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by the FCC’s Internet Access Report), Comcast’s fixed broadband share was 29.8 percent and TWC’s share was 13.0 percent in December 2012, even without including any mobile broadband customers in the calculations. (See Table 1.) After divestiture of three million customers, the post-transaction shares for the combined firm (again ignoring mobile broadband competition) will equal 39.5 percent.⁴⁴ If mobile wireless customers are included in the share calculation, the pre-transaction shares for Comcast and TWC are 15.0 percent and 6.5 percent, respectively, and the post-transaction share with the proposed divestitures is 19.9 percent.⁴⁵

Table 1: Comcast and TWC Broadband Shares for at Least 3 Mbps Downstream and 768 Kbps Upstream, December 2012

Subscriber Type	Subscriptions				Shares		
	Comcast	TWC	Combined	Total U.S.	Comcast	TWC	Combined
Fixed Broadband Only			25,505,903	64,596,000			39.5%
Fixed and Mobile Broadband			25,505,903	128,472,000			19.9%

Notes: The combined figure includes proposed divestitures. The 3 million divestitures are scaled down to || based on the ratio of TWC subscribers with at least 3 Mbps/down and 768 Kbps/up speed to all TWC HSD subscribers.

Sources: FCC Form 477 data (December 2012); FCC IAS Report (December 2013) (reporting data from December 2012).

wireless) and “mobile” wireless service. I have estimated shares both excluding and including mobile wireless in the universe of all broadband customers.

⁴⁴ David L. Cohen, “Comcast and Time Warner Cable Announce Merger, Detail Public Interest Benefits and Undertakings,” *Comcast Voices*, February 13, 2014, available at <http://corporate.comcast.com/comcast-voices/comcast-and-time-warner-announce-merger-detail-public-interest-benefits-and-undertakings>, site visited April 2, 2014 (indicating that Comcast is “prepared to divest systems serving approximately 3 million managed subscribers.”)

⁴⁵ I discuss competition between wireline and wireless broadband in Section II.B.1(b).

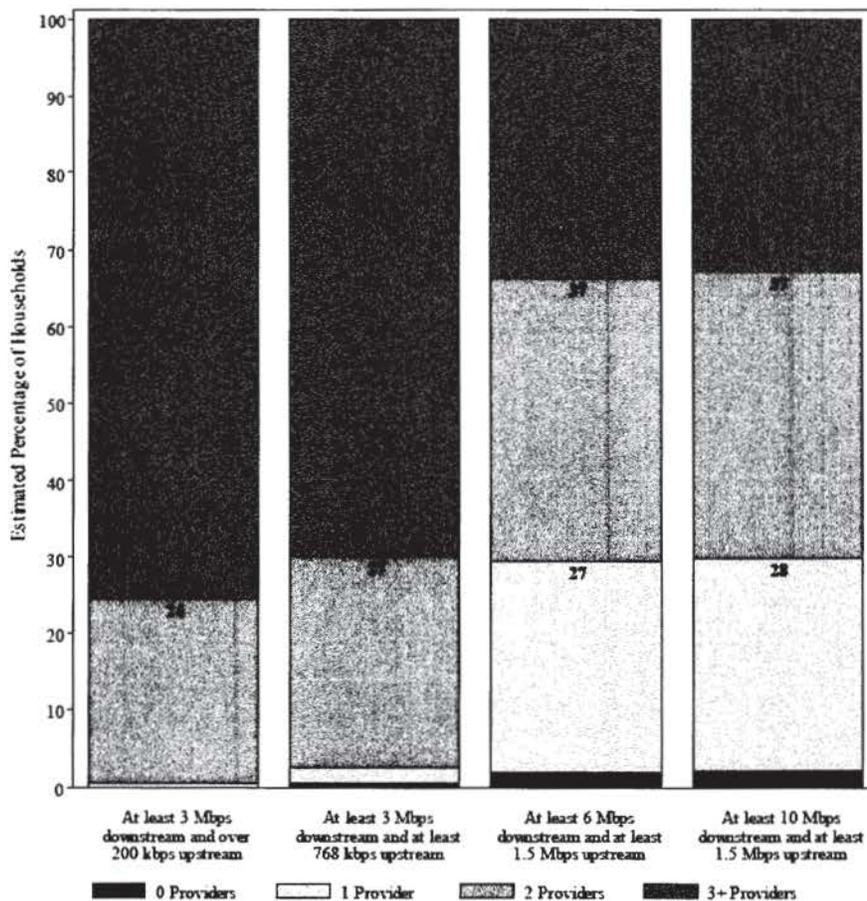
(2) *Other broadband providers provide a set of alternative platforms on which edge providers can reach end consumers*

43. The vast majority of consumers have access to multiple fixed broadband competitors. For example, as shown in Figure 1, the most recent *FCC IAS Report* indicates that approximately 97 percent of households are located in census tracts in which two or more fixed broadband providers report offering at least 3 Mbps downstream and 768 kbps upstream and approximately 70 percent are located in census tracts in which two or more providers report offering at least 10 Mbps downstream and at least 1.5 Mbps upstream.⁴⁶

⁴⁶ *FCC IAS Report*, Figure 5(a). Recall that Comcast and TWC do not overlap anywhere. Although the *FCC IAS Report* indicates that “the number of providers shown in Figure 5(a) does not necessarily reflect the number of choices available to a particular household, and does not purport to measure competition,” it nonetheless provides a sense of options available to consumers. In the following section, I provide more detail on the specific options available to residential consumers in Comcast’s and TWC’s footprints.

Figure 1: Fixed Broadband Options (Replicated from *FCC IAS Report*)

Figure 5(a)
 Percentages of Households Located in Census Tracts Where Providers Report Residential Fixed-Location Connections of Various Speeds as of December 31, 2012



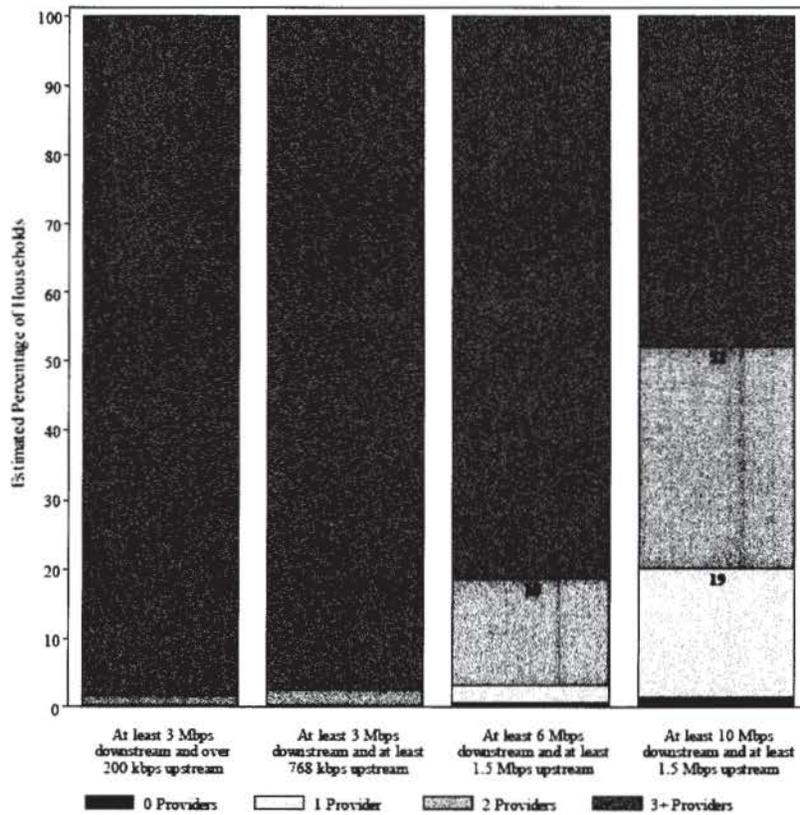
Figures may not sum to 100% due to rounding.

44. Taking into account mobile wireless broadband options, consumers have even more options. For example, as shown in Figure 2, approximately 97 percent of households are located in census tracts in which three or more broadband providers report offering at least 3 Mbps downstream and 768 kbps upstream or operate a mobile wireless network capable of delivering at least those speeds and approximately 80 percent are

located in census tracts in which two or more providers report offering at least 10 Mbps downstream and at least 1.5 Mbps upstream or operate a mobile wireless network capable of delivering at least those speeds.⁴⁷

Figure 2: Fixed and Mobile Broadband Options (Replicated from *FCC IAS Report*)

Figure 5(b)
Percentages of Households Located in Census Tracts Where Providers Report Residential Fixed-Location Connections of Various Speeds or Operate a Mobile Wireless Network Capable of Delivering Service of Various Speeds as of December 31, 2012



Figures may not sum to 100% due to rounding.

⁴⁷ *FCC IAS Report*, Figure 5(b).

45. Moreover, given the advances in fixed and mobile broadband speeds and coverage described in the following section, data from 2012 is likely to understate the options available to consumers.

46. In sum, the vast majority of customers in the footprint of the combined firm have multiple broadband providers from which to choose. Most importantly, the transaction does not change the number of broadband providers available to consumers and thus will have no impact on the competitive situation for any household.⁴⁸

47. The availability of these alternative broadband providers means that any action that the combined firm takes to reduce the value of its broadband service may induce customers to switch to alternative providers and therefore be costly to Comcast. And this possibility is heightened by the fact that edge providers (or their agents) have an incentive to encourage consumers to switch ISPs if that is competitively advantageous to them.

48. Below, I provide more detail on each of the main technologies used by these broadband competitors.

(a) FTTP

49. In a portion of their footprints, Comcast and TWC face competition from firms providing broadband via “fiber to the premises” (“FTTP”), a very high-quality form of

⁴⁸ See Section II.A.

broadband service. Ordinary-course documents indicate that Comcast and TWC consider broadband competition from FTTP providers to be an important competitive constraint.⁴⁹

50. A leading example of FTTP service is Verizon’s FiOS service, which is based on a 100 percent fiber-optic network. Verizon’s FiOS network enables the provision of broadband that typically meets or exceeds the speed offered by cable operators today, offering speeds up to 500 Mbps downstream and 100 Mbps upstream.⁵⁰ Verizon FiOS overlaps approximately [] percent of Comcast’s footprint and 13 percent of TWC’s footprint.⁵¹

51. Competition from FTTP providers is likely to increase in the future. Google recently entered the broadband marketplace, relying on FTTP service that offers speeds of up to one Gbps in both directions.⁵² Google Fiber is currently available in Kansas City,

⁴⁹ See, e.g., []

[].

⁵⁰ See <http://www.verizon.com/home/fios/>, site visited March 28, 2014.

⁵¹ []

[]; Arthur T. Minson, “Morgan Stanley Technology, Media & Telecom Conference (Transcript),” March 5, 2014.

I understand that Verizon has indicated that it does not intend to expand the FiOS footprint, but it is a strong competitor where it exists.

⁵² Carlos Kirjner and Ram Parameswaran, “Google Fiber: A Good Shot at Being Profitable and at (Very) Slowly Boiling the Incumbent Frog,” Bernstein Research, May 28, 2013, 6. Google charges customers a \$300 “construction fee” plus \$120 per month for 1 Gbps Internet plus TV, \$70 for 1 Gbps Internet, and no fee for 5 Mbps Internet. Jon Fingas, “Google Fiber Gets Formal Launch, Adds Google Fiber TV (Update: Event Video),” *Engadget*, July 26, 2012.

MO, Austin, TX, and Provo, UT, and Google is now in discussions with 34 cities in nine metro areas across the country to explore the rollout of a new fiber-optic network.⁵³

Comcast and/or TWC have a presence in eight of the nine metro areas being considered, and 31 of the 34 cities within those metro areas.⁵⁴ And ordinary-course decisions demonstrate the relevance of competition from Google, with both Comcast and TWC responding to Google's entry and expansion.⁵⁵

52. Although it is unclear exactly how the expansion of Google Fiber will progress, Google has a vested interest in maintaining competitive broadband markets, because its products and services are complementary to broadband service, meaning that Google benefits directly from competition in broadband markets.⁵⁶

⁵³ See <https://fiber.google.com/newcities/>, *site visited* March 10, 2014.

⁵⁴ Calculations based on data provided by Comcast and TWC.

⁵⁵ II

II. TWC recently increased the download speed in its highest tier from 50 Mbps to 300 Mbps in parts of Austin. (Brad Reed, "This Is What Happens When Time Warner Cable Is Forced to Compete," *BGR*, February 20, 2014, *available at* <http://bgr.com/2014/02/20/time-warner-cable-internet-speeds-austin/>, *site visited* March 28, 2014)

⁵⁶ Executives at Google have stated that they "always have profitability as one of the key criteria" for Google Fiber. (See "Google Inc (GOOG) CEO Discusses Q2 2013 Results – Earnings Call Transcript," July 18, 2013, *available at* <http://seekingalpha.com/article/1557292-google-inc-goog-ceo-discusses-q2-2013-results-earnings-call-transcript>, *site visited* March 28, 2014.)

However, industry experts have argued that Google has "larger ambitions" than simply operating a standalone ISP. Goldman Sachs, for instance, has pointed out that "Fiber's vastly greater speeds have the potential to drive more processing to the cloud and accelerate HTML5 adoption, thereby potentially breaking down the current ecosystem of

53. Similarly, AT&T recently began deploying FTTP in certain cities. Specifically, AT&T introduced its GigaPower product in Austin, TX. GigaPower is based on a 100 percent fiber optic network and AT&T is promising speeds up to 1 Gbps in 2014.⁵⁷ Randall Stephenson, Chairman and CEO of AT&T, recently indicated that AT&T is in the process of expanding its deployment of GigaPower:⁵⁸

And the cost dynamics to this [GigaPower] deployment have been really, really encouraging...And in fact I would tell you, we are so encouraged that we want to begin taking this to other communities and what we're doing is in cities and municipalities, we can get the terms and conditions like we have in Austin. We are redirecting VIP investment to fiber to the home deployment, and in fact we are going to launch the service in Dallas this summer. And so you are going to see other communities as we begin to deploy this technology emerge around the United States.

54. Moreover, new FTTP deployment is not limited to Google and AT&T. As of May 2013, there were 135 municipal FTTP networks in the United States.⁵⁹

end-point devices and client-side [operating systems]. These last two moves could serve to cement Google's dominance as a provider of enhanced web-services on both mobile devices and PCs." Consequently, "Google is ultimately indifferent to whether it or incumbent broadband providers deliver fiber-optic internet speeds since either case supports the company's vision of an open, services-based web." (Heather Bellini, Jason Armstrong, Drew Borst, Brian Baytosh, and Dan Pelligrini, "Google Fiber – Build or Bluff," Goldman Sachs, June 28, 2013, 1.)

⁵⁷ See <http://www.att.com/shop/u-verse/gigapower.html>, *site visited* March 28, 2014.

⁵⁸ "AT&T's CEO Presents at Morgan Stanley Technology, Media & Telecom Conference (Transcript)", March 6, 2014, *available at* <http://seekingalpha.com/article/2072813-at-and-ts-ceo-presents-at-morgan-stanley-technology-media-and-telecom-conference-transcript>, *site visited* March 28, 2014.

⁵⁹ Masha Zager, "Number of Municipal FTTP Networks Climbs to 135," *Broadband Communities*, May/June 2013, *available at*

(b) DSL

55. In many areas without FTTP service, telephone providers (“telcos”) have built out partial fiber networks that utilize fiber in the core network, but not all the way to the home, and then use DSL technology that relies on copper wiring to connect homes to the network.⁶⁰ Advanced services like VDSL, which are based on “fiber-to-the-node” (“FTTN”) architecture, offer speeds up to 100 Mbps.⁶¹ Non-FTTN DSL technology can deliver speeds up to 45 Mbps, which is more than sufficient to download HD movies, to watch streaming HD video, and for gaming.⁶²

56. With regard to FTTN technologies (including VDSL) in particular, the competitive threat to cable is well established. For example, international experience indicates that VDSL is an important high-speed broadband competitor to cable

<http://www.bbpmag.com/Features/0513feature-MuniCensus.php>, *site visited* March 12, 2014.

⁶⁰ DSL is a technology that facilitates the transmission of data over copper wires.

⁶¹ Karl Bode, “AT&T: 45 Mbps U-Verse Coming in ‘Next Few Months,’” *DSLReports.com*, July 24, 2013, *available at* <http://www.dslreports.com/shownews/ATT-45-Mbps-UVerse-Coming-in-Next-Few-Months-125101>, *site visited* April 2, 2014. (“With our plant technology advancements, 90 percent of our U-verse customer locations will have the capability to receive what we project to be 75 Mbps -- and 75 percent will have the capability to receive up to 100 Mbps,’ AT&T CEO John Donovan said back in January [2013]. ‘Almost 80 percent of the IP DSLAM customer locations will have the capability to receive 45 Mbps, with about half of those having the capability to receive up to 75 Mbps.’”)

⁶² *Id.* See also, Federal Communications Commission, “Broadband Speed Guide,” *available at* <https://www.fcc.gov/guides/broadband-speed-guide>, *site visited* April 2, 2014 (indicating that 4 Mbps is the minimum download speed required for HD-quality streaming, HD video conferencing, and two-way online gaming in HD.)

broadband.⁶³ Domestically, AT&T and CenturyLink, among other telcos, offer FTTN service in Comcast's and TWC's footprints. For example, AT&T's FTTN service, U-Verse, overlaps approximately [] percent of Comcast's footprint and CenturyLink's FTTN service overlaps approximately [] percent of Comcast's footprint.⁶⁴ Similarly, AT&T's U-Verse service overlaps approximately 28 percent of TWC's footprint.⁶⁵

57. The competitive pressure imposed by wired telco providers is likely to increase over time as telcos invest in new technologies, including FTTN and others, that improve the quality of their broadband services. In November 2012, AT&T announced plans to invest \$6 billion over the next three years to expand and upgrade its wireline network to include 57 million customer locations, representing 75 percent of its footprint.⁶⁶ The investments will upgrade and expand the FTTN-based U-verse footprint to 33 million

⁶³ Tim Johnson, "VDSL in Europe's future," Point Topic, August 1, 2013.

⁶⁴ []
[]]. Both AT&T and CenturyLink also offer FTTP in limited geographic areas. AT&T and CenturyLink also offer non-FTTN DSL services. I do not count the latter in the overlap statistics described in this paragraph.

⁶⁵ Arthur T. Minson, "Morgan Stanley Technology, Media & Telecom Conference (Transcript)," March 5, 2014.

⁶⁶ AT&T, "Laying a Foundation for Future Growth," November 7, 2012, 10, 39, and 96, available at http://www.att.com/Common/about_us/files/pdf/analyst_presentation_c.pdf, site visited April 2, 2014.

customer locations with broadband download speeds up to 100 Mbps.⁶⁷ And the speeds achievable using DSL technologies are expected to continue to increase; for example, Comcast anticipates that providers such as [[]] may be able to use new DSL technologies to achieve speeds as high as [[]] by the end of [[]].⁶⁸

58. Moreover, AT&T's chairman and CEO recently indicated that AT&T intends to accelerate its U-Verse expansion *in direct response to the proposed transaction*, demonstrating its pro-competitive nature (developed more fully in Section IV, below).⁶⁹

59. The DSL advances are not limited to FTTN. For example, outside the U-Verse footprint, AT&T will also upgrade ATM-DSLAMS to IP-DSLAMS for another 24 million households, allowing it to achieve speeds as high as 45 Mbps.⁷⁰

⁶⁷ AT&T, "Laying a Foundation for Future Growth," November 7, 2012, 39, *available at* http://www.att.com/Common/about_us/files/pdf/analyst_presentation_c.pdf, *site visited* April 2, 2014. *See also* note 61.

⁶⁸ [[]]

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⁶⁹ "AT&T's CEO Presents at Morgan Stanley Technology, Media & Telecom Conference (Transcript)", March 6, 2014, *available at* <http://seekingalpha.com/article/2072813-at-and-ts-ceo-presents-at-morgan-stanley-technology-media-and-telecom-conference-transcript>, *site visited* March 28, 2014. ("...in light of a new competitor, a new structure in the industry where we are going to be a little more aggressive and assertive in deploying that technology around the country.")

⁷⁰ AT&T, "Laying a Foundation for Future Growth," November 7, 2012, *available at* http://www.att.com/Common/about_us/files/pdf/analyst_presentation_c.pdf, *site visited* April 2, 2014), 39.

60. Overall, DSL is broadly deployed and the Commission considers it an effective broadband option.⁷¹ For example, the Commission recently found that “while there are some differences between technologies, DSL, cable, and fiber-to-the-home all are delivering quality service generally consistent with the speeds advertised.”⁷² Similarly, the Commission’s data indicate that, between December 2008 and December 2012, DSL-based broadband connections grew at an average annual rate of 25 percent, relative to cable broadband connections that grew at an average annual rate of only 18 percent.⁷³

(c) Wireless providers

61. Wireless broadband is increasingly becoming a competitor to wireline broadband, particularly with the rollout of 4G LTE and associated dramatic improvement in wireless speeds over the last few years. Currently, the fastest mobile LTE networks in the United States achieve average speeds of close to 20 Mbps and peak realized speeds of more than

⁷¹ *In the Matter of Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion, and Possible Steps to Accelerate Such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996, as Amended by the Broadband Data Improvement Act*, GN Docket No. 11-121, Eighth Broadband Progress Report, August 21, 2012, available at http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-12-90A1.pdf, site visited March 31, 2014, ¶ 60. (“Overall, more than 94 percent of Americans have access to fixed broadband meeting the speed benchmark. Cable providers continue to report the largest coverage area (85 percent) followed by DSL providers (79 percent).”)

⁷² *Id.*, ¶ 124.

⁷³ *FCC IAS Report*, Table 7.

70 Mbps.⁷⁴ Next generation wireless networks are expected to offer even faster speeds. For example, providers in Finland recently demonstrated LTE Advanced (“LTE-A”) technology that achieved data rates of 300 Mbps on a live commercial network.⁷⁵

62. High-speed wireless broadband networks have expanded their footprints dramatically in recent years and are now nearly ubiquitous in the United States. For example, Verizon’s 4G LTE network covers more than 97 percent of the population and Verizon continues to upgrade its LTE network by, among other things, adding additional spectrum.⁷⁶ According to NTIA data, the percentage of U.S. population with access to a mobile wireless provider offering broadband speed of 3 Mbps downstream and 768 kbps upstream or higher *increased from 46.9 percent to 99.3 percent between December 2010 and June 2013*. Similarly, the percentage of population with access to a mobile wireless provider offering downstream speed of at least 10 Mbps *increased from 7.9 percent in December 2010 to 97.3 percent in June 2013*. (See Figure 3 for a depiction of these

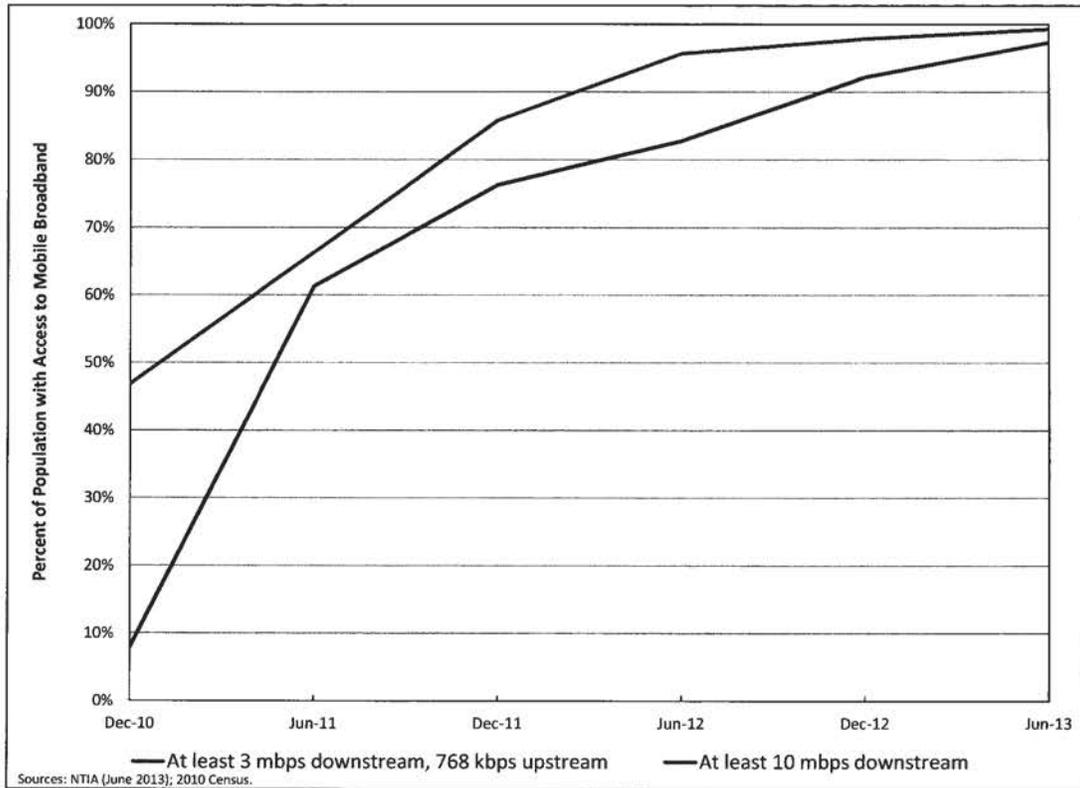
⁷⁴ See, e.g., T-Mobile USA, Press Release, “Customer Data Proves T-Mobile Network Now Fastest 4G LTE in the U.S.,” January 8, 2014, *available at* <http://newsroom.t-mobile.com/phoenix.zhtml?c=251624&p=irol-newsArticle&ID=1889173&highlight>, *site visited* March 28, 2014.

⁷⁵ Martha DeGrasse, “LTE-A in Finland Hits 300 Mbps on Live Network,” *RCRWireless*, February 11, 2014, *available at* <http://www.rcrwireless.com/article/20140211/carriers/lte-a-in-finland-hits-300-mbps-on-live-network/>, *site visited* March 28, 2014.

⁷⁶ See <http://www.verizonwireless.com/wcms/consumer/4g-lte.html>, *site visited* March 28, 2014. See also, Kevin Fitchard, “Verizon Quietly Unleashes Its LTE Monster, Tripling 4G Capacity in Major Cities,” *GigaOm*, December 5, 2013, *available at* <http://gigaom.com/2013/12/05/verizon-quietly-unleashes-its-lte-monster-tripling-4g-capacity-in-major-cities/>, *site visited* March 28, 2014.

dramatic trends in access to high-speed wireless broadband service.) Data from SNL Kagan indicate that by the end of 2018 there will be 316 million primary 4G LTE subscriptions and 224 million pure 4G LTE subscriptions in the United States.⁷⁷

Figure 3: Access to Mobile Broadband



⁷⁷ SNL Kagan defines primary 4G LTE subscriptions as those where the customer has a 4G plan and drops back to 3G only when 4G LTE reception fails. It defines pure 4G LTE subscriptions as those where the customer uses 4G LTE networks exclusively, with no (or minimal) fallback to 3G networks. (“Covered Pops & Subscribers by Technology in U.S. Wireless,” SNL Kagan, July 2013.)

63. A special type of wireless services is fixed wireless. Fixed wireless uses radio spectrum, typically licensed to providers of wireless telecommunications services, to communicate between two fixed points.⁷⁸ Although fixed wireless currently comprises less than one percent of residential broadband connections, recent announcements by wireless carriers and satellite companies indicate that it may become significantly more prominent in the future.⁷⁹ For example, DISH Network recently began trials in which it partners with wireless providers such as Sprint and Ntelos to provide fixed wireless services.⁸⁰ Sprint and DISH Network have announced plans to expand the service to additional markets beyond the initial test markets.⁸¹ In recent trials, Sprint and DISH

⁷⁸ Federal Communications Commission, “Internet Access Services: Status as of December 31, 2012,” (hereinafter *Internet Access Services Report*), 81, available at http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-324884A1.pdf, site visited March 31, 2014.

⁷⁹ As of December 2012, fixed wireless accounts for approximately 0.4 percent of fixed residential broadband connections and approximately 0.5 percent of wireless residential connections. (See *Internet Access Services Report*, 26.)

⁸⁰ See Dan Jones, “Dish Taps Sprint for 4G Trial in Texas,” *LightReading*, December 17, 2013, available at <http://www.lightreading.com/mobile/4g-lte/dish-taps-sprint-for-4g-trial-in-texas/d/d-id/707023>, site visited March 31, 2014; Sarah Reedy, “Son: Dish Could be Sprint’s Great Ally,” *LightReading*, March 27, 2014, available at <http://www.lightreading.com/mobile/4g-lte/son-dish-could-be-sprints-great-ally/d/d-id/708408>, site visited March 31, 2014.

⁸¹ Sprint, Press Release, “Sprint and DISH to Trial Fixed Wireless Broadband Service,” December 17, 2013, available at <http://newsroom.sprint.com/news-releases/sprint-and-dish-to-trial-fixed-wireless-broadband-service.htm>, site visited March 31, 2014.

achieved download speeds of 200 Mbps.⁸² Verizon also offers a HomeFusion fixed wireless product based on its LTE network, which offers average download speeds of five to 12 Mbps.⁸³

64. Recent research undertaken by [[
]] highlights the growing competitive threat to cable broadband operators imposed by wireless LTE technology.⁸⁴

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65. Moreover, estimates of the degree of wireless substitution are increasing over time. {{

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⁸² Sarah Reedy, “Son: Dish Could be Sprint’s Great Ally,” *LightReading*, March 27, 2014, available at <http://www.lightreading.com/mobile/4g-lte/son-dish-could-be-sprints-great-ally/d/d-id/708408>, site visited March 31, 2014.

⁸³ Verizon Wireless, “4G LTE HomeFusion Broadband,” available at <http://www.verizonwireless.com/b2c/homefusion/hf/main.do>, site visited April 2, 2014.

⁸⁴ [[
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⁸⁵ *Id.* at 3.

⁸⁶ *Id.* at 3. [[
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66. Industry participants back up the views expressed by || ||. For example, TWC recently concluded that {{

}}.⁸⁹ And both AT&T and Verizon have stated that their strategy is to supplement their FTTP and FTTN networks with LTE outside of their fiber footprints.⁹⁰

67. Making wireless networks more competitive over time is the rapid decline in the cost of sending data over such networks, which, as a matter of economics, puts corresponding downward pressure on wireless prices. As more spectrum is released (*e.g.*, through the upcoming 600 MHz incentive auction) and average spectral efficiency continues to improve through broader LTE deployment and advances in LTE

⁸⁸ || ||.

⁸⁹ Kevin Leddy, Executive Vice President, Corporate Strategy, TWC, February 28, 2014, interview.

⁹⁰ See AT&T, "Laying a Foundation for Future Growth," November 7, 2012, 13, 54, available at http://www.att.com/Common/about_us/files/pdf/analyst_presentation_c.pdf, site visited April 2, 2014; Fran Shammo (Verizon Communications Inc. Executive Vice President & Chief Financial Officer), 3Q11 Earnings Call, October 21, 2011. ("Now those lines that are outside that FiOS [area] and outside of any potential of passing ever with FiOS we will continue to be competitive in this area but I think it's going to be around LTE.")

technology,⁹¹ the associated increase in the capacity of wireless networks will put downward pressure on the cost and price per gigabyte on wireless networks. Indeed, this trend can be seen in recent history, as the price per gigabyte paid by consumers fell roughly [[[REDACTED]]].⁹² Going forward, wireless providers' costs are expected to fall an additional [[[REDACTED]]] over the next several years, which should in turn reduce consumer prices substantially.⁹³ Due to these declines in cost and thus price per gigabyte, wireless broadband will likely become an increasingly economical alternative in coming years, including higher usage levels as wireless networks progress.

(d) Other ISPs

68. Comcast and TWC also face competition from a variety of other ISPs within their footprints:⁹⁴

- Satellite broadband also provides a broadband option, especially in more rural areas. For example, ViaSat currently offers download speeds of 12 Mbps and

⁹¹ See FCC, "Incentive Auctions," available at <http://www.fcc.gov/incentiveauctions>, site visited March 28, 2014; [[[REDACTED]]].

⁹² [[[REDACTED]]].

⁹³ *Id.*, 19.

⁹⁴ *FCC IAS Report*, 26.

plans to launch a new, higher-capacity satellite in 2016.⁹⁵ Similarly, HughesNet recently launched a fourth generation satellite that offers download speeds of 15 Mbps.⁹⁶ The Commission recently recognized the improved quality of satellite broadband and found that “it will support many types of popular broadband services and applications.”⁹⁷

- Cable overbuilders such as RCN and WOW! are available to [[]] percent of households within Comcast’s footprint.⁹⁸ Cable overbuilders typically offer broadband services with download speeds in excess of 100 Mbps.⁹⁹

(c) *Edge providers can access the customers of any particular broadband provider through an array of interconnection alternatives*

69. The discussion in part (b) above illustrates that the existence of *multiple broadband providers* creates multiple ways for edge providers to reach end consumers.

In this section, I explain that the nature of Internet interconnection means that edge

⁹⁵ ViaSat, “High-Capacity Satellite System,” available at <http://www.viasat.com/broadband-satellite-networks/high-capacity-satellite-system>, site visited March 28, 2014.

⁹⁶ HughesNet, “Gen4 Plans,” available at <http://www.hughesnet.com/index.cfm?page=Plans-Pricing>, site visited March 31, 2014.

⁹⁷ Federal Communications Commission, “2013 Measuring Broadband America February Report: A Report on Consumer Wireline Broadband Performance in the US,” February 2013, 7, available at <http://transition.fcc.gov/cgb/measuringbroadbandreport/2013/Measuring-Broadband-America-feb-2013.pdf>, site visited March 28, 2014.

⁹⁸ See [[]] Note that Frontier has been excluded from the share as it is not considered an overbuilder.

⁹⁹ See, e.g., <http://www.rcn.com/dc-metro/high-speed-internet/services-and-pricing>, site visited March 28, 2014.

providers have multiple, cost-effective ways to reach the customers of *a given broadband provider*, such as Comcast or TWC.

70. As explained above, the presence of these multiple paths into the combined firm's network has important implications for any claim that the combined firm could harm edge providers by limiting their access to its network. First, the fact that any edge provider can contract with one or more CDNs or transit providers—potentially even “multi-homing” to obtain several alternative access paths into the Comcast network—means that these access alternatives are open to all edge providers, whether large or small, with small edge providers effectively able to pool their content with other providers who use a given CDN or transit provider. As described below, large edge providers may also contract directly with Comcast to arrange interconnection terms, but this is simply a direct version of what other edge providers—which may not place enough content on the Comcast network to make such direct contracting cost-efficient—can accomplish via CDNs and transit providers. Second, to meaningfully hinder these alternative access paths, Comcast would have to downgrade substantially its connectivity with the broader Internet, thus harming its broadband offering.

71. In what follows, I begin with some background on the nature of Internet interconnection, then explain how the wide array of alternatives for interconnection creates multiple paths by which edge providers can reach the combined firm's customers,

and finally detail the ways in which this interconnection environment limits any power an ISP has over edge providers.¹⁰⁰

(1) *Background on Internet interconnection*

72. The collection of networks that make up the Internet interconnect with one another through a variety of physical and financial arrangements.¹⁰¹ Traditionally, two types of commercial arrangements to exchange traffic have been common:

- *Transit*: One network (e.g., a local ISP)¹⁰² or edge provider contracts with another network (e.g., a national backbone provider)¹⁰³ to deliver its traffic to all other destinations on the Internet; and
- *Peering*: Two networks exchange traffic to be delivered to/from only one another and one another's direct customers. Peering may be either "paid" or "settlement-free," with settlement-free peering meaning that no money changes hands between connecting networks, but rather there is an exchange of roughly like "value" to

¹⁰⁰ The discussion in this section draws heavily on *Besen and Israel (2013)*. See also, Christopher S. Yoo (2010), "Innovations in the Internet's Architecture that Challenge the Status Quo," *J. on Telecomm. & High Tech. L.*, 8:79-99.

¹⁰¹ *Id.*

¹⁰² Examples of ISPs include Comcast, TWC, Verizon, and AT&T. (*Id.*)

¹⁰³ Backbone ISPs are sometimes distinguished by tier. As a general matter, Tier 1 backbone providers are defined as those that can reach the entire Internet without interconnecting with other transit providers and include Deutsche Telekom, Level 3, AT&T, Verizon, CenturyLink, Intelliquent, Sprint, NTT, TeliaSonera, and Tata. Tier 2 and 3 providers must interconnect with other transit providers in some cases. However, these tier definitions are becoming increasingly blurred over time. (*Id.* See also, *Level 3-Global Crossing Order*, ¶ 19.)

terminate one another's traffic.¹⁰⁴ Peering occurs not only between networks, but also is sometimes provided by a network to a CDN or large edge providers, typically on a paid basis.

73. Content delivery networks (CDNs) such as Akamai, Limelight, CDNetworks, Cloud Flare, EdgeCast, Amazon CloudFront, Level 3, and a host of others play a particularly important role in the evolving Internet architecture. Edge providers, whether large or small, can contract with CDNs, which effectively provide wholesale content distribution services. CDNs cache content across geographically diverse servers in order to reduce the costs of the delivery of content relative to the cost of traditional transit

¹⁰⁴ Faratin and Clark (2008) note that: “[i]n settlement free peering relationships with very large networks, there is frequently a requirement to keep traffic ‘in ratio.’ The traffic going from A to Z is measured, and the traffic going from Z to A is measured. If the two numbers are not close enough, peering will be denied. For very large networks, the traffic ratio requirement is usually 2:1, and sometimes 1.5:1.” (Peyman Faratin, David Clark, Steven Bauer, William Lehr, Patrick Gilmore, and Arthur Berger (2008), “The Growing Complexity of Internet Interconnection,” *Communications & Strategies*, 72: 51–71.) Dhamdhere *et. al* (2010) describe the traffic ratio rule as “widely used.” (Amogh Dhamdhere, Constantine Dovrolis, and Pierre Francois, “A Value-Based Framework for Internet Peering Agreements,” October 2010, *available at* http://www.caida.org/~amogh/depeering_itc10.pdf, *site visited* March 28, 2014.)

For examples of peering policies *see* Comcast's Settlement-Free Interconnection (SFI) Policy, *available at* <http://www.comcast.com/peering/>, *site visited* March 28, 2014; AT&T's Global IP Network Settlement-Free Peering Policy, *available at* <http://www.corp.att.com/peering/>, *site visited* March 28, 2014; Suddenlink Communications' Settlement-Free Interconnection (Peering) Policy, *available at* <http://www.suddenlink.com/terms-policy/peering.php>, *site visited* March 28, 2014; Verizon Business Policy for Settlement-Free Interconnection with Internet Networks, *available at* <http://www.verizonbusiness.com/terms/peering>, *site visited* March 28, 2014; and Qwest's North America IP Network Peering Policy, *available at* http://www.qwest.com/legal/peering_na.html, *site visited* March 28, 2014.

options. CDNs then negotiate interconnection arrangements with ISPs and/or buy transit to reach smaller ISPs.

74. Over time, the Internet has evolved from a “hierarchy”—in which interconnection was achieved by having ISPs purchase transit services from top-level backbones, with the top-level backbones engaging in settlement-free peering with one another—to a “mesh” in which peering occurs among a much larger number of participants and some peering arrangements involve payments from one peer to another. In this new environment, backbone providers, ISPs, CDNs, and suppliers of content have a far wider array of interconnection alternatives, both technical and financial, than they used to.

75. In this evolving Internet architecture, several interconnection arrangements have become more prominent, including:

- *Secondary peering*: Smaller IP networks directly interconnect, replacing traffic that otherwise would have flowed through transit connections.
- *Paid peering*: Technologically analogous to settlement-free peering, but compensation flows from one party to another (typically because of asymmetric traffic flows or network facilities). Such paid peering arrangements are more common in today’s internet environment than previously, when settlement-free peering was more the norm.¹⁰⁵

¹⁰⁵ *Besen and Israel (2013)*, 239. I understand that some in the industry, such as Level 3 and Cogent, have questioned whether paid peering should be permitted at all. The Besen and Israel paper, cited above, explains why limitations on paid peering would lead to competitive and consumer harm. One issue highlighted in that paper is that it is

- *Partial transit*: An ISP, CDN, or content provider buys transit access to some Internet networks but not all (usually because the entity has direct peering, or alternative transit arrangements, with the excluded networks).

76. Edge providers or CDNs can (and often do) make transit arrangements with several backbone providers or several CDNs (or both), a process known as “multi-homing.” Multi-homing allows a network to allocate traffic opportunistically and often in real-time in order to route around bottlenecks or otherwise optimize traffic flows. Multi-homing is quite common. For example, in its *Level 3-Global Crossing Order*, the Commission found that “86% to 88% of Level 3 and [Global Crossing] transit or direct Internet access (DIA) customers are ‘multi-homed’ with providers other than Level 3 and [Global Crossing].”¹⁰⁶

(2) *Range of interconnection alternatives*

77. In this evolving Internet architecture, there are many ways for edge providers to ensure that their traffic reaches Comcast’s network. Some large firms, including Netflix

economically efficient for ISPs to charge edge providers for the marginal costs that they impose on the ISPs’ networks: If edge providers do not fully internalize the costs they impose on the network, they will be incentivized to overprovide data relative to the socially optimal level. In particular, if edge providers do not internalize the costs they impose on data networks, they may not have the proper incentives to undertake costly, but efficiency-enhancing investments. As the Besen and Israel paper explains, “...it is important not to restrict through regulation the options for recovery of the costs of interconnection in order to encourage both efficient investment in, and efficient usage of, the Internet infrastructure.” (*Besen and Israel (2013)*, 242.) In any case, this is an industry-wide issue that is not specific to the proposed transaction.

¹⁰⁶ *Level 3-Global Crossing Order*, ¶ 27.

and Google, have invested in their own CDNs and negotiate direct access with ISPs such as Comcast. Other firms rely on third-party CDNs to deliver their content, thus acting as their agents in negotiations with ISPs.¹⁰⁷ Others rely on transit providers. And many rely on a combination of the above options.

78. In total, Comcast has over 40 settlement-free peering agreements, and thousands of commercial (*i.e.*, paid) connections, which include several dozen substantial peering and transit agreements (*e.g.*, with CDNs, ISPs, or larger edge providers).¹⁰⁸ Similarly, TWC has approximately [[]] settlement-free routes into its network through various providers, and more than [[]] paid connections with CDNs and others.¹⁰⁹

79. Bottom line, as a result of this rich network of interconnection options, both small and large edge providers have many pathways into Comcast's network for delivery of their content to Comcast's customers, including working with multiple CDNs and/or transit providers. Additionally, by going through third-party routes, the overwhelming

¹⁰⁷ See Dan Rayburn, "Here's What the Current CDN Landscape Looks Like, with List of Vendors," *streamingmedia.com*, December 10, 2013, available at <http://blog.streamingmedia.com/2013/12/heres-current-cdn-landscape-looks-like-list-vendors.html>, site visited March 28, 2014 for a list of CDN vendors. Seven CDNs (Akamai, Amazon, EdgeCast, Highwinds, Level 3, Limelight Networks and Microsoft) account for the vast majority of paid, third-party CDN services.

¹⁰⁸ Kevin McElearney, Senior Vice President, Network Engineering, Comcast Corporation, April 2, 2014, interview.

¹⁰⁹ Mike Hayashi, Executive Vice President, Architecture, Development & Engineering, TWC, February 28th, 2014, interview.