Consistent Measurement of Broadband Availability

FCC Data through December 2016

By

Advanced Analytical Consulting Group, Inc.

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Abstract

The strength of broadband competition, as measured by the number of alternative providers available to consumers, was an important consideration in the FCC's 2015 decision to impose regulatory restrictions on providers of broadband Internet access services and in its 2018 decision that eliminated those restrictions. This report updates the several measures of broadband availability described in Advanced Analytical Consulting Group's (AACG) previous reports in this series, which have been constructed consistently from 2009 to 2016, based on data available on the FCC's website.[1] They reveal substantial growth in the numbers of broadband providers over time. The FCC reports based on the same data have 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 report 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.

[1] The previous reports are available on AACG's website: http://aacg.com/litigation/telecommunications/net-neutrality/

For further information
contact AACG at Info@AACG.com

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 changing the regulation imposed on ISPs. In 2010, 2015,[2] and again in 2018,[3] the FCC cited the numbers of ISPs providing broadband service to persons or households within US Census tracts or blocks as measures of competition for broadband service to justify changing the regulation of ISP providers. For example, in its 2010 Open Internet Order that imposed new rules on ISP providing broadband Internet access services, 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.[4] The 2015 FCC Open Internet Order, which imposed more stringent rules on ISPs, 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.[5] The 2018 Internet Order, which eliminated the restrictions imposed in the 2015 order, used the same benchmark and a similar measurement of broadband availability as the 2015 Order, so that a clearer picture of broadband progress between the two orders could inform policy. However, the 2015 and 2018 Orders presented "one-off" measures developed within the record of the proceedings, and which differed from the consistent biannual measures that informed earlier decisions as well as the measures the FCC reported between the 2015 Order and the 2018 Order. Clearly a consistently measured and timely reported set of metrics about the extent of ISP offerings will serve to inform this regulatory process,[6] allowing a better

[2] 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.

[3] Federal Communications Commission, *Restoring Internet Freedom*, WC Docket No. 17-108, Declaratory Ruling, Report and Order, and Order, January 4, 2018, ("2018 Internet Order") , available at https://transition.fcc.gov/Daily_Releases/Daily_Business/2018/db0223/FCC-17-166A1.pdf.

[4] 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.

[5] 2015 Open Internet Order, ¶ 81.

[6] The FCC measured broadband availability regularly 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 later in this report), 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.

understanding of not only what the current levels of service offerings are, but also how competition has evolved over time.

We provide this needed 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 and in December 2016, when the FCC again considered competition in deciding on its 2018 Internet Order.

Changes from Previous Version

Our previous reports in this series described broadband availability as of June 30, 2015 and December 31, 2015.[7] In this report we add measures of broadband availability as of June 30, 2016 and December 31, 2016 for various speeds at the census tract and census block levels to the charts presented in the previous version of this report.[8] These are the most recent data the FCC has made available. In general, the number of geographies with increasing numbers of broadband providers continued to grow during the 12 month period between the end of December 2015 and the end of December 2016. In particular we note the following findings:

- At the FCC's current broadband benchmark of 25 Mbps downstream and 3 Mbps upstream, the percentage of households in census blocks with three or more providers of wireline broadband service increased from 2.6 percent as of December 2015 to 6.0 percent as of December 2016 and the percentage with two or more alternatives increased from 31.2 percent to 49.8 percent.[9] When fixed wireless and satellite alternatives are included, the percentage of households in census blocks with three or more providers of fixed broadband service increased from 7.1 percent as of December 2015 to 42.5 percent as of December 2016 and the percentage with two or more alternatives increased from 37.9 percent to 75.9 percent.

- For the metrics the FCC used for periods from December 2009 through December 2013, virtually all households continued to have three or more alternative companies providing service with downstream speeds of at least 3 Mbps and upstream speeds of at least 0.768 Mbps upstream somewhere within their census tracts. Ninety-nine percent of households

[7] These reports are available at http://aacg.com/litigation/telecommunications/net-neutrality/. An abbreviated version reporting availability as of June 30, 2016, which was filed as a Comment in the FCC's recent *Restoring Internet Freedom* proceeding, is also available at this site.
[8] The data used to produce the June 2016 and December 2016 broadband availability measures are available at https://www.fcc.gov/general/broadband-deployment-data-fcc-form-477. Because the most recent Internet Access Services reports (beginning with the report for the period ending June 30, 2015) include a new speed level (100 Mbps downstream/10 Mbps upstream), we have produced additional charts not included in the initial version.
[9] The growth in broadband availability measured at the census block level at the current benchmark from December 2013 to December 2016 approximates the growth in broadband availability measured at the census tract level for speeds of at least 10 Mbps downstream and 1.5 Mbps upstream from December 2009 to December 2011. See Figures 1 and 3.

live in census tracts with three or more providers offering speeds of at least 10 Mbps downstream and 1.5 Mbps upstream.

- Primarily because broadband satellite services is ubiquitously available at speeds in excess of 10 Mbps downstream (but less than 25 Mbps), broadband availability remains at high levels and continues to grow at the more granular census block level. In particular, the percentage of households living in census blocks with three or more companies offering service at least 3 Mbps downstream and 0.768 Mbps upstream somewhere in the census block increased from 91.4 percent as of the end of December 2015 to 97.6 percent as of the December 2016.[10] The corresponding increase in the percentage of households with three or more alternatives at speeds of at least 10 Mbps downstream and 0.768 Mbps upstream was from 84.9 percent to 94.2 percent.[11]

The time series of these measures along with others that the FCC has presented in the past are listed in graphs below. Details of the data used for this analysis are presented in Appendix A.

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).[12] The same set of consistent calculations for several other speed-levels is provided in Appendix B. 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

[10] When fixed wireless and satellite alternatives are excluded, the percentages of households living in census blocks with three or more alternatives changed from 14.4 percent to 12.6 percent and the percentage with two or more alternatives changed from 80.7 percent to 78.7 percent.

[11] When fixed wireless and satellite alternatives are excluded, the percentages of households living in census blocks with three of more alternatives changed from 9.9 percent to 9.5 percent and the percentage with two or more alternatives changed from 69.8 percent to 67.4 percent.

[12] The FCC adopted the previous standard in its 2010 Broadband Progress Report. The FCC adopted the current standard in its 2015 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. 09-137, *A National Broadband Plan for Our Future*, GN Docket No. 09-51, Sixth Broadband Deployment Report, July 20, 2010, ¶5, available at https://apps.fcc.gov/edocs_public/attachmatch/FCC-10-129A1_Rcd.pdf and 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, ¶ 3, available at https://apps.fcc.gov/edocs_public/attachmatch/FCC-15-10A1.pdf.

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.[13]

Table 1. FCC Internet Access Services Report Coverage and Release Dates: 2009-2013[14]

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

[13] 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.
[14] 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	November 30, 2016
June 30, 2016	March 3, 2017	April 21, 2017
December 31, 2016	November 16, 2017	February 8, 2018

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 our previous FCC reports and FCC practice, we report households with 3 or more, 2, and 0 or 1 available providers.[15] We use the data released by the FCC to extend its previous series described in Table 1 for periods beyond December 2013 (since the FCC has not reported these figures since October 2014, when it released the Internet Access Services Report for December 2013).[16] 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.

[15] 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.

[16] 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.

10 Mbps Downstream/1.5 Mbps Upstream Broadband Service Provision and Competition from December 2009 to December 2016

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 service and 1 or 0 ISPs offer that level of service, where some of those providers may offer satellite and fixed wireless services. The FCC last reported availability at the census tract level for this speed level as of December 2013.

Figure 1

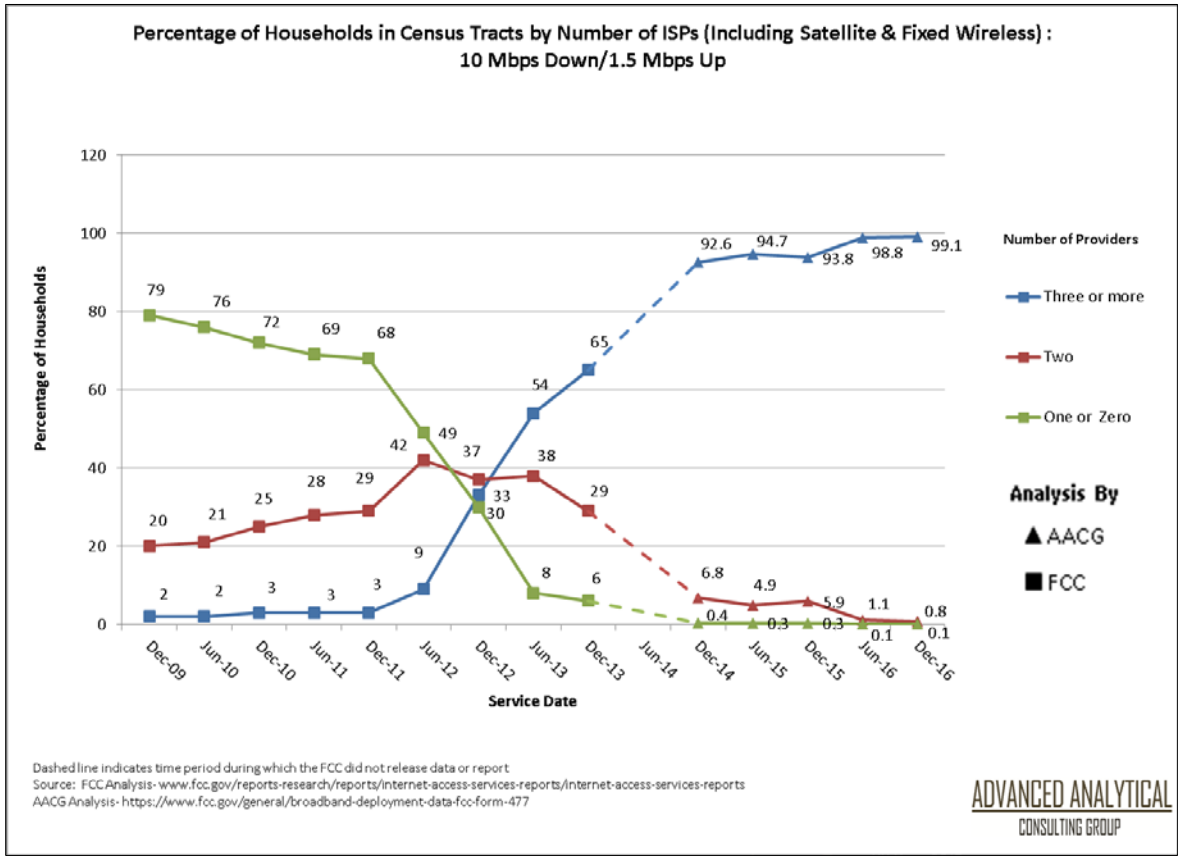


Figure 1 show that as of December 31, 2016, broadband service based on the FCC's December 2013 definition was offered by three or more ISPs in census tracts that include more than 99% of US households.[17] The data represented by a triangle were calculated by AACG, because the FCC no longer releases these figures, although they have 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 (but as of now has

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

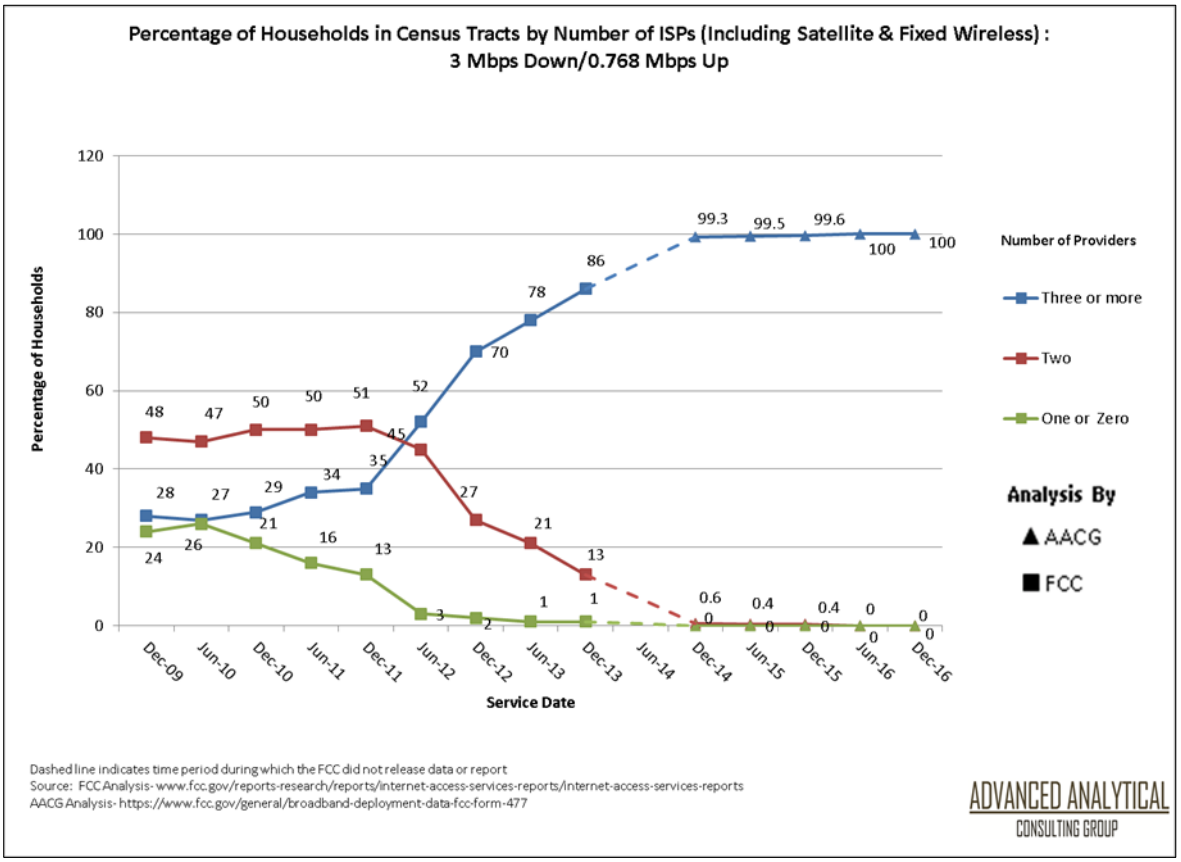
not released) the underlying data for June 2014. The most recent figures calculated and reported by the FCC for this speed-level showed that the percentage of households with access to three ISPs offering this service speed had nearly doubled in one year, from 33 percent in December 2012 to 65 percent in December 2013.[18]

3 Mbps Downstream/0.768 Mbps Upstream Broadband Service Provision and Competition from December 2009 to December 2016

Figure 2 shows the growth in broadband availability at the previous, slower, broadband benchmark reported by the FCC. As described earlier, this definition of broadband service was adopted in the FCC's Broadband Progress Report of July 2010 and was superseded by a new standard in February 2015 in the 2015 Broadband Progress Report.

[18] The ubiquitous availability of satellite broadband service since at least the end of 2014 could be a factor in that 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.

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

Beginning with its report for December 2014, the FCC's Internet Access Services Reports measure broadband availability at the census block, rather than census tract level. 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. Since census blocks are smaller than census tracts, fewer households would be considered to have broadband alternatives than under the previously-used census tract measure,[19] thus creating a discontinuity between the FCC's earlier and current availability measures.[20]

[19] 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 as having three providers, whereas the new metric counts only the households in that one block.

[20] For example, as shown in Figure 1 above, as of December 2013, 65 percent of households lived in census tracts with three of more broadband providers offering service at speeds of 10 Mbps down and 1.5 Mbps up within their tract, 29 percent had 2 or more, and 6 percent had one provider. The FCC's report for December 2014 shows that 61

In this section, we report numbers of ISPs based on census blocks, rather than census tracts. 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 Internet Order. In addition to basing performance measures on census tracts to census blocks, the FCC includes higher speeds in the broadband availability measures. We use census block-level data to produce availability percentages for December 2014, June 2015, December 2015, June 2016 and December 2016, the five most recent periods for which the FCC has released the raw data to date. For each speed level now used by the FCC, we present two series, with and without satellite and fixed wireless service. AACG has included higher speeds of broadband in the measures based on census blocks, presented below. Corresponding results for these higher speeds based on census tracts are presented in Appendix B.

25 Mbps Downstream/3 Mbps Upstream Broadband Service Provision and Competition from December 2013 to December 2016

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.

percent of census blocks had 3 providers, 28 percent had two providers, and 10 percent had one provider at the somewhat slower speed of 10 Mbps down and 1 Mbps up. Federal 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.

Figure 3

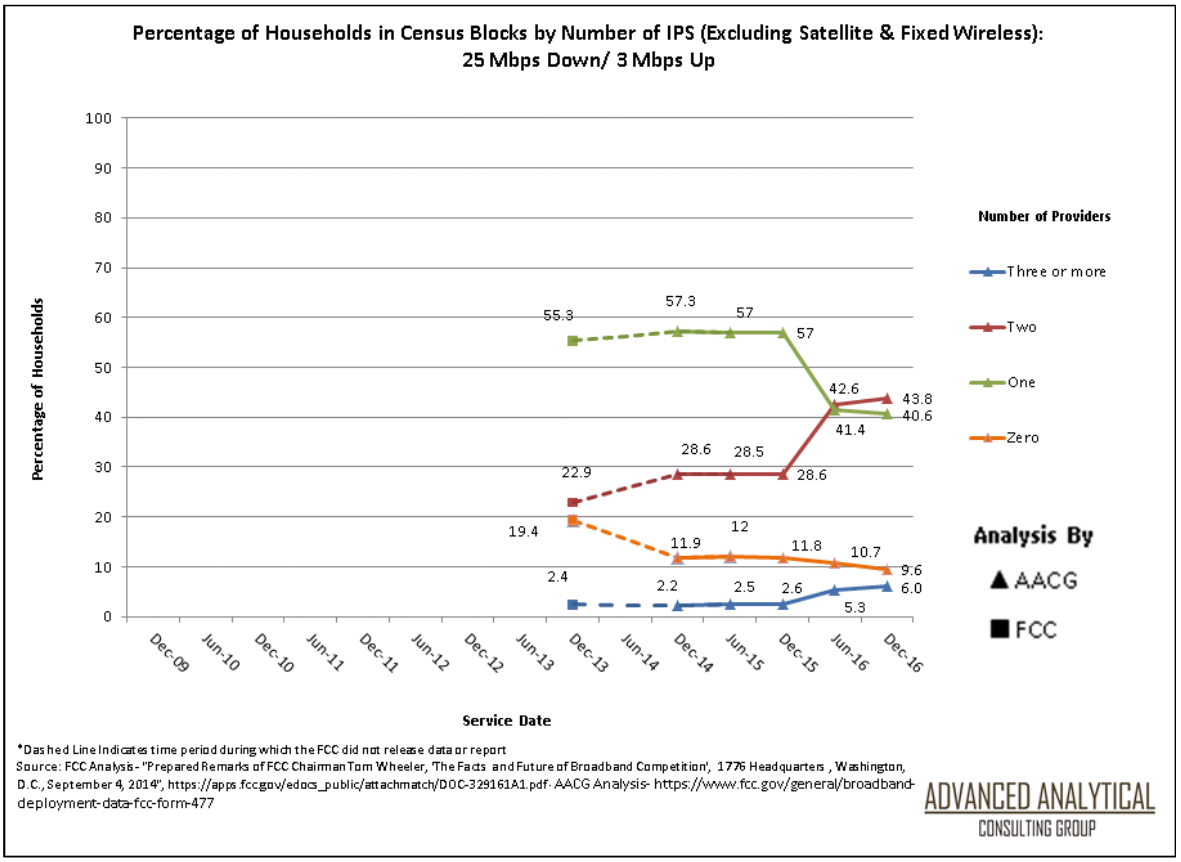
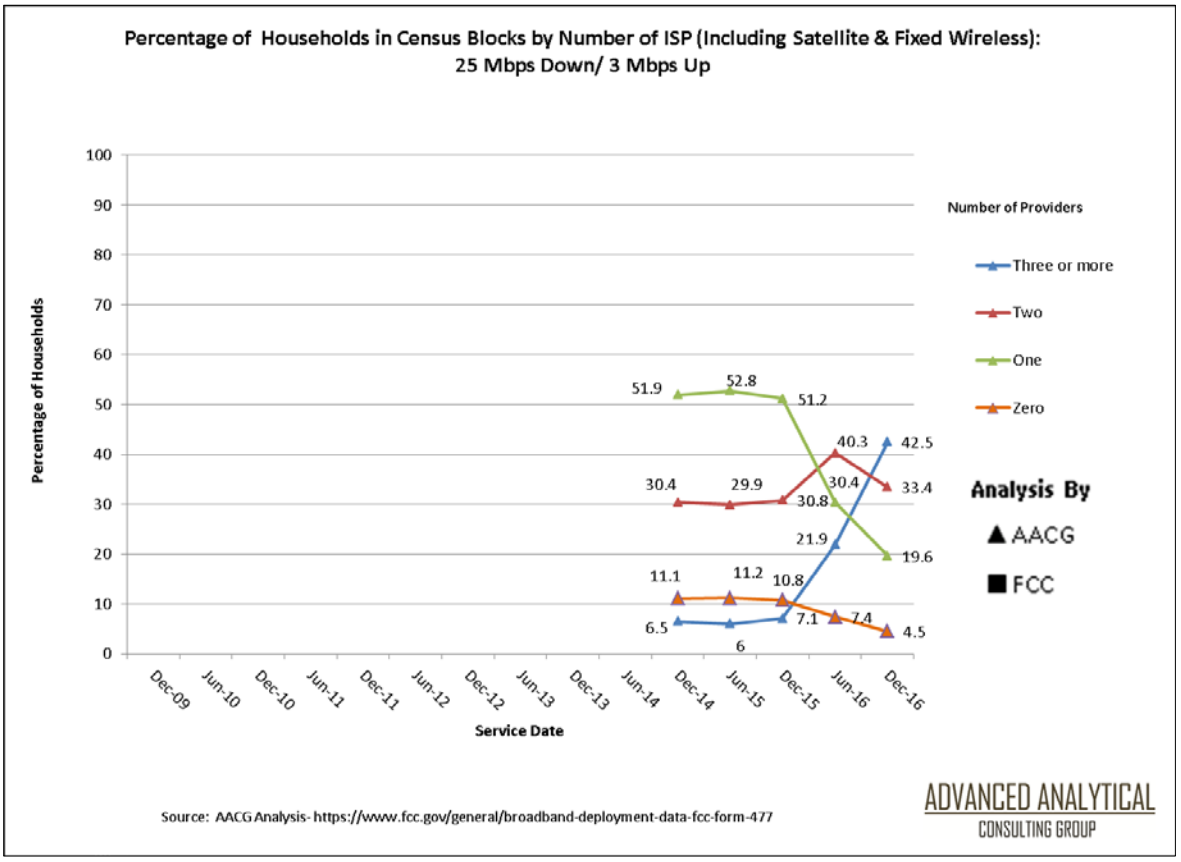


Figure 3 shows that over the 36 months from December 2013 to December 2016, the proportion of households living in census blocks without any provider decreased by about 13 percentage points.[21] Combining the zero and one alternative categories, as was done for the earlier figures, shows a decrease in these lower levels of availability from about 75 percent in Chairman Wheeler's data of December 2013, to approximately 50 percent for the more recent periods.

Figure 4 displays the availability percentages for December 2014, June 2015, December 2015, June 2016 and December 2016 including satellite and fixed wireless service.

[21] The approximately seven percentage point reduction between December 2013 and December 2014 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.

Figure 4



Comparison of Figures 3 and 4 shows the effects of excluding fixed wireless and satellite.[22] There was virtually no satellite available at the 25 Mbps downstream/3 Mbps upstream speed level through December 2015. [23] Therefore, for the first three periods (December 2014, June 2015, and December 2015), including fixed wireless increased the percentage of households with three or more alternatives (between Figures 3 and 4).

The beginning with June 2016, there was a large increase in the percentage of households in census block with two or more alternatives (from approximately 40 percent in December 2015 to more than 75 percent a year later, indicative of satellite alternatives becoming available at this speed level.[24]

[22] The FCC's percentages of census blocks, rather than percentages of households are very different. For example, 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 level. The corresponding percentages of households shown in Figure 4 are 6.5 percent, 30.4 percent, 51.9 percent, and 11.1 percent.
[23] 2016 Broadband Progress Report, ¶ 48.
[24] 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.

10 Mbps Downstream/0.768 Mbps Upstream Broadband Service Provision and Competition from December 2013 to December 2016

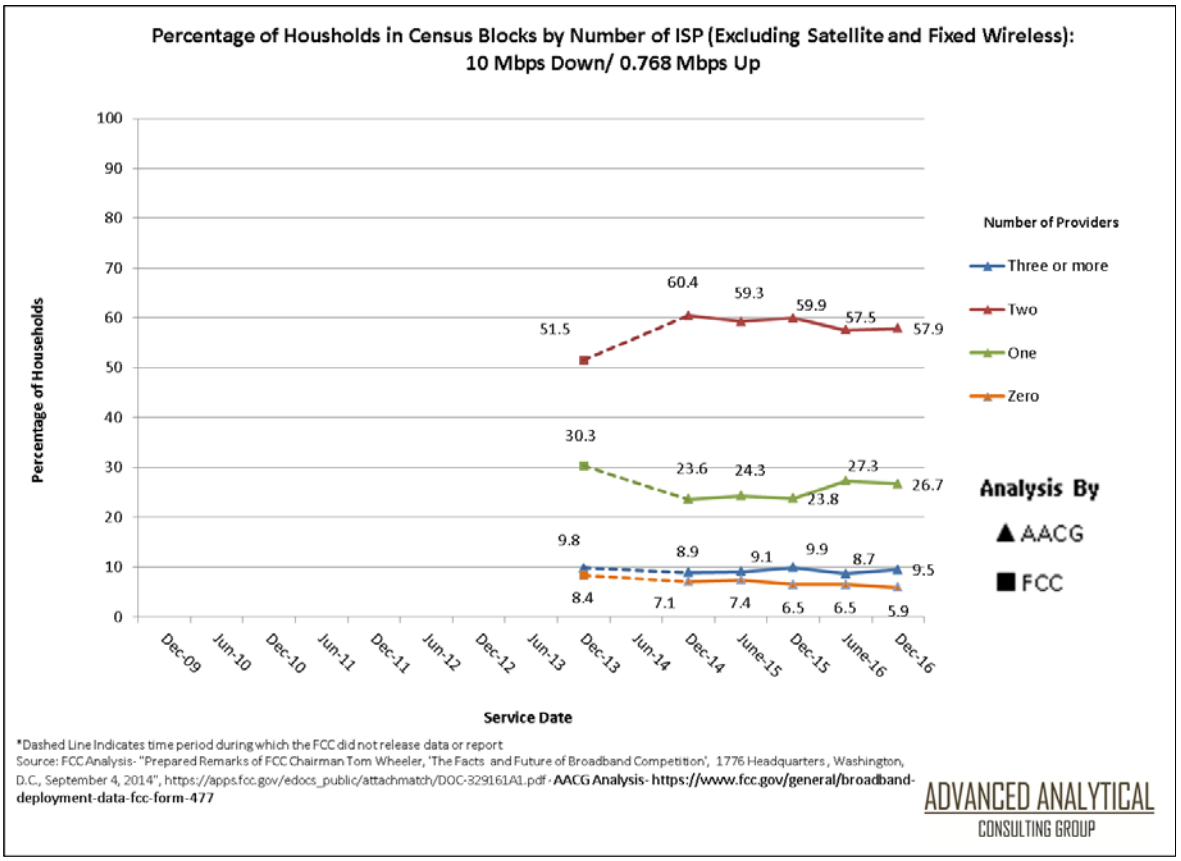
This subsection applies the analysis described in the previous subsection to the 10 Mbps downstream/0.768 Mbps upstream speed level.[25] Figure 5 shows the growth in broadband availability from December 2013 to December 2016 when satellite and fixed wireless are excluded.

	Dec-14		Jun-15		Dec-15		Jun-16		Dec-16	
Number of Providers	By Block	By Tract	By Block	By Tract	By Block	By Tract	By Block	By Tract	By Block	By Tract
3 or More	6.5%	26.8%	6.1%	27.0%	7.1%	29.7%	21.9%	46.6%	42.5%	68.1%
2	30.4%	48.8%	29.9%	49.5%	30.8%	47.7%	40.3%	39.9%	33.4%	24.8%
1	51.9%	22.4%	52.8%	21.4%	51.2%	20.8%	30.4%	12.6%	19.6%	6.6%
0	11.1%	2.1%	11.2%	2.1%	10.8%	1.7%	7.4%	0.9%	4.5%	0.6%
Source: AACG Calculation										

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) with an offsetting increase in the percentage of households with at least two alternatives. For example, as of December 2015, approximately 62 percent households lived in *census blocks* with zero or one alternative, in contrast to approximately 23 percent living in *census tracts* with zero or one alternative. The corresponding percentages for two or more alternatives were 38 percent and 77 percent, respectively. By December 2016, approximately three-quarters of households lived in census blocks with two or more alternatives, while more than 90 percent of households lived in census tracts with two or more alternatives.

[25] 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

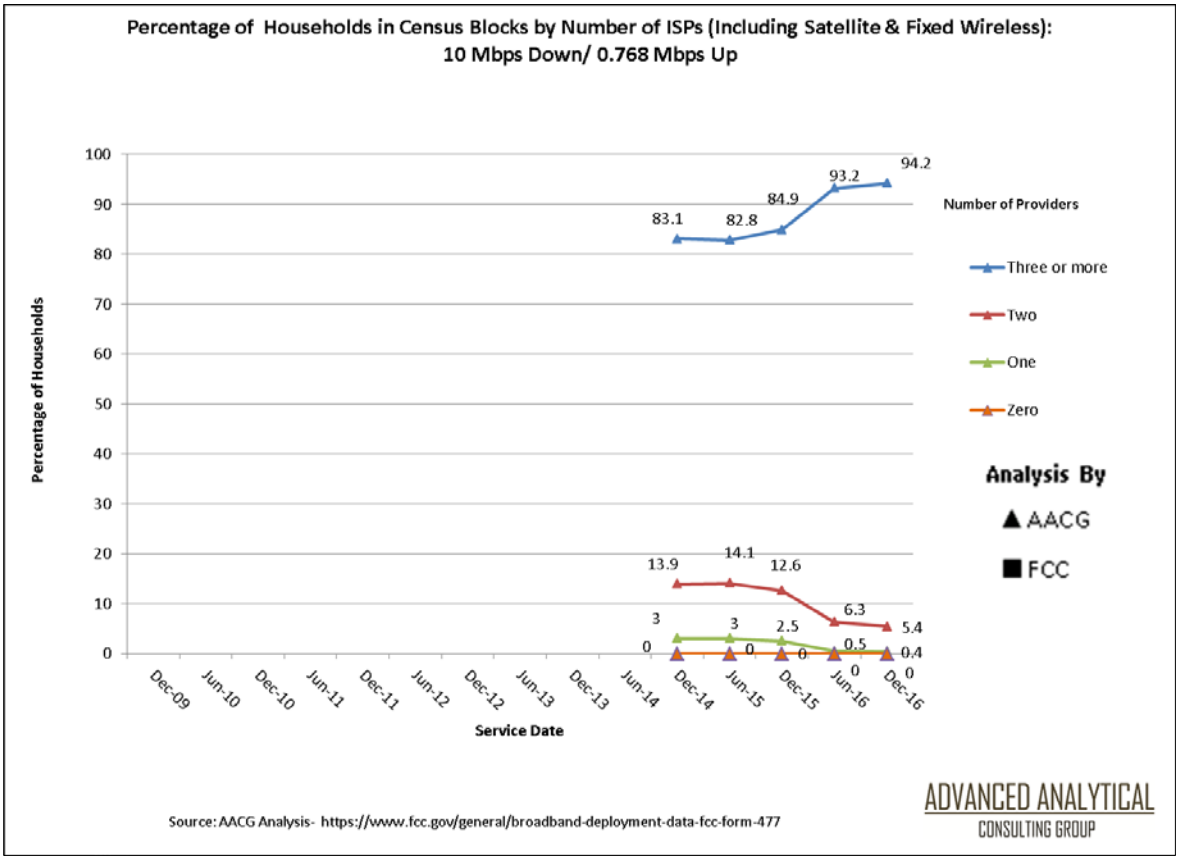


Figure 6 shows that, primarily because of the ubiquitous availability of satellite services at this speed level, more than nine out of ten households live in census blocks in which three or more broadband providers offer residential service within the census block.[26]

[26] 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 December 2016

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

Figure 7

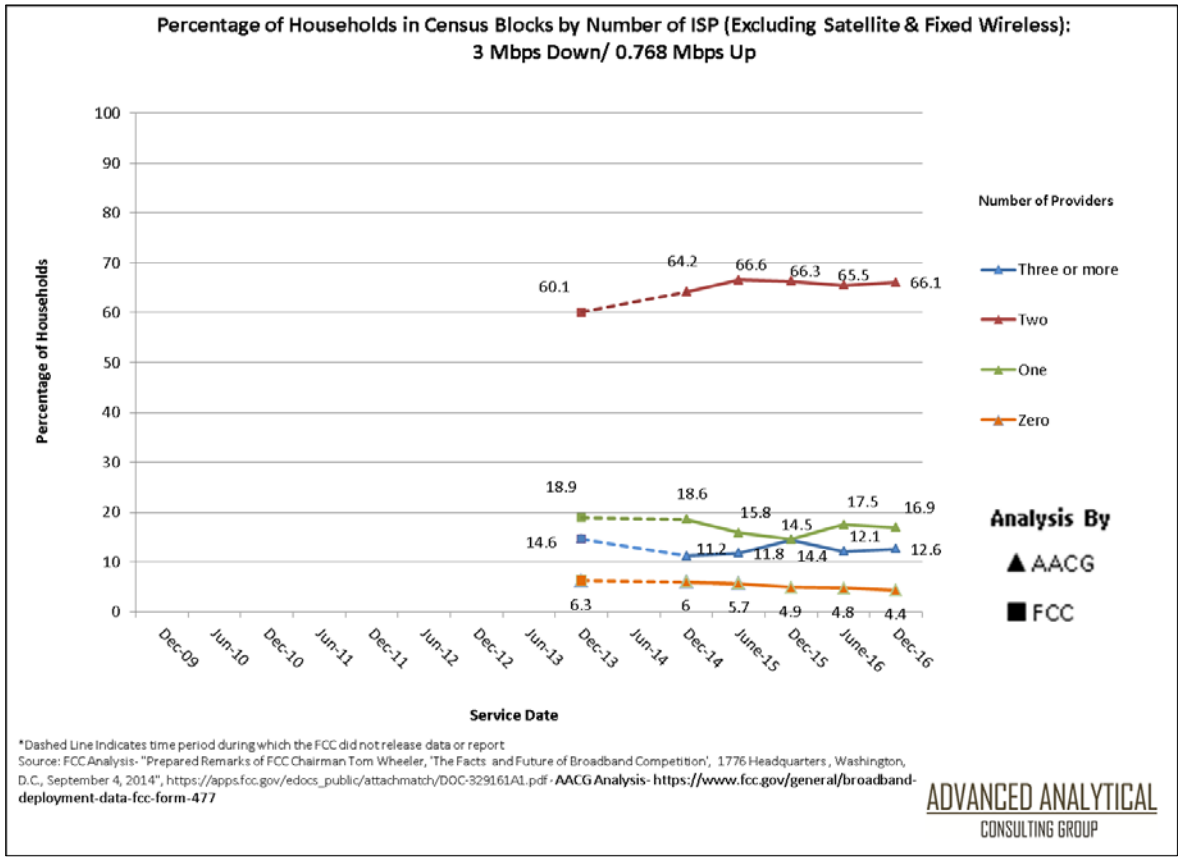
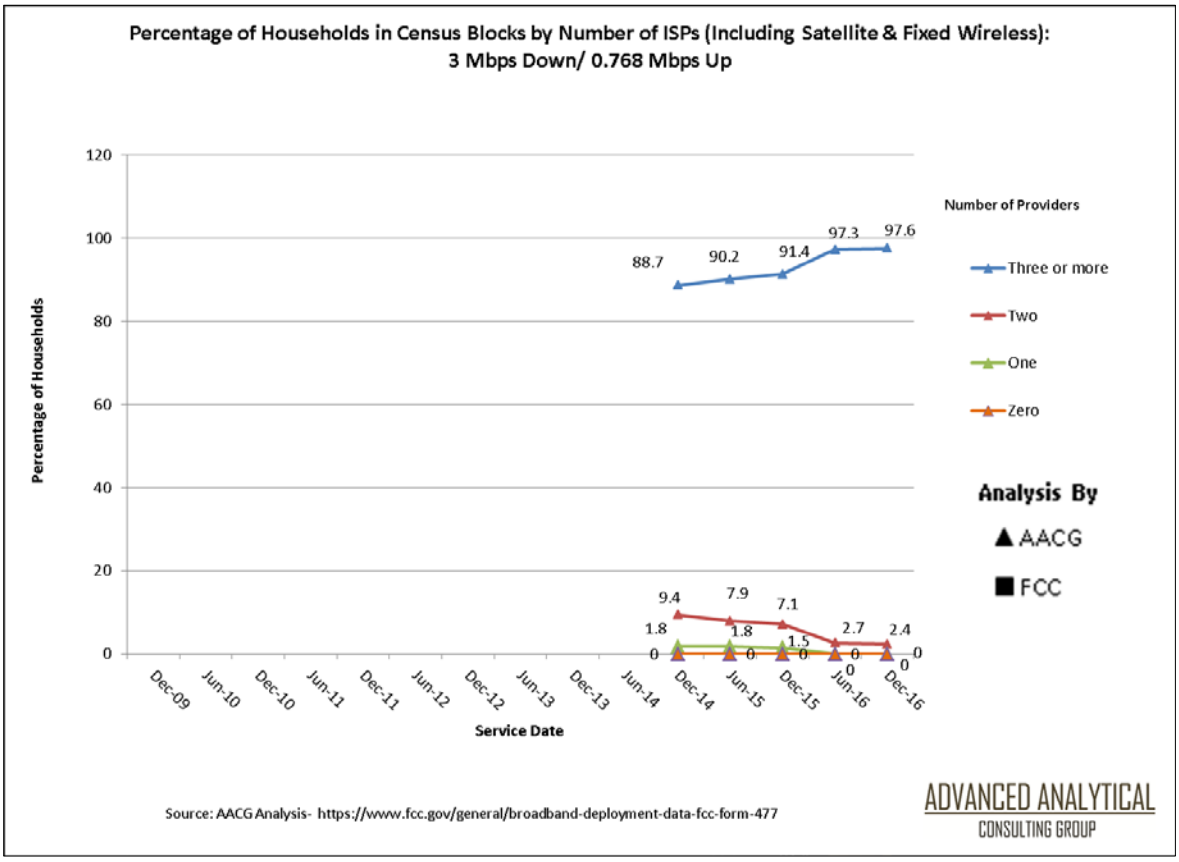


Figure 8



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 December 2016, 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), more than 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).[27]

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.

[27] 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:[28]

> 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 performance measured in December 2013 by the FCC that excluded fixed wireless and satellite. However, prior to the performance measured for December 2013, the FCC had included fixed wireless and satellite in its measures of performance. In addition, the FCC included fixed satellite and wireless in its performance measures reported after the 2015 Open Internet debate. It was only in this intervening period, when Chairman Wheeler was equating the level of competition to a duopoly, that the FCC excluded the two alternatives of fixed wireless and satellite, thereby reducing the apparent number of providers of broadband service even as comparted to the measures the FCC published before and after the Open Internet debate, which included fixed wireless and satellite. In addition, it was at the time of the Open Internet Debate that the FCC changed from measures based on census block measurement from census tract, again creating a measure that indicates a lower number of alternative providers. . 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.[29]

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

[28] 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.

[29] 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 of 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.

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.

The FCC also commented on availability of broadband alternatives when it rescinded many of the provisions of its 2015 Internet Order in the 2018 Internet Order. Based on December 2016 data that is essentially the same as that depicted in Figures 3 and 4 above,[30] the FCC characterized the competition at the 25 Mbps down/3 Mbps and lower speeds as widespread[31] and based on these data and other considerations concluded that: "We therefore find that the competition that exists in the broadband market, combined with the protections of our antitrust and consumer protection laws against anticompetitive behaviors, will constrain the actions of an ISP that attempts to undermine the openness of the Internet in ways that harm consumers."[32]

While the FCC focused on the level of competition, Figures 3 and 4 demonstrate that there had been considerable growth in competitive alternatives available at the 25 Mbps Down/3 Mbps Up speed level (based on census blocks) since it increased regulation in 2015, based in part on insufficient competition. For example, even when satellite and fixed wireless are not included, the percentage of households without broadband alternatives declined by more than 50 percent between December 2013 and December 2016--from about 20 percent to 10 percent, while the percentage of households with two or more alternatives approximately doubled—from 25 percent to 50 percent. When fixed wireless and satellite alternatives are added to the mix, growth was even more rapid. Between December 2014 and December 2016, the percentage of households with more than two alternatives had more than doubled from about 37 percent to about 76 percent, while the percentage with no alternatives had declined from about 11 percent to less than five percent.

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. The FCC has not provided a consistent set of measures of broadband competition that can be tracked over time, impeding informed analysis of the evolution of broadband service and competition over time. By providing a consistent set of measures of broadband competition over time, AACG hopes to improve the accuracy of analyses about the extent of competition for Internet access services,

[30] The 2018 Open Internet Order reported the percentage of the population in census blocks with particular numbers of providers, while Figures 3 and 4 report percentages of households. There are small differences in percentages based on the alternative measures.
[31] 2018 Internet Order, ¶ 125.
[32] *Ibid*., ¶ 123.

improving the quality of analysis about the internet market, and the quality of the evaluations about the need for regulation.

Appendix A

1. The FCC's Broadband Availability Data

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 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,[33] at the census block-level. Prior to 2014, the FCC used tract-level census data, which are coarser than block-level data.[34]

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.[35]

[33] The FCC also measured the number of mobile wireless providers at various speed levels in each census tract. However, because the FCC's measurement of mobile wireless speeds has changed, comparisons of counts of mobile wireless providers before and after the change are meaningless. Accordingly, the availability measures in this report do not include mobile wireless providers.

[34] 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.

[35] 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. 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

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, June 2015, December 2015, June 2016 and December 2016.

2. AACG's Calculations

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.[36] We first obtained the raw data for December 2014, June 2015, December 2015, June 2016 and December 2016 from the FCC's website.[37] 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.[38] 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.

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 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.

[36] 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.

[37] 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.

[38] These data are available at http://mcdc.missouri.edu/websas/geocorr12.html.

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 in the current version: (1) at least 3 Mbps downstream/0.768 Mbps upstream,[39] (2) at least 10 Mbps downstream/0.768 Mbps upstream, (3) at least 10 Mbps downstream/1 Mbps upstream, (4) at least 10 Mbps downstream/1.5 Mbps upstream,[40] and (5) at least 25 Mbps downstream/3 Mbps upstream,[41] (6) at least 50 Mbps downstream/3 Mbps upstream, (7) at least 100 Mbps downstream/3 Mbps upstream, and (8) at least 100 Mbps downstream/10 Mbps upstream. 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 the first four categories 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 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	10/1.5	25/3	50/3	100/3	100/10
560050001001015	3	3	3	3	0	0	0	0

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

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 blocks with no alternatives at this speed level, add up the number of households in these blocks, and then divide by the total

[39] This approximates the FCC's broadband benchmark that was in effect from 2010 through 2015.
[40] This level was the maximum speed reported from December 2009 through December 2013.
[41] This is the current broadband benchmark adopted in 2015.

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, the 2018 Internet Order, and its most recent Internet Access Services reports.[42] The 2016 Broadband Progress 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.[43]

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 percentages[44] 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.

Similarly, the FCC's 2018 Internet Order reported broadband availability as percentages of the population with various numbers of alternatives.[45] Table A.2 compares the FCC's percentages with our calculations. The percentages are very close. The 2018 Internet Order does not provide sufficient detail to identify possible explanations for the slight differences in the zero and one provider categories.

[42]Federal 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, August 2016," Figure 5, available at https://apps.fcc.gov/edocs_public/attachmatch/DOC-340664A1.pdf. Federal Communications Commission, "Internet Access Services: Status as of December 31, 2015, Industry Analysis and Technology Division, Wireline Competition Bureau, November 2016," Figure 4, available at https://apps.fcc.gov/edocs_public/attachmatch/DOC-342358A1.pdf. Federal Communications Commission, "Internet Access Services: Status as of June 30, 2016, Industry Analysis and Technology Division, Wireline Competition Bureau, April 2017," Figure 4, available at https://apps.fcc.gov/edocs_public/attachmatch/DOC-344499A1.pdf. Federal Communications Commission, "Internet Access Services: Status as of December 31, 2016, Industry Analysis and Technology Division, Wireline Competition Bureau, February 2018," Figure 4, available at https://transition.fcc.gov/Daily_Releases/Daily_Business/2018/db0207/DOC-349074A1.pdf.

[43] 2016 Broadband Progress Report, ¶ 86.

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

[45] 2018 Internet Order, ¶ 125.

Table A2. Percentage of U.S. Population in Developed Census Blocks in which Broadband Wireline ISPs Reported Deployment (as of December 31, 2016)

	FCC	AAGC
No Provider	**9.2%**	**9.1%**
One Provider	**39.6%**	**39.8%**
Two Providers	**45.2%**	**45.2%**
3+ Providers	**5.9%**	**5.9%**

Finally, our percentages of census blocks with zero, one, two, or three of more providers closely approximate the FCC's .percentages reported in the five biannual Internet Access Services Reports from December 2014 through December 2016.

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.

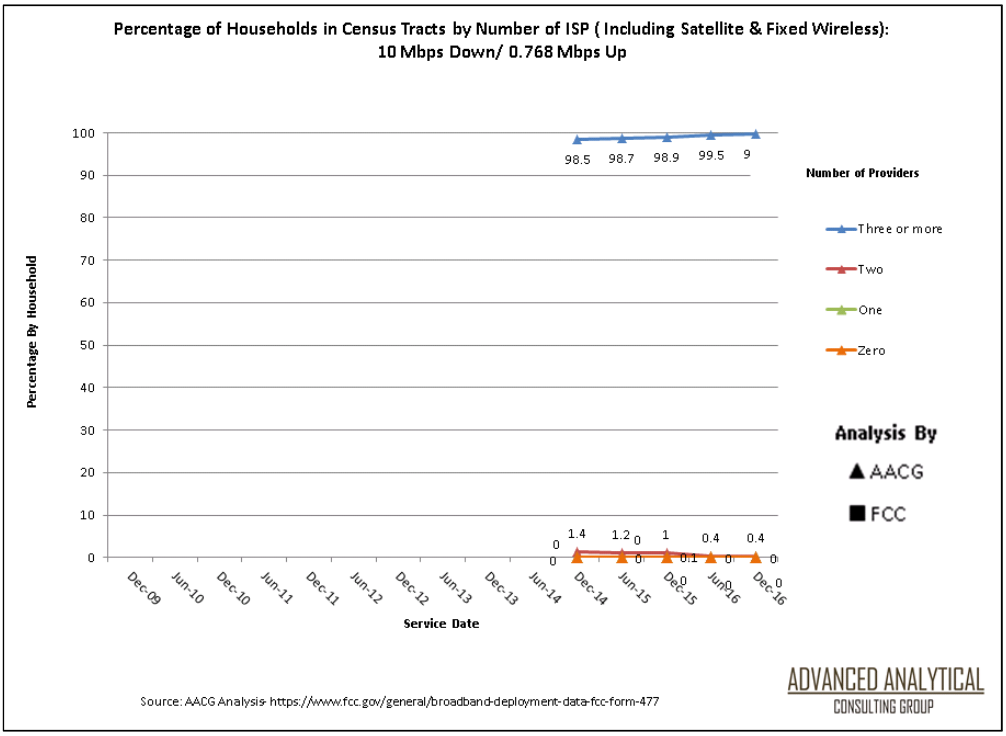
For example, as of December 2014, for census tract 56005000100, the holding company numbered 130228 offered service at speeds of at least 25 Mbps downstream and 3 Mbps upstream in 18 of the 346 blocks in that tract and the holding company numbered 130235 offered service at this speed level in 68 of the 346 blocks. Therefore, we counted two providers for this speed level in that census tract.

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 B6), 2) availability at the census tract level, excluding fixed wireless and satellite (Figures B7 to B14), 3) availability at the census block level, including fixed wireless and satellite (Figures B15 to B19), and 4) availability at the census block level, excluding fixed wireless and satellite (Figures B20 to B24). In addition, for the three time periods for which we have calculated broadband availability (December 2014, June 2015, December 2015, June 2016 and December 2016), 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 B24 to B27, the June 2015 bar graphs are Figures B28 to B31, the December 2015 bar graphs are Figures B32 to B35, the June 2016 bar graphs are Figures B36 to B36 and the December 2016 bar graphs are Figures B40 to B43. Figure 44 summarizes selected parameters characterizing the FCC's Internet Access Services reports.

Figure B1



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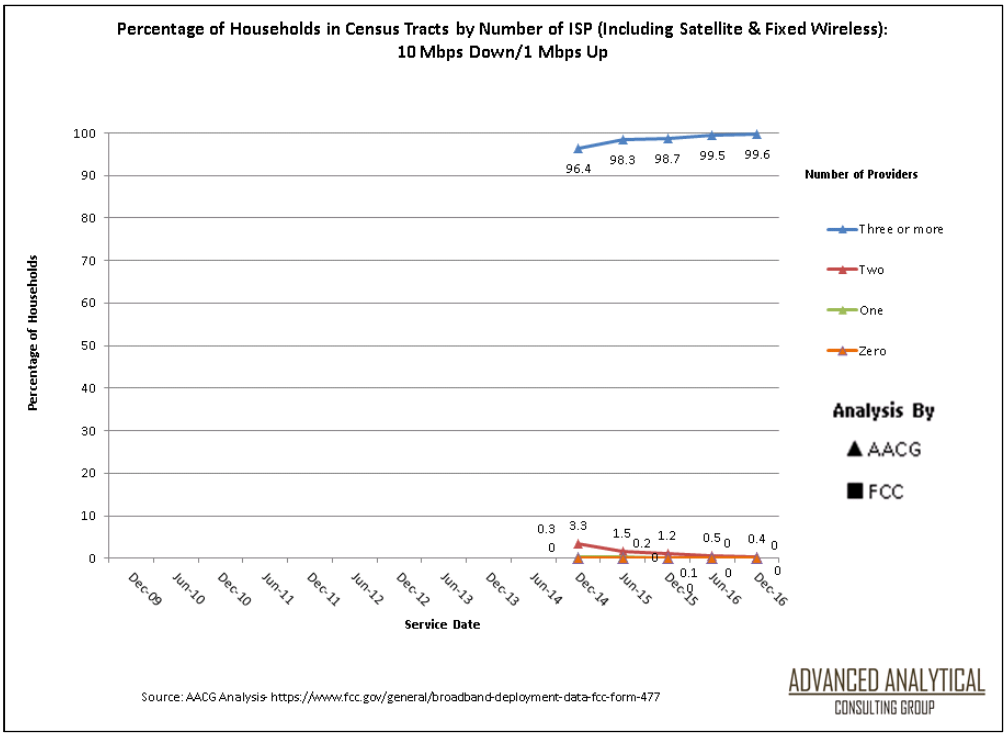

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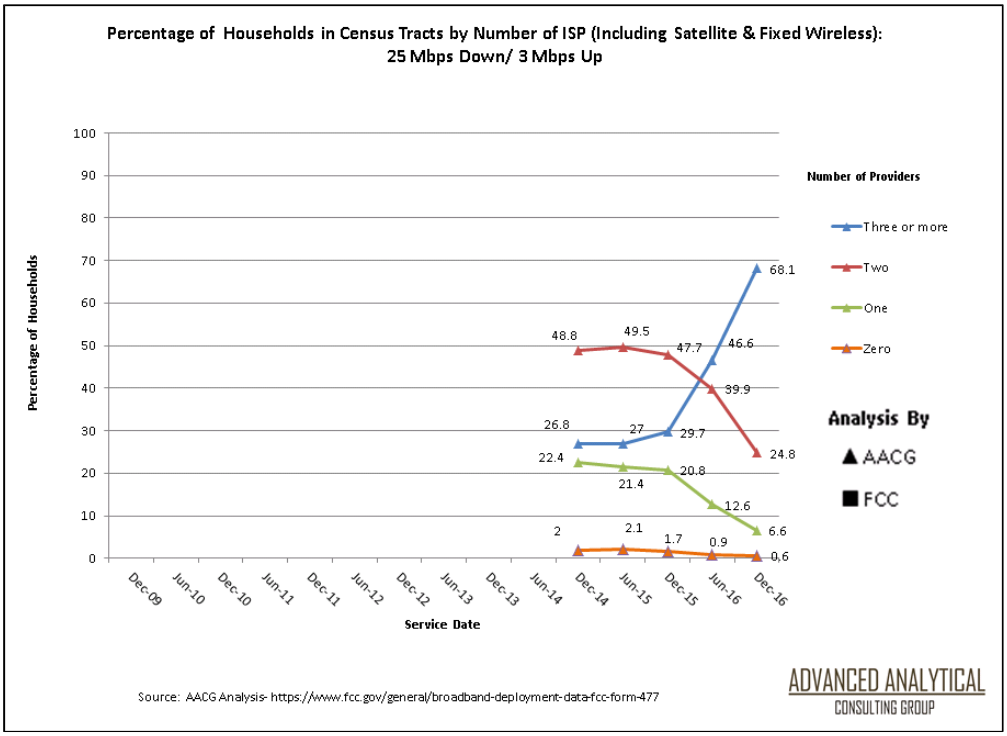

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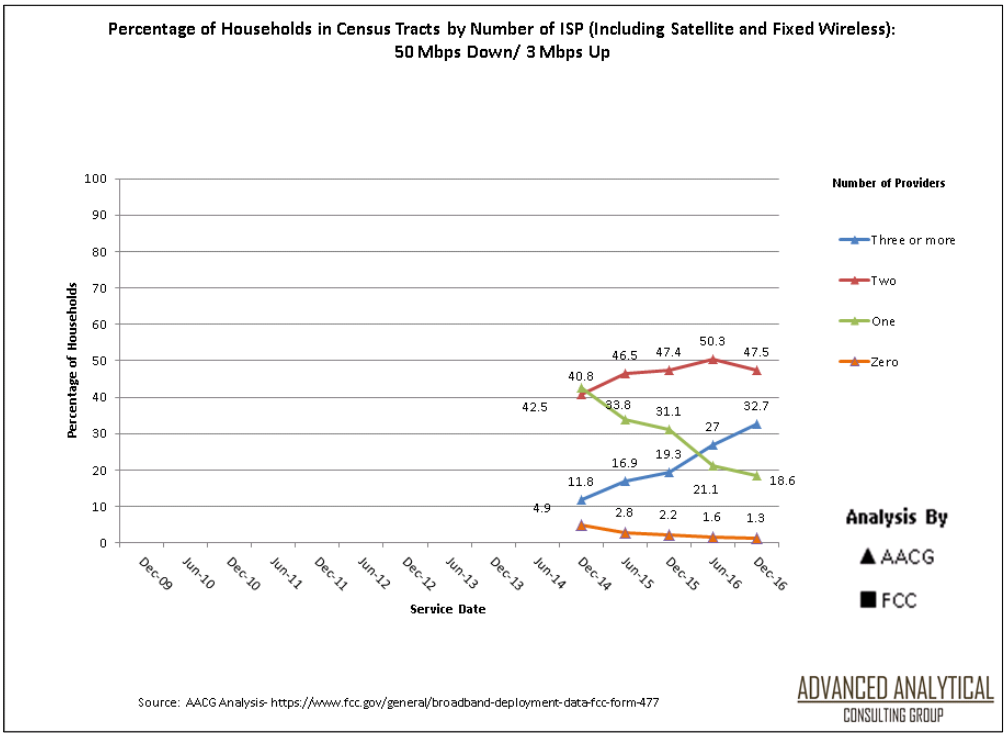

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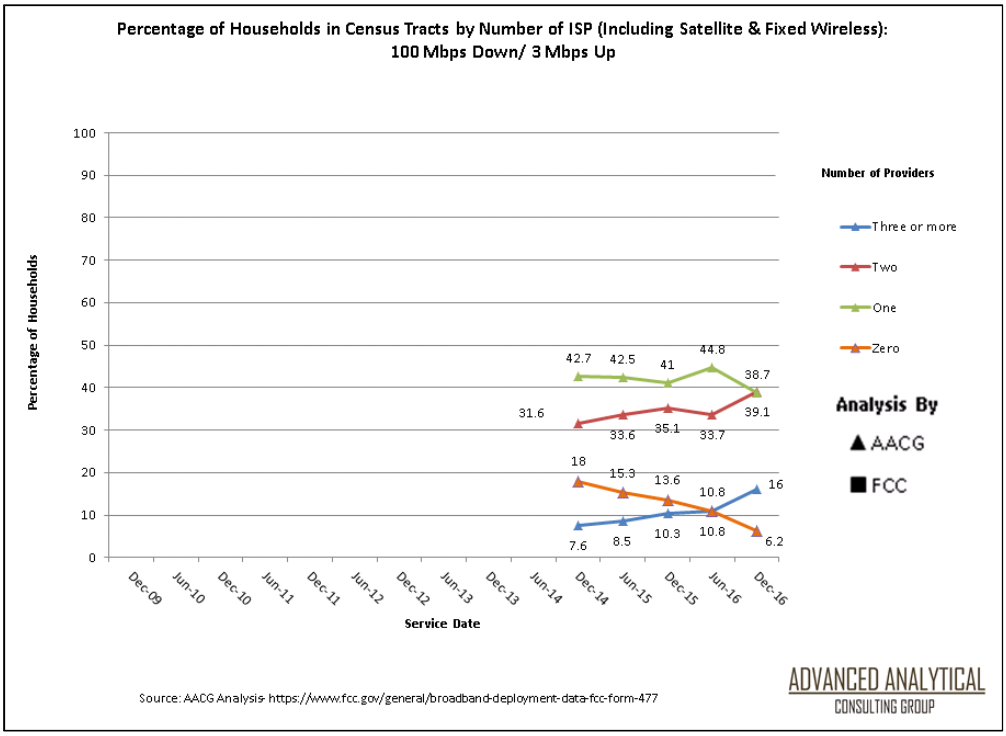

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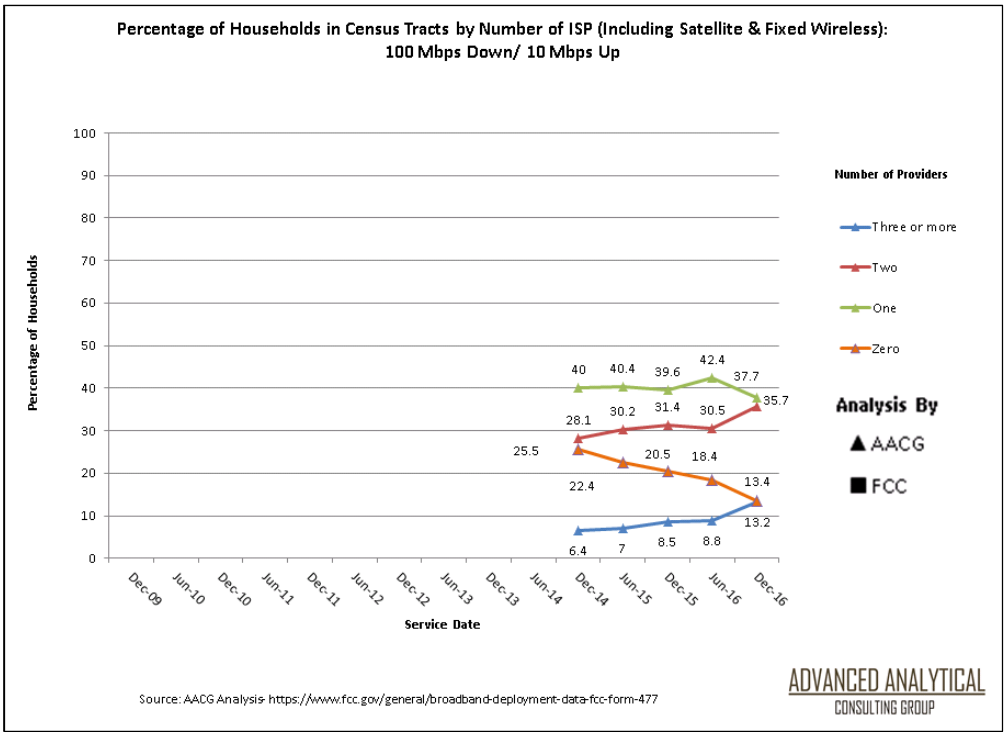

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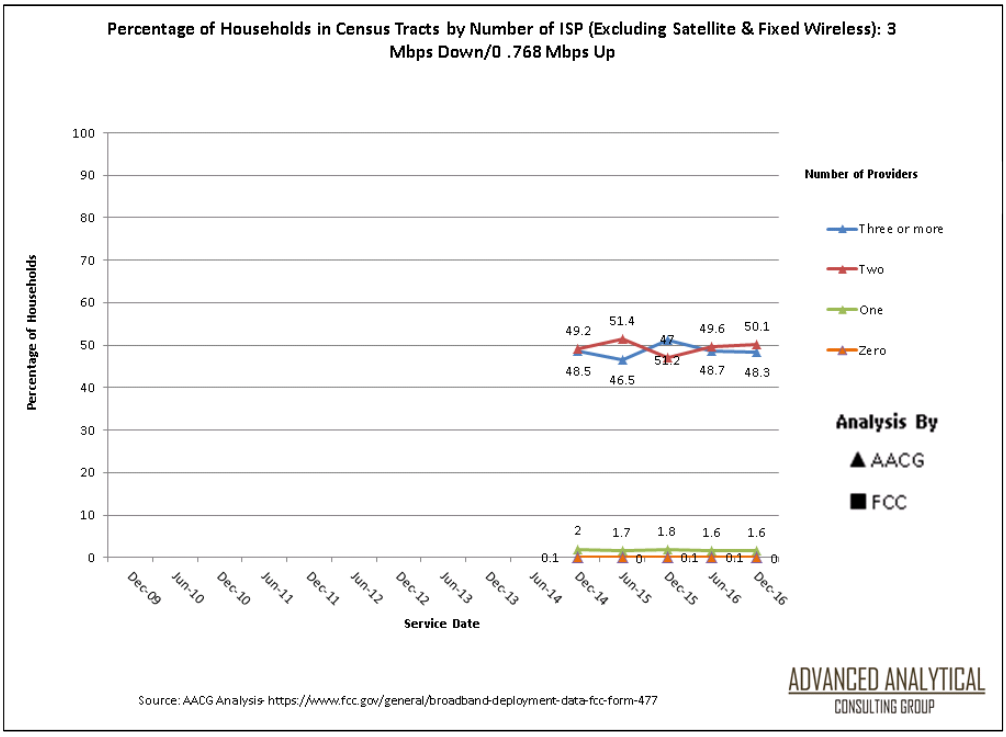

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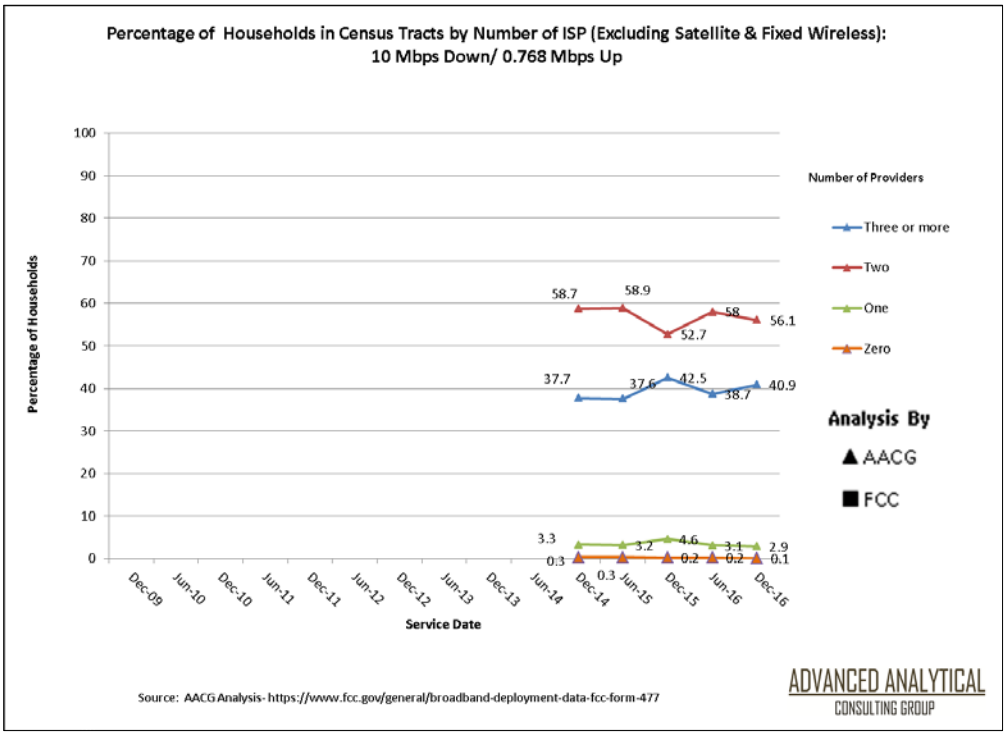

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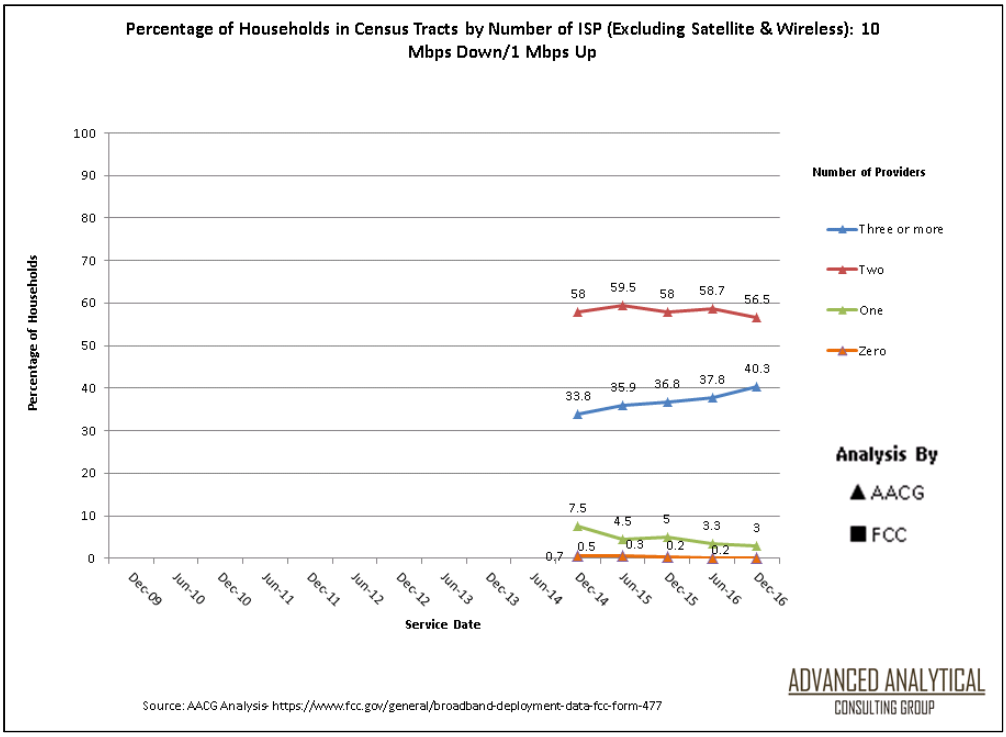

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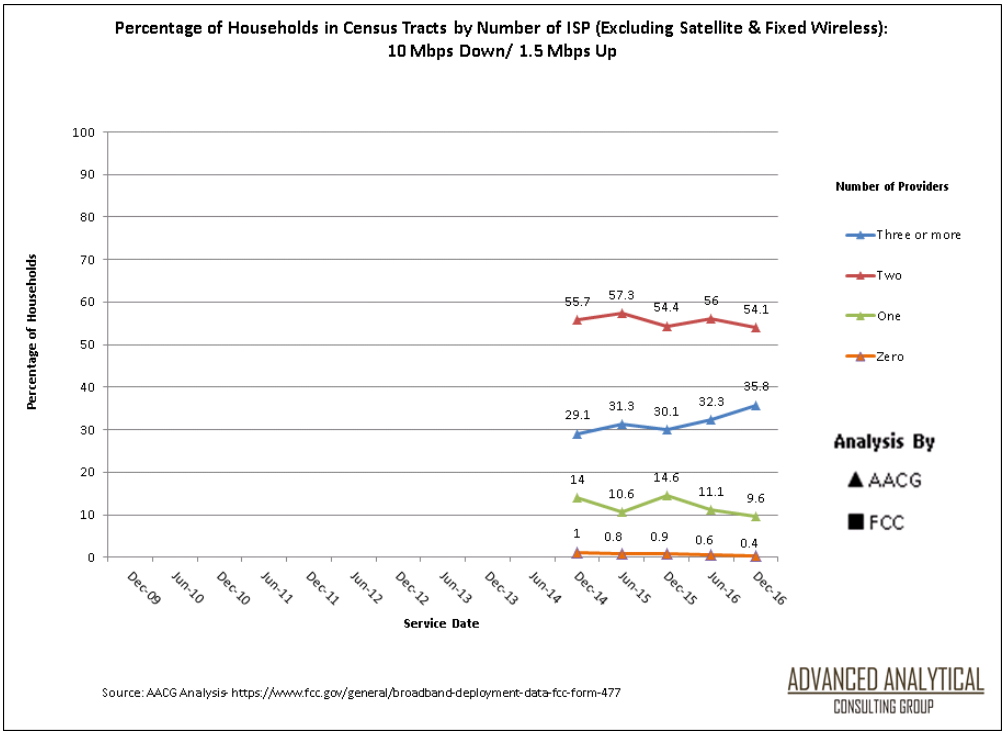

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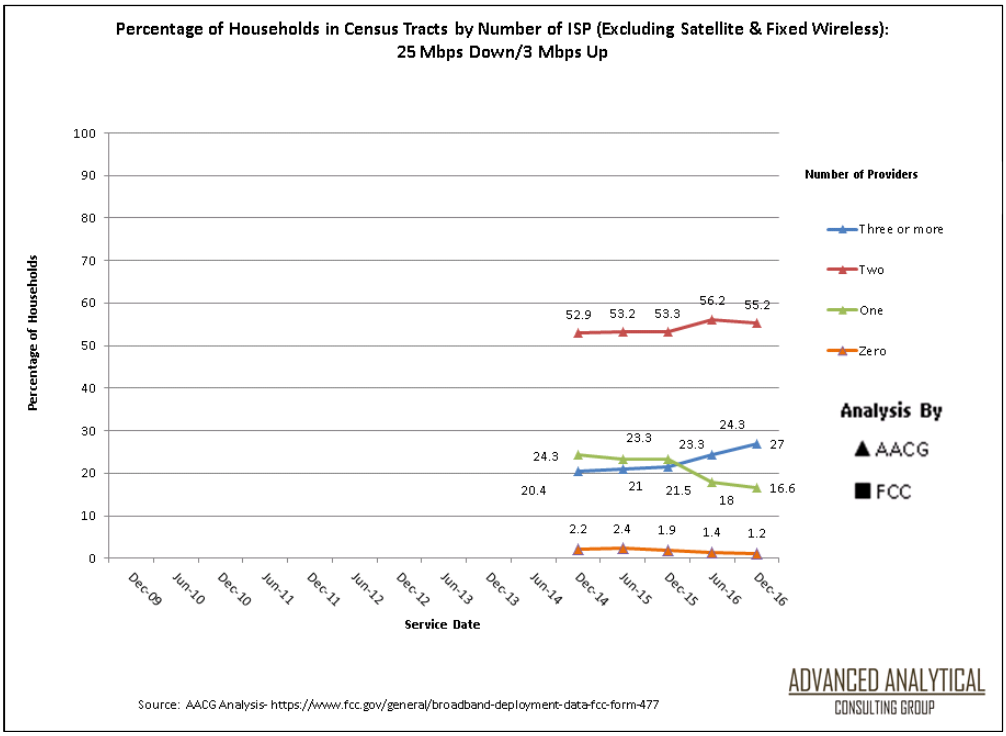

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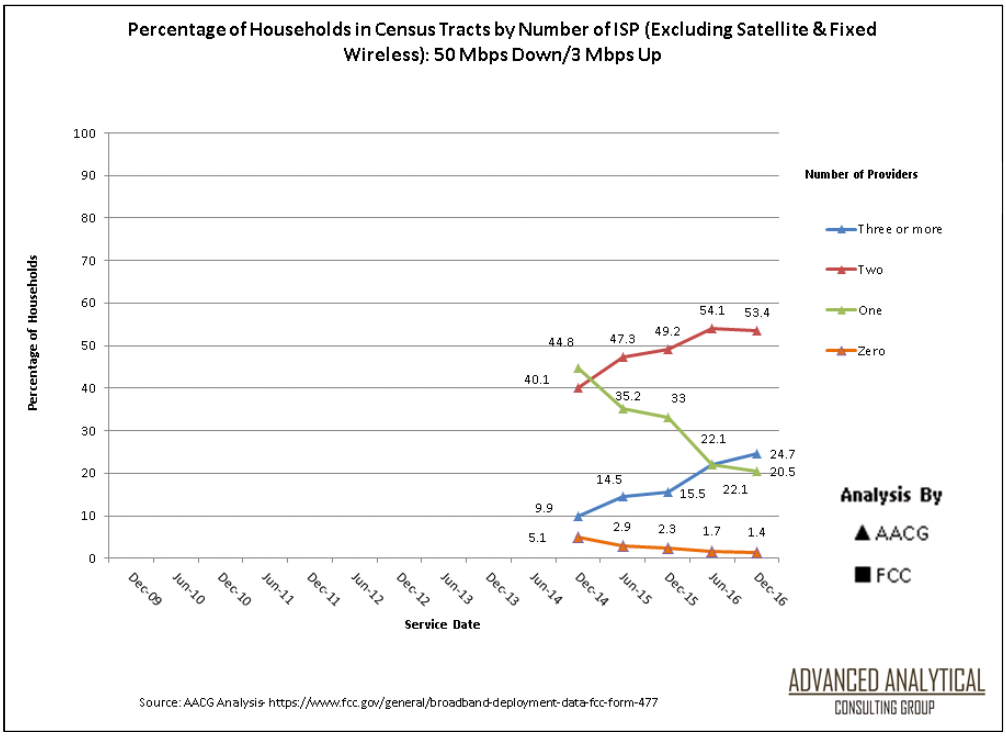

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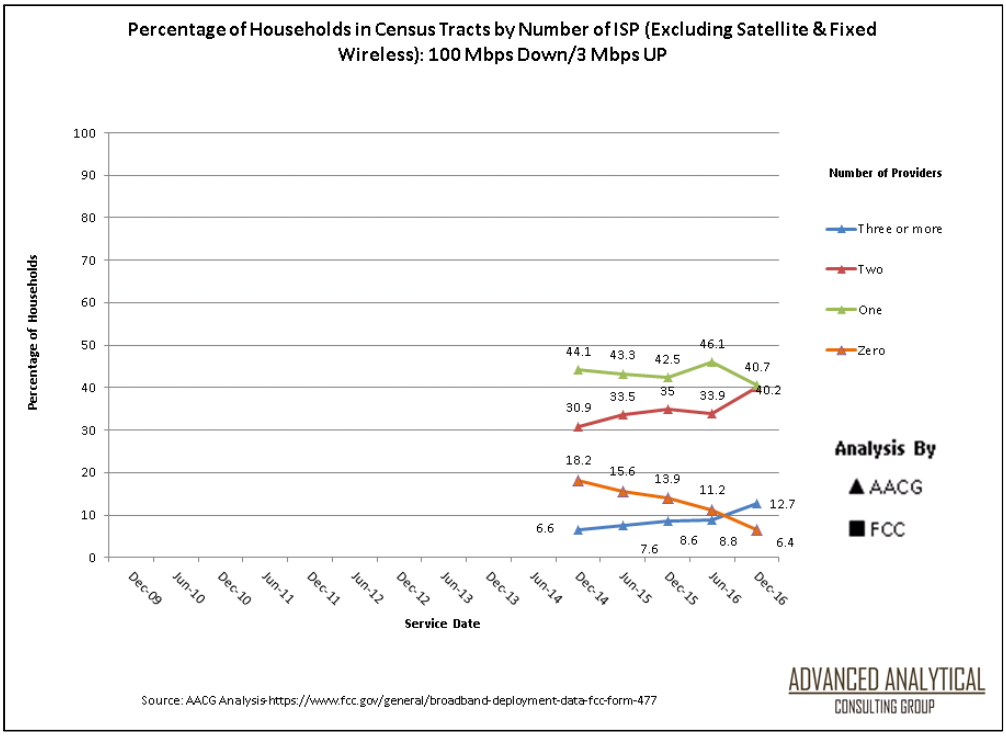

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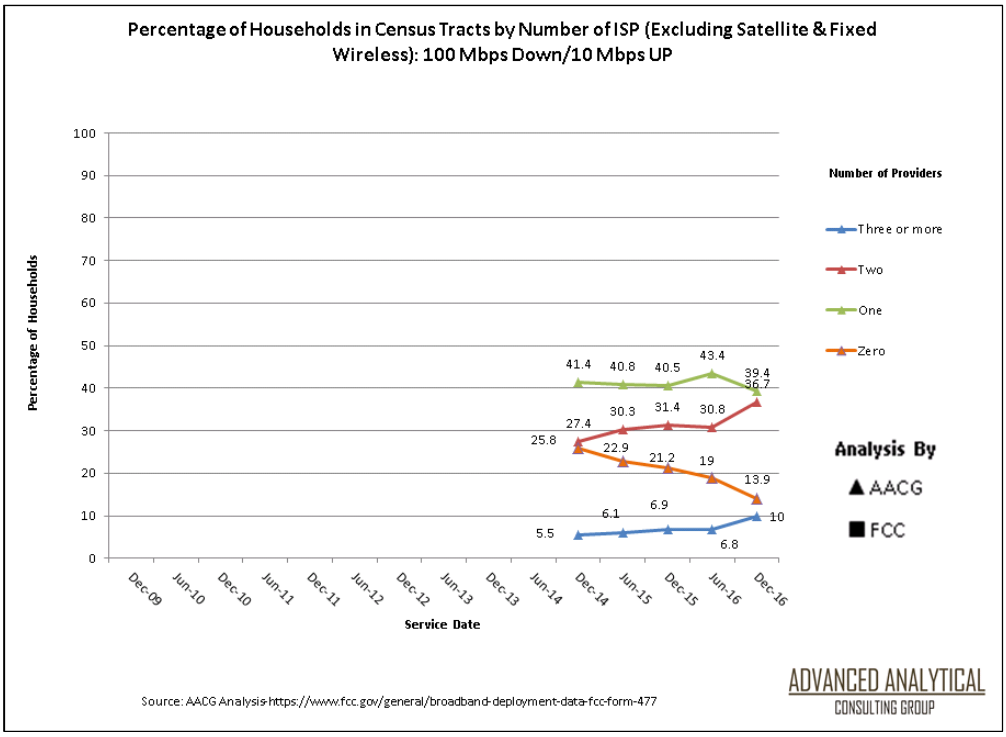

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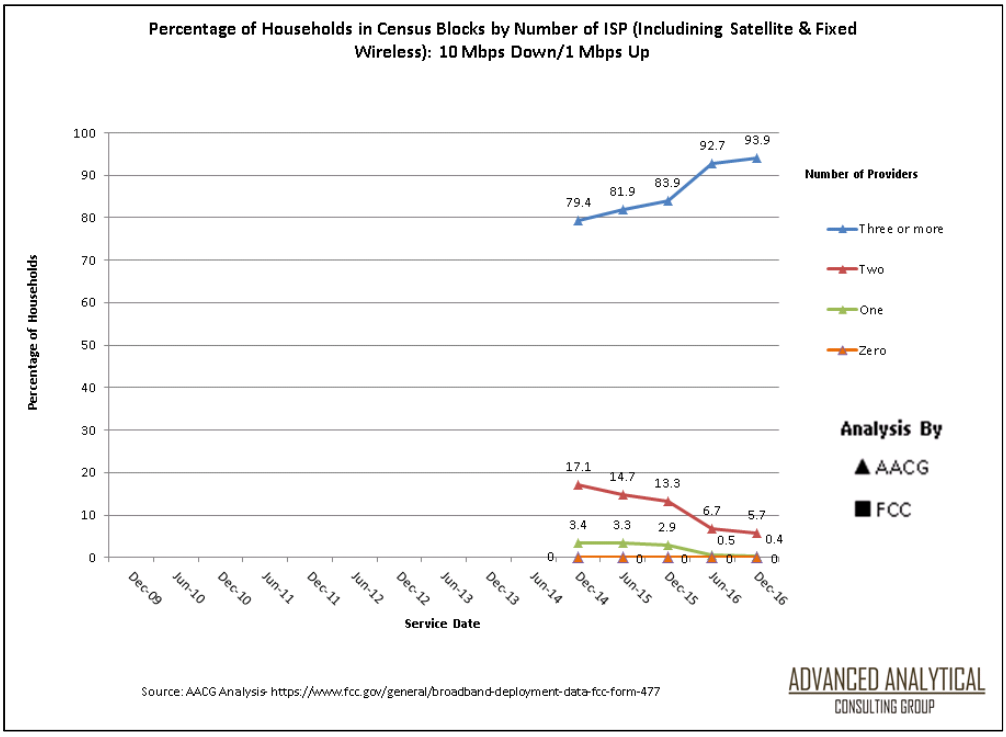

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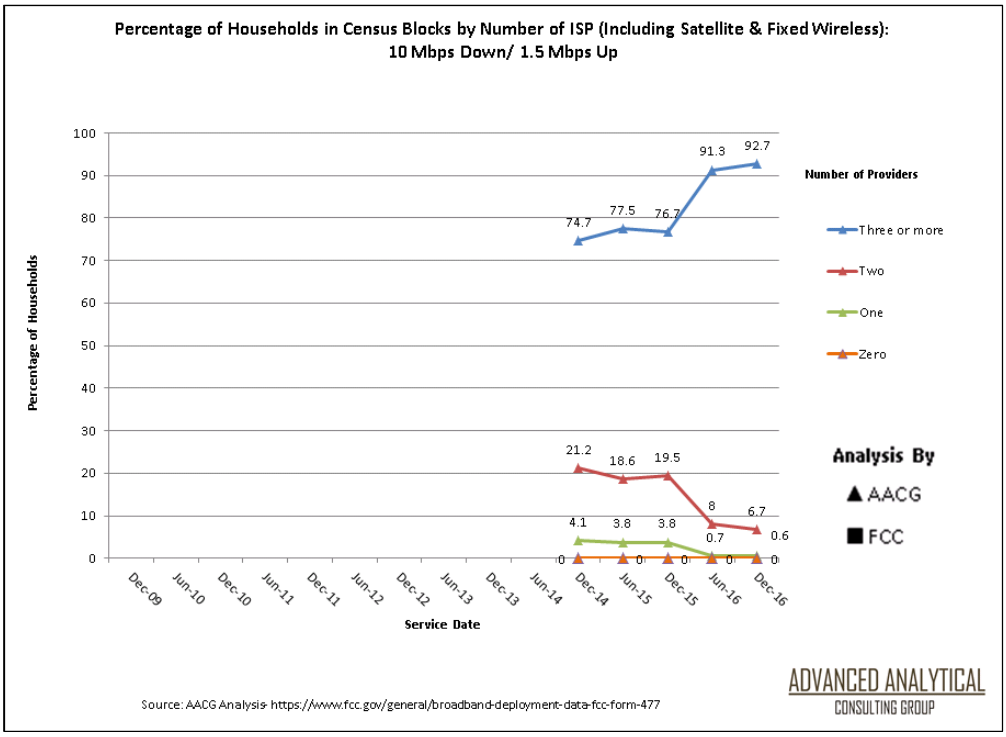

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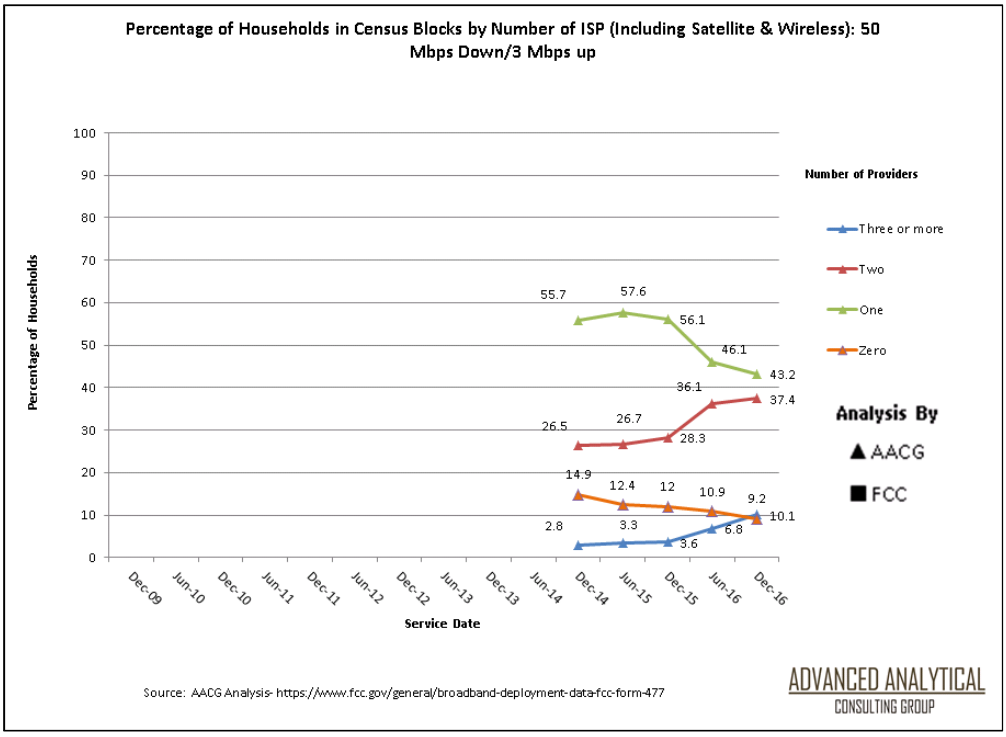

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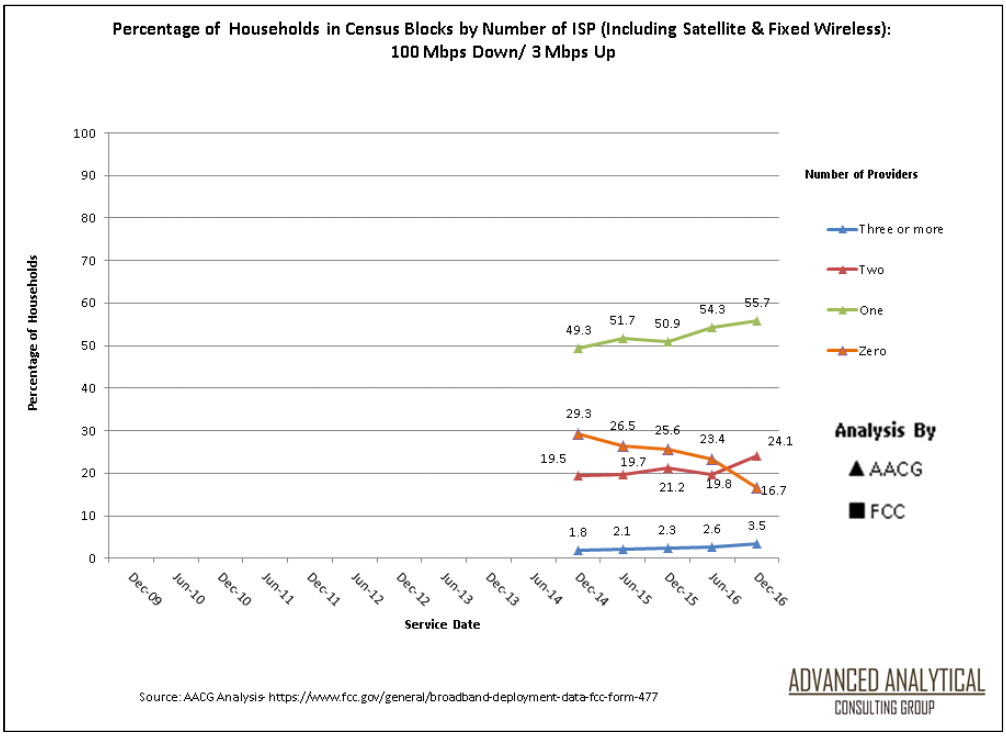

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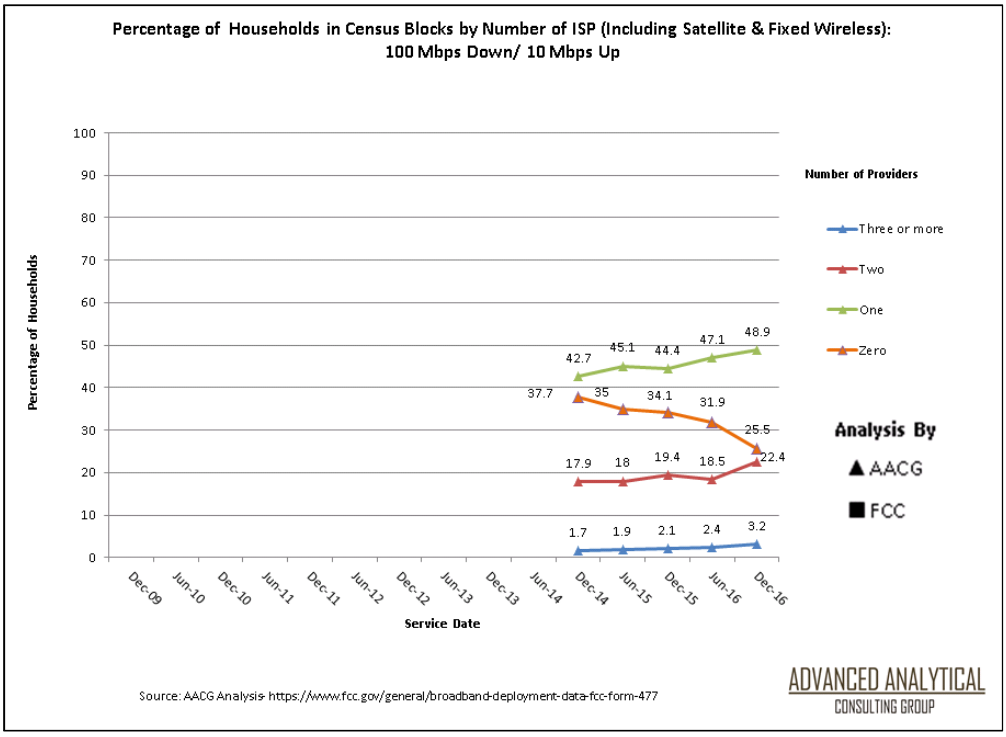

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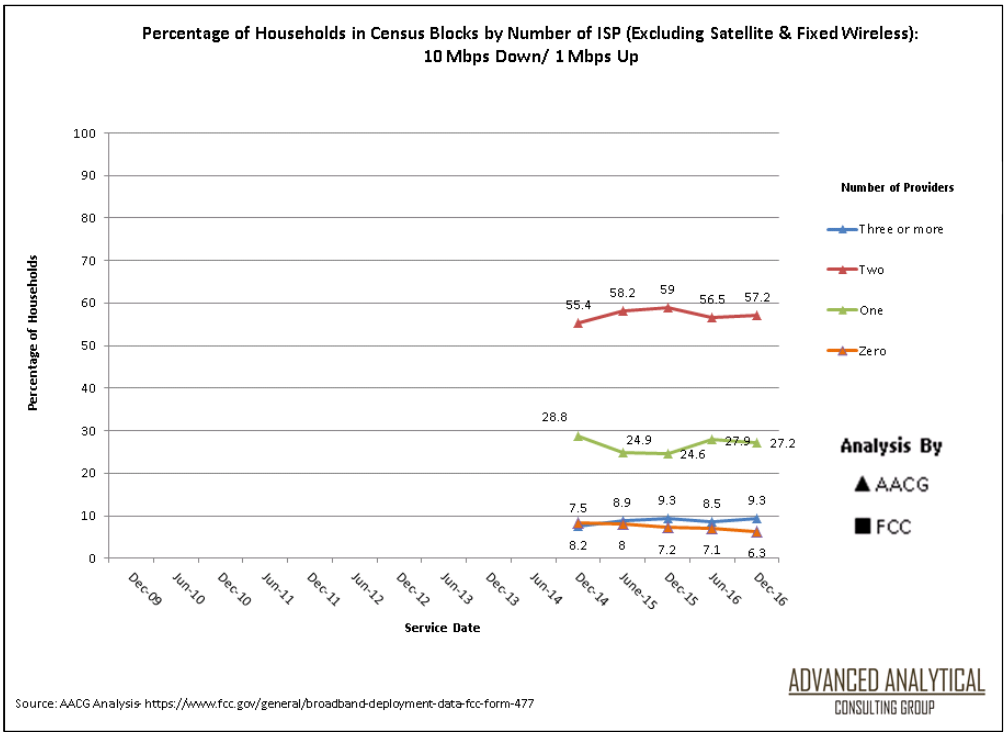

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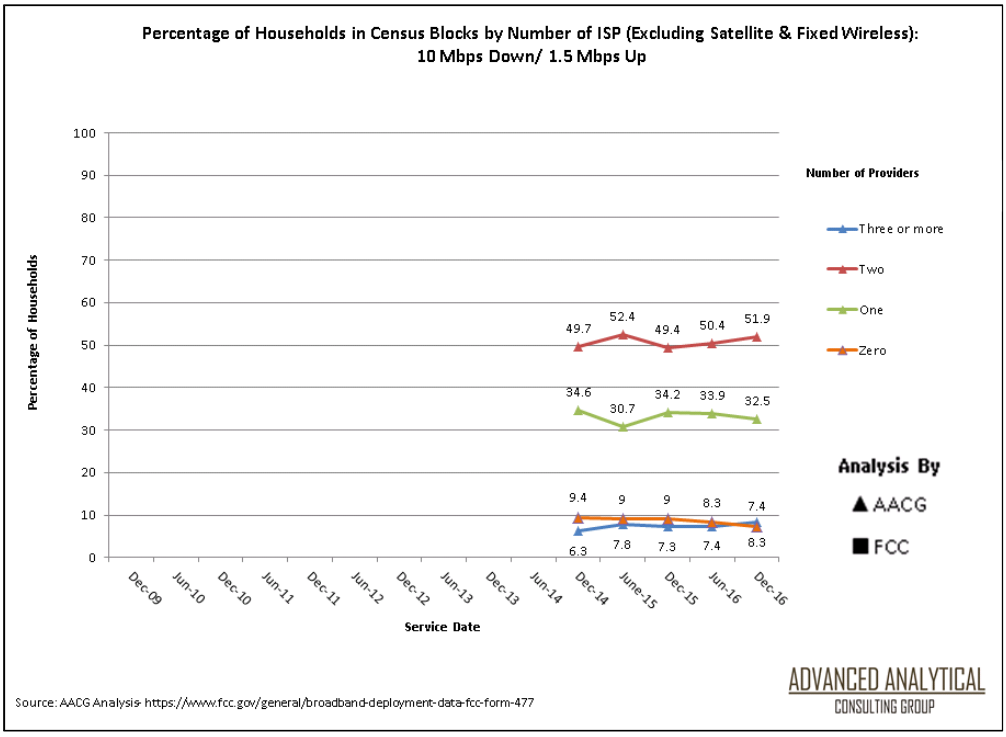

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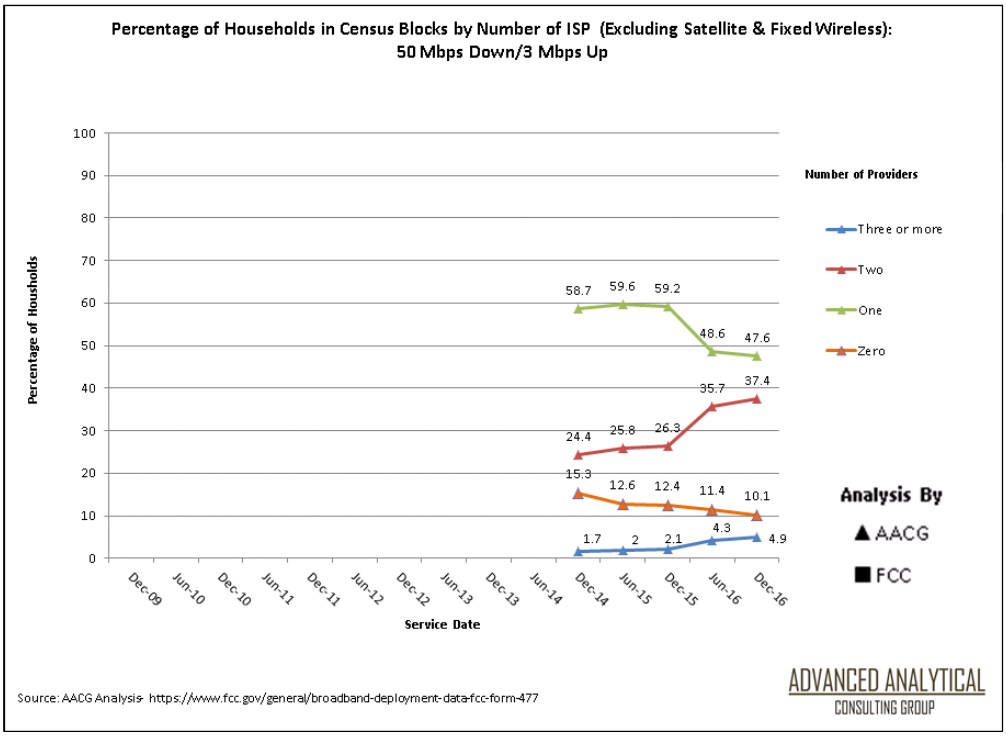

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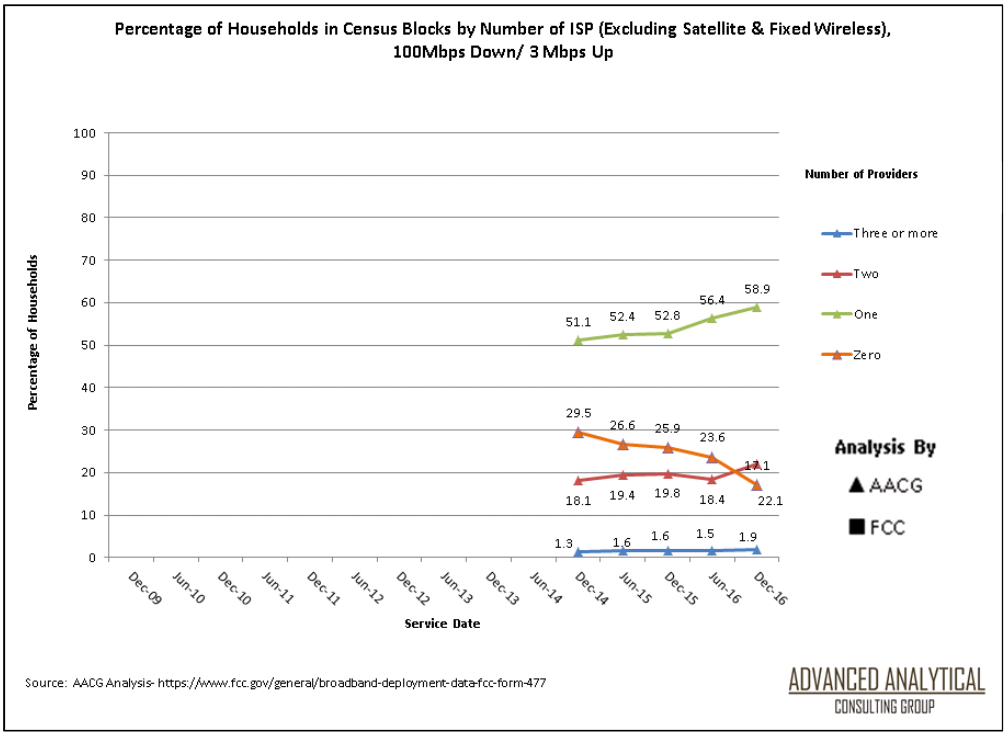

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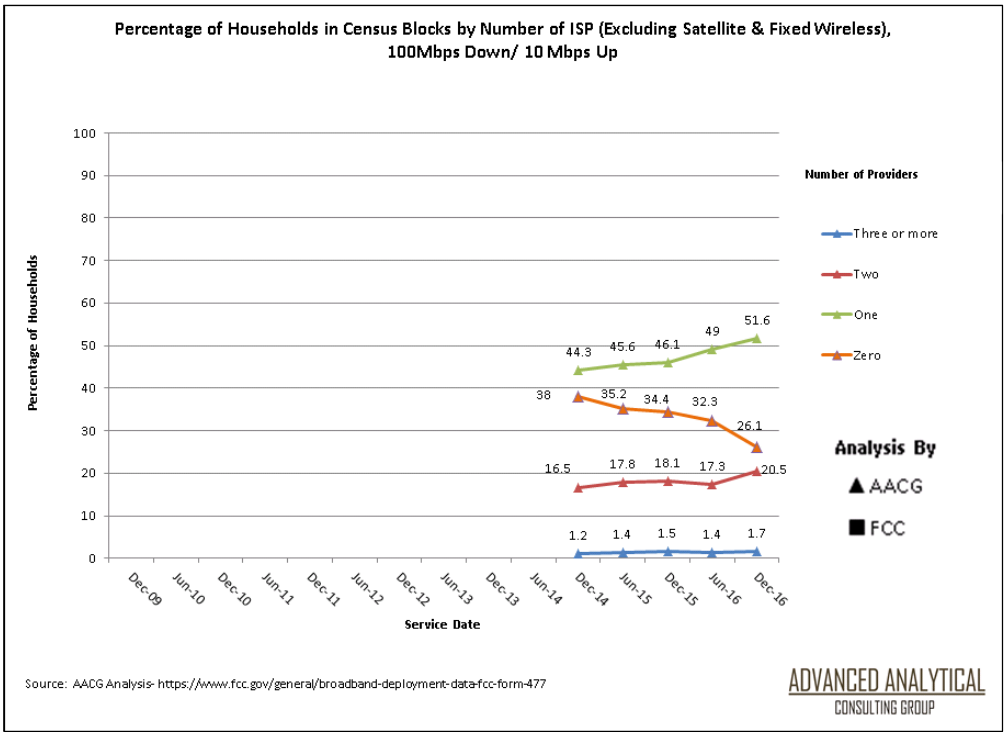

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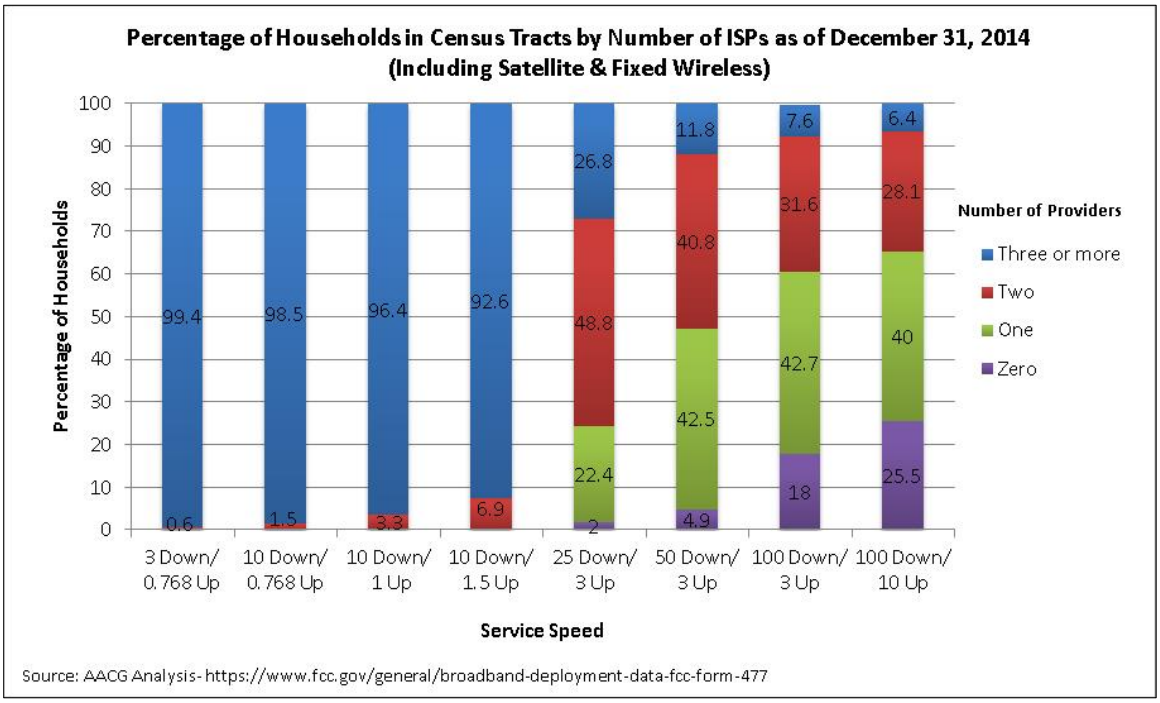

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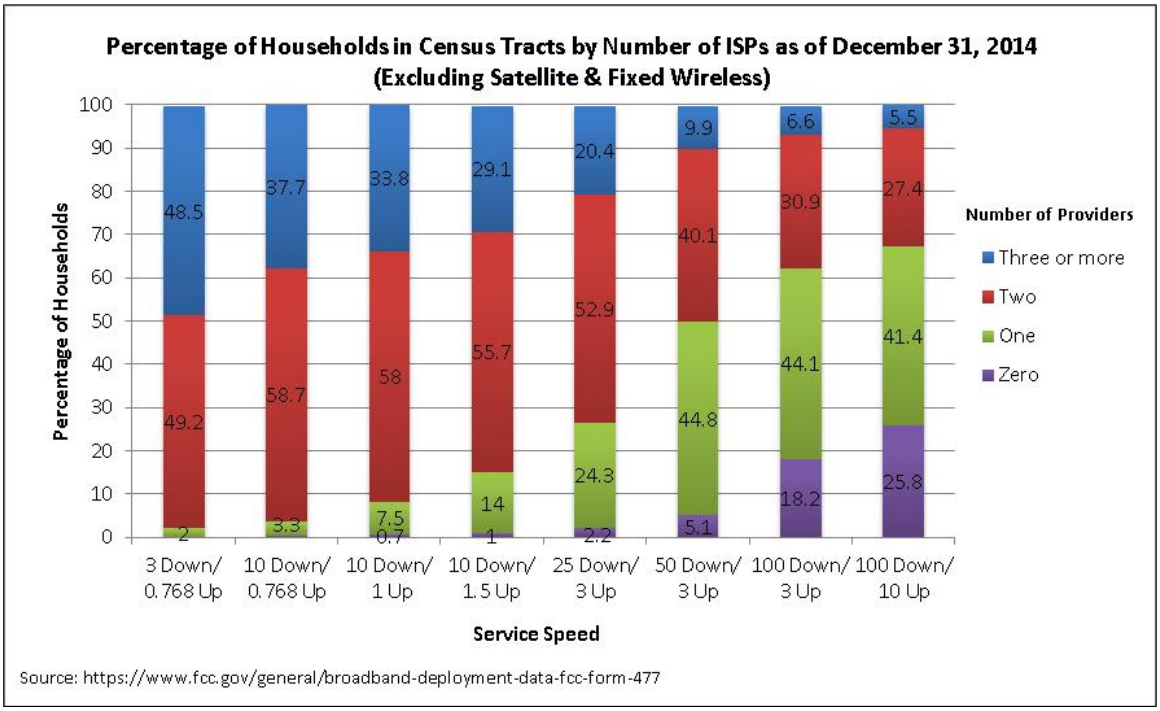
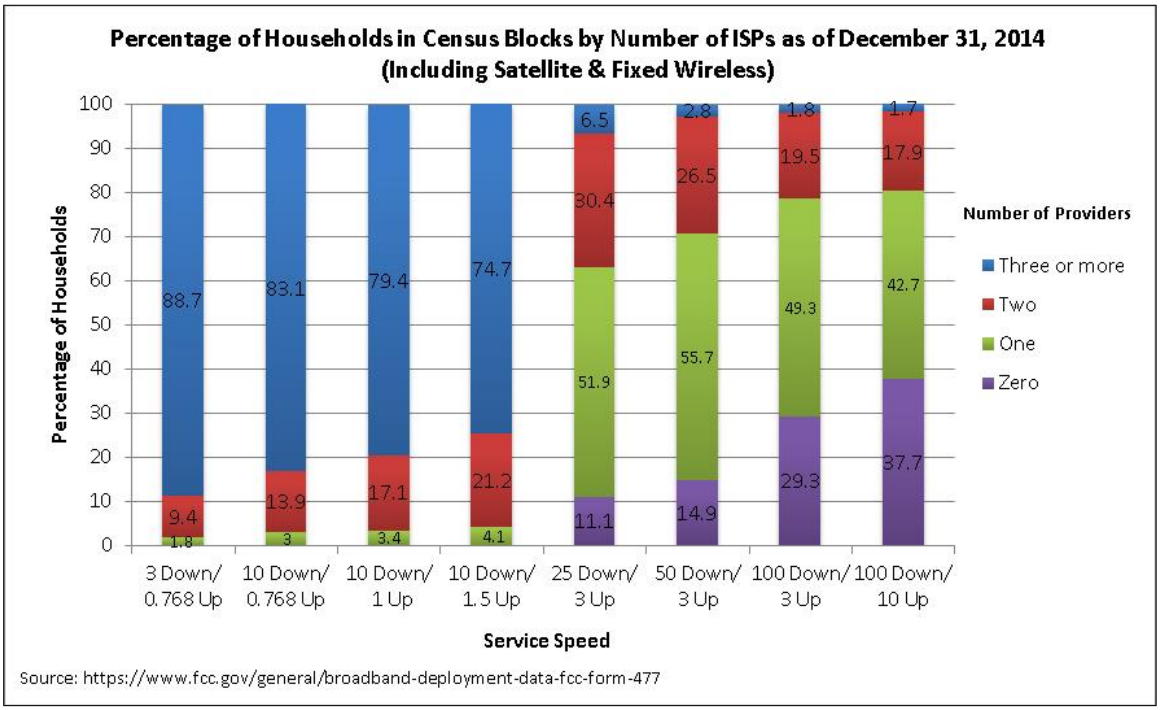
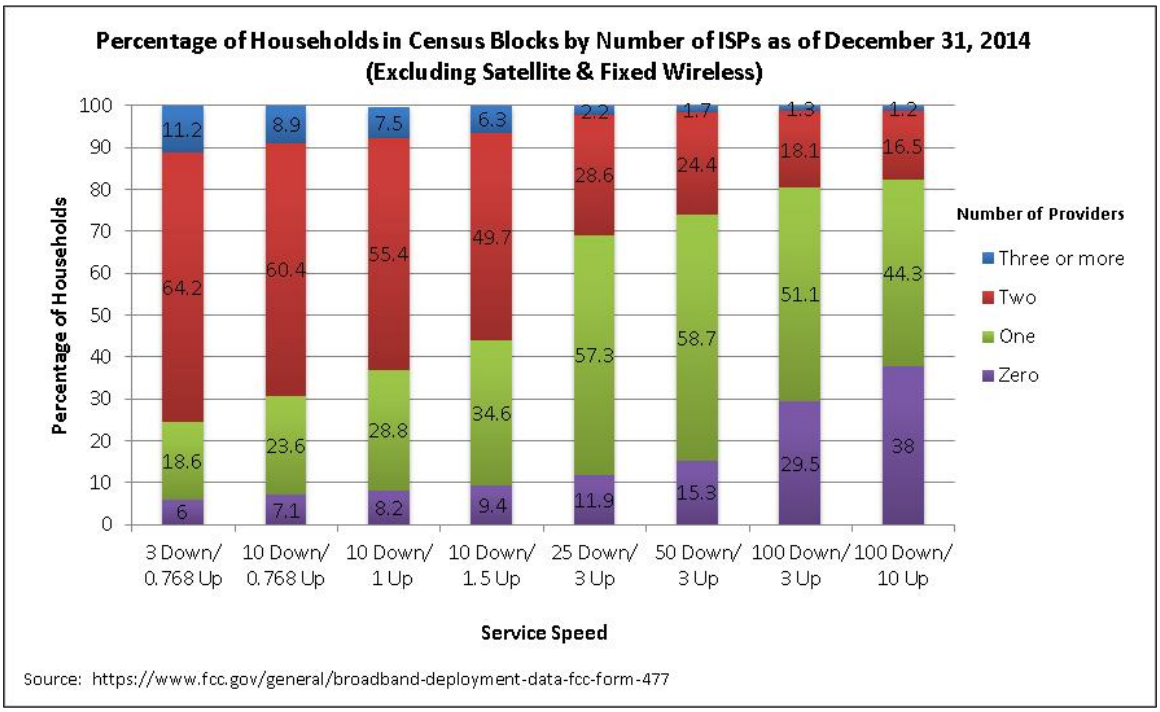


Figure B27



Source: https://www.fcc.gov/general/broadband-deployment-data-fcc-form-477

Figure B28



Source: https://www.fcc.gov/general/broadband-deployment-data-fcc-form-477

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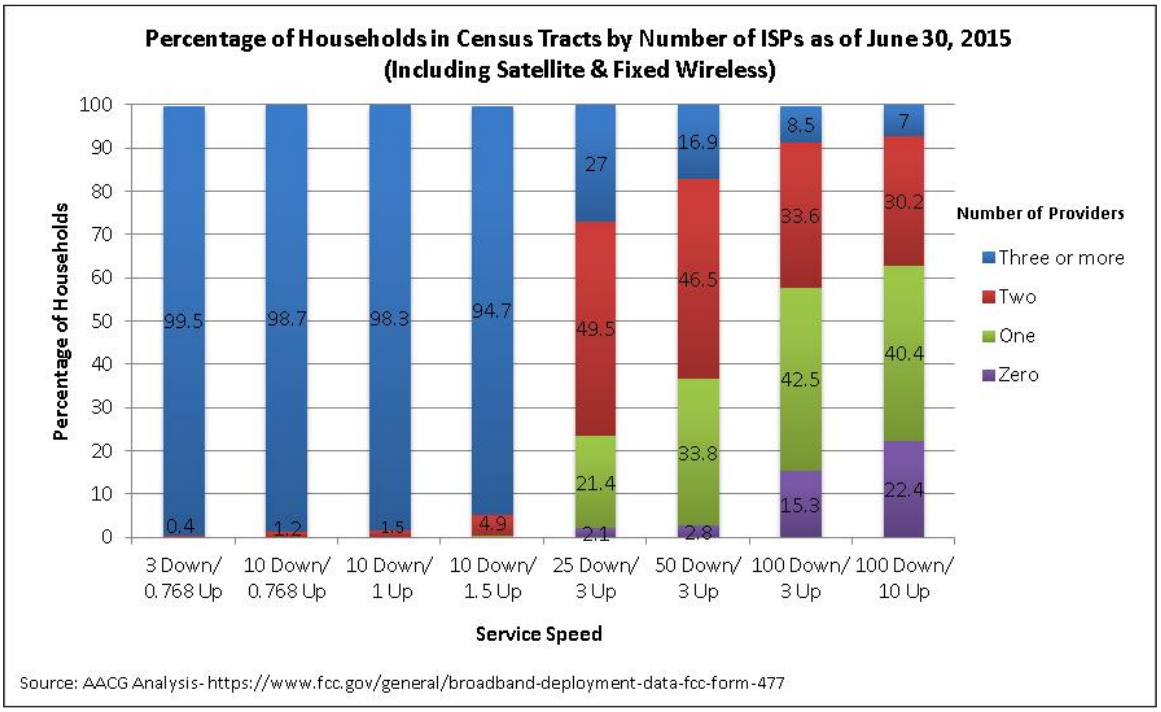

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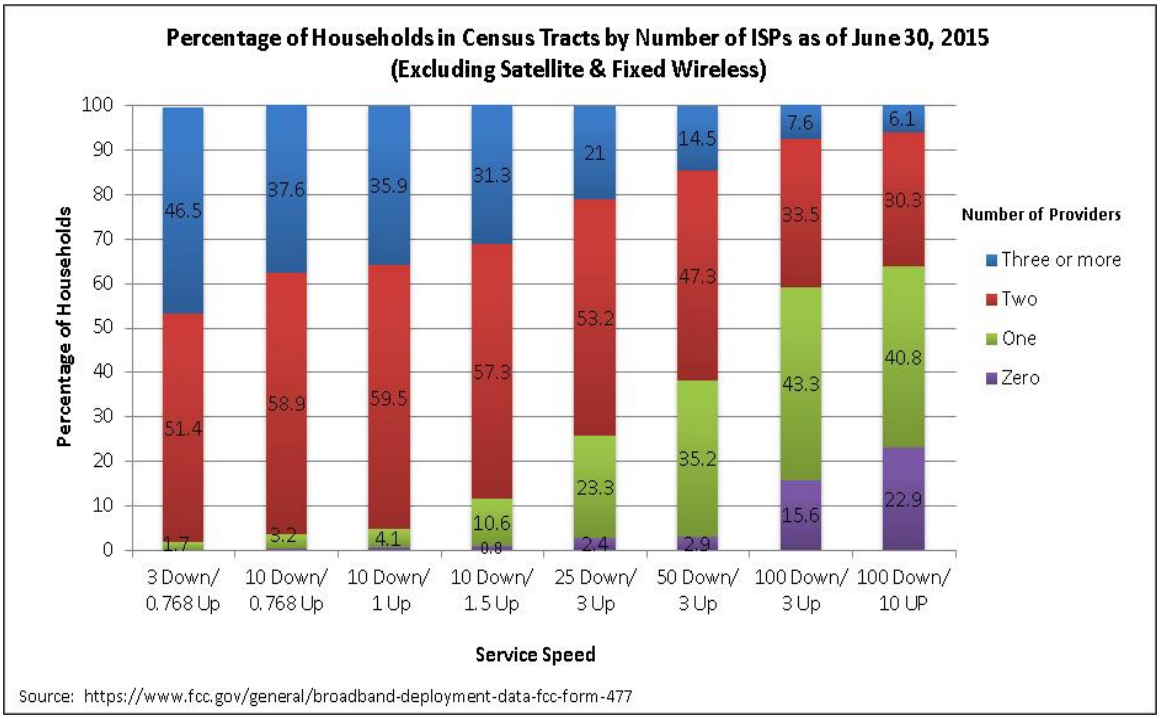

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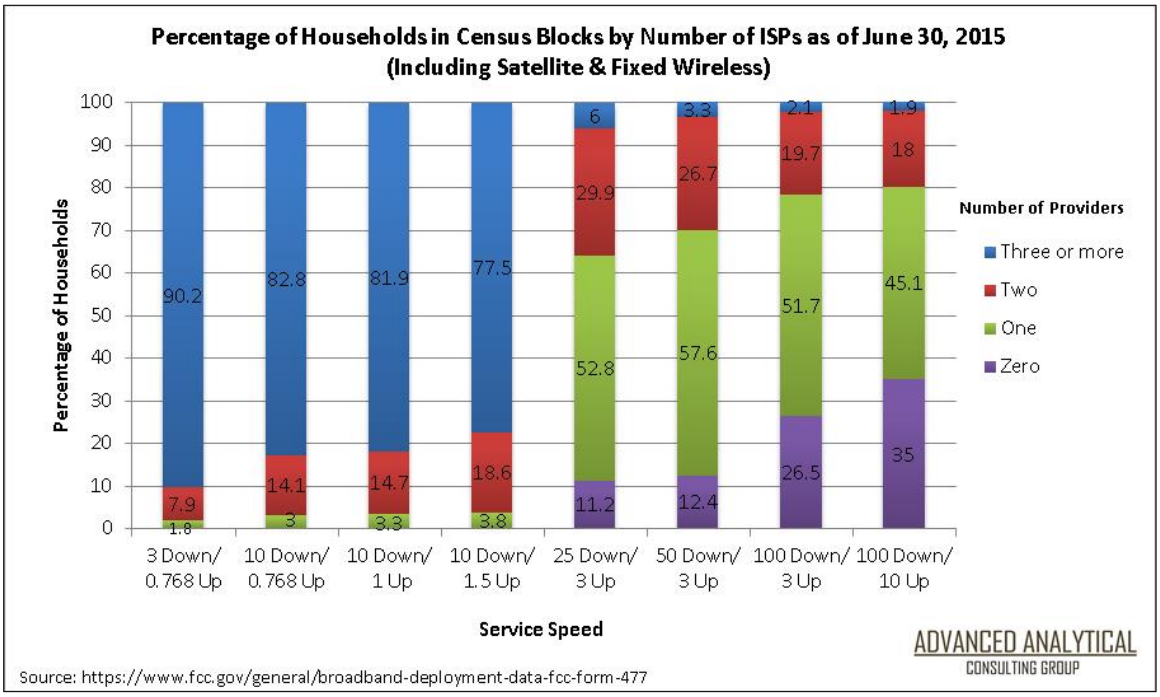

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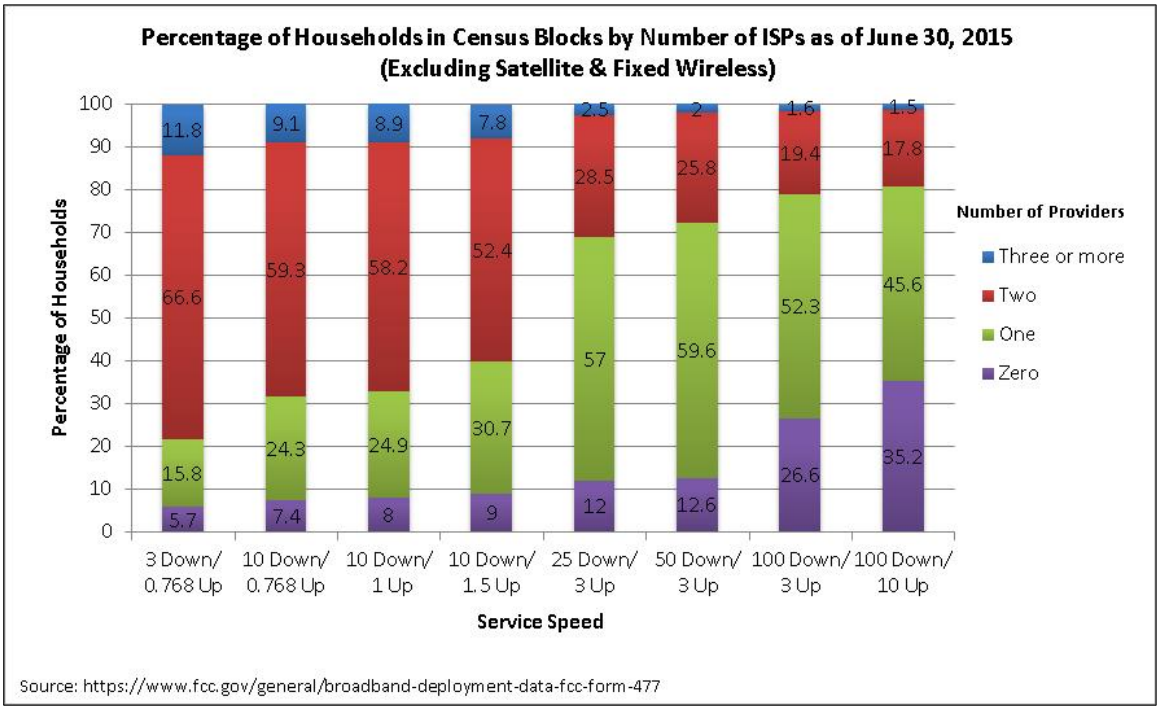

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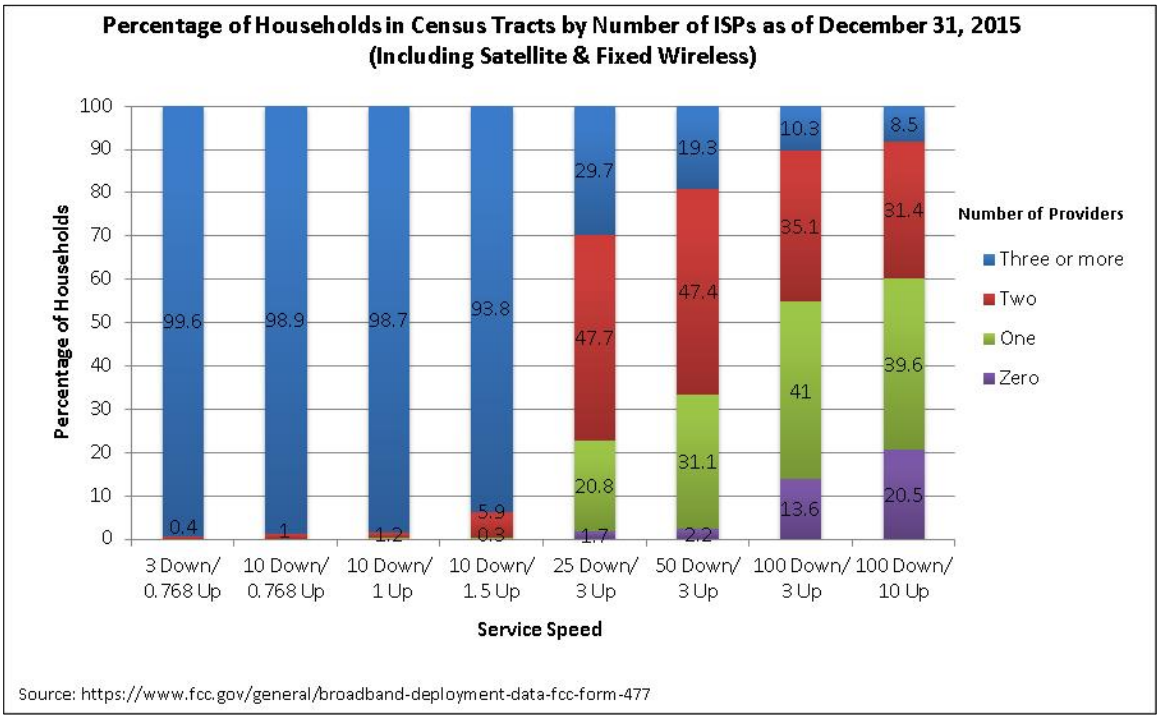

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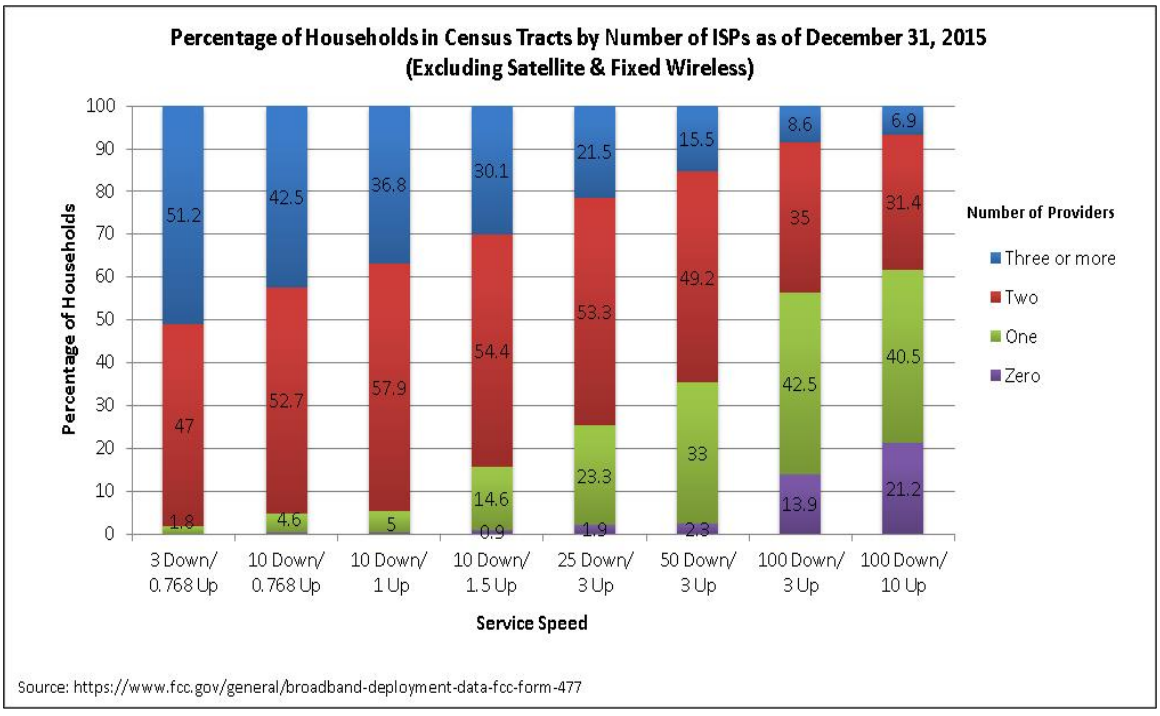

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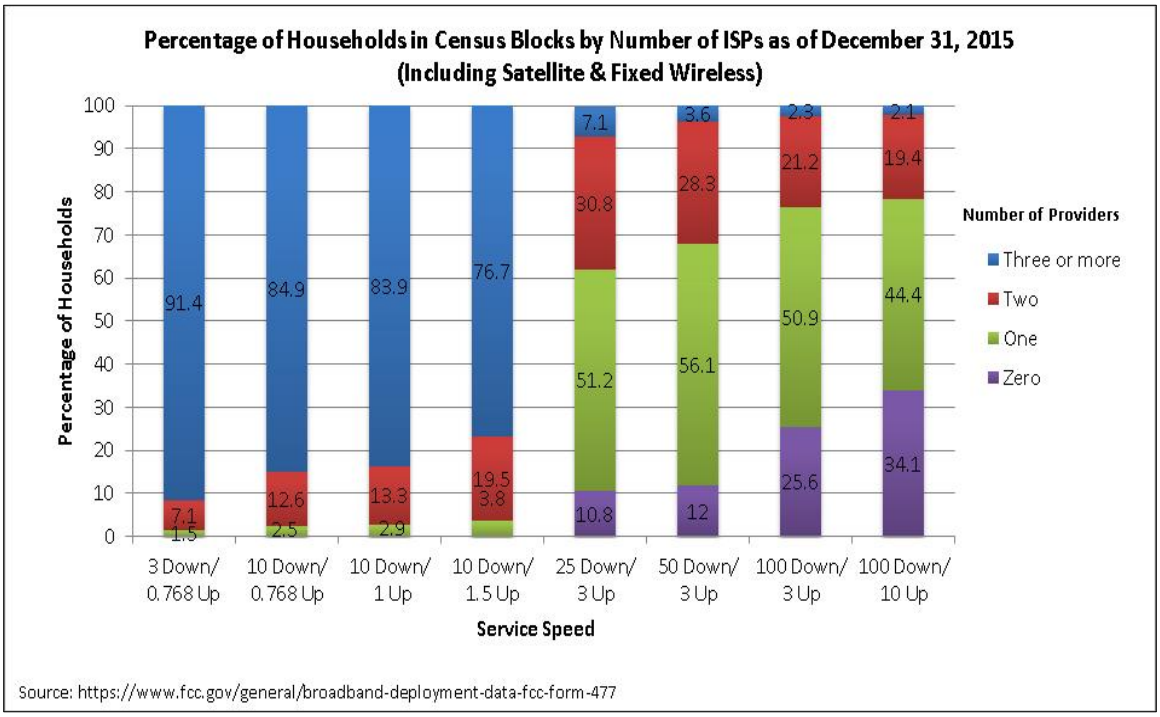

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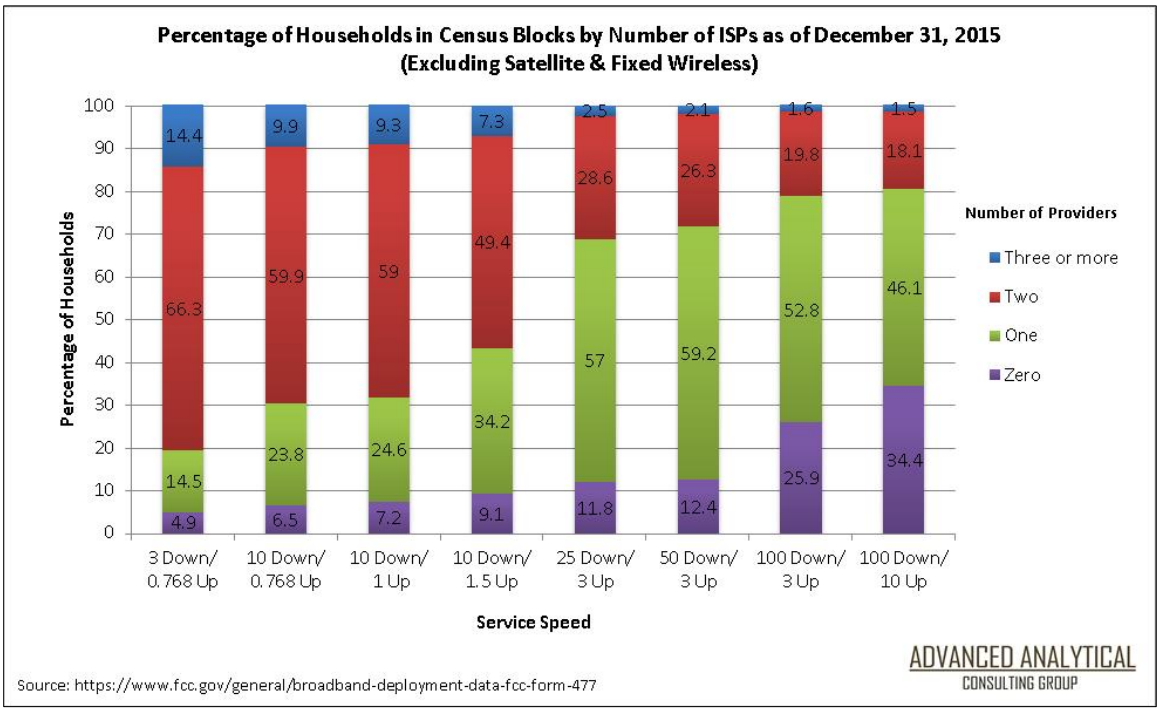
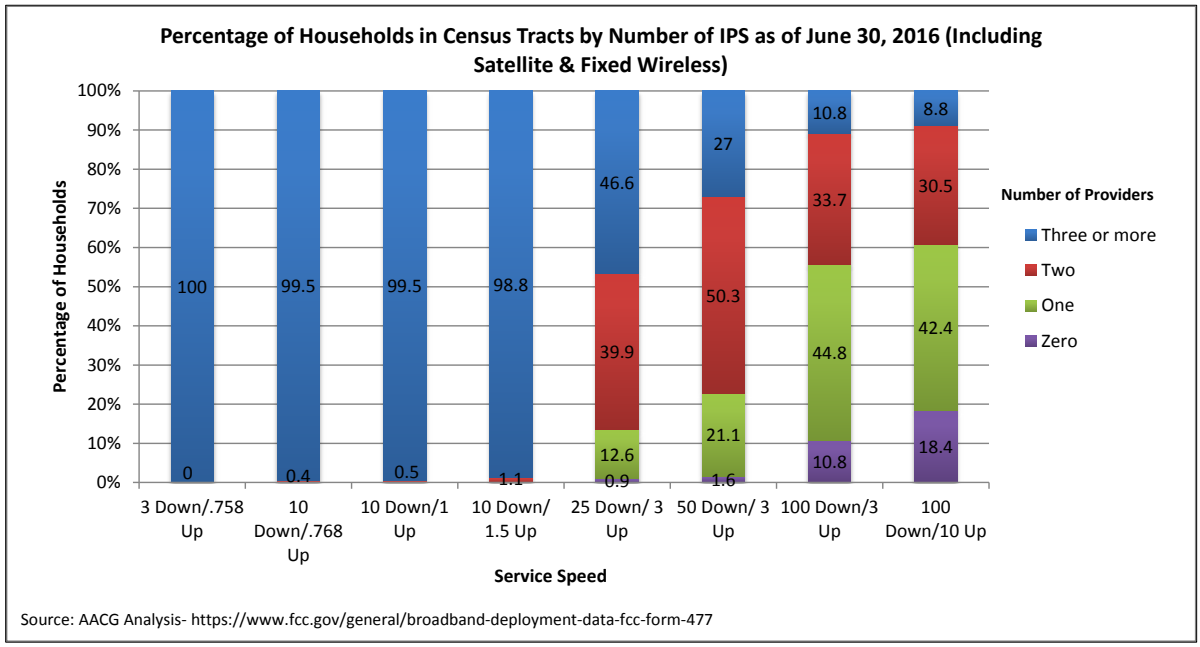
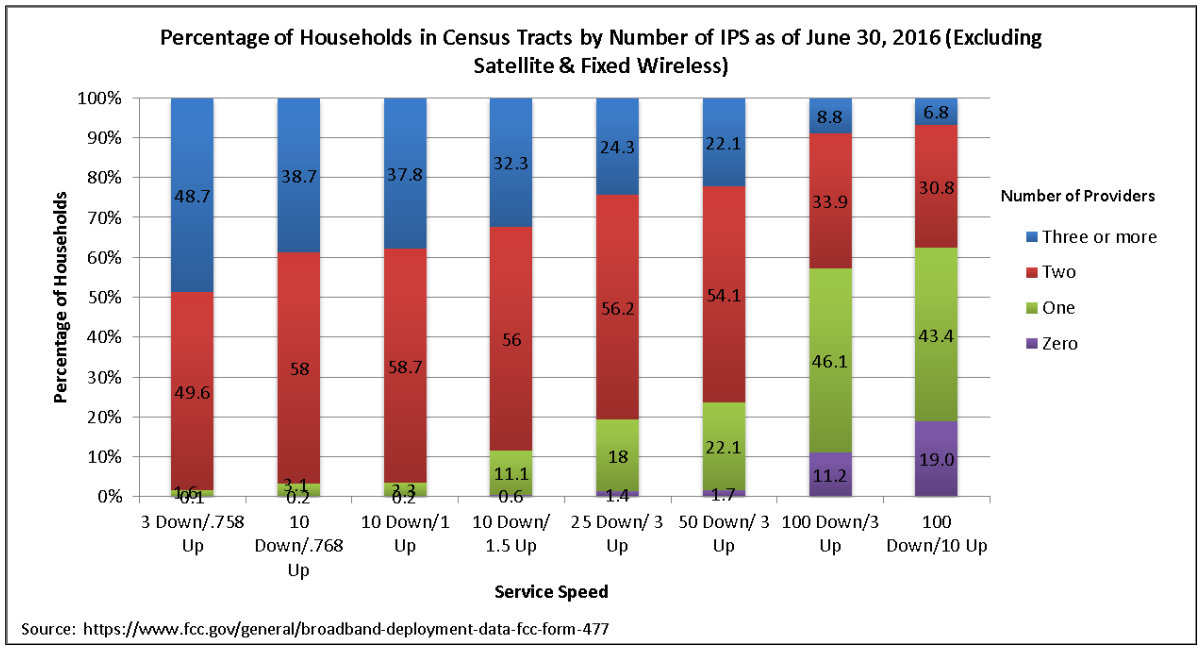


Figure B37



Source: AACG Analysis- https://www.fcc.gov/general/broadband-deployment-data-fcc-form-477

Figure B38



Source: https://www.fcc.gov/general/broadband-deployment-data-fcc-form-477

Figure B39

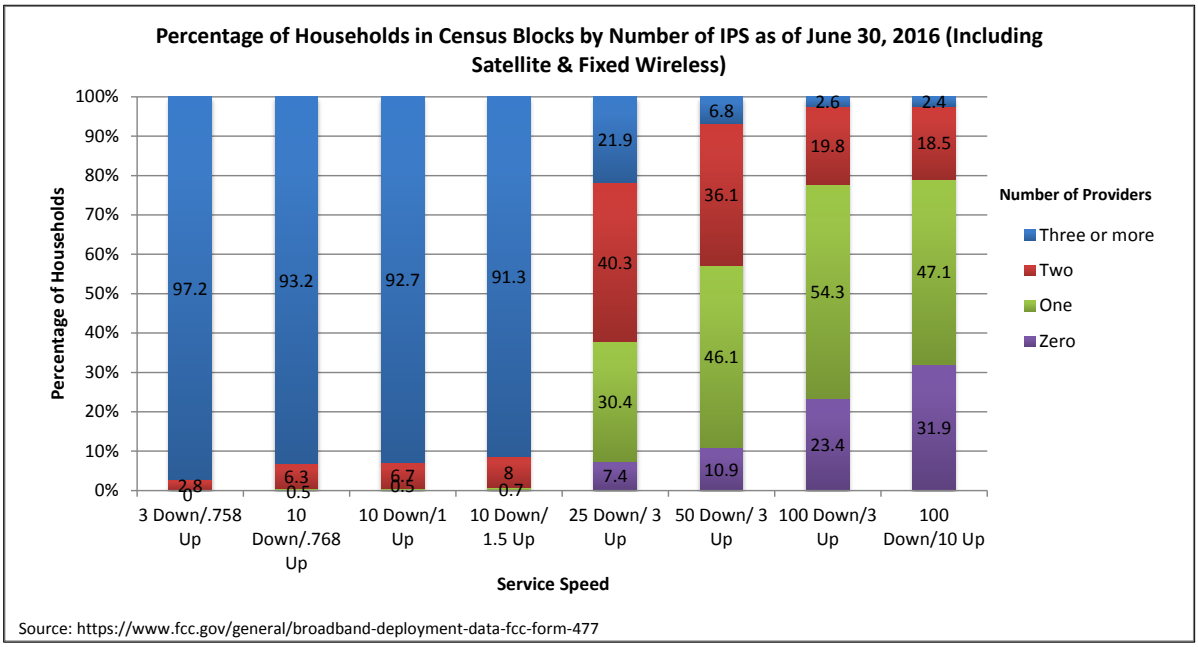


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Figure B40

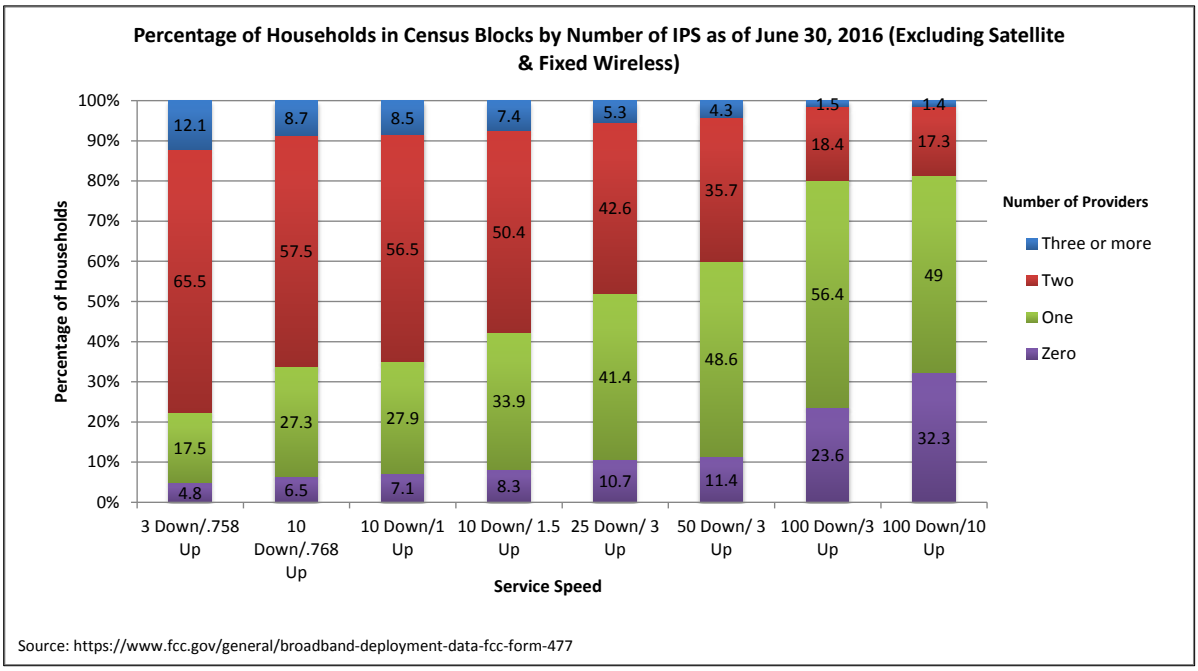

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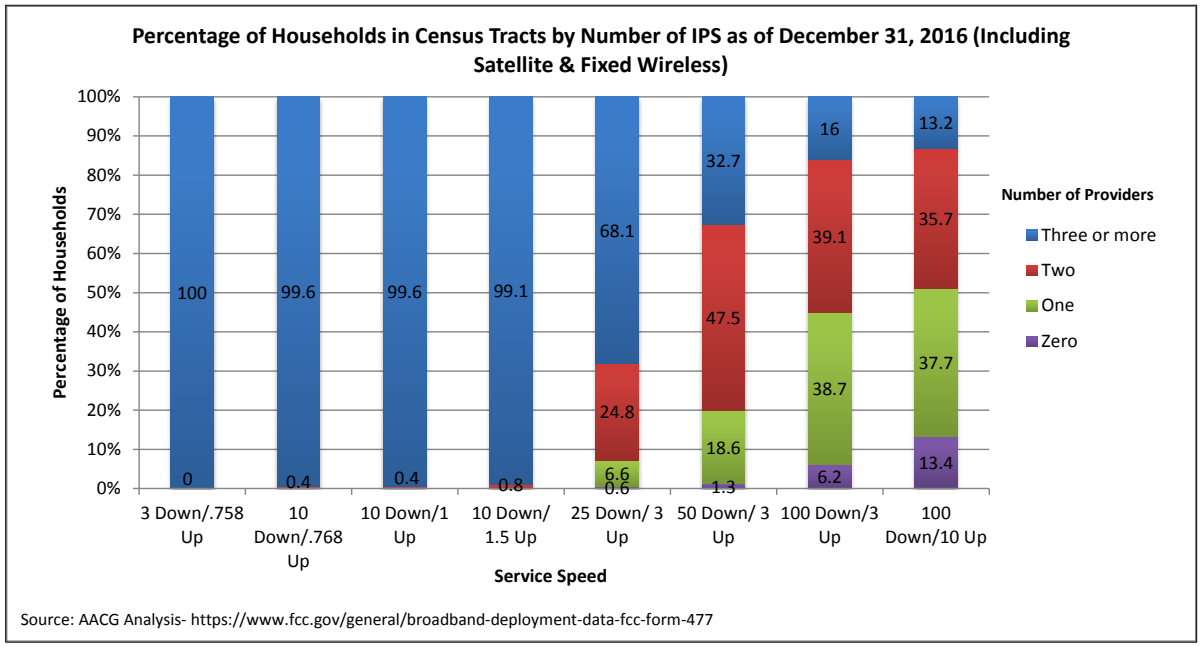
Figure B41



Source: AACG Analysis- https://www.fcc.gov/general/broadband-deployment-data-fcc-form-477

Figure B42

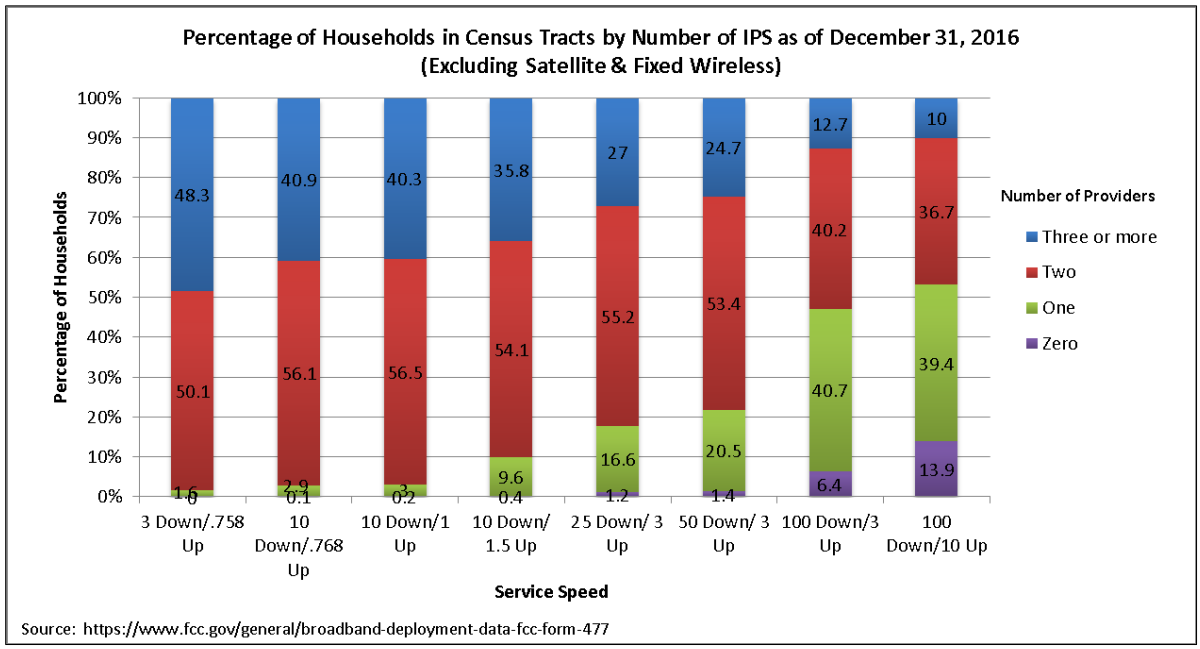


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Figure B43

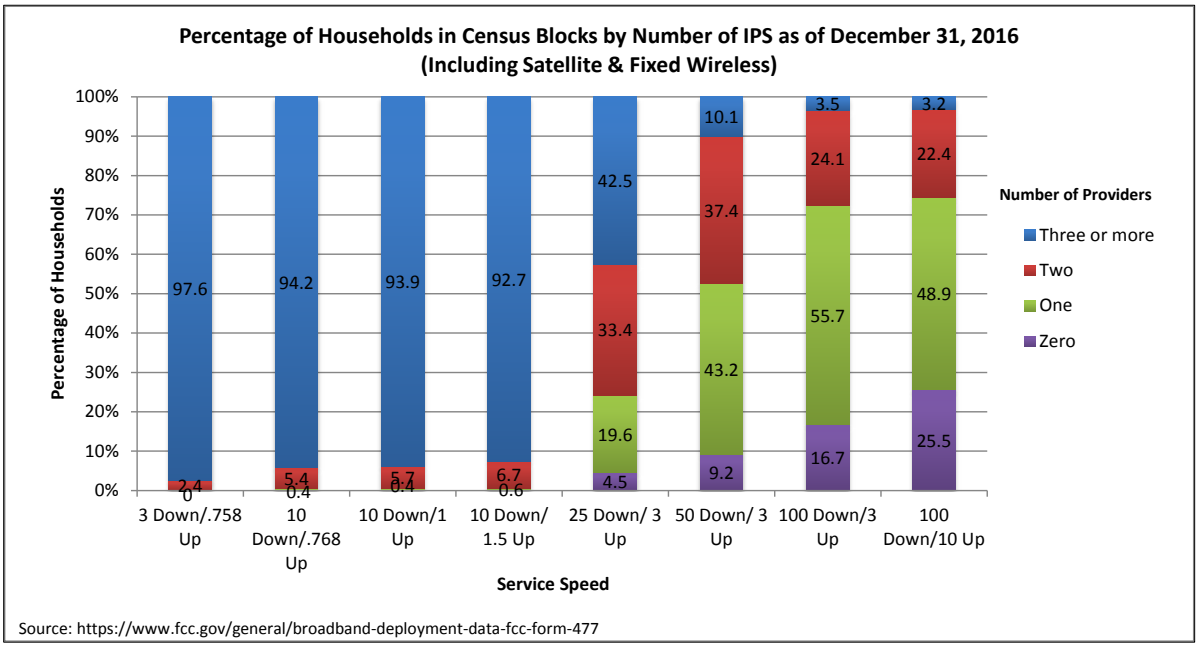

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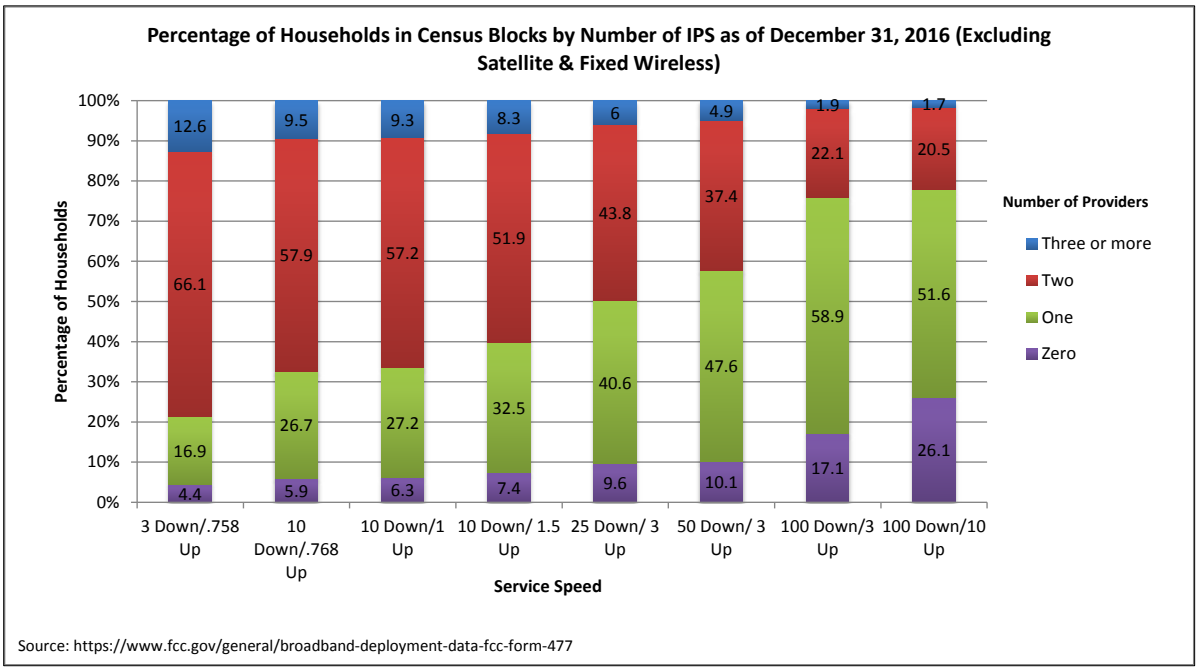
Figure B44



Source: https://www.fcc.gov/general/broadband-deployment-data-fcc-form-477

Figure B45. 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	June 2009 December 2009 June 2010 December 2010 June 2011 December 2011 June 2012 December 2012 June 2013 December 2013	September 2010 December 2010 March 2011 October 2011 June 2012 February 2013 May 2013 December 2013 June 2014 October 2014
3 Mbps Down/0.768 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 2013 December 2013	September 2010 December 2010 March 2011 October 2011 June 2012 February 2013 May 2013 December 2013 June 2014 October 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 2013 December 2013	September 2010 December 2010 March 2011 October 2011 June 2012 February 2013 May 2013 December 2013 June 2014 October 2014

10 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 2013 December 2013	September 2010 December 2010 March 2011 October 2011 June 2012 February 2013 May 2013 December 2013 June 2014 October 2014
3 Mbps Down/.768 Mbps Up	•Satellite Included •Fixed Wireless Included	Block	December 2014 June 2015 December 2015 June 2016 December 2016	March 2016 August 2016 November 2016 April 2017 February 2018
10 Mbps Down/ 1 Mbps UP	•Satellite Included •Fixed Wireless Included	Block	December 2014 June 2015 December 2015 June 2016 December 2016	March 2016 August 2016 November 2016 April 2017 February 2018
25 Mbps Down/ 3 Mbps Up	•Satellite Included •Fixed Wireless Included	Block	December 2014 June 2015 December 2015 June 2016 December 2016	March 2016 August 2016 November 2016 April 2017 February 2018
100 Mbps Down/ 10 Mbps Up	•Satellite Included •Fixed Wireless Included	Block	June 2015 December 2015 June 2016 December 2016	August 2016 November 2016 April 2017 February 2018

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