



# PUBLIC NOTICE

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DA 16-1107

Released: September 30, 2016

**FCC RELEASES DATA ON MOBILE BROADBAND DEPLOYMENT AS OF DECEMBER 31,  
2015  
COLLECTED THROUGH FCC FORM 477**

**WC Docket No. 11-10**

The Wireless Telecommunications Bureau (Bureau) today released data on mobile broadband deployment as of December 31, 2015. These data were collected through FCC Form 477 and are available on the Commission's Broadband Deployment Data – FCC Form 477 webpage at [www.fcc.gov/encyclopedia/broadband-deployment-data-fcc-form-477](http://www.fcc.gov/encyclopedia/broadband-deployment-data-fcc-form-477). This marks the Commission's second release of mobile broadband deployment data collected through Form 477. On November 10, 2015, the Commission released mobile broadband deployment data as of December 31, 2014.

Coverage area maps showing mobile broadband network deployment for each combination of provider and network technology are also available for download. These data are available in shapefiles, a file format used to store, depict, and analyze geospatial data. All the shapefiles show coverage nationwide. Users can download a single, large zip file containing all provider coverage areas or a zip file for an individual provider.

In addition, users can download tabular data showing mobile coverage in zipped CSV format by provider, state, or for the entire United States. For the first time, the CSV files present mobile coverage by technology at the census block level. Separate CSV files depict mobile coverage resulting from two different coverage analyses: centroid and actual area. The Attachment to this Public Notice provides additional background and describes the two coverage methodologies as well as the data and file formats.

The Bureau also has provided an explanation of the modifications made to the data prior to release and a description of the fields in the broadband deployment data. This information is available on the Explanations of the Broadband Deployment Data webpage at [www.fcc.gov/encyclopedia/explanation-broadband-deployment-data](http://www.fcc.gov/encyclopedia/explanation-broadband-deployment-data). Unless otherwise noted there, the Bureau has released the data as filed.

Providers can make revisions or corrections to their previously-filed Form 477 mobile data at any time. If filers submit a significant number of changes, the Bureau may release additional versions of the mobile broadband deployment data as of December 31, 2015.

Additional information on Form 477 is available on the Form 477 Resources for Filers webpage at [www.fcc.gov/form477](http://www.fcc.gov/form477). For questions related to the mobile broadband deployment data, please contact Melvin Del Rosario at [Melvin.DelRosario@fcc.gov](mailto:Melvin.DelRosario@fcc.gov) or (202) 418-0615, or Alex Rybak at [Alex.Rybak@fcc.gov](mailto:Alex.Rybak@fcc.gov) or (202) 418-0697.

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## ATTACHMENT

### Form 477 Mobile Wireless Data Report

#### Release of December 2015 Data

#### I. INTRODUCTION AND BACKGROUND

1. In 2013, the Commission took a significant step forward in its *Modernizing the FCC Form 477 Data Program* Order, which substantially revised and enhanced its collection of mobile voice and broadband coverage data. The scope and nature of the new Form 477 data on mobile services coverage was an improvement over earlier data sources in key respects, such as the uniformity of data reporting. As the Commission stated at the time: “The combination of data on network deployment, service availability, and subscription will assist the Commission in a number of analyses, including those in the Broadband Progress Reports and Mobile Wireless Competition Reports, the state of competition in the mobile wireless industry, and review of mergers and spectrum transactions”<sup>1</sup> In 2014, the Commission proposed to use Form 477 mobile deployment data, rather than its earlier sources, as it moved forward on mobile broadband universal service issues.<sup>2</sup>

2. Previously, the Commission relied in part on mobile coverage data collected through NTIA's State Broadband Initiative (SBI). The SBI implemented the American Recovery and Reinvestment Act and the Broadband Data Improvement Act, which envisioned a program to help integrate broadband and information technology into state and local economies.<sup>3</sup> Since accurate data on broadband coverage is critical to meeting this objective, a key function of the SBI was to assist states in gathering data twice a year on the availability, speed, and location of broadband services.<sup>4</sup> To advance this effort, NTIA awarded grants to all 50 states, five territories, and the District of Columbia to use, in part, to gather data on broadband deployment and coverage from broadband providers,<sup>5</sup> who voluntarily submitted such data to these government entities.<sup>6</sup>

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<sup>1</sup> See *Modernizing the FCC Form 477 Data Program*, Report and Order, 28 FCC Rcd 9887, 9909-10, para. 44 (2013) (*477 Report & Order*).

<sup>2</sup> See *Connect America Fund; Developing a Unified Intercarrier Compensation Regime; Establishing Just and Reasonable Rates for Local Exchange Carriers; ETC Annual Reports and Certifications; Universal Service Reform – Mobility Fund*; WC Docket Nos. 10-90, 07-135, 14-58, CC Docket No. 01-92, WT Docket No. 10-208, Report and Order, Declaratory Ruling, Order, Memorandum Opinion and Order, Seventh Order on Reconsideration and Further Notice of Proposed Rulemaking, 29 FCC Rcd 7051, 7128, para. 241 (2014).

<sup>3</sup> See <https://www.ntia.doc.gov/category/state-broadband-initiative>.

<sup>4</sup> See *id.*

<sup>5</sup> See *id.*

<sup>6</sup> See *477 Report & Order*, 28 FCC Rcd at 9898, para. 24.

3. The SBI data were first published in February 2011, as part of the National Broadband Map (NBM) and were updated every six months through April 2015.<sup>7</sup> For mobile services, the NBM data included information on mobile wireless broadband coverage at the census block level by provider, along with the deployed technology, maximum and typical upload and download speeds and spectrum bands. This dataset had certain limitations such as, amongst other things, the lack of a standardized data collection methodology.

4. Before the revision of the Form 477 Report, the Commission also relied on mobile coverage data from Mosaik Solutions (formerly known as American Roamer), which is an independent consulting firm that provides data on the coverage footprints of mobile voice and mobile data networks to the Commission under contract. While this dataset was one of the best available, it still had various shortcomings. For example, this data is not collected under a consistent methodology across geographic areas and service providers and is a voluntary collection. In addition, because Mosaik data is commercially-provided and subject to intellectual property protections, its utility is somewhat limited in the public policy sphere.

5. Recognizing the deficiencies in the existing data, the Commission adopted new reporting requirements for fixed and mobile broadband data network deployment in 2013. The Commission revised the existing Form 477 collection process to include data on deployments of fixed and mobile broadband networks and mobile voice networks.<sup>8</sup> The Form 477 data collection continues the collection of broadband deployment data through the SBI, but makes important adjustments to improve the data's reliability while reducing the reporting burden on providers.<sup>9</sup> Form 477 is a uniform, required filing for all providers on a semi-annual basis.<sup>10</sup>

## II. OVERVIEW OF FORM 477 MOBILE DATA COLLECTION

6. The Commission requires all facilities-based broadband providers<sup>11</sup> to file Form 477, which discloses where they offer Internet access service at speeds exceeding 200 kbps in at least one direction.<sup>12</sup> This section provides an overview of the new Form 477 mobile wireless coverage data, briefly describes these datasets, and relates how they were collected, the various metrics, and the level of granularity.

7. In particular, for each mobile broadband network technology (*e.g.*, EV-DO, WCDMA, HSPA+, LTE, WiMAX) deployed in each frequency band (*e.g.*, 700 MHz, Cellular, AWS, PCS, BRS/EBS), facilities-based mobile broadband providers must submit polygons representing their

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<sup>7</sup> See <http://www.broadbandmap.gov/about>.

<sup>8</sup> See *477 Report & Order*, 28 FCC Rcd at 9896-97, para. 20.

<sup>9</sup> See *id.* at 9897, para. 23.

<sup>10</sup> See *id.* at 9897-98, paras. 23-24.

<sup>11</sup> Providers subject to these requirements include incumbent and competitive local exchange carriers (LECs), cable television system operators, terrestrial fixed wireless providers (including wireless ISPs, or WISPs) that provide service to end user premises, satellite network operators, terrestrial mobile wireless operators with owned network facilities, electric utilities, public utility districts, municipalities, and other entities. See <https://transition.fcc.gov/form477/477inst.pdf>.

<sup>12</sup> A wired line or wireless channel that terminates at an end-user location and enables the end user to receive information from and/or send information to the Internet at information transfer rates exceeding 200 kilobits per second (kbps) in at least one direction. See <https://transition.fcc.gov/form477/477inst.pdf>.

nationwide coverage area (including U.S. territories) of that technology.<sup>13</sup> The data associated with each polygon indicates the minimum advertised upload and download data speeds associated with that network technology in that frequency band (in Mbps, with a maximum of three decimal places), and the coverage area polygon must depict the boundaries where users should expect to receive those advertised speeds.<sup>14</sup> If a provider advertises different minimum upload and download speeds in different areas of the country using the same technology and frequency band (e.g., HSPA+ on AWS spectrum), then the provider must submit separate polygons showing the coverage area for each speed.<sup>15</sup> Any variation in technology, frequency band, or speed requires the submission of a separate polygon.<sup>16</sup> If a provider does not advertise the minimum upload and/or download data speeds, the provider must indicate the minimum upload/download data speeds that users should expect to receive within the polygon depicting the geographic coverage area of the deployed technology in the given frequency band.<sup>17</sup>

8. Form 477 data offers significant advantages over the SBI data. First, providers' submission of data is mandatory, and filers must certify that the data are accurate.<sup>18</sup> Providers themselves have the best available information regarding their own network deployments -- including the technologies being used and performance characteristics experienced by consumers. These coverage metrics form the basis of their core business interests and inform their deployment strategies. Therefore, providers are best positioned to delineate their coverage areas for various technologies, and to identify those areas where consumers can expect to receive their advertised speeds. Using data submitted directly to the Commission by the providers, who certify the data as accurate, has substantial advantages over relying exclusively on third-party data sources for mobile wireless coverage. Therefore, this new Form 477 data significantly advances the Commission's ability to collect and publish complete and accurate data.<sup>19</sup>

9. Second, all providers are required to make a single, uniform filing to the Commission, rather than produce data in formats determined by individual states and territories.<sup>20</sup> This significantly reduces the potential for distortion or misleading comparisons of the data when the data are analyzed across boundaries and nationwide.<sup>21</sup> For example, in the absence of uniform Form 477 data, assessing broadband deployment and availability data in the DC-metro area would require the Commission to determine to what extent the voluntary reporting guidelines established by DC, Maryland, and Virginia were equivalent and determine what adjustments were necessary and/or feasible in order to accurately assess broadband deployment across the region.

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<sup>13</sup> See *477 Report & Order*, 28 FCC Rcd at 9908, para. 42. 1. Mobile wireless providers submit polygons in a shapefile format representing geographic coverage nationwide (including the 50 states, District of Columbia, Puerto Rico, and the Territories and possessions) for each mobile broadband transmission technology (as specified in Technology of Transmission Codes for Mobile Wireless Services table in Codes to Use in Data Upload Files section) deployed in each frequency band (as specified in the Spectrum Codes table in Codes to Use in Data Upload Files section).

<sup>14</sup> See *id.* at 9908-09, para. 42.

<sup>15</sup> See *id.* at 9909, para. 42.

<sup>16</sup> See *id.*

<sup>17</sup> See *id.*; see also <https://transition.fcc.gov/form477/477inst.pdf>.

<sup>18</sup> See *id.* at 9898, para. 24.

<sup>19</sup> See *id.*

<sup>20</sup> See *id.*

<sup>21</sup> See *id.*

10. Third, Form 477 collects mobile coverage data in conjunction with the technology and spectrum bands used by service providers, and the resulting speeds available to mobile users. In contrast, SBI data does not clearly link spectrum information to coverage boundaries.<sup>22</sup> This spectrum information provides the Commission with information on the actual use of spectrum bands, which promotes informed spectrum management policies in light of growing demand and evolving technologies.<sup>23</sup> And with respect to speed, Form 477 collects data on minimum advertised speed for mobile broadband, rather than the maximum advertised speed data collected through the SBI.<sup>24</sup> For mobile users, this is the more relevant figure as the minimum advertised speed is the speed they are more likely to consistently experience.<sup>25</sup>

11. Fourth, Form 477 collects mobile voice coverage data, in addition to broadband deployment information.<sup>26</sup> These data will allow the Commission to analyze voice deployment in different spectrum bands and further inform the Commission's spectrum and competition policies.<sup>27</sup>

### III. METHODOLOGIES FOR COVERAGE ANALYSIS

#### a. Centroid Methodology

12. Up until now, the Commission has analyzed of mobile network coverage primarily using a centroid methodology. This methodology overlays the geographic polygons showing wireless coverage onto a map of census blocks.<sup>28</sup> The centroid method codes a census block as "covered" if the calculated center point (the "centroid") of the census block is within the coverage polygon. If a centroid is covered, then all of the population and land area in the corresponding census block is also coded as covered. As we noted in several Mobile Wireless Competition Reports, this methodology has the potential to overstate coverage in certain blocks,<sup>29</sup> especially in large or irregularly shaped blocks. Therefore to get a more accurate picture of coverage, this analysis uses the actual area coverage methodology as outlined below.

#### b. Actual Area Coverage Methodology

13. With the release of this data, the Commission will be analyzing coverage data for the first time using an actual area coverage methodology. In particular, the data on sub-block coverage represents a significant step towards information transparency, since accurate and comprehensive data is critical for broadband planning, and for identifying coverage gaps. Instead of using the centroid methodology as a proxy for determining whether to count a block as either completely covered or not covered, this methodology analyzes reported coverage at a sub-block level for each of the 11 million blocks in the US. Using this methodology, we calculate the percentage of the block covered by each technology. Additionally, this methodology allows us to present the percentage of area in a block at each technology

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<sup>22</sup> See *id.* at 9910, para. 46.

<sup>23</sup> See *id.* at 9910, paras. 45-46.

<sup>24</sup> See *id.* at 9909, para. 43 & n.139.

<sup>25</sup> See *id.*

<sup>26</sup> See *id.* at 9913, para. 55.

<sup>27</sup> See *id.*

<sup>28</sup> A census block is the smallest geographic unit for which the Census Bureau tabulates decennial census data. There are 11,166,336 blocks designated in the 2010 Census, and they range in population from zero to several hundred. See U.S. Census Bureau, "2010 Census Summary File 1 – 2010 Census of Population and Housing, Technical Documentation" at p. 21 (March 2010), available at <http://www.census.gov/prod/cen2010/doc/sf1.pdf#page=504>.

<sup>29</sup> *Id.*

level that is reported as covered by each unique combination of providers. Although a complex and computationally intensive process, this methodology provides a unique ability to analyze coverage at a sub-block level.

14. As a first step in the methodology, we first remove the spectrum and speed information from each shapefile filed by a specific provider. Where the only differences between particular shapefiles are spectrum bands and speeds, multiple shapefiles are thereby reduced to one shapefile. For example, all things being equal, if only speed varied in two polygons, after excluding the speed information, the polygons are now identical. The same is applicable to the spectrum analysis. Therefore, once these data are excluded, the identical polygons are reduced to a single unique polygon for a particular technology for a particular providers.

15. We note that this analysis was done separately for each technology level. Therefore the percentage coverages it produces are valid for each technology and not across technologies. Thus, at the sub-block level, we distinguish the unique percentages covered by various providers using a particular technology, *e.g.*, LTE. We have not calculated how coverage reported for one technology does or does not overlap with coverage of other technologies, *e.g.*, 3G or 2G technologies. Thus, at the block level, we have provided the area served by LTE, 4G non-LTE, 3G, and 2G technologies. In calculating the coverage percentages, we exclude water-only blocks.

#### **IV. DATA RELEASE**

##### **a. Overall Data Description**

16. We are releasing the Form 477 shapefiles and associated data reflecting mobile coverage at a census block level as of December 2015 (filed by providers as of July 5, 2016).<sup>30</sup> This is the first time that the Commission is releasing mobile wireless coverage data at this level of granularity.

17. The files below include all publicly available data in a Shapefile or zipped .csv format. Users may download data by provider or geographic area. Each zip file is accompanied by a readme .txt file that explains the variables included and methodology used to derive the data. Additionally, we also provide a list of all mobile wireless providers who have filed the Form 477 data and are thus included in this data release. When publishing results of this data, please cite *FCC Form 477 'Month Year'*. If you have any questions about how to use the data, or to tell us how you are using it, send an email to xxxxx. Below, we describe the files being released.

##### **b. Shapefiles**

18. We are releasing two sets of shapefiles.

- i. A consolidated file where one will be able to download *nationwide mobile coverage* data. These are large zipped files where coverage shapefiles for all mobile wireless providers and all technologies are included. Associated with this file, we are publishing a file that lists all providers who have any network footprint in each particular state to assist those interested in analyzing data for one or more specific states. This dataset will enable users to focus on coverage in a particular geographic area, including a state, by technology.
- ii. A second set of shape files will be *by provider*. This dataset will enable users to focus on a particular provider's coverage by geographic area and technology.

##### **c. Data Based on the Centroid Methodology**

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<sup>30</sup> The filing deadline for this data is March 1, 2016. After the initial filing data quality checks are performed and providers are sometimes asked to refile if errors are found in their filing.

19. Based on the shapefiles, staff has produced .csv files that show coverage by technology at the census block level using the centroid methodology, as explained earlier. Each of these files contain an internal record ID, company identifier (DBA name<sup>31</sup>), state code and Form 477 technology code and a 15 digit census block identifier (FIPs code). These files only show census block that are covered based on the centroid methodology. These files only contain a list of served/covered blocks. For this analysis, we will release three sets of .csvs.

- i. The first data set comprises *nationwide data* by census blocks by provider and by technology. For every served block, there are multiple rows, with each showing a unique combination of provider and technology. It shows the census block FIPS code, a state code, a list of technologies present in the block and a list of providers present in the block.
- ii. The second set of data is a state level .csv zip file that will have the information produced in the national file disaggregated *by state*. So one could download these files and focus on particular states. Again, only covered/served blocks are contained in the dataset.
- iii. The third set data are .csv files *by provider*. These files will contain all the census blocks where the particular provider serves and the associated technology in the block. So for a particular provider, the .csv will provide the census block FIPS, the provider's DBA name, state code, and a list of Form 477 technology codes. As stated earlier, these only list the covered/served blocks for the particular provider.

**d. Data Based on the Actual Area Methodology**

20. These .csv files comprise data that were produced based on an analysis of the actual area covered by a particular technology, and by provider. Each of these files contain the 15 digit census block identifier (FIPs code), state code and technology. Like the centroid files, these .csv's contain only served/covered and not the unserved/uncovered blocks. There are three sets of files in this category.

- i. The first set of files is nationwide .csv files. The data are arranged by block with the 15 digit block FIPS code, state code and columns for the percentage of the block covered by 2G, by 3G, by 4G-non-LTE, and 4G-LTE and percentage of the block covered by any technology. This dataset has one unique row for each census block.
- ii. The second set of files is a nationwide .csv file *by block, by technology, by provider*. This file has the 15 digit block FIPS codes, state code, company identifier (DBA name) and every row is a unique combination of block FIPS, generation technology (2G, 3G, 4G-non-LTE, 4G-LTE, and block covered by any technology) and provide, with the technology column containing the percentage of the block covered by that technology. This dataset has multiple rows per blocks depending on how many providers and technologies are covering each block.
- iii. Both data sets referenced above will have the information produced from the national file disaggregated *by state*. So one could download these files and focus

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<sup>31</sup> The DBA ("Doing Business As") name is the business name of a company. This may differ from the legal name of the company.

on particular states. Again, only covered/ served blocks are contained in the dataset.



## TECHNICAL APPENDIX

### ACTUAL GEOGRAPHIC COVERAGE METHODOLOGY

1. As a pre-processing step, we transferred the “all broadband” and “2G-technology” (codes 85, 86, and 87) voice service area shapefiles to an ArcGIS file Geodatabase (GDB) with the GIS layer names changed to be valid for processing.<sup>32</sup> Next, we performed a validation routine for the provider identifier, *i.e.*, the DBA field.<sup>33</sup> Next, GIS layers were converted from multi- to single parts, GDB layer geometries (split self-intersecting polygons, delete null geometries) were repaired, and Z and M Coordinate values, if present, were removed. We then merged all provider layers into one aggregated layer projected to the Web Mercator (WGS\_1984\_Web\_Mercator\_Auxiliary\_Sphere; WKID: 3857) Coordinate System. We assigned “-1” values to the Voice MinUp and MinDown attributes in the merged provider GDB layer, converted Census 2010 Tiger Block polygon dataset into a GDB layer, re-projected it to the Web Mercator Coordinate System, repaired geometry of the GDB, and calculated area of each block in square meters. We then split the block GDB dataset into subsets by Census Tracts, keeping the Tract boundaries (containing Block polygons) in separate GDBs organized by US States and Territories.

2. We formed the GIS Overlap processing on a state-by-state basis. For each state, we performed the intersect processing at the tract level using the tract-Block GDBs prepared at the pre-processing stage. We began by intersecting the “global” merged provider GDB layer with a census tract GDB (with polygons of Blocks) from a list of tract boundaries within a state. The resultant intersect GDB has DBA, Technology, Spectrum, MinUp, MinDown, plus all Block fields (Block Number, and full Block Area in square meters). Then, we perform the “union” of the various intersect files by provider. The Union GIS operation gets all provider polygons intersected among themselves resulting, in separate polygon “stacks” of providers over a particular area. After the intersect and union, a “Multipart To SinglePart” GIS operation ensures that there is a separate record for each “individual” polygon in the dataset. The last GIS operation is “Repair Geometry,” which implies spatially cleansing the dataset. This final GDB layer table is exported to a .csv file in a state folder. The tract .csv is named with first two letters representing the state abbreviation and an 11-character FIPS number. This is then translated to a census block geometry.

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<sup>32</sup> Any special characters were replaced with underscores. If a file name started with a number, it was preceded with “the”.

<sup>33</sup> The DBA (“Doing Business As”) name is the business name of a company. This may differ from the legal name of the company. The DBA field was validated for being unique and not containing any special characters or white spaces. We also removed quotes from DBA name if present, and deleted all but the required fields (attribute columns, like DBA, Technology, Spectrum, MinUp, and MinDown).