



September 2021

BROADBAND

FCC Is Taking Steps to Accurately Map Locations That Lack Access

Accessible Version



A Century of Non-Partisan Fact-Based Work

GAO Highlight

Highlights of [GAO-21-104447](#), a report to congressional committees

Why GAO Did This Study

Broadband is critical for commercial, educational, and social functions. While most Americans have access to broadband, many still do not—a gap known as the digital divide. To help close this divide, federal programs provide funding to support broadband deployment in unserved areas. According to FCC, these programs rely on data FCC collects from broadband providers to identify which areas are and are not served to target their limited funds. However, GAO has raised concerns about FCC's data for lacking accuracy and overstating service. FCC has been measuring broadband deployment by counting an entire census block as served if a provider reports that it offers service to at least one location in the census block. This method can overstate the extent of broadband deployment if the data show that a census block has broadband but not all locations in the census block are actually served. FCC began an effort in 2017 to improve its broadband data, and, in 2020, the Broadband DATA Act required FCC to develop a location fabric.

The Broadband DATA Act included a provision for GAO to assess key data sources that may be used to develop a location fabric. This report (1) describes FCC's progress in developing a location fabric; and (2) describes challenges stakeholders identified that FCC faces in developing a location fabric. GAO reviewed relevant documents; surveyed officials in 54 states and territories; and interviewed officials from data companies, broadband providers, federal agencies, and states.

View [GAO-21-104447](#). For more information, contact Andrew Von Ah at (202) 512-2834 or Vonaha@gao.gov.

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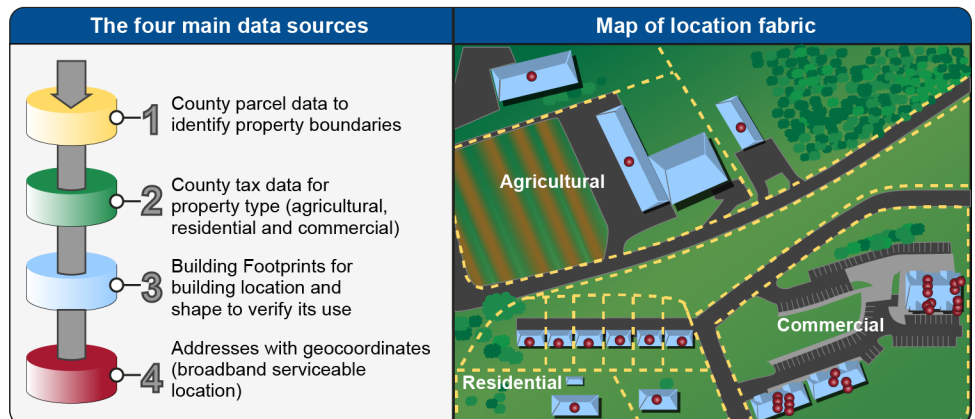
FCC Is Taking Steps to Accurately Map Locations That Lack Access

What GAO Found

The Federal Communications Commission (FCC) was tasked in the 2020 Broadband Deployment Accuracy and Technological Availability Act (Broadband DATA Act) to create a location fabric, which is a dataset of all locations or structures in the U.S. that could be served by broadband, over which broadband deployment data can be overlaid. The purpose of this data collection effort is to improve the granularity and precision of FCC's broadband deployment mapping, which will allow FCC to more precisely assess where Americans still lack access to broadband. As a start, FCC has hired a data architect and met with data companies and states to identify options. FCC has issued a request for proposals for a product to meet FCC's location fabric needs. Additionally, FCC officials said that the data company that generates the location fabric will be responsible for developing a process for state, local, and tribal entities, and others to question and correct fabric location data to improve their accuracy, as required by the law.

Stakeholders GAO interviewed identified challenges FCC faces with developing a location fabric, including incomplete or conflicting data sources, but said that such challenges can be overcome by using multiple sources of data. For example, according to stakeholders, there is no one source of location data that will be sufficient for FCC and its contract data company to develop a precise location fabric; therefore, it is necessary to integrate four main types of data to have a complete location fabric, as shown in the figure. These data can be sourced from federal, state, local, and commercial sources. State-level pilots have shown that overlaying these data increases the accuracy of the location fabric and addresses the limitation that some sources have incomplete data. FCC will need to manage other challenges as well, such as use restrictions.

Figure: Mapping Broadband Serviceable Locations Using the Four Key Data Types



Source: GAO analysis of stakeholder documents. | GAO-21-104447

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Abbreviations

Broadband DATA Act	Broadband Deployment Accuracy and Technological Availability Act
COVID 19	Coronavirus Disease 2019
DOT	Department of Transportation
e911	enhanced 911
FCC	Federal Communications Commission
NTIA	National Telecommunications and Information Administration
USDA	U.S. Department of Agriculture
USPS	U.S. Postal Service

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September 28, 2021

The Honorable Maria Cantwell
Chair
The Honorable Roger Wicker
Ranking Member
Committee on Commerce, Science, and Transportation
United States Senate

The Honorable Frank Pallone, Jr.
Chair
The Honorable Cathy McMorris Rodgers
Republican Leader
Committee on Energy and Commerce
House of Representatives

Access to broadband has become critical for economic opportunity, jobs, education, and civic engagement—as was highlighted during the outbreak of the Coronavirus Disease 2019 (COVID 19), when many in-person activities were replaced by remote activities that relied on broadband access.¹ As we have reported—and media reports continue to highlight—people in unserved and underserved areas, low-income families, some minority groups, and tribal communities are disproportionately affected by a lack of broadband access. This disparity is often referred to as “the digital divide.” Through programs such as the Federal Communications Commission’s (FCC) Universal Service Fund High-Cost Program and the Department of Agriculture’s (USDA) ReConnect program, the federal government provides funding to expand broadband infrastructure, in an effort to close the digital divide.

These programs rely on the broadband availability and quality (i.e. speed) of service data (together “deployment” data) that the FCC collects from broadband providers to target limited funds to areas with the greatest need. Specifically, these broadband deployment data show where broadband is available and where it is not. However, we have previously reported that FCC’s broadband deployment data for fixed broadband—

¹For more information on the COVID-19 pandemic, see GAO, *COVID-19: Sustained Federal Action Is Crucial as Pandemic Enters Its Second Year*, [GAO-21-387](#) (Washington, D.C.: Mar. 31, 2021).

that is, broadband provided to single locations such as customers' homes or businesses—have overstated existing service.² In 2014, FCC began collecting broadband availability data by census blocks.³ The agency counts an entire census block as served if a provider reports that it offers service to even one location in the census block. This method can overstate the extent of broadband deployment, since none of the other locations in that census block may be served. This situation is especially the case in rural areas, where a census block can cover a large geographic area. Having accurate deployment data is critical for programs that rely on FCC's data to make decisions about federal investment to support expanding broadband access. For example, for USDA's ReConnect program, at least 90 percent of households served by projects receiving a loan or grant through the program must be in a rural area without sufficient access to broadband.⁴ If the broadband deployment data used to determine whether those areas are eligible for funding are inaccurate, the ability of those programs to effectively target their funding is jeopardized. In other words, inaccurate deployment data raise the potential for too much—or not enough—federal support to be allocated.

²GAO, *Broadband Internet: FCC's Data Overstate Access on Tribal Lands*, [GAO-18-630](#) (Washington, D.C.: Sept. 7, 2018) and *Broadband: Observations on Past and Ongoing Efforts to Expand Access and Improve Mapping Data*, [GAO-20-535](#) (Washington, D.C.: June 25, 2020). Fixed broadband is in contrast to mobile broadband, which is provided by a wireless network wherever a customer has access to a signal and can connect using a mobile device, such as a smartphone. Mobile broadband is not within the scope of this review, as the Broadband DATA Act's requirements for FCC's location fabric are specific to fixed broadband services.

³A census block is a statistical area bounded by visible features such as roads, streams, and railroad tracks, and by nonvisible boundaries such as property lines, city, township, school district, county limits, and short line-of-sight extensions of roads. They are the building blocks for which the Census Bureau tabulates data.

⁴Section 779 of the Consolidated Appropriations Act, 2018 appropriated \$600 million to USDA to create a pilot program USDA named the ReConnect Program. The statute requires that at least 90 percent of households served by the program be in a rural area without sufficient access to broadband, defined for this pilot program as 10 Mbps downstream, and 1 Mbps upstream, which shall be reevaluated, as necessary, on an annual basis by USDA. Pub. L. No. 115-141, § 779, 132 Stat. 348, 399. The Consolidated Appropriations Act, 2019, Further Consolidated Appropriations Act, 2020, and the Coronavirus Aid, Relief, and Economic Security Act (CARES Act) each appropriated funds to USDA for the ReConnect Program under the same terms and conditions as the original appropriation. Pub. L. No. 116-6, § 762, 133 Stat. 13, 88; Pub. L. No. 116-94, § 787, 133 Stat. 2534, 2657 (2019); Pub. L. No. 116-136, § 11004, 134 Stat 281, 510 (2020). We have ongoing work to examine the ReConnect program.

In 2017, FCC began an effort to improve its broadband deployment data. In 2020, the Broadband Deployment Accuracy and Technological Availability Act (Broadband DATA Act) was enacted, requiring FCC to issue final rules that require twice yearly collection and dissemination of granular broadband deployment data, and to establish processes through which the accuracy of the data can be verified.⁵ The Broadband DATA Act also required FCC to develop a map-ready dataset (i.e., a dataset whose information can be integrated onto a map) of all broadband serviceable locations in the United States and its territories.⁶ Such a dataset, which would contain location data that can be used to pinpoint specific locations in the U.S., is referred to as a location “fabric” in the Broadband DATA Act and does not show where broadband service is deployed, as it does not include any deployment data. Rather, it shows all locations where broadband service could be deployed to provide service, which we will refer to as broadband serviceable locations.⁷ This location fabric, once developed, will serve as the foundation upon which all data relating to fixed broadband deployment data, which are collected separately from providers, shall be reported (and, in the case of reporting that uses shapefiles, overlaid) to show whether there is broadband access at each specific location.⁸ This location fabric will represent a more precise and granular means of mapping existing and needed broadband deployment sites than would be possible through FCC’s current maps because the location fabric will show the availability of broadband to individual locations rather than by Census blocks, as FCC’s data have previously shown.

The Broadband DATA Act included a provision for us to assess key data sources used for purposes of the location fabric to identify and geocode locations where fixed broadband internet access service can be installed. This report (1) describes FCC’s progress in developing a location fabric; and (2) describes challenges stakeholders identified that FCC faces in developing a location fabric.

⁵Pub. L. No. 116-130, § 802(a), 134 Stat. 228, 229-30.

⁶FCC regulations define broadband internet access service as a mass-market retail service by wire or radio that provides the capability to transmit data to and receive data from all or substantially all internet endpoints. 47 C.F.R. § 8.1.

⁷Broadband serviceable locations include homes, businesses, or farms, but not locations like trailheads or buildings where fixed broadband is not needed or may not even be possible due to a lack of electricity.

⁸A shapefile is a file format for storing, depicting, and analyzing geospatial data.

To describe FCC's progress in developing a location fabric, we reviewed relevant statutes, regulations, and our prior work related to broadband mapping, as well as FCC documents and filings in its broadband mapping proceeding, and FCC documents pertaining to the fabric's procurement, such as a request for information about approaches FCC could take in creating the location fabric. We also interviewed FCC officials on their progress with developing the location fabric.

To describe stakeholders' perspectives on the challenges they identified that FCC faces in developing a location fabric, we:

- Identified potential geographic data sources from the federal government, state governments, and the telecommunications industry by reviewing documents from industry and state-sponsored mapping pilots and efforts. We then asked the officials associated with these data sets, as stakeholders knowledgeable about available relevant data, for their perspectives on using similar data sources and methodologies for developing a location fabric similar to FCC's.
- Surveyed all 50 states, the District of Columbia, and three territories to determine whether any states and territories have developed a fabric of locations where broadband could be deployed, or broadband serviceable locations and if so, what data sources these entities used. We identified the state official with broadband leadership responsibilities as the person in each state to survey using a list from the Department of Commerce's National Telecommunications and Information Administration's (NTIA) State Broadband Leadership Network.⁹ We pretested the survey with three state broadband agencies. We received responses from 44 of these entities, representing over an 80 percent response rate.¹⁰ To develop the survey questions, we conducted initial interviews with state broadband officials in Georgia, New York, and South Carolina to discuss their experiences with data collection. We also interviewed officials from Alabama, Arkansas, Colorado, New Mexico, Pennsylvania, Vermont, and Washington, about their experiences as indicated in their survey results. Specifically, we interviewed officials from a selection of states

⁹The State Broadband Leadership Network is organized by the National Telecommunications and Information Administration and consisted of state officials from a variety of state offices, such as the public utility commission and the economic development office.

¹⁰Specifically, we surveyed 54 entities: all 50 states, the District of Columbia, and the territories of American Samoa, Puerto Rico, and the U.S. Virgin Islands. We received responses from 41 states, two territories, and the District of Columbia.

that indicated on their survey that they had a location fabric of broadband serviceable locations. We selected those states whose responses indicated their mapping approaches might have similarities to the approach FCC was pursuing. We also reviewed key literature on the data used for location-fabric development to ascertain the advantages and disadvantages of different potential location fabric data sources to identify the key data sources to include on our survey. We administered the survey from January through April 2021.

- Interviewed officials from FCC, NTIA, and three agencies that maintain national address databases: (1) the Department of Transportation (DOT); (2) the U.S. Postal Service (USPS); and (3) the U.S. Census Bureau. We also conducted semi-structured interviews with representatives from data companies; broadband providers; telecommunications industry associations; and other experts.¹¹ We identified stakeholders with relevant knowledge in broadband deployment mapping from our prior work that discussed broadband deployment data and mapping. These stakeholders are listed by interviewee type in appendix I. We selected the industry providers and associations to represent both large and small broadband providers of different types of technologies for providing broadband. Our interviews with stakeholders are not generalizable to the entire population of possible stakeholders.

We conducted this performance audit from July 2020 to September 2021 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

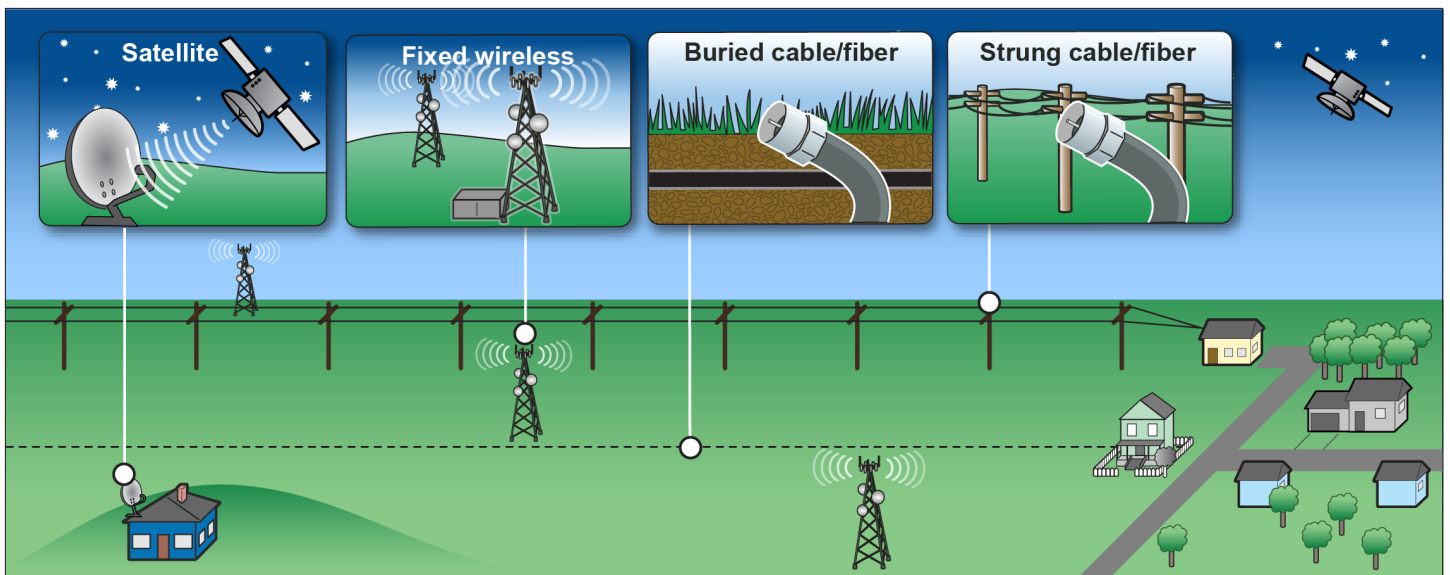
Background

American consumers receive fixed broadband service from telecommunications companies that own and operate cable, fiber, terrestrial fixed-wireless technologies, or satellite technologies that provide broadband access to single locations such as customers' homes

¹¹We spoke to three other experts in order to gain more background and context. One of these stakeholders researches broadband policy, another stakeholder is an academic who leads geospatial information projects, and the third advocates on behalf of communities to improve their broadband access.

or businesses (see fig. 1). Such service typically ensures quick availability. In 2015, the FCC updated its fixed broadband benchmark speed for advanced telecommunications capability to 25 megabits per second when downloading and 3 megabits per second when uploading, or “25/3 Mbps.”¹²

Figure 1: Types of Fixed Broadband



Source: GAO. | GAO-21-104447

As broadband use has increased, the federal government has emphasized the importance of ensuring Americans have access to broadband. For example, FCC is required to determine whether advanced telecommunications capability such as broadband is being deployed to all Americans in a reasonable and timely fashion on an annual basis.¹³ One focal point in this effort to ensure Americans have access to broadband has been the desire to close the “digital divide,” between those who have access to the social and economic benefits that broadband can provide and those who do not. As we have reported, people disproportionately affected by this lack of broadband access often

¹²FCC made this update as part of its annual inquiry into whether “advanced telecommunications capability is being deployed to all Americans in a reasonable and timely fashion” pursuant to Section 706 of the Telecommunications Act of 1996 (codified at 47 U.S.C. § 1302(b)).

¹³47 U.S.C. § 1302(b).

live in rural or economically disadvantaged areas where low returns on investment have not attracted new or expanded broadband infrastructure deployments by providers.¹⁴ Furthermore, after March 2020, the effects of the digital divide increased with the outbreak of COVID-19 in the United States. The limitations placed on large gatherings caused many Americans to rely solely upon broadband internet to continue their jobs, schooling, and socializing. For those Americans without broadband, or those who must deal with unaffordable or under-performing broadband service, the effect of these limitations was magnified.

Working to close the digital divide, a number of federal agencies provide funding for broadband deployment to areas that are unserved and underserved by broadband—in other words, those areas of the country that do not have any internet service at all or the service available is slower than the current broadband benchmark speed. FCC's Universal Service Fund is the largest program, which includes components designed to ensure access to affordable communications for schools, libraries, rural health care providers, low-income consumers, and those in rural and high-cost areas.

The largest component of the Universal Service Fund is the high-cost program—which includes the Connect America Fund and the Rural Digital Opportunity Fund—that targets financial support to rural high-cost areas for the deployment and maintenance of voice and broadband-capable networks.¹⁵ The Connect America Fund distributes about \$5 billion to broadband providers annually to reduce the high costs of constructing voice and broadband networks in remote areas. The Rural Digital Opportunity Fund helps to defray broadband provider deployment and maintenance costs in rural areas. Additionally, USDA also supports broadband deployment through grant and loan programs managed by the Rural Utilities Service, including the ReConnect program.¹⁶ These efforts

¹⁴[GAO-18-630](#) and [GAO-20-535](#).

¹⁵In addition to the high-cost program, the Universal Service Fund includes programs to serve schools and libraries (E-Rate), low-income households (Lifeline), and healthcare providers (Rural Health Care).

¹⁶The USDA Rural Utilities Service has four programs that finance broadband deployment: the Rural Broadband Access Loan and Loan Guarantees Program, the Telecommunications Infrastructure Loans and Loan Guarantees Program, the Community Connect Grants Program, and the ReConnect Program. Many recipients of loans from these programs also receive Universal Service Fund Connect America Fund program subsidies that they use to repay their USDA loans.

provide grants and loans to providers in rural areas to offset the costs of establishing reliable broadband access and maintaining access to high-speed internet service. A provider may receive funding from more than one program, such as receiving funding through ReConnect to expand broadband into an unserved area and support from the FCC's high-cost program to offset ongoing costs of providing service.

These programs rely on geographic information about the existing deployment of broadband for targeting their funds to the areas that need them most, according to FCC.¹⁷ In 2014, FCC began to collect broadband deployment data for the entire United States. These data report fixed broadband deployment by census blocks.¹⁸ However, we and others have raised concerns about the methodology that FCC uses to collect the broadband deployment data.¹⁹ Specifically, in 2018, we found that FCC considers an entire census block to be served if a provider reports that it does, or could offer, service to at least one household in the census block. This has led to broadband deployment being overstated, especially in rural—as well as tribal—areas, because service may not be available in other locations in the Census block. FCC has also noted this possibility to overstate service. We recommended that FCC develop and implement methods for collecting and reporting accurate and complete data on broadband access, especially on tribal lands where service is known to be lacking.²⁰ In response, FCC officials said they planned to address this

¹⁷In re Establishing the Digital Opportunity Data Collection; Modernizing the FCC Form 477 Data Program, Second Report and Order and Third Further Notice of Proposed Rulemaking, 35 FCC Rcd 7460 (2020).

¹⁸These “Form 477 data” are named for the form broadband providers use to submit information on local services they provide.

¹⁹As described later, the Broadband DATA Act directs FCC to reform the Form 477 collection process in a manner that enables the comparison of data and maps produced before enactment of the Broadband DATA Act, maintains the public availability of data relating to the deployment of broadband internet access service, and harmonizes reporting requirements regarding the deployment of broadband internet access service. § 802(b)(6), 134 Stat. at 235.

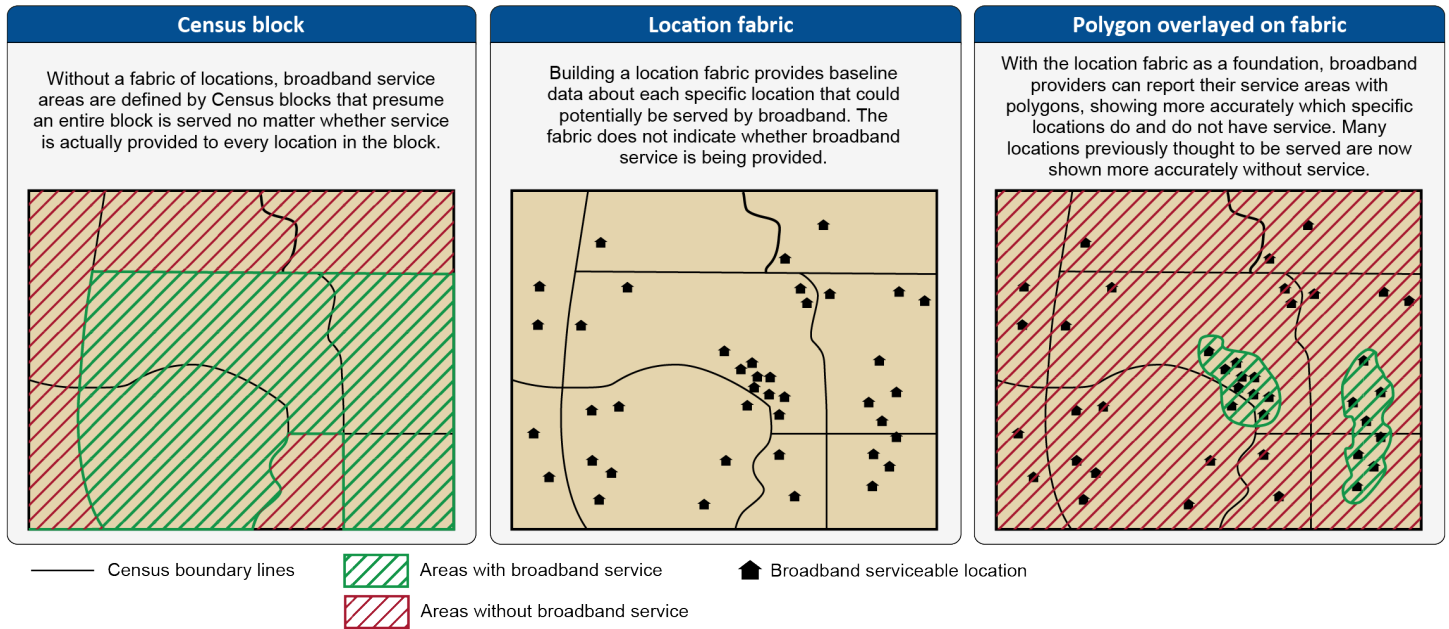
²⁰[GAO-18-630](#). We made three recommendations to FCC in this report: (1) develop and implement methods for collecting and reporting accurate and complete data on broadband access specific to tribal lands, (2) develop a formal process to obtain tribal input on the accuracy of provider-submitted broadband data that includes outreach and technical assistance to help tribes participate in the process, and (3) obtain feedback from tribal stakeholders and providers on the effectiveness of a statement FCC made to providers in 2012 on how to fulfill their tribal engagement requirements to determine whether FCC needs to clarify the agency's tribal engagement statement. As of August, 2021, FCC had not implemented these recommendations.

recommendation by targeting data collection in tribal areas through the agency's current efforts to improve its deployment data.

In 2019, FCC adopted new data collection and mapping procedures with the goal of gathering more granular, nationwide data on broadband deployment.²¹ This new initiative required that fixed broadband providers submit data on their coverage in a geospatial form, specifically as polygons—i.e., shapes whose outlines closely correspond to just the locations where their broadband is deployed in a specific area. In the existing FCC data collection, broadband providers report their coverage to FCC in more general terms, using census blocks to identify where providers have deployed fixed broadband service. Since then, FCC has sought to develop a baseline broadband-serviceable location fabric, which would locate and specify all locations in the United States that could be served by fixed broadband. In other words, this location fabric would be a geospatially accurate digital map that would plot broadband serviceable structures across the country. With the location fabric serving as a baseline, fixed broadband providers will report their broadband deployment data in reference to the locations in the fabric, either in the form of polygons covering locations with service, or by submitting lists identifying those locations. This will result in a more precise view of which locations are currently served and unserved by broadband than is possible with the current census-block reporting approach. Figure 2 illustrates the current approach, where broadband deployment is reported by census block, as compared to the new approach, where providers report broadband deployment using polygons that could be laid over a location fabric.

²¹NTIA also has a broadband map called the National Broadband Availability Map, which is a GIS platform used to visualize and analyze federal, state, and commercial broadband data sets. This map, however, is not based on an underlying location fabric of serviceable locations.

Figure 2: Comparison of FCC’s Current Census Block Method to the New Polygon-Reporting Method for Collecting Broadband Deployment Data



Source: GAO analysis of Federal Communications Commission and USTelecom information. | GAO-21-104447

In March 2020, the Broadband DATA Act was enacted and had the effect of superseding some aspects of FCC’s 2019 effort. The Broadband DATA Act required FCC to issue final rules on location fabric development and data collection for fixed broadband deployments using either polygons or a list of addresses or locations. In response, FCC issued rules in July 2020 on how it will collect location-specific data on broadband deployment from providers. In December 2020, FCC received \$98 million in appropriations enabling it to carry out its responsibilities under the Broadband DATA Act.²²

FCC Has Taken Steps to Develop a Location Fabric, Including Outreach to Stakeholders and

²²The Broadband DATA Act prohibited FCC from using funds from the Universal Service Fund programs to pay for any costs associated with implementing the act. Pub. L. No. 116-130, § 805, 134 Stat. at 238.

a Request for Proposals from Potential Contractors

Since receiving appropriations for its efforts, FCC has made progress toward developing a fabric of broadband serviceable locations by taking a number of steps.

- In February 2021, FCC established the Broadband Data Task Force, which it charged with creating and developing the broadband serviceable locations fabric. FCC then hired a data architect to address known challenges surrounding the development of an IT platform for the new location fabric and deployment data from providers.
- To collect more information on issues related to developing a location fabric, FCC issued a request for information in March 2021 that asked interested stakeholders in the telecommunications industry to provide their perspectives on anticipated project deliverables, contract requirements, data usage rights, and evaluation criteria. The request for information also identified specific requirements related to the location fabric for compliance with the Broadband DATA Act. FCC officials told us that they hired a project manager, and that this official is developing a project plan that will coordinate workflow to implement the Broadband DATA Act.
- In June 2021, FCC issued a request for proposals, which asks data companies to submit initial products for a fabric of locations for FCC within 4 months of the contract's signing date, according to FCC officials.²³ Responses to the request were due on July 1, 2021. According to FCC officials, the data company that it selects to develop its location fabric will be given a 1-year contract with the option of working with FCC for 4 additional years to update the location fabric with new data at least twice a year, depending on the data sources it uses. FCC officials said that the data updates and maintenance costs for the fabric of locations would be built into the procurement contract over the 5-year period. They said the agency plans to use the rest of the appropriations to build the other IT platforms associated with the new collection and assist smaller broadband providers and other

²³FCC, *Broadband Location Serviceable Fabric Statement of Objectives* (Washington, D.C.: June 1, 2021).

stakeholders in complying with the new reporting requirements and challenge processes established for the collection.²⁴

Most of the data companies we spoke with stated that it is possible to develop solutions to meet FCC's location fabric needs. These companies stated that creating a nationwide location fabric would be possible by integrating commercial datasets that are already in existence. The companies said that an advantage of a commercial location fabric product is that their developers have spent resources to compare available datasets and to harmonize, validate, and refine the data products they assemble. The data companies also stated that commercial entities are often better able to continuously update the product. These companies also said that they have spent a significant amount of time building their datasets. For example, one data company stated that its dataset required substantial investment and that the learning curve to identify each of the sources and join them together was considerable.

In addition to the data companies, there are two state-level location-fabric development efforts where officials discussed the benefits of purchasing a map-ready dataset from a data company. For example, the State of Georgia purchased a product from a data company because state officials determined that collecting data themselves was too costly and time consuming, according to Georgia officials. Additionally, US Telecom, a telecommunications industry association, also purchased its location fabric from a data company to pilot a method of broadband mapping in Virginia and Missouri that combined several types of data in a manner similar to what FCC was tasked to do by the Broadband DATA Act. Even with these data products, officials from Georgia and US Telecom told us their state-level efforts have been complicated, long-term, and have involved significant computing power and labor hours spent integrating data from multiple sources that were inconsistent or incomplete. Appendix II includes more information on selected state broadband-mapping efforts to date.

FCC officials said they have met with data companies and states to learn from their location fabric development efforts and to inform FCC's decisions. Additionally, FCC officials said they will have a process where state, local, and tribal entities can question or "challenge" location fabric data to incorporate their feedback as required by the Broadband Data

²⁴We will discuss the challenge process further later in the draft.

Act.²⁵ This challenge process will allow state, local, and tribal governments, along with other community organizations and others, to question and correct any inaccuracies in the data used in FCC's location fabric and report data inaccuracies. The data company that produces the location fabric will also be responsible for incorporating data from the challenge process as directed by FCC.²⁶

Stakeholders Identified Limitations with Data and Their Use as Key Challenges in Developing a Location Fabric

According to Stakeholders, Limitations with Location Data Are a Challenge but Could Be Addressed by Integrating Multiple Types of Data

According to stakeholders we interviewed, a key challenge for FCC will be addressing limitations in the location data for the location fabric. No single dataset is sufficient for developing a fabric of all locations in the U.S. where broadband could be deployed, according to the various data companies, broadband providers, telecommunications industry associations, and states we interviewed. Many of these stakeholders identified four key data types that each have advantages and limitations. However, these stakeholders also told us that when combined in various ways, these data can create a fabric of all broadband serviceable locations, and having a combination of data types would help address limitations with the data, which we describe further below. The four types of data are:

- **Address data.** These data contain information typically associated with locating properties for the purpose of mail delivery or travel. In some jurisdictions, address data have been enhanced, producing

²⁵The Broadband DATA Act requires FCC to establish a user-friendly challenge process through which consumers, state, local, and tribal governmental entities, and other entities or individuals may submit coverage data to FCC to challenge the accuracy of the coverage maps, any information submitted by a provider regarding the availability of broadband internet access service, or the information included in the Fabric. Pub. L. No. 116-130, § 802(b)(5), 134 Stat. 228, 233-34 (2020).

²⁶FCC, *Broadband Location Serviceable Fabric Statement of Objectives* (Washington, D.C.: June 1, 2021).

“geocoded” address data. For example, “e911 address data,” are address data that can be plotted using latitude and longitude coordinates in geospatial information systems, a process that improves dispatching of first responders.²⁷ Geocoded address data are useful to locate specific residences and businesses and associate them with specific broadband serviceable locations. According to a broadband mapping expert, addresses must be geocoded using longitude and latitude information to be useful in location fabric development.

- **Parcel data.** Parcel data identify property boundaries associated with a particular property and are useful for determining which structures on a property may need or currently receive broadband service.
- **County property tax assessor data.** These data contain information about the property taxes and use of a property, such as whether it is residential, agricultural, or commercial. Tax data can help verify broadband service needs or current access.
- **Building footprints.** Building footprint data—or renderings of the base of building structures—involve imagery taken from orbiting satellites or aerial craft and may be useful in the location fabric development and validation process for determining what a building is based on its size and shape. Building footprints can help with specifying types of structures and identifying likely broadband access points on a property. One data company said that the shape, size, appearance, context, and location of the building footprint should provide sufficient evidence to determine which buildings require broadband service and which do not.

Stakeholders from data companies, telecommunications industry associations, and states we interviewed said that there are completeness, accuracy, and consistency limitations with each of these types of data.

Completeness. Many of the data companies, broadband providers, telecommunications industry associations, and state and federal agencies we interviewed said that address, parcel, and building footprint data are not always complete with respect to all possible locations. One data company said that creating its data product required the company to

²⁷Enhanced 911, or e911 location data often include addresses and geocoded data such as the latitude and longitude of the specific location to assist with 911 first responder dispatch routing. One data company said that some jurisdictions consider e911 datasets proprietary and will not share with third parties. For more information, see GAO, *Next Generation 911: National 911 Program Could Strengthen Efforts to Assist States*, [GAO-18-252](#), (Washington D.C.: Jan. 31, 2018).

establish relationships with the over 3,000 county governments as well as hundreds of specialized vendors to develop a complete dataset. According to a data company, there are some locations where there may be little to no available information about some of the structures. Therefore, some broadband serviceable locations may not be readily identified in the data that FCC's contracted data company acquires from any data collection source of any data type. Several stakeholders pointed out that this is likely the case in some rural or tribal jurisdictions. Further, some jurisdictions—especially in rural and tribal areas—may not possess current data on the number of structures that exist, where precisely the structures are, or what the status of those structures may be, and many of these locations do not use standard addresses or may only have a post office box as a mailing address. Finally, as noted by a data company, some jurisdictions have hand-written records, which are not easily read or digitized, possibly creating gaps in the data that will require investigation and follow-up to complete.

Accuracy. Several stakeholders also told us that each of the data types have their own data accuracy issues. One data company said that the quality of jurisdictions' data is not uniform. Therefore, irregularities may arise in the data due to the way records are kept. For example, the data company mentioned that address data does not always link correctly to the correct broadband serviceable location in rural areas where the mail delivery point may be at the end of the road, or on multi-tenant properties where there are several broadband serviceable locations at one postal address. Further, according to officials from NTIA, geocoding structures is not always a simple process, since different geocoding tools may locate structures at different places. For instance, according to a data company, if a geocoding tool does not have precise longitude and latitude coordinates for a structure, it may estimate the structure's location in the middle of a nearby road or the relevant piece of land when it might be elsewhere on the property. Therefore, reconciliation would be necessary across geocoded datasets. Moreover, some address data may not be geocoded at all, according to a data company. Meanwhile, in terms of record keeping styles, another data company pointed out that parcel data are not always accurate in terms of boundary lines and are sometimes kept in hard copy, which, when digitized, may show distortions in property boundaries due to book binding.²⁸ These and other possible anomalies may also exist in datasets collected by data companies, requiring the data

²⁸"Book binding" refers to the marrying of pages together, in this case, within a hard-copy volume of a tax assessor record book. The folding of the pages near the bindings will cause the anomalies described.

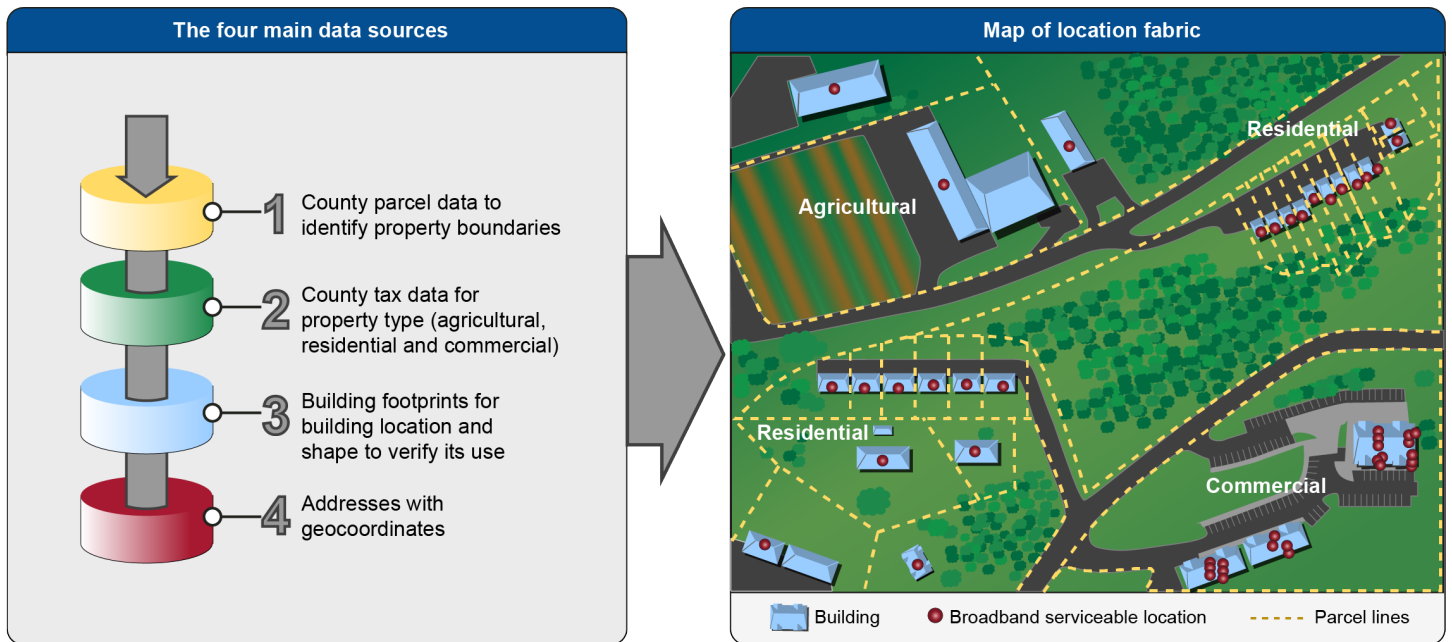
be corrected and standardized in order to improve accuracy before integrating them into the location fabric, according to data companies.

Consistency. Stakeholders we spoke to stated that there may be inconsistencies in the data. For example, one reason for inconsistency in address data is that there is no standard approach for geocoding addresses. Further, two data companies said that parcel and county tax data may be reported using a wide variety of unique administrative codes and other non-standard information that could complicate integrating tax data with other location data. For example, despite being typically collected by the same county tax offices, tax data and parcel data may not always link together. As the data aggregated by the data company selected by the FCC will likely need to come from multiple sources, each having different administrative codes and terminologies, these differences would need to be identified and addressed in order for the data to be linked together, according to FCC and state officials. For example, one data company stated that some jurisdictions may have fully digitized and geocoded data, while others may have only digitized and geocoded portions of their data or none at all. This will depend on what those jurisdictions have required from their data collection programs and maintenance efforts. In integrating multiple datasets with these differences, the data company retained by FCC will need to develop a single set of the consistent data elements so that the aggregated data collection can function as FCC's data company may expect, according to FCC and state officials.

A few data companies and states told us it is possible to overcome the limitations of one data type by combining it with one or more of the other data types. For instance, many of the completeness issues can be overcome if current satellite images are available to render building footprints to identify structures that may not be identified in some counties' address, parcel, or property tax data. Likewise, property tax and parcel data may offer clues as to whether broadband is plausibly needed at some structures, compensating for the lack of similar information in address data. Property tax and parcel data may also help to eliminate discrepancies raised by building footprints where the satellite images are unclear or are not current. Having multiple data types to rely on can also improve accuracy through validation between sources. Consistency of reporting styles, important codes, and terminology, however, may remain an outstanding issue unless the data company retained by FCC performs work to harmonize the codes and terminology. Still, according to data companies and other stakeholders, performing that analysis could be easier where multiple data types are available.

Such an approach has been piloted by some states and US Telecom, the industry association that piloted a mapping technique as discussed previously. For example, US Telecom told us that it contracted with a data company that established a pilot location fabric by layering all four of the above mentioned data types together in the states of Virginia and Missouri. First, the data company used parcel data as a foundation to assess the buildings and property boundaries. Second, the data company used property tax assessor data to identify general activities at the property, such as whether it was a residence, business, or farm. Thus, the assessor data formed the basis for assessing broadband service needs. Third, the data company analyzed building footprints through satellite imagery to pinpoint the location of each building that was expected to need or receive broadband service. Last, address data were used to allow reference to the location fabric data by outside sources. When the data did not align, the data company’s personnel visually reviewed the data sources to manually identify the specific location and where its geocoordinates should be placed. Figure 3 shows this approach of identifying broadband serviceable locations using data with geocoded addresses, parcel boundary lines, county tax data, and building footprints.

Figure 3: Mapping Broadband Serviceable Locations Using the Four Key Data Types



Source: GAO analysis of stakeholder documents. | GAO-21-104447

Other pilot location fabrics followed a similar methodology. For example, stakeholders from a different data company said they had recently developed a suite of machine learning algorithms that combines data from all four key types and renders them into a geospatial mapping platform. This company told us that FCC's need for a highly accurate location fabric depends on integrating the four data types. A further example is the State of Georgia, which used parcel data, geocoded addresses, and building footprints for validation for its state-level location fabric.

FCC's oversight of its contractor will include making sure the contractor addresses these data limitations. FCC's procurement documents require the data company that develops the location fabric to provide FCC with data quality reports explaining how the data company will use multiple types of data to produce the most accurate location fabric possible.²⁹ The chosen contractor will have to show its product's data accuracy and the most common errors with both the initial location fabric and estimates for how accuracy might improve over time through the challenge process and other twice-yearly updates. FCC officials said they will be working with their contractor to address such technical issues with the data as well as limitations with using data, as discussed below.

Private and Government Use Limitations Will Pose Further Challenges

An overarching challenge will be data use limitations, both from commercial and governmental data sources, according to stakeholders. The Broadband DATA Act requires that FCC deliver a publicly accessible version of its nationwide location fabric. Having a public version is also necessary, since the Broadband DATA Act also requires FCC to make the data public for its planned challenge process, in which anyone can challenge data they believe are inaccurate. This process will help ensure providers' data are accurate and will allow for the opportunity to provide such input on an ongoing basis. However, stakeholders pointed out that many commercial and governmental datasets prohibit unrestricted use of their data. The data company retained by FCC may face the challenge of having to negotiate licensing arrangements and pay fees for the appropriate data rights, if it could acquire them at all. FCC officials told us

²⁹FCC, *Broadband Location Serviceable Fabric Statement of Objectives* (Washington, D.C.: June 1, 2021).

that they are studying the licensing issues and costs across all data sources.

There are commercial, local, and federal data sources for all four kinds of data as described above. However, each has its own data use limitations, according to stakeholders. Commercial data companies do not want others to gain access to their data for free since their data are their product. As is typical of commercial datasets, use restrictions may be directly connected to licensing fees. Negotiations with the companies that maintain these data will likely focus on protection of the company's advantage versus its competitors, according to the three data companies we interviewed. Moreover, in terms of local and other non-federal government data, data companies and state officials said that some jurisdictions may not be able to share their information at all, due to privacy laws, while others may charge high fees for their data. Each case may require FCC to develop solutions that will respect local concerns and prepare contingencies for situations where acquisition is particularly difficult.

Federal data sources—such as the U.S. Postal Service, the U.S. Census Bureau, and the U.S. Department of Transportation—could be useful to FCC as an additional check on the accuracy of data its contractor uses from local-level sources, but also may have use limitations, according to federal officials. For example, FCC officials said they would like to work with Census to improve FCC's mapping, since Census data could help ensure reliability of location information. FCC officials have had discussions with officials from both USPS and Census about their agencies' data. Of the three federal data sources that we reviewed, all have large amounts of information on addresses, but two have data use limitations, which FCC does not have the authority to override, so they cannot be used to make a location fabric that must be publicly accessible.³⁰ Two of the databases we identified possess personally identifiable information, such as names, and federal law requires that agencies treat this information as confidential. The two federal address databases described below could be useful for location fabric development and validation, but statutory use restrictions pose challenges for FCC being able to make effective use of them for the location fabric and any future challenge process.

³⁰The Broadband DATA Act requires that the location fabric be accessible to public organizations for the challenge process and for broadband providers to report deployment.

U.S. Postal Service. The U.S. Postal Service told us that it maintains a dataset of about 160 million addresses, with a very high percentage of these having geocoded data. USPS has stated that its dataset is constantly updated with new addresses and regularly enhanced with geolocation points that map to mailboxes or front doors. However, federal law prohibits USPS from disclosing any list of names or addresses of postal patrons to the public.³¹ USPS has arrangements with some federal agencies that allows them to access its address data for validation purposes, while still not making the full dataset publicly available.³² For instance, the Department of Housing and Urban Development pays USPS to license data that helps the department verify the locations of vacant properties. Further, USPS makes address information products available to companies that produce commercially marketed validation apps,³³ which at least one state used in its location fabric development pilot. FCC's procurement documents included an optional work requirement to validate address data using the USPS address validation tool.

U.S. Census Bureau. According to Census officials, the Census Bureau's Master Address File and Topologically Integrated Geographic Encoding and Reference System contains over 155 million addresses, the majority of which have been geocoded across 14 million unique geographic areas. This database has also benefited from Census' close work with local, state, and tribal authorities to enhance location data on tribal lands, according to Census officials. However, federal law also restricts the Census Bureau from sharing these data to protect Census respondent confidentiality.³⁴

Additionally, DOT maintains the National Address Database, which contains about 60.5 million residential, business, and other addresses

³¹39 U.S.C. § 412.

³²Through its authority in 39 U.S.C. § 411, which allows USPS and executive agencies to furnish property and services to each other, USPS may disclose a list of names or addresses to another federal agency through interagency agreements that contain a valid non-disclosure agreement. The interagency agreement must also comply with 5 U.S.C. § 552a(n), which prohibits the sale or rental of an individual's name and address. 39 C.F.R. § 266.3(b)(3)(iii).

³³39 C.F.R. § 266.3, USPS may make mailing or other list of names or addresses available to the public under its authority contained in 39 U.S.C. 401(3) and when the agreement is subject to a valid non-disclosure agreement.

³⁴13 U.S.C. § 9.

and is available to the public.³⁵ However, the database does not include data for all states. Specifically, the database is comprised of data submitted by about half (26) of the states, and DOT officials said its role in the database is limited to compiling address data and that it relies on the quality control processes established at state, local, or tribal governments. Nevertheless, the database grows weekly and according to DOT officials, 10 new participant states were preparing their submissions as of June 2021. FCC has discussed data sharing with DOT as the National Address Database has already been published and is available to FCC for unrestricted use. However, FCC officials said the incompleteness of this data source makes it less useful since many states do not report to it.³⁶ Moreover, the Broadband DATA Act requires FCC to refresh its data at least twice a year, and according to FCC officials, the National Address Database does not currently include requirements for participating states to update their data, although DOT officials said a majority of its state partners update their submitted data either quarterly or twice a year.

FCC's procurement documents ask bidders to submit alternative proposals based on three tiers of data rights with different price points. According to FCC, this process will allow FCC to balance contract cost and data use limitations when evaluating the proposals it receives from data companies before deciding which location fabric product to purchase.

Agency Comments

We provided a draft of this product to FCC, Census, DOT, NTIA, and USPS for review and comment. We received technical comments from FCC, Census, DOT, and USPS, which we incorporated as appropriate. NTIA did not have any comments.

We are sending copies of this report to the appropriate congressional committees, the Acting Chair of the FCC, the Secretary of Commerce, the Secretary of Transportation, the Postmaster General, and other interested

³⁵Recognizing the need to maintain accurate and up-to-date addresses for transportation safety, DOT maintains this database as a part of Next Generation 911.

³⁶As we mentioned, the DOT National Address Database contains about 60.5 million addresses. When compared to the Census' Master Address File and the Postal Service's equivalent, the National Address Database appears to contain significantly fewer addresses than the other two sources.

parties. In addition, the report is available at no charge on the GAO website at <http://www.gao.gov>.

If you or your staff have any questions about this report, please contact me at (202) 512-2834 or VonAhA@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix III.

A handwritten signature in black ink, appearing to read 'Andrew Von Ah', with a stylized flourish at the end.

Andrew Von Ah
Director, Physical Infrastructure

Appendix I: Interviewees

Data Companies

- Black Knight
- CQA
- Ecopia
- GeoPartners
- Lightbox

Broadband Providers

- AT&T
- Lumen/Century Link

Telecommunications Industry Associations

- NCTA, The Internet and Television Association
- NTCA, The Rural Broadband Association
- US Telecom

States

- Alabama
- Arkansas
- Colorado
- Georgia
- New Mexico
- New York
- Pennsylvania
- South Carolina
- Vermont
- Washington

Other Experts

- Brookings
- Connected Nation

-
- University of Maryland, Geographic Information System Expert

Federal Agencies

- Federal Communications Commission (FCC)
- Census Bureau
- National Telecommunications and Information Administration (NTIA)
- U.S. Department of Transportation
- U.S. Postal Service

Appendix II: Selected State Broadband Mapping Efforts

Some states have developed state-level location fabrics of broadband serviceable locations (i.e. locations that could be served by broadband, such as homes or businesses), and some have collected broadband deployment data without first creating a location fabric. Regardless of the method used, these state broadband mapping efforts could offer FCC lessons for ensuring its location fabric of broadband serviceable locations is accurate and complete. Further, different states are trying out different data integration methods, which may provide FCC with examples for how it could structure its national location fabric in terms of what has worked well and provided the highest accuracy for the least cost. Of the 44 survey respondents to our state survey, 15 reported in their survey responses that they have developed a variety of different state-level mapping efforts with similarities to FCC's proposed approach. These efforts may provide some insight for how FCC could develop a national location fabric of broadband serviceable locations.¹ Table 1 below provides examples of these efforts as described by state officials we interviewed.

Table 1: Selected States with State-Level Broadband Mapping Efforts, as of June 2021

State	Broadband Mapping Tool
Alabama	Contracting with a data company for a location fabric of locations and plans to overlay broadband deployment data from providers
Arkansas	Purchased a fabric and service estimation data from data company responsible for US Telecom pilot, but is in the early stages of using the location fabric
Colorado	Subdivided census blocks into quadrants that does not quite reach the level of specific locations and overlays broadband deployment data from providers
Georgia	Purchased a data product from a data company that uses parcel data, geocoded addresses, and satellite imagery and overlays broadband deployment data from providers
New Mexico	Developed location fabric based on geocoded enhanced 911 (e911) address data and overlays broadband deployment data from providers
New York	Developed location fabric based on geocoded e911 address data as well as other private sources and overlays broadband deployment data from providers

¹The states of Virginia and Missouri are not included in this tally because the states did not indicate in their surveys that they had a state-level location fabric of their own.

Appendix II: Selected State Broadband Mapping Efforts

State	Broadband Mapping Tool
Pennsylvania	Developed location fabric based on Google maps, county tax data, public information on wireless towers and fiber, and the American Community Survey data.
South Carolina	Purchased a location fabric and service estimation data from data company responsible for US Telecom pilot, but is in the early stages of using the fabric
Vermont	Developed a location fabric based on geocoded e911 address data and overlays broadband deployment data from providers
Washington	Collects crowd-sourced speed test data with geocoded coordinates imbedded in the speed test survey to show broadband availability and performance, or the lack of broadband availability

Source: GAO. | GAO-21-104447

Note: Enhanced 911, or e911 location data often include addresses and geocoded data such as the latitude and longitude of the specific location to assist with 911 first responder dispatch routing.

Most states that responded to our survey reported that they have not developed state-level mapping tools. Of our 44 survey respondents, 29 said that they do not have a location fabric for the state, and 12 of these states and territories surveyed said that a lack of funds was the primary reason why the state or territory has not developed a fabric of locations. Other reasons include that internet service providers are not willing to provide data (6 respondents), or that state officials were waiting for FCC to develop the national location fabric of broadband serviceable locations (3 respondents).

In addition to the states that are working on developing underlying location datasets and mapping tools, 18 states have collected broadband availability data from providers or consumers to map areas that are and are not served, according to their survey responses. Such state broadband mapping efforts beyond creating a location fabric may offer FCC additional lessons for addressing the digital divide. About half of these states collect some sort of broadband provider data and report a variety of different types of service data to NTIA for the National Broadband Availability Map.² NTIA officials told us that data received from states vary in detail. In contrast to the provider data, five other states told us that they decided to map broadband availability by using customers' crowd-sourced speed test data as a way to show areas that might not have service.³ The speed test data may be collected from broadband customers who report their individual internet speed-test results to the

²The National Broadband Availability Map has 36 state partners that participate in the National Broadband Availability Map platform. Each state enters into a joint agreement with NTIA which makes NTIA data available to the state in exchange for the state making its broadband relevant data available to NTIA.

³One state told us they use both provider and speed test data. Six other states did not specify in their survey response what broadband availability data they collect.

state through online surveys or other collection techniques. These states that have not developed a location fabric rely on the provider data or crowd-sourced speed test data to show the served and unserved areas. For example, an official from Washington State said he has used crowd-sourced speed test data to help tribal areas receive federal grants for broadband deployment.

One of the reasons state officials said they either developed their own location fabrics or began collecting availability data from providers or customers was that FCC's inaccurate mapping at the census block level has posed challenges for getting funding to unserved areas in their states. If areas are marked "served" in FCC's census block-level broadband coverage data—even if they are not actually served—those areas are ineligible for funding from some federal programs. This is because federal programs such as ReConnect provide funding only to areas that are 90 percent or more unserved and rely on FCC's census block-level coverage data to determine which areas are unserved. Some of these states have used state-level mapping techniques such as the crowd-sourced speed test data described above to address these discrepancies and challenge grant decisions that were based on FCC's census-block based data.

Appendix III: Contact and Staff Acknowledgments

Contact

Andrew Von Ah, (202) 512-2834 or VonAhA@gao.gov.

Staff Acknowledgments

In addition to the individual named above, other key contributors to this report were Andrew Huddleston, Assistant Director; Sarah Jones, Analyst in Charge; David Dornisch; Camilo Flores; John Mingus; Malika Rice; Herbert Tinsley; and Michelle Weathers.

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