Working Toward Mobility Fund II: Mobile Broadband Coverage Data and Analysis

Wireless Telecommunications Bureau

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I. Introduction

1. The primary goal of the Mobility Fund Phase II (MF-II) established by the Commission in the 2011 *USF/ICC Transformation Order* is to provide ongoing support where needed to expand the availability of mobile voice and broadband services in areas where consumers live, work, and travel.[1] Consistent with the principle of fiscal responsibility underlying its universal service reforms, the Commission proposed to identify areas that need ongoing support by excluding areas where service is provided without high-cost support.[2] In 2014, in light of changes that had occurred since 2011, the Commission proposed that MF-II should focus on expanding the availability of 4G LTE service and that areas eligible for MF-II support should be identified based on data reported on the Commission's new Form 477.[3]

2. This Report reflects Commission staff work toward answering a number of threshold MF-II questions. It describes and analyzes data on mobile broadband coverage based on Form 477 submissions, which will enable the Commission to make fact-based decisions regarding where and how high-cost support should be deployed through the Mobility Fund. In particular, staff has focused its efforts on analyzing the Form 477 data to identify the specific areas that may require support in order to have 4G LTE coverage. In accordance with the Commission's policies for reform of universal service, as reflected in the 2011 and 2014 orders, staff analysis identifies areas within census blocks that do not today have unsubsidized 4G LTE coverage (*i.e.,* 4G LTE coverage provided without any form of high-cost universal service support). This Report presents the most accurate data available on actual areas that currently have 4G LTE coverage, and, based on that data, using assumptions set out below, estimates coverage data within each of the more than 11 million U.S. census blocks in terms of population and road miles. This actual area

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[1]*See Connect America Fund; A National Broadband Plan for Our Future; Establishing Just and Reasonable Rates for Local Exchange Carriers; High-Cost Universal Service Support; Developing a Unified Intercarrier Compensation Regime; Federal-State Joint Board on Universal Service; Lifeline and Link-Up; Universal Service Reform – Mobility Fund;* WC Docket Nos. 10-90, 07-135, 05-337, 03-109, CC Docket Nos. 01-92, 96-45, GN Docket No. 09-51, WT Docket No. 10-208, Report and Order and Further Notice of Proposed Rulemaking, 26 FCC Rcd 17663, 17824, para. 493 (2011) (*USF/ICC Transformation Order and/or FNPRM*).

[2] *USF/ICC Transformation Order and* FNPRM, 26 FCC Rcd 18070-71, paras. 1123-24. *See also Connect America Fund et al.,; 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, 7127-28, para. 239 (2014) (*April 2014 Connect America Order and/or FNPRM*).

[3] *April 2014 Connect America Order and/or FNPRM,* 29 FCC Rcd at 7128-29, paras. 241-42.

coverage approach uses sub-census-block level coverage reported directly by service providers on their Form 477 submissions to get an accurate representation of coverage by providers, rather than using analysis based on proxies for coverage within census blocks, such as the centroid methodology.[4] Using the actual geographic area coverage based on the Form 477 data provides a significantly more detailed basis for reforming universal service support for mobile services to target support where it is needed and thereby further our universal service objectives.

3. This Report first describes the sources of the data underlying our analysis of coverage and subsidies. Next, it describes how the data are used to identify the areas within census blocks that lack unsubsidized 4G LTE coverage. This entails identifying the actual areas where there is 4G LTE coverage, using high-cost support data to determine where 4G LTE is provided without subsidy, and then overlaying the coverage and the support data to identify the actual areas lacking unsubsidized 4G LTE. The resulting analysis, based on actual coverage data and reasonable assumptions, represents the most accurate information available on where universal service support may be needed on an ongoing basis to promote the universal availability of 4G LTE mobile voice and broadband services.

II. Underlying Data

4. This Report relies on three main data sources:
- 4G LTE coverage data provided by carriers in their Form 477 submissions;
- Geographic area, population and road mile data from the Census Bureau; and
- Support data from the Universal Service Administrative Corporation (USAC) and the FCC's website regarding where high-cost universal service support is currently being provided to mobile service providers.

Each of these data sources is explained in greater detail below.

a. Coverage Data

5. 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

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[4] *See* para. 20, *infra*.

broadband coverage data.[5] 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.[6] In 2014, the Commission proposed to use Form 477 mobile deployment data, rather than earlier sources, as it moved forward on mobile broadband universal service issues.[7]

6.   Before the new Form 477 data were available, the Commission relied on coverage data from Mosaik Solutions (formerly known as American Roamer),[8] to define eligible areas for purposes of providing one-time support through reverse auctions under Mobility Fund Phase I (MF-I).[9] While this dataset was one of the best available, it still had various shortcomings. For example, its data are not collected under a consistent methodology across geographic areas and service providers. In addition, Mosaik data are commercially provided subject to intellectual property protections, somewhat limiting their utility in the public policy sphere. The Commission has long expressed concern that Mosaik data, for various reasons, likely overstates the extent of mobile broadband coverage. For instance, in 2010, the Commission's National Broadband Plan relied on American Roamer data with respect to mobile broadband availability, but pointed out that the coverage was likely overstated.[10]

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[5] *See Modernizing the FCC Form 477 Data Program*, Report and Order, 28 FCC Rcd 9887 (2013) (*477 Report & Order*). Also see Form 477 PN 2016.

[6] *See 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*, 2016 Broadband Progress Report, 31 FCC Rcd 699, 708-09 para. 22 (2016) ("[D]ata from the Form 477 . . . help us better analyze mobile broadband deployment than in years past.").

[7] Since that time, the Commission has relied on Form 477 data to analyze mobile deployment outside the universal service context. *See*, *e.g.*, *id.*; *Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993, Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, Including Commercial Mobile Services*, Eighteenth Report, 30 FCC Rcd 14515 (WTB 2015) (*Eighteenth Mobile Competition Report*).

[8] Mosaik Solutions is an independent consulting firm that provides data on the coverage footprints of mobile voice and mobile data networks to the Commission under contract. The company creates coverage boundary maps based on the coverage boundaries voluntarily submitted to Mosaik by mobile wireless network operators. *See generally* Mosaik, About Us, www.mosaik.com (last visited August 24, 2016).

[9] *USF/ICC Transformation Order and/or FNPRM*, 26 FCC Rcd at 17784-85, paras. 333-37.

[10] *See* Federal Communications Commission, *Connecting America: The National Broadband Plan*, at 3.3, 22 (rel. Mar. 16, 2010) (National Broadband Plan). More recently, in the Eighteenth Mobile Competition Report, which was released at the end of 2015, the Wireless Telecommunications Bureau similarly concluded that limitations in the Mosaik data likely overstated the coverage experienced by consumers. This is because Mosaik reports advertised coverage as reported to it by service providers, each of which uses a different definition or determination of coverage. The data do not expressly account for factors such as signal strength, bit rate, or in-building coverage, and may convey a false sense of consistency across geographic areas and service providers. *See Eighteenth Mobile Competition Report*, 30 FCC Rcd at 14538, para. 34*; see also Seventeenth Mobile Competition Report,* 29 FCC Rcd at 15332-33 para. 45*; USF/ICC Transformation Order and FNPRM*, 26 FCC Rcd at 17785, para. 336 (referring to comments observing that Mosaik data may over report the extent of coverage).

7.   In light of the limitations of the Mosaik data and the importance of using the most accurate coverage data available for targeting universal service support, the Commission proposed in 2014 to use Form 477 deployment data as the basis for determining eligibility for MF-II. [11] The Form 477 revisions adopted the previous year, among other things, enhanced the reliability of the data collected by requiring that deployment shapefiles depict "the coverage boundaries where, according to providers, users should expect the minimum advertised upload and download data speeds associated with [a] network technology," such as LTE.[12] Providers were also required to certify as to the accuracy of the data submitted.[13]

8.   More specifically, the new Form 477 collects network deployment data for fixed and mobile broadband as well as mobile voice network deployment data.[14] There is a single, uniform filing format for the shapefiles submitted by mobile broadband and mobile voice providers showing their network coverage areas, which reduces the potential for distortion or misleading comparisons of the data. All facilities-based broadband providers are required to file data using Form 477 with the FCC twice a year identifying areas where they offer Internet access service at speeds exceeding 200 kbps in at least one direction. Specifically, 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), each facilities-based mobile broadband provider submits polygons representing its nationwide coverage area (including U.S. territories) of that technology. While these coverage data provide the most accurate depiction the Commission has on the deployment of mobile networks, they do not indicate the extent to which providers affirmatively offer service to residents in the covered areas.

b. Census Block Level Data

9.   This Report uses data published by the U.S. Census Bureau regarding land area, total area, road miles and population (or "pops") for every census block. These data are based on the 2010 Census and exclude all water-only blocks. There are 10,619,346 blocks in the US with a total population

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[11] *April 2014 Connect America Order and/or FNPRM,* 29 FCC Rcd at 7128, para. 241.

[12] *See 477 Report and Order*, 28 FCC Rcd 9887, 9908-09, para. 42.

[13] *See id.*, 28 FCC Rcd at 9897-98, paras 23-24. (noting that the certification obligation will help promote complete and accurate data).

[14] *See* Form 477 Mobile Wireless Data Report, July 2016 available at:

of 313 million. These comprise 3.54 million square miles of land area. Excluding Alaska,[15] there are 10,592,327 blocks and 312 million pops and 2.97 million square miles of land area.

10. For road mile data, this Report uses the same six categories of roads that were used in MF-I Auction 901, based on Census Bureau's TIGER database.[16] At that time, Commission staff determined in response to filings by interested parties that these six categories included the important types of roads in rural areas and thus well represented the roads where people live, work, and travel.[17] The use of the six categories promoted parity among the states for eligible road miles, in light of the differences between states in the manner in which they classify their roads.[18] Including Alaska, there are 6.82 million road miles in the U.S. based on the six categories listed below. Excluding Alaska, there are 6.79 million road miles in the U.S. For purposes of MF-I, Commission staff assigned road miles to census blocks so as to prevent double counting, *e.g.,* where a road forms the boundary between two census blocks, and this Report uses those data.[19] Commission staff has not yet mapped the roads within each census block, but anticipates doing so for purposes of obtaining more accurate data on the coverage of road miles. The descriptions of the road mile categories included in this Report's analysis are shown in the following table.

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[15] We note that the Commission recently adopted a comprehensive plan for providing high-cost support to mobile providers in Alaska. Because the plan provides a comprehensive substitute mechanism for mobile high-cost support, the Commission provided that there would be no support provided under Mobility Fund Phase II or Tribal Mobility Fund Phase II for mobile service within Alaska. *See Connect America Fund; Universal Service Reform – Mobility Fund*, WC Docket No. 10-90, WT Docket No. 10-208, Report and Order and Further Notice of Proposed Rulemaking, FCC 16-115, para. 98 (rel. Aug. 31, 2016) (*Alaska Plan Order*).

[16] U.S. Census Bureau, MAF/TIGER Feature Class Code Definitions, https://www2.census.gov/geo/pdfs/maps-data/data/tiger/tgrshp2009/TGRSHP09AF.pdf (last visited Sept. 28, 2016).

[17] Mobility Fund Phase I Auction Scheduled for September 27, 2012; Notice and Filing Requirements and Other Procedures for Auction 901, Public Notice, AU Docket No. 12-25, DA 12-641, 27 FCC Rcd 4725, para.24 (2012) (*Auction 901 Procedures Public Notice*).

[18] *Id.*

[19] *See Mobility Fund Phase I Auction; Release of Files with Recalculated Road Miles for Auction 901; Mock Auction Rescheduled for September 21, 2012,* Public Notice (DA 12-1446) rel. Sept. 7, 2012.

Table 1

Road Categories, Descriptions, and Total Miles in Eligible Census Blocks

MTFCC	Feature Class	Feature Class Description
S1100	Primary Road	Primary roads are generally divided, limited-access highways within the interstate highway system or under state management, and are distinguished by the presence of interchanges. These highways are accessible by ramps and may include some toll highways.
S1200	Secondary Road	Secondary roads are main arteries, usually in the U.S. Highway, State Highway or County Highway system. These roads have one or more lanes of traffic in each direction, may or may not be divided, and usually have at-grade intersections with many other roads and driveways. They often have both a local name and a route number.
S1400	Local Neighborhood Road, Rural Road, City Street	Generally a paved non-arterial street, road, or byway that usually has a single lane of traffic in each direction. Roads in this feature class may be privately or publicly maintained. Scenic park roads would be included in this feature class, as would (depending on the region of the country) some unpaved roads.
S1500	Vehicular Trail (4WD)	An unpaved dirt trail where a four-wheel drive vehicle is required. These vehicular trails are found almost exclusively in very rural areas. Minor, unpaved roads usable by ordinary cars and trucks belong in the S1400 category.
S1640	Service Drive usually along a limited access highway	A road, usually paralleling a limited access highway,that provides access to structures along the highway. These roads can be named and may intersect with other roads.
S1740	Private Road for service vehicles (logging, oil fields, ranches, etc.)	A road within private property that is privately maintained for service, extractive, or other purposes. These roads are often unnamed.

Source: *Auction 901 Procedures Public Notice,* Attachment B. https://www.fcc.gov/document/mobility-fund-auction-procedures-and-filing-requirements.

c. High-Cost Support Data

11. The Universal Service Fund (USF) provides support to carriers through the High Cost Program in order to preserve and advance voice and broadband service. Currently, there are two types of high-cost support provided to eligible mobile service providers (also referred to as competitive eligible telecommunications carriers or CETCs).[20] The first is the ongoing high-cost support regime, as modified by the *USF/ICC Transformation Order*; the second is the one-time support provided under MF-I, which was established by the *USF/ICC Transformation Order*. This Report's analysis reflects disbursements pursuant to both high-cost support mechanisms, described below.

12. Prior to the *USF/ICC Transformation Order*, competitive eligible carriers, including mobile service providers received high-cost support pursuant to the "identical support rule" in study areas where the costs of providing service were relatively high.[21] The level of support per wireless subscriber was based on the per-line support provided to the incumbent wireline provider. The *USF/ICC Transformation Order* eliminated the identical support rule, on grounds that it "fails to efficiently target support where it is needed;"[22] "bear[s] no relation to the efficient cost of providing mobile service"[23] and does not provide appropriate incentives to bring service to new markets.[24] Instead, the Commission provided for explicit support for mobility under the Mobility Fund.[25] In shifting from the existing high-cost support program to the new Mobility Fund framework, the Commission established a transitional framework to reduce the level of ongoing legacy CETC support over a period of years as the new universal service support mechanisms were put in place.[26] Pursuant to that framework, legacy CETC support continues to be provided at

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[20] Note that there are a certain number of CETCs that provide fixed, rather than mobile, service. Data regarding subsidies provided to fixed CETCs are excluded from this analysis.

[21] By statute, only providers that have been designated eligible telecommunications carriers (ETCs) may receive universal service support. A provider that is designated an ETC must provide the services supported in accordance with the terms of the specific universal service mechanism under which the support is received, and do so throughout the service area for which it is designated an ETC. *See* 47 U.S.C. §§ 214(e) and 254(e). USAC generally refers to a provider's service area as its "study area."

[22] *USF/ICC Transformation Order and/or FNPRM*, 26 FCC Rcd at 17827, para. 502.

[23] *Id.*, 26 FCC Rcd at 17828, para. 504.

[24] *Id.* at para. 505.

[25] *Id.*, 26 FCC Rcd at 17827-17830, paras. 502-11.

[26] *Id.*, 26 FCC Rcd at 17830-17833, paras. 513-22.

levels that are 60 percent of the amounts being received as of December 31, 2011, regardless of the number of subscribers in a CETC's study area.[27]

13. Data regarding CETC support was obtained from USAC. This annual company-level dataset shows the amount of support that each eligible mobile service provider receives in a particular study area in a state. The USAC data include the study area name and study area code (SAC) and the total amount of support that a CETC receives in a given study area.

14. For the US, including Alaska, the USAC data show approximately $575 million in annual legacy support currently going to wireless CETCs. Excluding Alaska, which receives approximately $105 million annually, this figure is currently around $470 million. Of that amount, Mississippi receives the greatest share of support ($87 million), with Puerto Rico receiving the next largest share ($79 million). By contrast, Oregon and West Virginia receive $11 million and $8.7 million respectively, and Montana and Idaho each receive approximately $5 million. The top 5 companies[28] receiving ongoing CETC support account for approximately two-thirds of total support provided, with the largest recipient being AT&T, which receives approximately $160 million in annual support.

15. An eligible mobile service provider may also be entitled to receive support pursuant to MF-I. MF-I provided one-time support for the deployment of 3G or 4G mobile networks (including 4G LTE) where such coverage was not available, including support dedicated to Tribal lands.[29] MF-I support data are obtained both from USAC and from the FCC's publicly available auction website, which lists all the winning bidders along with the amount of winning bids and the associated census blocks.[30]

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[27] *See id.* at para. 519. Separate rules applied to the receipt of CETC support in Alaska. *See Alaska Plan Order*, FCC 16-115 at para. 66 *et seq.*

[28] USAC reports the amounts of ongoing legacy support on a CETC-specific basis. For purposes of this Report, Commission staff has aggregated support received by affiliated CETCs. Staff identifies affiliated companies by tracking the filings of mobile wireless providers in connection with transactions over the years. We match each provider identifier up with the holding company names to create a dataset with unique company identifiers is created. This involves tracking all transactions (mergers, sales etc.) of mobile wireless providers and attributing various entities to their appropriate parent companies after the transactions are consummated. We then merge the shapefiles for these companies and their affiliates to create aggregated coverage shape files (by technology) for the parent entity.

[29] *Id.*, 26 FCC Rcd at 17674, 17773-34, 17819-20, paras. 28, 301, 481.

[30] Federal Communications Commission, Summary for Auction 901, http://wireless.fcc.gov/auctions/901 (last visited August 29, 2016); Federal Communications Commission, Summary for Auction 902, http://wireless.fcc.gov/auctions/902 (last visited August 29, 2016).

III. Identifying Areas Within Census Blocks Lacking Unsubsidized 4G LTE

16. As noted earlier, the primary goal of MF-II is to provide ongoing support where needed to expand the availability of mobile voice and broadband services. For this purpose, the Commission has proposed to target MF-II primarily to expand 4G LTE (or LTE) service to areas that lack such service and to preserve such service where it is provided only on a subsidized basis.[31] To identify these areas, staff overlaid Form 477 coverage data with corresponding support data to determine, on a block-by-block basis, which blocks were entirely served by 4G LTE without subsidy, and which ones lacked such service – either in whole or in part.

17. At a high level, the process worked as follows. Using the Form 477 shape files described above, and census block boundaries, staff derived each provider's actual LTE coverage area for each census block. This enabled staff to identify census blocks with 100 percent 4G LTE coverage, as well as the percentage of 4G LTE coverage by area in census blocks where there is less than 100 percent coverage. It also allowed staff to overlay a provider's 4G LTE coverage data with the USAC support data by study area to determine the area(s) where that provider's 4G LTE coverage is currently being subsidized. By comparing that information across all providers of 4G LTE coverage in a census block, staff identified those census blocks that lacked unsubsidized 4G LTE, either in whole or in part. Below we describe this process in more detail.

a. Using the Actual Area for 4G LTE Coverage Analysis

18. This section discusses our evaluation of the actual area and percentage of 4G LTE coverage within a census block. By overlaying the carrier-certified data included in the Form 477 shape files with census block geographies, staff determined the actual area of 4G LTE coverage within each block by each provider of the service. By aggregating the provider-specific data, staff identified the set of blocks that, on an actual area basis, are 100 percent covered by 4G LTE, as well as the actual area of 4G LTE coverage within each block with less than 100 percent 4G LTE coverage.

19. Staff then calculated the actual area coverage as a percentage of the total area of each census block. For purposes of this Report, staff then applied that percentage to the total population and road miles to estimate coverage based on those metrics for each block. Staff assumed, in a given

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[31] *USF/ICC Transformation Order,* 26 FCC Rcd at 10875, para. 1142; *April 2014 Connect America Order and/or FNPRM.* 29 FCC Rcd at 7128-29, paras. 240-42.

census block, that the proportion of population and road miles covered is the same as the proportion of the area covered, i.e., that population and roads are uniformly distributed throughout the area of a census block.. For example, if 90 percent of the land area of a block is covered by LTE, staff assumed that 90 percent of the population, as well as 90 percent of the road miles, in the block are covered by LTE. This proportional approach provides an approximation of the actual road miles and population covered. Staff anticipates that it can use Census Bureau data to establish the actual covered road miles in a MF-II reverse auction. For population, staff is not aware of any equivalent publicly-available data on the distribution of population, or households, at a sub-census-block level, so staff is not able to distribute population more precisely within census blocks.

20. In contrast to the actual area approach employed here, the Commission utilized a different methodology – based on the centroid of a census block – to assess coverage to determine eligibility for MF-I. This method considered a census block as covered if the center point (the "centroid" as it is commonly called, or "internal points" in Census Bureau terminology) of the census block, as published by the Census Bureau, lies within the coverage polygon.[32] If a centroid is covered, then all of the land area, population and road miles in the corresponding census block are also coded as covered. This methodology has some limitations.

21. Importantly, the centroid method is an approximation of coverage based on a single geographic point in each census block, whereas the approach taken here reflects actual coverage. As noted in several Mobile Wireless Competition Reports, the centroid methodology has the potential to overstate coverage in certain blocks,[33] especially in large or irregularly shaped blocks. [On the other hand, it may undercount coverage for other blocks, that is, blocks that have a partial area coverage that does not happen to include the centroid of the block.] Such inaccuracies raise particular concerns where, as is the case for MF-II, the Commission seeks to target support only to areas that need it and data accuracy, on a granular basis, is important. Because it can identify

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[32]http://www.census.gov/geo/maps-data/data/gazetteer2010.html. These files contain the latitude and longitude of the centroid at the block level. The latitude/longitude coordinate is approximately the geographic center of the geographic entity (e.g., county, place, etc) and is also referred to as the internal point of the entity. The Census Bureau calculates an internal point (latitude and longitude coordinates) for each geographic entity. For many geographic entities, the internal point is at or near the geographic center of the entity. For some irregularly shaped entities (such as those shaped like a crescent), the calculated geographic center may be located outside the boundaries of the entity. In such instances, the internal point is identified as a point inside the entity boundaries nearest to the calculated geographic center and, if possible, within a land polygon.

[33] See e.g., *Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993; Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, Including Commercial Mobile Services*, WT Docket No. 15-125, Eighteenth Report, 30 FCC Rcd 14515, para. 34 (WTB 2015).

specific areas *within* each census block where 4G LTE coverage is absent, the actual area coverage approach is a significant improvement over the centroid method in reaching our universal service goals. It is a far more precise way to target our MF-II budget, even though we currently approximate the unserved road miles and population in those unserved areas.

22. Tables 2a and 2b include some metrics based on this analysis of LTE coverage for the US, excluding Alaska. Table 2a presents data on the extent of LTE coverage in those areas. These figures are current best estimates and are subject to revision as updated data are available. For instance, population and road miles figures are based on uniformly distributing 2010 census population and road miles within each census block and not on actual distributions of population and roads in a block. The specific percentages shown represent the percentage that a particular number comprises of the total in the first row of that particular column. For instance, 67.8% of road-miles uncovered by LTE are in census blocks with partial LTE coverage. Table 2b mirrors Table 2a and presents data on the extent of LTE coverage for Tribal areas[34] excluding Alaska. Again, the specific percentages shown represent the percentage that a particular number comprises of the total in the first row of that particular column. For instance, 52.8% of road-miles uncovered by LTE are in census blocks with partial LTE coverage.

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[34] *See* Tribal Mobility Fund Phase I Auction Rescheduled for December 19, 2013; Notice and Filing Requirements and Other Procedures for Auction 902, *Public Notice*, AU Docket No. 13-53, DA 13-1672, paras. 17-23, 28 FCC Rcd 11628, 11635-38 (2013) (*Auction 902 Procedures Public Notice*).

US Coverage Analysis (Excluding Alaska): LTE Coverage

	Blocks	Pop. Density	Area (sq mi)	Road Miles	Population	LTE Covered Area (sq mi)	LTE Uncovered Area (sq mi)	LTE Covered Road Miles	LTE Uncovered Road Miles	LTE Covered Population	LTE Uncovered Population
Blocks With Complete LTE Coverage	10,025,526 94.6%	165	1,864,053 62.9%	5,474,988 80.6%	308,046,217 98.7%	1,864,053 74.4%	N/A	5,474,988 87.8%	N/A	308,046,217 99.1%	N/A
Blocks With Partial LTE Coverage	351,511 3.3%	3	1,008,007 34.0%	1,137,707 16.8%	3,377,520 1.1%						
Covered						642,543 25.6%		759,838 12.2%		2,656,594 0.9%	
Uncovered							365,464 77.8%		377,869 67.8%		720,926 50.3%
Blocks With No LTE Coverage*	215,920 2.0%	7	104,007 3.5%	179,411 2.6%	712,524 0.2%		104,404 22.2%		179,411 32.2%		712,524 49.7%

Note: Based on Form 477 December 2015 coverage data. 2010 Census data on population and road miles. Blocks exclude Alaska and water-only blocks. 100% service is actually calculated as 99.9% service to take coverage bleed into account.

*This includes blocks with no mobile service and blocks with less than LTE coverage.

Table 2b

Tribal Coverage Analysis (Excluding Alaska): LTE Coverage

	Blocks	Pop. Den-sity	Area (sq mi)	Road Miles	Population	LTE Covered Area (sq mi)	LTE Uncovered Area (sq mi)	LTE Covered Road Miles	LTE Uncovered Road Miles	LTE Covered Population	LTE Uncovered Population
	359,605	22	163,924	303,081	3,582,934	127,836	36,088	251,581	51,501	3,461,007	121,927
Blocks With Complete LTE Coverage	300,912	41	83,202	204,184	3,372,535	83,202		204,184		3,372,535	
	83.68%		50.76%	67.37%	94.13%			81.16%		97.44%	
Blocks With Partial LTE Coverage	24,981	2	70,053	74,605	125,095						
	6.95%		42.73%	24.62%	3.49%						
Covered						44,635		47,397		88,474	
						34.92%		18.84%		2.56%	
Uncovered							25,418		27,209		36,621
							70.43%		52.83%		30.04%
Blocks With No LTE Coverage*	33,712	8	10,670	24,292	85,304		10,669		24,291		85,304
	9.37%		6.51%	8.01%	2.38%		29.57%		47.17%		69.96%

Note: Based on Form 477 December 2015 coverage data. 2010 Census data on population and road miles. Tribal Blocks exclude Alaska and water-only blocks. 100% service is actually calculated as 99.9% service to take coverage bleed into account.

*This includes blocks with no mobile service and blocks with less than LTE coverage.

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b. Identifying Areas where LTE is Provided on an Unsubsidized Basis

23. This section discusses the methodology used to determine areas where 4G LTE coverage is provided on an unsubsidized basis, based on existing distribution of universal service support. To identify these areas, staff overlaid 4G LTE coverage data from the Form 477 with high-cost support data from USAC, along with the census blocks covered by MF-I winning bids. Staff conducted two separate assignments of support based on how universal service support is currently disbursed and then aggregated the data.[35]

24. To assign ongoing legacy CETC support, staff overlaid each provider's LTE coverage areas with the geographies of the study areas in which the provider is receiving support and treated the area of overlap as subsidized LTE coverage. For example, if the study area for which a wireless provider is receiving ongoing legacy support[36] comprises 100 census blocks, but its LTE coverage includes parts or all of only 80 blocks, then its actual LTE coverage areas within those 80 blocks would be considered subsidized.

25. In considering MF-I support, staff treated service as subsidized in any eligible census blocks in the census tracts for which the provider was awarded support through the MF-I auctions to provide either 3G or 4G service.[37]

26. A provider's coverage in any areas that do not fall within those support categories is treated as unsubsidized. Staff then compared those unsubsidized coverage areas with the LTE coverage areas reported on the Form 477 submissions.

c. Identifying Blocks Lacking 100% Unsubsidized LTE Coverage

27. Once support was assigned geographically for each provider, staff examined for each census block the actual LTE coverage of all the providers to determine whether there is at least one provider of unsubsidized LTE coverage in every part of the census block. Staff classified as lacking 100 % unsubsidized LTE any census block with less than 100% LTE coverage as well as any census

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[35] *See* Methodology Appendix, *supra*, for details.

[36] *See* Methodology Appendix, *supra*, for details.

[37] *See, infra.* n. 27; *see also USF/ICC Transformation Order*, 26 FCC Rcd at 18070, para. 1124 n. 2247 (noting that any provider offering 3G or better service in an area for which it is receiving MF-I support, would not be considered unsubsidized for purposes of MF-II). Blocks where MF-I subsidy may not have been authorized or disbursed due to non-fulfilment of certain obligations, but were covered by winning bids in the auctions, are treated as subsidized blocks for the winning bidder.

block with 100% LTE coverage if the coverage of some portion of the block is provided only by a subsidized provider.

i. US Analysis Excluding Alaska

28. Tables 3- i and 3-ii show data resulting from staff analysis of provider-specific LTE coverage information overlaid with areas where specific provider(s) of LTE receive high-cost support, as described above. As set out in these Tables, the analysis identifies the degree to which 4G LTE coverage is not being provided on an unsubsidized basis. The results show that, overall, areas with no LTE coverage or where LTE is provided only on a subsidized basis cover:

   a. Approximately 575,000 square miles (19% of total area);

   b. Approximately 755,000 road miles (11% of total road miles); and

   c. Approximately 3.1 million people (1% of total population).

29. In addition to providing these overall metrics, Tables 3-i and 3-ii provide separate metrics on the two component parts – that is, the extent to which LTE coverage is not available, as well as the extent to which LTE coverage currently is provided only with universal service support. For example, Table 3-ii shows that of the approximately 3.1 million people in areas with no LTE or only subsidized LTE, 1.4 million have no LTE coverage, while another 1.7 million live in areas where LTE coverage is provided only on a subsidized basis. Tables 3-i and 3-ii similarly show that LTE coverage is provided only on a subsidized basis in a total area of 105,000 square miles, covering approximately 200,000 road miles, with the remaining uncovered area and road-miles falling in areas with no LTE coverage.

Table 3-i

US Coverage Analysis (Excluding Alaska): Analysis of LTE Network Coverage and Current Universal Service Support Area Coverage

	Blocks	Pop. Den.	Area (sq mi)	Road Miles	Population	Area with Unsubsidized LTE Coverage	Area with No LTE Coverage	Area with Only Subsidized LTE	Totals - Areas with No LTE or Only Subsidized LTE Coverage
	10,592,327	105	2,965,291	6,792,106	312,136,261	2,114,150	469,470	104,595	
Blocks WITH Complete LTE Coverage and No Subsidized Provider of Any Mobile Service	6,469,519	198	1,080,916	3,338,300	213,496,098	1,080,916			
	61.1%		36.5%	49.1%	68.4%	51.1%			
Blocks WITH Less than Complete LTE Coverage, or WITH At Least One Subsidized LTE Provider	4,122,808	28	1,884,375	3,453,806	98,640,163	1,033,234	469,470	104,595	574,065
	38.9%		63.5%	50.9%	31.6%	48.9%	100.0%	100.0%	100.0%
Blocks With *NO LTE SERVICE*	215,290	7	104,007	179,411	712,524		104,007		104,007
	2.0%		3.5%	2.6%	0.2%		22.2%		18.1%
Blocks With *LESS THAN 100% LTE Coverage*	351,511	3	1,008,007	1,137,707	3,377,520	517,903	365,463	47,247	412,710
	3.3%		34.0%	16.8%	1.1%	24.5%	77.8%	45.2%	71.9%
Blocks With *100% LTE COVERAGE, BUT WITH AT LEAST ONE SUBSIDIZED LTE PROVIDER*	3,556,007	121	783,137	2,136,688	94,550,119	515,331		57,348	57,348
	33.6%		26.4%	31.5%	30.3%	24.3%		54.8%	10.0%

Note: Based on Form 477 December 2015 coverage data. 2010 Census data on population and road miles. Subsidy data is from USAC's December 2015 High-cost database and MF-I auction data. Blocks exclude Alaska and water-only blocks. 100% service is actually calculated as 99.9% service to take coverage bleed into account.

Table 3-ii

US Coverage Analysis (Excluding Alaska): Analysis of LTE Network Coverage and Current Universal Service Support
Road Miles and Population Coverage

	Est'd Road Miles in Areas with Unsubsidized LTE Coverage	Est'd Road Miles in Areas with No LTE Coverage	Est'd Road Miles in Areas with Only Subsidized LTE	Totals - Est'd Road Miles in Areas with No LTE or Only Subsidized LTE	Est'd Pops in Areas with Unsubsidized LTE Coverage	Est'd Pops in Areas with No LTE Coverage	Est'd Pops in Areas with Only Subsidized LTE	Totals - Est'd Pops in Areas with No LTE or Only Subsidized LTE
	5,931,116	557,280	198,565		308,465,200	1,433,450	1,656,753	
Blocks WITH Complete LTE Coverage and No Subsidized Provider	3,338,300				213,496,098			
	56.3%				69.2%			
Blocks WITH Less than Complete LTE Coverage, or WITH At least One Subsidized LTE Provider	2,592,816	557,280	198,565	755,845	94,969,102	1,433,450	1,656,753	3,090,203
	43.7%	100.0%	100.0%	100.0%	30.8%	100.0%	100.0%	100.0%
Blocks With *NO LTE SERVICE*		179,411		179,411		712,524		712,524
		32.2%		20.8%		49.7%		23.1%
Blocks With *LESS THAN 100% LTE Coverage*	588,633	377,869	66,060	443,929	1,788,880	720,926	286,857	1,007,783
	9.9%	67.8%	33.3%	63.8%	0.6%	50.3%	17.3%	32.6%
Blocks With *100% LTE COVERAGE, BUT WITH AT LEAST ONESUBSIDIZED LTE PROVIDER*	2,004,183		132,505	132,505	93,180,223		1,369,896	1,369,896
	33.8%		67.7%	15.4%	30.2%		82.7%	44.3%

Note: Based on Form 477 December 2015 coverage data. 2010 Census data on population and road miles. Subsidy data is from USAC's December 2015 High-cost database and MF-I auction data. Blocks exclude Alaska and water-only blocks. Blocks with 100% unsubsidized LTE are those with 100% LTE coverage where there is at least one provider of unsubsidized LTE in every part of the block. 100% service is actually calculated as 99.9% service to take coverage bleed into account.

30. The following provides a more detailed description of the contents of these two tables. The first row in these tables indicate the US total for each of the columns. The second row in these tables separate out those census blocks that have complete LTE coverage, with no provider of LTE coverage receiving a subsidy, *i.e.,* blocks that have 100 percent LTE coverage and receive no subsidies either through CETC support of MF-I support. The third row (and its subcomponents) include those blocks with no LTE coverage as well as those blocks with partial LTE coverage and those with complete LTE coverage but with at least one provider of LTE receiving support. In our analysis of area in Table 3-i, the column totaling the areas where LTE coverage is provided on an unsubsidized basis represents LTE coverage that presumptively has no need for ongoing MF-II support. The column totaling the areas with no LTE coverage, when combined with the column totaling the areas where the only LTE coverage is by a provider(s) receiving support, yield the final column identifying those areas where the provision of ongoing subsidy may be needed – either to expand LTE coverage where it is not available today or potentially to continue provision of LTE coverage provided today only on a subsidized basis. Table 3-i provides the same analysis for road miles and pops.

ii. Tribal Analysis (Excluding Alaska)

31. Tables 4-i and 4-ii mirror Tables 3-i and 3-ii and show data resulting from staff analysis of the LTE coverage information overlaid with areas of eligibility for current high-cost support for Tribal census blocks. As set out in these Tables, the analysis indicates that overall, areas with no LTE or LTE provided only on a subsidized basis cover:

    a. Approximately 42,000 square miles (26% of total Tribal area);

    b. Approximately 62,000 road miles (13% of total Tribal road miles); and

    c. Approximately 174,000 people (5% of total Tribal population).

32. Again, on a more disaggregated basis, Table 4-i shows that of the 174,000 people in areas with no LTE coverage or only subsidized LTE coverage, 122,000 have no LTE coverage, while another 52,000 live in areas where LTE coverage is provided only on a subsidized basis. And Tables 4-i and 4-ii show that such coverage is provided only on a subsidized basis in 5,800 square miles, covering 10,400 road miles, with the remainder falling in areas with no LTE coverage.

Table 4-i

Tribal Coverage Analysis (Excluding Alaska): Analysis of LTE Network Coverage and Current Universal Service Support Area Coverage

	Blocks	Pop. Den.	Area (sq mi)	Road Miles	Population	Area with Unsubsi-dized LTE Coverage	Area with No LTE Coverage	Area with Only Subsidized LTE	Totals - Areas with No LTE or Only Subsidized LTE Coverage
	359,605	22	163,924	303,081	3,582,934	82,276	36,088	5,844	41,932
Tribal Blocks WITH Complete LTE and No Subsidized Provider	125,636	20	41,362	92,429	811,460	41,362			
	34.94%		25.23%	30.50%	22.65%	50.27%			
Tribal Blocks WITH Less than Complete LTE Coverage, or WITH At least One Subsidized LTE Provider	233,969	8	122,563	210,652	2,771,474	40,915	36,088	5,844	41,932
	65.06%		74.77%	69.50%	77.35%	49.73%	100%	100%	100%
Blocks With *NO LTE SERVICE*	33,712	8	10,670	24,292	85,304		10,670		10,670
	9.37%		6.51%	8.01%	2.38%		29.57%		25%
Blocks With *LESS THAN 100% LTE Coverage*	24,981	2	70,053	74,605	125,095	36,883	25,418	3,673	29,091
	6.95%		42.73%	24.62%	3%	44.83%	70.43%	62.85%	69%
Blocks With *100% LTE COVERAGE, BUT WITH AT LEAST ONE SUBSIDIZED LTE PROVIDER*	175,276	61	41,840	111,755	2,561,075	4,032		2,171	2,171
	48.74%		25.52%	36.87%	71.48%	4.90%		37.15%	5%

Note: Based on Form 477 December 2015 coverage data. 2010 Census data on population and road miles. Subsidy data is from USAC's December 2015 High-cost database and MF-I auction data. Tribal blocks exclude Alaska and water-only blocks. 100% service is actually calculated as 99.9% service to take coverage bleed into account.

Table 4-ii

Tribal Coverage Analysis (Excluding Alaska): Analysis of LTE Network Coverage and Current Universal Service Support

	Est'd Road Miles in Areas with Unsubsidized LTE Coverage	Est'd Road Miles in Areas with No LTE Coverage	Est'd Road Miles in Areas with Only Subsidized LTE	Totals - Est'd Road Miles in Areas with No LTE or Only Subsidized LTE	Est'd Pops in Areas with Unsubsidized LTE Coverage	Est'd Pops in Areas with No LTE Coverage	Est'd Pops in Areas with Only Subsidized LTE	Totals - Est'd Pops in Areas with No LTE or Only Subsidized LTE
	136,844	51,501	10,395	61,896	917,518	121,927	52,011	173,938
Tribal Blocks WITH Complete LTE Coverage and No Subsidized Provider	92,429				811,460			
	67.54%				88.44%			
Tribal Blocks WITH Less than Complete LTE Coverage, or WITH At least One Subsidized LTE Provider	44,416	51,500	10,395	61,895	106,059	121,927	52,011	173,937
	32.46%	100.00%	100%	100%	11.56%	100%	100%	100%
Blocks With *NO LTE SERVICE*		24,292		24,292		85,304		85,304
		47.17%		39%		69.96%		49.04%
Blocks With *LESS THAN 100% LTE Coverage*	37,598	27,209	4,746	31,954	70,199	36,621	6,159	42,780
	27.48%	52.83%	45.65%	52%	7.65%	30.04%	11.84%	24.60%
Blocks With *100% LTE COVERAGE, BUT WITH AT LEAST ONESUBSIDIZED LTE PROVIDER*	6,817		5,649	5,649	35,859		45,853	45,854
	4.98%		54.35%	9.13%	3.91%		88.16%	26.36%

Note: Based on Form 477 December 2015 coverage data. 2010 Census data on population and road miles. Subsidy data is from USAC's December 2015 High-cost database and MF-I auction data. Tribal blocks exclude Alaska and water-only blocks. 100% service is actually calculated as 99.9% service to take coverage bleed into account.

IV. Methodology for Allocating Legacy CETC and MF-I Support Amounts

33. Certain MF-II-related analyses may require allocating specific amounts of current high-cost legacy CETC disbursements and MF-I support to particular census blocks. For instance, in many of the geographic areas in which CETCs currently receive legacy ongoing support, there is provision of 4G LTE on an unsubsidized basis by other providers. It is not reasonable to assume that every dollar of CETC support being provided to a recipient for its entire wireless study area is needed to ensure the continuation of LTE coverage in those portions of the study area that lack unsubsidized LTE coverage. As discussed in the previous section, staff has identified for each provider the census blocks in which its LTE coverage is currently being subsidized. Here staff describes its methodology for allocating the support dollars being received among the census blocks in the area receiving support.

34. As described above, ongoing legacy CETC support is a continuation of support that had been based on the number of subscribers anywhere in that area. The support provided was not associated with mobile coverage of any particular census blocks within that area. As a result, staff has to make certain assumptions to allocate this support to blocks.

35. We allocate CETC dollars using three different metrics for allocating support among blocks – covered population, covered road miles, covered area. Below we discuss the rationale for each in brief. Given that high-cost support was originally provided on a per-subscriber basis, we first use population to allocate the amount of a provider's support among individual census blocks based on estimates of covered population. To estimate covered population in each block, staff multiplied the fraction of the area covered by the subsidized carrier by the population of the block. Then for each wireless study area receiving support, staff allocated a provider's legacy support among blocks based on the fraction of estimated covered population in each block relative to the total covered population in the entire study area.

36. For example, assume a study area of CETC entity X is composed of three blocks, A, B and C. For this study area, X receives $100. In Block A, there are four people, with 75% covered by any type of technology by X. In Block B, there are five people, with 80% covered by any type of technology by X. And in block C, there are seven people with 50% covered by any type of technology by X. Total coverage in the SAC is estimated to be 75%*4+80%*5+50%*7=10.5

people, or 3 people in Block A, 4 people in Block B, and 3.5 people in Block C. Thus, 28.57% of the total estimated population falls in Block A (3/10.5); 38.10% falls in in Block B (4/10.5), and 33.33% falls in Block C (3.5/10.5). With $100 in total support, this translates to $28.57 assigned to A, $38.10 assigned to B and $33.33 assigned to C.

37. Staff used a similar approach when using road miles to allocate CETC support. To estimate covered road miles in each block, staff multiplied the fraction of the area covered by the subsidized carrier by the road miles of the block. Then for each wireless study area, staff assigned a provider's legacy support among blocks based on the fraction of estimated covered road miles in each block relative to the total covered road miles in the entire study area. For area, staff used the actual area covered in each block to allocate the support based on the fraction of covered area in each block to the total covered area in the study area.

38. Certain results flowing from all three allocation methodologies are shown in Tables 4a and 4b. Table 4a shows the allocation of support to census blocks based on the extent of LTE coverage (no coverage, partial coverage and full coverage), while Table 4b represents the allocation of support to census blocks that already receive complete unsubsidized LTE coverage from one or more providers. For instance, Table 4a shows that blocks without any LTE service receive less than 1% of CETC support under all three allocation methodologies. In addition, blocks that lack 100% LTE coverage irrespective of subsidy, receive only 2% of the CETC support under the population methodology and 10% and 16% respectively under the road miles and area methodologies.

39. Table 4b shows that under all three metrics, a substantial majority of current ongoing legacy CETC support is allocated to census blocks that already have complete LTE coverage from one or more service providers not receiving any support.[38] For instance, those blocks receive 88.7% of CETC support when the allocation is done using population. The comparable metric is 73.7% when using road miles as the metric and 64.3% when using area.

40. Using each of these methodologies has its own advantages and drawbacks. For instance, when using covered population, zero dollars are assigned to unpopulated blocks although the area and road miles contained in these blocks may have LTE coverage because a provider chooses to cover

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[38] Table 4b's estimates of CETC support to these blocks is a conservative estimate of support being received for areas currently receiving unsubsidized LTE coverage because it does not reflect a sub-block-level analysis. In particular, this estimate does not include any support being received for areas with unsubsidized LTE coverage that are in blocks with less than complete LTE coverage. Certain providers may be receiving support in those blocks even though a provider not receiving any subsidy may provide a substantial portion, or all, of the LTE coverage in the blocks.

roads in that census block. Using covered area to allocate the CETC support has the opposite bias. This methodology has the potential to allocate CETC dollars in blocks that have no road miles and no population. Allocating CETC subsidies by road miles reflects the Commission's approach to the provision of mobile support under MF-I. Based on the road miles methodology, approximately 73.7% of ongoing CETC support is going to blocks with 100% unsubsidized LTE coverage.

41. Winning bids for one-time MF-I support covered the specific number of road miles in the eligible census blocks within particular census tracts on which the bid was placed at auction. As a result, for purposes of this Report, staff allocated MF-I support among census blocks in a tract based on the per-road-mile winning bid for that tract. The distribution of one-time support provided under MF-I differs significantly from that of ongoing legacy support discussed above. For instance, approximately 60% of the MF I support goes to blocks without 100% LTE coverage irrespective of subsidy. And less that 20% of MF-I support is allocated to census blocks that already have complete LTE coverage from one or more service providers not receiving any support.

Table 4a

CETC Subsidy and LTE Coverage (Excluding Alaska)

	Blocks	LTE Uncovered Area (sq mi)	LTE Uncovered Road Miles	LTE Uncovered Population	Using Population	Using Road Miles	Using Area	MMF-I Subsidy
	10,592,327	469,482	557,295	1,433,551	469,733,143	469,733,143	469,733,143	254,617,864
Blocks With No LTE Service*	215,920	104,007	179,411	712,524	3,375,339	3,895,643	3,105,472	15,377,876
	2.04%	22.15%	32.19%	49.70%	0.72%	0.83%	0.66%	6.04%
Blocks Without 100% LTE Service	351,511	365,464	377,869	720,926	9,769,241	46,918,857	75,806,587	151,647,161
	3.32%	77.84%	67.80%	50.29%	2.08%	9.99%	16.14%	59.56%
Blocks with 100% LTE Service	10,025,526				456,588,563	418,918,641	390,821,082	87,592,827
	94.65%				97.20%	89.18%	83.20%	34.40%

Note: Based on Form 477 December 2015 coverage data. 2010 Census data on population and road miles. Subsidy data is from USAC's December 2015 High-cost database and MF-I auction data. Excludes Alaska and water-only blocks. 100% service is actually calculated as 99.9% service to take coverage bleed into account.

Table 4b

US Subsidy Allocation to Blocks Where One or More Providers Offer Unsubsidized LTE Coverage Over the Entire Block (Excluding Alaska)

		Blocks	CETC Subsidy ($)	MMF-I Subsidy ($)
		10,592,327	469,733,143	254,617,864
Blocks with 100% LTE Coverage Provided by One or More Unsubsidized LTE Providers		9,797, 196 ---- 92.49%		49,519,560 ---- 19.44%
CETC Subsidy Allocation Method	By Population		416,478,939 ---- 88.66%	
	By Road Miles		346,046,931 ---- 73.67%	
	By Area		302,162,750 ---- 64.33%	

Note: Based on Form 477 December 2015 coverage data. 2010 Census data on population and road miles. Subsidy data is from USAC's December 2015 High-cost database and MF-I auction data. Excludes Alaska and water-only blocks. 100% service is actually calculated as 99.9% service to take coverage bleed into account.

Methodology Appendix

1. To identify which Census blocks had both 1) coverage by 4G LTE or not and 2) subsidies or not requires an analysis involving both support from the Mobility Fund I program and the CETC legacy support and the Form 477 coverage information.

2. Staff determined coverage in blocks using the shapefiles submitted though Form 477. In Form 477, each carrier submits shapefiles of their U.S. coverage by all of their transmission technologies. These files were overlaid with the Census block shapefiles which allowed staff to calculate the actual area in each block by each carrier covered by a given transmission technology or by any technology. To approximate the amount of population and road miles covered in each block, staff assumed that coverage using these metrics is proportional to the area coverage in the block. So, if a fraction of the block's area is covered by LTE, staff assumes that same fraction of the block's population and road miles is also covered by LTE.

3. Allocating support amounts to particular census blocks is more complex and requires the above calculated coverage information. The identity of the blocks supported in Mobility Fund I are known to staff because the specific blocks eligible for support were identified prior to the assignment of support in Auctions 901 and 902. However, allocating the MF-I support dollar amounts to each block requires further calculation because winning bids covered all of the eligible blocks within a Census tract. To estimate the MF-I support in each eligible block staff followed the procedure described below for each carrier.

    i. First, all eligible blocks with no coverage at all by the carrier in question are ignored. This is based on the assumption that the lack of coverage by the carrier in a block indicates that no subsidy was spent in the block.

    ii. Because road miles were the basis of subsidy assignment in MF-I, staff then calculates the total number of road miles in the remaining eligible blocks for each tract.

    iii. Staff next determines the fraction of road miles in each of the eligible blocks in which the carrier provides coverage relative to the total road miles that were calculated in step two. Staff assumes that this fraction of the total tract support was spent in this block.

4. CETC legacy support is known only at the study area level, a geography much larger than the Census block. Moreover, study areas do not map into any Census geography. To assign CETC support at the block level, the following procedure was used for each carrier.

i. Blocks are assigned to a carrier's study area by first assigning blocks to the wire centers. Although wire centers do not map onto any Census geography exactly, they are more easily matched to blocks than study areas because they are smaller. This matching was done internally by staff manually matching blocks to wire centers. In turn, wire centers can be mapped into study areas, so this allows staff to assign blocks to study areas.[39]

ii. Staff then determines the total of the study area population/ road miles / area covered with any technology by the carrier in question using our previous estimates of covered population/ roadmiles/ area at the block level.

iii. Staff can then find the fraction of covered population/ roadmiles/ area in each block relative to the study area as a whole.

iv. The total high-cost support is then allocated to each block in the study area by the fraction calculated in step 3.

5. WA block (or area within a block) is "subsidized" if it has non-zero support from MF-I or CETC legacy support allocated to it through the process described above. Thus, for this Report, staff counts as subsidized any block (or area within a block) that is:

i. Covered by a winning bid in the MF-I auctions (Auctions 901 and 902) and had non-zero coverage from the corresponding carrier, i.e., the winning bidder; or

ii. In a CETC study area for which support is provided and had non-zero coverage by the corresponding carrier.

6. We note that a block considered "subsidized" in this Report may be allocated zero dollars of support under our methodology for allocating support to specific census blocks when using the population or road miles allocation metric depending on whether the block has zero road miles and/or zero population.

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[39] Note that since wire centers and blocks do not exactly match up, there is double counting of blocks for certain border of wire centers. The above algorithm handles this by summing the predicted subsidies from both high-cost support mechanisms in question.