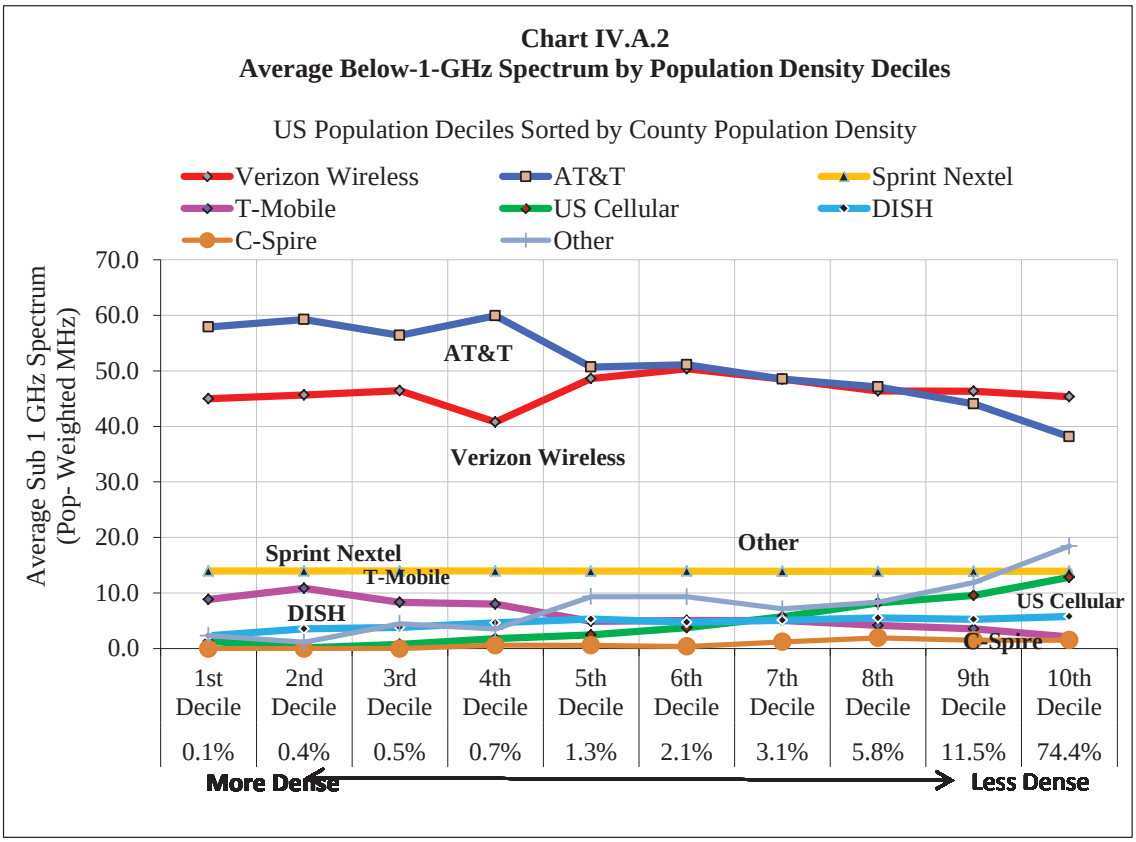


Source: FCC staff estimates generally based on transactions consummated as of the beginning of June, 2014.

105. Chart IV.A.1 above shows the population-weighted spectrum holdings of nationwide wireless providers by frequency. It provides a side-by-side comparison of each licensee's total spectrum holdings by band, measured by population-weighted average megahertz. We consider population-weighted spectrum holdings in order to account for the variation of customer bases in different geographic areas. A spectrum license in Los

Angeles or New York City, for example, covers more customers than a spectrum license over the same amount of land area in White Sands, NM.

106. Below-1-GHz spectrum includes Cellular (850 MHz), SMR (800/900 MHz), and the 700 MHz band. Of this spectrum, Verizon Wireless and AT&T each hold a significant amount of the available Cellular and 700 MHz spectrum. In particular, when measured on a licensed MHz-POP basis, Verizon Wireless holds approximately 38 percent of the licensed MHz-POPs of the combined Cellular and 700 MHz band spectrum, while AT&T holds approximately 42 percent. Additionally, T-Mobile holds approximately five percent of these bands and US Cellular holds approximately four percent. A number of other smaller licensees, combined, hold the remaining approximately 11 percent of the Cellular and 700 MHz band spectrum. Sprint holds 96.5 percent of the SMR spectrum. Providers also vary with respect to their below-1-GHz spectrum holdings according to population density as seen in Chart IV.A. 2 below. In particular, AT&T and T-Mobile have focused their low frequency spectrum acquisition on urban centers, Sprint and Verizon Wireless have purchased their licenses in both urban and rural areas, and the other smaller providers hold more spectrum in rural areas than they do in urban areas.



Source: FCC staff estimates generally based on transactions consummated as of the beginning of June, 2014.

107. All four nationwide providers hold substantial amounts of above-1-GHz spectrum. Verizon Wireless, AT&T, and T-Mobile each hold a substantial number of PCS and AWS-1 spectrum licenses, while Sprint holds significant amounts of PCS spectrum. In the PCS and AWS-1 spectrum bands, no licensee holds more than 41 percent of the total MHz-POPs for either of these two bands. Verizon Wireless holds approximately 25 percent of the licensed MHz-POPs of the combined PCS and AWS-1 band spectrum, AT&T holds approximately 24 percent, Sprint holds approximately 17 percent, and T-Mobile holds approximately 30 percent. Regional provider US Cellular holds approximately one percent of the combined PCS and AWS-1 band spectrum,

while other smaller providers hold the remaining four percent. In addition to its PCS and AWS-1 holdings, AT&T holds approximately 91 percent of the licensed MHz-POPs of WCS spectrum.[223] Sprint holds a predominant amount of 2.5 GHz spectrum, comprised of the BRS and EBS bands, the highest frequencies currently considered suitable and available for the provision of mobile broadband service.[224]

B. Non-Spectrum Input Segments

1. Wireless Infrastructure

108. Wireless infrastructure facilities hosting cellular base stations are a major input into the provision of mobile wireless services. They include towers and other tall structures for macro sites, such as lattice towers, guyed towers, monopoles, rooftops, water towers, and steeples. In addition to the use of towers and other tall structures, wireless infrastructure also include distributed antenna systems (DAS)[225] and facilities for small cell technologies[226] that are generally deployed to address coverage and capacity issues indoors, in densely populated areas outdoors, and even underground.[227] For example, small cells and DAS antennas can be placed on utility poles, buildings, or traffic signal poles, in areas where constructing towers is not feasible or wireless traffic demands are too great to be met solely with fewer, large cells.[228] In order to expand capacity and improve coverage, wireless service providers are also relying more on Heterogeneous Networks ("HetNets") that use a mix of traditional macro cells, DAS, and small cells, to tailor coverage and capacity to best serve a particular location.[229]

109. The number of cell sites of all types in use by providers continues to grow in order to satisfy the increased demand for mobile wireless services, to expand geographic service area coverage, to improve coverage in existing service areas, and to accommodate newer technologies. Large-scale deployments of small cells are only starting to take off in the United States.[230] According to CTIA, there were 304,360 cell sites in use at year-

[223] *See AT&T-WCS Order*, 27 FCC Rcd at 16461-16462 ¶ 4-6; *see generally*, *WCS Order on Reconsideration*.

[224] *See SoftBank-Sprint Order*, 28 FCC Rcd at 9645 ¶ 11.

[225] A DAS is a network of antennas typically connected by fiber optic cables to a central hub housing transceiver that is linked to macrocellular network. *See* The DAS Forum, *Distributed Antenna Systems (DAS) and Small Cell Tech ologies Distinguished*, February 4, 2013, at 2, available at http://www.thedasforum.org/wp-content/uploads/2013/02/DAS-And-Small-Cell-Technologies-Distinguished-2_4_13.pdf (visited July 25, 2014).

[226] A small cell normally refers to an operator-controlled, low-powered radio access node deployed at a particular location that include both antenna and transceiver operating in licensed spectrum or unlicensed carrier-grade Wi-Fi. Small cells typically have a range from 10 meters (or 11 yards) to several hundred meters (or yards). Types of small cells include femtocells, picocells, metrocells and microcells – broadly increasing in size from femtocells (the smallest) to microcells (the largest). *See* Small Cell Forum, *What is a Small Cell*, at http://www.smallcellforum.org/aboutsmallcells-small-cells-what-is-a-small-cell (visited July 25, 2014).

[227] *See* HetNet Forum, *DAS & Small Cell Solutions: Improving In-Building Wireless*, at 4, available at http://www.thedasforum.org/wp-content/uploads/2013/07/HITEC-presentation-from-HetNet-Forum-final.pdf, and (visited July 25, 2014). *See also* Tammy Parker, *All Four National Mobile Carriers to Use NYC Subway DAS*, FIERCEWIRELESS, Apr. 28, 2013.

[228] Because DAS sites are less visible than tower structures, they may be particularly desirable in areas with stringent siting regulations, such as historic districts. See *Sixteenth Competition Report* at ¶ 318.

[229] HetNets are an emerging deployment option for service providers. See 4G AMERICAS, *Developing and Integrating a High Performance Het-Net 2*, October 2012. *See also PCIA Comments* at fn. 3 (*"'Heterogeneous network' is a term used to describe the combination of 'macro', or large, infrastructure such as monopoles with small cells and distributed antenna systems. By integrating the two types of infrastructure together, providers are able to target geographic areas to increase network capacity.").

[230] *See* Phil Goldstein, *Crown Castle Sees Small Cell Opportunity as Big as Cell Towers in Early 2000s*, July 25, 2014, http://www.fiercewireless.com/story/crown-castle-sees-small-cell-opportunity-big-cell-towers-early-2000s/2014-07-25 (visited July 29, 2014). *See also*, FierceWirelessTech, *AT&T's Mansfield: Outdoor LTE Small Cell Market will Ramp Up*

end 2013.[231] This represents a 0.9 percent (or 2,581) increase in the number of cell sites from the year-end 2012, a 26 percent increase in the past five years (since December 31, 2008), and an 87 percent increase in the past ten years (since December 31, 2003).[232]

110. A specialized communications tower industry has developed to provide and manage support structures for the cell sites required by mobile wireless service providers by leasing space to them. Today, there are more than 80 tower and DAS operators in the United States,[233] and a majority of towers are now owned or operated by independent companies rather than mobile wireless service providers.[234] Independent tower operators own, operate and lease shared wireless communications and broadcasting towers, manage other high structure sites (such as rooftops, water towers) for property owners, and to a lesser extent, build and operate DAS networks and small cell facilities for mobile service providers.[235] In most cases, tower operators and property owners have an incentive to increase their business by leasing antenna, rooftop and other site space to as many wireless service providers as possible.[236] According to PCIA, the three largest publicly-traded neutral host providers – Crown Castle, American Tower and SBA Communications – own and operate more than 66,000 towers.[237] Another estimate indicates that these three tower operators own, manage, or operate more than 83,000 towers in the United States out of a total 102,000 as of January 2014.[238] The availability of leased space on existing towers may eliminate the need to build new towers for competing service providers and new entrants in a market, reduce the capital requirements for network deployments and capacity expansion, and facilitate entry of new wireless service

Next Year, June 24, 2014, available at http://www.fiercewireless.com/tech/special-reports/atts-mansfield-outdoor-lte-small-cell-market-will-ramp-next-year (visited July 29, 2014).

[231] *See* CTIA, *2013 Annual Wireless Industry Survey Results ("CTIA2013")*, at 114, June 2014. Because multiple cell sites can be co-located in the same "tower" site, the reported cell sites should not be equated with "towers." *See also CTIA2013* at 105. The reported cell sites include repeaters and other cell-extending devices (e.g., femtocells, or distributed antenna systems). See CTIA2013 at 105 and 106.

[232] The incremental cell site count might be skewed by changes in the survey population, and not reflect actual new cell site deployment. *See CTIA2013* at 109. All calculations based on *CTIA2013* Table 35 at 107. Appendix Table IV.B.i provides further breakout details on the number of reported cell sites per provider. Cell site counts for individual service provider are from *US Wireless 411*: Version 51, Figure 51 at 30, March 2014. The total industrywide cell count is from *CTIA2013*, at 114, June 2014.

[233] *See* http://www.wirelessestimator.com/t_content.cfm?pagename=US-Cell-Tower-Companies-Complete-List (list of tower operators).

[234] Some major wireless service providers have sold or in the process of selling their tower business to third party tower operators. *See* AT&T News Release, *AT&T and Crown Castle Close $4.83 Billion Tower Transaction*, December 16, 2013; Crown Castle News Release, *Crown Castle Completes Tower Transaction With T-Mobile USA*, November 30, 2012;Sprint Nextel News Release, *Sprint Nextel Completes Tower Sale to TowerCo for Approximately $670 Million in Cash*, September 24, 2008.

[235] *See* American Tower 2013 Annual Report at 1, Crown Castle 2013 Annual Report (10-K) at 1, SBA Communications 2013 Annual Report (10-K) at 1.

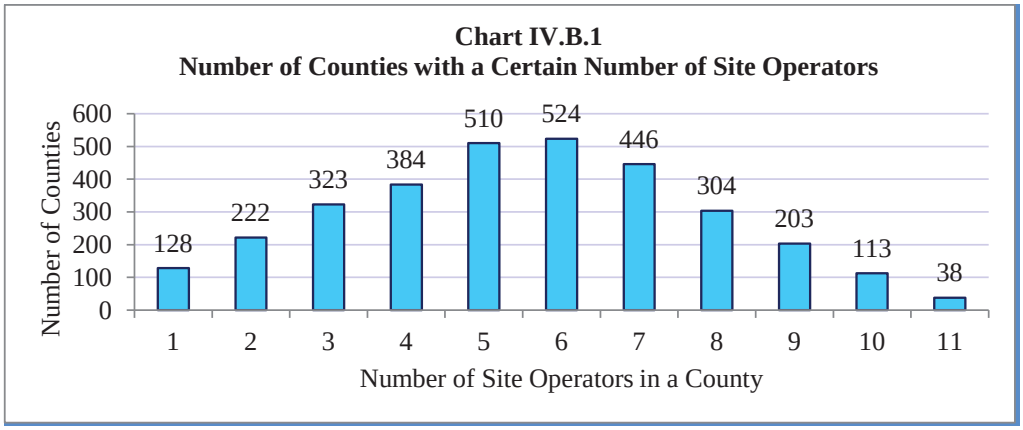
[236] *See* American Tower, Investor Relations ("Our primary business is leasing antenna space on multiple-tenant communications sites to wireless service providers, radio and television broadcast companies, wireless data providers, government agencies and municipalities and tenants in a number of other industries"), at http://www.americantower.com/corporateus/investor-relations/index.htm. *See also* Verizon Network Real Estate Inquires ("Verizon Wireless receives thousands of inquiries each year from property owners, property managers and customers who offer property on which our communications facilities can be located"), at http://www.verizonwireless.com/b2c/realestate/.

[237] *See PCIA Comments* at 8

[238] *See* http://www.wirelessestimator.com/t_content.cfm?pagename=US-Cell-Tower-Companies-Complete-List (list of tower operators, with Crown Castle 39,739, American Tower 28,463, and SBA Communications 14,873 as of January 2014. Not including DAS structures and rooftops. Visited July 25, 2014).

providers into a market.

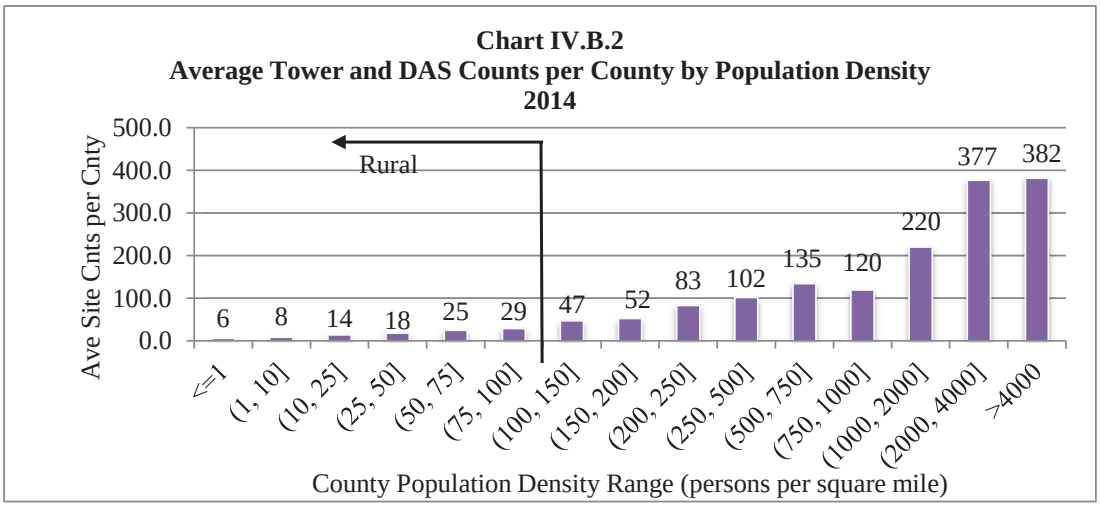
111. Based on tower site information (including towers, rooftops, and DAS) collected by Commission staff from eleven large tower operators (owning or operating close to 90 percent of towers in the United States),[239] as of September 2013, 89 percent of counties have more than three tower operators, and 50 percent have more than six tower operators (see Chart IV.B.1).



Note: Data based on eleven tower companies. These companies are Crown Castle, American Tower, SBA Communications, KGI Wireless, Global Tower Partners, AT&T Towers, T-Mobile Towers, InSite Towers, SubCarrier Communications, Clear Channel, Central States Tower, CTI Towers, Skyway Towers, and Pegasus Wireless. Population density is from 2010 census.

112. Based on the data, tower operators build and operate more towers and DAS nodes in densely populated areas in order to support better coverage and more wireless data usage. For example as of September 2013, the average number of tower and DAS sites per county is 29 for counties with a population density between 75 and 100 persons per square mile, compared with an average of 377 per county for counties with a population density between 2000 and 4000 (see Chart IV.B.2).

[239] They are Crown Castle, American Tower, SBA Communications, KGI Wireless, Global Tower Partners, AT&T Towers, T-Mobile Towers, InSite Towers, SubCarrier Communications, Clear Channel, Central States Tower, CTI Towers, Skyway Towers, and Pegasus Wireless. Tower and cell site information is downloaded in the first week of September, 2014 from their websites that can be found at http://www.wirelessestimator.com/t_content.cfm?pagename=US-Cell-Tower-Companies-Complete-List.

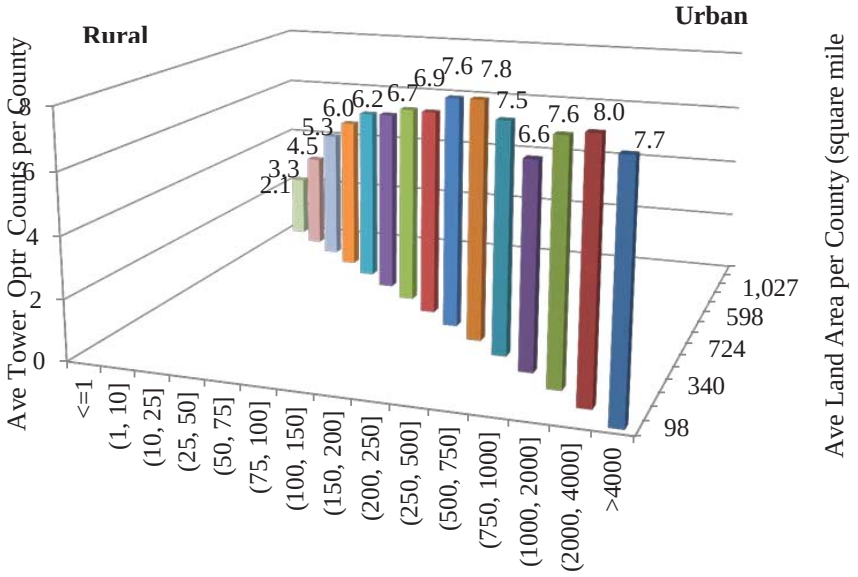


Note: The number of sites has been rounded to the nearest decimal. Data based on eleven tower companies referenced above. Counties considered rural are those with fewer than 100 persons per square mile.

113. In addition, there are also more tower operators in densely populated counties (often associated with smaller land areas) than less populated counties (often associated with larger land areas). The numbers range from two operators per county in rural counties with one person or less per square mile and an average land size of 11,122 square miles to more than seven operators in dense urban counties with a population density of more than 4000 and an average land size of 98 square miles (see Chart IV.B.3). [240]

[240] Population density is from the 2010 Census.

Chart IV.B.3
Ave Tower Operator Counts per County by Pop Density and County Land Area 2013



Note: Data based on eleven tower companies referenced above. Counties considered rural are those with fewer than 100 persons per square mile.

114. Two significant constraints faced by wireless infrastructure providers that need to add or modify tower and DAS sites are capital expenditure, and the need to obtain necessary regulatory and zoning approvals from local and federal authorities.[241] Below, we briefly discuss each of these constraints. In terms of capital expenditure, collocating wireless equipment on existing structures is often the most efficient and economical solution for mobile wireless service providers that need new cell sites, either to expand their existing coverage area, increase their capacity, or deploy 4G broadband services. The average cost to build a new tower is between $250,000 and $300,000, whereas the average cost of collocation on an existing tower is less than 25 percent of the total cost of a new tower.[242] The largest, publicly-traded infrastructure companies alone made capital expenditures of approximately $1.16 billion in 2012, up from $1.02 billion in 2011.[243] Their capital expenditures for 2013 are estimated to have been between $1.3 and $1.5 billion. Significant portions of these capital expenditures are dedicated to network improvement, including new site construction and improvements to existing sites to accommodate more provider facilities. In 2012, these network improvement expenditures totaled approximately $658 million, compared to $306 million in 2011. Such investments are estimated to have been up to $917 million

[241] Delays in the zoning approval process were the subject of a Petition for Declaratory Ruling filed by CTIA in 2008. 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. See *Sixteenth Report* at ¶ 326. There is no evidence that shortages of transmission equipment, including antennas, to install at cell sites act as a barrier to cell site deployment. See *Sixteenth Competition Report*, ¶ 325.

[242] *See PCIA Comments* at 8. *See also* Martha DeGrasse, *AT&T Cell Site of the Future Hits a Speed Bump*, July 17, 2014 ("the cost per site was coming in at $380,000" in New York metro area), available at http://www.rcrwireless.com/article/20140717/infrastructure-2/att-cell-site-future-hits-speed-bump/ (visited July 28, 2014).

[243] See *PCIA Comments* at 6.

in 2013.[244] The total annual expenditure for structures by wireless service providers (excluding satellite service providers) was estimated to be $5,741 billion for 2012, almost 45 percent increase from $3,966 Billion in 2011, or 48 percent increase from $3,890 billion in 2009.[245]

115. Recent FCC Initiatives. Section 6409 of the Middle Class Tax Relief and Job Creation Act of 2012 provides that a state or local government "may not deny, and shall approve" any request for collocation, removal, or replacement of transmission equipment on an existing wireless tower or base station, provided this action does not substantially change the physical dimensions of the tower or base station.[246] In January 2013, the Commission offered its interpretive guidance to assist parties in understanding their obligations under Section 6409(a).[247] In August 2014, the Commission adopted a Report and Order to streamline and eliminate outdated provisions of the Part 17 Rules governing the construction, marking and lighting of antenna structures. [248] In 2013, the Commission began a rulemaking proceeding to consider certain options to reduce regulatory barriers and streamline process at the local level and at the Commission for infrastructure deployment.[249] On October 21, 2014, the Commission adopted an order that eliminated unnecessary reviews, and therefore costs and delays, for wireless facilities siting.[250] The Commission has also entered into two Nationwide Programmatic Agreements (NPA) with the Advisory Council on Historic Preservation (ACHP) and the National Conference of State Historic Preservation Officers (NCSHPO) – (1) to clarify the National Historic Preservation Act (NHPA) Section 106 process for new tower construction,[251] and (2) to provide guidance on collocation of communications equipment on existing tower structures.[252]In addition, the Commission has taken steps with relevant government and non-governmental stakeholders to develop a process for "clearing" existing towers that were not subject to historic preservation review prior to construction, including "twilight towers that were not required to, and did not, complete the Section 106 historic preservation review process."[253] Once complete, this effort will make thousands of additional towers available for collocation.[254]

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[244] See *PCIA Comments* at 6.

[245] *See CTIA2013* Chart 18 at 112 (citing information from the United States Census).

[246] Middle Class Tax Relief and Job Creation Act of 2012, Pub. L. No. 112-96, § 6409(a) (2012).

[247] Wireless Telecommunications Bureau Offers Guidance on Interpretation of Section 6409(a) of the Middle Class Tax Relief and Job Creation Act of 2012, *Public Notice*, 28 FCC Rcd. 1 (Jan. 25, 2012), http://hraunfoss.fcc.gov/edocs_public/attachmatch/DA-12-2047A1_Rcd.pdf.

[248] *See* FCC News Release, *FCC Streamlines Part 17 Rules to Provide Clarity Regarding Antenna Structure Lighting and Marking*, August 8, 2014.

[249] *See* Acceleration of Broadband Deployment by Improving Wireless Facilities Siting Policies; Acceleration of Broadband Deployment: Expanding the Reach and Reducing the Cost of Broadband Deployment by Improving Policies Regarding Public Rights of Way and Wireless Facilities Siting; 2012 Biennial Review of Telecommunications Regulations, WT Docket No. 13-238, WC Docket No. 11-59, WT Docket No. 13-32, *Notice of Proposed Rulemaking*, 28 FCC Rcd 14238 (2013).

[250] *See* Acceleration of Broadband Deployment by Improving Wireless Facilities Siting Policies; Acceleration of Broadband Deployment: Expanding the Reach and Reducing the Cost of Broadband Deployment by Improving Policies Regarding Public Rights of Way and Wireless Facilities Siting; 2012 Biennial Review of Telecommunications Regulations, WT Docket Nos. 13-238, 11-59, 13-32, *Report and Order*, FCC 14-143 (rel. Orc. 21, 2104).

[251] *See* 47 C.F.R. 1, Appendix C

[252] *Id* at appendix B.

[253] *See* Section 106 of the National Historic Preservation Act (NHPA) 16 U.S.C. 470(f). "Twilight Towers" are towers built between March 16, 2001 and March 7, 2005.

[254] *Wireless Infrastructure Report and Order at 4.* .

2. Backhaul

116. Backhaul facilities link a mobile wireless service provider's cell sites to the mobile switching centers that provide connections to the provider's core network, the public switched telephone network, or the Internet, carrying wireless voice and data traffic for routing and onward transmission. Backhaul connections are an integral component of a wireless service provider's network, and the cost of backhaul is approximately 30 percent of the operating cost of providing wireless service.[255] Backhaul services are generally provided by incumbent local exchange carriers (ILECs); competitive local exchange carriers (CLECs); competitive fiber and microwave wholesalers; cable providers; and independent backhaul operators.[256] In some areas, the vast majority of existing wireless towers have fiber connections.[257] High bandwidth fiber backhaul also allows wireless service providers to rapidly deploy 4G LTE services,[258] while a lack of fiber backhaul can delay a provider's LTE rollout.[259]

117. Mobile backhaul needs will keep increasing as wireless providers continue to deploy LTE technology in their networks and mobile subscribers use mobile devices for more data intensive applications, such as mobile video streaming.[260] Analysts project that demand for mobile backhaul will grow by 9.7 times between 2011 and 2016.[261] Infonetics Research estimates that the annual investment in the backhaul market will be in the range of $8 to $9 billion over the next few years[262] even with a slower projected growth in the demand for mobile backhaul.[263] This is a significant increase given that the entire market was worth less than $5 billion in 2009.[264] Infonetics Research projects that telecom service providers will collectively spend $43 billion on backhaul over five years from 2013 – 2017.[265]

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[255] See *Sprint Comments* at 6

[256] FierceTelecom.com, *Telco Backhaul Strategies*, at 1-2, November 2011. Providers of backhaul services include ILECs such as AT&T, Verizon, and CenturyLink; CLECs such as Level 3, tw telecom inc., Cbeyond, Inc., and XO Communications, LLC; competitive fiber and microwave wholesalers such as Level 3, FPL FiberNet, IP Networks, and Zayo; cable providers such as Charter Communications, Comcast Business, Cox Carrier Services, and Time Warner Cable Business Class; independent backhaul operators, including backhaul specialists such as Telecom Transport Management, and Tower Cloud, and potentially some tower operators

[257] *See Windstrem Annual Report*, 2013, page F-3.

[258] *See* SASCHA SEGAN, *Exclusive: T-Mobile CTO Talks Carrier's Journey to Fastest LTE Network*, January 8, 2014, available at http://www.pcmag.com/article2/0,2817,2429285,00.asp (last visited April 3, 2014).

[259] *See* Phil Goldstein, *Sprint's LTE rollout hampered by lack of backhaul and Network Vision issues*, July 24, 2013, available at http://www.fiercewireless.com/story/sprints-lte-rollout-hampered-lack-backhaul-and-network-vision-issues/2013-07-24.

[260] Clayton Funk, et. al. *Trends and forecasts for the Wireless tower Industries*, September 2013 at 50. http://www.aaeconline.com/wp-content/uploads/2013/11/AGL-Trends-and-Forecasts-9-2013.pdf.

[261] See *Verizon Wireless Comment* at 58 citing FIERCEWIRELESS *U.S. Mobile Backhaul Demand Forecast to Grow More Than Nine Times in the Next Four Years* (Mar. 13, 2012), http://www.fiercemobilecontent.com/press-releases/us-mobile-backhaul-demand-forecast-grow-more-ninetimes-next-four-years. (The global demand for mobile backhaul equipment is projected to reach $10.4 billion in 2014 (compared to $7.2 billion in 2009) and Infonetics Research Press Release, *Shift Seen in Operator Strategy for Mobile Backhaul; Equipment Spending Up 21% (Apr. 21, 2010)*, *http://www.infonetics.com/pr/2010/Mobile-Backhaul-and-Microwave-Market-Highlights.asp*.

[262] Infonetics Research, *Mobile backhaul market passes $8 billion, driven by HSPA/HSPA+ and LTE deployments*, April 2, 2013 *http://www.infonetics.com/pr/2013/2H12-Macrocell-Mobile-Backhaul-Market-Highlights.asp*.

[263] Infonetics Research, *Macrocell Mobile Backhaul Market Growth Decelerating*, October 30, 2013. *http://www.marketwatch.com/story/infonetics-research-macrocell-mobile-backhaul-market-growth-decelerating-2013-10-30*.

[264] Infonetics Research, *Mobile backhaul market passes $8 billion, driven by HSPA/HSPA+ and LTE deployments*, April 2, 2013

[265] Infonetics Research, *Macrocell Mobile Backhaul Market Growth Decelerating*, October 30, 2013.

118. As the mobile data traffic has grown rapidly in recent years, major mobile wireless providers have deployed or are in the process of deploying Ethernet backhaul either over fiber or microwave to their cell sites. Over 90 percent of AT&T's data traffic is on enhanced backhaul as of June 2013.[266] T-Mobile already has upgraded backhaul facilities for its 40,000 LTE sites as of March 2014 and is expected to update the remaining 15,000 sites by the summer of 2015.[267] In connection with its Network Vision Plan, Sprint has deployed 33,000 LTE/Network Vision sites with Ethernet backhaul covering more than 200 million people at the end of 2013 and is expected to cover 250 million people with its LTE sites by the middle of 2014.[268] Verizon Wireless also deployed fiber backhaul facilities for its 4G LTE sites,[269] which carries 69 percent of its data traffic as of the fourth quarter of 2013.[270]

119. *Recent FCC Initiatives.* The Commission has examined issues related to backhaul including special access services and the use of microwave spectrum for backhaul services.[271] In January 2005, the Commission started a proceeding to broadly examine the regulatory framework for local exchange carriers' (LECs) interstate special access services.[272] On August 22, 2012 the Commission adopted a Report and Order that suspended, on an interim basis, rules that allowed for automatic grants of pricing flexibility for special access services in light of evidence in the record the rules failed to accurately reflect the state of competition in the market for special access.[273] On September 15, 2014 the Commission's Wireline Competition Bureau issued an *Order on Reconsideration* that set a deadline of December 15, 2014 for providers to submit data on networks, prices, and terms for special access in order to enable the Commission to assess the state of competition.[274] In August 2013, the Commission significantly modified the Commission's Part 15 rules governing unlicensed communication equipment in the 57-64 GHz band to enhance the use of unlicensed spectrum as a relatively low-cost, high-capacity short-range backhaul alternative to connect wireless broadband networks and for other wireless applications.[275]

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[266] *See AT&T 4G LTE Network Ranked Fastest For Second Straight Year*, AT&T news release, June 10, 2013.

[267] *See* Neal Gompa, "T-Mobile's LTE will cover 250 million people in 2014, everywhere in the US by 2015," March 14, 2014, available at http://www.extremetech.com/electronics/178517-t-mobiles-lte-will-cover-250-million-people-in-2014-everywhere-in-the-us-by-2015 (visited April 9, 2014). *See also* Sascha Segan, "Exclusive: T-Mobile CTO Talks Carrier's Journey to Fastest LTE Network," January 8, 2014, available at http://www.pcmag.com/article2/0,2817,2429285,00.asp (visited September 18, 2014).

[268] *See Sprint Quarterly Presentation for the 4th Quarter 2013, Feb. 11, 2014, at 14,* and BENNY HAR-EVEN, *Interview: Senior Systems Engineer, Sprint: "We expect that small cells will be key to 2500MHz network densification,"* October 20, 2013, available at http://lteconference.wordpress.com/2013/10/30/senior-systems-engineer-sprint-we-expect-that-small-cells-will-be-key-to-2500mhz-network-densification/.

[269] *See* Transcript for Verizon at Oppenheimer Holdings Inc Technology, Internet & Communications Conference, at 7, August 15, 2012, available at http://www.verizon.com/investor/DocServlet?doc=oppenheimer_vz_transcript.pdf.

[270] *See* Verizon presentation for the 4th Quarter 2013 earnings, at 10, available at http://www.verizon.com/investor/qreport_4q_2013_quarter_earnings_01212014.htm.

[271] See *Sixteenth Competition Report* at ¶ 336 – 338.

[272] *See 2005 Special Access NPRM.*

[273] *See*, In the Matter of Special Access for Price Cap Local Exchange Carriers; WC Docket No. 05-25 and AT&T Corporation Petition for Rulemaking to Reform Regulation of Incumbent Local Exchange Carrier Rates for Interstate Special Access Services. RM-10593, 27 FCC Rcd 10557 (2012).

[274] See *Special Access for Price Cap Local Exchange Carriers; AT&T Corporation Petition for Rulemaking to Reform Regulation of Incumbent Local Exchange Carrier Rates for Interstate Special Access Services*, WC Docket No. 05-25, RM-10593, Order on Reconsideration, DA 14-1327 (Wireline Comp. Bur. rel. Sept. 15, 2014) (*Reconsideration Order*)

[275] *See* FCC new release *FCC MODIFIES PART 15 RULES TO SPUR THE DEPLOYMENT OF WIRELESS SERVICES, UNLICENSED SPECTRUM INNOVATION IN THE 57-64 GHZ BAND,* August 9, 2013.

C. Downstream Mobile Wireless Ecosystem

120. Handsets and devices are a central part of consumers' mobile wireless experience. In general, smartphone adoption has increased significantly over the past few years. In 2011, 46 percent of mobile wireless consumers reported to have smartphones, and 60 percent of consumers who purchased a new mobile device during the fourth quarter selected a smartphone over a feature phone.[276] By January 2014, 68 percent of mobile wireless consumers reported using smartphones, and 84 percent of new phone purchases were smartphones.[277] Since Apple entered the smartphone business with the iPhone in June 2007, many handset manufacturers have introduced competing products with similar features such as touch screens, mobile web browsing capabilities, and current-generation operating systems. During 2011, the iPhone exclusive handset arrangement between Apple and AT&T ended, and multiple service providers began offering the iPhone on their networks.[278] In 2012, Verizon Wireless, Sprint and other providers started selling the iPhone 4s and iPhone 5s. Innovative smartphones that are not subject to exclusive arrangements are widely available. Popular smartphone operating systems such as the Android and the Apple iOS are available from multiple service providers, permitting consumers to pair their preferred operating systems with different service providers.

121. The operating system of a smartphone is one of the major factors that determine the smartphone's ability to support mobile applications and Internet-based services. Apple's iOS and Google's Android have emerged as the two leading mobile operating systems.[279] According to ComScore, by August 2014, 174 million people in the US owned smartphones. Android's share of the smartphone operating system grew from three percent in May 2009 to 52 percent inAugust 2014, while iOS's market share increased from 20 percent to 42 percent over the same period.[280] Over essentially the same period, (Research in Motion) RIM's market share has declined from the top position to one of less than two percent of the market.[281]

122. Until recently, the prevailing model for the distribution of handsets to U.S. postpaid mobile subscribers was the handset subsidy model, where consumers were offered a bundling contract in which a provider conditioned the sale of a subsidized handset upon the consumer's agreement to purchase a multi-month wireless service subscription, typically for a minimum of one or two years in a postpaid service plan[282] with a locked handset that could only be used with the particular provider As discussed in more detail below, service providers increasingly are offering equipment installment payment (EIP) plans as an alternative to traditional handset subsidies.[283] Under these plans, consumers purchase the device at the full price, but instead of paying the cost upfront, are billed in monthly installment payments. Many service providers generally unlock phones at the customer's request when the service terms have been fulfilled, subject to a certain number of conditions, *e.g.*, a limit on the number of devices that can be unlocked, a minimum number of days of activation, and that the device

[276] *Sixteenth Report*, 28 FCC Rcd at 3836, ¶ 339.

[277] Nielsenwire, The Nielsen Company, *Multiplying Mobile: How Multicultural Consumers are Leading Smartphone Adoption*, March 4, 2014.

[278] Prior to 2011, Apple distributed its iPhone through AT&T (and its affiliates) only. An exclusive handset arrangement (EHA) is an arrangement in which a handset manufacturer or vendor agrees to sell a particular handset model to only one wireless service provider, usually for a specified period of time. See *Fifteenth Report*, 26 FCC Rcd at 9853 ¶ 332.

[279] *See* ComScore press release, ComScore Reports August 2014 US Subscriber Market Share.

[280] ComScore press release, ComScore Reports August 2014 US Subscriber Market Share.

[281] ComScore press release, ComScore Reports August 2014 US Subscriber Market Share.

[282] *See Antitrust Law and Economics*, at 326 ("Under a tying arrangement, the seller of a product conditions the sale of one product upon the buyer's agreement to purchase a second product.") In particular, the sale of the handset is conditioned on the subsequent purchase of the multi-month wireless service subscription.

[283] *See* Section V.A *infra* for a detailed discussion.

has not been reported lost or stolen.[284]

123. *Cell Phone Unlocking*. On February 11, 2014, CTIA-The Wireless Association adopted six principles on cell phone unlocking into their evolving Consumer Code for Wireless Service ("Consumer Code").[285] Under these six principles, wireless providers will disclose their unlocking policies, unlock postpaid devices when contracts have been fulfilled, unlock prepaid devices within a year of activation, notify customers of eligibility for unlocking at the time of eligibility, unlock devices with a reasonable period of time, and unlock devices for deployed personnel.[286] The Consumer Code included a three month timeline for implementation of half of the principles and a one year timeline for implementation of all of the principles by February 11, 2015.[287]

124. Nationwide wireless providers have begun implementation of the unlocking policies in accordance with the timeline in the Consumer Code. Verizon, AT&T, Sprint, and T-Mobile have established dedicated webpages disclosing their unlocking policies. AT&T has created an online unlocking portal to enable online unlocking requests.[288] Sprint and T-Mobile provide toll free customer service numbers to call for unlocking codes.[289] Verizon does not generally lock its devices.[290] Verizon's Phone-in-the-Box prepaid service is restricted to Verizon's prepaid service for six months and Verizon's network for 12 months.[291] After six months, Verizon automatically and remotely removes the restriction on these devices to the prepaid network.[292] In August 2014, T-Mobile deployed an unlocking application that allows customers to request unlocking on a permanent or temporary basis for travel.[293] Some MVNOs that have committed to comply with the Consumer Code, like Tracfone,[294] have also begun implementation of the unlocking principles in the Consumer Code.[295]

125. A handset that functions on one network may not be compatible with a network using the same air interface technology if the networks operate on different spectrum bands. For example, T-Mobile's WCDMA handsets operate in the AWS-1 spectrum (1.7/2.1 GHz band) while AT&T's WCDMA handsets operate in the

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[284] *See* Section II.C.2, *infra* and Verizon Wireless, Customer Agreement, available at http://www.verizonwireless.com/b2c/globalText?textName=CUSTOMER_AGREEMENT&jspName=footer/customerAgreement.jsp (last visited April 11, 2014); Sprint, Standardized Wireless Service Checklist, available at http://www.sprint.com/landings/ctiachecklist/docs/ctia-transparency-postpaid.pdf (last visited April 11, 2014); and T-Mobile Support blog post, "Unlock Your Phone with a SIM Unlock Code," updated on March 11, 2014, available at http://support.t-mobile.com/docs/DOC-1588 (last visited April 11, 2014).

[285] https://www.fcc.gov/device-unlocking-faq; *see also* https://fcc.github.io/device-unlocking/

[286] http://www.ctia.org/policy-initiatives/voluntary-guidelines/consumer-code-for-wireless-service

[287] http://www.ctia.org/policy-initiatives/voluntary-guidelines/consumer-code-for-wireless-service

[288] https://www.att.com/deviceunlock/client/en_US/

[289] https://www.sprint.com/legal/unlocking_policy.html; http://support.t-mobile.com/docs/DOC-1588

[290] https://www.verizonwireless.com/aboutus/commitment/safety-security/device-unlocking-policy.html

[291] https://www.verizonwireless.com/aboutus/commitment/safety-security/device-unlocking-policy.html

[292] https://www.verizonwireless.com/aboutus/commitment/safety-security/device-unlocking-policy.html

[293] http://arstechnica.com/gadgets/2014/08/t-mobile-becomes-first-american-carrier-to-release-phone-unlocking-app/

[294] *Federal-State Joint Board on Universal Service, TracFone Wireless, Inc. Petition for Designation as an Eligible Telecommunications Carrier in the State of New York et al.*, CC Docket No. 96-45, Order, 23 FCC Rcd 6206, 6212 n.37 (2008) (TracFone ETC Designation Order) ("TracFone committed that it will comply with the Consumer Code for Wireless Service of the CTIA."); *see also* 47 C.F.R. § 54.202 (allowing ETCs to demonstrate commitment to consumer protection by committing to comply with CTIA's Consumer Code for Wireless Services).

[295] http://www.tracfone.com/includes/content/popup/unlocking_policy.jsp?a=1296504971589

Cellular (850 MHz band) and PCS (1.9 GHz band) spectrum. Similarly, service providers are deploying LTE on different spectrum bands. For example, AT&T launched LTE using Lower 700 MHz B and C block spectrum while Verizon Wireless launched LTE using the Upper 700 MHz C block spectrum.[296] Other providers holding primarily Lower 700 MHz Band A Block licenses filed a petition for rulemaking asking the Commission to require that all mobile units for the 700 MHz band be capable of operating over all frequencies in the band.[297] In September, 2013, a number of the principal wireless providers licensed in this band, along with the Competitive Carriers Association, developed a voluntary industry solution to resolve the lack of interoperability in the Lower 700 MHz band while allowing flexibility in responding to evolving consumer needs and technological developments.[298] In October, 2013, the Commission adopted a *Report and Order and Order of Proposed Modification* to effectuate the industry solution and thereby provide for interoperable LTE service in the Lower 700 MHz band.[299] Since October, 2013, the Commission has adopted specific interoperability requirements for the AWS-3 band,[300] as well as for the 600 MHz Band, which is to be auctioned as part of the broadcast incentive auction.[301]

V. PRICING LEVELS AND TRENDS

126. Among the most significant developments in mobile pricing during the period under review have been changes in the two major pricing models traditionally used in the United States. Most mobile telephone subscribers are billed monthly for their mobile wireless service after the service has been provided ("postpaid" service). In contrast, other mobile subscribers, including those lacking the necessary credit history, are required to pay for their service in advance ("prepaid service"). Historically, the terms "*postpaid*" and "*prepaid*" service were largely synonymous with "*contract*" and "*no-contract*" pricing plans. This is because the handset subsidy model traditionally used in postpaid service requires customers to sign a contract for a specified period (typically two years) in return for receiving a significant upfront discount on the price of a handset, with service providers recovering the balance of the handset cost over the course of the contract through the higher monthly fees they charge for mobile wireless services.[302] As noted earlier, there has recently been a significant increase in new service plans that employ a different, "no-contract" postpaid model, due primarily to the offering of installment payment plans and a separation of service and equipment fees. Thus, some of the distinctions between the two service offerings have diminished. There are now more postpaid plans with no handset subsidies or service contracts than were previously available. In addition, similar pricing plan options are increasingly available to customers of both models.

127. While the lines have been blurred somewhat, there remain certain features, such as access to

[296] *See* Section IV.A, *supra*

[297] *700 MHz Block A Good Faith Purchaser Alliance Petition for Rulemaking Regarding the Need for 700 MHz Mobile Equipment to be Capable of Operating on All Paired Commercial 700 MHz Frequency Blocks*, filed Sept. 29, 2009 (*700 MHz Equipment Petition*), at iii, 12.

[298] [cite early September filings of parties in the proceeding.]

[299] In the Matter of Promoting Interoperability in the 700 MHz Commercial Spectrum, Requests for Waiver of Lower 700 MHz Band Interim Construction Benchmark Deadlines, WT Docket Nos. 12-69, 12-332, *Report and Order and Order of Proposed Modification*, 28 FCC Rcd 15122 (2013). As a final step implementing the industry solution, the Commission issued an Order in January, 2014, modifying AT&T's Lower 700 MHz B and C Block licenses consistent with the 700 MHz Interoperability *Report and Order and Order of Proposed Modification. See* In the Matter of Promoting Interoperability in the 700 MHz Commercial Spectrum, WT Docket No. 12-69, Order of Modification, 29 FCC Rcd 281 (2014).

[300] See *AWS-3 Report and Order at* , ¶¶ 225-231.

[301] See *Incentive Auctions Report and Order at* ¶¶ 731-737.

[302] Alexia Gonzalez Fanfalone and Agustin Diaz-Pines, *Mobile Handset Acquisition Models*, Organization for Economic Cooperation and Development, July 5, 2013, at 1-7.

roaming coverage, means of enforcing data allowance limits, and, importantly, the requirement of a credit check, that continue to differentiate the two models. The following discussion of developments in mobile service pricing plans addresses these issues, and is divided into two sections. The first section covers developments in postpaid plans. The second section covers developments in prepaid plans, including traditional prepaid service plans and higher-end prepaid service plans that include data. The discussion focuses on recent changes made by providers during the period covered by this *Report*. It does not present a comprehensive comparison of pricing plans and pricing data.[303]

A. Postpaid Service

128. In the period since the *Sixteenth Report*, the most significant development in postpaid service has been the rise of the equipment installment plan (EIP) as an alternative to the traditional handset subsidy model. As discussed below, the growth of EIPs was accompanied by the introduction of discounted no-contract service plans for customers who forego handset subsidies, and this reduction in the price of non-subsidized postpaid service plans has been accompanied by other types of pricing changes. The following section focuses on the rise of EIPs and its effects, both direct and indirect, on the pricing of postpaid service. Other key developments in postpaid service, including the continuing evolution of data pricing models and new services that exempt certain types of data usage from counting against a mobile subscriber's monthly data allowance, are also examined at the end of the section.

1. Equipment Installment Plans

129. During the period covered by the *Sixteenth Report*, there has been an increase in the availability of different types of Equipment Install Plans (EIPs) for postpaid services. For instance, early in this period, T-Mobile lowered monthly service fees on its highest tiered data plans for customers who brought their own handset, paid full price up-front, or signed a contract to pay for a new handset in monthly installments. While other nationwide providers were already offering a month-to-month no-contract option to customers who brought their own device or paid the full price of a new device upfront, they did not offer any reduction in monthly service fees or an EIP financing option.

130. In March 2013, T-Mobile ceased offering traditional contract plans with handset subsidies to new customers and shifted exclusively to a no-contract model with discounted monthly service fees for customers who bring their own handset, pay the full price upfront, or sign a contract to pay for a handset in monthly installments. Since then, the other three nationwide providers and some regional providers have all introduced their own version of an installment payment option and a discounted, no-contract postpaid service plan.[304] To date, however, T-Mobile remains the only nationwide provider that has completely eliminated handset subsidies and shifted exclusively to the no-contract version of the postpaid model.

131. While the other three nationwide providers continue to offer traditional contract plans with handset subsidies alongside the no-contract EIP option, all four nationwide providers have structured customer incentives to encourage the adoption of EIPs.[305] Beginning with T-Mobile, all four nationwide providers and

[303] While mobile pricing plans have become increasingly national in scope, the geographic coverage of any particular pricing plan or offer may vary across regional markets for a number of reasons. In some cases, service providers may not offer certain broadband data plans in geographic markets where they have not yet upgraded their networks. In other cases, service providers conduct pilot tests of new pricing plans (or changes in existing pricing plans) in selected regional markets before offering them across the rest of their network footprint. We have not attempted to make a systematic determination of the geographic availability of the pricing plans and rates covered in this section of the *Report* on a market-by-market basis. Therefore, we cannot state with certainty that all the particular pricing plans and rates covered by the *Report* are available in any given geographic market. *See, e.g.*, *AT&T-Leap Order*, 29 FCC Rcd at 2749 ¶ 30,31; *SoftBank-Sprint Order*, 28 FCC Rcd at 9657 ¶ 38

[304] See Appendix Tables V.A.i and V.A.ii for details

[305] David W. Barden *et al*., *The Rise of Installment Payment Plans and Implications for Wireless Carriers*, Bank of America Merrill Lynch, Equity Research, Feb. 7, 2014, at 2, 4-5.

some regional providers have introduced early handset upgrade plans that link the option to upgrade more frequently to EIPs. Although the details of early upgrade plans vary across providers, all such plans allow customers to upgrade earlier and more frequently than allowed under traditional subsidized plans, but require customers who take advantage of this early upgrade option to pay for their new handsets with an EIP.

132. A second way service providers have encouraged EIP adoption is by offering lower monthly service fees to customers who pay for handsets in monthly installments. While AT&T and Verizon initially limited their efforts to incentivize EIP adoption to their early handset upgrade plans, they began offering such service fee discounts within a year if introducing EIPs,followed by a subsequent round of greater discounts. As noted below, when Sprint introduced new shared data plans in August 2014, it offered discounts for EIP customers that are similar to those offered by AT&T and Verizon. In addition, a subsequent price reduction on the unsubsidized version of Sprint's unlimited data plan for individuals effectively increased the discount available to EIP customers for this particular plan.[306]

133. From the outset, most of the nationwide providers – T-Mobile, AT&T, and Sprint – consistently offered the same discounts available for EIP customers to other customers who pay for their own handsets in other ways, including customers who pay the full price of a new handset upfront, new customers who bring their own devices ("BYOD"), and existing customers who have already paid for their current handset under a traditional two-year contract that has expired. In contrast, when Verizon first started offering EIP discounts, the company initially limited eligibility to customers on its "Edge" EIP/upgrade plan: it only subsequently extended these same discounts to existing customers on month-to-month contracts and new customers who bring their own devices. In addition, while most providers have offered discounts exclusively to customers who pay for their own devices in one of these ways, in February 2014 AT&T extended the same discounts it offers on non-subsidized no-contract plans to its existing subsidized contract customers – in other words, customers who had not yet shifted to EIPs -- until their next handset upgrade.

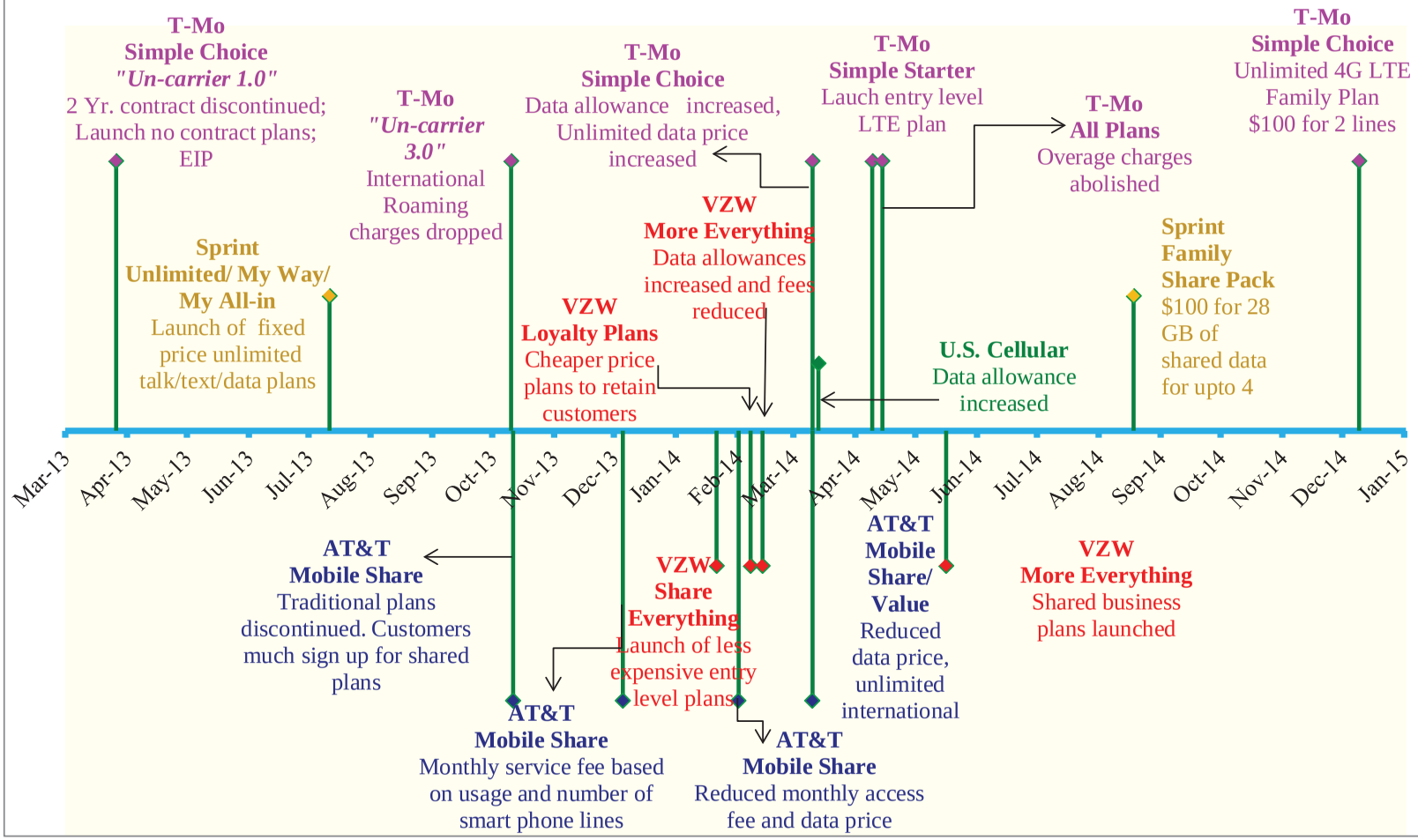
134. As noted above, the reduction in the price of non-subsidized no-contact plans was accompanied by other pricing changes that effectively reduced the price of traditional subsidized contract plans along with the new no-contract plans. These other types of pricing changes are examined in greater detail below.

2. Changes in Monthly Pricing of Postpaid Plans

135. In addition to offering discounts on service fees to EIP customers and others who forego handset subsidies, service providers made a number changes to the monthly pricing of postpaid service plans that effectively cut the price of postpaid service for customers whose data use had, previously, either put them at risk of overages or would have necessitated subscribing to the next highest tier. In some cases, both AT&T and Verizon cut the monthly service fees on selected data tiers outright. More commonly, some providers, including Verizon, T-Mobile and U.S. Cellular, effectively reduced the price of postpaid service plans by increasing monthly data allowances on usage-based data plans without increasing monthly service fees. In addition, some providers increased the value of existing plans by adding new features, including international text messaging and cloud storage allowances.

[306] *It's a New Day for Unlimited Data*, Press Release, Sprint, Aug. 21, 2014; Mike Dano, *Sprint Drops Unlimited Everything Plan to $60, Undercuts T-Mobile by $20*, FIERCEWIRELESS, Aug. 21, 2014.

Chart V-1
Major Changes to Pricing of Postpaid Service Plans
2013- December 2014



136. During this period, Sprint limited its response to providing discounts for EIP customers and other non-subsidized subscribers through its Framily plans. In August 2014, Sprint replaced its Framily plans with a new shared data offering, called Sprint Family Share Pack.[307] Data pricing under the new plans is lower than Sprint's previous data pricing, and is either in line with or substantially lower than that of Verizon's and AT&T's shared data offerings depending on the usage level and whether the plan is subsidized or unsubsidized.[308] The key difference between Sprint's shared data offering and those of Verizon and AT&T lies in the size of the monthly data allowances -- most of Sprint's shared data tiers offer at least double the data allowance of similarly-priced shared data tiers from AT&T and Verizon.

137. Sprint followed up shortly thereafter by reducing the price of its unlimited data plan for individuals to $60 per month, down from $80 per month for the subsidized version of its unlimited data plan and $75 per month for the unsubsidized version.[309] The plan is available to both new and existing Sprint customers, but customers must purchase their device through Sprint's EIP plan (Easy Pay), pay full retail price, or bring their own compatible device to qualify for the plan.

138. For Verizon and AT&T, price cuts on postpaid service plans generally benefited both subscribers on traditional subsidized contract plans and those on unsubsidized no-contract plans, inasmuch as both providers set the discounts on no-contract plans that are similar to the prices of the corresponding traditional contract offerings.[310] Similarly, when Sprint introduced its new shared data plans, it effectively reduced prices for both subsidized and unsubsidized plans. In contrast, since T-Mobile no longer offers traditional contract plans with handset subsidies, its postpaid subscribers could get a price reduction only by signing up for one of the new non-subsidized no-contract plans. Just recently in early December, T-Mobile introduced an unlimited 4G LTE family plan for $100 for 2 lines.[311]

139. While price cuts were the predominant form of changes to the monthly pricing of postpaid service plans, there were exceptions. In March 2014, for example, T-Mobile increased the price of its unlimited data plan by $10 per month, though it also doubled the tethered data allowance on this same plan to 5GB at the same time.

[307] *It's a New Day for Data for American Consumers*, Press Release, Sprint, Aug. 19, 2014.

[308] Jonathan Chaplin *et al*., *Sprint Focuses Value Proposition on More Data Rather Than Lower Pricing*, New Street Research, Equity Research, Aug. 19, 2014, at 2-4; Phil Goldstein, *Analysts: Sprint's New Shared Data Plans Not Disruptive Enough to Change its Fortunes*, FIERCEWIRELESS, Aug. 19, 2014. Sprint charges the same monthly line access fee per smartphone for traditional subsidized contract plans as AT&T and Verizon, and the discounts on this line access charge offered for unsubsidized no-contract plans are similar to those offered by AT&T and Verizon.

[309] *It's a New Day for Unlimited Data*, Press Release, Sprint, Aug. 21, 2014; Mike Dano, *Sprint Drops Unlimited Everything Plan to $60, Undercuts T-Mobile by $20*, FIERCEWIRELESS, Aug. 21, 2014. The plan also includes unlimited voice and texting.

[310] Both Verizon and AT&T discount their shared data plans for EIP customers by reducing the monthly access fee for adding a smartphone line, rather than the monthly fee for each tier's shared data allowance. Accordingly, when they reduce the monthly fee for the shared data allowance of a specific data tier or increase the shared data allowance of a specific data tier at existing price levels, the pricing change benefits both subsidized and non-subsidized customers.

[311] http://newsroom.t-mobile.com/news/unlimited-family-plan.htm (accessed December 11, 2014)

Chart V.A.2
Installment Payment Plans with Early Upgrade Options
2013- August 2014

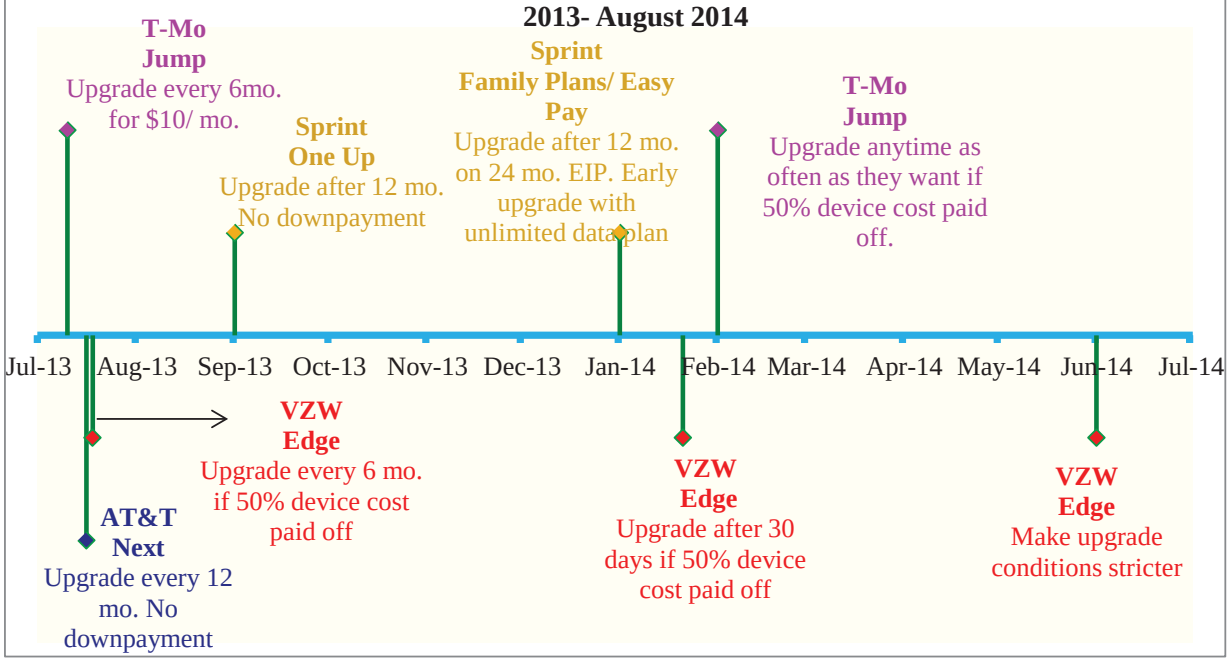
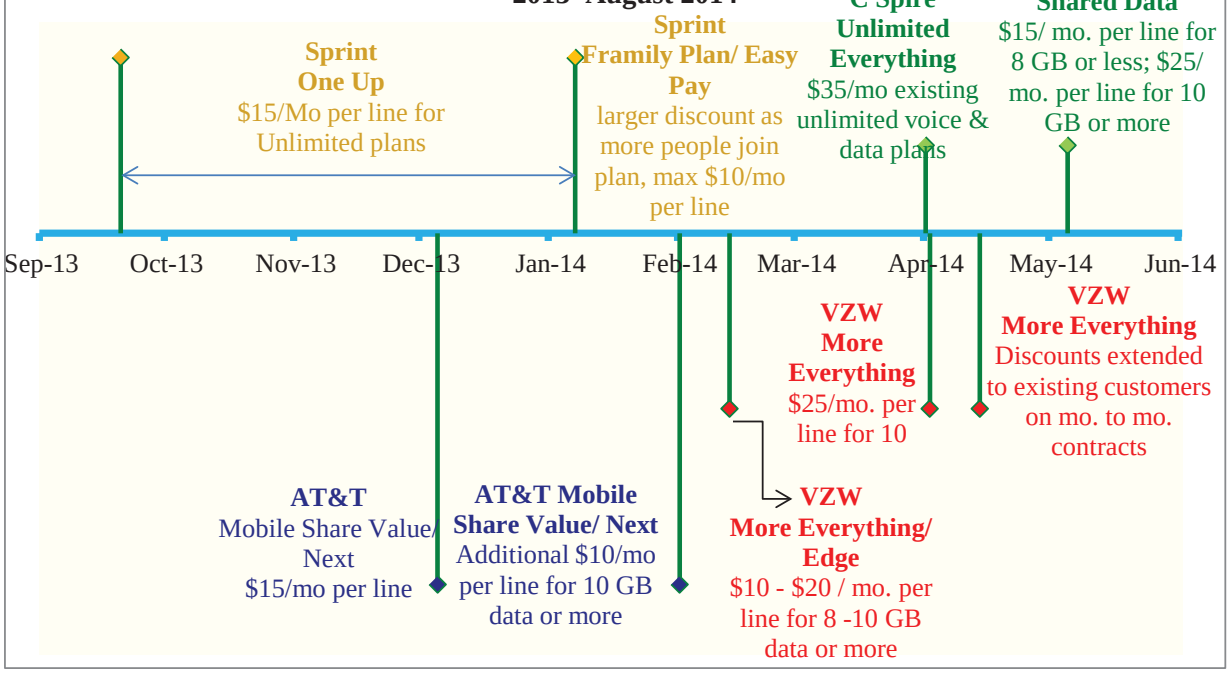


Chart V.A.3
Discounts on Monthly Service Fees for EIP Customers
2013- August 2014



3. Impact of EIPs on Consumer Costs

140. As discussed above, service providers now offer lower monthly service fees to customers who opt to pay for smartphones in monthly installments. Discounts typically range from $10 to $25 per month, relative to traditional contract plans with handset subsidies, depending on what data tier customers choose. As various industry analysts note, the overall cost of postpaid service to consumers under these plans depends, on a consideration of the costs of both the handset and the service plan. As one report points out, [312] installment payment plans have also reduced handset subsidies, and the subsidy reduction offsets the reduction in monthly service fees over the life of the customer. Different analysts have attempted to determine the net effect of installment plans on the total cost facing consumers both for service and the handset. The results vary, due in part to differences in method, underlying assumptions and the way analysts interpret industry developments.

141. Macquarie Research estimated that consumers who choose the no-contract installment payment option pay $74 more per year on average than consumers on traditional contract plans with embedded handset subsidies.[313] Under Macquarie's assumptions, the reduction in the handset subsidy raises the total cost to the consumer by more than the reduction in the price of the service plan lowers the total cost.[314] On the other hand, because customers on installment payment plans are no longer under contract, they are free to switch providers whenever they want.[315]

142. Another analysis by Bank of America Merrill Lynch suggests that the net effect of installment payment plans on the total cost facing the consumer varies depending on the service provider and the type of service plan.[316] According to this report, the first $10-15 of monthly service price reductions for EIP subscribers is essentially the shift from service to equipment revenue, but discounts over and above this threshold represent real price reductions. The report concluded that an installment payment plan is a cheaper option than receiving a subsidized device over a 24 month period for Verizon's and AT&T's plans with ten or more gigabytes of shared data, where the service price discounts offered for taking the installment payment option are higher than the discounts offered with lower data tiers.[317]

143. The conclusion of an analysis by New Street Research is that, installment plans represent a price cut despite the reduction in the handset subsidy.[318] New Street Research has estimated that the monthly price of

[312] Jonathan Chaplin *et al*., *1Q14 Wireless Trends Review: Competition Takes Toll; Pressures Likely to Intensify in Coming Quarters*, New Street Research, Equity Research, May 22, 2014, at 20.

[313] Jay Yarow, *U.S. Wireless Carriers are About to Change How People Buy Smartphones*, BUSINESS INSIDER, May 15, 2014.

[314] Macquarie assumed that the discount on an LTE data plan for the installment payment option is $10 per month, which is at the low end of the range of currently available discounts. Macquarie also estimated that customers on installment payment plans pay $28 more per month on average and that their total payments are $1,434 more on average over an eight-year period.

[315] Jay Yarow, *U.S. Wireless Carriers are About to Change How People Buy Smartphones*, BUSINESS INSIDER, May 15, 2014.

[316] David W. Barden *et al*., *The Numbers, the Comparable Numbers, and What's Next …*, Bank of America Merrill Lynch, Equity Research, May 27, 2014, at 7-8.

[317] David W. Barden *et al*., *The Numbers, the Comparable Numbers, and What's Next …*, Bank of America Merrill Lynch, Equity Research, May 27, 2014, at 7-8. Both Verizon and AT&T offer a discount of $25 per line per month to customers who take the installment payment option with data tiers of 10GB or more; for data tiers of less than 10GB, AT&T offers a $15 per line monthly discount, and Verizon offers a $10 per line monthly discount. The analysis assumes that four lines share the data tiers with at least 10GB.

[318] Jonathan Chaplin *et al*., *1Q14 Wireless Trends Review: Competition Takes Toll; Pressures Likely to Intensify in Coming Quarters*, New Street Research, Equity Research, May 22, 2014, at 13.

representative service plans in May 2014 decreased by an average of 20 percent over the previous year.[319] According to this analysis. most if not all of the cost savings due to lower handset subsidies have been offset by ETF buyouts and increased tablet subsidies, as well as a rise in sales and marketing expenditure, while the price of service plans is unlikely to rise.[320]

4. Promotions and Incentives

144. Historically, handset subsidies have been an important marketing tool for customer acquisition and retention in the U.S. mobile wireless market.[321] With the shift away from handset subsidies, service providers have increasingly offered a wide variety of other types of promotions and incentives in an effort both to attract and retain customers and encourage increased usage of mobile wireless services, especially data.[322] The discussion in this section focuses on two of the most widely used types of offers -- Early Termination Fee (ETF) buyouts and tablet promotions and subsidies.

145. The purpose of ETF buyouts is to encourage customers to switch from rivals by reducing switching costs. To this end, ETF buyouts typically include a cash payment or credit to reimburse ETFs (or pay off the remaining balance on an EIP) plus a separate device credit for trading in the customer's current handset. . The first ETF buyout offer came from AT&T which for one month offered up to $450 in credit to customers who switched from T-Mobile to AT&T and traded in their current devices. The offer was limited to customers who pay for their handset via EIP, full price upfront, or BYOD. Shortly thereafter, T-Mobile offered to reimburse up to $350 in ETFs and a $300 device credit for phone trade-in to customers who switched from any of the other three nationwide providers to T-Mobile. In April 2014, Sprint offered to reimburse up to $650 in switching costs for customers who switch their number to Sprint from another postpaid provider and sign up for Sprint's non-subsidized, no-contract "Framily" plan. Regional providers such as C Spire and U.S. Cellular made similar buyout offers. Sprint offered yet another ETF buyout in conjunction with the launch of its new shared data plans in August 2014. While AT&T's buyout offer lasted one month and Sprint has stated that its offer is available for an undefined, limited time basis, T-Mobile has said that it has no plans to end its ETF buyout..

146. During this period, many providers also offered various incentive plans for customers purchasing tablets that use cellular networks in addition to Wi-Fi access. For example, T-Mobile offered lifetime access to 200MB of free LTE data per month to all customers who use tablets on their network, and Verizon offered 1GB of extra data per month free of additional charge to customers who activate a tablet on its shared data plans at or above the 1GB data tier. Providers have also tried to encourage increased tablet data usage on their networks by subsidizing tablets. Sprint offered a free Samsung tablet to customers who join its no-contract "Framily" plan if they also sign up for a qualifying data plan. Sprint's free tablet offer began as a short-term promotion, but was extended multiple times in the first quarter of 2014. Similarly, Verizon retail stores have been offering customers a $100 discount off the price of tablets with a two-year contract, and some Verizon stores have offered selected tablets for either $50 or free of charge with a two-year contract.[323] T-Mobile temporarily offered LTE-enabled

[319] Jonathan Chaplin *et al*., *1Q14 Wireless Trends Review: Competition Takes Toll; Pressures Likely to Intensify in Coming Quarters*, New Street Research, Equity Research, May 22, 2014, at 13. The estimate is for representative 3-line plans. For prior plans, the estimate assumes unlimited voice and text, with approximately 2GB of data per subscriber for AT&T and Verizon, 2GB for T-Mobile, and unlimited data for Sprint. For current plans, the estimate assumes unlimited voice and text, with 2GB per subscriber for AT&T and Verizon, and 3GB for Sprint and T-Mobile.

[320] *Id*., at 20-22.

[321] Jonathan Chaplin *et al*., *1Q14 Wireless Trends Review: Competition Takes Toll; Pressures Likely to Intensify in Coming Quarters*, New Street Research, Equity Research, May 22, 2014, at 20. See also, Alexia Gonzalez Fanfalone and Agustin Diaz-Pines, *Mobile Handset Acquisition Models*, Organization for Economic Cooperation and Development, July 5, 2013, at 1, 8.

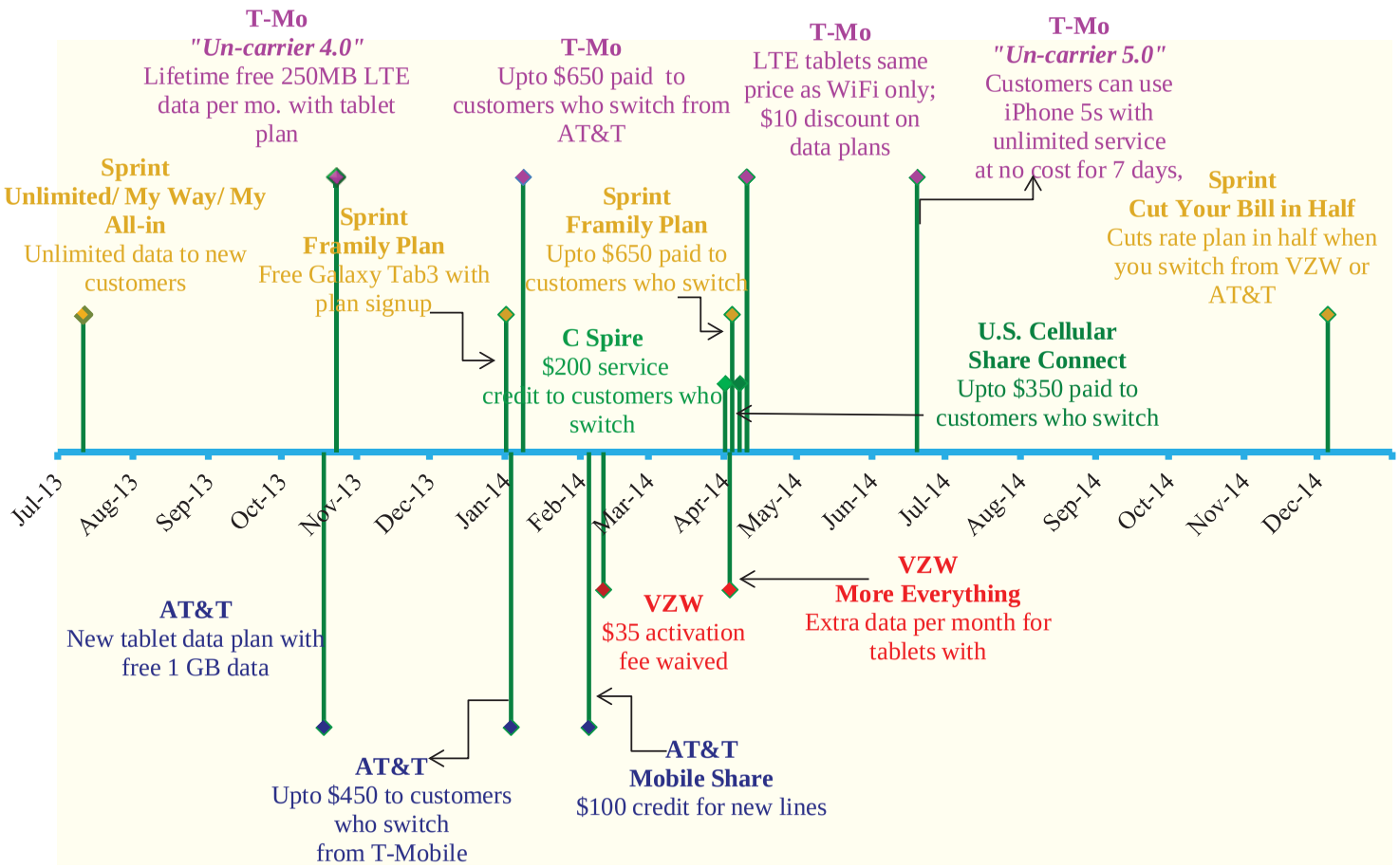
[322] see Appendix Table V.A.iii for details

[323] Mike Dano, *Verizon's Comprehensive Tablet Strategy is Leading the Way*, FierceWireless, July 23, 2014.

tablets for the same price as Wi-Fi-only models for any postpaid activation of a mobile internet data plan of 1GB or more In early December 2014, Sprint came out with a promotional offer to cut consumers' rate plans in half if they switch from Verizon Wireless or AT&T to Sprint. This offer would be good for as long as they stay a Sprint customer.[324]

[324] http://newsroom.sprint.com/blogs/devices-apps-and-services/sprint-ceo-marcelo-claure-bold-move-cuts-wireless-bills-in-half.htm

Chart V-4
Promotions and Incentives to Attract and Retain Customers
2013- December 2014



5. Evolution of Data Pricing Models

147. In addition to the shift to EIPs and associated pricing changes, the data pricing models that the nationwide providers use to differentiate their service offerings continued to evolve during the period covered by this Report. The overall trend was toward somewhat greater convergence of data pricing models than before.[325]

148. As noted in the *Sixteenth Report*, three distinct data pricing models had emerged in 2011 – the tiered, usage-based data pricing model with overage charges adopted by AT&T and Verizon; the tiered, usage-based model with speed reductions adopted by T-Mobile; and the unlimited data pricing model used by Sprint. There were two major changes to these pricing models in the second half of 2012. First, both AT&T and Verizon launched shared data plans that allow customers to pool their monthly data allowance across multiple smartphones, tablets, and other devices, rather than having to purchase a separate data plan for each device.[326] Second, T-Mobile reintroduced an unlimited data plan alongside its usage-based data tiers. Sprint remained the only nationwide provider that continued to offer exclusively an unlimited data plan.

149. Since the period covered by the *Sixteenth Report*, the most significant change for Sprint was its introduction of usage-based data plans, although its unlimited data pricing model remains a significant part of its pricing strategy. Sprint first launched an entry-level, usage-based data tier with overage charges alongside its unlimited data plans in the second half of 2013, and subsequently included two usage-based data tiers with overage charges in the Framily plans for EIP customers that it introduced at the beginning of 2014. In July 2013 it launched a promotion guaranteeing unlimited data for the life of the line to new and existing customers who sign up for one of its unlimited data plan options. In August 2014, Sprint replaced it usage-based Framily plans with the new Family Share Pack shared data plans discussed above, and cut the price of its unlimited data plan for individuals.[327]

150. During this time, AT&T also modified its data pricing in ways that made it more similar to Verizon's pricing. When shared data plans were first introduced in 2012, Verizon ceased offering its existing individual tiered data plans while AT&T continued to offer both individual and shared data plans. In addition, whereas Verizon charged a standard monthly fee ($40 per month) to add a smartphone line for all data tiers, AT&T instituted a sliding scale of fees ($30-50 per month) depending on the data tier. In the second half of 2013, AT&T discontinued its legacy tiered data plans, and subsequently established a standard monthly fee of $40 per month to add a smartphone line in place of the original sliding scale of fees.

151. T-Mobile continues to differentiate its general data pricing model based on the use of speed reductions, rather than overage charges, when data users reach the limit of their monthly data allowance. In May 2014, T-Mobile abolished remaining overage charges on all plans for domestic calls, text messages and data usage. T-Mobile also launched a new entry-level LTE data plan in April 2014, where service is suspended entirely once the customer reaches the 500MB monthly LTE data allowance, with the customers having the option to purchase a temporary data pass for an extra charge. [328]

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[325] See Appendix Table V.A.iv for details. In addition, Appendix Table V.A.v presents selected basic and smartphone plans for the four national and selected regional providers that are representative of the pricing changes in the marketplace

[326] At the time Verizon started offering its shared data plan, it also ceased offering unlimited data plans to new customers.

[327] In conjunction with the launch of this new unlimited plan, Sprint discontinued its promotional offer guaranteeing unlimited data for the life of the line to new customers who sign up for certain unlimited data plans. Sprint's new unlimited data plan does not come with this guarantee, and existing customers who already have that benefit on their account must stay on the rate plan that includes the lifetime guarantee in order to retain the benefit. Phil Goldstein, *Sprint Kills Unlimited Data for Life Guarantee for New Customers*, FierceWireless, Aug. 21, 2014.

[328] Appendix Table V.A.v presents selected basic and smartphone plans for the four national and selected regional providers that are representative of the pricing changes in the marketplace

6. Other Developments

152. During this period, certain mobile providers have implemented plans and services that exclude certain types of data usage from counting against a customer's monthly data allowance. This effectively lowers the price of data for any consumers who use the affected services and who exceed or may exceed their data allowance based on the use of those services. In January 2014, AT&T announced data plans, called "Sponsored Data," that will allow content providers to pay for mobile subscribers' data usage.[329] In addition, T-Mobile's recently announced "Music Freedom" unlimited free streaming music service allows customers unlimited access to six music streaming services without using up any of the data allowance on their 4G plan.[330]

153. Another recent development is the launch of more attractive international roaming plans. T-Mobile is currently the only provider that does not charge international roaming fees for certain services in more than 100 countries through its Simple Global plan. Individual and business customers on the Simple Choice plan receive unlimited 2G (Edge) data and texting globally.[331] As of February 2014, AT&T has adopted 4G LTE data roaming in 15 countries, and is still the only US provider to have 4G LTE speeds abroad.[332]

B. Prepaid Service

154. The four nationwide providers offer their own prepaid service, in addition to contracting with MVNOs who then offer service on those nationwide networks. As identified in previous *Reports*, analysts believe that it is appropriate to split the prepaid market into a low-end segment and a high-end segment.[333] The low-end segment involves traditional pay-as-you-go service, while the high-end segment encompasses unlimited and tiered usage-based plans.[334] All national providers serve both the low-end segment and the high-end segment.[335] Of the major players in the prepaid segment, AT&T offers prepaid and pay-as-you-go plans under its GoPhone brand,[336] and also offers higher-end prepaid plans under the Cricket brand name.[337] T-Mobile offers a selection of prepaid plans, including both pay-as-you-go plans and unlimited higher end plans under the T-Mobile, MetroPCS, and GoSmart brand names. Depending on the brand name and plan structure, these plans include varying allotments of monthly 4G LTE data, along with unlimited data at slower speeds. T-Mobile offers the same monthly plans for its monthly prepaid customers as it does to its postpaid customers, although, as described below, certain other differences remain between the offerings for the two sets of customers. Sprint offers several prepaid brands on its network, all with both smartphone and feature phone plans, and each with a different target audience. Boost Mobile[338] serves subscribers who are voice and text

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Mike Dano, Hershey's, Cut the Rope Among Advertisers Using AT&T's Sponsored Data Service, FierceWireless, June 25, 2014; Phil Goldstein, AT&T Sponsored Data Partner Syntonic Wireless to Launch Toll-Free Content Store, FierceWireless,, July 7, 2014.

[330] Sue Marek, *T-Mobile Entices Consumers to "Cheat on their Wireless Carrier' With7-Day Free iPhone Trial*, FierceWireless, June 19, 2014.

[331] http://www.fiercewireless.com/story/t-mobile-kills-international-data-roaming-fees/2013-10-09 (visited June 26, 2014)

[332] In December, AT&T launched LTE data roaming in Canada and the United Kingdom. Now, AT&T has made those speeds available to Spain, France, Japan, South Korea, Australia, Hong Kong, Switzerland, Malaysia, Russia, Singapore, Guam, Hong Kong and Antigua & Barbuda. AT&T plans to continue expanding its LTE footprint. The provider has agreements allowing LTE roaming in 200 countries; See http://www.fiercewireless.com/press-releases/att-launches-lte-roaming-more-countries-remains-only-us-carrier-offer-inter-0 (visited July 8, 2014).

[333] Need cite

[334] *Sixteenth Report*, 28 FCC Rcd at ¶ 160-161.

[335] See Appendix V.B for detailed information of selected pre-paid plans.

[336] http://www.att.com/shop/wireless/gophone.html

[337] https://www.cricketwireless.com/cell-phone-plans

[338] http://www.boostmobile.com/

messaging-centric. It also provides a plan with a price that falls as monthly payments are repeatedly made on time. Virgin Mobile[339] serves subscribers who are device and data-oriented, and also provides service for the Lifeline program under the Assurance Wireless brand.[340] Verizon Wireless offers basic pay-as-you-go[341] and daily prepaid plans,[342] only for use with feature phones, as well as monthly prepaid plans.[343]

155. The *Sixteenth Report* noted several key trends in prepaid service pricing during that period.[344] First, nationwide service providers increased their presence in the prepaid market segment by launching their own prepaid brands in competition with resellers and multi-metro prepaid service providers such as Leap and MetroPCS. Second, prepaid service providers expanded their mobile broadband data service offerings for smartphones and other connected devices. Third, prepaid mobile broadband pricing plans shifted from unlimited data pricing to tiered, usage-based data pricing coupled with speed reductions after usage exceeds a monthly allowance for high-speed data.

156. The structure of the prepaid market continued to evolve during the period covered by the this *Report*. The prepaid service segment has witnessed robust growth , and a substantial proportion of mobile customers in the United States now purchase their service on a prepaid basis.[345] Consumers of these prepaid plans may be less frequent users, lack the credit history necessary for postpaid service, or may prefer the flexibility and value of prepaid plans. Higher end prepaid plans are generally purchased on a per-month or per-day basis, while lower-end prepaid plans are generally those in which the customer incrementally reloads their account with data, voice, and text.

157. While one continuing trend in the prepaid service segment has been the offering of some prepaid pricing plans very similar to postpaid plans, there are significant differences in non-price plan features of prepaid plans – although the limitations vary by service provider and by plan. The main distinctions, apart from the issue of a credit check for customers, tend to be more limited data speeds, less extensive geographic coverage, more limited usage allowances, and more limited handset options. For instance, while some plans might include 4G (and some limited LTE) data, many prepaid plans restrict users to 2G/3G speeds. Certain providers restrict their prepaid customers from accessing roaming networks. Providers may also prioritize their postpaid traffic over their prepaid traffic, leading to possible quality degradation for the prepaid service. For example, T-Mobile prioritizes T-Mobile-branded traffic over that of its MetroPCS and GoSmart Mobile prepaid brands on its HSPA and LTE network.[346]

[339] http://www.virginmobileusa.com/

[340] http://www.sec.gov/Archives/edgar/data/101830/000010183014000012/sprintcorp201310-k.htm

[341] http://www.verizonwireless.com/pre-paid/pay-as-you-go/

[342] http://www.verizonwireless.com/wcms/consumer/shop/pre-paid.html?t=2

[343] http://www.verizonwireless.com/wcms/consumer/shop/pre-paid.html?t=2

[344] *Sixteenth Report*, 28 FCC Rcd at ¶161-173.

[345] As of June 2014, prepaid customers accounted for approximately 34 percent of mobile customers in the United States, based on ComScore MobilLens 3 month average survey data.

[346] Mike Dano, *AT&T Caps Cricket's Peak Download Speeds to 8 Mbps on LTE, 4 Mbps on HSPA+*, FIERCEWIRELESS, May 20, 2014.

Chart V.A.5
Major Changes to Pricing of Prepaid Service Plans
2013- July 2014

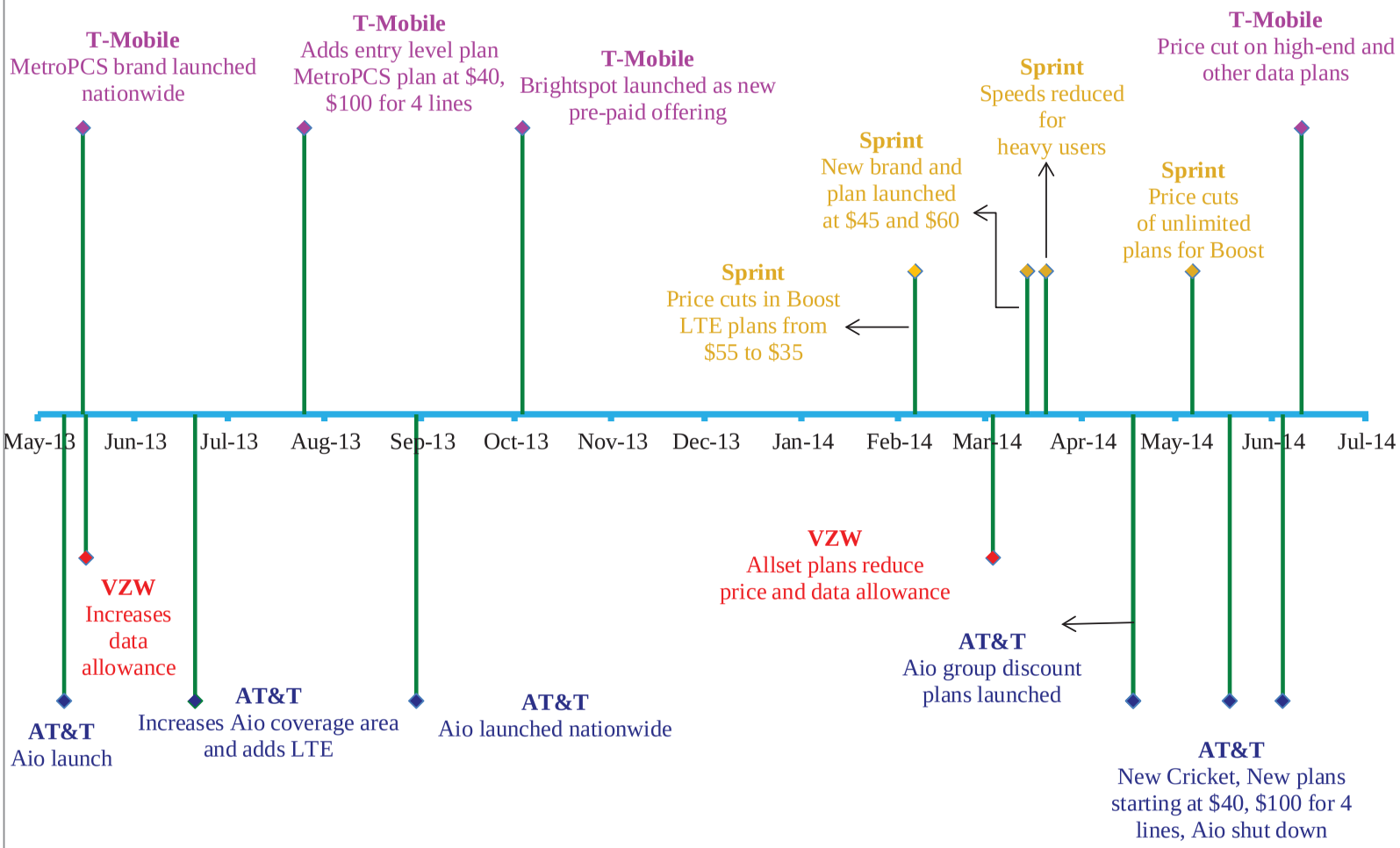
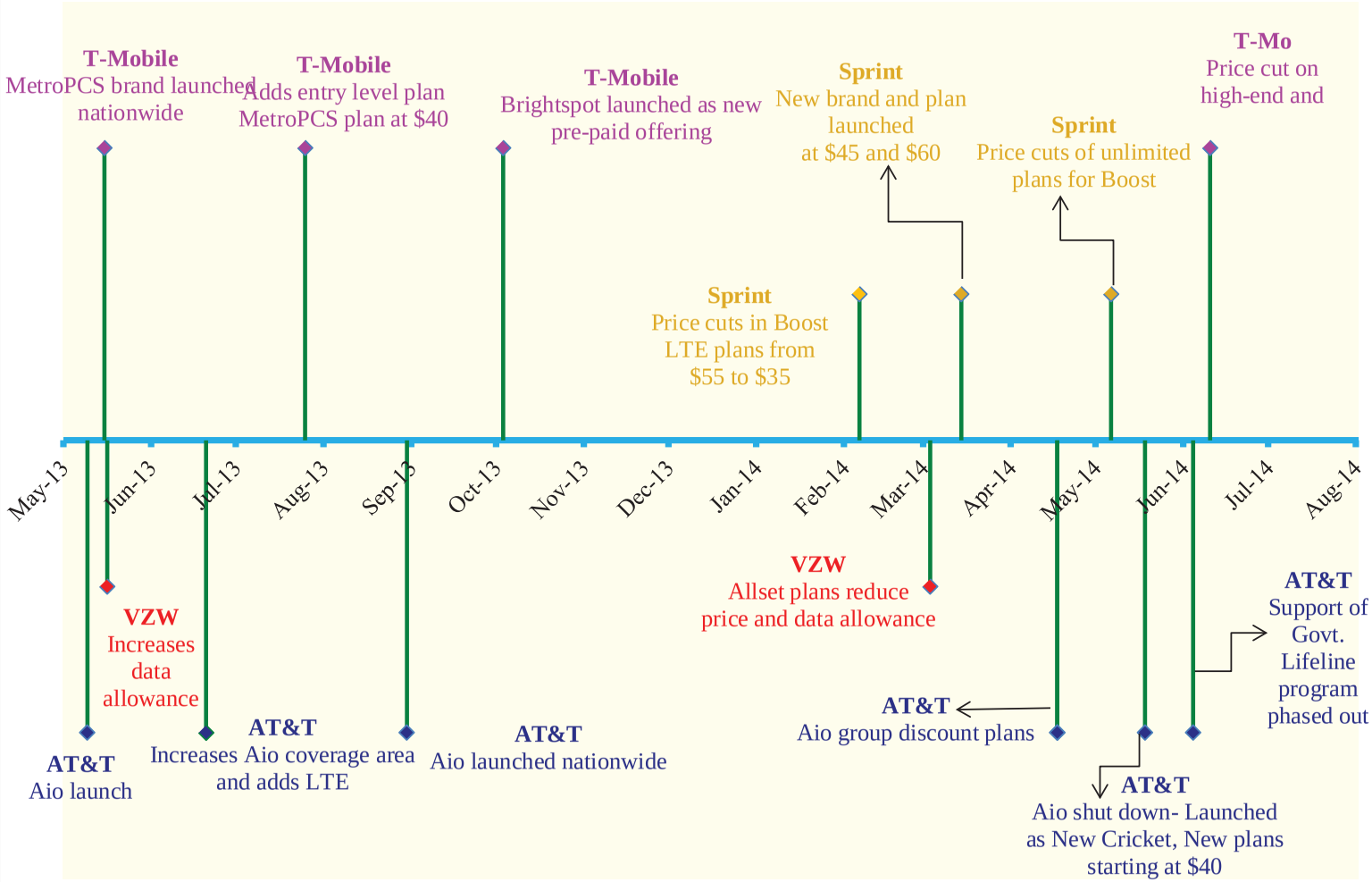


Chart V-5
Major Changes to Pricing of Pre-paid Service Plans
2013- August 2014



158. In addition, during the period under review, the four nationwide providers took significant steps in their offering of prepaid services, including acquisition of the two largest facilities-based prepaid service providers. In early 2013, T-Mobile acquired MetroPCS, and soon after, in May 2013, AT&T launched its nationwide prepaid brand Aio, in selected markets.[347] In July 2013, T-Mobile launched the MetroPCS brand in 15 new metro areas,[348] increasing the MetroPCS footprint by 50 million POPs.[349] In early 2014, AT&T acquired Leap (marketed as Cricket Wireless)[350] and launched it as the New Cricket in May 2014 while simultaneously shutting down its existing Aio Wireless prepaid brand.[351] Key developments in the prepaid market are discussed below and shown in Chart V.A.5.[352]

1. Prepaid Plan Choices

159. Since early 2013, the nationwide providers have continued to offer both value-conscious low-end prepaid plans, as well as higher-end prepaid plans.[353] In May 2013, AT&T, through Aio, offered prepaid customers three simple rate plans. Aio's unlimited talk, text, and data rate plans ranged from $35 to $70 per month, with pricing varying by market. It also offered 4G download speeds of up to 4Mbs per second. Customers also had the opportunity to bring a compatible, unlocked device for activation on the Aio network (BYOD).[354] In July 2013, T-Mobile launched Metro PCS in newer markets and launched a $40 rate plan that offers unlimited voice, texting and 500 MB of LTE data. Once a customer reaches 500 MB, their data speeds are slowed for the rest of their billing cycle. MetroPCS continues to offer $50 and $60 plans with larger high-speed data allotments.[355] T-Mobile also expanded the MetroPCS BYOD program, which currently supports AT&T and T-Mobile iPhones, and the iPhone 5s from Verizon Wireless and Sprint. It also supports GSM-based Android phones and Windows Phone devices. T-Mobile also launched a shared Metro PCS group plan that costs $100 for 4 lines.[356] Sprint and Verizon subsequently made changes in their own in-house prepaid brand offerings. The prepaid offerings included Verizon's Allset prepaid plans for the 3G CDMA network and Sprint's new Prepaid Smart plans. Sprint's Boost Mobile launched an LTE promotion and then reduced prices by introducing new plans at lower price points. In May 2014, AT&T shut down the Aio brand and launched the New Cricket, which matched the Metro PCS price offers with a $40 rate plan that includes unlimited voice, texting and 500 MB of data. Like MetroPCS, New Cricket also offered a shared plan where customers can purchase four lines for $100.

160. Providers such as US Cellular and C-Spire did not launch any new prepaid rate plans during this period. For smartphones, the entry level US Cellular plan cost $50 with unlimited talk and text and 500 MB of

[347] http://www.att.com/gen/press-room?pid=24185&cdvn=news&newsarticleid=36421&mapcode=

[348] MetroPCS' new markets include Baltimore; Birmingham, Ala.; Cleveland, Akron, Sandusky and Toledo, Ohio; Austin, Corpus Christi, Rio Grande Valley and San Antonio, Texas; Fresno, Calif.; Houston; Memphis, Tenn.; New Orleans; San Diego, Calif.; Seattle and Tacoma, Wash.; Tallahassee, Fla.; and Washington, D.C

[349] Phil Goldstein, *T-Mobile expands MetroPCS foortprint by 50M POPs, adds $40 rate plan,* FIERCEWIRELESS, July 25, 2013.

[350] http://about.att.com/story/att_completes_acquisition_of_leap_wireless.html

[351] Sue marek, *AT&T revamped Cricket will take on T-Mobile's MetroPCS with Aio-like look, rate plans,* FIERCEWIRELESS, May 18, 2014.

[352] See Appendix Table V.B.i for further details

[353] See Appendix V.B.ii-vii for prepaid price plans.

[354] http://www.att.com/gen/press-room?pid=24185&cdvn=news&newsarticleid=36421&mapcode=

[355] Phil Goldstein, *T-Mobile expands MetroPCS foortprint by 50M POPs, adds $40 rate plan,* FIERCEWIRELESS, July 25, 2013.

[356] *Id*

data. For C-Spire the cheapest plan including data is $35 (for 30 days) and includes 350 nationwide minutes, unlimited texts, and 500 MB of data.

161. There are several MVNOs who also provide service in the prepaid space. The largest of these is TracFone, which runs on the networks of all four nationwide providers. TracFone's Straight Talk prepaid plans offer customers unlimited voice and text, and 3 GB of high speed data for $45. When unlimited international texting is included the price increases to $60.

2. Availability of Handsets

162. One key distinction between prepaid and postpaid plans has been the differing availability of handsets. Usually, the handsets available to prepaid customers have been older models with fewer features than those available to high-end or postpaid customers, the iPhone being a good example. For instance, T-Mobile's GoSmart brand offers lower end monthly plans with a limited phone selection, and the smartphone selection for Sprint prepaid is limited as well.[357] However, smartphone availability is continuing to progress, with more options becoming available to prepaid customers.[358]

3. Service Coverage

163. Roaming, and hence the service coverage area, is another aspect that often distinguishes prepaid and postpaid offerings. AT&T's prepaid GoPhone and Cricket customers are limited to service provided only on AT&T's own network, and do not have coverage pursuant to AT&T's roaming agreements with other providers.[359] T-Mobile's GoSmart customers have access to the T-Mobile network, but these plans do not include access to service partner networks.[360] Neither Boost Mobile nor Virgin Mobile provides access to Sprint's roaming partners. However, MetroPCS- and T-Mobile-branded prepaid plans include roaming coverage provided by service partners, and Sprint prepaid also includes the same network coverage as Sprint postpaid.[361]

4. Data Speeds and Data Allowances

164. Non-price data rationing continues to differentiate some prepaid smartphone offerings from postpaid offerings. Prepaid data plans typically include a monthly high-speed data allowance, after which subscribers' data speeds are reduced. Sprint introduced greater speed reductions for heavy data users on its Boost Mobile and Virgin prepaid brands, and AT&T capped data speeds on its New Cricket brand prepaid service once a customer used all of their data allowance.[362] T-Mobile offers a selection of pay-as-you-go-plans that do not include high-speed data access. T-Mobile's GoSmart offers lower end monthly plans with no 4G data access, and employs speed reductions or service suspensions, while offering customers the option to purchase additional high-speed data. At this time, Verizon Wireless does not provide access to its LTE network with its prepaid plans.

C. Price Indicators for Mobile Data

165. As the discussion above shows, there is a wide variety of pricing plans offered by the different mobile wireless providers that vary along several dimensions. As discussed earlier[363] and in previous *Reports*,

[357] http://www.sprint.com/landings/pre-paid/

[358] See Section VI.D, *infra*

[359] http://www.att.com/maps/wireless-coverage.html#fbid=B9wW8Cw618U

[360] http://www.t-mobile.com/coverage.html; http://pre-paid-phones.t-mobile.com/pre-paid-coverage; http://www.metropcs.com/metro/maps/coverage-map.jsp; https://www.gosmartmobile.com/coverage-check

[361] http://www.sprint.com/landings/pre-paid/

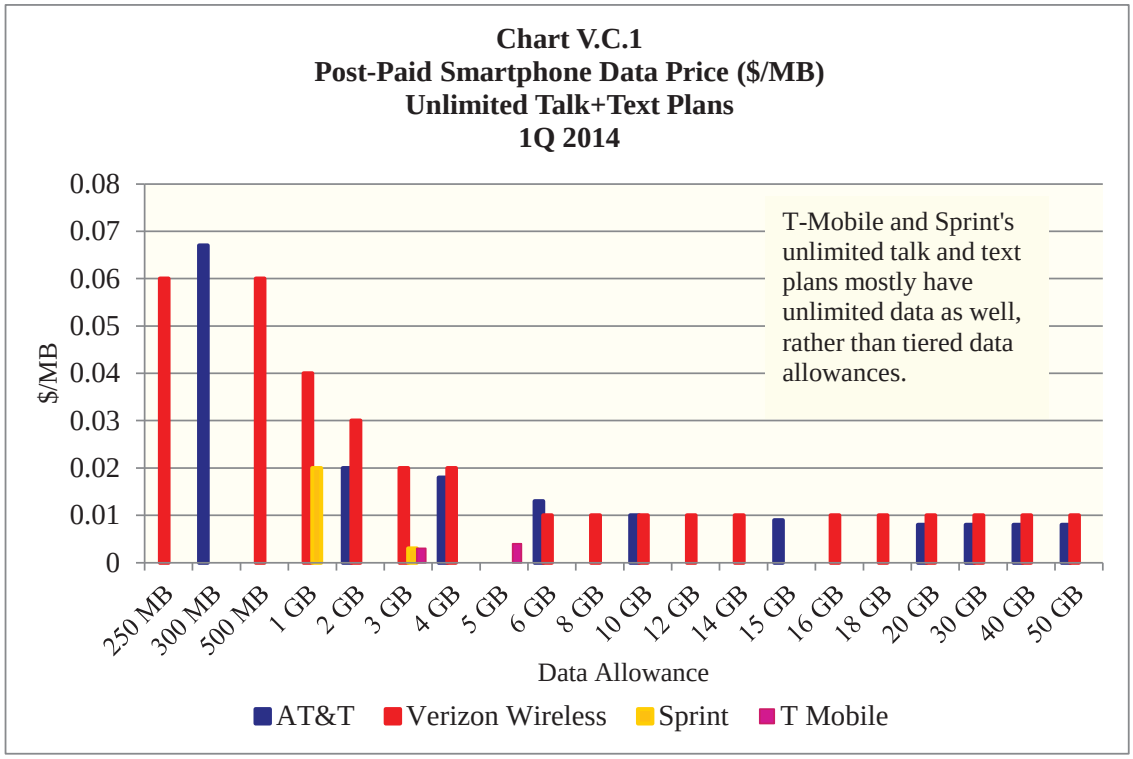
[362] New Cricket plans slow customer speeds once their data allowance is reached. See

[363] See Section II.D.1 *infra*

it is difficult to identify sources of information that track actual mobile wireless service prices in a comprehensive and consistent manner. However, average price metrics, although imperfect, are useful in comparing trends in prices across providers and over time. Below we present two such metrics – one which shows trends in average wireless unit prices (average revenue per unit), and the other, which tracks mobile data prices (average revenue per megabyte).

1. Postpaid Smartphone Data Price

166. The Commission, as well as analysts outside the Commission, have relied on CTIA's estimates of wireless data service revenues and, more generally, the existence of separate prices for wireless voice and data plans, to derive estimates of the unit price of wireless data service, measured in average revenue per megabyte. Without such disaggregated data it is challenging to estimate the price of wireless data service. Also, it is difficult to calculate a meaningful estimate of average revenue per megabyte actually being paid by consumers without knowing the composition of plans for each provider, the uptake rates for various plans, non-advertised promotions, and the proportion of legacy plans in a provider's customer base. It is possible, however, to understand overall trends in smartphone data price by surveying current postpaid data offerings by mobile wireless providers. As seen in Chart V.C.1,[364] the average price for data allowances above 5 GB is approximately 1 cent per megabyte or less, assuming consumers use their full data allowance. This translates into less than $10 per gigabyte of data. One caveat is that this price is calculated only for plans with data allowances and excludes unlimited data plans. The price may be lower for some heavy users on unlimited data plans.

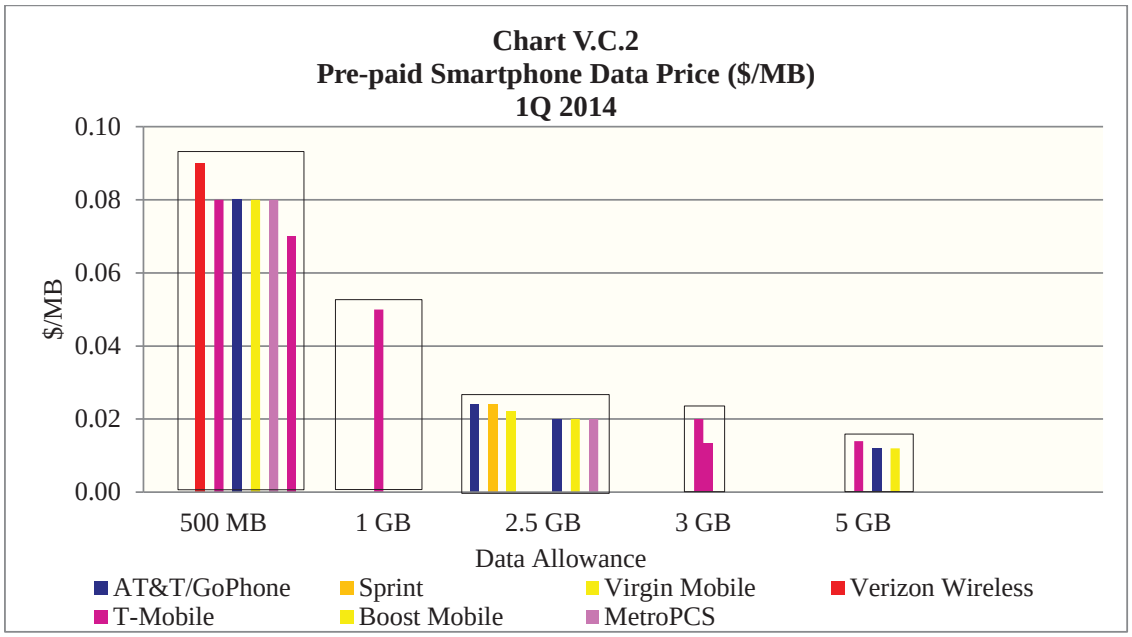


Note: Data are based on BoA/ML, "A Frantic Start to 2014 in Wireless Pricing", 4 April 2014, and company websites. Only unlimited talk + text plans are included. Unlimited data plans are excluded.

[364] The data are presented in Appendix Table V.C.i.

2. Prepaid Smartphone Data Price

167. Chart V.C.2 shows the current price per megabyte ($/MB) of prepaid smartphone data for the four national providers and their associated MVNOs. Data allotments included with prepaid plans are priced slightly higher than data allotments included with postpaid plans. There is a cluster of prepaid smartphone plans with high-speed data allowances of 500 MB and a data price of approximately eight cents per megabyte. This translates into roughly $8 per GB of data, assuming a consumer uses the maximum allowed by the price plan. As data allowances increase, price per megabyte drops considerably. For example, plans with a 5 GB data bucket cost approximately 1.5 cents per megabyte for customers consuming their full data allowance. Sprint (along with its MVNOs such as Boost and Virgin) and also T-Mobile (along with MetroPCS) offer plans that span both the high and low end of the data buckets.[365]



Note: Data are based on Bank of America analysts' reports and staff calculations. Only unlimited talk + text plans are included. The AT&T plans include Cricket and GoPhone plans, and those of T-Mobile include the provider's own prepaid plans and GoSmart plans.

VI. NON-PRICE RIVALRY

168. Mobile wireless service providers also compete for customers on dimensions other than price, including investment, network coverage and technology, service quality, as well as other factors such as advertising and marketing. Providers take actions and make expenditures to differentiate themselves from competitors and to imitate initiatives of their competitors that have been successful in attracting customers. Such non-price rivalry can influence a customer's choice of a provider and impose significant competitive constraints, especially in high technology industries that experience rapid innovation. This section presents data in five broad categories reflecting non-price rivalry among mobile wireless service providers: investment; network coverage and technology upgrades; quality of service; differentiation in handsets and devices; and other factors such as advertising and marketing.

[365] Prepaid pricing data are listed in more detail in Appendix Tables V.B.iii-vii.

A. Investment

169. Mobile wireless service providers differentiate themselves in the marketplace by improving the customer network experience through improvements in capacity, coverage, and service quality. Providers have been able to expand into new geographic areas and/or upgrade networks in existing markets after adding to their spectrum portfolios through participation in spectrum auctions and secondary market transactions. Providers have also expanded their network coverage and capacity through increased investment in and expansion of their existing assets and infrastructure. In this section, we focus on non-spectrum-related investment, which is one of the ways in which wireless mobile providers compete in the marketplace. Some providers make strategic capital expenditure (CAPEX) decisions to differentiate their service offerings from those of rivals by becoming the first to deploy a particular upgrade or new network technology. Other providers wait for rivals to make the first move and then respond by upgrading their own networks.[366]

170. Wireless providers in the U.S. have spent more than $134 billion in capital investments during the past five years.[367] Incremental capital investment by wireless providers rose to $33.1 billion in 2013, a 10.1 percent increase from the $30.1 billion spent in 2012. Verizon Wireless, AT&T, Sprint, and T-Mobile spent a combined $16 billion in the first half of 2014 and $31.5 billion in 2013, accounting for more than 96 percent of total industry capital investment in these time periods.[368] AT&T and Verizon Wireless together spent $11.9 billion in the first half of 2014, over 71 percent of the industry total. [369] This had spent $20.6 billion on capital investment in 2013, which was over 63 percent of the industry total.[370] Chart VI.A.1 below shows the capital expenditures for the four national providers, as well as for selected regional providers, during the past few quarters. As seen from the chart, capital expenditures have continued to vary significantly amongst providers. AT&T and Verizon Wireless continued to invest more than Sprint or T-Mobile by wide margins. Apart from a temporary increase in 2Q12, neither AT&T nor Verizon Wireless significantly increased its capital expenditures between 2Q11 and 2Q14. For Sprint and T-Mobile, the 4Q12 increase appears to be more persistent, and both providers show higher levels of capital expenditure in 4Q13 compared to 2Q11. In its comments,[371] Verizon Wireless states that since 2000, it has invested more than $80 billion in its network, with capital expenditures of more than $26 billion in the last three years alone.

[366] See *Sixteenth Report, 28 FCC Rcd at 3836* at ¶ 219

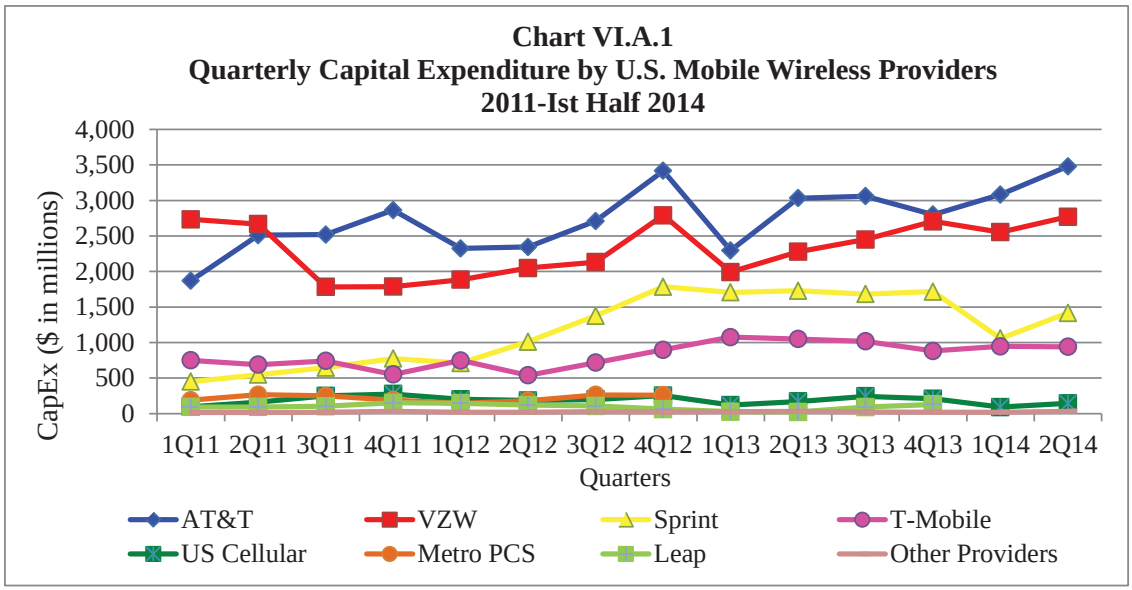
[367] *CTIA Year-End 2013 Wireless Indices Report*, at 96. CTIA's figure includes incremental investment in currently operational systems, including expenditures for building operating systems, land and capital leases, and all tangible non-system capital investment, but does not include the cost of spectrum licenses purchased at auctions or other acquisition processes or greenfield builds.

[368] UBS 411 Report, Version 51, April 2014. UBS 2Q 2014. T-Mobile includes MetroPCS

[369] *Id*

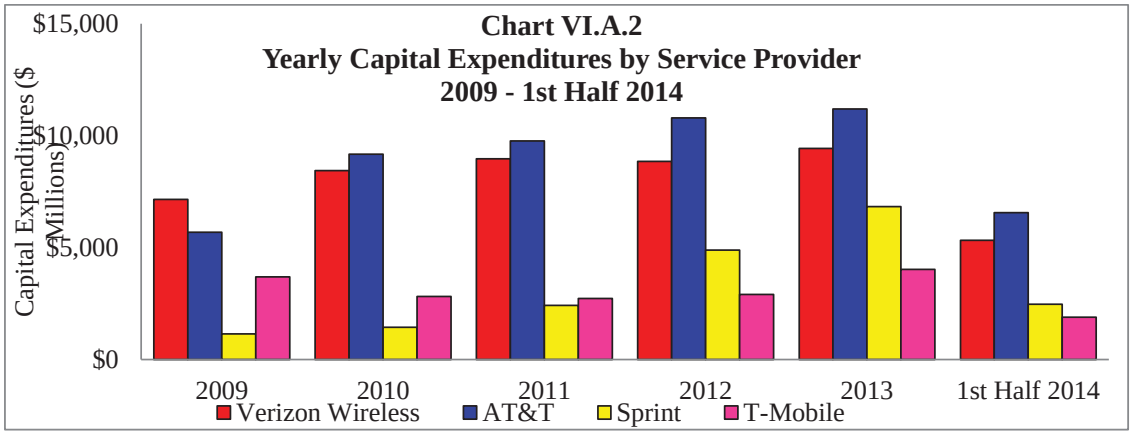
[370] *Id*

[371] See *Verizon Wireless Comments* at 26



Notes: Based on UBS Wireless 411 Report, Version 51 at 28. UBS 411 2Q 2014. Data in the chart is for second and fourth quarter. Metro PCS data are not available separately after the fourth quarter of 2012 as the T-Mobile and MetroPCS merger was consummated in early 2013. Leap is reported separately from AT&T as the AT&T and Leap merger was not consummated by the fourth quarter of 2013.

171. Looking beyond the short-term data in Chart VI.A.1, we see that an increase in capital expenditures has taken place over the last six years for the national providers.[372] In Chart VI.A.2 below we present annual capital expenditures for the four nationwide providers from 2009 – 21st half 2014.[373] AT&T steadily increased its nominal investment. Sprint more than doubled its investment from 2011– 2013. Capital expenditures by Verizon Wireless and T-Mobile have held fairly steady from 2010 – 2013, with a slight increase in 2013. However, there appears to be substantial variation in both the level and growth of CAPEX, even amongst national providers.



Source: Company SEC 10-K filings and *UBS Wireless 411, Version 51, UBS 411 Version 54.*

[372] For more details, see Appendix Table VI.A.i

[373] *US Wireless 411 Version 51*, March 2014

172. Variations in CAPEX may not be synchronized across providers for several reasons. First, providers follow different technological migration paths, which may be on different timeframes. Recently, the industry has followed distinct technological migration paths for LTE upgrades, with each provider implementing its own sequence of upgrades. As a result, CAPEX can vary from one service provider to the next. Second, providers often base their investment decisions on an assessment of how network deployments and upgrades affect future earnings. Third, the timing of network investments often has a strategic component vis-à-vis rivals, as discussed above. Finally, access to capital may be difficult for some providers, and this may hinder investment. According to NTCA, which consists exclusively of small, rural providers, 68 percent of the rural providers who were surveyed described the process of obtaining financing for their wireless projects as "fairly difficult" or "very difficult", while another 13 percent found it "virtually impossible".[374]

B. Network Coverage and Technology Upgrades

173. Network investment remains a centerpiece of service providers' efforts to improve their customers' mobile wireless service experience. During 2013 and early 2014 several providers continued to upgrade and expand their networks with technologies that enable faster data transfer speeds. Other providers announced plans to make additional upgrades in the near future.[375] As discussed below, a critical way in which mobile wireless service providers differentiate themselves is with the speeds, reliability, capabilities, and coverage of their mobile broadband networks.[376] Most wireless providers offer national coverage, using a combination of their own facilities and roaming arrangements. Since coverage and performance remain key elements of competition, small, regional, and national providers alike continue to invest substantially in their networks.[377] In the following discussion, we consider current network coverage by provider, technology and roaming by provider, and future network deployment plans by provider, including the implications for competition in the mobile wireless industry.

1. Current Coverage by Provider

174. This section presents an overview of wireless voice and broadband coverage by provider. As discussed earlier,[378] for purposes of this Report , mobile wireless coverage represents either mobile voice or mobile broadband coverage, and "mobile broadband" includes coverage and services offered using the following 3G and 4G technologies: EVDO, EVDO Rev A, WCDMA/HSPA, HSPA+, LTE, and mobile WiMAX.

175. Similar to the analysis of nationwide mobile coverage in Chapter III, the discussion in this section is based on U.S. census blocks overlaid on coverage maps provided to the Commission through a contract with Mosaik Solutions. As discussed earlier, these coverage estimates represent deployment of mobile networks and do not indicate the extent to which providers actually offer service to any or all residents in the covered areas. While recognizing that this analysis likely overstates the coverage experienced by consumers because of limitations in Mosaik data, we find that this analysis is useful because it provides a general baseline that can be compared over time across network technologies, and providers.[379]

a. Mobile Wireless Network Coverage by Provider

176. Mobile voice coverage by provider is presented in Chart VI.B.1.[380] Each of the four nationwide

[374] NCTA, *2013 Wireless Survey Report*, January 2014, at 3 and 10.

[375] *See* Table VI.B.1 and Section VI.B.3, *infra*.

[376] *See Sixteenth Report, 28 FCC Rcd at 3836* at ¶ 182; AT&T Comments at 31; WCAI Reply at 5.

[377] See *Verizon Wireless Comments* at 27

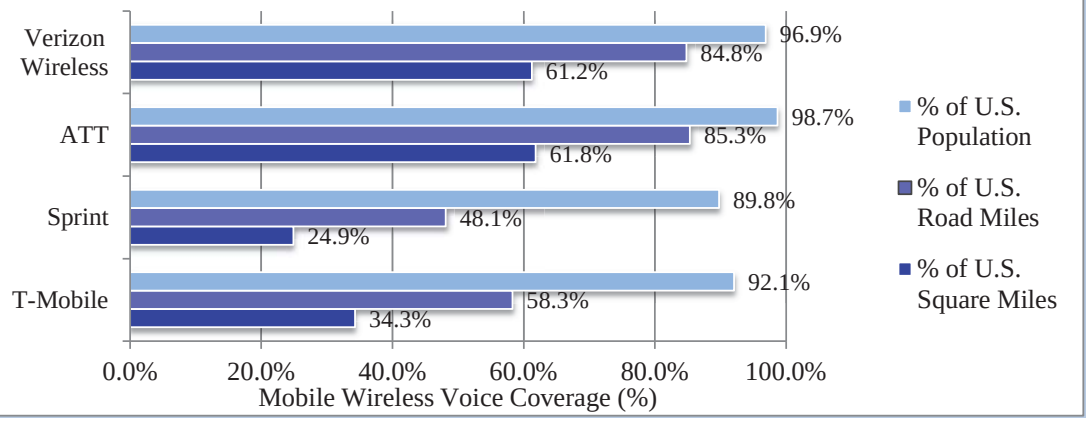
[378] See Section III.A *infra*

[379] See Section II.A *infra*

[380] Also see Appendix Tables VI.B.i and VI.B.ii

providers covered census blocks containing at least 90 percent of the population with their respective mobile wireless networks as of January 2014. Verizon Wireless and AT&T each covered approximately 85 percent of U.S. road miles, while Sprint covered 48.1 percent and T-Mobile covered 58.3 percent of U.S. road miles. Verizon Wireless and AT&T each covered approximately 61 percent of U.S. land area with their respective mobile wireless networks, while Sprint and T-Mobile each covered less than 35 percent of land area.

Chart VI.B.1
Estimated Mobile Wireless Coverage in the U.S. by Provider , January 2014



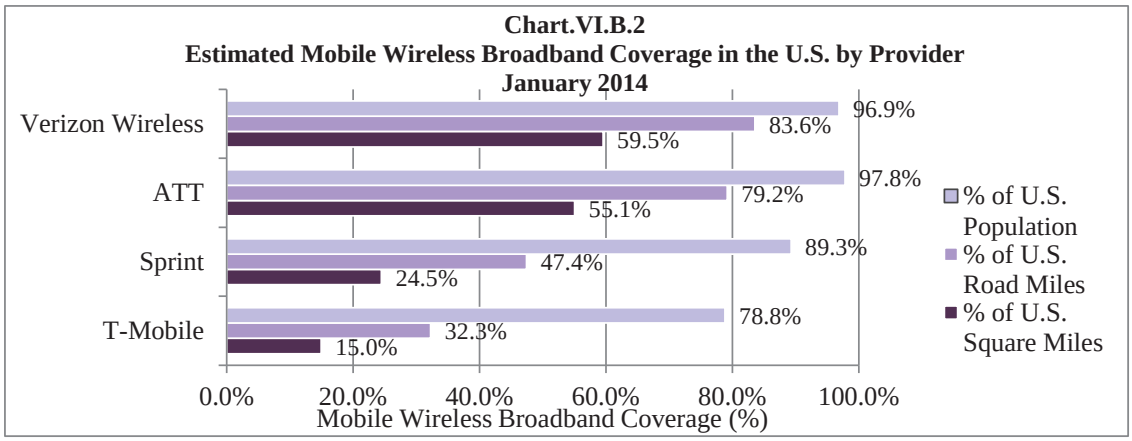
Source: Staff calculations based on January 2014 Mosaik coverage data and 2010 Census population data. We note the data underlying these estimates measure mobile network "coverage," and not network providers affirmatively offering service to residents in all those locations. Also, calculations based on Mosaik data have certain limitations that likely overstate the extent of mobile wireless coverage.

b. Mobile Broadband Network Coverage by Provider

177. Mobile broadband coverage is presented in Chart VI.B.2.[381] Verizon Wireless and AT&T each covered census blocks containing at least 97 percent of the population with mobile broadband as of January 2014, while Sprint covered 89.3 percent and T-Mobile covered 78.8 percent.[382] Verizon Wireless and AT&T each covered over 79 percent of US road miles and over 55 percent of U.S. land area, while Sprint and T-Mobile each covered less than 50 percent of US road miles and less than 25 percent of US land area with mobile broadband.

[381] Also see Appendix Tables VI.B.iii and VI.B.iv

[382] Commission estimates based on census block analysis of Mosaik Coverage Right coverage maps, January 2014.The estimates for the regional providers apply both to mobile wireless coverage and to mobile broadband coverage.

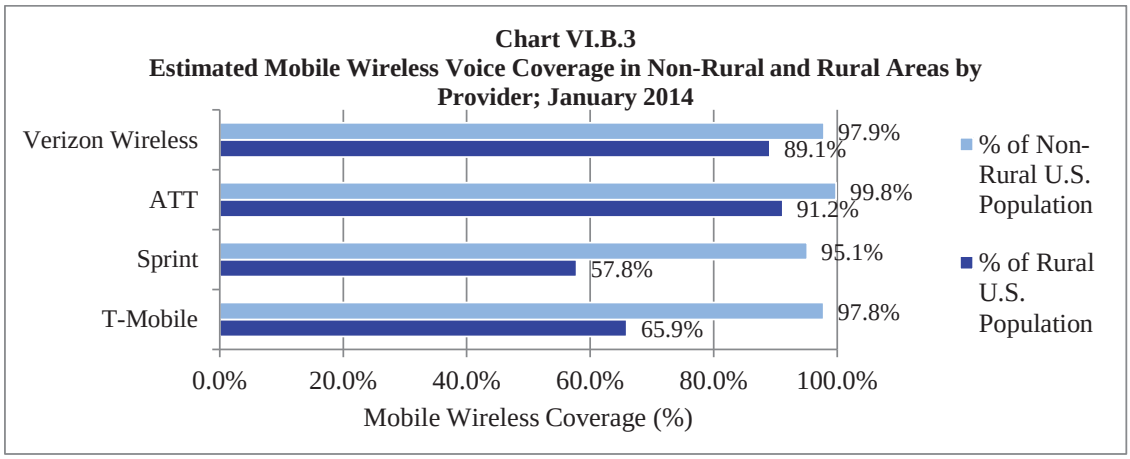


Source: Staff calculations based on January 2014 Mosaik coverage data and 2010 Census data on population. We note the data underlying these estimates measure mobile network "coverage," and not network providers affirmatively offering service to residents in all those locations. Also, calculations based on Mosaik data have certain limitations that likely overstate the extent of mobile broadband coverage.

c. Urban/Rural Comparisons

(i) Mobile Wireless Network Coverage

178. As seen in Chart VI.B.3, each of the four nationwide providers covered census blocks containing at least 95 percent of the non-rural population with their mobile wireless voice networks, as of January 2014.[383] In terms of the rural population, Verizon Wireless and AT&T covered census blocks containing 89.1 percent and 91.2 percent, respectively, while Sprint and T-Mobile covered census containing 57.8 and 65.9 percent, respectively. Each of the four nationwide providers covered a significantly higher percentage of non-rural than rural land area and road miles.



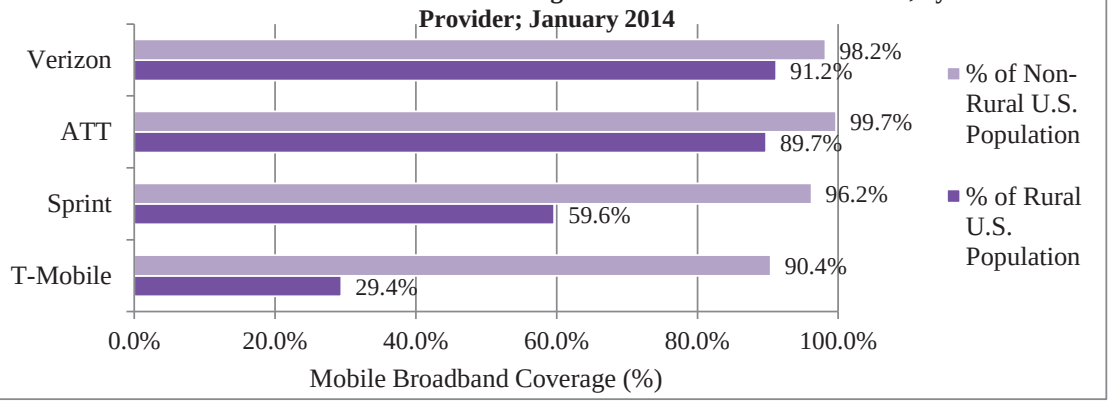
Source: Staff calculations based on January 2014 Mosaik coverage data and 2010 Census data on population. We note the data underlying these estimates measure mobile network "coverage," and not network providers affirmatively offering service to residents in all those locations. Also, calculations based on Mosaik data have certain limitations that likely overstate the extent of mobile broadband coverage.

[383] See Appendix Tables VI.B.v and VI.B.vi for more detailed data on estimated mobile wireless coverage by provider in rural areas and non-rural areas, respectively.

(ii) Mobile Broadband Network Coverage

179. As seen in Chart VI.B.4, each of the four nationwide providers covered census blocks containing at least 90 percent of the non-rural population with their mobile wireless broadband networks, as of January 2014.[384] In terms of the rural population, Verizon Wireless and AT&T covered census blocks containing 91.2 percent and 89.7 percent, respectively, while Sprint covered census blocks containing 59.6 percent and T-Mobile covered census blocks containing 29.4 percent of the rural population. Each of the four nationwide providers covered a significantly higher percentage of non-rural than rural land area and road miles.

Chart VI.B.4
Estimated Mobile Broadband Coverage in Non-Rural and Rural Areas, by Provider; January 2014



Source: Staff calculations based on January 2014 Mosaik coverage data and 2010 Census data on population. We note the data underlying these estimates measure mobile network "coverage," and not network providers affirmatively offering service to residents in all those locations. Also, calculations based on Mosaik data have certain limitations that likely overstate the extent of mobile broadband coverage.

2. Coverage and Roaming

180. Service providers may use roaming services to enhance their coverage for a variety of reasons, including temporary arrangements while their networks are being deployed, and as permanent arrangements due to the economics of the market or to their business models, as discussed earlier in Section IV.C. No facilities-based provider – including the four nationwide providers – has built out its entire licensed service area, and consequently all employ roaming to some extent to fill gaps in their coverage.[385] In addition, there are non-nationwide providers whose business plans do not include nationwide networks. Many of these non-nationwide providers are able to offer their customers coverage that is national in scope through roaming agreements with other mobile wireless providers. Accordingly, roaming remains particularly important for small and regional providers, allowing them to compete with nationwide providers for customers in their network service areas.[386] Similarly, roaming provides important assistance to potential new entrants who wish to begin offering service

[384] See Appendix Tables VII.B.vii and VII.B.viii for more detailed data on estimated mobile wireless broadband coverage by provider in rural areas and non-rural areas, respectively.

[385] *Sixteenth Report*, 28 FCC Rcd at 3836 ¶ 208; *Roaming Order on Reconsideration*, 25 FCC Rcd at 4192 ¶ 23. One potential measure of the significance of roaming in the wireless industry is roaming revenues, which are discussed in detail below. *See also* AT&T Reply Comments at 18-19.

[386] *Sixteenth Report*, 28 FCC Rcd at 3836 ¶ 208; *see also* RCA Comments at 15; NTCA Comments at 3-4 (arguing that regional and local providers offer a small footprint and need to partner with other providers through roaming agreement to offer their subscribers competitive expanded coverage.).

before they have fully deployed their networks.[387]

181. By definition, MVNOs and resellers rely on using the networks of one or several facilities-based providers to compete with the nationwide providers. As they do not have networks of their own, it is essential that they maintain wholesale arrangements with facilities-based service providers in order to provide coverage. Depending on the particular arrangement, customers of MVNOs and resellers may have limited or no access to networks other than that of the underlying wholesale provider For example, the coverage experienced by customers of TracFone's Straight Talk[388] varies depending on the underlying wholesale provider. A Straight Talk customer obtaining service on an underlying CDMA network, for instance, will not have access to voice and SMS service when not within the coverage of that network. A Straight Talk customer whose service is provided on an underlying GSM network, by contrast, may have voice and SMS service when outside that network's coverage area. [389]

3. Service Provider Network Deployments

182. Network investment remains a centerpiece of service providers' efforts to improve their customers' mobile wireless service experience. During the past few years, several providers upgraded and expanded their networks with technologies that enable faster data transfer speeds. Other providers announced plans to make additional upgrades in the near future.[390] While service providers initially upgraded their networks with various technologies, all of the major mobile wireless providers now offer or plan to deploy LTE. The following section includes a brief discussion of the deployment strategies for each of the top five providers, as well as a detailed discussion of the mobile network upgrades of the major mobile wireless providers. For purposes of this Report, we include all 3G (CDMA EV-DO, EV-DO Rev. A, WCDMA/UMTS/HSPA, HSPA+) and 4G (LTE, and mobile WiMAX) network technologies in our discussion of mobile broadband.[391] While the Mosaik deployment data distinguish among different mobile wireless network technologies, other factors than network technology may affect network performance. These factors may include the configuration of the network, the amount of spectrum used, and the type and capacity of backhaul connection to the cell site.[392] Below, we provide a detailed look at network deployment plans by provider and include a detailed discussion of deployment plans.

[387] *Sixteenth Report*, 28 FCC Rcd at 3836 ¶ 208; *see also Roaming Order on Reconsideration*, 25 FCC Rcd at 4191-92 ¶ 21 (recognizing that without the ability to offer roaming in markets where they hold spectrum, new entrants would in effect be required "to build out their networks extensively throughout the newly obtained license area before they can provide a competitive service to consumers, all without the benefit of financing the construction of new networks over time with revenues from existing services and reliance on roaming to fill in gaps during build out"); *see also* NTCA Comments at 3.

[388] http://www.straighttalk.com/wps/portal/home/h/about (visited July 7, 2014)

[389] http://www.straighttalk.com/wps/portal/home/h/legal/terms-and-conditions (visited July 7, 2014)

[390] *See* Section IV.B.1.A, *infra*.

[391] The terms "3G" and "4G" are used by industry for marketing purposes, as well as by the International Telecommunications Union (ITU) for technical specifications. See *Sixteenth Report*, 28 FCC Rcd at 3796 ¶ 186

[392] *2012 Eighth Broadband Progress Report*, GN Docket No. 11-121, (rel. Aug. 21, 2012), ¶ 40.

Table VI.B.1
3G/4G/ LTE Deployment Reported by Selected Mobile Wireless Service Providers
As of December 2014

Service Provider	HSPA, HSPA+, and EV-DO Deployment	LTE and WiMAX Deployment	Additional Discussion
AT&T Wireless	Entire network is covered by HSPA+, covering 300 million POPs.	AT&T covered 320 million[393] POPS with 4G/LTE as of 4Q14, up from 300 million POPs in 2Q14, 280 million POPs in 4Q13 and approximately 250 million POPs in 3Q13.[394]	AT&T highlighted that about 50 percent of postpaid smartphones are now LTE compatible.
Verizon Wireless	EV-DO Rev. A network covered 300 million POPs.	As of 4Q14 Verizon Wireless covered 308 million POPs in over 500 US markets with LTE, accounting for 98 percent of POPs.[395] Verizon's LTE network over layed 99 percent of its 3G EV-DO mobile broadband network. XLTE, is now available in more than 400 markets across the country.	Verizon had already migrated 54 percent of its data traffic to its LTE network. It is now adding capacity to its 4G LTE network using AWS spectrum. The additional bandwidth is called XLTE
Verizon Wireless – LTE in Rural America Partners		13 providers had launched LTE and covered 1.8 million POPs.[396] Program included 20 small, rural providers that had already launched or plan to launch LTE to areas covering approximately 2.8 million people across 14 states.	
Sprint	EV-DO Rev. A network covered approximately 277 million POPs.	Sprint's LTE and WiMAX deployments covered 250 million POPs[397] in 470 markets as of 4Q14, up from 200 million POPs in 443 markets as of 4Q13, and 230 markets in 3Q13.[398] Sprint expects to expand its coverage to over 2.5 million square miles[399] through its partnership with the Competitive Carrier's Association Data Roaming	Sprint continues to target 250 million 4G / LTE covered POPs by year end 2014 under the Network Vision project, using FDD-LTE with 800 / 1900 MHz spectrum.

[393] http://www.att.com/network/en/index.html (accessed December 9, 2014)

[394] http://about.att.com/content/dam/snrdocs/4g_evolution_infographic.pdf (accessed Mar. 26, 2014)

[395] http://www.verizonwireless.com/news/LTE/Overview.html (accessed December 9, 2014 and Mar. 25, 2014)

[396] https://aboutus.verizonwireless.com/technology/network/ (accessed December 9, 2014 and Mar. 25, 2014)

[397] http://shop.sprint.com/modals/4g_lte_plan_details.html (accessed December 9, 2014)

[398] http://www.sprint.com/netdotcom/index.html (accessed December 9, 2014 and March 24, 2014)

[399] http://newsroom.sprint.com/news-releases/sprint-competitive-carriers-association-and-netamerica-alliance-join-forces-to-accelerate-deployment-and-utilization-of-4g-lte-across-the-united-states.htm (accessed March 27 2014)

		Hub. Sprint also formed a strategic partnership with NetAmerica Alliance to expand 4G LTE coverage in rural markets.	
T-Mobile	HSPA+ 21 network covered over 200 million POPs and HSPA+ 42 network covered 184 million POPs.	As of 4Q14, T-Mobile's 4G LTE network reached 273 metro areas nationwide. It covered 230 million people in 4Q14, up from 210 million people in 1Q14.[400]	T-Mobile is the process of upgrading its 2G/EDGE network to 4G/LTE, with plans to complete 50 percent of the work in 2014, and to substantially complete the upgrade by the middle of 2015.

183. *AT&T*: In its Comments, AT&T stated that as of April 2013 it had built out LTE to cover more than 200 million POPs, and it expected to reach 90 percent of its planned 300 million POP LTE deployment by the end of 2013.[401] As of December 2014, its LTE network covered 320 million POPS, as seen in Table VI.B.1 above. AT&T has announced plans to deploy commercial mobile broadband services using carrier aggregation technology - which is part of the LTE Advanced specifications - to combine transmissions across either AWS or PCS high-band band spectrum with 700 MHz D and E block spectrum.[402] AT&T is also exploring the possibility of offering eMBMS[403] services on these bands.[404] AT&T is developing a "broadcast capability" to remove video traffic from its wide-area wireless networks.[405] . AT&T is also exploring using LTE Advanced technology to ensure that it can meet users' data demands as more customers start using LTE.[406] AT&T launched Voice over LTE (VoLTE) in select markets in May 2014.[407]

184. *Verizon*: Verizon Wireless augmented its LTE network in 50 different cities with AWS spectrum in the first half of 2014 to avoid potential capacity issues, as more than 66 percent of the company's data traffic now rides on 4G LTE.[408] In December 2014, it covered 308 million POPs as seen in the table above. The company will begin to re-farm PCS spectrum to LTE from its 3G network in 2015.[409] In every major city east of the Mississippi and in several western markets, Verizon Wireless is using 40 megahertz of spectrum, compared to the 20 megahertz it has deployed on its 700 MHz Upper C Block spectrum for its macro LTE deployment.[410] In

[400] http://www.t-mobile.com/coverage.html (accessed December 9, 2014 and March 24, 2014)

[401] See *AT&T Comments* at 9

[402] http://apps.fcc.gov/ecfs/comment/view?id=6017610610

[403] eMBMS refers to evolved multimedia broadcast/ multicast service on LTE advanced, see http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=6353684&tag=1

[404] “”AT&T ‘exploring the possibility” of LTE Broadcast with eMBMS”, Mike Dano, Fierce Wireless, April 2, 2014, http://www.fiercewireless.com/story/att-exploring-possibility-lte-broadcast-embms/2014-04-02

[405] http://www.fiercewireless.com/story/att-use-lower-700-mhz-d-and-e-block-spectrum-lte-broadcast/2013-09-24#ixzz2yIw98jwV

[406] http://www.fiercewireless.com/story/att-edging-lte-advanced-technologies-capacity-not-speed/2014-02-26#ixzz2yJ0Mj5pX

[407] http://about.att.com/story/att_introduces_high_definition_voice_in_initial_markets.html

[408] http://www.verizonwireless.com/news/article/2013/12/verizon-wireless-4g-lte-three-year-anniversary.html

[409] http://www.fiercewireless.com/story/verizon-start-refarming-pcs-spectrum-lte-2015/2013-06-27

[410] http://www.fiercewireless.com/story/verizon-will-deploy-aws-spectrum-50-markets-mid-2014/2013-12-09#ixzz2yJ2KLBIM

addition, after several delays,[411] in September 2014, Verizon Wireless has started rolling out VoLTE service nationwide but is initially making VoLTE available on only two smartphones.[412] 4G LTE roaming for Verizon Wireless customers outside the U.S. will also begin in select countries.[413] Verizon Wireless' LTE in Rural America (LRA) program allows Verizon Wireless to expand its 4G LTE network into rural areas, and to allow customers of participating companies to roam on Verizon Wireless' 4G LTE network throughout the U.S., including Alaska.[414]

185. *Sprint*: Sprint is in the process of replacing its WiMAX technology with LTE. The transition is expected to be complete by the end of 2015, at which point the WiMAX network will be completely decommissioned.[415] Sprint also shut down its iDEN Nextel network in 2013.[416] Once WiMAX is transitioned off of Sprint's 800 megahertz band in a given market, this spectrum will be used to launch Sprint Spark. Sprint Spark harnesses three different frequencies in the LTE spectrum, and actively cycles between them depending on usage and need.[417] In its Comments,[418] Sprint states that one important facet to Sprint's competitive efforts has been its Network Vision project, which is an initiative to consolidate Sprint's networks and technologies into a single nationwide 3G and 4G network. .Sprint 4G LTE service is available to 250 million Americans in 470 markets in December 2014, and Sprint expects 100 million Americans will have Sprint Spark or 2.5GHz coverage by the end of this year as well.[419] By December 2014, Sprint Spark was live in 20 cities with plans for expanding to 100 more cities in the next three years.[420] Sprint plans to eventually launch VoLTE, but there is currently no established timeline.[421]

186. In addition, Sprint has announced that it will partner with both CCA and NetAmerica to accelerate the deployment of 4G LTE in rural communities.[422] Through these partnerships, CCA providers and NetAmerica Alliance Members are positioned to more efficiently and quickly deploy and support their owned and operated 4G LTE networks. In turn, Sprint's customers will be able to roam on the 4G LTE networks being built by CCA and NetAmerica Alliance Members across the country. To facilitate roaming between these networks, beginning in January 2015, Sprint plans to offer 4G LTE devices that will include a chipset allowing the devices to roam on the lower 700 MHz spectrum primarily in use by CCA and NetAmerica Alliance Members, which is

[411] http://www.fiercewireless.com/story/att-admits-volte-delay-wont-offer-new-launch-date/2014-02-26; http://www.forbes.com/sites/greatspeculations/2014/08/20/verizon-to-launch-volte-service-by-december-delays-launch-of-lte-only-phones/

[412] "Verizon starts rolling out VoLTE, but on only 2 phones to start", Phil Goldstein, Fierce Wireless, September 17, 2014; http://www.fiercewireless.com/story/verizon-starts-rolling-out-volte-only-2-phones-start/2014-09-17

[413] http://www.verizonwireless.com/news/article/2013/12/verizon-wireless-4g-lte-three-year-anniversary.html

[414] http://www.verizonwireless.com/news/2013/09/4g-lte-rural-america-program-alaska.html

[415] http://www.sec.gov/Archives/edgar/data/101830/000010183014000012/sprintcorp201310-k.htm

[416] http://www.fiercewireless.com/story/sprint-shutter-wimax-network-end-2015-will-turn-least-6000-clearwire-sites/2014-04-07#ixzz2yQUccesC

[417] http://faster.sprint.com/2014/03/17/sprint-spark-arrives-in-2-new-markets/?INTMKT=MA:MS:103013:SparkHub:Articles_RelatedContent

[418] See *Sprint Comments* at 7

[419] http://newsroom.sprint.com/presskits/sprint-spark.htm, (accessed December 8, 2014 and September 10, 2014)

[420] http://www.sprint.com/netdotcom/ (accesed December 9, 2014)

[421] http://www.broadsoft.com/news/2014/sprint-selects-broadsoft-to-deliver-next-generation-ims-and-voice-over-lte-services/

[422] http://newsroom.sprint.com/news-releases/sprint-competitive-carriers-association-and-netamerica-alliance-join-forces-to-accelerate-deployment-and-utilization-of-4g-lte-across-the-united-states.htm

notable because Sprint doesn't own any 700 MHz spectrum.[423]

187. *T-Mobile*: In 2013 T-Mobile made substantial investments to upgrade to LTE.[424] During the first quarter of 2013 alone, T-Mobile invested $1.1 billion, in support of an accelerating network modernization program.[425] T-Mobile's LTE coverage now reaches 250 milion people, up from 220 million POPs in earky 2014.[426] Where it does not offer 4G LTE, T-Mobile customer devices will automatically transition to its 4G HSPA+ network. Under T-Mobile's network strategy, 4G HSPA+ essentially serves as a fallback such that consumers can access 4G coverage with multiple technologies. T-Mobile has continued to launch its LTE network, and is now kicking off a new program to upgrade its 2G/EDGE network with 4G LTE. The company plans to complete 50 percent of the work in 2014, and expects the program to be substantially complete by the middle of 2015.[427] The upgrade will provide customers who currently experience 2G/EDGE coverage new access to 4G LTE, and will also expand the existing 4G LTE network. T-Mobile is in the process of acquiring 700 MHz A-Block spectrum, on which they plan to deploy 4G LTE.[428] T-Mobile has launched VoLTE across its 4G LTE network.[429] T-Mobile is now known as T-Mobile USA, after a merger with MetroPCS. MetroPCS is marketed as a separate brand. The MetroPCS footprint has continued to expand, first through the Apollo 15 program, and soon through the upcoming Apollo 30 program.

188. *U.S. Cellular and Other Providers*: U.S. Cellular plans to add more than 1,200 4G LTE cell sites in 2014, and to expand the existing 4G LTE service in 13 states. By the end of 2014, more than 93 percent of U.S. Cellular customers will have access to 4G LTE.[430] In 2013, U.S. Cellular sold customers and certain PCS license spectrum in the Chicago, central Illinois, St. Louis and certain Indiana/Michigan/Ohio markets to Sprint.[431] They then focused their LTE expansion in the remaining markets. In addition to the providers discussed above, several other smaller, regional operators had deployed 3G and 4G technologies within their networks as of January 2014.[432]

C. Quality of Service

189. Key characteristics for mobile wireless performance include network speeds, latency and packet loss. The Commission has recognized the importance of accurate and timely data on these characteristics in informing consumer decisions, Commission policy, and service provider network investment decisions. This

[423] http://www.fiercewireless.com/story/sprint-add-700-mhz-band-12-capabilities-some-new-devices-starting-next-year/2014-03-26#ixzz2yQMeKWmI

[424] See *AT&T Comments* at 10; T-Mobile, Press Release, *T-Mobile USA Reports First Quarter 2013 Results* (Mar. 8, 2013), *available at* http://investor.t-mobile.com/phoenix.zhtml?c=177745&p=irol-IRHome ("*T-Mobile USA 2013 First Quarter Results*").; Phil Goldstein, *T-Mobile boasts of lead in LTE Advanced*, FierceWireless, Apr. 23, 2013, *available at* http://www.fiercewireless.com/story/t-mobile-boasts-lead-lte-advanced/2013-04-23 .

[425] Se *T-Mobile Comments* at 20-21.

[426] See Table VI.B.1 *infra*. http://newsroom.t-mobile.com/issues-insights-blog/the-un-carrier-network-designed-data-strong.htm?AID=11031750&PID=6147683&SID=ovrfcgqnm36a; http://www.fiercewireless.com/tech/story/t-mobiles-data-strong-network-gains-lte-coverage-bandwidth/2014-06-19

[427] http://newsroom.t-mobile.com/news/t-mobile-celebrates-1st-anniversary-of-lte-rollout-by-launching-major-network-upgrade-program.htm

[428] http://newsroom.t-mobile.com/phoenix.zhtml?c=251624&p=irol-newsArticle&ID=1908666&highlight=

[429] http://newsroom.t-mobile.com/issues-insights-blog/firing-on-all-cylinders-earnings-jdp.htm

[430] http://www.uscellular.com/about/press-room/2014/USCellular-Announces-New-Markets-to-Receive-4G-LTE-Service-in-2014.html

[431] http://usc.q4cdn.com/bd464866-e7e0-4821-8879-8a5c2a35f568.pdf

[432] *Infra*

Report will primarily analyze speed data using the Ookla Net Index data, data from the FCC Speed Test App, RootMetrics data, and the CalSPEED drive-test data gathered by the California Public Utility Commission.

190. Mobile broadband network service quality experienced by consumers may vary greatly with a number of real world factors such as the service provider's received signal quality, cell traffic loading and network capacity in different locations, as well as the capability of consumers' devices.[433] First, mobile connection quality will vary based on the location of the receiving device in reference to the transmitting device, which is often a cellular tower. If the receiving device (and the person using it) is behind a wall, blocked by terrain or otherwise has an impaired connection with the tower, the mobile broadband service will be degraded or not available. Second, the performance of the broadband connection degrades over distance to the tower, even with a clear line of sight. Performance at the edge of a tower's coverage is not equal to performance close to the tower. Third, cellular signals are shared by many users—the more simultaneous usage, the lower the potential performance of any one connection.[434] It is also important to note that for all mobile technologies, speed and performance measurements are only valid when a wireless connection can be accessed. "Dead zones" and loss of signal reduce wireless effectiveness.[435] Moreover, from the customer's perspective, overall network performance is the product of more than network quality alone and often reflects differences in device capability as well.[436] For data services, network quality as perceived by the customer may also be use-, case-, or application-dependent (*e.g.*, a consumer who solely uses e-mail may view the quality of the network differently than one who streams video regularly). Furthermore, consumers may place more weight on one particular aspect of network quality than another – such as coverage or peak data speeds – when choosing their mobile wireless services.[437]

191. In recognition of the effects of these different parameters on mobile network performance, mobile network speeds are commonly assessed using various methodologies. The two most prevalent approaches rely on crowdsourced data or drive-test data. Crowdsourced data are user-generated data produced by consumers who voluntarily download speed test applications on their mobile devices. These apps commonly collect data on the provider, location of device, download and upload speeds, latency and packet loss, which are then transmitted to the company or entity that developed the app. In some cases, the apps automatically schedule these tests to run at certain times during the day, while in others, the user has to choose to run the tests. Generally, crowdsourced data can bring the benefits of generating a large volume of data at a very low cost and of measuring actual consumer experience on a network in a wide variety of locations, indoor and outdoor. We note, however, that crowdsourced data are often not collected pursuant to statistical sampling techniques, and may require adjustments to construct a representative sample from the raw data. For instance, crowdsourced mobile data come from a self-selected group of users, and there often is little control for most tests regarding such parameters as when people implement the test, whether the test is performed indoors or outdoors, the geographic location of the tester, and the vintage of

[433] For example, the received signal quality is dependent on the service provider's deployed cell site density, low/high frequency radio wave propagation losses, user locations, indoor obstructions and outdoor foliage or clutter, weather, inter-cell interference conditions, and wireless network optimization parameters. The cell traffic loading or demand is dependent on the overall number of concurrent active mobile broadband users sharing the same cell, which in turn depends on user locations, the day of the week, and the time of the day. The capacity of a provider's wireless network is dependent on the deployed mobile wireless technology, sites and equipment, available bandwidth, and enhanced backhaul connections. See *Sixteenth Report* at ¶ 290.

[434] The FCC Omnibus Broadband Initiative (OBI). Broadband Performance - OBI Technical Paper No. 4. at 19

[435] *Id* at 19-20

[436] The capability of consumer devices (e.g. smartphones, tablets, USB dongles, and laptops) could result in users experiencing different data speeds on the same mobile wireless broadband network. Even differing capabilities within each device category, such as smartphone processing power and memory, could result in better user experiences on 4G networks.

[437] *See* Consumer Satisfaction with Service Providers, *infra*, for a discussion of overall consumer satisfaction with their mobile wireless services.

the consumer's device.[438] Drive test data, by contrast, are generated from tests that control for the location and time of the tests as well as for the devices. Drive tests, however, are more expensive to conduct, involve significant judgment about when and where the tests are run, often do not involve significant testing indoors or in many rural areas, and typically produce datasets that are not as rich as crowdsourced data – all of which are likely to have some effects on reported results.

192. Ookla is one of the most prominent providers of crowdsourced data. The FCC has also made available a mobile app that has also started gathering such data. CalSPEED measures mobile network speeds in California based primarily on drive tests. RootMetrics publishes broadband performance metrics that is largely based on drive test data in 125 U.S. cities and in 50 airports, but also incorporates results of some crowdsourced data.

1. Network Speed

a. Ookla

193. Ookla gathers crowdsourced mobile speed data through the use of their Speedtest mobile app.[439] This app is available free of charge to smart phone users, and is designed to test the performance of mobile cellular connections including LTE, 4G, 3G, EDGE, and EVDO networks. Once the app is downloaded, the user can periodically measure the speed of their wireless connection. This data are then used to produce Ookla's Net Index dataset.[440] Because the speed tests rely on the phone's connection to the server, such factors as congestion, location of the server, proximity and access to a cell tower, and phone quality can affect the result. As presented below and in the Appendices, the Ookla data show significant variation in different geographies, as well as among service providers. Our analysis is based on the speed test source data that Ookla, proprietor of speedtest.net, makes publicly available on its Net Index website.[441]

194. In this *Report*, we present the nationwide median download and upload speeds by provider, based on all available U.S. cities in the dataset with sufficient sample size. Chart VI.C.1 presents Ookla's median download speed measurements for the four nationwide providers from 2012 to June 2014.[442] As seen from the chart, upload and download speeds vary by provider.[443] AT&T and Verizon Wireless had the two highest download speeds in 2013. Sprint's users reported the lowest median download speeds during the reporting period. T-Mobile experienced significant speed improvements throughout the reporting period, supplying the second highest median download speeds during the first half of 2014.

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[438] By contrast, crowdsourced fixed broadband speed data, such as those collected by the FCC through SamKnows, can be gathered with more control. The SamKnows whiteboxes are able to measure actual fixed network speed and are not dependent on the vintage of the client hardware or software. Additionally, the testers are chosen according to a valid sampling technique.

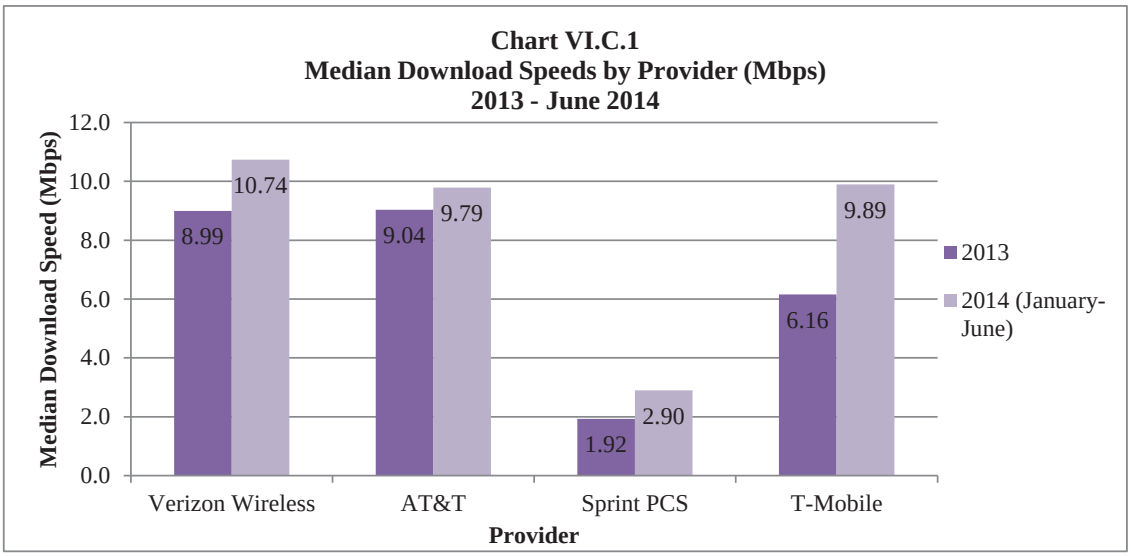
[439] http://www.speedtest.net/mobile/. Website accessed 4/18/2014

[440] Additional aspects of the Ookla test methodologies are discussed in Appendix VI.C.

[441] http://www.netindex.com/. Accessed 4/9/2014. The Ookla dataset used in this report is based on daily mobile download and upload speed data by city and provider for 2013 – June 2014. We drop cities that do not have sufficient observations as well as outliers. Also see Appendix VI.C.i *infra*

[442] More details can be found in Appendix Tables VI.C.i – VI.C.iv

[443] One factor that may lead to speed differences between wireless providers is the composition of currently used smartphones. The Ookla Speedtest application is available for download on iOS, Android, or Windows Phones. Each of these operating systems has evolved over time. Vintage smartphones, which do not support 4G, or possibly even 3G service, are still in use. Based on current and past promotions and partnerships, each wireless provider may have a customer base with a different smartphone profile, which can directly affect speed measurements.



Source: Net Index data by Ookla, 2013 – June 2014

b. FCC

195. In September 2012, the FCC announced that it was expanding its Measuring Broadband America program to include information on mobile broadband service performance in the United States using a crowdsourced approach.[444] The program uses the FCC Speed Test app for Android and iPhone devices to test the speed and performance of volunteers' smartphone mobile broadband services.[445] The FCC Speed Test app is available free of charge for Android phones and for the iPhone. The FCC speed test can be set to run automatically in the background on Android phones, but iPhone users must execute the speed test manually. This app allows users to measure their mobile broadband performance and voluntarily report these data to the FCC. Collected data include upload and download speed, latency and packet loss, as well as the wireless performance characteristics of the broadband connection and the kind of handsets and versions of operating systems tested. Several other passive metrics are also recorded, including signal strength of the connection, and device manufacturer and model.[446] The FCC Speed Test app provides the benefits, and has the limitations, described above for crowdsourced mobile data.

196. The results reported here do not incorporate all attempted tests reported to the Commission. Each individual test report includes information on whether the test completed successfully, whether it timed out due to connection problems, and whether any data from the test are missing. Missing data from a test reflect issues in the operation of the app for that particular test, so that particular test observation is dropped from the dataset. If the test timed out, we did not include speed observations, thereby reporting network speeds only in situations where the test completed successfully. Tests where the user was on a Wifi network were filtered out. We then used a standard econometric test to identify outliers in the data and dropped those outlier observations.[447] Based

[444] http://www.fcc.gov/measuring-broadband-america/mobile, visited 7/10/2014

[445] See http://ldevndj-web01:8080/. The data collected includes speed, latency, and packet loss for both upload and download. .

[446] http://www.fcc.gov/measuring-broadband-america/mobile

[447] We use the hadimvo test in STATA to identify the outliers. This test identifies multiple outliers in multivariate data using the method of Hadi (1992, 1993), See STATA Manual.

on the remaining data, we calculated the overall mean and median download and upload speeds by service provider.[448]

197. Based on nationwide FCC Speed Test App data for the time period between November 2013, and July 11, 2014, Verizon Wireless had the highest mean nationwide upload and download speeds, followed by T-Mobile, AT&T, and Sprint. For the median speed, T-Mobile had the highest download speed followed by Verizon and AT&T, while Verizon had the highest median upload speed followed by T-Mobile and AT&T. We see similar patterns in the California data as well. We present the FCC data for the U.S. in Table VI.C.2 and for California in Table VI.C.3.[449]

Table VI.C.2
FCC - Mean and Median Download and Upload Speeds by Provider, Nationwide
November 2013 – July 2014

Service Provider	Mean Download Speed	Median Download Speed	Number of Download Observations	Mean Upload Speed	Median Upload Speed	Number of Upload Observations
Verizon Wireless	13.79	9.41	154,106	5.56	3.65	131,836
AT&T	9.83	6.33	99,426	4.20	2.00	83,019
Sprint	3.86	1.40	120,385	1.66	0.78	100,566
T-Mobile	12.76	9.93	142,998	5.05	2.32	121,569

Note: Data from FCC Measuring Mobile Broadband America data. Table based on staff calculations. Under this methodology, only tests that were fully completed ("TRUE" value) were included in the data. All other test results were excluded. Outliers have been dropped. The data were extracted in July 2014.

Table VI.C.3
FCC - Mean and Median Download and Upload Speeds by Provider, California
November 2013 – July 2014

Service Provider	Mean Download Speed	Median Download Speed	Number of Download Observations	Mean Upload Speed	Median Upload Speed	Number of Upload Observations
Verizon Wireless	12.85	7.99	21,414	5.65	3.64	18,724
AT&T	9.14	6.03	14,160	3.94	1.36	12,219
Sprint	3.08	0.98	15,709	1.41	0.74	13,438
T-Mobile	12.20	9.29	23,826	5.81	2.38	20,012

Note: Data from FCC Measuring Mobile Broadband America data. Table based on staff calculations. Under this methodology, only tests that were fully completed ("TRUE" value) were included in the data. All other test results were excluded. Outliers have been dropped. The data were extracted in July 2014.

c. RootMetrics

198. RootMetrics runs a test program that measures mobile data, call, and text performance in all 50 states across the United States. Tests are conducted in the 125 most populous metropolitan markets and within the 50 busiest U.S. airports. Each location is tested twice a year by, using the latest Android smartphone available from each provider. All tests, which are conducted solely on the networks of the four nationwide providers, are

[448] We describe in more detail the FCC Speed Test methodologies, and present some additional results, in Appendix VI.C.

[449] More details can be found in Appendix Tables VI.C.v and VI.C.vi and the associated writeup.

performed identically across all operators' devices.[450]

199. According to RootMetrics, tests are performed during all hours of the day, every day of the week, and nearly every week of the year, but the testing schedule is weighted more heavily toward typical consumer usage hours. Performance is measured indoors and outdoors at the same randomly chosen locations, and drive testing takes place during travel between locations. Results are reported at the national, state, and metro levels. U.S. Census Places are divided into groups by population size, and each population-based group is given equal weighting in the results.[451] At the airport level, data collection is conducted within three major publicly accessible areas within each airport: check-in, baggage claim, and various domestic terminals behind security. Efforts are made to avoid well-known busy travel days, such as major holidays.[452]

200. The RootMetrics Speed Index takes into account speed measurements of both data and texts.[453] These results are combined and converted into scores using a proprietary algorithm. RootScores are meant to reflect a consumer's experience of network performance and are scaled from 0 – 100,[454] with the lower limit representing network performance that would result in a poor consumer experience and the upper limit reflecting extraordinary performance.[455] The publicly available RootMetrics results are not directly comparable with the Ookla, FCC,,or CalSPEED data, as RootMetrics reports its proprietary speed index as opposed to actual mean and median speeds. However, one can compare the rankings of mobile service providers based on their relative speed performance. Table VI.C.4 provides the national Speed Index data for the second half of 2013 and the first half of 2014.[456] Table VI.C.5 provides the same Speed Index data for California[457] as a comparison with the CalSPEED speed test data for California.

Table VI.C.4
RootMetrics: National Speed Index Data
2nd Half 2013, 1st Half 2014

Service Provider	2nd Half 2013	1st Half 2014
Verizon	88.5	75.7
AT&T	88.7	71.1
Sprint	65.8	54.2
T-Mobile	74.3	64.4

Source: RootMetrics Data, 2013, 2014. Total tests=4,666,641

[450] http://www.rootmetrics.com/us/methodology In addition to the performance scores at each location, an Online Coverage Map is available (http://webcoveragemap.rootmetrics.com/us) This map incorporates the sample data described above, along with crowdsourced data that is available through consumer use of the free CoverageMap app, available on Android and iOS.
[451] http://www.rootmetrics.com/us/methodology
[452] http://www.rootmetrics.com/us/methodology
[453] http://www.rootmetrics.com/us/methodology

[454] Prior to January 2014, Data RootScores in Metro and Airport RootScore Reports could exceed 100 if performance was extraordinary, http://www.rootmetrics.com/us/methodology

[455] http://www.rootmetrics.com/us/standards

[456] Source: http://www.rootmetrics.com/us/rsr/united-states/2013/2H and http://www.rootmetrics.com/us/rsr/united-states/2014/1H. For detailed data on the index see Appendix Tables VI.c.viii and VI.c.ix

[457] Source: Rootmetrics State Root Score Report found at - http://www.rootmetrics.com/us/rsr/united-states/2013/2H and http://www.rootmetrics.com/us/rsr/california/2014/1H

Table VI.C.5
Rootmetrics: California Speed Index Data
2nd Half 2013, 1st Half 2014

Service Provider	2nd Half 2013	1st Half 2014
Verizon	84.4	88.9
AT&T	80.3	83.0
Sprint	58.9	62.3
T-Mobile	70.8	83.0

Source: RootMetrics Data, 2013, 2014. Total tests = 436,383.

d. CalSPEED

201. CalSPEED is an open source, non-proprietary, network performance measurement tool and methodology created for the California Public Utilities Commission with the assistance of a grant from the National Telecommunications and Information Administration.[458] The CalSPEED data presented in this *Report* is the result of a structured sampling program of 1,986 locations (originally 1,200) scattered throughout California. These sites are visited every six months and tests are run on both the latest Android phones and a USB network device on a Windows based netbook, for each of the four major providers. CalSPEED has now had five rounds of sampling in California.[459]

202. The CalSPEED data used in this *Report* were collected from the Spring of 2013 through Spring 2014.[460] For our analysis of the data, we dropped any observation that was not in the provider's coverage area, or any observation that was terminated by the tester. Any other errors are counted as zero throughput. Similar to our analysis of the FCC data, we use an econometric test to identify and drop the outliers in the download and upload speed data from CalSPEED.[461] We then calculate the overall mean throughput by provider for three time periods -- the whole of 2013, and Fall 2013 and Spring 2014 combined, and Spring 2014. The second time period corresponds with the FCC speed tests data availability, and makes the two datasets comparable in terms of the time covered. For most of the 2012-2013 period, Verizon Wireless had the fastest mean upload and download speeds, followed by AT&T, T-Mobile, and finally Sprint. In Spring 2014, T-Mobile surpassed AT&T in both mean and median download and upload speeds. Mean download and upload speeds are displayed below in Tables VI.C.6 and VI.C.7, respectively.[462]

[458] More discussion of the CalSPEED dataset is available in Appendix VI.C and Appendix Tables VI.C.vii and VI.C.viii

[459] CalSPEED: California Mobile Broadband - An Assessment. Ken Biba Managing Director and CTO Novarum, Inc.

[460] Spring 2013 tests were taken between the dates of 4/4/2013 to 4/29/2013, while Fall 2013 tests were taken between the dates of 10/17/2013 to 12/18/2013. Spring 2014 tests were taken between the dates of 4/10/2014 and 6/05/2014.

[461] See Section VI.C.1 and footnote 505 *infra*

[462] CalSPEED: California's Mobile Broadband Assessment, Fall 2014 (Spring 2014 measureent data). Ken Biba, Novarum, Inc. November 2014. Charts VI.C.3 - VI.C.5 taken directly from pages 6-8.

Table VI.C.6
CalSPEED - Estimated Download Speeds by Provider

Service Provider	2013			Fall 2013 and Spring 2014			Spring 2014		
	Mean Down load Speed (Mbps)	Median Down load Speed (Mbps)	Number of Tests	Mean Down load Speed (Mbps)	Median Down load Speed (Mbps)	Number of Tests	Mean Down load Speed (Mbps)	Median Down load Speed (Mbps)	Number of Tests
Verizon	8.08	6.48	6,127	9.73	8.54	7,506	10.46	9.71	3,697
AT&T	4.99	3.30	5,784	6.21	4.03	7,116	6.65	4.64	3,471
Sprint	0.63	0.40	3,619	2.56	0.75	5,282	2.90	0.84	2,623
T-Mobile	4.35	0.85	4,099	6.02	3.34	5,307	7.16	5.37	2,534

Note: The calculations are based on the CalSPEED data. Outliers have been identified and dropped using an outlier test. 2013 CalSPEED tests include fall and spring tests. Spring 2013 tests were taken between the dates of 4/4/2013 to 4/29/2013, while Fall 2013 tests were taken between the dates of 10/17/2013 to 12/18/2013. Spring 2014 tests were taken between the dates of 4/10/2014 and 6/05/2014.

Table VI.C.7
CalSPEED - Estimated Upload Speeds by Provider

Service Provider	2013			Fall 2013 and Spring 2014			Spring 2014		
	Mean Upload Speed (Mbps)	Median Upload Speed (Mbps)	Number of Tests	Mean Upload Speed (Mbps)	Median Upload Speed (Mbps)	Number of Tests	Mean Upload Speed (Mbps)	Median Upload Speed (Mbps)	Number of Tests
Verizon	5.01	3.92	6,132	5.65	5.19	7,508	6.07	5.95	3,697
AT&T	2.34	1.14	5,827	3.09	1.18	7,133	3.39	1.22	3,477
Sprint	0.61	0.63	3,808	1.46	0.79	5,296	1.67	0.81	2,629
T-Mobile	2.16	0.60	4,101	3.77	1.07	5,307	4.82	2.07	2,534

Note: The calculations are based on the CalSPEED data. Outliers have been identified and dropped using an outlier test. 2013 CalSPEED tests include fall and spring tests. Spring 2013 tests were taken between the dates of 4/4/2013 to 4/29/2013, while Fall 2013 tests were taken between the dates of 10/17/2013 to 12/18/2013. Spring 2014 tests were taken between the dates of 4/10/2014 and 6/05/2014.

e. Other

203. Speed measurements are also performed by other entities such as by PC Magazine. PC Magazine uses a drive testing methodology. To run the test, they used field-test software from network testing firm "Sensorly," loaded onto Android-powered smartphones. They tested speeds in 30 different cities during 2013 and 2014 In each city, the drivers stopped in eleven locations for at least 15 minutes (five test cycles) each. They also collected data while moving, both within and between cities. The final speed score is a weighted average balancing 70 percent speed and 30 percent network reliability. In 2013, based on drive tests, PC Magazine ranked AT&T's LTE network as the fastest overall, followed closely by Verizon LTE. The next in order of speed were T-Mobile HSPA, AT&T HSPA, Sprint LTE, Verizon 3G, and finally Sprint 3G. [463] In 2014, Nielsen ranked Verizon LTE as the highest with an average download speed of 19.6 Mbps. T-Mobile followed with 16.8 Mbps and AT&T had 11.9 Mbps, and Sprint had 4.4 Mbps.[464] Nielsen uses a crowdsourced application similar to Ookla and the FCC to measure mobile provider speed.

[463] *See* http://www.pcmag.com/article2/0,2817,2420334,00.asp, visited 7/17/2014

[464] Nielsen testmy.net speed test data. Visited on Nov. 6, See 2014http://www.pcmag.com/article2/0,2817,2459186,00.asp

2. Latency

204. Latency refers to several types of delays typically incurred during network data processing, and is typically measured in milliseconds (ms). One common measure is round-trip latency, which measures the amount of time it takes a data packet to travel from a source to a destination and back.[465] Latency is often affected by factors such as the specifics of the cellular network architecture or processing delays that may occur when the packets need to pass through proxy servers.[466]

205. *Ookla Data.* Ookla speedtest automatically selects the server with the fastest latency, chosen from an initial set of possible test servers, which may bias subsequent tests towards higher performance. For the given time period (2013 – June 2014), Verizon has the lowest latency, closely followed by AT&T.

206. *FCC Data.* Similar to Ookla, the FCC test selects the server with the fastest latency, chosen from an initial set of possible test servers, which may bias subsequent tests towards higher performance. It is possible that consecutive tests in the same place, on the same provider, and at about the same time may test to different servers. If a packet is not received back within three seconds of sending, it is treated as lost.[467] Based on FCC Speed Test App data as of July , 2014, T-Mobile had the lowest reported latency, at 98 ms. This was followed by Verizon at 102 ms, AT&T at 124 ms, and finally Sprint, at 135 ms.

207. *CalSPEED Data.* CalSPEED tests the complete network path, from the client device, through the local access network, through the Internet backbone, to two ultimate server destinations. One server is physically located in Northern California and the other in Northern Virginia.[468] Based on the CalSPEED data, latency continues to improve, with Verizon and AT&T having the lowest latency, followed by Sprint and then T-Mobile.[469]

D. Differentiation in Mobile Wireless Handsets/ Devices

208. In addition to competing on price and network quality, mobile wireless providers continue to compete by offering consumers a variety of different mobile wireless devices with innovative features.[470] In particular, providers offer a range of data-centric smartphones[471] and tablets which are made by different

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[465] More precisely, it is measured as the sum of time from the start of packet transmission by a source to the start of packet reception by a destination plus the time that it takes for the packet to travel back from the receiving destination to the source. This excludes the amount of time that a destination system spends processing the packet.

[466] International Broadband Data Report; http://www.fcc.gov/document/international-broadband-data-report. DA 12-1334 at 14.

[467] http://www.fcc.gov/measuring-broadband-america/mobile/technical-summary

[468] CalSPEED: California Mobile Broadband - An Assessment. Ken Biba Managing Director and CTO Novarum, Inc.

[469] CalSPEED: California's Mobile Broadband Assessment, Fall 2014 (Spring 2014 measureent data). Ken Biba, Novarum, Inc. November 2014.

[470] AT&T Comments at 4, 24, 27; Verizon Comments at 77

[471] While there is no industry standard definition of a smartphone, for purposes of this *Report* we continue to consider the distinguishing features of a smartphone to be: an HTML browser that allows easy access to the full, open Internet; an operating system that provides a standardized interface and platform for application developers; and a larger screen size than a traditional, voice-centric handset. Many smartphones also have touch screens and/or a QWERTY keypad, and run an operating system that offers a standard platform for application developers to create and sell device software through an application store. See *Sixteenth Report* 28 FCC Rcd at 3821 ¶ 220. By contrast, the basic handset category includes voice-centric handsets that do not allow or are not designed for easy web browsing. In addition to smartphones and basic handsets, a third category of devices consists of data-centric devices that have no inherent voice capability, such as USB wireless modem laptop cards, mobile Wi-Fi devices, e-readers, and laptops and netbooks with embedded mobile wireless modems.

manufacturers and run different operating systems. Smaller carriers, however, have cited limited access to highly sought-after devices as an impediment to their ability to compete. [472]

209. Since Apple entered the smartphone business with the iPhone in June 2007, many handset manufacturers have introduced competing products with similar features such as touch screens, mobile web browsing capabilities, and current-generation operating systems. Popular smartphone operating systems such as the Android and the Apple iOS were available from multiple service providers, permitting consumers to pair their preferred operating systems with various service providers.

210. Although many devices are offered by multiple providers, some providers may offer certain devices only on postpaid plans. For example, from September 2013 to early December 2013, Walmart only sold the iPhone 5s and the iPhone 5c with a two-year contract.[473] As of December 13, 2013, Walmart began offering these devices with the purchase of contract-free Straight Talk Wireless and Net10 Wireless network plans (both owned by TracFone).[474] For T-Mobile, until recently, the phone selection for prepaid plans was not as extensive or updated as the phone selection for postpaid plans, and the iPhone was excluded from its prepaid selection. In June 2014, T-Mobile announced that it would sell the latest iPhone on its prepaid plans as well, further blurring the lines between postpaid and prepaid price plans. Additionally, for a limited time, T-Mobile also offered $50 cash/gift card incentive to customers who purchased a new iPhone with T-Mobile's prepaid service. Sprint sells the iPhone for use on its Boost Mobile and Virgin Mobile prepaid brands. AT&T's Cricket/Aio brand offers a slightly higher-end handset selection, including the Samsung Galaxy S4, the Apple iPhone 5c, and the Apple iPhone 5s 16GB. Cricket plans to offer a wider variety of smartphones, starting at around $50 but also including high-end smartphones including Apple's iPhone 5c and 5s. AT&T's GoPhone brand however, offers feature phones and lower-end smartphones, such as the iPhone 4, Nokia Lumia 520, and Samsung Galaxy Express. Verizon offers both smartphone and feature phone packages for its monthly prepaid plans. Although the most recently released smartphones are not available with these plans, the iPhone 4 and the iPhone 4s are available for purchase. Tablet and data-only devices are not commonly offered on the prepaid platform.

211. In addition to offering a variety of smartphones and traditional handsets, mobile wireless providers also sell or provide connectivity for other data-only devices such as tablets, e-readers, wireless data cards, mobile Wi-Fi hotspots,[475] and netbook computers with embedded modems. The use of data-only devices with mobile network connectivity has grown in recent years.[476] Providers compete with one another by offering such devices; and also on the speed, coverage, and price of the mobile data connections on which these devices rely. Mobile wireless providers offer wireless data cards and mobile Wi-Fi hotspots to consumers seeking mobile Internet connections for laptop computers and other Wi-Fi enabled devices. Because such devices tend to have similar characteristics and functionality across equipment manufacturers, providers generally differentiate their offerings of these products based on the speed and coverage of the mobile data networks to which such devices connect, rather than the uniqueness of the devices themselves.

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[472] *See* CCA Reply Comments at 8.

[473] *iPhone 5S and 5C come to Walmart's no-contract plans*, CNet.com, Dec. 9, 2013. http://www.cnet.com/news/iphone-5s-and-5c-come-to-walmarts-no-contract-plans/ (visited July 1, 2014).

[474] *Id.*

[475] Mobile Wi-Fi, or "Mi-Fi," devices are credit card-sized, mobile Wi-Fi routers with mobile broadband wide-area connections that allow a certain number of Wi-Fi-enabled devices in short range to connect to the Internet via a Wi-Fi connection. Many smartphones are now sold with built-in Wi-Fi hotspot capabilities, allowing them to serve as mobile Wi-Fi hotspots for an additional charge.

[476] *US Wi-Fi Households to Own Average of 11 Wi-Fi Devices in 2017 says Strategy Analytics*, Press Release, Strategy Analytics, Feb. 27, 2014. http://www.strategyanalytics.com/default.aspx?mod=pressreleaseviewer&a0=5483 (visited June 17, 2014).

E. Advertising and Marketing

212. Mobile wireless providers also compete for customers through advertising and marketing, including by establishing retail and distribution networks that reach their target audience. Several providers stated that the goal of their advertising and marketing efforts is to increase and maintain brand awareness and to support distribution.[477] Providers may also engage in advertising and marketing either to inform consumers about available products or services or to try to increase sales by influencing consumer preferences.[478] Providers may advertise in the media, in internet and mobile applications, in sponsorships and co-branding, and at events.[479]

213. Overall, the Communications/Telecommunications segment had an annual growth in TV spot advertising of 1.4 percent from 2012 to 2013.[480] Mobile advertising is expected to show the largest increase, with advertisers predicted to spend 83 percent more on tablets and smartphones in 2014 than they did in 2013.[481] By the end of 2014, mobile is expected to represent almost 10 percent of all media ad spending, surpassing newspapers, magazines, and radio.[482] In 2013 and 2014, mobile wireless service providers were quite aggressive with their advertising campaigns.[483] Some providers' marketing campaigns continued to focus on the quality and size of their mobile broadband networks.[484] Many providers sought to highlight their network speed, coverage and the data capabilities of devices available on these networks. Some providers promoted the advantages of their particular service plans relative to those of rivals. In Kantar Media's 2013 rankings of advertising spending, AT&T and Verizon Communications were the third and eighth largest U.S. advertisers, respectively.[485]

214. In 2013, T-Mobile branded itself as the "Uncarrier" and vowed to "shake-up the industry," using the advertising slogan: "Don't play by the rules. Break them. Unleash."[486] It advertised the elimination of contracts and payment of early termination fees for customers who switched from another provider to T-Mobile. T-Mobile continued this plan throughout 2013 and into the beginning of 2014 with "unrelenting attacks on its top

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[477] See 2013 SEC Form 10-K for Sprint Nextel at 5, and 2013 SEC Form 10-K for US Cellular at 5.

[478] *See* Kyle Bagwell, "The Economic Analysis of Advertising," in *Handbook of Industrial Organization, Volume 3*, ed. M. Armstrong and R. Porter, (Elsevier B.V., 2007), at 1705-1706. Mobile wireless service is an "experience good" – a product or service that the customer must consume before determining its quality. *See* Lynne Pepall, Dan Richards, and George Norman. Industrial Organization (4th ed.), Blackwell Publishing, 2008, at 524. Consequently, information contained in wireless advertising tends to be indirect information. By advertising, a firm may signal that it is efficient, implying that it offers good deals. Advertising may also remind repeat consumers of the quality of an experience good. Finally, since a firm has an incentive to direct its advertising toward the consumers who may value its product the most, a seemingly uninformative advertisement can better match products with buyers. See Kyle Bagwell, "The Economic Analysis of Advertising," in *Handbook of Industrial Organization, Volume 3*, ed. M. Armstrong and R. Porter, (Elsevier B.V., 2007), at 1718-1720, 1774-1791; Phillip Nelson, "Advertising as Information," in *Journal of Political Economy*, v. 82 (1974) at 729-754.

[479] *See*, for example, 2013 SEC Form 10-K for Sprint Nextel, and US Cellular.

[480] *See Historical Analysis of Broadcast Spot Advertising Revenue Categories*, SNL Kagan Broadcast Investor, June 19, 2014.

[481] *See Total US Ad Spending to See Largest Increase Since 2004*, eMarketer, July 2, 2014.

[482] *Id.*

[483] *AT&T Takes on T-Mobile, Verizon with New Marketing Slogan*, FierceWireless, Jan. 6, 2014, http://www.fiercewireless.com/story/att-takes-t-mobile-verizon-new-marketing-slogan/2014-01-06 (visited May 28, 2014).

[484] *See Fourteenth Report*, 25 FCC at 11493 ¶ 132.

[485] *Kantar Media Reports U.S. Advertising Expenditures Increased 0.9 Percent in 2013, Fueled by Larger Advertisers*, Kantar Media, March 25, 2014, http://kantarmedia.us/press/kantar-media-reports-us-advertising-expenditures-increased-09-percent-2013, (visited May 28, 2014).

[486] *See* http://www.t-mobile.com/landing/whyt-mobile.html (visited April 29, 2014).

competitors."[487] For example, in 2014, T-Mobile targeted Verizon Wireless by arguing that Verizon Wireless' ads on network coverage are misleading.[488] T-Mobile's ads say "Fold up your old map, Verizon," and claim that T-Mobile covers 96 percent of all Americans with voice and data.[489] In the beginning of 2014, AT&T announced a marketing slogan targeting T-Mobile and Verizon Wireless. AT&T tried to differentiate itself from its competitors by advertising, "Bigger than T-Mobile, faster than Verizon Wireless and more reliable than everybody."[490]

215. Some providers' advertisements highlighted network improvements. In 2014, AT&T launched an advertising campaign called "Better Network" to show how it is improving coverage and capacity on its wireless network.[491] Likewise, in 2014, Verizon Wireless introduced an advertising campaign named XLTE to make customers aware of improvements in portions of its network.[492] In addition to marketing with traditional media, service providers have also advertised their products on the internet, social media, mobile applications, and through sponsorships.[493]

VII. CONCLUSION

216. Promoting competition is a fundamental goal of the Commission's policymaking. Competition has played and must continue to play an essential role in the mobile wireless industry – leading to lower prices and higher quality for American consumers, and producing innovation and investment in wireless networks, devices, and services. This *Report* analyzes competition in the mobile wireless industry pursuant to section 332(c)(1)(C) of the Communications Act and highlights several key trends in the industry. As with past reports, this *Report* examines various facets of the mobile wireless industry including market concentration, the conduct and rivalry of service providers, industry performance and outcomes, and consumer responses to mobile wireless service offerings. It also analyzes competition in other segments of the mobile wireless ecosystem, including spectrum, backhaul facilities, and handsets/devices and mobile applications.

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[487] "*AT&T Goes After T-Mobile Attack Ads*," March 1, 2013. http://www.bloomberg.com/news/2013-02-28/at-t-goes-after-former-merger-partner-t-mobile-with-attack-ads.html

[488] "*T-Mobile Takes on Verizon in LTE Advertising and Network Battle*," FierceWireless, March 14, 2014, http://www.fiercewireless.com/story/t-mobile-takes-verizon-lte-advertising-and-network-battle/2014-03-14 (visited May 28, 2014).

[489] *Id.*

[490] *AT&T Takes on T-Mobile, Verizon with New Marketing Slogan*, FierceWireless, Jan. 6, 2014, http://www.fiercewireless.com/story/att-takes-t-mobile-verizon-new-marketing-slogan/2014-01-06 (visited May 28, 2014).

[491] *AT&T Launches New Ad Campaign "Better Network' Highlighting Small Cells, DAS*, FierceWireless.com, March 17, 2014, http://www.fiercewireless.com/story/att-launches-new-ad-campaign-better-network-highlighting-small-cells-das/2014-03-17 (visited May 23,2014).

[492] *Verizon Wireless Names Faster Part of Its Network: XLTE*, New York Times, May 19, 2014, http://bits.blogs.nytimes.com/2014/05/19/verizon-wireless-names-faster-part-of-its-network-xlte/?_php=true&_type=blogs&_php=true&_type=blogs&_r=1& (visited May 23, 2014).

[493] *See* Sprint 2013 SEC Form 10-K, at 7.

VIII. PROCEDURAL MATTERS

217. This *Seventeenth Report* is issued pursuant to authority contained in Section 332(c)(1)(C) of the Communications Act of 1934, as amended, 47 U.S.C. § 332(c)(1)(C), and authority delegated to the Wireless Telecommunications Bureau under section 0.331 of the Commission's rules, 47 C.F.R. § 0.331.

218. It is ORDERED that copies of this *Report* be sent to the appropriate committees and subcommittees of the United States House of Representatives and the United States Senate.

FEDERAL COMMUNICATIONS COMMISSION

Roger C. Sherman

Chief, Wireless Telecommunications Bureau

APPENDIX I

Map Appendix

APPENDIX II

COMPETITIVE DYNAMICS WITHIN THE INDUSTRY

Connections, Net Adds and Churn

Table II.B.i
Estimated Total Mobile Wireless Connections

	NRUF			CTIA
Year	Connected Devices (millions)	Increase from previous year (millions)	Connections Per 100 People	Estimated Connections (millions)
2001	128.5	N/A	45	128.4
2002	141.8	13.3	49	140.8
2003	160.6	18.8	54	158.7
2004	184.7	24.1	62	182.1
2005	213.0	28.3	71	207.9
2006	241.8	28.8	80	233.0
2007	263.0	21.2	86	255.4
2008	279.6	16.6	91	270.3
2009	290.7	11.1	94	285.6
2010	301.8	11.1	97	296.3
2011	317.3	15.5	102	316.0
2012	329.2	11.9	106	326.5
2013	339.2	10.0	109.9	335.7

Note: Based on CTIA Year-End 2013 Wireless Indices Report, table 6. NRUF 2001 – 2013. 2010 Census data (Nationwide Population = 308,745,538)

Table II.B.ii
Quarterly Total Mobile Wireless Connections by Service Segment
2011 – 2nd Quarter 2014

Quarter Year	Postpaid	Prepaid	Wholesale	Connected Devices	Total Connections
1Q11	213,375	62,412	9,017	21,035	305,838
2Q11	213,967	63,506	10,034	22,487	309,995
3Q11	214,412	65,238	11,153	23,933	314,736
4Q11	215,827	67,236	12,659	24,009	319,731
1Q12	215,466	69,133	13,955	24,502	323,056
2Q12	215,633	70,649	13,423	24,982	324,687
3Q12	216,129	71,112	13,567	25,836	326,644
4Q12	218,246	71,728	13,416	26,889	330,279
1Q13	217,887	73,007	16,847	28,233	335,974
2Q13	218,473	71,687	17,445	29,551	337,156
3Q13	221,142	71,906	17,881	30,932	341,862
4Q13	223,759	72,978	18,683	31,958	347,378
1Q14	225,580	74,827	17,738	33,661	351,807
2Q14	228,348	73,875	18,713	35,234	356,170

Source: *UBS Investment Research. USB Wireless 411 Version 51,* Figure 17: *UBS 411 Version 54.*

Table II.B.iii
Quarterly Net Adds in Mobile Wireless Connections by Service Segment (In thousands)
2009 – 1st Half 2014

Quarter Year	Postpaid	Prepaid	Wholesale	Connected Devices	Total Net Adds
1Q09	684	2,675	308	244	3,911
2Q09	689	1,530	(50)	758	2,927
3Q09	1,173	1,018	132	184	2,507
4Q09	1,175	2,792	306	1,345	5,618
1Q10	(6)	2,464	671	1,237	4,366
2Q10	813	749	483	1,421	3,466
3Q10	823	1,565	607	1,634	4,629
4Q10	895	2,633	39	1,831	5,398
1Q11	196	2,661	1,210	1,725	5,791
2Q11	787	1,093	1,017	1,452	4,349
3Q11	583	1,730	1,119	1,446	4,878
4Q11	1,304	1,998	1,506	76	4,884
1Q12	(147)	1,891	1,296	493	3,533
2Q12	784	414	568	480	2,246
3Q12	(405)	462	1,244	854	2,156
4Q12	2,177	603	(151)	1,053	3,682
1Q13	(3,872)	1,278	3,431	1,344	2,181
2Q13	263	(1,391)	598	1,318	788
3Q13	1,132	280	436	1,381	3,229
4Q13	2,492	1,069	802	1,026	5,389
1Q14	3,147	472	-945	1,703	4,378
2Q14	2,899	(1,029)	975	1,574	4,418

Source: 1Q09 - 4Q10 data from *Sixteenth Competition Report* 28 FCC Rcd at 3836, *UBS Wireless 411 4Q11 at 10.* 1Q12 - 2Q14 data from *UBS Wireless 411: Version 54*. UBS categorizes Tracfone customers as prepaid, not wholesale.

Market Share and Concentration

Table II.C.i
Market Concentration by EA, 2011 – 2013

			HHI		
2013 Rank	EA	Market Name	2011	2012	2013
1	142	Scottsbluff, NE-WY	6618	6606	6689
2	144	Billings, MT-WY	6305	6417	6557
3	145	Great Falls, MT	6315	6571	6414
4	116	Sioux Falls, SD-IA-MN-NE	6028	6150	6297
5	111	Minot, ND	5542	5933	6033
6	110	Grand Forks, ND-MN	5549	5672	5948
7	115	Rapid City, SD-MT-ND-NE	5570	5643	5894
8	113	Fargo-Moorhead, ND-MN	5354	5458	5624
9	143	Casper, WY-ID-UT	5745	5708	5611
10	119	Lincoln, NE	5015	5076	5348
11	14	Salisbury, MD-DE-VA	5152	5122	5293
12	117	Sioux City, IA-NE-SD	4532	4589	5051
13	56	Toledo, OH	4847	4770	5005
14	149	Twin Falls, ID	4504	4444	4997
15	85	Lafayette, LA	4512	4795	4915
16	95	Jonesboro, AR-MO	4376	4583	4909
17	36	Dothan, AL-FL-GA	4128	4508	4861
18	45	Johnson City-Kingsport-Bristol, TN-VA	4182	4403	4807
19	148	Idaho Falls, ID-WY	4534	4432	4782
20	42	Asheville, NC	4357	4497	4763
21	4	Burlington, VT-NY	4704	4658	4700
22	38	Macon, GA	4358	4136	4661
23	72	Paducah, KY-IL	5116	4931	4616
24	109	Duluth-Superior, MN-WI	4464	4587	4567
25	37	Albany, GA	3801	3821	4522
26	7	Rochester, NY-PA	4343	4373	4508
27	154	Flagstaff, AZ-UT	4287	4203	4434
28	139	Santa Fe, NM	4544	4520	4409
29	92	Fayetteville-Springdale-Rogers, AR-MO-OK	4428	4306	4407
30	55	Cleveland-Akron, OH-PA	3948	4104	4404
31	54	Erie, PA	4159	4161	4352
32	52	Wheeling, WV-OH	4169	4203	4335
33	105	La Crosse, WI-MN	4031	4131	4310

34	90	Little Rock-North Little Rock, AR	3526	3823	4241
35	69	Evansville-Henderson, IN-KY-IL	4190	4061	4237
36	91	Fort Smith, AR-OK	3628	3842	4201
37	9	State College, PA	4648	4132	4187
38	6	Syracuse, NY-PA	3989	4044	4185
39	120	Grand Island, NE	6397	5707	4176
40	84	Baton Rouge, LA-MS	4114	4232	4166
41	39	Columbus, GA-AL	3553	3643	4145
42	43	Chattanooga, TN-GA	3755	3851	4124
43	75	Tupelo, MS-AL-TN	4375	4346	4097
44	106	Rochester, MN-IA-WI	3770	3882	4085
45	86	Lake Charles, LA	3487	3728	4070
46	35	Tallahassee, FL-GA	3540	3657	4046
47	89	Monroe, LA	3482	3723	3973
48	118	Omaha, NE-IA-MO	3558	3641	3969
49	98	Columbia, MO	3918	3912	3955
50	1	Bangor, ME	3783	3852	3944
51	51	Columbus, OH	3417	3520	3893
52	171	Anchorage, AK	3971	4083	3863
53	97	Springfield, IL-MO	3713	3914	3851
54	147	Spokane, WA-ID	3586	3620	3841
55	68	Champaign-Urbana, IL	3682	3710	3839
56	162	Fresno, CA	2953	2989	3787
57	27	Augusta-Aiken, GA-SC	3426	3410	3762
58	48	Charleston, WV-KY-OH	3618	3626	3749
59	74	Huntsville, AL-TN	3329	3441	3743
60	41	Greenville-Spartanburg-Anderson, SC-NC	3525	3426	3739
61	79	Montgomery, AL	3325	3496	3725
62	101	Peoria-Pekin, IL	3474	3552	3697
63	87	Beaumont-Port Arthur, TX	3383	3469	3692
64	28	Savannah, GA-SC	2766	2925	3671
65	165	Redding, CA-OR	3299	3405	3621
66	5	Albany-Schenectady-Troy, NY	3524	3518	3617
67	88	Shreveport-Bossier City, LA-AR	3263	3456	3612
68	66	Fort Wayne, IN	3551	3471	3601
69	53	Pittsburgh, PA-WV	3256	3310	3587
70	8	Buffalo-Niagara Falls, NY-PA	3255	3303	3586
71	94	Springfield, MO	3641	3600	3565
72	135	Odessa-Midland, TX	3474	3526	3560
73	168	Pendleton, OR-WA	3337	3397	3542

74	150	Boise City, ID-OR	3226	3273	3527
75	128	Abilene, TX	3687	3635	3499
76	151	Reno, NV-CA	3110	3175	3474
77	24	Columbia, SC	3260	3166	3471
78	15	Richmond-Petersburg, VA	3338	3362	3467
79	47	Lexington, KY-TN-VA-WV	3548	3342	3467
80	46	Hickory-Morganton, NC-TN	2973	3001	3447
81	23	Charlotte-Gastonia-Rock Hill, NC-SC	3068	3120	3440
82	140	Pueblo, CO-NM	3418	3317	3436
83	26	Charleston-North Charleston, SC	3076	3152	3430
84	132	Corpus Christi, TX	2306	2411	3412
85	11	Harrisburg-Lebanon-Carlisle, PA	3445	3406	3362
86	125	Oklahoma City, OK	2988	2825	3316
87	25	Wilmington, NC-SC	2940	3044	3296
88	50	Dayton-Springfield, OH	2722	2774	3291
89	65	Elkhart-Goshen, IN-MI	3170	3158	3287
90	134	San Antonio, TX	2403	2444	3276
91	2	Portland, ME	3036	3057	3260
92	100	Des Moines, IA-IL-MO	3046	3081	3252
93	67	Indianapolis, IN-IL	3199	3163	3247
94	22	Fayetteville, NC	2885	2947	3245
95	155	Farmington, NM-CO	3276	3191	3232
96	104	Madison, WI-IA-IL	3276	3281	3224
97	62	Grand Rapids-Muskegon-Holland, MI	3088	3142	3217
98	156	Albuquerque, NM-AZ	3006	3032	3216
99	57	Detroit-Ann Arbor-Flint, MI	2800	2902	3193
100	124	Tulsa, OK-KS	2926	2635	3184
101	19	Raleigh-Durham-Chapel Hill, NC	2854	2949	3174
102	44	Knoxville, TN	2714	2815	3135
103	126	Western Oklahoma, OK	2512	2861	3132
104	78	Birmingham, AL	3035	3042	3129
105	81	Pensacola, FL	2979	3054	3109
106	130	Austin-San Marcos, TX	2723	2754	3100
107	96	St. Louis, MO-IL	2728	2782	3083
108	93	Joplin, MO-KS-OK	3270	3252	3083
109	18	Greensboro-Winston-Salem-High Point, NC-VA	2770	2781	3080
110	158	Phoenix-Mesa, AZ-NM	2778	2813	3080
111	76	Greenville, MS	2958	3150	3075
112	159	Tucson, AZ	2792	2779	3070
113	80	Mobile, AL	3150	3149	3067

114	20	Norfolk-Virginia Beach-Newport News, VA-NC	2823	2882	3063
115	167	Portland-Salem, OR-WA	2711	2771	3036
116	71	Nashville, TN-KY	2584	2645	3016
117	77	Jackson, MS-AL-LA	3031	3079	3016
118	73	Memphis, TN-AR-MS-KY	2507	2585	3010
119	102	Davenport-Moline-Rock Island, IA-IL	2779	2819	3000
120	83	New Orleans, LA-MS	3189	3175	2976
121	3	Boston-Worcester-Lawrence-Lowewell-Brockton, MA-NH	2841	2843	2967
122	123	Topeka, KS	2843	2882	2967
123	136	Hobbs, NM-TX	2966	3207	2957
124	161	San Diego, CA	2581	2637	2913
125	163	San Francisco-Oakland-San Jose, CA	2720	2742	2899
126	133	McAllen-Edinburg-Mission, TX	2823	2533	2899
127	107	Minneapolis-St. Paul, MN-WI-IA	2815	2832	2898
128	13	Washington-Baltimore, DC-MD-VA-WV-PA	2695	2735	2891
129	166	Eugene-Springfield, OR-CA	2651	2704	2886
130	164	Sacramento-Yolo, CA	2727	2741	2882
131	49	Cincinnati-Hamilton, OH-KY-IN	2437	2543	2870
132	141	Denver-Boulder-Greeley, CO-KS-NE	2479	2533	2869
133	122	Wichita, KS-OK	2821	2826	2868
134	70	Louisville, KY-IN	2545	2549	2846
135	31	Miami-Fort Lauderdale, FL	2286	2292	2839
136	21	Greenville, NC	2602	2669	2833
137	12	Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	2619	2612	2831
138	127	Dallas-Fort Worth, TX-AR-OK	2617	2681	2829
139	103	Cedar Rapids, IA	2645	2666	2817
140	170	Seattle-Tacoma-Bremerton, WA	2763	2778	2816
141	40	Atlanta, GA-AL-NC	2570	2602	2778
142	33	Sarasota-Bradenton, FL	2640	2639	2771
143	16	Staunton, VA-WV	2740	2726	2755
144	169	Richland-Kennewick-Pasco, WA	2803	2761	2729
145	157	El Paso, TX-NM	2309	2349	2717
146	10	New York-North New Jersey-Long Island, NY-NJ-CT-PA	2582	2591	2702
147	29	Jacksonville, FL-GA	2440	2461	2695
148	131	Houston-Galveston-Brazoria, TX	2318	2357	2687
149	152	Salt Lake City-Ogden, UT-ID	2460	2476	2685
150	138	Amarillo, TX-NM	2857	2774	2685
151	160	Los Angeles-Riverside-Orange County, CA-AZ	2415	2437	2634
152	34	Tampa-St. Petersburg-Clearwater, FL	2247	2262	2632
153	137	Lubbock, TX	2792	2704	2629

154	60	Appleton-Oshkosh-Neenah, WI	2510	2488	2602
155	32	Fort Myers-Cape Coral, FL	2402	2433	2595
156	30	Orlando, FL	2392	2401	2578
157	172	Honolulu, HI	2497	2528	2559
158	153	Las Vegas, NV-AZ-UT	2139	2211	2557
159	99	Kansas City, MO-KS	2357	2388	2553
160	59	Green Bay, WI-MI	2478	2515	2545
161	17	Roanoke, VA-NC-WV	2375	2387	2510
162	108	Wausau, WI	2010	2008	2474
163	82	Biloxi-Gulfport-Pascagoula, MS	2491	2501	2473
164	64	Chicago-Gary-Kenosha, IL-IN-WI	2120	2180	2360
165	129	San Angelo, TX	2056	2078	2317
166	63	Milwaukee-Racine, WI	2119	2143	2237
	112	Bismarck, ND-MT-SD	5809	5963	*
	58	Northern Michigan, MI	*	*	*
	61	Traverse City, MI	*	*	*
	114	Aberdeen, SD	*	*	*
	121	North Platte, NE-CO	*	*	*
	146	Missoula, MT	7178	*	*

Note: Based on NRUF and 2010 census data, EAs defined as in 1995.

Financial Indicators

Table II.D.i
Annualized Average Revenue Per Reported Subscriber Unit (ARPU)
1993 – 2013

Year	Total Annual Service Revenue	Percentage Change	Average Reported Subscribers	Average Monthly Revenue per Active Subscriber Unit
1993	$10,895,174,566		11,861,362	$76.55
1994	$14,229,921,264	30.6%	18,299,487	$64.80
1995	$19,081,239,000	34.1%	26,757,320	$59.43
1996	$23,634,971,000	23.9%	35,554,818	$55.40
1997	$27,485,632,936	16.3%	46,375,849	$49.39
1998	$33,133,174,978	20.6%	58,455,471	$47.23
1999	$40,018,489,104	20.8%	71,885,076	$46.39
2000	$52,466,019,720	31.1%	90,048,320	$48.55
2001	$65,316,235,000	24.5%	109,318,848	$49.79
2002	$76,508,187,000	17.1%	125,002,023	$51.00
2003	$87,624,093,000	14.5%	141,658,059	$51.55
2004	$102,121,210,043	16.5%	161,980,026	$52.54
2005	$113,538,220,438	11.2%	186,801,940	$50.65
2006	$125,456,824,884	10.5%	213,077,033	$49.07
2007	$138,869,303,958	10.7%	234,921,960	$49.26
2008	$148,084,169,893	6.6%	252,539,475	$48.87
2009	$152,551,853,953	3.0%	265,038,212	$47.97
2010	$159,929,646,977	4.9%	280,392,201	$47.53
2011	$169,767,314,353	6.2%	306,840,648	$46.11
2012	$185,013,934,995	9.0%	314,685,754	$48.99
2013	$189,192,811,836	2.3%	323,133,932	$48.79

Note: Based on CTIA Year-End 2013 Wireless Indices Report, Table 27.

Table II.D.ii

Change in CPI, 1997 - 2013

Year	CPI		Wireless Telephone Services CPI		Telephone Services CPI		Land-line Telephone Services CPI	
	Index Value	Annual Change	Index Value	Annual Change	Index Value	Annual Change	Index Value	Annual Change
1997	100		100		100		-	-
1998	101.6		95.1		100.7		-	-
1999	103.8	2.2%	84.9	-10.7%	100.1	-0.6%	-	-
2000	107.3	3.4%	76.0	-10.5%	98.5	-1.6%	-	-
2001	110.3	2.8%	68.1	-10.4%	99.3	0.8%	-	-
2002	112.1	1.6%	67.4	-1.0%	99.7	0.4%	-	-
2003	114.6	2.3%	66.8	-0.9%	98.3	-1.4%	-	-
2004	117.7	2.7%	66.2	-0.9%	95.8	-2.5%	-	-
2005	121.7	3.4%	65.0	-1.8%	94.9	-0.9%	-	-
2006	125.6	3.2%	64.6	-0.6%	95.8	0.9%	-	-
2007	129.2	2.8%	64.4	-0.3%	98.2	2.6%	-	-
2008	134.1	3.8%	64.2	-0.2%	100.5	2.2%	-	-
2009	133.7	-0.4%	64.3	0.0%	102.4	1.9%	-	-
2010	135.9	1.6%	62.4	-2.9%	102.4	0.0%	101.6	-
2011	140.1	3.2%	60.1	-3.6%	101.2	-1.1%	103.3	1.7%
2012	143.0	2.1%	59.4	-1.2%	101.7	.04%	106.1	2.7%
2013	145.2	1.5%	58.2	-1.6%	101.6	0%	109.3	3.0%
1997 to 2013		**34.0%**		**-42.7%**		**1.2%**		**7.4%**

Note: Data from Bureau of Labor Statistics. All CPI figures were taken from BLS databases found on the BLS Internet site available at http://www.bls.gov. Beginning in January 2010, the CPIs for local telephone service and long-distance telephone service were discontinued and replaced by a new CPI for land-line telephone services.

APPENDIX III

OVERALL WIRELESS INDUSTRY METRICS

Network Coverage

The tables below are based on Commission estimates derived from census block analysis of Mosaik CoverageRight coverage maps, January 2014. Population data are from the 2010 Census, and include the United States and Puerto Rico. Square miles include the United States and Puerto Rico. There are approximately 11 million census blocks and 312 million people in the entire United States (based on the 2010 Census).

We note that the percentages of population located in census blocks where zero, one, two, or three or more mobile broadband providers represent network coverage, which does not necessarily mean that they offered service to residents in the census block. In addition, we emphasize that a provider reporting mobile broadband coverage in a particular census block may not provide coverage everywhere in the census block. For both these reasons, the number of providers in a census block does not necessarily reflect the number of choices available to a particular individual or household, and does not purport to measure competition. In addition, calculations based on Mosaik data on coverage, while useful for measuring developments in mobile wireless coverage, have certain limitations that likely overstate the extent of mobile wireless and mobile broadband coverage.

Table III.A.i
Estimated Mobile Wireless Coverage by Census Block Including Federal Land, Jan. 2014

Number of Providers with Coverage in a Block	Number of Blocks (Thousands)	POPs Contained in Those Blocks	% of Total US POPs	Square Miles Contained in Those Blocks	% of Total US Square Miles	Road Miles Contained in Those Blocks	% of Total US Road Miles
US Total	11,155,486	312,471,327	100.0	3,802,067	100.0	6,821,187	100.0
1 or more	10,941,378	312,063,148	99.9	2,846,332	74.9	6,516,291	95.5
2 or more	10,607,309	310,530,748	99.4	2,466,422	64.9	6,063,229	88.9
3 or more	9,573,697	302,526,668	96.8	1,790,407	47.1	4,971,642	72.9
4 or more	8,075,773	285,562,448	91.4	1,134,924	29.9	3,692,196	54.1
5 or more	2,586,130	71,229,295	22.8	394,447	10.4	1,251,742	18.4

Note: Based on January 2014 Mosaik Data and 2010 Census Data. The number of providers in a census block represent network coverage, which does not necessarily reflect the number of choices available to a particular individual or household, Coverage calculations based on Mosaik data, while useful for measuring developments in mobile wireless coverage, have certain limitations that likely overstate the extent of mobile wireless coverage.

Table III.A.ii
Estimated Mobile Wireless Coverage by Census Block Excluding Federal Land, Jan. 2014

Number of Providers with Coverage in a Block	Number of Blocks	POPs Contained in Those Blocks	% of Total US POPs	Square Miles Contained in Those Blocks	% of Total US Square Miles	Road Miles Contained in Those Blocks	% of Total US Road Miles
US Total	10,449,282	307,208,959	100.0	2,664,706	100.0	5,893,270	100.0
1 or more	10,335,706	306,912,383	99.9	2,260,521	84.8	5,764,976	97.8
2 or more	10,094,846	305,622,313	99.5	2,058,971	77.3	5,486,365	93.1
3 or more	9,194,561	298,173,820	97.1	1,561,830	58.6	4,612,503	78.3
4 or more	7,863,487	282,686,396	92.0	1,040,690	39.1	3,532,347	59.9
5 or more	4,106,624	147,056,170	47.9	456,311	17.1	1,712,159	29.1

Note: Based on January 2014 Mosaik Data and 2010 Census Data. The number of providers in a census block represent network coverage, which does not necessarily reflect the number of choices available to a particular individual or household, Coverage calculations based on Mosaik data, while useful for measuring developments in mobile wireless coverage, have certain limitations that likely overstate the extent of mobile wireless coverage.

Table III.A.iii
Estimated Mobile Wireless Providers Offering Service by CMA, Excluding Territories, December 2011

	Two Percent Market Share Threshold		Five Percent Market Share Threshold	
Number of Providers Offering Service Anywhere in a CMA	Number of CMAs	Total CMAs (Percent)	Number of CMAs	Total CMAs (Percent)
Total for U.S., excluding territories	*716*	*100%*	*716*	*100%*
1 provider	1	0.1%	2	0.3%
2 providers	51	7.1%	120	16.8%
3 providers	152	21.2%	213	29.7%
4 providers	210	29.3%	246	34.4%
5 or more providers	302	42.2%	135	18.9%

Note: Market share analysis based on December 2011 NRUF data. The number of providers in a CMA which does not necessarily reflect the number of choices available to a particular individual or household.

Table III.A.iv
Estimated Mobile Wireless Broadband Coverage by Census Block Including Federal Land, Jan. 2014

Number of Providers with Coverage in a Block	Number of Blocks	POPs Contained in Those Blocks	% of Total US POPs	Square Miles Contained in Those Blocks	% of Total US Square Miles	Road Miles Contained in Those Blocks	% of Total US Road Miles
US Total	11,155,486	312,471,327	100.0	3,802,067	100.0	6,821,187	100.0
1 or more	10,791,991	311,491,813	99.7	2,669,327	70.2	6,322,249	92.7
2 or more	10,278,668	308,660,133	98.8	2,191,769	57.6	5,657,579	82.9
3 or more	8,502,584	291,761,257	93.4	1,284,356	33.8	4,013,320	58.8
4 or more	6,139,995	256,391,204	82.1	597,066	15.7	2,407,023	35.3
5 or more	1,008,800	36,863,284	11.8	94,732	2.5	393,493	5.8

Note: Based on January 2014 Mosaik Data and 2010 Census Data. The number of providers in a census block represent network coverage, which does not necessarily reflect the number of choices available to a particular individual or household, Coverage calculations based on Mosaik data, while useful for measuring developments in mobile wireless coverage, have certain limitations that likely overstate the extent of mobile wireless coverage.

Table III.A.v
Estimated Mobile Wireless Broadband Coverage by Census Block Excluding Federal Land, Jan. 2014

Number of Providers with Coverage in a Block	Number of Blocks	POPs Contained in Those Blocks	% of Total US POPs	Square Miles Contained in Those Blocks	% of Total US Square Miles	Road Miles Contained in Those Blocks	% of Total US Road Miles
US Total	10,449,282	307,208,959	100.0	2,664,706	100.0	5,893,270	100.0
1 or more	10,230,158	306,455,948	99.8	2,173,496	81.6	5,648,813	95.9
2 or more	9,829,372	303,962,307	98.9	1,881,757	70.6	5,194,362	88.1
3 or more	8,244,196	288,200,564	93.8	1,172,461	44.0	3,817,550	64.8
4 or more	6,152,808	257,389,204	83.8	589,635	22.1	2,412,437	40.9
5 or more	2,571,728	114,527,905	37.3	169,321	6.4	870,215	14.8

Note: Based on January 2014 Mosaik Data and 2010 Census Data. The number of providers in a census block represent network coverage, which does not necessarily reflect the number of choices available to a particular individual or household, Coverage calculations based on Mosaik data, while useful for measuring developments in mobile wireless coverage, have certain limitations that likely overstate the extent of mobile wireless coverage.

Table III.A.vi
Estimated Mobile Voice Coverage in *Rural Areas* by Census Block, Jan. 2014

Total Number of Providers with Coverage in a Block	Number of Rural Census Blocks	POPs Contained in Rural Census Blocks	% of Total U.S. POPs	Square Miles Contained in Those Blocks	% of Total U.S. Square Miles	Road Miles Contained in Those Blocks	% of Total U.S. Road Miles
Total for Rural U.S.	5,387,335	59,151,859	18.9	3,213,692	84.5	4,591,032	67.3
			% of Total Rural U.S. POPs		% of Total Rural U.S. Square Miles		% of Total Rural U.S. Road Miles
1 or More	5,160,096	58,712,204	99.3	2,248,109	70.0	4,248,704	92.5
2 or More	4,779,873	57,001,226	96.4	1,825,852	56.8	3,726,980	81.2
3 or More	3,811,443	49,812,101	84.2	1,205,330	37.5	2,698,595	58.8
4 or More	2,555,860	37,625,516	63.6	650,851	20.3	1,612,597	35.1
5 or More	1,014,029	15,296,417	25.9	226,545	7.0	594,720	13.0

Note: Based on January 2014 Mosaik Data and 2010 Census Data. This table includes federal lands.The number of providers in a census block represent network coverage, which does not necessarily reflect the number of choices available to a particular individual or household, Coverage calculations based on Mosaik data, while useful for measuring developments in mobile wireless coverage, have certain limitations that likely overstate the extent of mobile wireless coverage.

Table III.A.vii
Estimated Mobile Voice Coverage in *Non-Rural* Areas by Census Block, Jan. 2014

Total Number of Providers with Coverage in a Block	Number of Non-Rural Census Blocks (Thousands)	POPs Contained in Non-Rural Census Blocks (Thousands)	% of Total U.S. POPs	Square Miles Contained in Those Blocks (Thousands)	% of Total U.S. Square Miles	Road Miles Contained in Those Blocks (Thousands)	% of Total U.S. Road Miles
Total for Non-Rural U.S.	5,768,151	253,319,468	81.8	588,375	15.5	2,230,155	32.7
			% of Total Non-Rural U.S. POPs		% of Total Non-Rural U.S. Square Miles		% of Total Non-Rural U.S. Road Miles
1 or More	5,750,963	253,260,183	100.0	546,881	92.9	2,213,491	99.3
2 or More	5,714,196	252,971,345	99.9	521,471	88.6	2,178,190	97.7
3 or More	5,593,620	251,393,015	99.2	466,532	79.3	2,079,909	93.3
4 or More	5,235,114	243,596,108	96.2	365,486	62.1	1,832,856	82.2
5 or More	1,364,861	52,683,798	20.8	103,069	17.5	498,572	22.4

Note: Based on January 2014 Mosaik Data and 2010 Census Data. This table includes federal lands.The number of providers

in a census block represent network coverage, which does not necessarily reflect the number of choices available to a particular individual or household, Coverage calculations based on Mosaik data, while useful for measuring developments in mobile wireless coverage, have certain limitations that likely overstate the extent of mobile wireless coverage.

Table III.A.viii
Estimated Mobile Broadband Coverage in *Rural Areas* by Census Block, Jan. 2014

Total Number of Providers with Coverage in a Block	Number of Rural Census Blocks (Thousands)	POPs Contained in Rural Census Blocks (Thousands)	% of Total Rural U.S. POPs	Square Miles Contained in Those Blocks (Thousands)	% of Total Rural U.S. Square Miles	Road Miles Contained in Those Blocks (Thousands)	% of Total Rural U.S. Road Miles
1 or More	5,049,676	58,280,354	98.5	2,131,052	66.3	4,117,997	89.7
2 or More	4,581,100	55,844,770	94.4	1,681,950	52.3	3,497,094	76.2
3 or More	3,029,025	42,565,205	72.0	852,242	26.5	2,019,829	44.0
4 or More	1,394,545	23,427,622	39.6	303,882	9.5	813,212	17.7
5 or More	279,145	5,085,565	8.6	54,609	1.7	152,891	3.3

Note: Based on January 2014 Mosaik Data and 2010 Census Data. This table includes federal lands. The number of providers in a census block represent network coverage, which does not necessarily reflect the number of choices available to a particular individual or household, Coverage calculations based on Mosaik data, while useful for measuring developments in mobile wireless coverage, have certain limitations that likely overstate the extent of mobile wireless coverage.

Table III.A.ix
Estimated Mobile Broadband Coverage in Non-*Rural* Areas by Census Block, Jan. 2014

Total Number of Providers with Coverage in a Block	Number of Non-Rural Census Blocks (Thousands)	POPs Contained in Non-Rural Census Blocks (Thousands)	% of Total Non-Rural U.S. POPs	Square Miles Contained in Those Blocks (Thousands)	% of Total Non-Rural U.S. Square Miles	Road Miles Contained in Those Blocks (Thousands)	% of Total Non-Rural U.S. Road Miles
1 or More	5,742,315	253,211,459	100.0	538,275	91.5	2,204,252	98.8
2 or More	5,697,568	252,815,363	99.8	509,819	86.6	2,160,484	96.9
3 or More	5,473,559	249,196,052	98.4	432,114	73.4	1,993,491	89.4
4 or More	4,745,450	232,963,582	92.0	293,184	49.8	1,593,811	71.5
5 or More	729,655	31,777,719	12.5	40,123	6.8	240,602	10.8

Note: Based on January 2014 Mosaik Data and 2010 Census Data. This table includes federal lands. The number of providers in a census block represent network coverage, which does not necessarily reflect the number of choices available to a particular individual or household, Coverage calculations based on Mosaik data, while useful for measuring developments in mobile wireless coverage, have certain limitations that likely overstate the extent of mobile wireless coverage.

Chart III.A.i

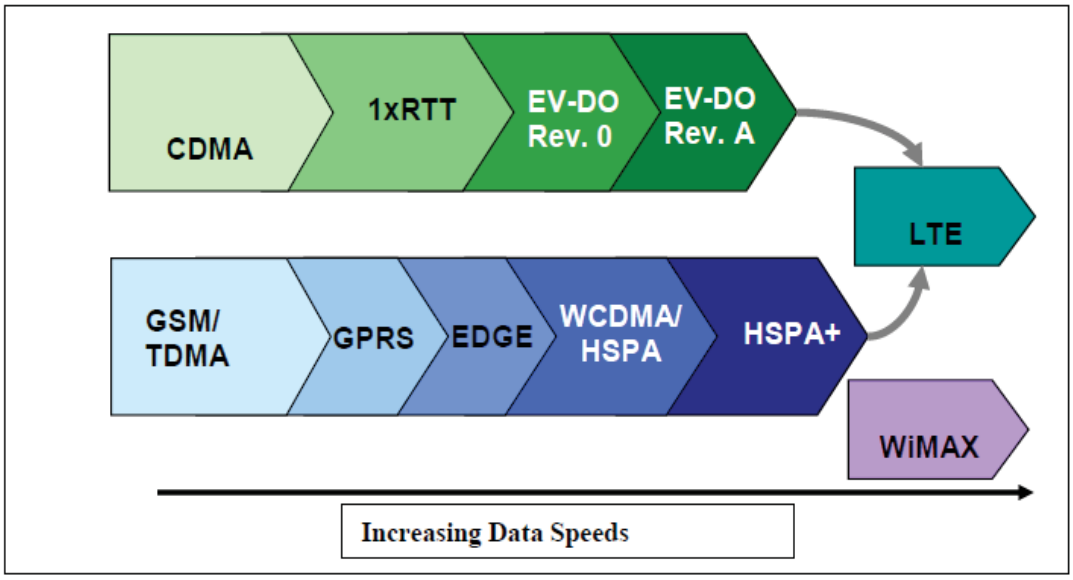

Table III.A.viii

Estimated Mobile Wireless Coverage by Technology, Jan. 2014[494]

Technology	POPs in Covered Blocks (Thousands)	% of Total POPs	Square Miles Contained in Those Blocks (Thousands)	% of Total Square Miles	Road Miles Contained in Those Blocks (Thousands)	% of Total U.S. Road Miles
CDMA	310,432	99.3	2,537	66.7	6,125	89.8
GSM/TDMA	310,454	99.4	2,520	66.3	6,091	89.3
iDEN	15,286	4.9	106	2.8	310	4.5
Total Digital	**311,972**	**99.8**	**2,795**	**73.5**	**6,462**	**94.7**

Note: Based on January 2014 Mosaik Data and 2010 Census Data.

[494] Includes Federal lands. Commission estimates based on census block analysis of Mosaik CoverageRight coverage maps, October 2012. Population data are from the 2010 Census, and the square miles include the United States and Puerto Rico.

Overall Connections and Customers

Table III.B.i
EA Penetration Rates

2013 Rank	EA	Market Name	Penetration Rate	
			2012	2013
1	120	Grand Island, NE	101%	188%
2	57	Detroit-Ann Arbor-Flint, MI	128%	137%
3	55	Cleveland-Akron, OH-PA	121%	130%
4	122	Wichita, KS-OK	109%	127%
5	51	Columbus, OH	111%	120%
6	83	New Orleans, LA-MS	118%	116%
7	20	Norfolk-Virginia Beach-Newport News, VA-NC	111%	115%
8	89	Monroe, LA	123%	115%
9	10	New York-North New Jersey-Long Island, NY-NJ-CT-PA	111%	115%
10	13	Washington-Baltimore, DC-MD-VA-WV-PA	117%	114%
11	85	Lafayette, LA	113%	114%
12	49	Cincinnati-Hamilton, OH-KY-IN	112%	114%
13	64	Chicago-Gary-Kenosha, IL-IN-WI	108%	114%
14	135	Odessa-Midland, TX	110%	114%
15	111	Minot, ND	113%	113%
16	90	Little Rock-North Little Rock, AR	117%	113%
17	31	Miami-Fort Lauderdale, FL	108%	112%
18	50	Dayton-Springfield, OH	106%	112%
19	84	Baton Rouge, LA-MS	111%	111%
20	155	Farmington, NM-CO	110%	111%
21	87	Beaumont-Port Arthur, TX	108%	111%
22	40	Atlanta, GA-AL-NC	109%	111%
23	17	Roanoke, VA-NC-WV	110%	110%
24	3	Boston-Worcester-Lawrence-Lowewell-Brockton, MA-NH	107%	110%
25	97	Springfield, IL-MO	108%	109%
26	171	Anchorage, AK	98%	109%
27	73	Memphis, TN-AR-MS-KY	107%	109%
28	12	Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	106%	109%
29	99	Kansas City, MO-KS	104%	109%
30	44	Knoxville, TN	108%	109%
31	71	Nashville, TN-KY	111%	108%
32	88	Shreveport-Bossier City, LA-AR	112%	108%
33	124	Tulsa, OK-KS	118%	108%

34	79	Montgomery, AL	106%	108%
35	22	Fayetteville, NC	110%	107%
36	15	Richmond-Petersburg, VA	106%	107%
37	34	Tampa-St. Petersburg-Clearwater, FL	104%	107%
38	78	Birmingham, AL	107%	107%
39	37	Albany, GA	104%	106%
40	131	Houston-Galveston-Brazoria, TX	104%	106%
41	80	Mobile, AL	105%	106%
42	132	Corpus Christi, TX	103%	106%
43	172	Honolulu, HI	102%	106%
44	86	Lake Charles, LA	109%	106%
45	93	Joplin, MO-KS-OK	104%	106%
46	125	Oklahoma City, OK	115%	106%
47	127	Dallas-Fort Worth, TX-AR-OK	103%	106%
48	81	Pensacola, FL	104%	106%
49	77	Jackson, MS-AL-LA	103%	106%
50	29	Jacksonville, FL-GA	102%	105%
51	56	Toledo, OH	102%	105%
52	96	St. Louis, MO-IL	105%	105%
53	141	Denver-Boulder-Greeley, CO-KS-NE	103%	105%
54	69	Evansville-Henderson, IN-KY-IL	99%	105%
55	107	Minneapolis-St. Paul, MN-WI-IA	102%	105%
56	152	Salt Lake City-Ogden, UT-ID	101%	105%
57	82	Biloxi-Gulfport-Pascagoula, MS	105%	105%
58	161	San Diego, CA	103%	105%
59	53	Pittsburgh, PA-WV	103%	105%
60	38	Macon, GA	105%	105%
61	170	Seattle-Tacoma-Bremerton, WA	103%	104%
62	163	San Francisco-Oakland-San Jose, CA	101%	104%
63	24	Columbia, SC	100%	104%
64	74	Huntsville, AL-TN	106%	104%
65	63	Milwaukee-Racine, WI	99%	104%
66	70	Louisville, KY-IN	101%	104%
67	27	Augusta-Aiken, GA-SC	104%	104%
68	8	Buffalo-Niagara Falls, NY-PA	101%	104%
69	153	Las Vegas, NV-AZ-UT	101%	104%
70	134	San Antonio, TX	99%	103%
71	41	Greenville-Spartanburg-Anderson, SC-NC	100%	103%
72	128	Abilene, TX	98%	102%
73	160	Los Angeles-Riverside-Orange County, CA-AZ	100%	102%
74	45	Johnson City-Kingsport-Bristol, TN-VA	103%	102%
75	23	Charlotte-Gastonia-Rock Hill, NC-SC	101%	102%

76	159	Tucson, AZ	97%	102%
77	35	Tallahassee, FL-GA	100%	102%
78	18	Greensboro-Winston-Salem-High Point, NC-VA	101%	101%
79	5	Albany-Schenectady-Troy, NY	100%	101%
80	136	Hobbs, NM-TX	85%	101%
81	101	Peoria-Pekin, IL	98%	100%
82	30	Orlando, FL	97%	100%
83	67	Indianapolis, IN-IL	98%	100%
84	95	Jonesboro, AR-MO	105%	100%
85	143	Casper, WY-ID-UT	98%	100%
86	16	Staunton, VA-WV	99%	100%
87	2	Portland, ME	98%	100%
88	43	Chattanooga, TN-GA	99%	99%
89	137	Lubbock, TX	96%	99%
90	130	Austin-San Marcos, TX	96%	99%
91	133	McAllen-Edinburg-Mission, TX	97%	99%
92	7	Rochester, NY-PA	97%	99%
93	42	Asheville, NC	98%	99%
94	75	Tupelo, MS-AL-TN	97%	99%
95	103	Cedar Rapids, IA	100%	99%
96	102	Davenport-Moline-Rock Island, IA-IL	98%	99%
97	154	Flagstaff, AZ-UT	97%	99%
98	25	Wilmington, NC-SC	96%	98%
99	142	Scottsbluff, NE-WY	98%	98%
100	158	Phoenix-Mesa, AZ-NM	95%	98%
101	129	San Angelo, TX	94%	98%
102	26	Charleston-North Charleston, SC	98%	98%
103	9	State College, PA	96%	98%
104	138	Amarillo, TX-NM	93%	98%
105	28	Savannah, GA-SC	97%	98%
106	6	Syracuse, NY-PA	96%	98%
107	72	Paducah, KY-IL	93%	98%
108	167	Portland-Salem, OR-WA	95%	98%
109	66	Fort Wayne, IN	95%	97%
110	62	Grand Rapids-Muskegon-Holland, MI	93%	97%
111	76	Greenville, MS	97%	97%
112	59	Green Bay, WI-MI	94%	97%
113	106	Rochester, MN-IA-WI	95%	97%
114	36	Dothan, AL-FL-GA	93%	97%
115	39	Columbus, GA-AL	100%	97%
116	48	Charleston, WV-KY-OH	99%	97%
117	109	Duluth-Superior, MN-WI	93%	97%

118	19	Raleigh-Durham-Chapel Hill, NC	96%	96%
119	100	Des Moines, IA-IL-MO	96%	96%
120	119	Lincoln, NE	93%	96%
121	91	Fort Smith, AR-OK	99%	96%
122	94	Springfield, MO	90%	96%
123	151	Reno, NV-CA	92%	96%
124	144	Billings, MT-WY	93%	96%
125	118	Omaha, NE-IA-MO	95%	96%
126	11	Harrisburg-Lebanon-Carlisle, PA	93%	96%
127	164	Sacramento-Yolo, CA	92%	96%
128	148	Idaho Falls, ID-WY	95%	95%
129	166	Eugene-Springfield, OR-CA	92%	95%
130	157	El Paso, TX-NM	92%	95%
131	139	Santa Fe, NM	94%	95%
132	4	Burlington, VT-NY	92%	95%
133	156	Albuquerque, NM-AZ	93%	95%
134	98	Columbia, MO	95%	95%
135	52	Wheeling, WV-OH	95%	95%
136	110	Grand Forks, ND-MN	93%	94%
137	116	Sioux Falls, SD-IA-MN-NE	93%	94%
138	169	Richland-Kennewick-Pasco, WA	92%	94%
139	147	Spokane, WA-ID	92%	94%
140	126	Western Oklahoma, OK	102%	94%
141	68	Champaign-Urbana, IL	92%	93%
142	32	Fort Myers-Cape Coral, FL	91%	93%
143	165	Redding, CA-OR	90%	93%
144	65	Elkhart-Goshen, IN-MI	90%	93%
145	123	Topeka, KS	90%	93%
146	140	Pueblo, CO-NM	89%	93%
147	149	Twin Falls, ID	92%	92%
148	1	Bangor, ME	93%	92%
149	113	Fargo-Moorhead, ND-MN	90%	92%
150	54	Erie, PA	90%	92%
151	33	Sarasota-Bradenton, FL	90%	92%
152	60	Appleton-Oshkosh-Neenah, WI	90%	92%
153	150	Boise City, ID-OR	89%	92%
154	108	Wausau, WI	92%	92%
155	117	Sioux City, IA-NE-SD	91%	92%
156	104	Madison, WI-IA-IL	90%	91%
157	47	Lexington, KY-TN-VA-WV	88%	90%
158	21	Greenville, NC	90%	90%
159	145	Great Falls, MT	88%	90%

160	46	Hickory-Morganton, NC-TN	90%	89%
161	14	Salisbury, MD-DE-VA	90%	89%
162	162	Fresno, CA	84%	87%
163	115	Rapid City, SD-MT-ND-NE	90%	87%
164	92	Fayetteville-Springdale-Rogers, AR-MO-OK	88%	86%
165	168	Pendleton, OR-WA	83%	86%
166	105	La Crosse, WI-MN	84%	85%
	112	Bismarck, ND-MT-SD	94%	*
	58	Northern Michigan, MI	*	*
	61	Traverse City, MI	*	*
	114	Aberdeen, SD	*	*
	121	North Platte, NE-CO	*	*
	146	Missoula, MT	*	*

Consumers and Mobile Wireless

Table III.C.i
Market Share by Smartphone Model, 2009 – 2013

Operating System Developer	Share of Smartphones in Use				
	December 2009	August 2010	September 2011	September 2012	September 2013
Google/Android	5.2%	19.6%	44.8%	52.2%	51.80%
Apple	25.3%	24.2%	27.4%	34.3%	40.60%
RIM/BlackBerry	41.6%	37.6%	18.9%	8.4%	3.8%
Microsoft	18.0%	10.8%	5.6%	3.6%	3.3%
Palm	6.1%	4.6%	0.0%	0.0%	0.0%
Symbian	0.0%	0.0%	1.8%	0.6%	0.3%
All Others	3.8%	3.2%	1.5%	0.6%	0.20%

Note: based on ComScore MobiLens 3-month survey data averages

Table III.C.ii
Percentage of U.S. Adults Living in Households with/without Wireless and Landlines (2008 - 2013)

	Percent of Adults in Households with:			
Date of interview	Landline with Wireless	Landline without Wireless	Wireless-only	Phoneless
Jul–Dec 2008	63.7%	15.1%	18.4%	1.7%
Jan–Jun 2009	63.5%	13.4%	21.1%	1.5%
Jul–Dec 2009	62.5%	12.6%	22.9%	1.7%
Jan–Jun 2010	62.2%	10.9%	24.9%	1.7%
Jul–Dec 2010	59.4%	10.7%	27.8%	1.8%
Jan–Jun 2011	58.8%	9.0%	30.2%	1.8%
Jul–Dec 2011	57.3%	8.3%	32.3%	1.9%
Jan–Jun 2012	56.1%	7.8%	34.0%	1.9%
Jul–Dec 2012	54.4%	7.0%	36.5%	1.9%
Jan–Jun 2013	52.8%	6.9%	38.0%	2.2%
Jun-Dec 2013	51.5%	7.0%	39.1%	2.2%

Note: Adults are aged 18 and over, children are under age 18, Source: CDC/NCHS National Health Interview Survey Early Release Program, "Wireless Substitution: Early Release of Estimates From the National Health Interview Survey, July–December 2013", Table 1, Released July 2014

Table II.C.iii
Percentage of U.S. Children Living in Households with/without Wireless and Landlines (2008 - 2013)

	Percent of Children in Households with:			
Date of interview	Landline with Wireless	Landline without Wireless	Wireless-only	Phoneless
Jul–Dec 2008	67.1%	11.1%	18.7%	2.4%
Jan–Jun 2009	67.6%	9.1%	21.3%	1.7%
Jul–Dec 2009	63.4%	8.5%	25.9%	1.9%
Jan–Jun 2010	62.8%	6.4%	29.0%	1.7%
Jul–Dec 2010	59.8%	6.2%	31.8%	2.0%
Jan–Jun 2011	56.7%	5.1%	36.4%	1.7%
Jul–Dec 2011	54.7%	4.8%	38.1%	2.2%
Jan–Jun 2012	52.7%	4.5%	40.6%	2.2%
Jul–Dec 2012	49.5%	3.4%	45.0%	1.9%
Jan–Jun 2013	48.3%	3.6%	45.4%	2.6%
Jul–Dec 2014	46.4%	3.8%	47.1%	2.5%

Note: Adults are aged 18 and over, children are under age 18, Source: CDC/NCHS National Health Interview Survey Early Release Program, "Wireless Substitution: Early Release of Estimates From the National Health Interview Survey, July–December 2013", Table 1, Released July 2014.

APPENDIX IV

INPUT MARKET

Non-Spectrum Input Segments

Table IV.B.i
Year End Cell Site Counts by Provider, 2011 – 2014[495]

Cell Sites	2011	2012	2013	1st Half 2014
Verizon Wireless	43,390	44,590	46,655	47,855
AT&T	56,200	56,900	61,800	63,700
Sprint	67,500	57,900	55,000	55,000
T-Mobile	50,545	51,104	63,879	63,945
Leap	9,000	9,000	9,000	
NTELOS	1,353	1,429	1,444	1,445
US Cellular	7,882	8,028	6,975	6,183
Total by Top Seven Reported Service Providers	235,870	228,951	244,753	238,128
CTIA Reported Total Industry-wide Cell Sites	283,385	301,779	304,360	

Note: Cell site counts for individual service provider are from *UBS Wireless 411*: Version 54, Figure 48. The total industry-wide cell count is from *CTIA2013*, at 114, June 2014.

[495] *See* CTIA, *2013 Annual Wireless Industry Survey Results ("CTIA2013")*, at 114, June 2014. Because multiple cell sites can be co-located in the same "tower" site, the reported cell sites should not be equated with "towers." *See also CTIA2013* at 105. The reported cell sites include repeaters and other cell-extending devices (e.g., femtocells, or distributed antenna systems). See CTIA2013 at 105 and 106.

APPENDIX V

PRICING LEVELS AND TRENDS

Postpaid Service

Table V.A.i

Equipment Installment Payment (EIP) Plans with Early Upgrade Option

Date	Provider	Plan Name	Description
7/13	T-Mobile	Jump "Un-carrier 2.0"	Customers can upgrade their device every six months for an additional $10 per month on top of an existing plan with trade-in of existing device.[i]
7/13	AT&T	Next	Customers can buy a device and upgrade to a new device every 12 months with no down payment and trade-in of existing device.[ii]
7/13	Verizon	Edge	When Edge was first introduced, customers were allowed to upgrade every 6 months if 50 percent of the retail cost of the handset had been paid off,[iii] Share Everything data plan required.
9/13 to 1/14	Sprint	One Up	Customers can purchase a device with no down payment and upgrade after 12 months with trade-in of existing device.[iv]
1/14	Sprint	Framily Plans/ Easy Pay	Customers can get a smartphone or feature phone for a down payment and 24 monthly installment payments and upgrade after 12 months on certain qualifying plans with trade-in of existing or equivalent model.[v] Early upgrade option (annual upgrades) available only with purchase of unlimited data plan.[vi]
1/14	Verizon	Edge	Customers who enroll can select a device and then upgrade after 30 days with trade-in of existing device if at least 50% of the retail price of the device is paid off.[vii] Share Everything data plan required. Promotion allowing Edge customers to upgrade after 30 days.[viii]
2/14	T-Mobile	Jump	Customers can upgrade any time they want and as often as they want if they have paid off at least 50% of the cost of the device (T-Mobile will cover remaining payments up to half of device cost). Trade-in requirement and $10 monthly fee still apply. Tablets added to Jump plan.[ix]
6/14	Verizon	Edge	Changes to conditions of upgrade program: [x]
			(1) Customers are required to pay off 60% of the retail price of the device before upgrading, up from 50% previously.
			(2) Device financing costs are spread over 20 months instead of the previous 24 months, thereby raising customers' monthly equipment installment payments but allowing them to pay off devices more rapidly.

Table V.A.ii

Discounts on Monthly Service Fees for EIP Customers[496]

Date	Provider	Plan Name	Description
9/13 - 1/14	Sprint	One Up	$15/month discount per line off unlimited contract plans (Unlimited, My Way and My All-in).[xi]
12/13	AT&T	Mobile Share Value/ Next	$15/month discount per line – from $40/month per device to $25/month per device.[xii]
1/14	Sprint	Framily Plans/ Easy Pay	Gives customers progressively larger discounts as more people join the Framily up to a maximum discount of $30/month per line and a limit of 10 phone numbers per group.[xiii] $5/month discount per line off unlimited data contract plan; $15/month discount per line off 1GB data contract plan. All Framily plans include unlimited voice and text messaging, which starts at $55/month for one line and progressively decreases in price per line as more lines are added. Options for data add-ons - unlimited data for $20/month, 3GB for $10/month and 1GB for no additional charge. The 3GB and 1GB data add-ons have an overage charge of 1.5 cents/MB.[xiv]
2/14	AT&T	Mobile Share Value/ Next	Reduces price by $40 on a plan with four smartphones with unlimited voice and text and 10 GB of data which now costs $160. Additional $10/month discount per line for Next customers with data buckets of 10GB or more – from already discounted $25/month per device to $15/month per device.[xv]
2/14	Verizon	More Everything/ Edge	$10/month discount per line off smartphone access for data buckets of 8GB or less, and $20/month discount per line off smartphone access for data buckets of 10GB or more – from $40/per month per line to $30/month per line for 8GB bucket or less, and $20/month per line for 10GB bucket or more. Discounts limited to Edge customers who pay for devices with EIP.[xvi]
4/14	Verizon	More Everything	$25/month discount per line off smartphone access for data buckets of 10GB or more – from already discounted $20/month per line to $15/month per line.[xvii] Matches AT&T in offering 10GB for 4 lines for $160/month.
4/14	C Spire	Unlimited Everything	$35/month discount off existing unlimited voice and data plan – from $100/month to $65/month. Plan includes unlimited voice, texting, picture messaging, web, music and video. [xviii]
4/14	Verizon	More Everything	Eligibility for EIP discounts on monthly smartphone access fees extended to existing customers on month-to-month contracts and new customers who bring their own device -- $30/month per line

[496] T-Mobile, AT&T and Sprint have consistently offered the same EIP discounts to customers who pay the full retail price of the device upfront, bring their own device, and those who have already paid for their device under a traditional two-year service contract that has expired. In contrast, when Verizon first started offering EIP discounts, the company initially limited eligibility to Edge customers. Subsequently, Verizon extended the same discounts to existing customers on month-to-month contracts and new customers who bring their own device, but only for a limited time. Phil Goldstein, *Analysts: Verizon's 'More Everything' Plans Show No. 1 Carrier Isn't Immune to Price War*, FIERCEWIRELESS, Feb. 13, 2014; Debi Lewis, *More Savings Coming for Verizon Wireless Customers Beginning April 17*, Press Release, Verizon Wireless, Apr. 14, 2014.

			to add a smartphone for data buckets of 8GB or less, and $15/month per line for data buckets of 10 GB or more. The new offer is available only for a limited time.[xix]
5/14	C Spire	Shared Data	$15/month discount per line off smartphone access for data buckets of 8 GB or less – from $40/month per line to $25/month per line.[xx]
			$25/month discount per line off smartphone access for data buckets of 10GB or more – from $40/month per line to $15/month per line. Matches AT&T and Verizon in offering 10GB for 4 lines for $160/month.[xxi]

Table V.A.iii

Major Changes to Pricing of Postpaid Service Plans

Date	Provider	Plan Name	Description
3/13	T-Mobile	Simple Choice "Un-carrier 1.0"	Discontinued offering of traditional two-year contracts with monthly fees that include the cost of device subsidies discontinued. All new retail customers must sign up for no-contract plans that separate service and equipment fees. EIP option available to customers with good credit.[xxii] [xxiii]
7/13	Sprint	Unlimited, My Way; My All-in	Launched new unlimited rate plans – All plans include unlimited voice and text, which starts at $50/month for one line. As more devices are added to account, customers get progressively larger discounts, up to a maximum discount of $30/month per line and a limit of 10 lines per account. Customers can also purchase 1GB per month of mobile hotspot usage for $10/month. "My All-in" also includes 5GB of mobile hotspot usage for a total of $110/month. [xxiv]
			Unlimited data for smartphones is offered as a $30/month add-on. Therefore, unlimited voice, text and data for one device costs $80/month, down $30/month from previous Simply Everything unlimited rate plan.
			Launched 1GB data tier - option is offered as a $20/month add-on. - $70/month including unlimited voice and text.[xxv] Sprint becomes last nationwide operator to shift from exclusively unlimited data pricing to tiered, usage-based data pricing for smartphones.
10/13	AT&T	Mobile Share	Discontinued offering of traditional voice and data plans based on usage of individual devices. All new retail customers must sign up for shared data plans.[xxvi]
12/13	AT&T	Mobile Share	Restructured rate plan -- standard $40/month fee to add a smartphone line replaces previous sliding scale of $30-50/month depending on data bucket size. Price of 1-2GB buckets raised $5/month, and price of 6-20GB buckets reduced by $10-50/month. Before the change, the cost to add a smartphone to a shared data plan was $50/month for the 300MB tier, $45/month for 1-2GB, $40/month for 4GB, $35/month for 6GB and $30/month for larger data tiers.[xxvii] Net effect on monthly service fees depends on usage and number of smartphone lines.[xxviii]

1/14	Verizon	Share Everything	Introduced less expensive entry-level plan with smaller data bucket: $60/month for 250MB of smartphone data.[xxix]
2/14	AT&T	Mobile Share	Restructured rate plan and offered to existing AT&T customers -- monthly line access fees reduced for existing subsidized contract customers until next upgrade -- from $40/month per device to $25/month for data buckets of 2GB to 6GB, and to $15/month for data buckets of 10GB or more. The change effectively allowed current traditional contract customers with subsidized devices to switch to the same discounted pricing structure as AT&T's Mobile Share Value plans for Next/ EIP customers[xxx] Current customers can keep the discounted pricing indefinitely with their existing devices. However, once customers decide to upgrade to a new device, they will have to sign up for the Next EIP plan or purchase the new device outright to keep the discounted pricing. Prices will go back up if they choose to get another subsidized device through a traditional contract plan.
2/14	Verizon	Loyalty Plans	Loyalty plans offered to retain customers: $60/per month for unlimited voice, texting and 2GB of smartphone data.[xxxi]
2/14	Verizon	More Everything	Increased data allowances on selected tiers without increasing monthly prices – from 500MB to 1GB on $40/month plan, from 1GB to 2GB on $50/month plan and from 2GB to 3GB on $60/month plan. Unlimited international messaging and 25GB of cloud storage per line added to all pricing tiers.[xxxii]
			The monthly fee on basic 700 MOU voice-only calling plan was also reduced by $5/month -- from $40/ month to $35/month. Monthly data fees reduced by $10/month on 500MB data bucket (), and by $5/month on 250MB data bucket ().
3/14	T-Mobile	Simple Choice	Increased high-speed data allowances on tiered data plans without increasing monthly prices – from 500MB to 1GB on $50/month entry-level plan, and from 2.5GB to 3GB on $60/month plan. Unlimited international texting added to all tiers.[xxxiii]
			Monthly price of unlimited data plan increased $10/month, from $70/month to $80/month. Tethered data allowance on unlimited plan doubled to 5GB. New 5GB high-speed data tier introduced at $70/month price point of original unlimited data plan.[xxxiv]
3/14	AT&T	Mobile Share/ Mobile Share Value	Monthly price reduction of entry-level 2GB data bucket for single-line customers and for two lines sharing the 2GB data allowance -- from $55/month to $40/month (excluding monthly device access fees per line).[xxxv] Price cut applies equally to EIP and subsidized subscribers. Unlimited international messaging added to all tiers at no additional cost.
3/14	U.S. Cellular		Data allowances increased on tiered plans without increasing monthly prices – from 300MB to 1GB on $40/month plan, from 1GB to 2GB on $50/month plan, and from 2GB to 3GB on $60/month plan.[xxxvi]
4/14	T-Mobile	Simple Starter[497]	Introduction of new entry-level 500MB LTE data plan for $40/month, with service suspension for the month after LTE data

[497] In place of overage charges or speed reductions, the service is suspended entirely for the month once the user reaches the 500MB LTE data allowance. Customers who wish to exceed the 500MB LTE data allowance need to purchase either a

			allowance reached. In place of overage charges or speed reductions, the service is suspended entirely for the month once the user reaches the 500MB LTE data allowance. Customers who wish to exceed the 500MB LTE data allowance need to purchase either a 500MB one-day on-network data pass for $5 or a 1GB 7-day on-network data pass for $10. The plan does not include international service packages or roaming. [xxxvii]
4/14	T-Mobile	All plans	Overage charges abolished on all plans, including legacy plans, for domestic calls, text messages and data usage.[xxxviii]
8/14	Sprint	Family Share Pack	New shared-data plan that offers double the high-speed data at a lower price than AT&T and Verizon Wireless. $100 for 4 lines with 28 GB of shared data and $100 for 10 lines and 40 GB of shared data. % GB of data per line plus 2 GB of extra data per line through 2015.[xxxix]
12/14	T-Mobile	Simple Choice	Introduces unlimited 4G LTE Family Plan for $100 for 2 lines and goes all the way up to 10 people for $40 more per line. [xl]

500MB one-day on-network data pass for $5 or a 1GB 7-day on-network data pass for $10. The plan does not include international service packages or roaming.

Table V.A.iv

Selected Promotions and Incentives to Attract and Retain Customers

Date	Provider	Plan Name	Description
7/13	Sprint	Unlimited, My Way; My All-in	Guarantees unlimited data for the life of the line to new customers who sign up for, and existing customers who switch to, Unlimited, My Way or My All-in plans.[xli]
10/13	AT&T		New tablet data plans: $5/day plan with 250MB per day, and $25 plan with 1GB that can be used any time during 3-month period.[xlii]
10/13	T-Mobile	"Un-carrier 4.0" Tablets Un-leashed	All customers who use tablets on the network have lifetime access to 200MB of free LTE data per month. Customers need to purchase a $10 SIM card from T-Mobile to connect a tablet. Existing voice customers with a phone plan and new customers who pay full price for tablets can access the 200MB of free data without signing up for additional plans, but customers who wish to pay for a tablet using the company's no-money-down EIP are required to purchase a monthly data plan before gaining access to the 200MB of free data.[xliii]
1/14	Sprint	Framily Plan	Customers who join a Framily plan can get a free Galaxy Tab 3 tablet if they sign up for a qualifying data plan. Sprint's free tablet offer began as an initially short-term promotion in January 2014, but was extended multiple times during the first quarter of 2014. [xliv]
1/14 to 2/14	AT&T		Customers who switch to AT&T from T-Mobile and trade-in their eligible smartphone can get up to $450. When they pay for their device (Next EIP, full retail price or BYOD) get $200 credit per line and ability to trade in current device for promotion card worth up to $250, which could be used toward purchase of AT&T products or services.[xlv]
1/14	T-Mobile		Offer to reimburse up to $650 in ETFs for customers switching to T-Mobile from the other 3 nationwide providers (AT&T, Verizon or Sprint). Offer includes up to $300 device credit for trading in handset and up to $350 payment per line depending on proof of ETF paid to previous provider. In order to qualify, a customer must trade in their old handset, purchase a new T-Mobile handset, and port their phone number to T-Mobile. [xlvi]
2/14 to 3/14	AT&T	Mobile Share	New and existing customers who open new line of service will receive a $100 credit for each new smartphone, feature phone, tablet, mobile Hot Spot or Wireless Home Phone they add.[xlvii]
2/10/14 to 2/17/14	Verizon		No-activation fee promotion: $35 activation fee waived for new customers who signed a two-year service contract during the promotion period.[xlviii]
4/14	C Spire		Customers who switch to C Spire get up to $200 service credit as reimbursement for ETFs, plus $50 bill credit and an extra $100 for every third customer referral.[xlix]

4/14	Verizon	More Everything	Customers who activate a tablet on shared data plans at or above the 1GB data tier get 1GB of extra data per month free of additional charge. There is a $10/month charge for adding a tablet line to shared data plans.[l]
4/14 to 5/14	Sprint	Framily	Offer to reimburse up to $650 in switching costs for customers who switch number to Sprint from another postpaid provider and sign up for Sprint Framily Plan. Offer includes up to $300 credit for phone trade-in and a Visa® Prepaid Card worth up to $350 to cover ETFs or, for customers not on contract, their remaining equipment installment balance.[li]
4/14 to ?	U.S. Cellular	Shared Connect	Offer to pay off customers' old contracts, up to $350 per line, when they switch to Shared Connect plan and choose Retail Installment Contract. Customers who port their number from another provider and send in their final bill with the ETF on it will receive a prepaid debit card for that amount.[lii]
4/14 to 5/14	T-Mobile		LTE-enabled tablets offered for same price as Wi-Fi-only models for any postpaid activation on a 1GB or more mobile internet data plan.[liii]
4/14	T-Mobile		$10/month discount off most popular internet data plans for new and existing customers through end of 2014.[liv]
6/14	T-Mobile	T-Mobile Test Drive Un-carrier 5.0	From June 23, customers will be able to test iPhone 5s with unlimited service for seven days at no cost.[lv]
12/5	Sprint	Cut Your Bill in Half Event	Effective 12/05/2014, available for limited time only, Sprint is introducing the Cut Your Bill in Half Event for Verizon and AT&T customers who are interested in switching to Sprint to cut their rate plan in half.

Table V.A.v

Selected Postpaid Plans for Basic and Smartphones as of July 2014

Provider	Phone type	Plan Name	Talk/Text	Sample Data Tier	Details	Voice and Text	Data	Voice + Data + Text
AT&T	Basic/ Feature Phone	AT&T Mobile Share® Value Plans with Unlimited Talk & Text	Unlimited	300MB	Base fee for basic phone=$20, until the data reaches 10 GB and it falls to $15. Additional basic or smartphones may be added. Data tiers are purchased for the following prices: 300MB=$20; 1GB=$25; 2GB=$40; 4GB=$70; 6GB=$80; 10GB=$100; 15GB=$130; 20GB=$150; 30GB= $225; 40GB=$300; 50GB=$375	$ 20.00	$ 20.00	$ 40.00
AT&T	Smartphone	AT&T Mobile Share® Value Plans with Unlimited Talk & Text	Unlimited	1 GB	Base fee for smartphone = $40. Additional basic or smartphones may be added. Data tiers are purchased for the following prices: 300MB=$20; 1GB=$25; 2GB=$40; 4GB=$70; 6GB=$80; 10GB=$100; 15GB=$130; 20GB=$150; 30GB=$225; 40GB=$300; 50GB=$375	$ 40.00	$ 25.00	$ 65.00
Verizon Wireless	Basic/ Feature Phone	More Everything Plan	Unlimited	700 min	Base fee=$30. Data added [how much data?] for $5	$ 30.00	$ 5.00	$ 35.00
Verizon Wireless	Smartphone	More Everything Plan	Unlimited	1GB	Base fee = $40. Data tiers are purchased for the following prices: 250MB=$15; 500MB=$30; 1GB=$40; 2GB=$50; 3GB=$60; 4GB=$70; 6GB=$80; 8GB=$90; 10GB=$100; 12GB=$110; 14GB=$120; 16GB=$130; 18GB=$140; 20GB=$150; 30GB=$225; 40GB=$300; 50GB=$375	$ 40.00	$ 40.00	$ 80.00

Provider								
Sprint	Basic/ Feature Phone	Unlimited My Way	Unlimited	Unlimited	Base fee = $50. Unlimited data for basic phones can be added for $10.	$ 50.00	$ 10.00	$ 60.00
Sprint	Smartphone	Unlimited My Way	Unlimited	1 GB	Base fee = $50. Data tiers are purchased for the following prices: 1GB=$20; unlimited data=$30	$ 50.00	$ 20.00	$ 70.00
Sprint	Basic/ Feature Phone	Framily Plan	Unlimited	1 GB	Base fee for initial phone = $55. Per-phone fee of $55 falls by $5 for every member of plan as new members are added, until it reaches $25. The maximum size of a framily is 10 people. Plan comes with 1GB data. Higher data tiers may also be purchased.	$ 55.00	$ -	$ 55.00
Sprint	Smartphone	Framily Plan	Unlimited	3 GB	Base fee for initial phone = $55. Per-phone fee of $55 falls by $5 for every member of plan as new members are added, until it reaches $25. The maximum size of a framily is 10 people. Plan comes with 1GB data. Higher data tiers may also be purchased: 3GB=$10, unlimited data=$20	$ 55.00	$ 10.00	$ 65.00
T-Mobile	Basic/ Feature Phone	Simple Starter Plan	Unlimited	500 MB	Plan may be used with smartphones or basic phones	$ 40.00	$ -	$ 40.00
T-Mobile	Smartphone	Simple Choice Plan	Unlimited	1 GB	Base fee = $50. Data tiers are purchased for the following prices: 1GB=included with plan; 3GB=$10; 5GB=$20; unlimited data=$30	$ 50.00	$ -	$ 50.00

Provider								
US Cellular	Basic/ Feature Phone	Shared Connect Plans	Unlimited	300 MB	Base fee=$30. Data tiers are purchased for the following prices: 300 MB=$15, 1GB=$40; 2 GB=$50; 3GB=$60	$30	$40	$70
US Cellular	Smartphone	Shared Connect Plans	Unlimited	1 GB	Base fee=$40. Data tiers are purchased for the following prices: 300 MB=$15, 1GB=$40; 2 GB=$50; 3GB=$60	$40	$40	$80
C Spire	Basic/ Feature Phone	Unlimited talk & text	Unlimited (including pictures)	Unlimited (assume 30 days)	$1 for 24 hours of data access	$50	$30	$80
C Spire	Smartphone	Unlimited Everything Plans	Unlimited (including pictures)	Unlimited	Unlimited			$80
C Spire	Smartphone	Unlimited talk & text	Unlimited (including pictures)	1 month of streaming	Base fee=$50. Data passes available ($5 for 2 hrs., $10 for 5 hrs., $30 for 1 month of streaming)	$50	$30	$80
C Spire	Smartphone	Unlimited talk & text	Unlimited (including pictures)	1 GB	Base fee=$50. No data included. Data tiers are purchased for the following prices (valid 30 days): 500 MB =$10, 1GB=$15; 3 GB=$45; 5 GB= $75	$50	$15	$65
C Spire	Smartphone	Plans with second Line Discount: Unlimited	Unlimited (including pictures)	Unlimited	Can add a second line on the plan for $50	$100	$-	$100
C Spire	Smartphone	Plans with second Line Discount: Unlimited Lite	Unlimited (including pictures)	Unlimited web and online music, 30 min. of online video	Can add a second line on the plan for $50. Data passes available ($5 for 2 hrs., $10 for 5 hrs., $30 for 1 month of streaming)	$80	$-	$80

Prepaid Service

Table V.B.i

Selected Major Developments in Prepaid Pricing Plans

Date	Provider	Brand/MVNO	Description
5/13	AT&T	Aio	New brand launched on HSPA+ network in selected regional markets. Plans for feature phones and smartphones include unlimited voice and text and a choice of data tiers, with speed reductions after data allowances reached.[lvi] Tablet plans also available.
5/13	T-Mobile	MetroPCS	After T-Mobile-MetroPCS transaction closes, combined company begins process of migrating customers off MetroPCS legacy CDMA network onto LTE network and taking MetroPCS brand nationwide.[lvii]
5/13	Verizon		Data allowances increased on prepaid plans: unlimited voice, text and 2GB of data for $60/month, up from 500MB of data; unlimited voice, text and 4GB of data for $70/month, up from 2GB of data.[lviii]
6/13	AT&T	Aio	LTE service added to service originally launched with support for only HSPA+ network. Service footprint also expanded to additional markets.[lix]
7/13	T-Mobile	MetroPCS	New entry-level rate plan added: $40/month for unlimited voice, text and 500MB of LTE data, with data speeds slowed after data allowance is reached.[lx]
8/13	AT&T	Aio	Service launched on nationwide basis.[lxi] Positioned as competitor to prepaid brands including Sprint's Boost and Virgin Mobile brands and T-Mobile USA's MetroPCS brand.[lxii]
10/13	T-Mobile	Brightspot	New prepaid offering launched with Target as retail partner.[lxiii]
2/14 to 3/14	Sprint	Boost	LTE promotion cuts price of unlimited voice, text and 2.5GB of data before speed reductions from $55/month to $35/month for first 6 months, after which price will increase to $50/month. Once introductory period ends, customers will qualify for Boost's Shrinking Payments plan, under which Sprint will take $5 off the customer's monthly bill for every six on-time payments, down to a floor of $40/month.[lxiv]
3/14	Verizon	Allset	New plans for 3G CDMA network reduce monthly prices and data allowances. Customers can add more data via "Bridge Data." Smartphone plans start at $45/month for unlimited voice, text and 500MB of data. The plan for feature phones includes 500 voice minutes, unlimited text and 500MB of data for $35/month. *Id*. Customers can add 500MB for $5 with a 30-day expiration and 1GB for $10 or 3GB for $20 with a 90-day expiration[lxv]
3/14	Sprint	Prepaid Smart	New brand launched with two smartphone plans: unlimited voice, text and WiFi-enabled data only for $45/month; or unlimited voice, text and unlimited data for $60/month, with speed reductions after 2.5GB of data use. Video streaming may be limited to 3G speeds on the 2.5GB data tier.[lxvi]
3/14	Sprint	Boost, Virgin	Slower speeds for heavy data users: speeds of users who exceed 2.5GB of data usage in a monthly cycle will be reduced to 128 Kbps for the remainder of the billing cycle, down from previous 256 Kbps, unless they top up their accounts.[lxvii]
3/14	AT&T	Cricket	FCC approves AT&T's acquisition of Leap. AT&T agreed to offer a

			prepaid plan for feature phones that includes unlimited voice, text and data (with speeds slowed after 500 MB) for $40 per month for at least 18 months. AT&T begins process of migrating Cricket customers off Leap's legacy CDMA network onto AT&T's nationwide GSM-based network.[lxviii]
4/14	AT&T	Aio	Group discount plans launched that offer customers progressively increasing monthly discounts for adding new lines to an existing account. All accounts pay the full monthly price on the first line, with progressively increasing discounts applied to each new additional line: a $10/month discount on the second line, a $20/month discount on the third line and a $30/month discount on the fourth and fifth lines. The discounts are available on plans starting at $40/month. [lxix] .
5/14	Sprint	Boost	Prices cut through introduction of new 'Monthly Unlimited Select' plans at lower price points than legacy plans. All plans include unlimited voice and text, plus one of three data options -- 500MB for $40/month, 2.5GB for $50/month and 5GB for $60/month. Data speeds are slowed down to 2G after thresholds are reached. The new plans replace $50/month feature phone plan and $55/month smartphone plan. The 'Bill Shrink' plan, which was launched in March 2012, rewarded customers for making on-time payments by progressively reducing their monthly bill, up to a maximum discount of $15/month. 'Bill shrink' option discontinued. [lxx]
5/14	AT&T	Aio/New Cricket	Existing Aio Wireless prepaid brand shut down and re-launched as Cricket. Re-launch of Cricket brand on nationwide network begins.[lxxi]
5/14	AT&T	New Cricket	New rate plans similar to Aio's plans introduced: 500MB for $40/month, 2.5GB for $50/month, and 5GB and international texting for $60/month. Plans include unlimited voice and text.[lxxii]
			Peak download speeds of 8 Mbps on LTE, and 4 Mbps on HSPA+, reduced to 128 Kbps if customers exceed monthly data allowance.[lxxiii]
			$5/month discount if customer selects autopay option. Monthly rates drop to $35, $45 and $55.[lxxiv]
			Group discounts: discounted monthly rates available for additional lines within a family or group of friends. As with Aio group discount plans, group discounts provide a $10/month discount for each new line of service added to a single account. [lxxv]
			Customers who make 12 on-time payments in a year offered a $50 device credit or reward that can be used to upgrade to new handset.[lxxvi]
5/14	AT&T	New Cricket	Handset financing options for prepaid phones launched. All three financing options are available for phones $149.98 and higher, with accessories excluded from eligibility.[lxxvii]
			Tier I installment loan: 0% APR for 24 months with minimum monthly payment of 4.16% of initial balance;
			Tier II installment loan: 29.99% APR for 6 months deferred interest and 24-month term and minimum monthly payment of 5.4% of initial balance;
			Lease to own: 12-month lease term, at end of which customer owns device. 90-day same-as-cash payoff option.
6/14	T-Mobile	GoSmart	Price cut on high-end plan – $40/month for unlimited voice, text and the

			first 3GB of data at 3G speeds before reducing speed, down from $45/month.[lxxviii]
			Data speeds of $35 mid-level plan increased – unlimited voice, text and the first 500MB of data at 3G speeds before reducing speed to 2G speeds. Data users were previously limited to 2G speeds.[lxxix]
6/14	T-Mobile	Brightspot	Price cuts and other revisions to offerings: [lxxx]
			Unlimited voice and messaging for $30/month, down from $35/month.
			New data-centric plan with 300 voice minutes, unlimited messaging and 3GB of data at HSPA+ or LTE speeds before reducing speeds for $35/month.
			Unlimited voice, messaging and 1GB of data at HSPA+ or LTE speeds before reducing speeds for $45/month, down from $50/month.
			Unlimited voice, messaging and 3GB of data at HSPA+ or LTE speeds before reducing speeds for $55/month, replacing previous $65 high-end plan with 4GB of LTE data before reducing speeds.
7/15	Verizon	Allset	Verizon added LTE service for its Allset prepaid plans on Tuesday. Previously, Verizon's prepaid customers were only allowed on the CDMA network. Prices are staying the same as before: the base plan, which includes unlimited calls, texts, and 500MB of mobile data, costs $45 and you get the option to add 1GB and 3GB blocks of rollover data. LTE speeds will require an LTE-capable device, and you can either bring your own or purchase one from Verizon. If you've got an XLTE-capable device, you can take advantage of the added speeds from Verizon's new LTE network as well.[lxxxi]

Table V.B.ii
AT&T and Cricket Prepaid Plan Offerings
As of June 2014

GoPhone Monthly Smartphone Plans[lxxxii]				
Price	**Talk**	**Text**	**International Text***	**Data**
$60/month	Unlimited	Unlimited	Unlimited	2.5GB (Add more: $10/1GB)
$40/month	500 minutes	Unlimited	Unlimited	500MB (Add more: $5/100MB)
$25/month	250 minutes	Unlimited	Unlimited	Add a data package, $5/50MB
GoPhone Basic and Messaging Phone Plans				
Price	**Talk**	**Text**	**International Text***	**Data**
$45/month	Unlimited	Unlimited	Unlimited	Unlimited: First 2GB at speeds up to 3G
$25/month	250 minutes	Unlimited	Unlimited	Pay per use or add $5/50MB package
$2/day, only on days used	Unlimited	Unlimited	Unlimited	Pay per use 1¢/5KB
10¢/minute	10¢/minute	20¢/text or buy package	25¢/text message	Pay per use 1¢/5KB
Cricket Smartphone and Basic Cell Phone Plans[lxxxiii]				
Price	**Talk**	**Text**	**International Text***	**Data[498]**
Pro: $60/month*	Unlimited	Unlimited	Unlimited Texting to 35 countries	5GB at high-speed**
Smart: $50/month*	Unlimited	Unlimited		2.5 GB at high-speed**
Basic: $40/month*	Unlimited	Unlimited		500MB at high-speed **
Talk & Text: $25/month	Unlimited	Unlimited	Available if you add Cricket Passport ($15/ month, text to 35 countries)	Basic phones only - does not include data or multimedia messaging

#Eligibility and Monthly Discount on Cricket plans: Customers in good standing with at least two (2) eligible lines of service on one account will be automatically enrolled to receive Group Save discounts. Only eligible lines two-five on the same account receive the monthly discount described below. Only lines of service on a Basic, Smart, or Pro rate plan are eligible. Your first eligible line does not receive a discount; the second eligible line = $10 monthly discount; the third eligible line = $20 monthly discount; and the fourth and fifth eligible lines each = $30 monthly discount. The maximum monthly discount is $90 when you have five (5) eligible lines.

*$5 Auto-pay credit. Eligible for group save discounts.MMS not included
***Unlimited data available at reduced speeds after high-speed data limit is reached

[498] Add 1 GB high-speed for $10/month

Table V.B.iii
Verizon Wireless Prepaid Plans
As of June 2014

Verizon Allset Smart Phone Monthly Prepaid Plan			
Price	**Talk**	**Text**	**Data***
$45/month	Unlimited	Unlimited	500 MB
Verizon Allset Basic Phone Monthly Prepaid plan			
Price	**Talk**	**Text**	**Data***
$45/month	Unlimited	Unlimited	500 MB
$35/month	500 minutes	Unlimited	500 MB
*Data does not include 4G/LTE. Additional data may be purchased: 500 MB for $5 (expires after 30 days); 1 GB for $10 (expires after 90 days); or 3 GB for $20 (expires after 90 days)			

Verizon Wireless Pay-as-you-go Plans				
Price	**Mobile to Mobile Calling (with Verizon Wireless customers)**	**Talk**	**Text/Picture Messaging (price per minute)**	**Mobile Web***
$1.99/day	Unlimited	Unlimited	2¢/25¢	99¢/day
99¢/day	Unlimited	10¢/minute	10¢/25¢	99¢/day
pay as you go	25¢/minute	25¢/minute	20¢/25¢	99¢/day

Table V.B.iv
Sprint Prepaid Plans[lxxxiv]
As of June 2014

Sprint Prepaid Monthly Smartphone Plans*			
Plan/Price	**Talk**	**Text**	**High speed 3G/4G data****
Smart Plus: $60/month	Unlimited	Unlimited	2.5GB/month of high-speed data.
Smart: $45/month	Unlimited	Unlimited	Data not included
Sprint Prepaid Monthly Basic Plans*			
Plan/Price	**Talk**	**Text**	**Data**
Basic Plus ($50/month)	Unlimited	Unlimited	Unlimited
Basic ($35/month)	500 minutes	Unlimited	Unlimited
*All Prepaid Plans include voicemail, long distance, call waiting, call forwarding ** When monthly usage exceeds applicable data plan allotment, speeds (including video) reduced to 2G speeds for remainder of plan cycle			

Boost Mobile Monthly Prepaid Plans			
Price	**Talk**	**Text**	**High speed 3G/4G data***
$60/month	Unlimited	Unlimited	5 GB. .
$50/month	Unlimited	Unlimited	2.5 GB
$40/month	Unlimited	Unlimited	500 MB
Boost Mobile Daily Prepaid Plans			
Price	**Talk**	**Text**	**Data**
$ 3/day (smartphones)	Unlimited	Unlimited	Unlimited
$2/day (basic phones)	Unlimited	Unlimited	Unlimited
***All Prepaid Plans include voicemail, long distance, call waiting, call forwarding** * When monthly usage exceeds applicable data plan allotment, speeds (including video) reduced to 2G			

speeds for remainder of plan cycle

Boost Shrinking Payment Plan			
Price*	Talk**	Text	Data***
$60 initially, falls to $45	Unlimited	Unlimited (includes BBM Voice)	Unlimited
$55 initially, falls to $40	Unlimited	Unlimited	Unlimited
$50 initially, falls to $35	Unlimited	Unlimited	Unlimited
$45 initially, falls to $30	Unlimited	Unlimited	Unlimited

*Shrinking Payments reduces your payment by $5/month for every six on-time payments.
**Plans include voicemail, long distance, call waiting, call forwarding
***Includes 2.5GB/month of high-speed data. Adaptive Protocol Video limited to 3G

Virgin Mobile Beyond Talk Unlimited Plans (Android Compatible)			
Price	Talk	Text	Data (4G data where available)
$55/month	Unlimited	Unlimited	Unlimited
$45/month	1200 minutes	Unlimited	Unlimited
$35/month	300 minutes	Unlimited	Unlimited

Virgin Mobile PayLo Talk & Text Plans (Not Android Compatible)			
Plan & Price	Talk	Text	Data
$40/month	Unlimited	Unlimited	50 MB included
$30/month	1500 minutes	1500 messages	30 MB included
$20/month	400 minutes	15¢/message	$1.50/MB

Table V.B.v
Selected T-Mobile and Metro PCS Prepaid Plan Offerings[lxxxv]
As of June 2014

T-Mobile Monthly and Daily Prepaid Plans[lxxxvi]			
Price	Talk	Text	Data (4G LTE*)
$80/month	Unlimited	Unlimited	Unlimited
$70/month	Unlimited	Unlimited	5 GB
$60/month	Unlimited	Unlimited	3 GB
$50/month	Unlimited	Unlimited	1 GB
$40/month*	Unlimited	Unlimited	500 MB
$30/month	100 minutes	Unlimited	5 GB
$35/month	Unlimited	Unlimited	NA
$3/day	Unlimited	Unlimited	200 MB
$2/day	Unlimited	Unlimited	Only 2G available

*Simple starter plan

MetroPCS Monthly Prepaid Plans[#lxxxvii]			
Price*	Talk	Text	Data (4G LTE**)
$60/month	Unlimited	Unlimited	Unlimited
$50/month	Unlimited	Unlimited	2.5 GB
$40/month	Unlimited	Unlimited	500 MB

*Save $5 per line/month with a family plan, a family can consist of up to 5 people (a total savings of $25/month)
**Data are still available at reduced speeds after reaching the data limit
MetroPCS offers pay by minute and pay by week plans, only in brick and mortar stores.

GoSmart Monthly Prepaid Plans[lxxxviii]				
Price	**Talk***	**Text****	**Data**	**Facebook and Facebook Messenger**
$45/month	Unlimited	Unlimited	3GB at 3G speeds, then 2G speeds for the rest of the cycle	Unlimited
$35/month	Unlimited	Unlimited	500 MB at 3G speeds, then 2G speeds for the rest of the cycle	Unlimited
$25/month	Unlimited	Unlimited	NA	Unlimited

T-Mobile Pay-as-you-go[lxxxix] without Data				
Price	**Talk**			**Text**
	Minutes	**Cost/min**	**Duration**	
$100	1000	10¢/min	1 year	10¢ to send/receive texts, 25¢ to send/receive pictures & videos
$50	400	13¢/min	90 days	
$30	160	19¢/min	90 days	
$10	30	33¢/min	90 days	

* Optional $10/month international texting and calling bundle
** Optional $5/month international texting

Table V.B.vi

US Cellular Prepaid Plans[xc]
July 2014

US Cellular Simple Connect Smart Phone Monthly Prepaid Plan			
Price	**Talk**	**Text**	**Data**
$60/month	Unlimited	Unlimited	Unlimited with 2 GB at high speed, speeds reduced thereafter
$50/month	Unlimited	Unlimited	Unlimited with 500 MB at high speed, speeds reduced thereafter
US Simple Connect Cellular Basic Phone Monthly Prepaid plan			
Price	**Talk**	**Text**	**Data**
$40/month	Unlimited	Unlimited	Unlimited data for basic phones

Table V.B.vii

C-Spire Prepaid Plans[xci499]
July 2014

C-Spire Pay-as-you-go Prepaid Plan			
Price	**Talk**	**Text & Pictures**	**Data**
$65/30 days	Unlimited	Unlimited	Unlimited
$55/30 days	Unlimited	Unlimited	1 GB
$50/30 days	500 nationwide minutes	Unlimited	500 MB
$35/30 days	350 nationwide minutes	Unlimited	500 MB
C-Spire Pay-as-you-go Prepaid Plan without Data			
Price	**Talk**	**Text & Pictures**	**Data**
$50/ 30 days	Unlimited	Unlimited	
$25/ 30 days	250 nationwide minutes	Unlimited	Purchase data day pass for $1/day for basic phone
$2/day	Unlimited	Unlimited	

[499] As of 7/7/2014, http://www.cspire.com/shop_and_learn/plans/category_plan_landing.jsp?id=cat320003#prepaid.

Price Indicators for Mobile Data

Table V.C.i

Current Postpaid Smartphone Data Pricing for Mobile Wireless Providers[500]
1st Quarter 2014

	AT&T		Verizon		Sprint			T-Mobile		US Cellular		C-Spire	
Base Fee	**$40**		**$40**		**$50**			**$50**[501]		**$40**		**$50**	
Data Allowance	$/Mth	₵/MB	$/Mth	₵/MB	$/Mth subsidized device, 2-year contract	$/Mth unsubsidized device	₵/MB	$/Mth	₵/MB	$/Mth	₵/MB	$/Mth	₵/MB
MB													
250			$15	6.0₵									
300	$20	6.7₵								$15	5.0₵		
500			$30	6.0₵								$10	2.0₵
GB													
1			$40	4.0₵	$20		2.0₵			$40	4.0₵	$15	1.5₵
2	$40	2.0₵	$50	2.5₵				$10		$50	2.0₵		
3			$60	2.0₵		$10	3.0₵		0.5₵	$60	2.0₵	$45	1.5₵
4	$70	1.8₵	$70	1.75₵									
5								$20	0.5₵₵			$75	1.5₵
6	$80	1.3₵	$80	1.33₵									
8			$90	1.13₵									
10	$100	1.0₵	$100	1.0₵									
12			$110	0.92₵									
14			$120	0.86₵									
15	$130	0.87₵											
16			$130	0.81₵									

[500] Derived from BoA/ML 4 April 2014, "A Frantic Start to 2014 in Wireless Pricing", Table 3, pp. 7. Numbers in the table are BofA Merrill Lynch Global Research estimates and company websites visited on 7/7/2014.

[501] Basic unlimited talk and text smartphone individual plan includes1GB of data.cost $50. 3 GB plan costs $60 5 GB plan cists $70. The incremental data cost for 3 GB plan is an extra $10 for 2 GB of data, and for the 5GB plan the incremental cost is $20 for 4 GB of data as 1 Gb is already included in the base price.

18			$140	0.78₵									
20	$150	0.75₵	$150	0.75₵									
30	$225	0.75₵	$225	0.75₵									
40	$300	0.08₵	$300	0.75₵									
50	$375	0.08₵	$375	0.75₵									

Source: BoA/ML, “A Frantic Start to 2014 in Wireless Pricing”, 4 April 2014

APPENDIX VI

NON-PRICE RIVALRY

Investment

Table VI.A.i

Quarterly Capital Expenditure by Mobile Wireless Providers (In millions)
1Q2011 – 2Q2014

	1Q11	2Q11	3Q11	4Q11	1Q12	2Q12	3Q12	4Q12	1Q13	2Q13	3Q13	4Q13	1Q14	2Q14
National Operators														
Verizon Wireless	2,735	2,667	1,784	1,787	1,885	2,048	2,133	2,791	1,992	2,278	2,450	2,705	2,554	2,771
AT&T	1,870	2,511	2,520	2,863	2,324	2,345	2,709	3,417	2,296	3,033	3,060	2,802	3,082	3,480
Sprint	449	546	647	774	710	1,012	1,376	1,786	1,706	1,728	1,683	1,716	1,057	1,416
T-Mobile	749	688	741	551	747	539	717	898	1,076	1,050	1,017	882	947	940
Total National	5,803	6,412	5,692	5,975	5,666	5,944	6,935	8,892	7,070	8,089	8,210	8,105	7,640	8,607
Regional Operators														
Cincinnati Bell	5	1	5	7	6	2	4	3	8	2	2	4	6	0.6
Leap	93	93	103	152	146	119	106	63	26	22	90	130		
Metro PCS	187	265	248	190	144	182	262	258						
NTELOS	8	13	14	23	13	19	22	19	17	27	21	16	14	32
US Cellular	96	162	248	276	201	183	199	253	118	169	243	208	90	144
Total Regional	388	534	618	649	511	505	593	595	170	220	356	358	110	177
Total	6,191	6,946	6,310	6,624	6,177	6,449	7,528	9,487	7,240	8,309	8,566	8,462	7,750	8,784

Notes: Based on UBS Wireless 411 Report, Version 51 at 28. Metro PCS data are not available separately after the fourth quarter of 2012 as the T-Mobile and MetroPCS merger was consummated in early 2013. Leap is reported separately from AT&T as the AT&T and Leap merger was not consummated by the fourth quarter of 2013.

Network Coverage and Technology Upgrades

219. Appendix Tables VI.B.i – VI.B.vi contain detailed data on the percentage of the U.S. population, land area, and road miles covered by each of the top four mobile wireless service providers, and top four mobile broadband providers, and also show rural and non-rural breakdown for these categories. All tables are derived from Commission estimates based on census block analysis of Mosaik Coverage Right coverage maps, January 2014. Excludes coverage for Island Areas (Guam, American Samoa, US Virgin Islands, Mariana Islands. Population data are from the 2010 Census. The data underlying these estimates measure mobile network "coverage," and not the number of network providers affirmatively offering service to any or all residents in those locations. Coverage calculations based on Mosaik data, while useful for measuring developments in mobile wireless coverage, have certain limitations that likely overstate the extent of mobile wireless coverage.

Table VI.B.i
Estimated Mobile Wireless Coverage in the U.S. by Provider
January 2014

Provider	Number of Blocks	POPS Contained in Those Blocks	% of Total US POPs	% of Total US Square Miles	% of Total US Road Miles
ATT	10,324,435	308,396,818	98.7	61.8	85.3
VZW	10,164,336	302,838,131	96.9	61.2	84.8
Sprint	7,606,057	280,488,603	89.8	24.9	48.1
T-Mobile	8,286,265	287,702,030	92.1	34.3	58.3

Source: Mosaik January 2014, Census 2010.The data underlying these estimates measure mobile network "coverage," and not the number of network providers affirmatively offering service to any or all residents in those locations. Coverage calculations based on Mosaik data, while useful for measuring developments in mobile wireless coverage, have certain limitations that likely overstate the extent of mobile wireless coverage.

Table VI.B.ii

Estimated Mobile Wireless Network Coverage, Selected Facilities-Based Providers
Voice Networks,
2009-2014 (Covered POPs, in millions)

Service Provider	Oct. 2009	Oct. 2010	Apr. 2011	Jan. 2012	Oct. 2012	Jan. 2014
AT&T	262.8	281.9	306.3	306.6	307.2	306.9
Verizon Wireless	270.5	284.9	299.5	299.5	300.0	300.6
T-Mobile	246.2	249.5	282.5	284.8	281.4	286.7
Sprint Nextel	258.0	263.2	292.1	291.2	290.3	275.2
MetroPCS	84.6	92.1	105.0	105.4	108.1	-
Leap	80.5	82.7	94.0	93.4	94.2	-
US Cellular	41.7	41.5	44.2	44.0	44.0	314.6

Note: The estimates in this Table are based on our census block analysis of Mosaik CoverageRight coverage maps using the April 2011, January 2012, and October 2012 data. The population data are from the 2010 Census. Estimates for 2009 and 2010 are obtained from the *Fifteenth Report*, 25 FCC Rcd at 9702 ¶ 45. The data underlying these estimates measure mobile network "coverage," and not the number of network providers affirmatively offering service to any or all residents in those locations. Coverage calculations based on Mosaik data, while useful for measuring developments in mobile wireless coverage, have certain limitations that likely overstate the extent of mobile wireless coverage.

Table VI.B.iii
Estimated Mobile Wireless Broadband Coverage in the U.S. by Provider
January 2914

Provider	Number of Blocks	POPS Contained in Those Blocks	% of Total US POPs	% of Total US Square Miles	% of Total US Road Miles
ATT	9,920,357	305,640,460	97.8	55.1	79.2
VZW	10,113,892	302,645,159	96.9	59.5	83.6
Sprint	7,507,299	278,989,810	89.3	24.5	47.4
T-Mobile	5,603,484	246,362,777	78.8	15.0	32.3

. Source: Mosaik January 2014, Census 2010. The data underlying these estimates measure mobile network "coverage," and not the number of network providers affirmatively offering service to any or all residents in those locations. Coverage calculations based on Mosaik data, while useful for measuring developments in mobile wireless coverage, have certain limitations that likely overstate the extent of mobile wireless coverage.

Table VI.B.iv

Estimated Mobile Wireless Network Coverage, Selected Facilities-Based Providers
***Broadband Networks*,**
2009-2014 (Covered POPs, in millions)

Service Provider	Nov. 2009	Aug. 2010	Apr. 2011	Jan. 2012	Oct. 2012	Jan. 2014
AT&T	212.3	228.6	276.1	289.9	296.7	305.7
Verizon Wireless	266.7	270.0	298.0	299.2	300.4	302.6
Sprint Nextel	226.9	239.4	276.4	273.7	275.1	279.1
T-Mobile	133.9	183.8	214.7	227.6	235.4	246.3
MetroPCS	-	-	62.2	72.4	108.3	-
Clearwire	-	-	108.9	105.1	105.3	-
Leap	79.2	81.5	92.6	92.3	93.4	-
US Cellular	26.6	30.0	40.7	41.1	43.2	311.9

Note: For purposes of this, and earlier, *Mobile Wireless Competition Reports*, we include coverage by WCDMA/HSPA, HSPA+, EV-DO, WiMAX, and LTE networks within our estimate of mobile broadband network coverage. Commission estimates based on census block analysis of Mosaik CoverageRight coverage maps, April 2011, January 2012, and October 2012. Population data are from the 2010 Census. Estimates for 2009 and 2010 are obtained from the *Fifteenth Report*. *Fifteenth Report*, 25 FCC Rcd at 9702 ¶ 45. The recent *Broadband Progress Report* did not include WCDMA/HSPA or EV-DO networks in its definition of mobile broadband networks. *2012 Eighth Broadband Progress Report*, WN Docket No. 11-121 (rel. Aug. 21, 2012) ¶ 40. The data underlying these estimates measure mobile network "coverage," and not the number of network providers affirmatively offering service to any or all residents in those locations. Coverage calculations based on Mosaik data, while useful for measuring developments in mobile wireless coverage, have certain limitations that likely overstate the extent of mobile wireless coverage.

Table VI.B.v
Estimated Mobile Wireless Voice Coverage in Rural Areas by Provider
January 2014

	Number of Rural Census Blocks	POPS Contained in Rural Census Blocks	% of Total U.S. POPs	% of Total U.S. Square Miles	% of Total U.S. Road Miles
Total for US	5,387,335	59,151,859	18.9	84.5	67.3
Provider	**Number of Rural Census Blocks**	**POPS Contained in Rural Census Blocks**	**% of Total Rural U.S. POPs**	**% of Total Rural U.S. Square Miles**	**% of Total Rural U.S. Road Miles**
ATT	4,349,508	53,931,208	91.2	49.3	72.1
VZW	4,404,874	52,710,410	89.1	54.1	76.1
Sprint	2,153,983	34,185,221	57.8	15.3	27.7
T-Mobile	2,763,501	38,999,396	65.9	25.3	41.1

Source: Mosaik January 2014, Census 2010. The data underlying these estimates measure mobile network "coverage," and not the number of network providers affirmatively offering service to any or all residents in those locations. Coverage calculations based on Mosaik data, while useful for measuring developments in mobile wireless coverage, have certain limitations that likely overstate the extent of mobile wireless coverage.

Table VI.B.vi
Estimated Mobile Wireless Voice Coverage in Non-Rural Areas by Provider
January 2014

	Number of Non-Rural Census Blocks	POPS Contained in Non-Rural Census Blocks	% of Total U.S. POPs	% of Total U.S. Square Miles	% of Total U.S. Road Miles
Total for US	5,768,151	253,319,468	81.8	15.5	32.7
Provider	**Number of Non-Rural Census Blocks**	**POPS Contained in Non-Rural Census Blocks**	**% of Total Non-Rural U.S. POPs**	**% of Total Non-Rural U.S. Square Miles**	**% of Total Non-Rural U.S. Road Miles**
ATT	5,716,694	252,900,141	99.8	89.4	97.7
VZW	5,582,339	247,913,734	97.9	85.7	95.3
Sprint	5,158,015	240,994,632	95.1	60.6	79.8
T-Mobile	5,425,720	247,797,133	97.8	74.8	89.4

Source: Mosaik January 2014, Census 2010. The data underlying these estimates measure mobile network "coverage," and not the number of network providers affirmatively offering service to any or all residents in those locations. Coverage calculations based on Mosaik data, while useful for measuring developments in mobile wireless coverage, have certain limitations that likely overstate the extent of mobile wireless coverage.

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Table VI.B.vii
Estimated Mobile Broadband Coverage in Rural Areas by Provider
January 2014

	Number of Rural Census Blocks	POPS Contained in Rural Census Blocks	% of Total U.S. POPs	% of Total U.S. Square Miles	% of Total U.S. Road Miles
Total for US	5,387,335	59,151,859	18.9	84.5	67.3
Provider	**Number of Rural Census Blocks**	**POPS Contained in Rural Census Blocks**	**% of Total Rural U.S. POPs**	**% of Total Rural U.S. Square Miles**	**% of Total Rural U.S. Road Miles**
ATT	4,235,577	53,085,491	89.7	49.3	70.8
Verizon	4,503,652	53,936,545	91.2	54.6	77.5
Sprint	2,260,761	35,283,398	59.6	17.0	30.1
T-Mobile	991,184	17,388,659	29.4	8.4	14.1

Source: Mosaik January 2014, Census 2010. The data underlying these estimates measure mobile network "coverage," and not the number of network providers affirmatively offering service to any or all residents in those locations. Coverage calculations based on Mosaik data, while useful for measuring developments in mobile wireless coverage, have certain limitations that likely overstate the extent of mobile wireless coverage.

Table VI.B.viii
Estimated Mobile Broadband Coverage in Non-Rural Areas by Provider
January 2014

	Number of Non-Rural Census Blocks	POPS Contained in Non-Rural Census Blocks	% of Total U.S. POPs	% of Total U.S. Square Miles	% of Total U.S. Road Miles
Total for US	5,768,151	253,319,468	81.8	15.5	32.7
Provider	**Number of Non-Rural Census Blocks**	**POPS Contained in Non-Rural Census Blocks**	**% of Total Non-Rural U.S. POPs**	**% of Total Non-Rural U.S. Square Miles**	**% of Total Non-Rural U.S. Road Miles**
ATT	5,684,780	252,554,969	99.7	86.3	96.4
Verizon	5,610,240	248,708,614	98.2	86.6	96.0
Sprint	5,246,538	243,706,412	96.2	65.5	83.0
T-Mobile	4,612,300	228,974,118	90.4	50.8	69.7

Source: Mosaik January 2014, Census 2010. The data underlying these estimates measure mobile network "coverage," and not the number of network providers affirmatively offering service to any or all residents in those locations. Coverage calculations based on Mosaik data, while useful for measuring developments in mobile wireless coverage, have certain limitations that likely overstate the extent of mobile wireless coverage.

C. Quality of Service

i. Ookla

1. *Description of Ookla Speed Test.* The Ookla speed test is solely crowdsourced and requires users to choose to run each individual test. This app is available free of charge for iOS, Amazon, Android, and Windows Phones. It tests latency, download speed and upload speed. Ookla Net Index mobile app users are able to perform speed tests any time they have a wireless connection.

2. To measure download speed, the tested device first downloads small binary files from the web server to the client, and Ookla measures that download to estimate the connection speed. There are several factors that can affect the speed of individual samples, therefore the fastest 10 percent and slowest 10 percent of the samples are discarded. In addition, because the ramp-up period can take a significant part of the beginning of the test, an additional 20 percent of the bottom samples are trimmed. Overall, the fastest 10 percent and slowest 30 percent of the samples are discarded. The remaining samples are averaged together to determine the final reported result.[502] To measure upload speed, a small amount of random data is first generated in the client device and sent to the web server to estimate the connection speed. Based on this result, an appropriately sized chunk of randomly generated data are selected for upload. The upload test is then performed in chunks of uniform size. The slowest 50 percent of the observations are dropped, and the fastest 50 percent of the observations are averaged to eliminate anomalies and determine the result. [503]

3. The latency test simply sends HTTP requests to the selected server, and measures the time it takes to get a response.[504] The Ookla speed test chooses a server for each test individually, based on which server from a set of possible test servers has the fastest latency. However, the tester also has the ability to choose the server that the test will use.

4. *Presentation of Ookla Speed Test Data*. For this presentation, we use the city-level Net Index speed data, which presents daily mean upload and download speeds by city.[505] The daily, city-level observations can consist of thousands of speed measurements, averaged into one data point.[506] Because this dataset is aggregated at the city level on a daily basis, we cannot identify individual connection speeds.

5. In this *Report*, we present mobile wireless upload and download speeds within the United States for 2013, and for the first half of 2014. We estimate nationwide speeds by service provider. We also estimate California-only speeds by service provider, in order to facilitate comparison with CalSPEEDdata. Not all wireless providers are represented in the Net Index data. For example, there were no observations for US Cellular during this time frame.[507] Similarly, not all states are represented during these years, due to the lack of Ookla mobile app users in certain states. For instance, Alaska, North Dakota, West Virginia, Wyoming, and Vermont are not represented in the 2014 data.

6. We calculate the median[508] and mean upload and download speeds by service provider. The

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[502] From: https://support.speedtest.net/entries/20862782-How-does-the-test-itself-work-How-is-the-result-calculated-

[503] From: https://support.speedtest.net/entries/20862782-How-does-the-test-itself-work-How-is-the-result-calculated-

[504] From: https://support.speedtest.net/entries/20862782-How-does-the-test-itself-work-How-is-the-result-calculated-

[505] Net Index speed data are available at the city level (city_isp_daily_speeds.csv), the state level (region_isp_daily_speeds.csv), and the country level (country_isp_daily_speeds.csv) at http://www.netindex.com/#source ; http://www.ookla.com/support/a39030078/Frequently-Asked-Questions

[506] The free dataset that is publicly available from Ookla consists of anonymous daily index values. The dataset reports the average speed, the number of tests that generate the speed and the date when the tests were done for every geographic location found at NetIndex.com. *See* http://netindex.com/source-data/. There is also available for purchase a more extensive dataset from Ookla that contains every individual speed test measurement.

[507] MetroPCS was dropped from this analysis, as there were only 10 observations for this provider from 2012 until the present. We also drop a few cities due to insufficient observations.

[508] The median speed is actually a median of daily averages, and therefore does not represent a true median speed.

estimated nationwide download speeds by service provider are presented in table VI.C.i, and the estimated nationwide upload speeds by service provider are presented in table VI.C.ii. The estimated California-only upload speeds by service provider are presented in table VI.C.iii, and the estimated California-only download speeds by service provider are presented in table VI.C.iv.

Table VI.C.i
Ookla - Estimated Download Speeds by Service Provider, Nationwide

Service Provider	2013			Jan - June 2014		
	Mean down load speed (Mbps)	Median down load speed (Mbps)	Number of tests ('000s)	Mean down load speed (Mbps)	Median down load speed (Mbps)	Mumber of tests ('000s)
Verizon	9.13	8.99	30,200	10.81	10.74	12,500
AT&T	9.21	9.04	7,588	9.58	9.79	2,955
Sprint	2.26	1.92	28,800	3.2	2.9	11,700
T-Mobile	6.48	6.16	4,719	9.96	9.89	3,146

Source: Ookla NetIndex data

Table VI.C.ii
Ookla - Estimated Upload Speeds by Service Provider, Nationwide

Service Provider	2013			Jan - June 2014		
	Mean upload speed (Mbps)	Median upload speed (Mbps)	Number of tests ('000s)	Mean upload speed (Mbps)	Median upload speed (Mbps)	Number of tests ('000s)
Verizon	4.22	4.14	30,200	5.41	5.37	12,500
AT&T	3.97	3.86	7,588	4.44	4.55	2,955
Sprint	0.83	0.67	28,800	1.09	0.89	11,700
T-Mobile	2.03	1.76	4,719	4.22	4.16	3,146

Source: Ookla NetIndex data

Table VI.C.iii
Ookla - Estimated Download Speeds by Service Provider, California Only.

Service Provider	2013			Jan - June 2014		
	Mean down load speed (Mbps)	Median down load speed (Mbps)	Number of tests ('000s)	Mean down load speed (Mbps)	Median down load speed (Mbps)	Number of tests ('000s)
Verizon	8.51	8.49	6,973	9.82	9.82	2,822
AT&T	9.56	9.27	1,230	9.71	9.42	6445
Sprint	1.77	1.22	6,888	2.94	2.38	2,069
T-Mobile	7.39	7.03	944	10.49	10.35	886

Source: Ookla NetIndex data

Table VI.C.iv
Ookla - Estimated Upload Speeds by Top 4 Nationwide Service Provider, California only.

Service Provider	2013			Jan - June 2014		
	Mean upload speed (Mbps)	Median upload speed (Mbps)	Number of tests ('000s)	Mean upload speed (Mbps)	Median upload speed (Mbps)	Number of tests ('000s)
Verizon	4.47	4.45	6,973	5.60	5.56	2,822
AT&T	4.17	4.04	1,230	4.82	4.58	645
Sprint	0.70	0.55	6,888	1.02	0.67	2,069
T-Mobile	2.54	2.33	944	4.66	4.63	886

Source: Ookla NetIndex data

ii. FCC

7. The FCC Speed Test app is available free of charge for Android phones and for the iPhone. The application measures mobile broadband performance in four active categories: download speed, upload speed, latency and packet loss. Several other passive metrics are also recorded, including signal strength of the connection, and device manufacturer and model.[509] The FCC speed test can be set to automatically run in the background of Android phones, but not iPhone devices, for which the user must execute the speed test manually. No tests are executed if the device is transferring more than 64kbit/s at the time a test is scheduled to execute. Tests that are skipped are rescheduled to execute at a later time. By default the app will limit the total monthly data traffic used for execution of scheduled tests to a maximum of 100MB. Volunteers can adjust the data cap to suit their preference.[510]

8. When starting a measurement cycle, the application runs a brief latency test to measurement servers in the application's configuration. The nearest measurement server with the lowest round-trip latency is selected as the target for all subsequent measurements (throughput, latency and packet loss).[511] In a manner similar to the Ookla test, the FCC test makes an adjustment to account for possible slow TCP startup. If a packet is not received back within three seconds of sending, it is treated as lost.[512]

9. The speed test measures the download and upload speed of the given connection in bits per second by performing multi-connection GET and POST HTTP requests to a target test node. Binary non-zero content, herein referred to as the payload, is hosted on a web server on the target test node. The test operates for either a fixed duration (in seconds) or a fixed volume (in MB). It can also report the recorded average throughput at multiple intervals during the test (e.g. once every five seconds). The client will attempt to download as much of the payload as possible for the duration of the test.[513] The speed test preconditions streams to get past possible slow TCP startup, which can bias the throughput test towards reporting higher throughput.[514] Further details regarding the methodology used in presenting FCC Speed Test app data are provided in the text of this *Report*.

iii. RootMetrics

10. RootMetrics tests data, call, and text performance in all 50 states across the United States. As described by the company, its testing of data performance measures reliability and speed for file uploads and

[509] http://www.fcc.gov/measuring-broadband-america/mobile

[510] http://www.fcc.gov/measuring-broadband-america/mobile

[511] http://www.fcc.gov/measuring-broadband-america/mobile/technical-summary

[512] http://www.fcc.gov/measuring-broadband-america/mobile/technical-summary

[513] http://www.fcc.gov/measuring-broadband-america/mobile/technical-summary

[514] CalSPEED: Measuring California Mobile Broadband - A Comparison of Methodologies

downloads, for downloading email, and for loading lite data files that represent loading typical webpages and apps.[515] Its call testing measures how reliably each network is able to place and maintain calls.[516] Finally, its text testing measures how reliably and quickly consumers can send and receive text messages.[517] RootMetrics uses these measurements to calculate a Reliability Index and a Speed Index, denoted as RootScores, using a proprietary algorithm that it describes as focusing on large-scale patterns of performance and minimizing the effects of isolated, rare events.[518] These RootScores are available for each of the airports and metropolitan areas included in the sample, as well as at the state and national levels.[519] Finally, RootMetrics combines these RootScores using a proprietary method to compute an overall performance score. In this section we discuss only the national Speed Index data for the top four facilities-based providers.

11. The RootMetric Speed Index takes into account the speed measurements of both data and texts. The data speed measurements assess how quickly consumers can connect to the network, as well as how quickly data tasks can be completed online (downloading/uploading files, downloading email, and downloading lite data files that approximate loading a typical webpage or app). The text speed measurements assess how quickly consumers can send and receive text messages.[520] The raw data speed measurements and text speed measurements are then converted by RootMetrics into separate speed indices for data and for text. These separate indices are then combined and converted into overall speed indices using a proprietary algorithm. According to RootMetrics, RootScores (i.e. the indices) are meant to reflect a consumer's experience of network performance and are scaled from 0 – 100, with the lower limit representing network performance that would result in a poor consumer experience and the upper limit reflecting extraordinary performance.[521] Table V.C.v provides the national Speed Index data for the four nationwide providers and their separate data and text components for the second half of 2013 and the first half of 2014.[522] Table V.C.vi provides the same data for California.

[515] During file transfer testing, RootMetrics attempts to open an HTTP connection(s), and then measures network connection success rates, as well as upload and download transfer speeds. The testing measures how reliably and quickly each network is able to: 1) connect to an IMAP server and download a group of 10 emails and 2) establish a network connection and download lite data files to represent typical web and app behaviors. http://www.rootmetrics.com/us/methodology

[516] To measure call performance, RootMetrics places a call from each network's phone and attempts to hold that call open for the duration of the test cycle. The testing shows blocked and dropped outgoing call failure rates. http://www.rootmetrics.com/us/methodology

[517] To analyze texting, RootMetrics measures send failure rates and the speed at which each network can send and receive texts from a phone within its own network and phones within the other networks. http://www.rootmetrics.com/us/methodology

[518] http://www.rootmetrics.com/us/methodology

[519] http://www.rootmetrics.com/us/methodology

[520] http://www.rootmetrics.com/us/methodology

[521] http://www.rootmetrics.com/us/standards. Prior to January 2014, Data RootScores in Metro and Airport RootScore Reports could exceed 100 if performance was extraordinary, http://www.rootmetrics.com/us/methodology.

[522] Source: http://www.rootmetrics.com/us/rsr/united-states/2013/2H and http://www.rootmetrics.com/us/rsr/united-states/2014/1H.

Table VI.C.v
RootMetrics: National Speed Index Data
2nd Half 2013, 1st Half 2014

	2nd Half 2013			1st Half 2014		
	Speed Index	Data Performance	Text Performance	Speed Index	Data Performance	Text Performance
AT&T	88.7	83.9	94.3	71.1	78.1	81.2
Verizon	88.5	87.3	94.7	75.7	81.5	80.4
Sprint	65.8	51.2	92.8	54.2	63.7	78.8
T-Mobile	74.3	48.7	90.1	64.4	67.1	78.4

Source: RootMetrics RootScore Report Data, 2nd half 2013, 1st half 2014.

Table VI.C.vi
RootMetrics: California Speed Index Data
2nd Half 2013, 1st Half 2014

	2nd Half 2013			1st Half 2014		
	Speed Index	Data Performance	Text Performance	Speed Index	Data Performance	Text Performance
AT&T	85.3	80.4	92.2	83.0	89.6	87.9
Verizon	88.5	84.3	92.8	88.9	93.7	88.6
Sprint	62.6	44.7	89.3	62.3	72.0	87.2
T-Mobile	82.5	65.9	90.2	83.0	86.3	87.3

Source: RootMetrics RootScore Report Data, 2nd half 2013, 1st half 2014.

iv. CalSPEED

12. *Description of CalSPEED.*_CalSPEED is a structured sampling program of 1,986 locations (originally 1,200) scattered throughout California. The sites are spread across urban (37 percent), rural (56 percent) and tribal (seven percent), lands. These sites are visited every six months and speed tests are run on the latest available Android phone and also on a USB network device on a Windows based netbook, for each of the four major providers (Verizon, AT&T, Sprint, and T-Mobile).[523] Tests are not performed using iPhones. CalSPEED data was collected in five rounds from the spring of 2012 through Spring 2014.[524]

13. Each test in the structured sampling program is run using the same protocol. Tests are performed inside a stationary automobile. First, a valid GPS reading is obtained from the GPS receiver connected to a netbook, and tests are run using the data cards for each provider. Next, the smart phone tests are performed. Results are uploaded to the cloud-based database server at each location. In cases where data cannot be uploaded from the tested location, the test results remained on the netbook or smart phone until the tester reaches a location with sufficient network coverage to upload the data.[525]

14. Although not yet incorporated into CalSPEED's published speed test results, in April 2013 CalSPEED launched a free mobile speed test app that is available for download on Android phones.[526] The

[523] From CalSPEED: California Mobile Broadband - An Assessment. Ken Biba Managing Director and CTO Novarum, Inc.

[524] Spring 2013 tests were taken between the dates of 4/4/2013 to 4/29/2013, while Fall 2013 tests were taken between the dates of 10/17/2013 to 12/18/2013. Spring 2014 tests were taken between the dates of 4/10/2014 and 6/05/2014.

[525] California Public Utilities Commission: Spring 2012 Mobile Broadband Field Testing Initial Staff Report. September, 2012. pp. 3.

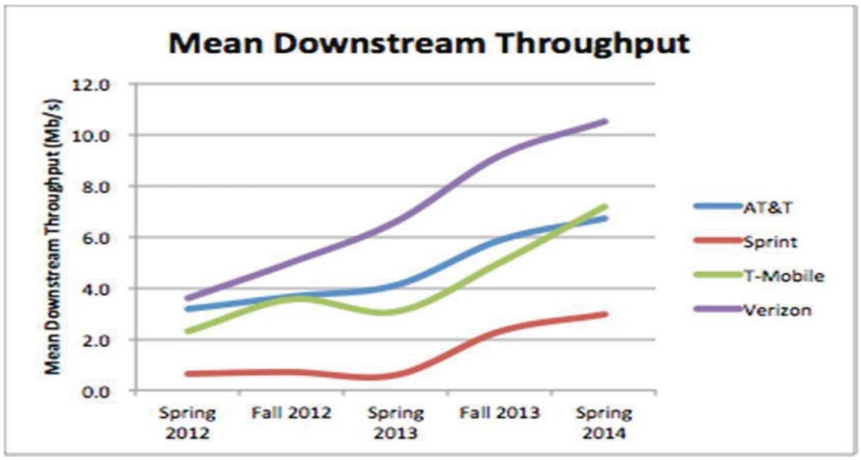
[526] http://calbroadbanddrivetest.blogspot.com/2013/04/calspeed-is-now-available-on-google-play.html

smartphone user must manually run this test, as it does not automatically run in the background of the phone. The CalSPEED crowdsourced data are not included in our analysis.[527]

15. CalSPEED measures the complete network path, from the client device, through the local access network, through the Internet backbone, to two fixed servers. One server is physically located in Northern California and the other in Northern Virginia - both in the Amazon Web Services cloud.[528] CalSPEED measures network metrics including end-to-end packet latency, upload speed, download speed, packet loss and jitter. These data track three major trends over time: changes in performance (throughput, latency and jitter) due to new technology and capacity deployment, changes in performance due to increases in user load, and changes in coverage as providers deploy their footprint. Observations are not included in the analysis if the measurement was taken outside of the carrier's coverage area, or if the tester did not complete the test. Any other errors are counted as zero throughput. CalSPEED reduces their calculated means by one standard deviation.

16. In this *Report*, we present mobile wireless upload and download speeds and latency within the United States for 2013 through Spring 2014. The estimated download speeds by provider are presented in Chart VI.C.i, and the estimated upload speeds by provider are presented in Chart VI.C.ii. In terms of both median and mean speeds, Verizon has the fastest download and upload speeds in 2013, followed by AT&T, T-Mobile, and then Sprint. For the period spanning fall 2013 and spring 2014, Verizon still has the highest mean and median download and upload speeds. T-Mobile shows significant speed improvements in Spring 2014, surpassing AT&T in both mean and median download speeds.

Chart VI.C.i
CalSPEED Mean Downstream Throughput, 2012-2014

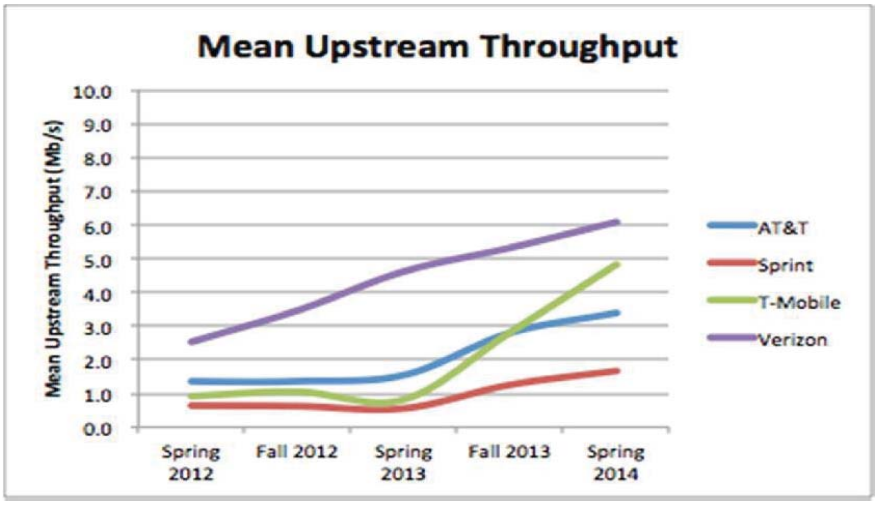


Source: "CALSPEED - California's Mobile Broadband Assessment", November 2014.

Chart VI.C.ii
CalSPEED Mean Upstream Throughput, California, 2012-2014

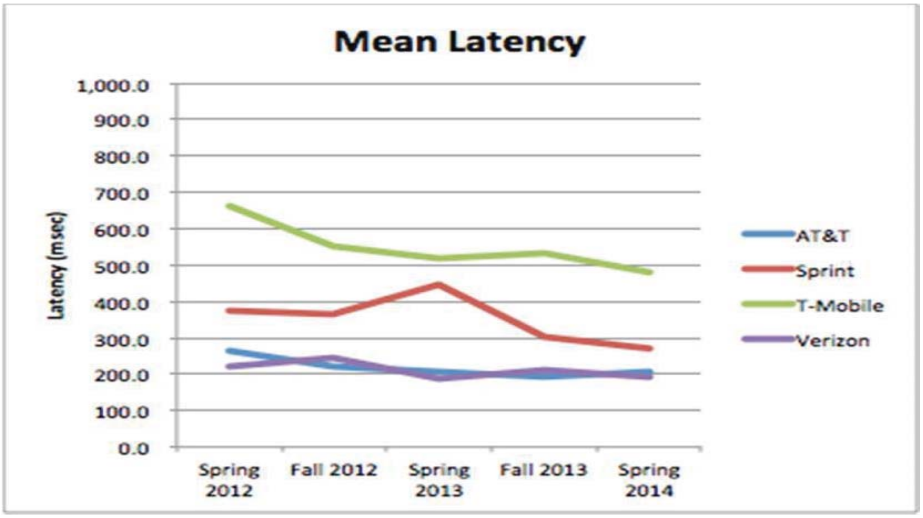
[527] From CalSPEED: California Mobile Broadband - An Assessment. Ken Biba Managing Director and CTO Novarum, Inc.

[528] From CalSPEED: California Mobile Broadband - An Assessment. Ken Biba Managing Director and CTO Novarum, Inc.



Source: "CALSPEED - California's Mobile Broadband Assessment", November 2014.

Chart VI.C.iii
CalSPEED Mean Latency, California, 2012-2014



Source: "CALSpeed - California's Mobile Broadband Assessment", November 2014.

APPENDIX VII

LIST OF ABBREVIATIONS AND ACRONYMS

2G	Second Generation
3G	Third Generation
4G	Fourth Generation
ALMB	Average Local Monthly Bill

ARPU	Average Revenue Per User
ATN	Atlantic Tele-Network
AWS	Advanced Wireless Service
BEA	Bureau of Economic Analysis
BLS	Bureau of Labor Statistics
BRS	Broadband Radio Service
BTA	Basic Trading Area
CFR	Code of Federal Regulations
CAPEX	Capital Expenditures
CDC	Centers for Disease Control
CDMA	Code Division Multiple Access
CEA	Component Economic Area
CEO	Chief Executive Officer
CMA	Cellular Market Area
CMRS	Commercial Mobile Radio Services
CPI	Consumer Price Index
DA	Delegated Authority
DAS	Distributed Antenna System
DOJ	Department of Justice
DSL	Digital Subscriber Line
EA	Economics Area
EBIT	Earnings before Interest and Taxes
EBITDA	Earnings before Interest, Taxes, Debt, and Amortization
EBS	Educational Broadband Service
EDGE	Enhanced Data Rates for Global Evolution
EHA	Exclusive Handset Agreement
ETF	Early Termination Fee
EV-DO	Evolution Data Optimized
FCC	Federal Communications Commission
FDD	Frequency Division Duplex
FNPRM	Further Notice of Proposed Rulemaking
FSS	Frequency Spread Spectrum
FTC	Federal Trade Commission
GAO	Government Accountability Office
GB	Gigabyte
GHz	Gigahertz
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communication
HHI	Herfindahl-Hirschman Index
HSPA	High Speed Packet Access
HTC	HTC Corporation
HTML	HyperText Markup Language
HTTP	Hypertext Transfer Protocol
IB	International Bureau
iDEN	Integrated Digital Enhanced Network
ILEC	Independent Local Exchange Carrier
ITIF	Information Technology & Innovation Foundation
ITU	International Telecommunication Union
kbps	Kilobits per Second
LEC	Local Exchange Carrier
LLC	Limited Liability Corporation
LNP	Local Number Portability
LTE	Long Term Evolution
M&O	Management and Operations
M2M	Machine-to-Machine
MB	Megabyte

Mbps	Megabits per Second
MEA	Major Economic Area
MHz	Megahertz
MIMO	Multiple Input Multiple Output
MMS	Multimedia Messaging Service
MOUs	Minutes of use (average minutes of use per subscriber per month)
MSA	Metropolitan Statistical Area
MSS	Mobile Satellite Service
MTA	Major Trading Area
MVNO	Mobile Virtual Network Operator
NCHS	National Center for Health Statistics
NFC	Near-Field Communication
NHIS	National Health Interview Survey
NIST	National Institute of Standards and Technology
NOI	Notice of Inquiry
NPA-NXX	the first six digits of a ten-digit telephone number
NPAC	Number Portability Administration Center
NPRM	Notice of Proposed Rulemaking
NRUF	Numbering Report / Utilization Forecast
NTCA	National Telecommunications Cooperative Association
NTIA	National Telecommunications and Information Administration
OBI	Omnibus Broadband Initiative
OET	Office of Engineering & Technology
OS	Operating System
PC	Personal Computer
PCS	Personal Communications System
PN	Public Notice
POPs	population (people)
PSTN	Public Switched Telephone Network
PUC	Public Utility Commission
R&D	Research and Development
R&O	Report and Order
RF	Radio Frequency
RIM	Research in Motion
RPM	Revenue per Minute
RSA	Rural Service Area
SEC	Security and Exchange Commission
SF 1	Summary File 1
SIM	Subscriber Identity Module
SMR	Specialized Mobile Radio
SMS	Short Message Service
TB	Terabyte
TDD	Time Division Duplex
TDM	Time Division Multiplexing
TDMA	Time Division Multiple Access
ULS	Universal Licensing System
UMTS	Universal Mobile Telecommunications System
US	United States
USB	Universal Serial Bus
USC	United States Code
USF	Universal Service Fund
VoIP	Voice over Internet Protocol
VZ	Verizon
WCDMA	Wideband Code Division Multiple Access
WCS	Wireless Communications Service
WiMAX	Worldwide Interoperability for Microwave Access

WLAN	Wireless Local Area Network
WTB	Wireless Telecommunications Bureau

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