

Consistent Measurement of Broadband Availability

By

Advanced Analytical Consulting Group, Inc.

September 2016

Abstract

This paper provides several, consistent measures of broadband availability from 2009 to 2015, based on data available on the FCC's website. They reveal substantial growth in the numbers of broadband providers over time. The FCC analysis has not provided consistent measures over time or even sufficient overlap in evolving measures to assess the evolution of competition over time. The FCC produced only a subset of the measures presented in this paper for 2009 to 2013, never produced any measures of broadband service or the underlying data that the FCC collected in June 2014, and for subsequent years changed how broadband availability is measured. Further, the broadband availability measures that the FCC described in its 2015 Open Internet Order (1) were based on service levels from December 2013—over a year before the 2015 Order was adopted, and (2) introduced a new metric that the FCC had not relied on in previous orders (e.g., 2010 Open Internet Order). This measurement change renders evaluation of the growth in broadband availability difficult, if not impossible. This report provides several consistent series of measures calculated from raw data available at the FCC's website that extend the FCC's 2009-2013 data series to later dates, facilitating comparison of broadband availability levels over time.

Introduction

The number of Internet Service Providers (“ISPs”) providing broadband service across the United States has been an important factor in policy debates and in the Federal Communications Commission’s (FCC) justification for increasing the regulation imposed on ISPs. In 2010 and again in 2015, the FCC cited the numbers of ISPs providing broadband service to individual households within US Census tracts or blocks as measures of competition for broadband service to justify increased regulation of ISP providers.¹ For example, in the FCC’s 2010 Open Internet Order, the FCC observed that in December 2009 only about 30 percent of households had more than two choices of ISPs providing broadband. At that time the FCC defined broadband as downstream speeds of least 4 megabits per second (Mbps) and upstream speeds of at least 1 Mbps.² The 2015 FCC Open Internet Order referenced data showing an even lower percentage of households had more than two ISPs providing broadband. However, the FCC had changed the definition of broadband between the 2010 and 2015 Orders. The benchmark the FCC used in 2015 was service of at least 25 Mbps downstream and at least 3 Mbps upstream.³ Clearly a consistently measured and reported set of metrics about the extent of ISP offerings will serve to inform this regulatory process,⁴ allowing a better understanding of not only what the current levels of service offerings are, but also how competition has evolved over time.

We provide such a consistent set of measures in this report. We display these measures of competition over time. Finally, we describe the availability of broadband service that existed in December 2014, when the FCC was deliberating on the 2015 Open Internet Order. During this time period, the FCC’s support for the eventual 2015 Open Internet Order was based, in part, on ISP broadband Internet offerings that existed more than one year earlier, in December 2013.

Data Used

The data used in this report are from the FCC website, listing the service offerings of ISPs by location. For the period from December 2009 through December 2013, the FCC issued reports

¹ Federal Communications Commission, *Protecting and Promoting the Open Internet*, GN Docket No. 14-28, Report and Order on Remand, Declaratory Ruling, and Order, March 12, 2015, (“2015 Open Internet Order”), available at https://apps.fcc.gov/edocs_public/attachmatch/FCC-15-24A1.pdf.

² Federal Communication Commission, *Preserving the Open Internet*, GN Docket No. 09 191, Broadband Industry Practices, WC Docket No. 07 52, Report and Order, December 23, 2010, ¶ 32, (“2010 Open Internet Order”), available at https://apps.fcc.gov/edocs_public/attachmatch/FCC_10_201A1_Rcd.pdf.

³ 2015 Open Internet Order, ¶ 81.

⁴ The FCC measured broadband availability consistently twice a year from December 2009 (the data reported in the 2010 Open Internet Order) through December 2013. These reports are available at <https://www.fcc.gov/reports-research/reports/internet-access-services-reports/internet-access-services-reports>. Among other differences described in detail below, the FCC’s new measurement of broadband availability requires that a provider be available in a census block, while the earlier measure considered an alternative to be available to all households in a census tract (a larger geography), even if that alternative were not available in every census block in that tract.

twice per year. While the data and reports described nine periods that were six months apart, the reports were released with lags ranging from 8.7 months to 17.6 months, with an average lag of 11.6 months.

The FCC uses this underlying ISP offering data to produce several metrics and definitions of broadband service. While the FCC has changed the metric over time, this report, in contrast, uses the underlying FCC data to create a set of consistent measures that can be tracked over time, thus facilitating an assessment of the growth of competitive alternatives. Beginning in 2014, the underlying data collected by the FCC count all providers of broadband service to fixed residential locations, including fixed wireless and satellite,⁵ at the census block-level. Prior to 2014, the FCC used tract-level census data, which are coarser than block-level data.⁶

During the debate about and adoption of the 2015 Open Internet Order, the FCC used another data source to construct its benchmark for broadband performance and its assessment of competition, even though it had collected and produced reports about the same set of data it had used in its previous reports of broadband service. The data the FCC chose to use was collected by the National Telecommunications and Information Administration (NTIA). The NTIA data differed from the FCC-collected data in the following ways: (1) ISPs reported availability on a voluntary, rather than mandatory, basis, (2) ISP service was considered to be available to a household if service was offered within the household's census block as opposed to the tract, as previously reported by the FCC, and (3) satellite broadband (and for some analyses fixed wireless broadband) were not included in the metrics reported by the FCC during the debate about the Open Internet Order, but had been included in the FCC's reports for December 2009 through December 2013.⁷

⁵ The FCC also measured the number of mobile wireless providers at various speed levels in each census tract. However, the FCC's measurement of mobile wireless speeds has changed, so provider counts before and after the change are meaningless. Accordingly, this report includes only competitive alternatives to fixed residential locations.

⁶ The Internet Access Services reports based on these data are available at <https://www.fcc.gov/reports-research/reports/internet-access-services-reports/internet-access-services-reports>.

⁷ In contrast to the FCC's consistent measurement of broadband availability in its Internet Access Services reports from December 2009 through 2013, it presented alternative measures of broadband availability in the 2015 Broadband Progress Report, which was the source of the data relied upon in the 2015 Open Internet Order. Federal Communications Commission, *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. 14-126, 2015 Broadband Progress Report and Notice of Inquiry on Immediate Action to Accelerate Deployment, February 4, 2015, available at https://apps.fcc.gov/edocs_public/attachmatch/FCC-15-10A1.pdf. For example, the FCC reports percentages of the population, rather than percentages of households—a different weighting of the granular data that produces slight differences in availability percentages. More significant, the 2015 Broadband Progress Report (§ 83 and note 314) describe two different availability measures. The first of these (1) counts a provider that offers only business services as being available to residential customers and (2) includes fixed wireless providers. The second of these excludes providers that offer only business services (consistent with previous availability measures) and fixed wireless alternatives. Neither measure included satellite services, which

Starting with the measurement of broadband availability in 2014 and later years, the separate data collections formerly undertaken by the FCC and the NTIA have been consolidated. In particular, (1) like the earlier FCC data collection, carriers are required to report availability of all technologies, including satellite and (2) carriers report availability at the census block-level, as was done for the NTIA data collection. At the time of writing this report, the FCC had not released data nor provided broadband availability percentages for June 2014. It appears that the FCC may be skipping the reporting of this period as it has already issued its Internet Access Services Reports for December 2014 and June 2015.

Extending the FCC's Previous Series

In this section, we report a consistent set of calculations of broadband availability at the census tract-level for two speed levels: (1) 10 Mbps downstream/1.5 Mbps upstream (the fastest speed reported as broadband by the FCC prior to the debate about the 2015 Open Internet Order and which the FCC last reported in December 2013) and (2) 3 Mbps downstream/0.768 Mbps upstream (which approximates the FCC's previous broadband benchmark of 4 Mbps/1 Mbps. For ease of reference, Tables 1 and 2 list the speed levels reported by the FCC, the time period for which broadband availability was being measured, and the release date for each report. Table 1 lists all speeds that were described in each of the FCC reports between December 2009 and December 2013. The FCC reported each of these measures listed in the upper panel in each of the FCC reports listed in the lower, right panel. The lower panel of Table 1 lists the period for which the underlying data was collected (left panel) and the date on which the FCC reported the summary statistics (right panel). Table 2 presents the corresponding information for the FCC's Internet Access Services Reports for the periods after December 2013.⁸

had been included in previous reports. The second of these measures, which we use in the results presented below, was prominently featured in an earlier speech by Chairman Wheeler, in which he emphasized the lack of competition for broadband services. Chairman Tom Wheeler, "The Facts and Future of Broadband Competition," September 4, 2014, ("Wheeler Speech"), available at https://apps.fcc.gov/edocs_public/attachmatch/DOC-329161A1.pdf.

⁸ The FCC also releases the raw data for these reports at the census block level. Table 2 lists the initial release dates for these data, which have been a few months earlier than when the corresponding reports have been released.

Table 1. FCC Internet Access Services Report Coverage and Release Dates: 2009-2013⁹

December 2009 through December 2013 Available Data: Census Tract Speed Levels: 3 Down/ 0.2 Up 3 Down/ 0.768 Up 6 Down/ 1.5 Up 10 Down/ 1.5 Up	
Reference Period (End Date)	Report Release Date
December 31, 2009	December 8, 2010
June 30, 2010	March 21, 2011
December 31, 2010	October 2011
June 30, 2011	December 2012
December 31, 2011	February 2013
June 30, 2012	May 2013
December 31, 2012	December 24, 2013
June 30, 2013	June 25, 2014
December 31, 2013	October 16, 2014

⁹ The specific dates listed in the third column are taken from the FCC's press releases announcing the reports, which we were not able to find for all of the reports. In these cases, we listed the month indicated on the report's title page. Data release dates in Table 2 indicate initial release on the FCC website. While the data may subsequently be updated, the later version(s) have not had a noticeable impact on availability percentages. .

Table 2. FCC Internet Access Services Report Coverage and Release Dates: 2014 and Later

2014 and Later Available Data: Census Block Speed Levels: 3 Down/ 0.768 Up 10 Down/ 1Up 25 Down/ 3 Up 100 Down/ 10 Up		
Reference Period (End Date)	Data Release Date	Report Release Date
June 30, 2014	NA	NA
December 31, 2014	November 11, 2015	March 30, 2016
June 30, 2015	May 16, 2016	August 5, 2016
December 31, 2015	September 13, 2016	NA

Consistent with the FCC’s previous reporting, we present percentages of households with a given number of ISPs offering a given speed of service (“availability percentage”) including fixed wireless and satellite service. Also consistent with previous FCC reports, we report households with 3 or more, 2, and 0 or 1 available providers.¹⁰ While the data released by the FCC can be used to extend its previous series, the FCC has not reported these figures since October 2014, when it released the Internet Access Services Report for December 2013.¹¹ Appendix A describes how we calculated the availability percentages. We also, present availability percentages over time based on other definitions, such as excluding fixed wireless and satellite, and based on census block rather than census tract elsewhere in this report and in Appendix B.

10 Mbps Downstream/1.5 Mbps Upstream Broadband Service Provision and Competition from December 2009 to June 2015

Figure 1 lists the percentage of households living in census tracts with three differing numbers of ISPs: 3 or more ISPs offer 10 Mbps downstream/1.5 Mbps upstream, 2 ISPs offer that level of

¹⁰ The FCC presented separate results for zero and one provider. Since by the end of 2013, the percentages of households at the census tract level with zero providers was small to *de minimis*, we combine these results in the figures in this section.

¹¹ Federal Communications Commission, “Internet Access Services: Status as of December 31, 2013,” Industry Analysis and Technology Division, Wireline Competition Bureau, October 2014, Figure 5(a), available at https://transition.fcc.gov/Daily_Releases/Daily_Business/2014/db1016/DOC-329973A1.pdf.

service and 1 or 0 ISPs offer that level of service, where some of those providers may offer satellite and fixed wireless services.

Figure 1

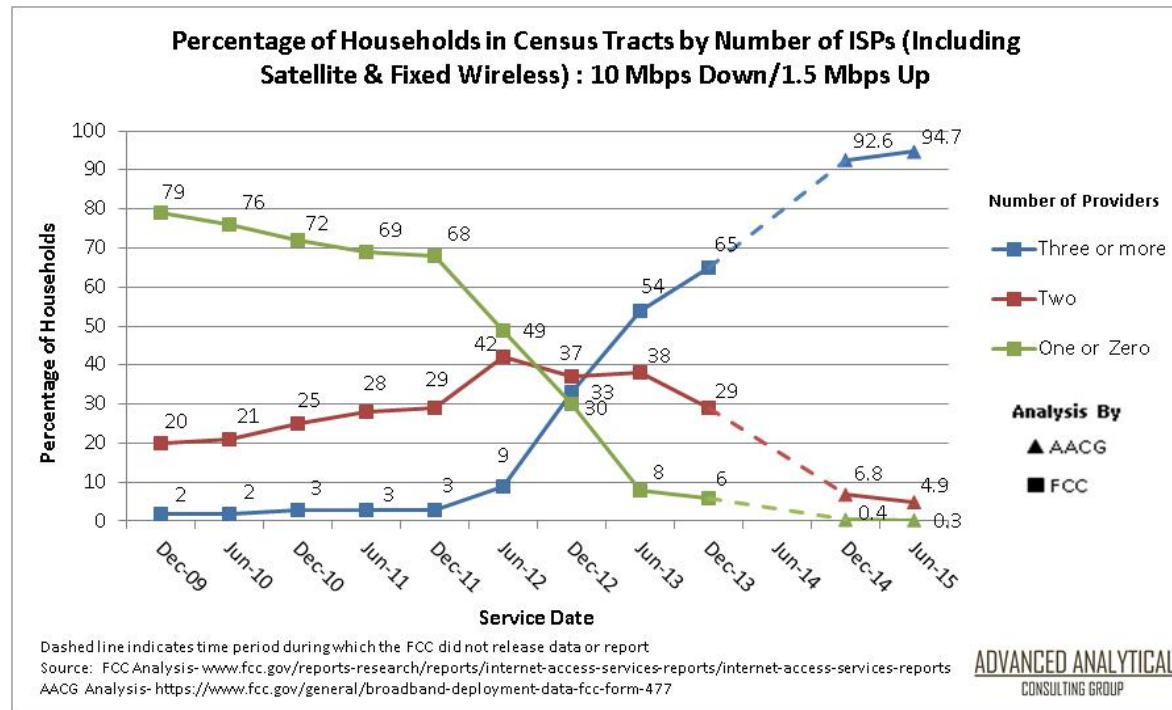


Figure 1 shows that as of June 30, 2015, broadband service based on the FCC’s December 2013 definition was offered by three or more ISPs in census tracts that include nearly 95% of US households.¹² The data represented by a triangle were calculated by AACG, because the FCC no longer releases these figures, although they had released the underlying data upon which the AACG calculations are based. The dashed line represents the time period during which the FCC has released neither the calculation of the number of providers nor the underlying data needed to perform those calculations. It is our understanding that the FCC had collected the underlying data. The most recent figures reported by the FCC show that the percentage of households with access to three ISPs offering this service speed had nearly doubled in one year, from 33 percent in December 2012 to 65 percent in December 2013.¹³

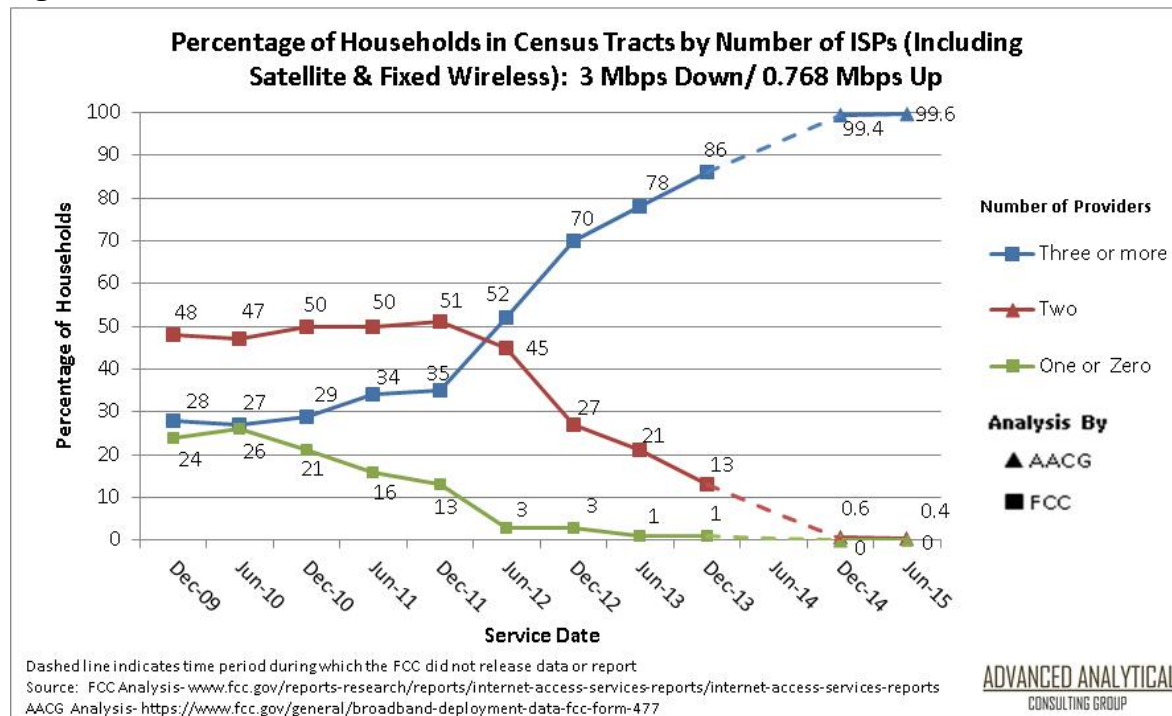
¹² The dates on the horizontal axis of Figure 1 indicate broadband availability as of the end of that date.

¹³ The fact that satellite broadband service is ubiquitously available could be a factor in the most recent growth. Federal Communications Commission, “Internet Access Services: Status as of December 31, 2014, Industry Analysis and Technology Division, Wireline Competition Bureau, March 2016, Figure 5 (“December 2014 Internet Access Services Report”), available at https://apps.fcc.gov/edocs_public/attachmatch/DOC-338630A1.pdf.

3 Mbps Downstream/0.768 Mbps Upstream Broadband Service Provision and Competition from December 2009 to June 2015

Figure 2 shows the growth in broadband availability at the previous, slower, broadband benchmark reported by the FCC. This definition of broadband service was adopted in the FCC's Broadband Progress Report of July 2010¹⁴ and was superseded by a new standard in February 2015 in the 2015 Broadband Progress Report.

Figure 2



Based on this definition of broadband nearly 100% of households live in census tracts with three or more ISPs offering this service.

Number of Providers Available to Households: Census Block Series

In this section, we report numbers of ISPs based on census blocks, rather than census tracts. An ISP is considered to offer a given level of broadband if it offers residential service within the census block. Our objective is to produce a data series analogous to the household availability percentages the FCC reported for December 2013, during the debate about the 2015 Open

¹⁴ Federal Communications Commission, *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. 09-137, *A National Broadband Plan for Our Future*, GN Docket No. 09-51, Sixth Broadband Deployment Report, July 20, 2010, available at https://apps.fcc.gov/edocs_public/attachmatch/FCC-10-129A1_Rcd.pdf.

Internet Order. We use census block-level data to produce availability percentages for December 2014 and June 2015, the two most recent periods for which the FCC has released the raw data to date. Since census blocks are smaller than census tracts, the effect of this change is lower availability statistics.¹⁵ In addition to using census block-level data, the FCC has changed its availability measure to percentages of census blocks, rather than percentage of households. For each speed level now used by the FCC, we present two series, with and without satellite and fixed wireless service.

25 Mbps Downstream/3 Mbps Upstream Broadband Service Provision and Competition from December 2013 to June 2015

Figure 3 presents the results of our calculations for the 25 Mbps downstream/3 Mbps upstream speed level, where satellite and fixed wireless are not included in the availability percentage. Figure 3 also includes data for December 2013 that was presented by Chairman Wheeler and described in the 2015 Broadband Progress Report.

Figure 3

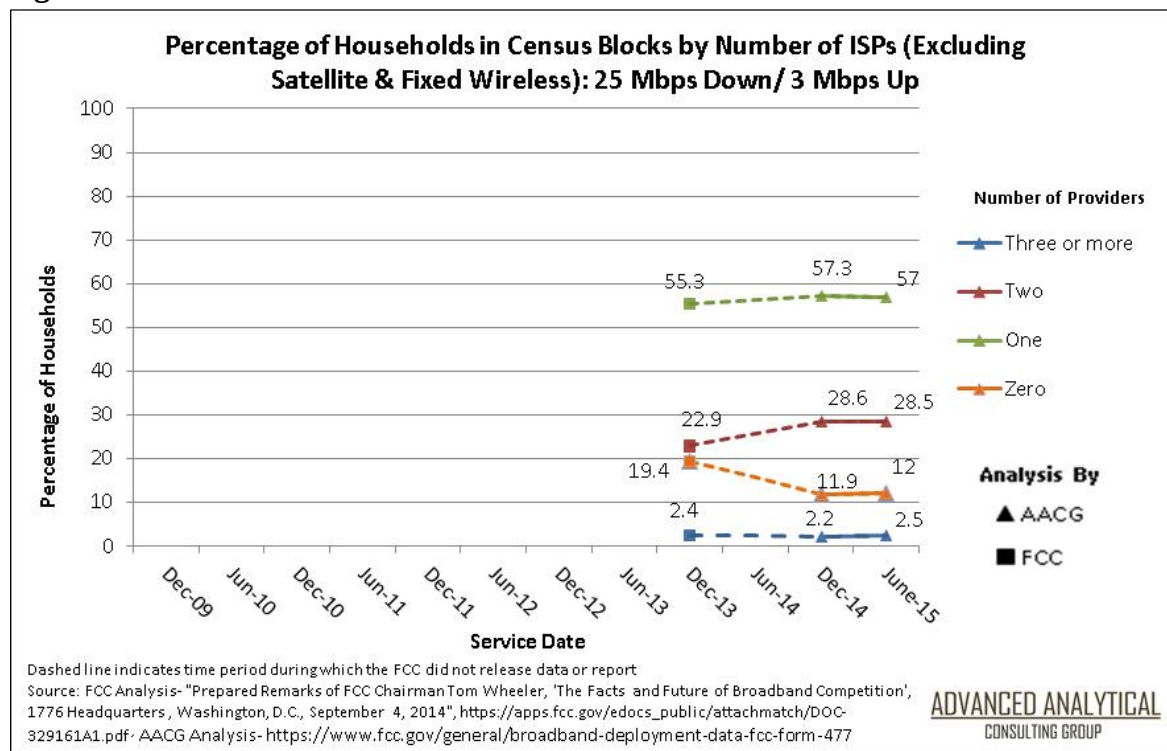


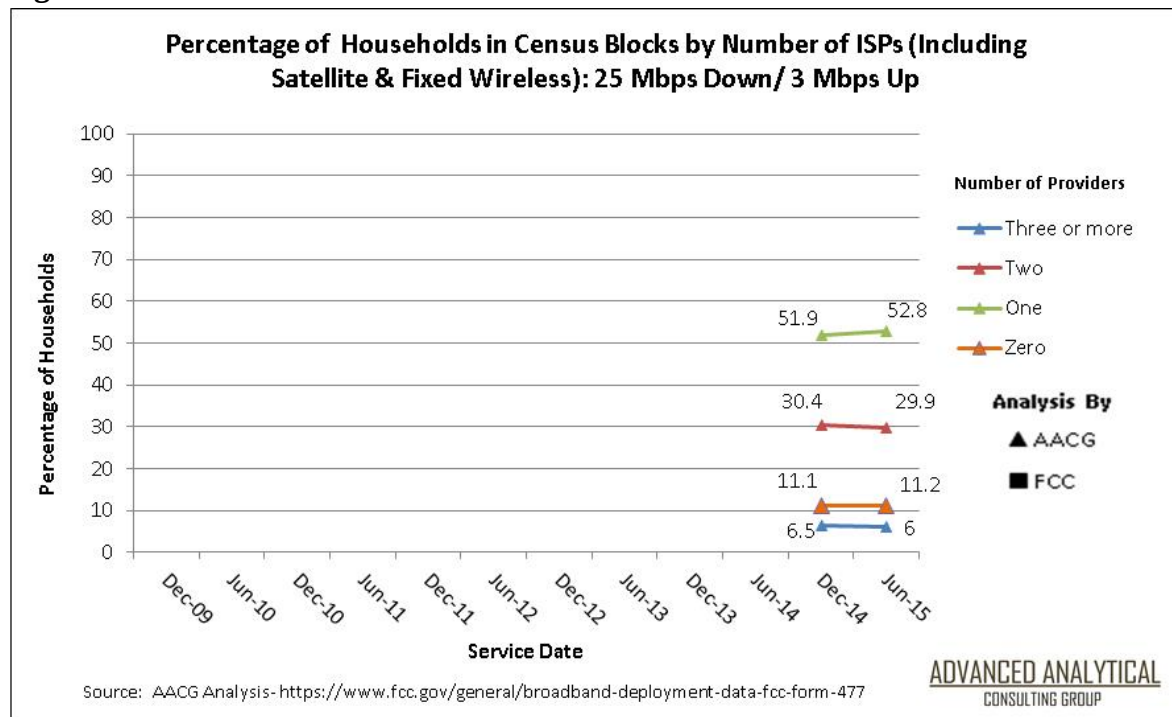
Figure 3 shows that over the 18 months from December 2013 to June 2015, the proportion of households living in census blocks without any provider decreased by about seven percentage

¹⁵ The average number of occupied census blocks per census tract is about 85. Suppose only one block in a tract was served by three providers. The old metric counted all households in the tract, whereas the new metric counts only the households in the block with access.

points, with a similar increase in the percentage of households with two alternative providers.¹⁶ Combining the zero and one alternative categories, as was done for the earlier figures, shows a decrease in these lower levels of availability from about 75 percent in Chairman Wheeler's data of December 2013, to approximately 69 percent for the more recent periods.

Figure 4 displays the availability percentages for December 2014 and June 2015 including satellite and fixed wireless service.

Figure 4



Comparison of Figures 3 and 4 shows the effects of excluding fixed wireless and satellite.¹⁷ For the 25 Mbps downstream/3 Mbps upstream speed level, the exclusion of these technologies

¹⁶ The approximately seven percentage point reduction in the percentage of households in census blocks with no alternatives is consistent with the seven percentage point reduction in the percentage of the US population without alternative providers shown in Table 7 of the FCC's 2016 Broadband Progress Report. Federal Communications Commission, *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. 15-191, 2016 Broadband Progress Report, January 29, 2016, available at https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-6A1_Rcd.pdf.

¹⁷ The FCC's percentages of census blocks, rather than percentages of households are very different. For December 2014, the FCC reported that 3 percent of census blocks had three or more providers, 20 percent had two providers, 47 percent had one provider, and 30 percent had no provider at the 25 Mbps downstream/3 Mbps upstream speed

reduced the percentage of households with three or more alternatives, with most of the offsetting increase in the one alternative category. Since the FCC's data include no satellite alternatives offering residential services at this speed level,¹⁸ these effects resulted from excluding fixed wireless.¹⁹

10 Mbps Downstream/0.768 Mbps Upstream Broadband Service Provision and Competition from December 2013 to June 2015

This subsection applies the analysis described in the previous subsection to the 10 Mbps downstream/0.768 Mbps upstream speed level.²⁰ Figure 5 shows the growth in broadband availability from December 2013 to June 2015 when satellite and fixed wireless are excluded.

level. The corresponding percentages of households shown in Figure 3 are 6.7 percent, 30.4 percent, 51.9 percent, and 11.1 percent.

¹⁸ 2016 Broadband Progress Report, ¶ 48.

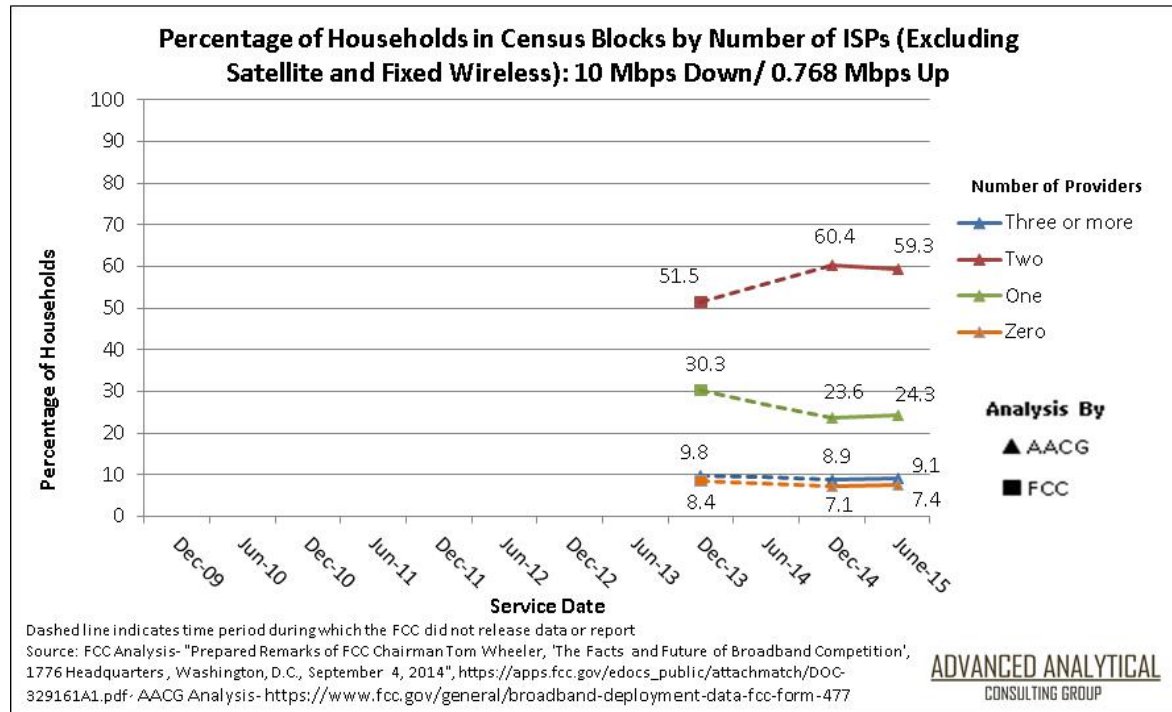
¹⁹ The effect of measuring broadband availability at the census block, rather than census tract level, as the FCC had done through December 2013, is shown in the following table.

Number of Providers	12/31/2014		6/30/2015	
	By Block	By Tract	By Block	By Tract
3 or More	6.7%	26.8%	6.0%	27.0%
2	30.4%	48.7%	29.9%	49.5%
1	51.9%	22.3%	52.8%	21.3%
0	11.1%	2.0%	11.2%	2.1%
Source: AACG Calculations				

For the 25 Mbps downstream/3 Mbps upstream speed level, the primary effect of this measurement change is a reduction in the percentage of households with no choice (zero or one alternatives) from approximately 63 to 64 percent to approximately 23 to 24 percent, with an offsetting increase in the percentage of households with at least two alternatives from 36 to 37 percent to about 75 percent.

²⁰ The FCC's most recent Internet Access Services Report uses a slightly different speed level: 10 Mbps/1 Mbps, which in turn produces slightly different availability percentages. Figure 5 shows the results for the 10 Mbps/0.768 speed level, which was used in the results reported by Chairman Wheeler for December 2013.

Figure 5



The percentage of households with two alternative providers has increased, with a similar decrease in the percentage of households with only a single available provider. Figure 6 includes fixed wireless and satellite providers (as the FCC reports have customarily reported).

Figure 6

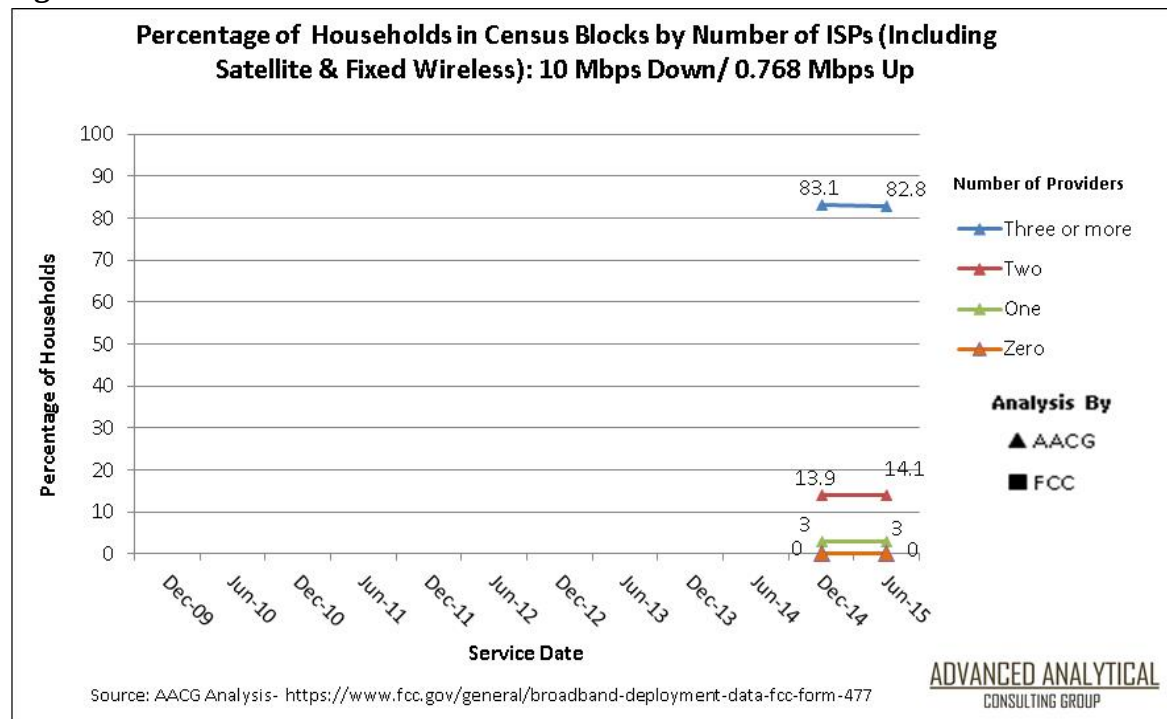


Figure 6 shows that, primarily because of the ubiquitous availability of satellite services at this speed level, more than four out of five households live in census blocks in which three or more broadband providers offer residential service within the census block.²¹

²¹ The FCC's percentages of census blocks, rather than percentages of households are very different. For December 2014, the FCC reported that 61 percent of census blocks have three or more providers, 28 percent had two providers, and 10 percent had one provider at the 10 Mbps downstream/0.768 Mbps upstream speed level. The corresponding percentages of households shown in Figure 6 are 83.1 percent, 13.9 percent and 3 percent. Finally, almost 99 percent of households live in *census tracts* in which three or more providers offer residential service somewhere in that tract (see Appendix B, Figure B3).

3Mbps downstream/0.768 Mbps Upstream Broadband Service Provision and Competition from December 2013 to June 2015

Figures 7 and 8 display the availability measures for the 3 Mbps downstream/0.768 Mbps upstream speed level.

Figure 7

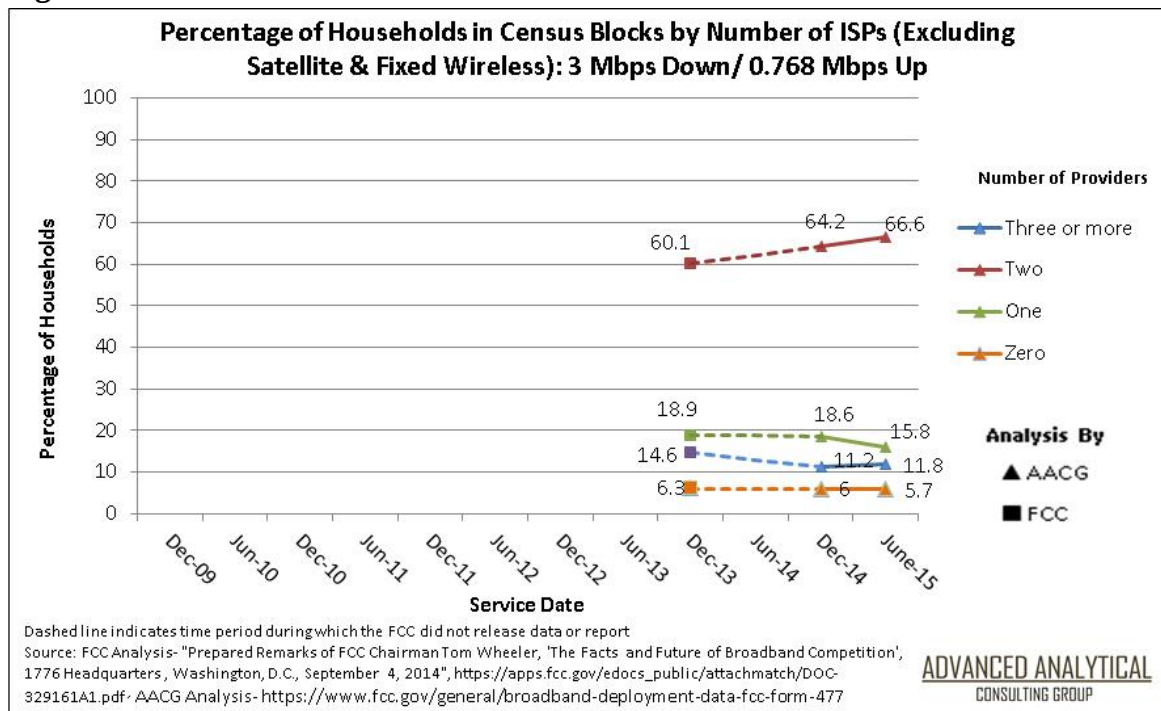
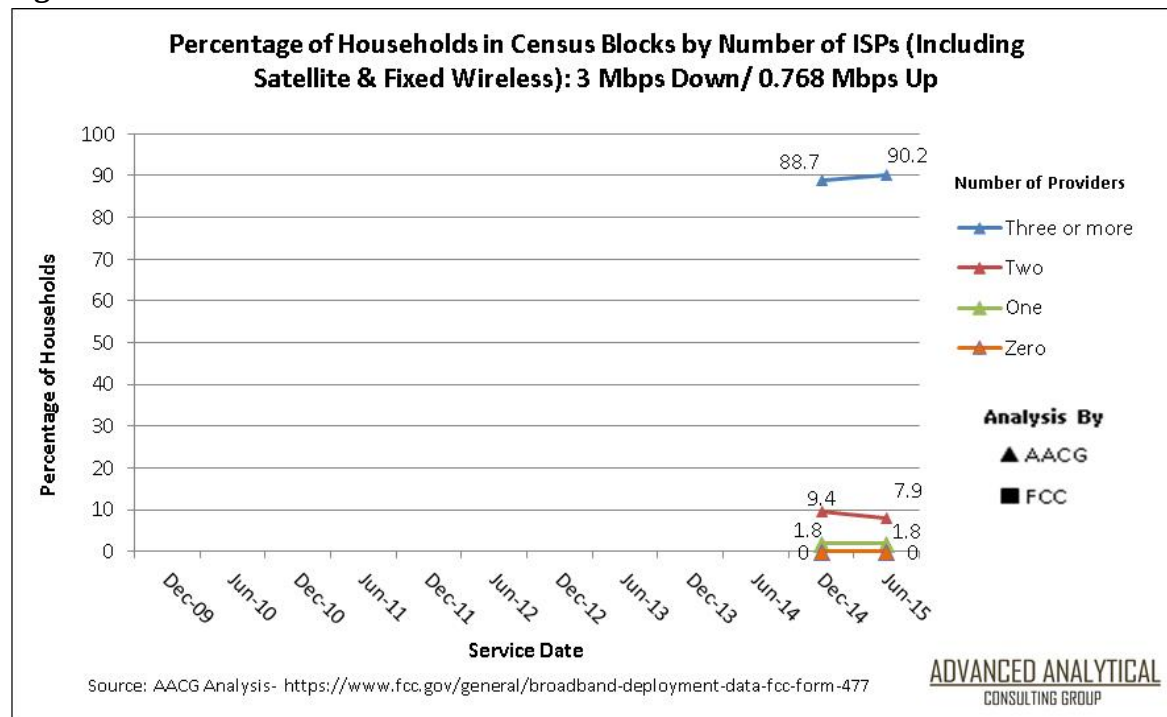


Figure 8



These results exhibit a pattern similar to the results for the 10 Mbps downstream/0.768 Mbps upstream speed level. Figure 7 shows that when fixed wireless and satellite are excluded, the percentage of households with two or more alternative providers moderately increased between December 2013 and June 2015, with a decrease of similar magnitude in the proportion of households with zero or one available provider. As shown in Figure 8, when fixed wireless and satellite providers are included (as the FCC reports have customarily done), about nine out of ten households live in census blocks in which three or more broadband providers offer residential service within the census block (primarily because of the ubiquitous availability of satellite services at this speed level).²²

As mentioned above, Appendix B to this report provides graphs for service at additional speeds, measurement areas (tract or block), and type of service (fixed wireless, satellite) combinations.

²² The FCC's percentages of census blocks, rather than percentages of households are very different. For December 2014, the FCC reported that 74 percent of census blocks have three or more providers, 20 percent had two providers, and 6 percent had one provider at the 3 Mbps downstream/0.768 Mbps upstream speed level. The corresponding percentages of households shown in Figure 8 are 88.7 percent, 9.4 percent and 1.8 percent. Finally, virtually every household lives in *census tracts* in which three or more providers offer residential service somewhere in that tract.

What We Know Now Versus What We Knew Then

Chairman Wheeler’s assessment of competition among ISPs appears to have been an important element in the Open Internet rules he proposed and the 2015 Open Internet Order the FCC adopted in February 2015. Chairman Wheeler’s conclusions on the adequacy of competition were informed by the December 2013 availability data shown in Figures 3, 5, and 7 above. In a speech a few months before the approval of the 2015 Open Internet Order, Chairman Wheeler described the state of competition as follows:²³

At the low end of throughput, 4 Mbps and 10 Mbps, the majority of Americans have a choice of only two providers. That is what economists call a “duopoly”, a marketplace that is typically characterized by less than vibrant competition.

This assessment was based on an FCC measure that, in December 2013, excluded fixed wireless and satellite alternatives, two alternatives which had been included in the FCC’s broadband availability measures both before and after December 2013, as well as a change to the census block measurement from census tract. When fixed wireless and satellite technologies are included, Figures 6 and 8 show a picture of December 2014 that was quite different. Rather than majorities of households being limited to two alternative providers, about 90 percent of households had three or more providers at the 4 Mbps level and more than 80 percent had three or more providers at the 10 Mbps level.²⁴

While December 2014 data do not reveal changes of the same magnitude for the 25 Mbps downstream/3 Mbps upstream speed level, there nonetheless was some growth between 2013 and 2014. In particular, the percentage of households living in census blocks with no providers at this speed declined by about seven percentage points between 2013 and 2014, with a comparable increase in the percentage of households with two or more providers. This pattern is similar to the growth in competitive alternatives between 2009 and 2010 at the formerly fastest-measured speed of 10 Mbps downstream/1.5 Mbps upstream (shown in Figure 1)—which within four years had 65 percent of households with 3 or more ISPs offering service.

²³ Wheeler Speech, p. 4. When describing choice at the 4 Mbps level, Chairman Wheeler was referring to the number of providers at the 3 Mbps/0.768 speed level—the level closest to the then current broadband benchmark of 4 Mbps/1 mbps.. We follow that convention in describing results for December 2014 in the following paragraph.

²⁴ The FCC did not include satellite alternatives in the availability measures based on December 2013 census block level data on the grounds that the satellite information collected by the NTIA was unreliable. Therefore, a comparison of the availability of satellite alternatives in the December 2013 data used by the FCC and the December 2014 data described here is not possible. However, there appears to have been some increase in the availability of satellite alternatives as suggested by (1) the fact that the FCC’s Internet Access Services Report for December 2014 indicates that satellite service at the 10 Mbps speed level is ubiquitously available, while earlier reports did not and (2) the percentage of households with three or more alternatives measured at the more granular census block level (e.g., about 80 percent for the 10 Mbps speed level) is greater than the corresponding percentage at the less granular census tract level for December 2013.

Conclusion

The graphs and data in this report provide several consistent time series of measures that have been discussed as relevant in the evaluation of Internet access services. By providing a time series of measures that have been referenced by the FCC in assessing the extent of competition for Internet access services, evaluations of the extent of competition can be more accurate, improving the quality of analysis about the internet market, and the need for regulation.

Appendix A

The following processes were used to calculate the percentages displayed in this report. The objective is to follow to the extent possible the approach used by the FCC in its Internet Access Services Reports.²⁵ We first obtained the raw data for December 2014 and June 2015 from the FCC's website.²⁶ When a broadband provider offers service in a particular census block, these data include a number of characteristics for that provider. We used the following variables: (1) holding company identification (HocoNum), census block code (BlockCode), whether the provider offers residential service in that block (Consumer = 1), the maximum advertised downstream speed for that block (MaxAdDown), and the maximum advertised upstream speed for that block (MaxAdUp). We also obtained housing unit and population counts from the 2010 census from the Missouri Census Data center.²⁷ As described below, these counts were added to the FCC data.

While this report described broadband availability at the national level, the same data can be used to provide comparable results for smaller geographies. For example, our calculations can be adapted to measure broadband availability for individual states and/or subareas of states.

Census Block Level Calculations

The first step is determining the speed category (or categories) for each observation. Based on categories used in the FCC's reports, we use the following categories: (1) at least 3 Mbps downstream/0.768 Mbps upstream,²⁸ (2) at least 10 Mbps downstream/0.768 Mbps upstream, (3) at least 10 Mbps downstream/1.5 Mbps upstream,²⁹ and (4) at least 25 Mbps downstream/3 Mbps upstream.³⁰ For example, if a particular provider reported that it offered residential service with a maximum advertised downstream speed of 20 Mbps and an upstream speed of 2 Mbps, that carrier would be counted as offering service in all but the highest speed category listed above.

In the event that two (or more) providers affiliated with the same holding company offer service in the same census block, the FCC counts one provider. Our replication of this process is equivalent to the following: (1) for census blocks with more than one observation for the same holding company, determine the maximum speed level for those observations, (2) determine the categories for the maximum observation as described above, and (3) do not count any of the remaining observations for that holding company. Following this step, we simply count the

²⁵ See, for example, Federal Communications Commission, "Internet Access Services: Status as of December 31, 2013, Industry Analysis and Technology Division, Wireline Competition Bureau, October 2014, Technical Notes, available at https://transition.fcc.gov/Daily_Releases/Daily_Business/2014/db1016/DOC-329973A1.pdf.

²⁶ <https://www.fcc.gov/general/broadband-deployment-data-fcc-form-477>. This report used version 2 of the December 2014 data and version 1 of the June 2015 data.

²⁷ These data are available at <http://mcdc.missouri.edu/websas/geocorr12.html>.

²⁸ This approximates the FCC's broadband benchmark that was in effect from 2010 through 2015.

²⁹ This level was the maximum speed reported from December 2009 through December 2013.

³⁰ This is the current broadband benchmark adopted in 2015.

number of times a holding company offers service in each of the four speed categories. For services available as of December 2014, including satellite and fixed wireless, the relevant information at this point is the following.

BlockCode	3/0.768	10/0.768	10/1.5	25/3
560050001001015	3	3	3	0

For this fifteen-digit block code, there are 3 providers at the first three speeds and no provider at the highest speed.

The block code is used to append housing unit and population data from the 2010 Census. Following the FCC's approach, census blocks with zero population (even if they contain housing units and/or carriers report broadband services) are not included in further calculations. The illustrative census block had 30 housing units and 76 people in the 2010 census.

The final step is to calculate the percentage of households with 0, 1, 2, or 3 or more alternatives available in their census blocks. For example, the illustrative census block has no alternative providers at the highest speed level. We identify all other census block with no alternatives at this speed level, add up the number of households in these blocks, and then divide by the total number of U.S. housing units (approximately 131 million in the 2010 census) to obtain the percentage of households with no alternatives at that speed level.

Our processes produce results that are quite close to the FCC's results in its 2016 Broadband Progress Report and its most recent Internet Access Services reports.³¹ The former report lists the percentages of the population with no alternative providers, 1 provider, or 2 or more providers for the current broadband benchmark of 25 Mbps downstream/3 Mbps upstream.³²

³¹Federal Communications Commission, "Internet Access Services: Status as of December 31, 2014, Industry Analysis and Technology Division, Wireline Competition Bureau, March 2016", Figure 5, available at https://apps.fcc.gov/edocs_public/attachmatch/DOC-338630A1.pdf. Federal Communications Commission, "Internet Access Services: Status as of June 30, 2015, Industry Analysis and Technology Division, Wireline Competition Bureau, March 2016", Figure 5, available at https://apps.fcc.gov/edocs_public/attachmatch/DOC-340664A1.pdf.

³² 2016 Broadband Progress Report, ¶ 86.

Table A1. Estimated Percentage of Americans With Multiple Options for Fixed Advanced Telecommunications Capability as of December 31, 2014

	FCC	AACG
No Provider	10%	10.4%
One Provider	51%	51.6%
More than One Provider	38%	38.0%

The minor differences between our percentages³³ and the FCC's may be due to (1) our use of 2010 census data, rather than the FCC's use of a commercial product that updates census data and (2) the fact that the FCC's results include US territories, while we include the fifty states and the District of Columbia. With regard to the latest Internet Access Service reports, our percentages closely approximate the FCC's calculations.

Census Tract Level Calculations

Calculation of percentages in the census tract level are based on considering a particular provider offering service in a census tract if it offered service in some (but not necessarily all) blocks within that tract. Our assignment of providers within a census tract is consistent with the following process. First, we determined whether a particular holding company offered service at the four speed levels within each block within that tract. Second, we determined the number of blocks within which the holding company offered service at each speed level. Third, if those numbers were greater than zero, the holding company was considered to offer broadband service. Fourth, this process was followed for each holding company offering service within that census tract. Finally, the number of holding companies offering service at each speed level is counted.

For example, for census tract 56005000100, the holding company numbered 130228 offered service at speeds of at least 25 Mbps downstream and 3 Mbps upstream in 18 of the 346 blocks in that tract and the holding company numbered 130235 offered service at this speed level in 68 of the 346 blocks. Therefore, we counted two providers for this speed level in that census tract.

³³ For the purpose of this validation exercise, we weighted by population, rather than housing units. Housing unit results differ only slightly from population results.

Appendix B

Additional Charts

We have produced time series charts analogous to Figures 1 through 8 in the main part of this report for several other speed levels. These charts include the following: 1) availability at the census tract level, including fixed wireless and satellite (Figures B1 to B5), 2) availability at the census tract level, excluding fixed wireless and satellite (Figures B6 to B11), 3) availability at the census block level, including fixed wireless and satellite (Figures B12 to B15), and 4) availability at the census block level, excluding fixed wireless and satellite (Figures B16 to B19). In addition, for the two time periods for which we have calculated broadband availability (December 2014 and June 2015), we present bar graphs analogous to those appearing in the FCC's Internet Access Services Reports. For each period, we present four bar charts: two charts at the census tract and block levels, one including fixed wireless and satellite and the other chart with these technologies excluded. The December 2014 bar graphs are Figures B20 to B23 and the June 2015 bar graphs are Figures B24 to B27. Figure 28 summarizes selected parameters characterizing the FCC's Internet Access Services reports.

Figure B1

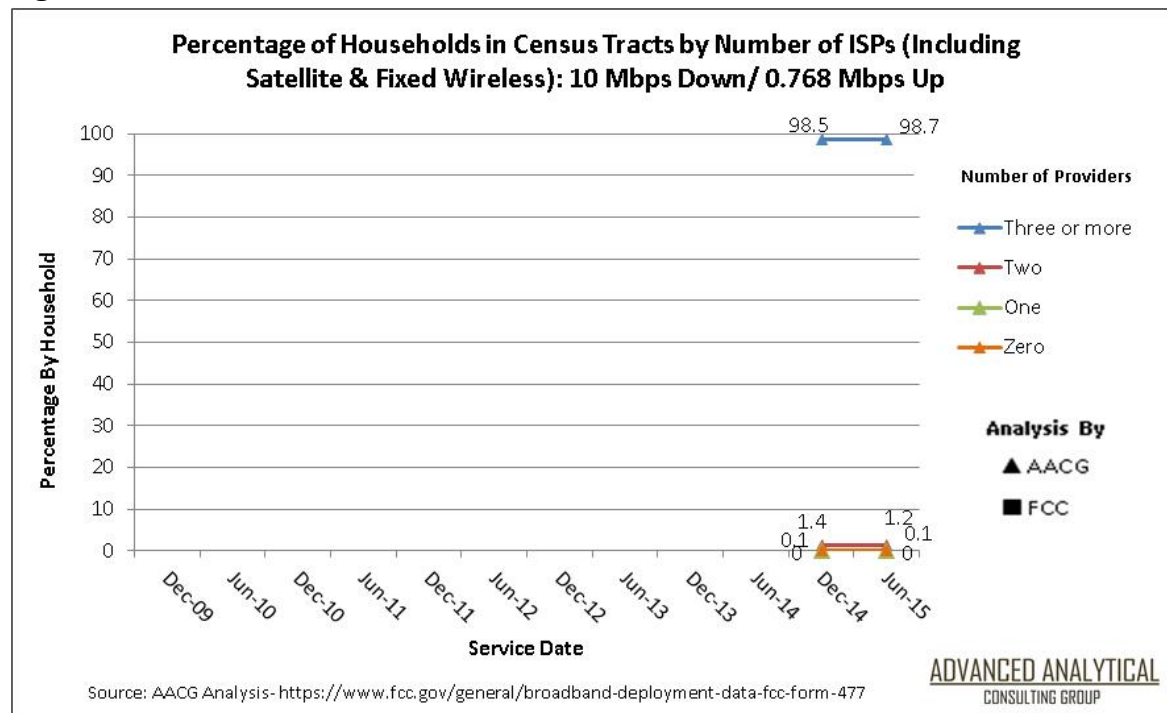


Figure B2

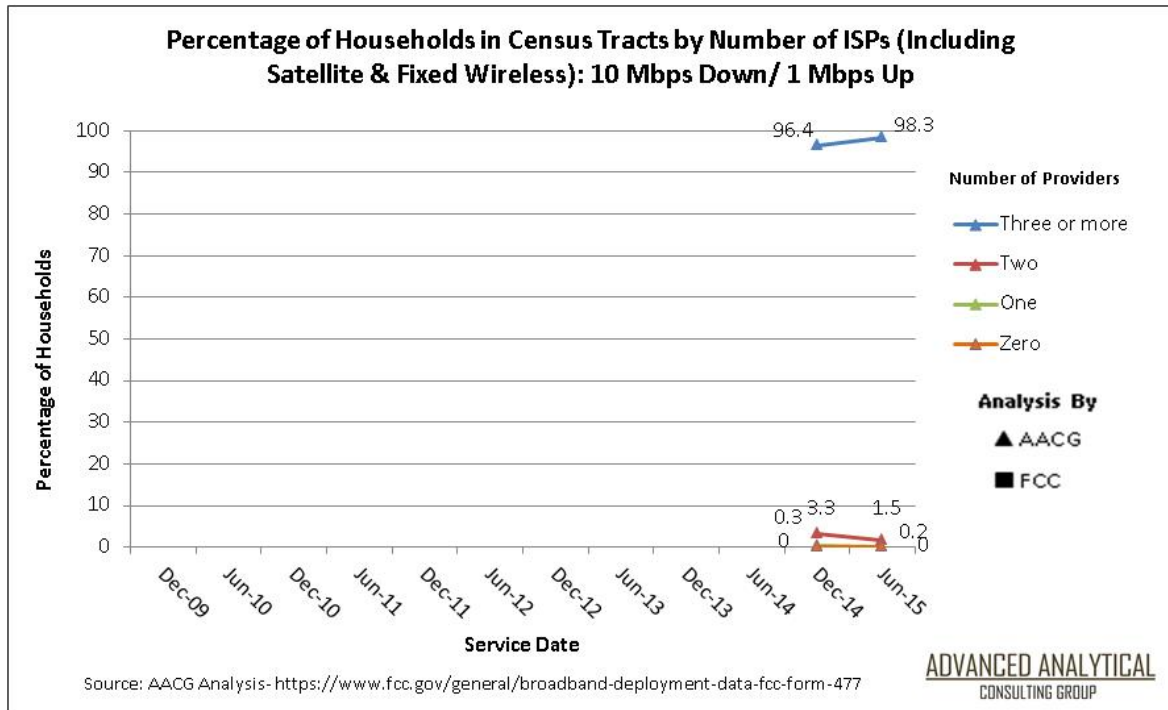


Figure B3

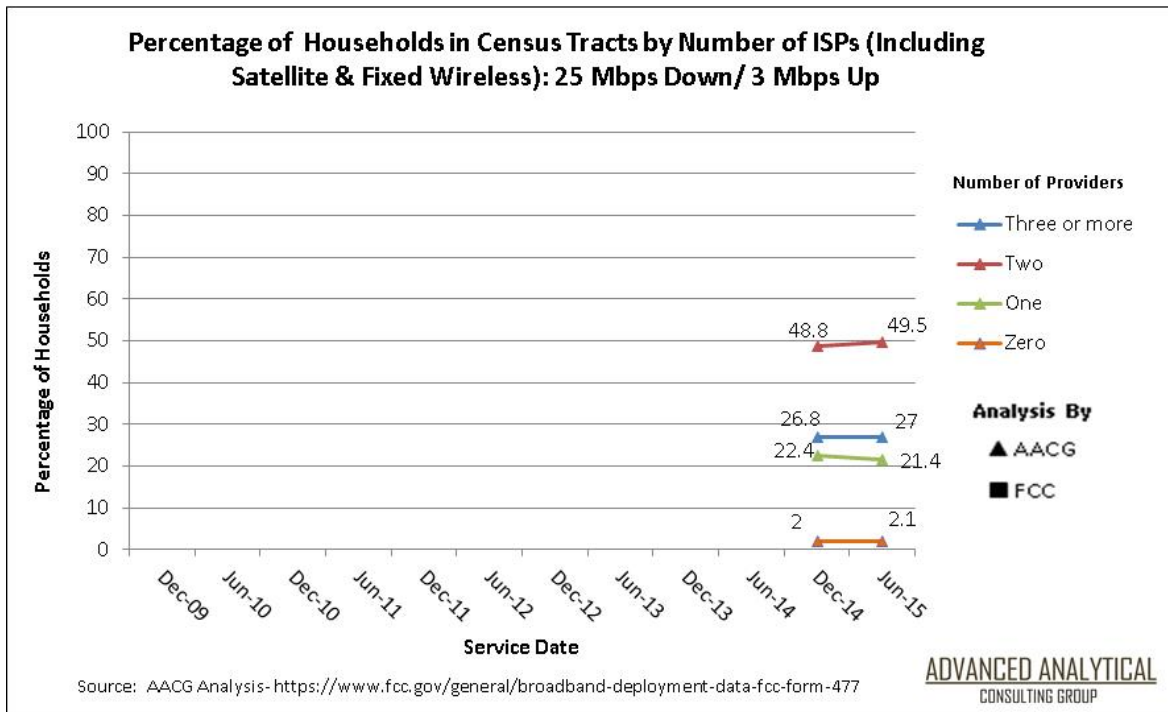


Figure B4

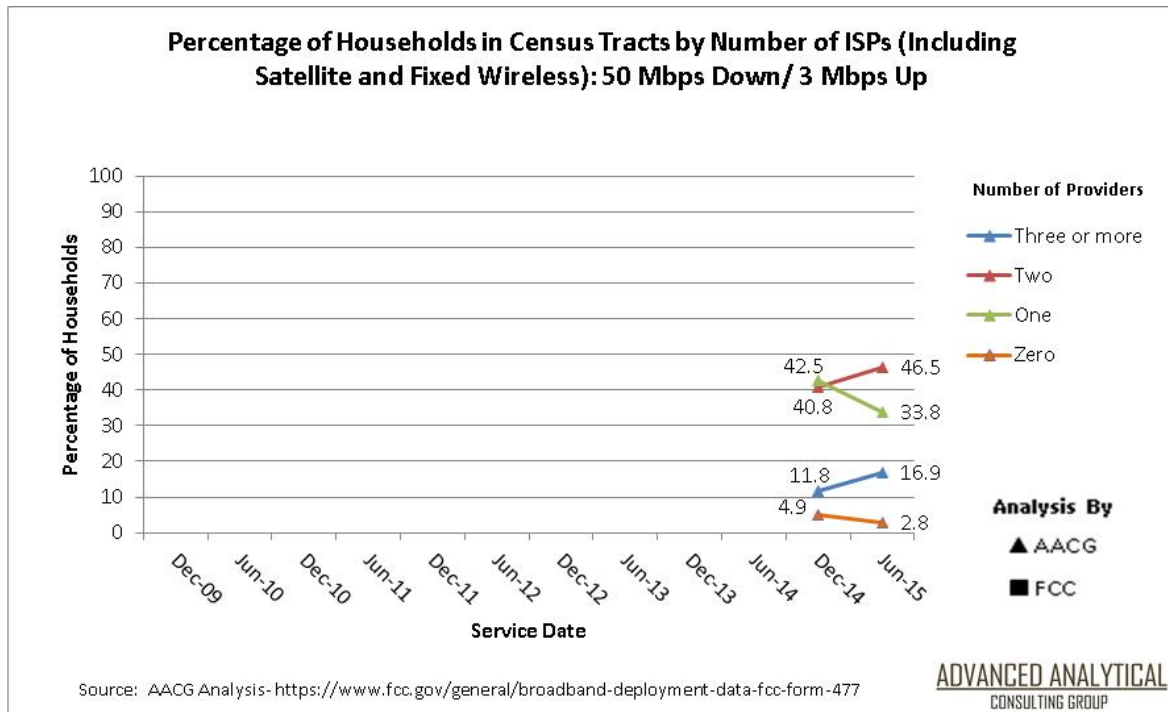


Figure B5

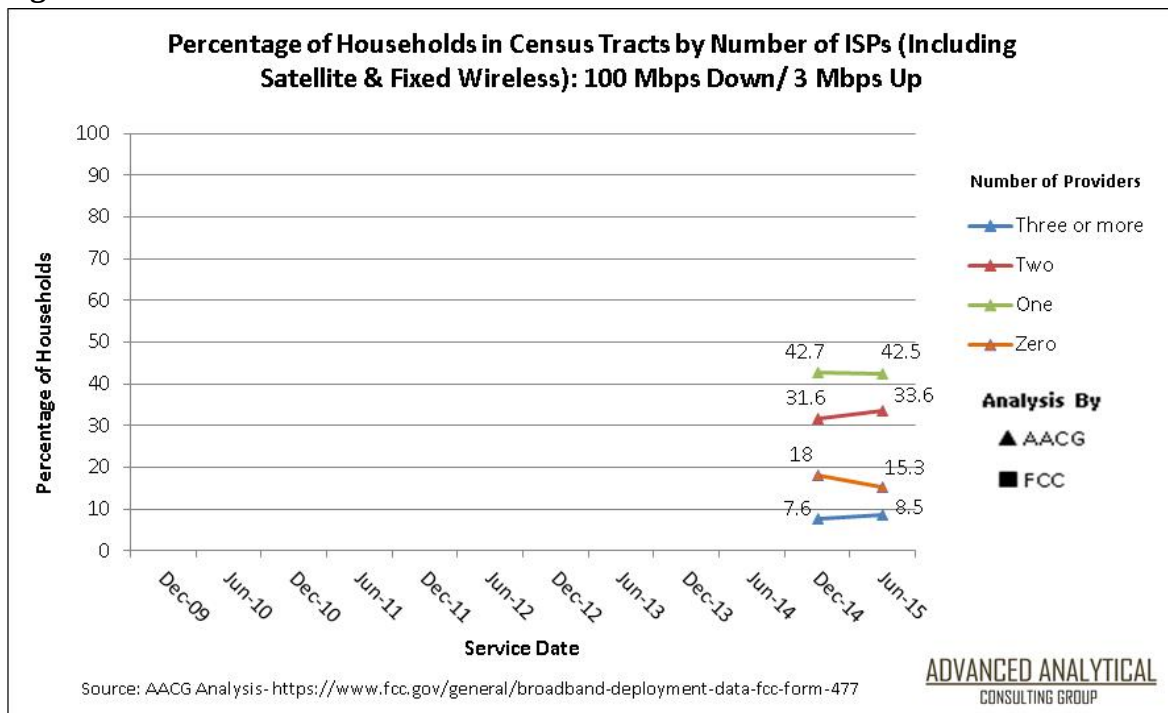


Figure B6

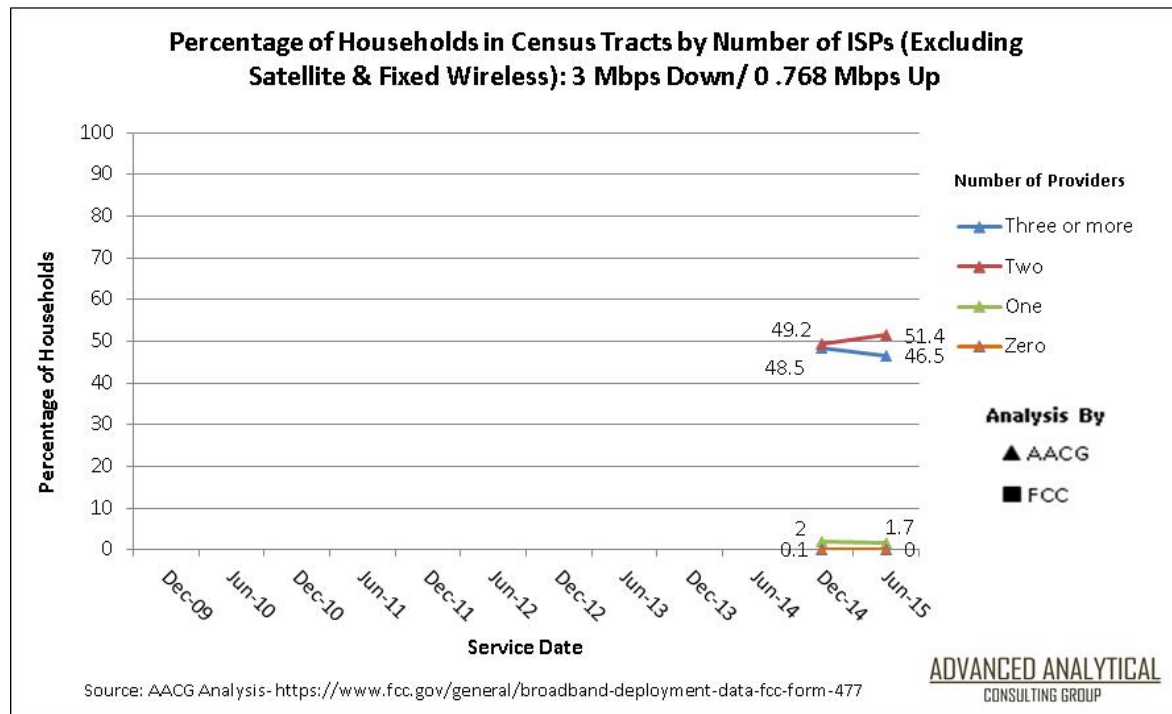


Figure B7

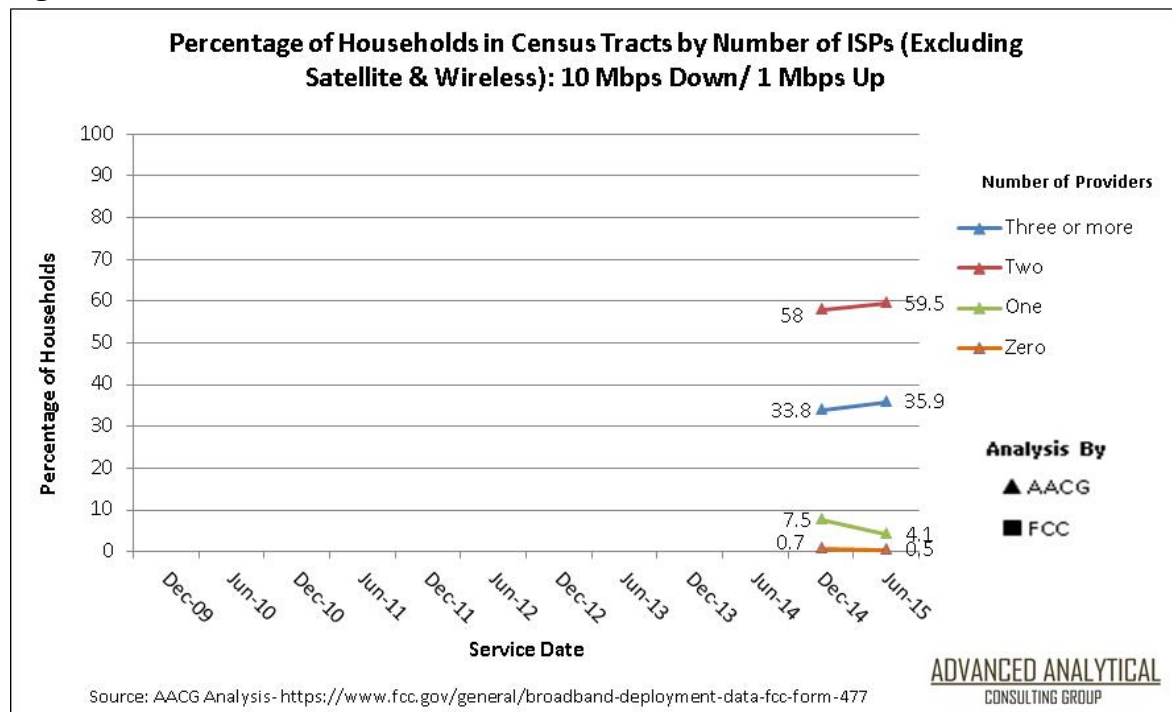


Figure B8

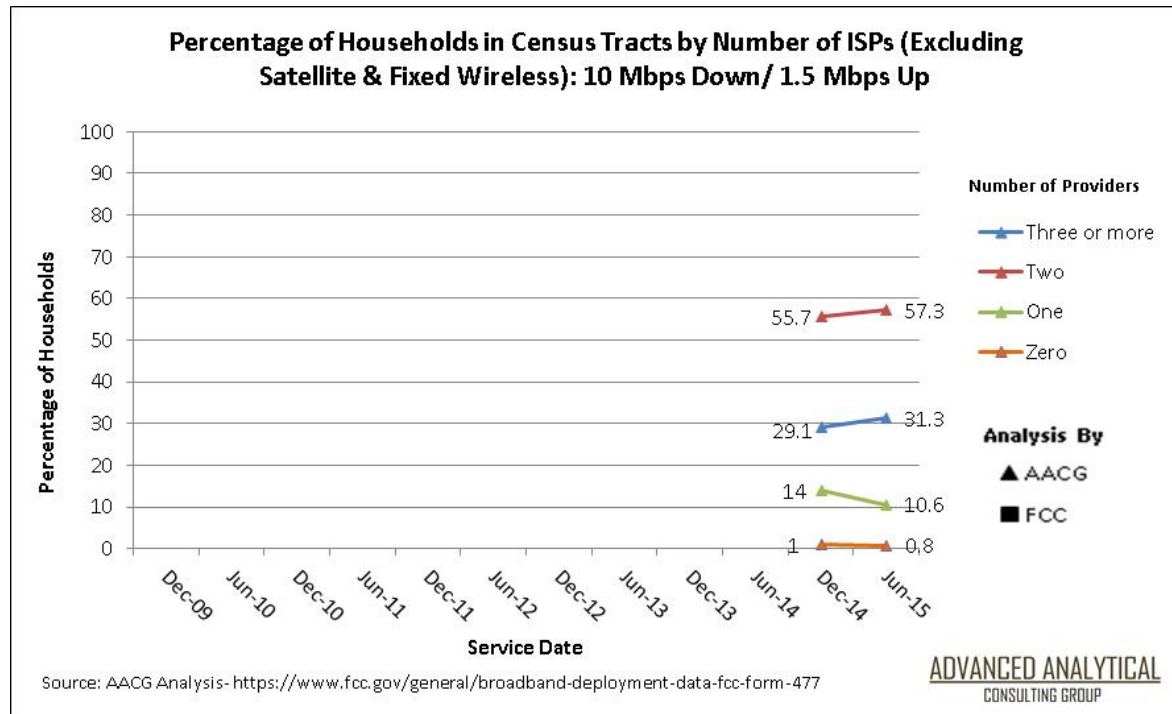


Figure B9

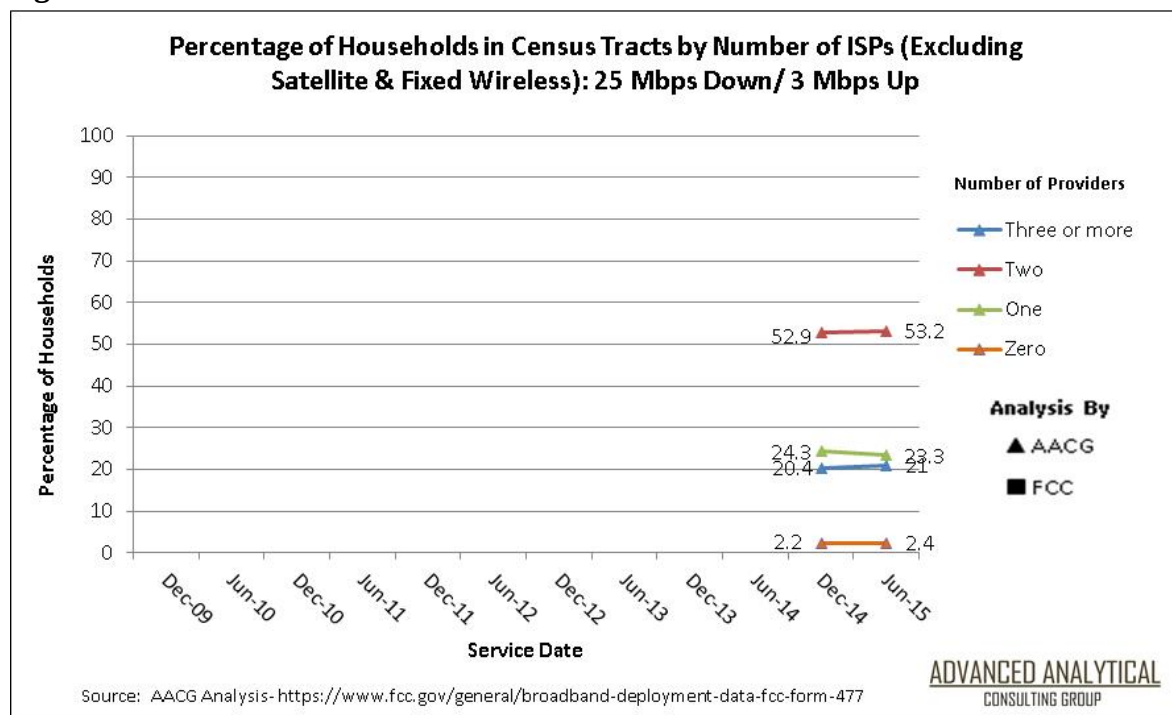


Figure B10

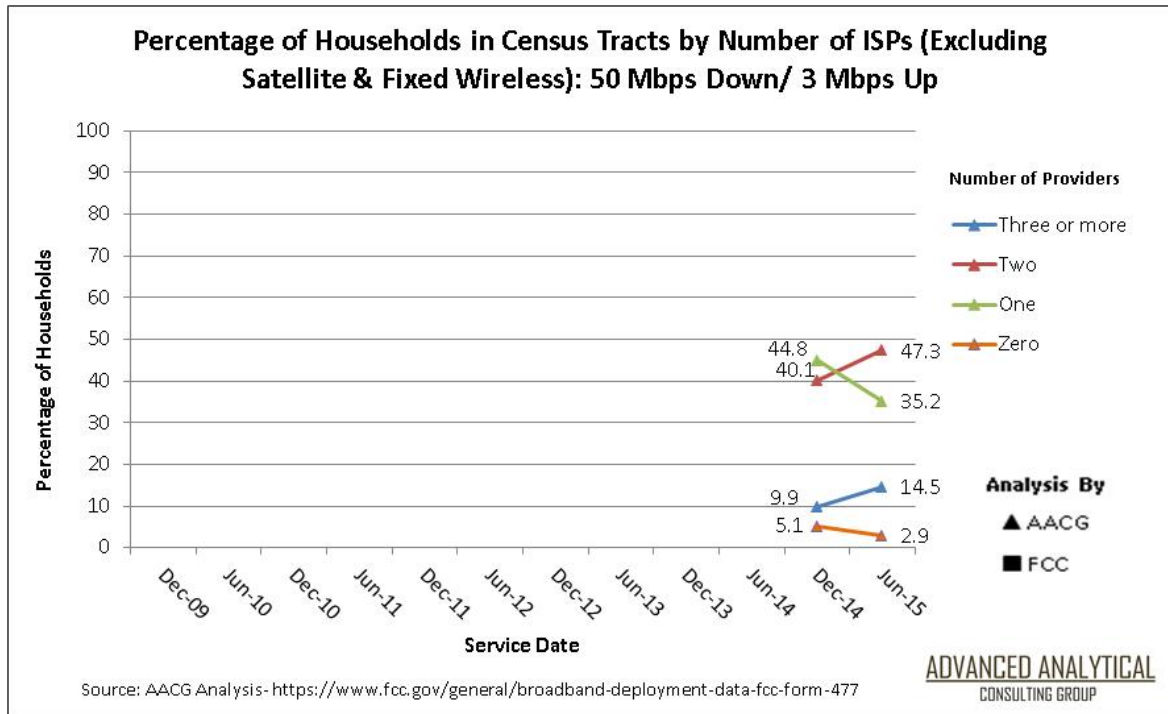


Figure B11

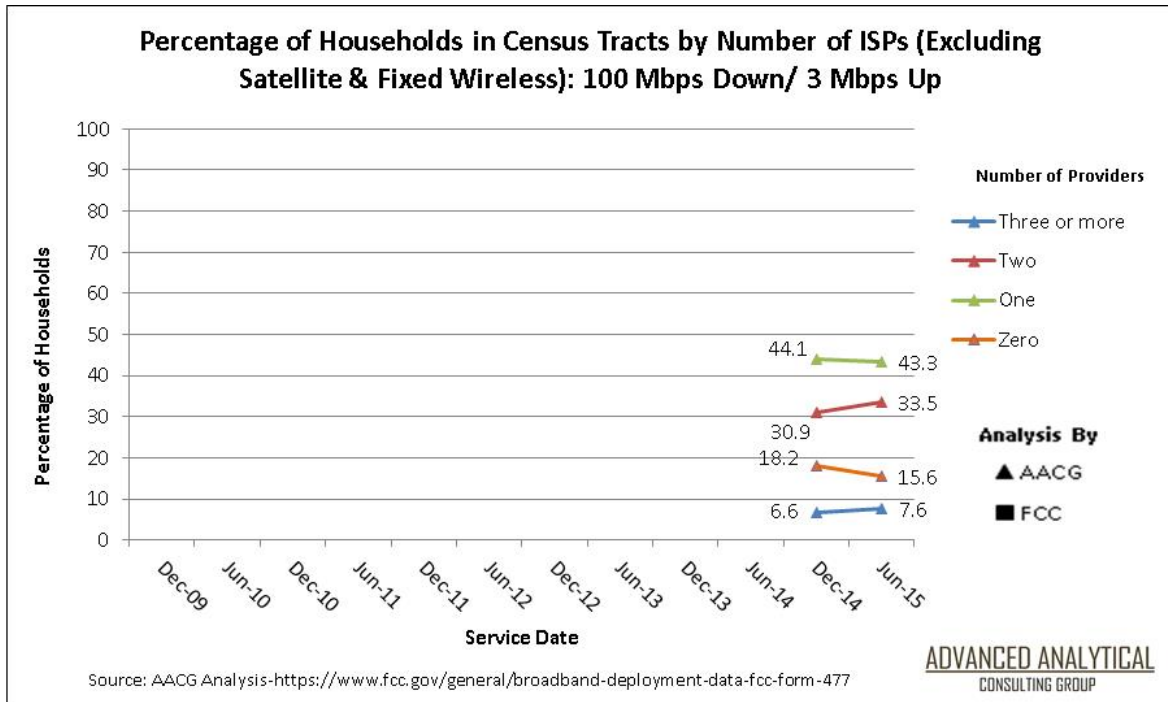


Figure B12

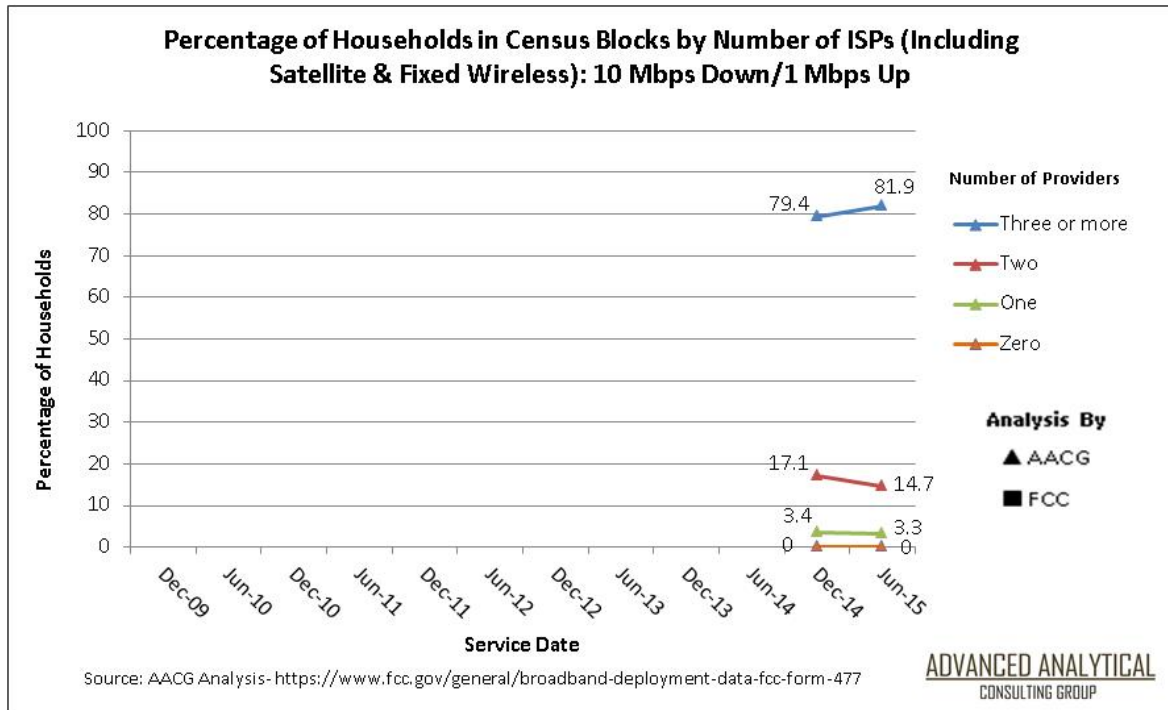


Figure B13

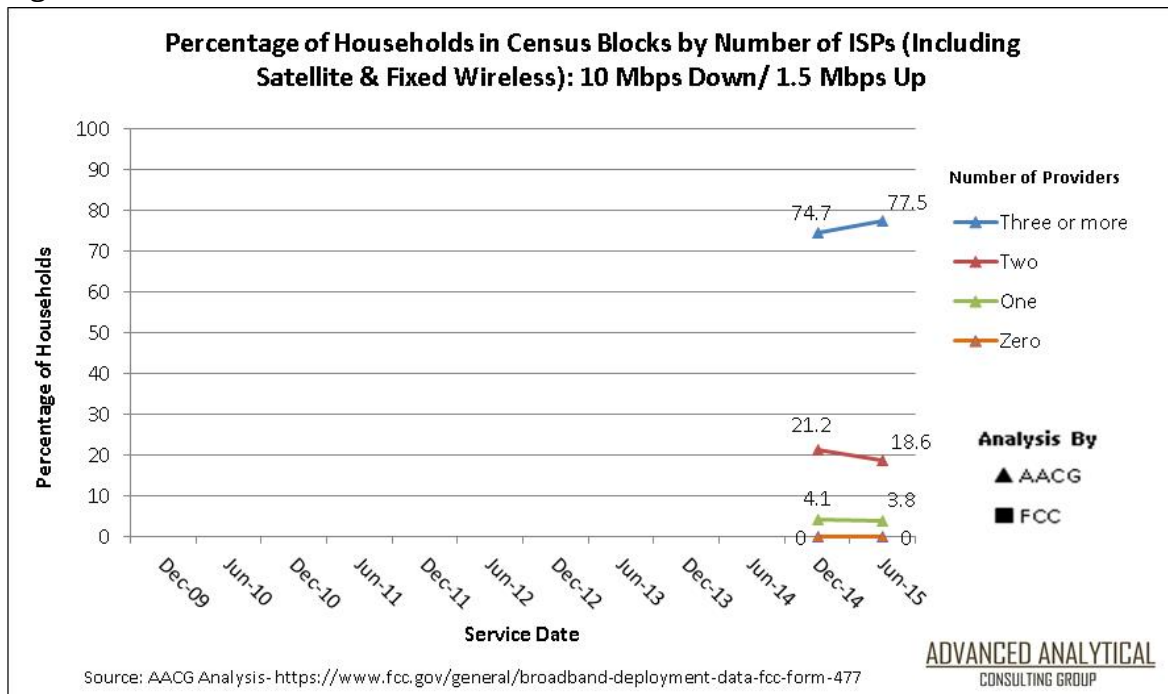


Figure B14

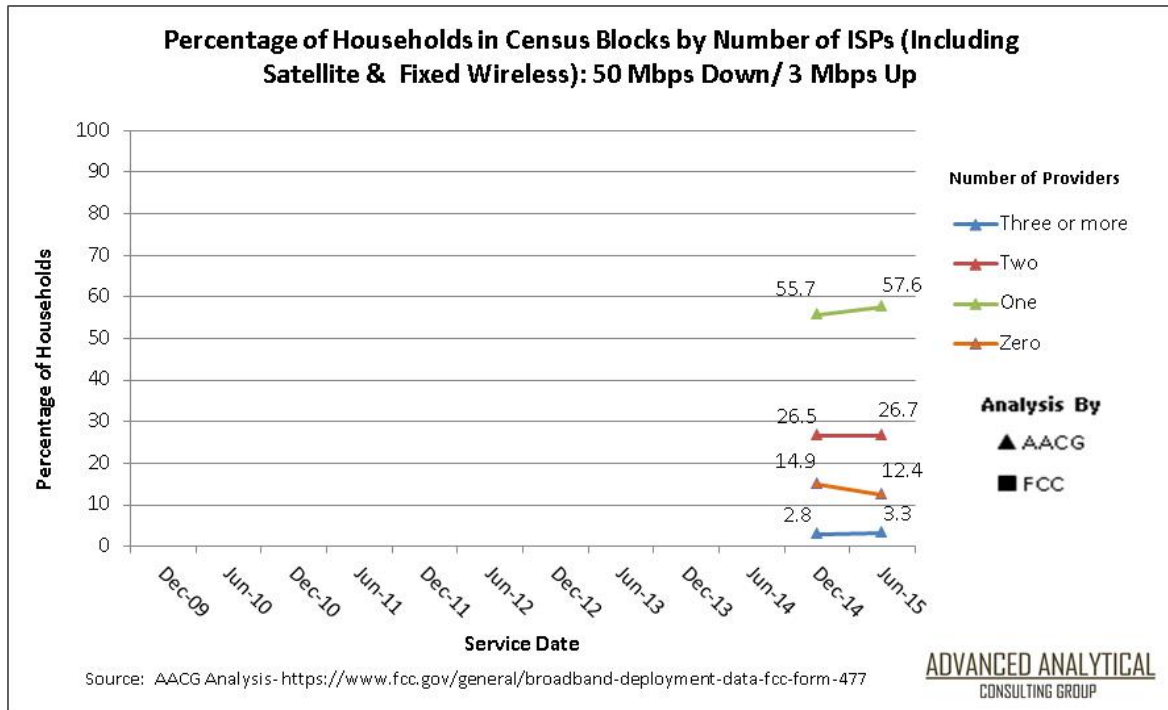


Figure B15

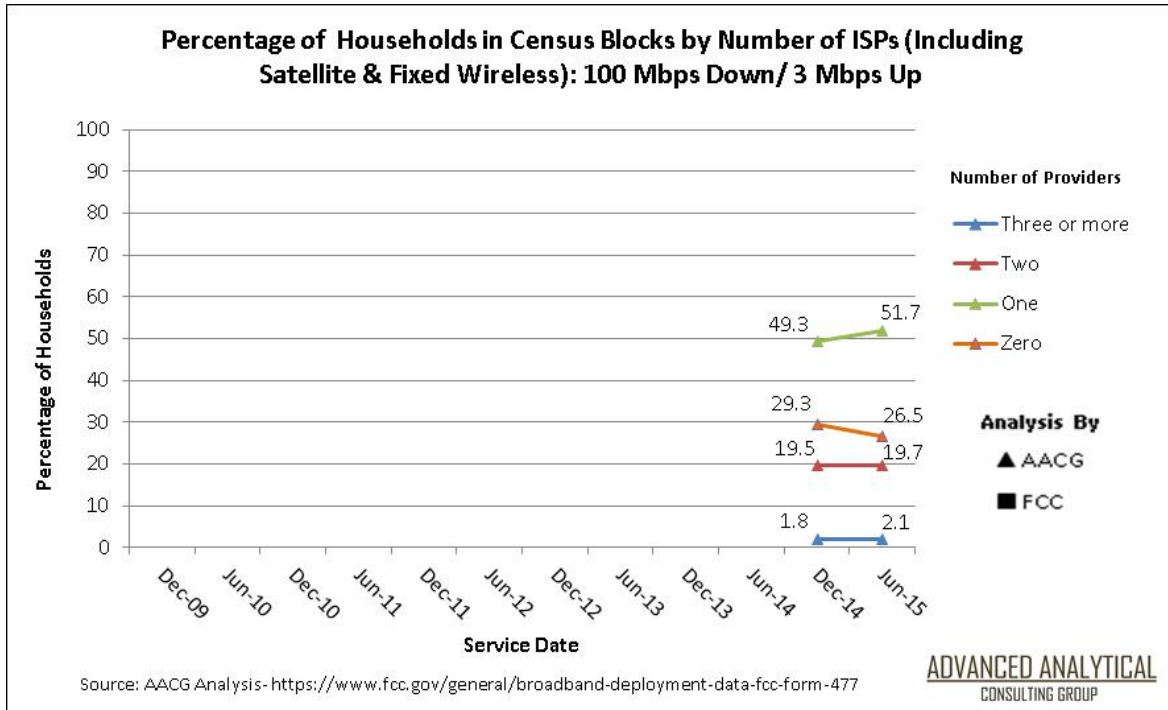


Figure B16

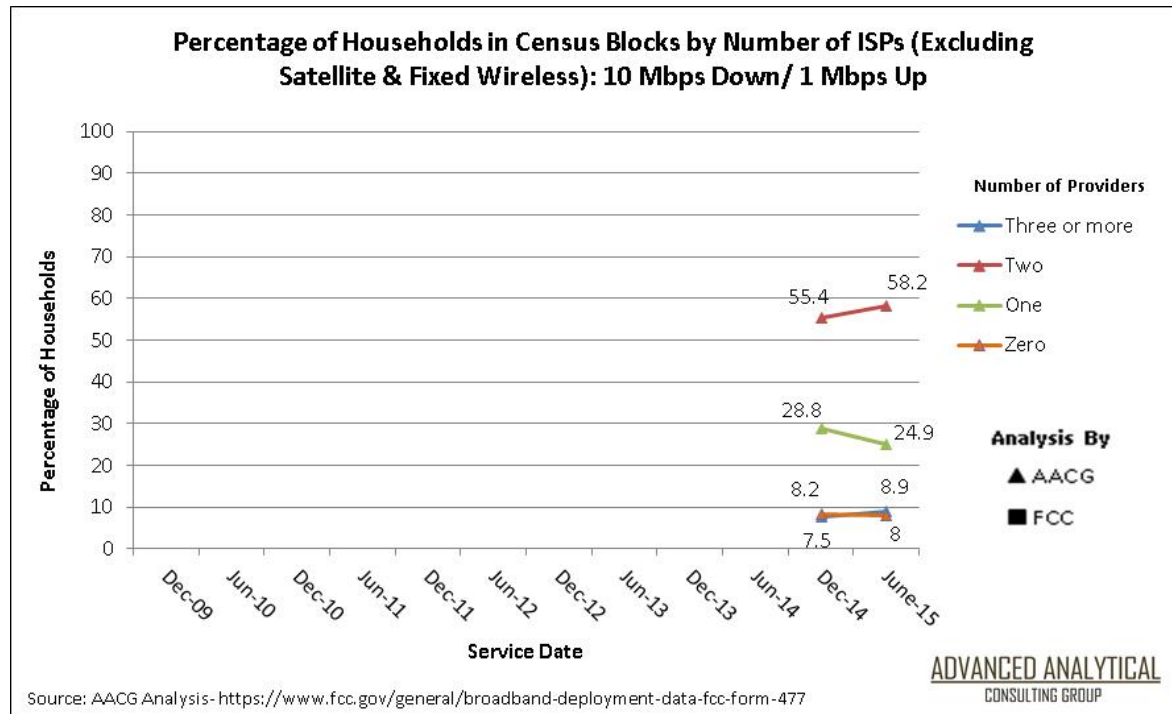


Figure B17

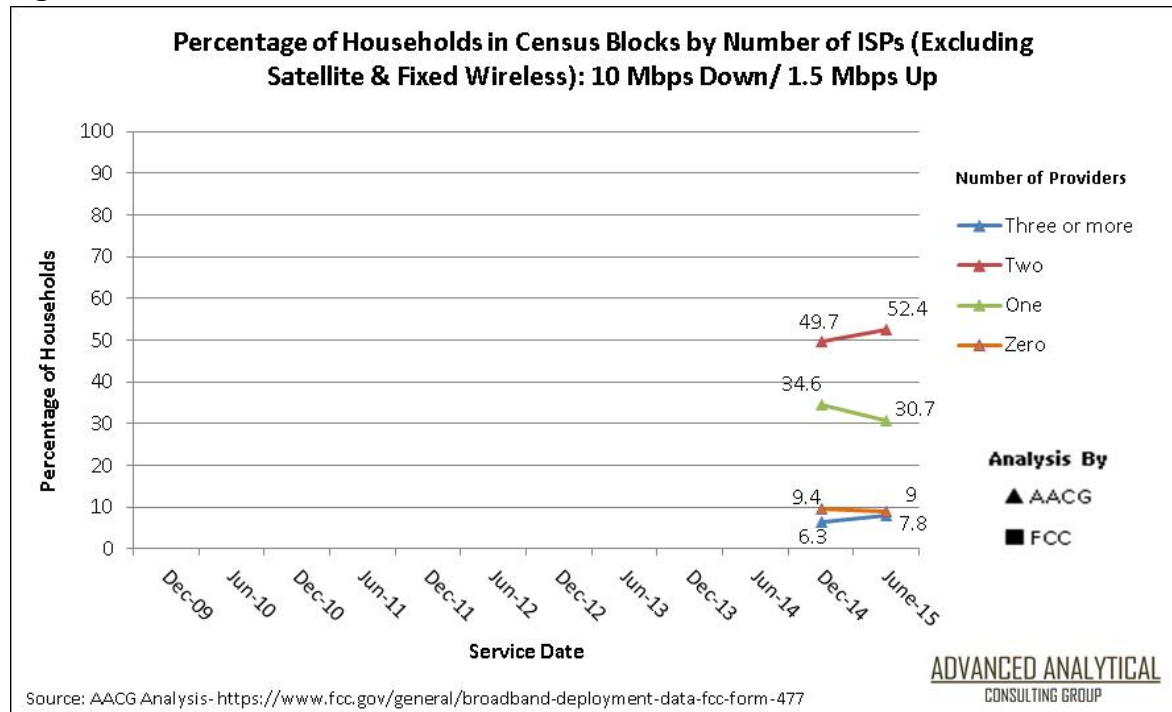


Figure B18

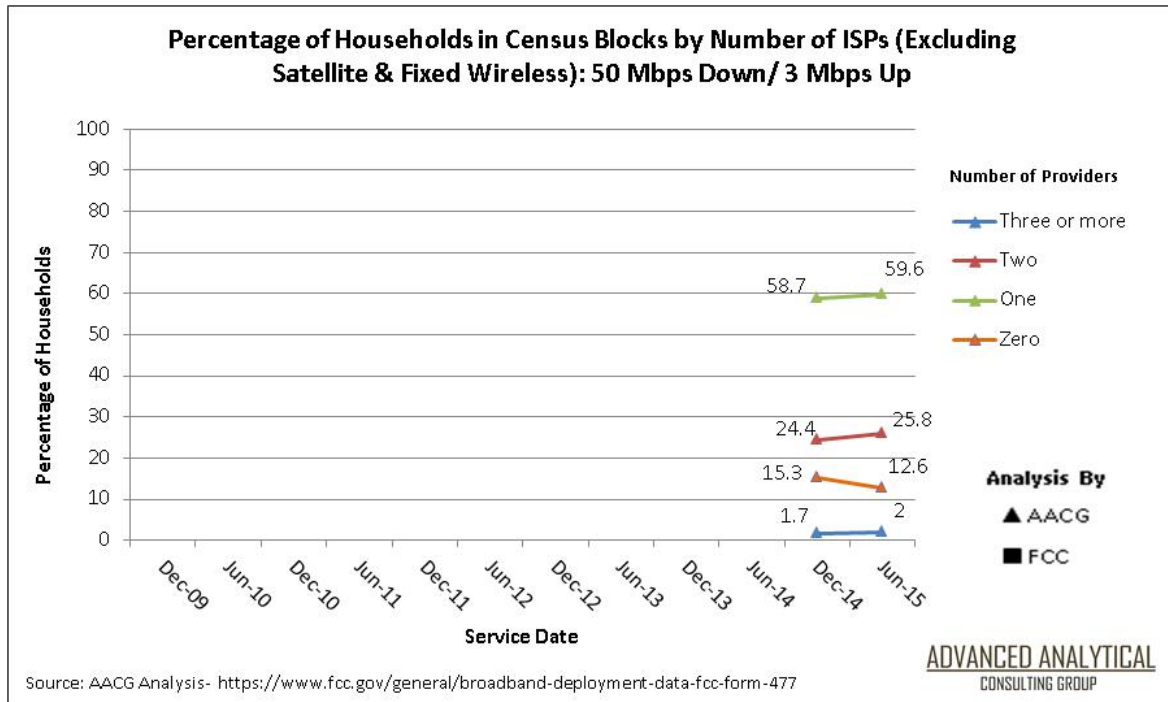


Figure B19

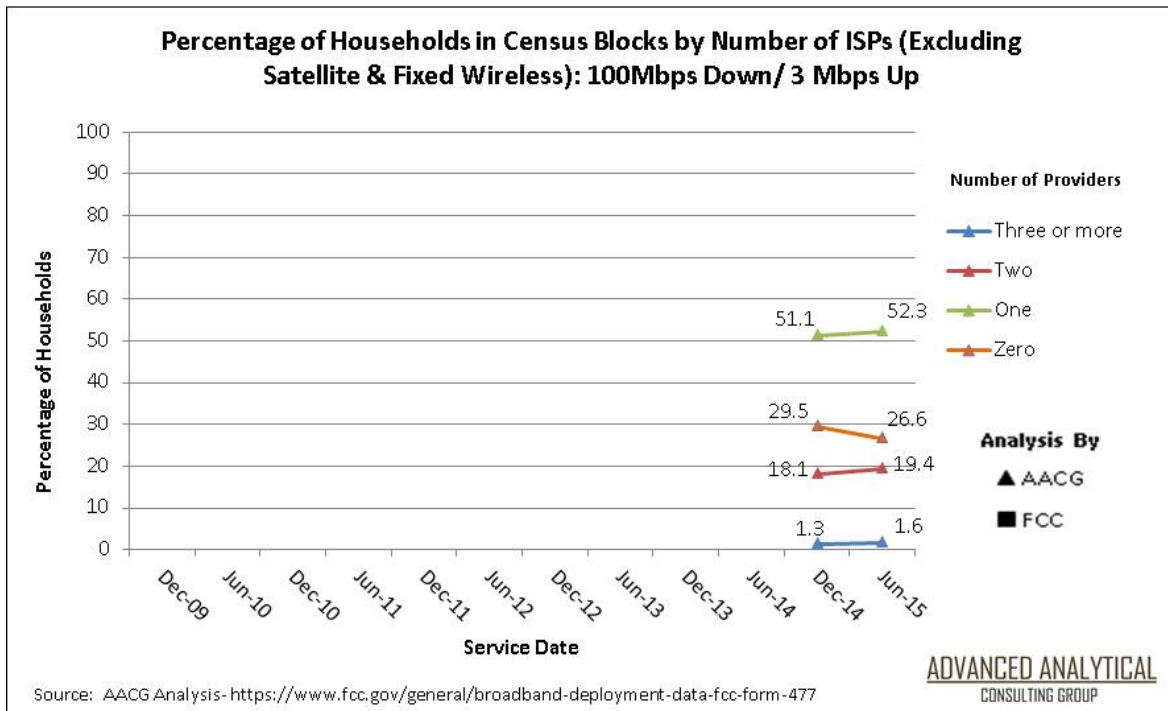


Figure B20

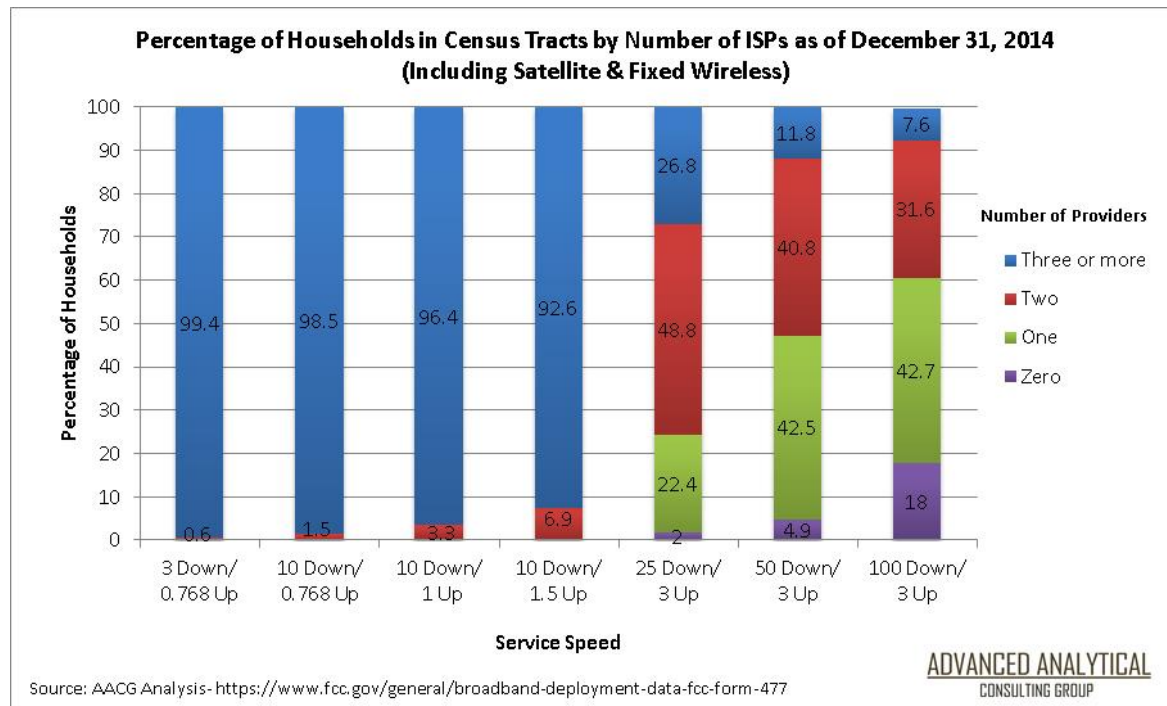


Figure B21

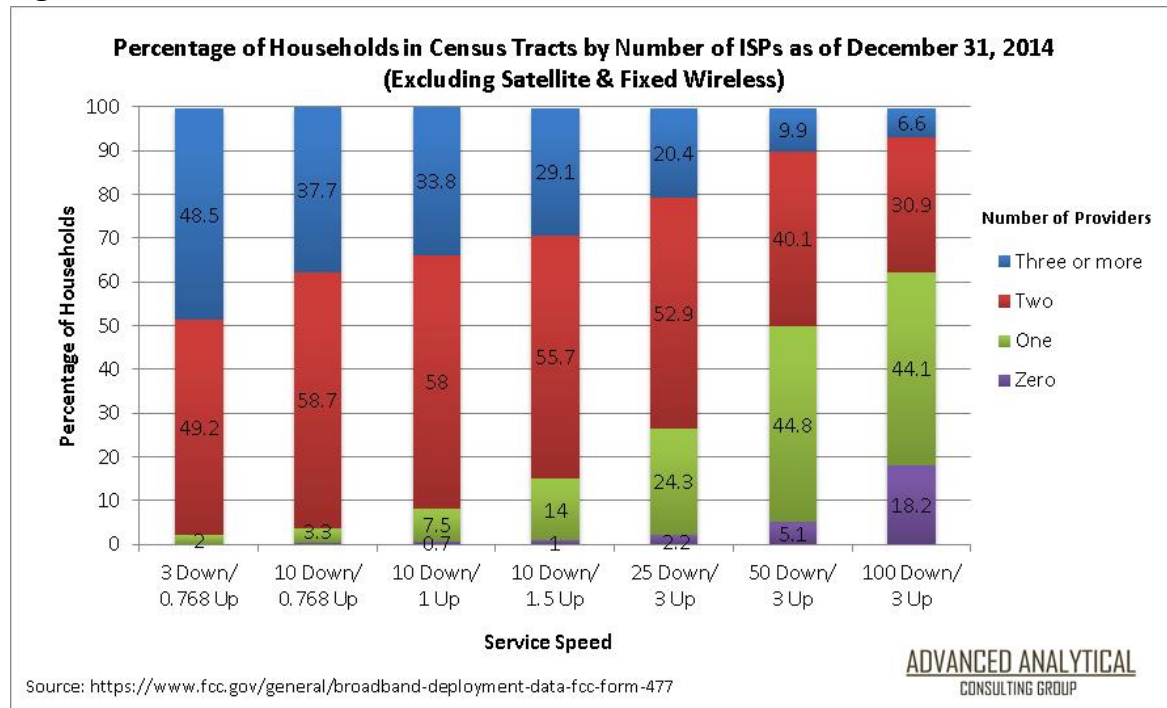


Figure B22

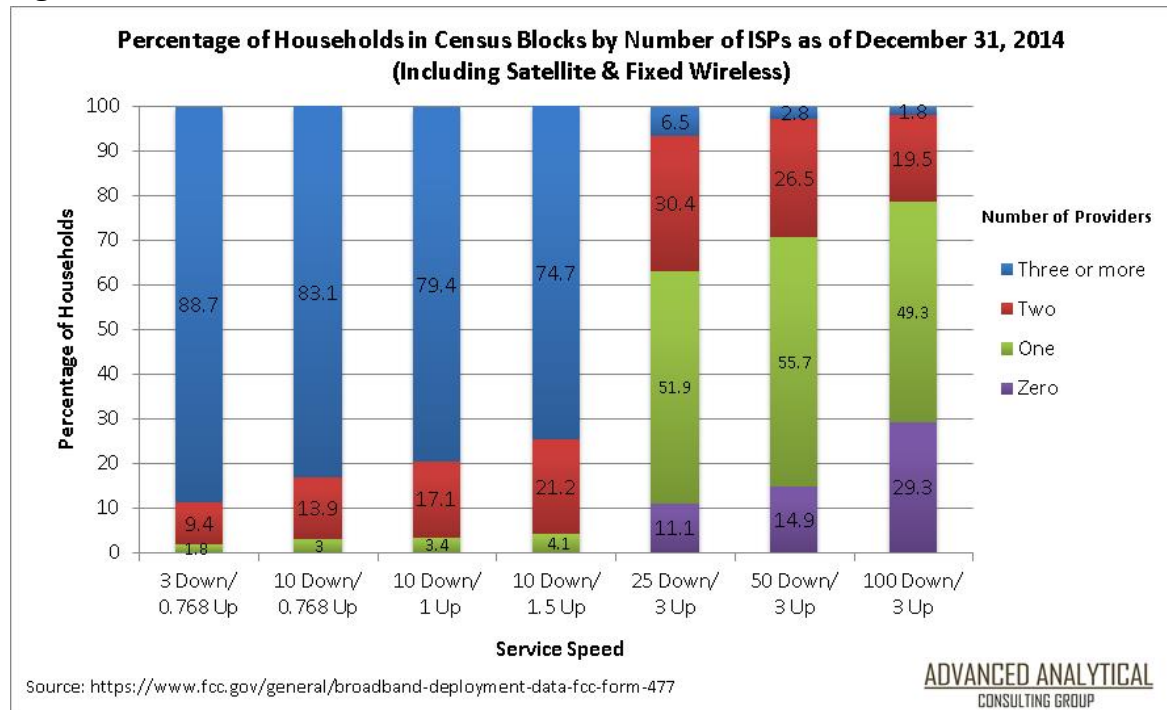


Figure B23

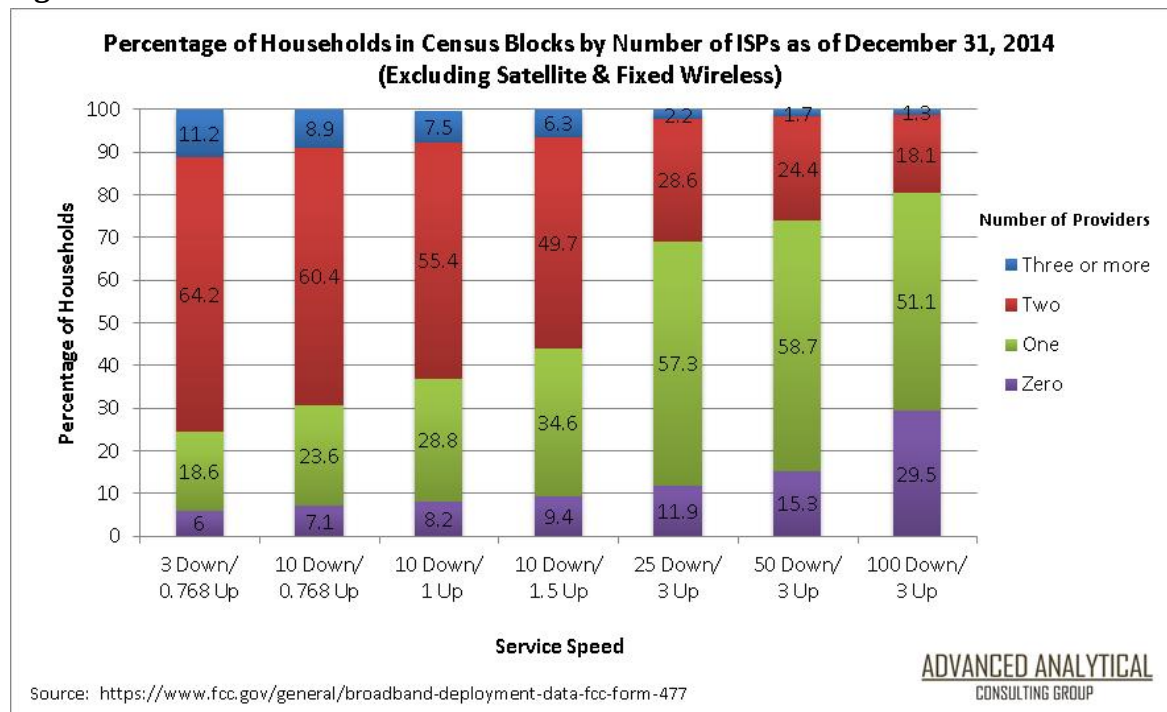


Figure B24

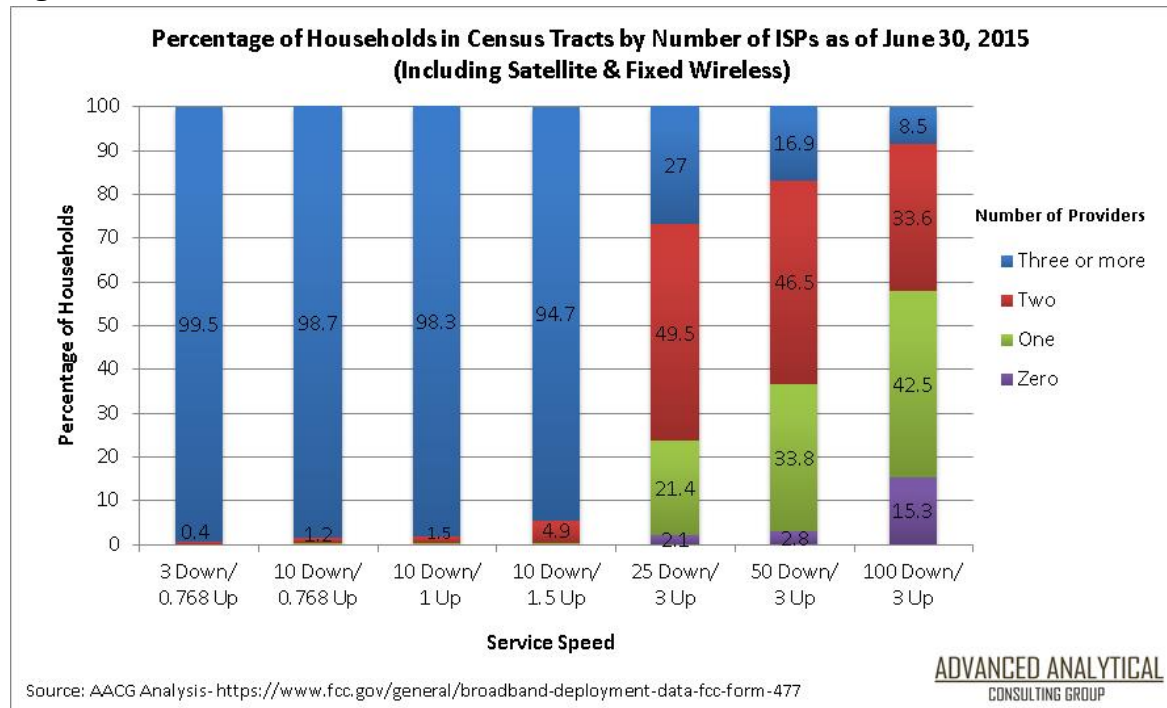
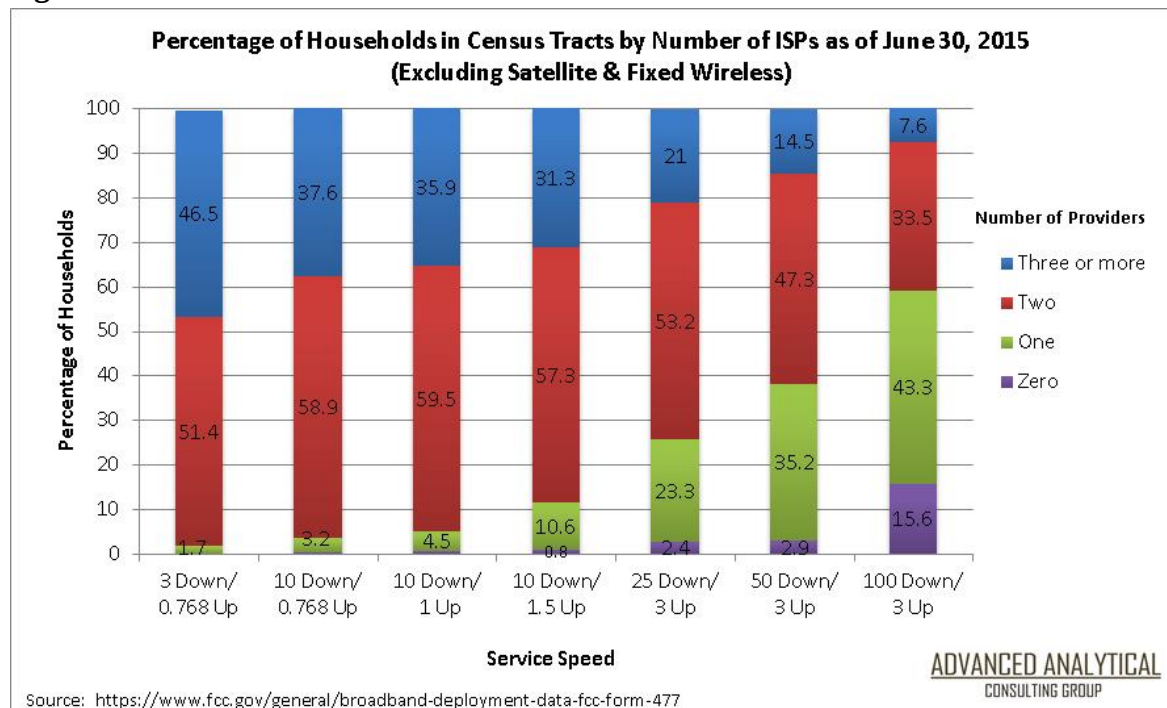


Figure B25



s)

Figure B26

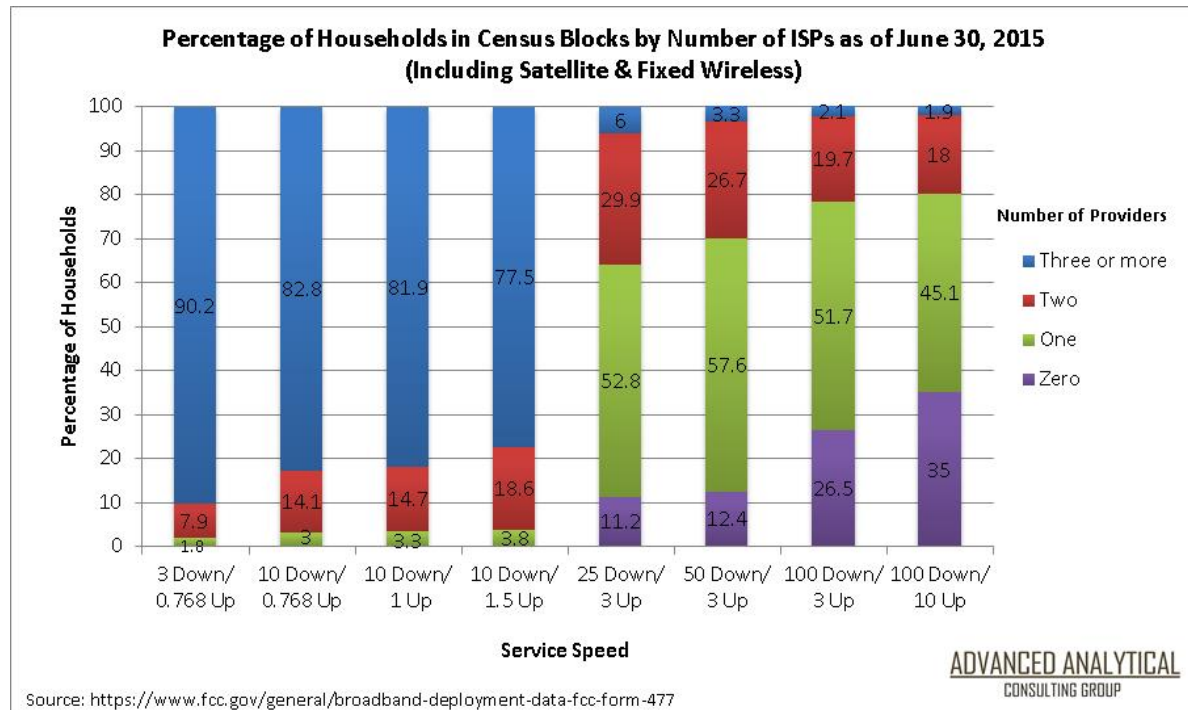


Figure B27

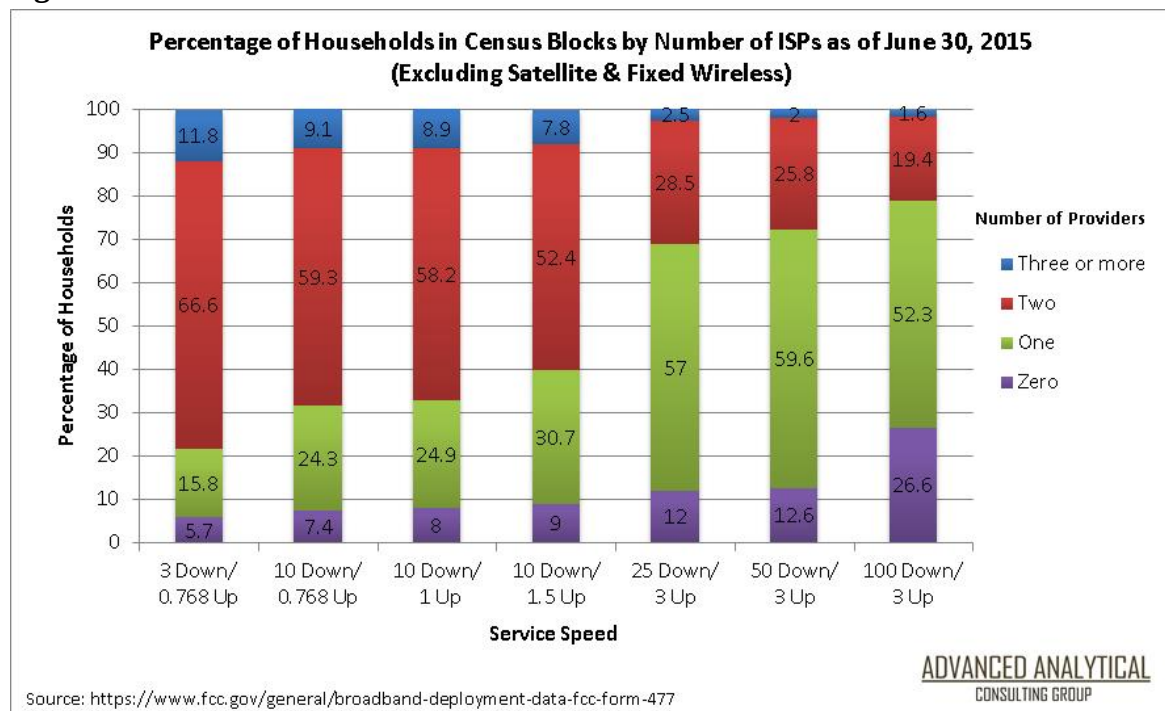


Figure B28. Summary of FCC's Internet Access Services Report Parameters

Speeds Included in FCC Reports	Services Included	Level of Analysis By FCC	Data Date	Report Release Date
3 Mbps Down/0.20 Mbps Up	•Satellite Included •Fixed Wireless Included	Tract	December 2009, June 2010, December 2010, June 2011, December 2011, June 2012, December 2012, June 2013	December 2010, March 2011, October 2011, June 2012, February 2013, May 2013, December 2013, June 2014
3 Mbps Down/0.768 Mbps Up	•Satellite Included •Fixed Wireless Included	Tract	December 2009, June 2010, December 2010, June 2011, December 2011, June 2012, December 2012, June 2013	December 2010, March 2011, October 2011, June 2012, February 2013, May 2013, December 2013, June 2014
6 Mbps Down/ 1.5 Mbps UP	•Satellite Included •Fixed Wireless Included	Tract	June 2009, December 2009, June 2010, December 2010, June 2011, December 2011, June 2012, December 2012, June 2015	September 2010, December 2010, March 2011, October 2011, June 2012, February 2013, May 2013, December 2013, June 2014
10 Mbps Down/ 1.5 Mbps Up	•Satellite Included •Fixed Wireless Included	Tract	December 2009, June 2010, December 2010, June 2011, December 2011, June 2012, December 2012, June 2013	December 2010, March 2011, October 2011, June 2012, February 2013, May 2013, December 2013, June 2014
3 Mbps Down/.768 Mbps Up	•Satellite Included •Fixed Wireless Included	Block	December 2014, June 2015	March 2016, August 2016
10 Mbps Down/ 1 Mbps UP	•Satellite Included •Fixed Wireless Included	Block	December 2014, June 2015	March 2016, August 2016
25 Mbps Down/ 3 Mbps Up	•Satellite Included •Fixed Wireless Included	Block	December 2014, June 2015	March 2016, August 2016

Contents

Table 1. FCC Internet Access Services Report Coverage and Release Dates, 2009-2013	4
Table 2. FCC Internet Access Services Report Coverage and Release Dates, 2014 and Later	5
Figure 1. Percentage of Households in Census Tracts by Number of ISPs (Including Satellite & Fixed Wireless): 10 Mbps Down/ 1.5 Mbps Up	6
Figure 2. Percentage of Households in Census Tracts by Number of ISPs (Including Satellite & Fixed Wireless): 3 Mbps Down/ 0.768 Mbps Up	7
Figure 3. Percentage of Households in Census Blocks by Number of ISPs (Excluding Satellite & Fixed Wireless): 25 Mbps Down/ 3Mbps	8
Figure 4. Perce(Including Satellite & Fixed Wireless): 25 Mbps Down/ 3 Mbps up	9
Figure 5. Percentage of Households in Census Blocks by Number of ISPs (Excluding Satellite and Fixed Wireless): 10 Mbps Down/ 0.768 Mbps Up	11
Figure 6. Percentage of Households in Census Blocks by Number of ISPs (Including Satellite & Fixed Wireless): 10 Mbps Down/ 0.768 Mbps Up	12
Figure 7. Percentage of Households in Census Blocks by Number of ISPs (Excluding Satellite & Fixed Wireless): 3 Mbps Down/ 0.768 Mbps Up	13
Figure 8. Percentage of Households in Census Blocks by Number of ISPs (Including Satellite & Fixed Wireless): 3 Mbps Down/ 0.768 Mbps Up	14
Table A1. Estimated Percentage of Americans With Multiple Options for Fixed Advanced Telecommunications Capability as of December 31, 2014	19
Figure B1. Percentage of Households in Census Tracts by Number of ISPs (Including Satellite & Fixed Wireless): 10 Mbps Down/ 0.768 Mbps Up	20
Figure B2. Percentage of Households in Census Tracts by Number of ISPs (Including Satellite & Fixed Wireless): 10 Mbps Down/ 1 Mbps Up	21
Figure B3. Percentage of Households in Census Tracts by Number of ISPs (Including Satellite & Fixed Wireless): 25 Mbps Down/ 3 Mbps Up	21
Figure B4. Percentage of Households in Census Tracts by Number of ISPs (Including Satellite and Fixed Wireless): 50 Mbps Down/ 3 Mbps Up	22
Figure B5. Percentage of Households in Census Tracts by Number of ISPs (Including Satellite & Fixed Wireless): 100 Mbps Down/ 3 Mbps Up	22
Figure B6. Percentage of Households in Census Tracts by Number of ISPs (Excluding Satellite & Fixed Wireless): 3 Mbps Down/ 0.768 Mbps Up	23
Figure B7. Percentage of Households in Census Tracts by Number of ISPs (Excluding Satellite & Wireless): 10 Mbps/ 1 Mbps Up	23
Figure B8. Percentage of Households in Census Tracts by Number of ISPs (Excluding Satellite & Fixed Wireless): 10 Mbps Down/ 1.5 Mbps Up	24

Figure B9. Percentage of Households in Census Tracts by Number of ISPs (Excluding Satellite & Fixed Wireless): 25 Mbps Down/ 3Mbps Up	24
Figure B10. Percentage of Households in Census Tracts by Number of ISPs (Excluding Satellite & Fixed Wireless): 50 Mbps Down/ 3 Mbps Up	25
Figure B11. Percentage of Households in Census Tracts by Number of ISPs (Excluding Satellite & Fixed Wireless): 100 Mbps Down/ 3 Mbps Up	25
Figure B12. Percentage of Households in Census Blocks by Number of ISPs (Including Satellite & Fixed Wireless): 10 Mbps Down/ 1 Mbps Up	26
Figure B13. Percentage of Households in Census Blocks by Number of ISPs (Including Satellite & Fixed Wireless): 10 Mbps Down/ 1.5 Mbps Up	26
Figure B14. Percentage of Households in Census Blocks by Number of ISPs (Including Satellite & Fixed Wireless): 50 Mbps Down/ 3 Mbps Up	27
Figure B15. Percentage of Households in Census Blocks by Number of ISPs (Including Satellite & Fixed Wireless): 100 Mbps Down/ 3 Mbps Up	27
Figure B16. Percentage of Households in Census Blocks by Number of ISPs (Excluding Satellite & Fixed Wireless): 10 Mbps Down/ 1 Mbps Up	28
Figure B17. Percentage of Households in Census Blocks by Number of ISPs (Excluding Satellite & Fixed Wireless): 10 Mbps Down/ 1.5 Mbps Up	28
Figure B18. Percentage of Households in Census Blocks by Number of ISPs (Excluding Satellite & Fixed Wireless): 50 Mbps Down/ 3 Mbps Up	29
Figure B19. Percentage of Households in Census Blocks by Number of ISPs (Excluding Satellite & Fixed Wireless): 100 Mbps Down/ 3 Mbps Up	29
Figure B20. Percentage of Households in Census Tracts by Number of ISPs as of December 31, 2014 (Including Satellite & Fixed Wireless).....	30
Figure B21. Percentage of Households in Census Tracts by Number of ISPs as of December 31, 2014 (Excluding Satellite & Fixed Wireless)	30
Figure B22. Percentage of Households in Census Blocks by Number of ISPs as December 31, 2014 (Including Satellite & Fixed Wireless)	31
Figure B23. Percentage of Households in Census Blocks by Number of ISPs as of December 31, 2014 (Excluding Satellite & Fixed Wireless)	31
Figure B24. Percentage of Households in Census Tracts by Number of ISPs as of June 30, 2015 (Including Satellite & Fixed Wireless)	32
Figure B25. Percentage of Households in Census Tracts by Number of ISPs as of June 30, 2015 (Excluding Satellite & Fixed Wireless)	32
Figure B26. Percentage of Households in Census Blocks by Number of ISPs as of June 30, 2015 (Including Satellite & Fixed Wireless)	33

Figure B27. Percentage of Households in Census Blocks by Number of ISPs as of June 30, 2015 (Excluding Satellite & Fixed Wireless)	33
Figure B28. Summary of FCC’s Internet Access Services Report Parameters	34