Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Communications Marketplace Report	)	GN Docket No. 22-203

2022 COMMUNICATIONS MARKETPLACE REPORT

Adopted: December 30, 2022 **Released: December 30, 2022**

By the Commission: Commissioner Carr approving in part, concurring in part, and issuing a statement.

TABLE OF CONTENTS

I. INTRODUCTION AND EXECUTIVE SUMMARY

1. The Commission is required to publish a *Communications Marketplace Report* every two years that assesses generally the state of competition across the broader communications marketplace.[1] The Commission must evaluate competition to deliver voice, video, audio, and data services among providers of telecommunications, providers of commercial mobile service, multichannel video programming distributors, broadcast stations, providers of satellite communications, Internet service providers (ISPs), and other providers of communications services.[2] As part of its evaluation, the Commission must consider all forms of competition, including "the effect of intermodal competition, facilities-based competition, and competition from new and emergent communications services."[3] The Commission also must assess whether laws, regulations, regulatory practices, or marketplace practices pose a barrier to competitive entry into the communications marketplace or to the competitive expansion of existing providers of communications service.[4]

2. With this *2022 Communications Marketplace Report*,[5] the Commission fulfills its mandate to provide a comprehensive evaluation of the state of competition in the communications marketplace in the United States.[6] As required, this third *Report*[7] assesses the state of all forms of competition in the communications marketplace; the state of deployment of communications capabilities,

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[1] 47 U.S.C. §§ 163(a), (b)(1); *see also* Section 401 of the Repack Airwaves Yielding Better Access for Users of Modern Services Act of 2018, Pub. L. No. 115-141, 132 Stat. 1087 (codified at 47 U.S.C. § 163) (RAY BAUM'S Act of 2018).

[2] 47 U.S.C. §§ 163(a), (b)(1).

[3] *Id.* § 163(d)(1).

[4] *Id.* § 163(b)(3). In assessing the state of competition under subsection (b)(1) and regulatory barriers under subsection (b)(3) of the Act, the Commission must also "consider market entry barriers for entrepreneurs and other small businesses in the communications marketplace in accordance with the national policy under section 257(b)." *Id.* § 163(d)(3). The Commission must include the International Broadband Data Report required by section 103(b)(1) of the Broadband Data Improvement Act as part of the Communications Marketplace Report. *See* RAY BAUM'S Act of 2018 § 402(c), 132 Stat. at 1089; 47 U.S.C. § 163; 47 U.S.C. § 1303(b)(1).

[5] *See Office of Economics and Analytics Seeks Comment On The State Of Competition In The Communications Marketplace*, GN Docket No. 22-203, Public Notice, DA 22-535 (OEA 2022) (*2022 CMR Public Notice*). The Office of Economics and Analytics (OEA) released the *2022 CMR Public Notice* on May 16, 2022. The comment period ended July 1, 2022, and the reply comment period ended Aug. 1, 2022. Appx. A of this *Report* provides a list of all the parties who filed in this proceeding.

[6] 47 U.S.C. §§ 163(a), (b)(1); *see also* RAY BAUM'S Act of 2018.

[7] In December 2020, the Commission adopted its second *Communications Marketplace Report*, providing a comprehensive evaluation of the state of the communications marketplace as of year-end 2019. *Communications Marketplace Report et al.*, GN Docket No. 20-60, Report, 36 FCC Rcd 2945 (2020) (*2020 Communications Marketplace Report*), https://www.fcc.gov/document/fcc-releases-2020-communications-marketplace-report (last visited Sept. 27, 2022); *Communications Marketplace Report et al.*, GN Docket No. 18-231 et al., Report, 33 FCC Rcd 12558 (2018) (*2018 Communications Marketplace Report*), https://www.fcc.gov/reports-research/reports/consolidated-communications-marketplace-reports/CMR-2018 (last visited Sept. 27, 2022). The first *Communications Marketplace Report* was adopted in December 2018, and provided data and information as of year-end 2017. In February 2020, the Commission updated certain figures, maps, and tables contained in the *2018 Communications Marketplace Report* to reflect the most recent data available as of year-end 2018. *FCC Releases Certain Data Updated as of December 31, 2018 for the Communications Marketplace Report*, GN Docket No. 18-231, Public Notice, 35 FCC Rcd 1479 (OEA 2020), https://www fcc.gov/communications-marketplace-report-updates (last visited Sept. 27, 2022).

including advanced telecommunications capability;[8] and barriers to competitive entry, including market entry barriers for entrepreneurs and other small businesses.

3. At the outset, we note that the U.S. communications marketplace is in a substantial state of change and re-examination. During the past two years, the COVID-19 pandemic drove millions of people to work and learn remotely, and consumers' demand for fixed and mobile broadband, video, and audio services increased significantly.[9] At the same time, there were considerable developments in the regulatory, technological, and business environment that will likely influence competition in the sector in the coming years. We see an emerging set of issues and opportunities presented by these changes in the marketplace: some trends that are encouraging and others that may pose challenges.

4. First is the potential for more competitive broadband markets. Currently available data demonstrates that millions of Americans lack access to high-speed broadband or can only access high-speed broadband through a single provider. However, this market is on the cusp of generational change. The $1 trillion Infrastructure and Investment and Jobs Act has earmarked $65 billion for continued broadband adoption and deployment throughout the country. The Commission's effort to develop new broadband maps that will help identify broadband gaps and better target federal support is well underway. New technologies like 5G fixed wireless services are deploying and may provide new competition to traditional fixed broadband services, particularly in rural areas. And while these trends develop, the Commission has taken steps to create more accountability in markets where competition may be lagging. For example, the Commission has adopted new rules that prohibit ISPs from entering into certain agreements with landlords that keep competitors locked out as well as new rules that require them to display clear "nutrition labels" to help consumers comparison shop. More recently, the Commission started a proceeding to combat and prevent digital discrimination and to promote equal access to broadband.

5. Second is change in the wireless sector in the 5G era. The sector landscape has been reshaped in recent years by multibillion-dollar horizontal and vertical acquisitions. T-Mobile acquired Sprint, shrinking the number of U.S. nationwide mobile service providers from four to three. Verizon also completed its acquisition of TracFone, previously the largest wireless reseller in the United States. Meanwhile, DISH has entered the wireless sector, started to deploy a cloud-native 5G Open RAN network, and has committed to emerging as a nationwide competitor. In addition to acquisitions, wireless service providers have spent approximately $108.5 billion in 5G spectrum auctions over the past two years and made multibillion-dollar capital investments to deploy next generation 5G networks, doing so twice as fast as the previous generation of wireless technology. Mobile wireless providers are also increasingly providing fixed, home broadband service. Against this backdrop, there is also rising interest in edge computing and private cellular networks and ongoing work to reassess cybersecurity and risk management in 5G networks and equipment markets.

6. Third is the rapid expansion of LEO satellite constellations and the emergence of new players in the commercial satellite industry. Reductions in launch costs and other innovations have helped make it possible to cheaply put thousands of satellites in orbit. Approximately 98% of all satellite launches in 2021 were deployed into LEO to provide internet connectivity back here on Earth. Starlink has a significant head start, having launched more than 3,350 of its Starlink satellites. However, over roughly the last two years, the Commission also has approved new satellite constellations from Kuiper and Boeing, with applications representing thousands of additional satellites still under review. In addition, the Commission has taken a range of actions to support competition, including making more

[8] 47 U.S.C. § 1302. The term "advanced telecommunications capability" is defined, without regard to any transmission media or technology, as high-speed switched, broadband telecommunications capability that enables users to originate and receive high-quality voice, data, graphics, and video telecommunications using any technology.

[9] *See infra* section V.

spectrum available to support commercial space launches and satellite communications, updating processing round rules for non-geostationary satellites to encourage spectrum sharing and information sharing, and adopting new rules to address orbital debris risks. And the video and audio industries are also experiencing a great deal of change, as technological change and consumer preferences transform the marketplace.

7. In the coming years, the Commission will continue to monitor these trends and what they mean for the state of competition and consumer choice in the communications marketplace, as advanced communications services play an ever-larger role in our lives.

II. ASSESSMENT OF THE STATE OF COMPETITION

8. The RAY BAUM'S Act of 2018 requires the Commission to assess the state of competition in the communications marketplace. In section II, we assess the state of competition separately within several specific components of the broader communications marketplace, including the fixed broadband marketplace, the mobile wireless marketplace, the voice services marketplace, the satellite marketplace, the video marketplace, including cable industry prices, and the audio marketplace. In section III, we present information on access to advanced telecommunications capability, and provide a summary of the International Broadband Data Report.

9. In assessing the state of competition, we report on several economic indicators. These include indirect measures of competition—such as the number of providers, along with barometers of market concentration—that are recognized as being associated with the level of competition. We also report, among other things, prices and product offerings. This entails looking at the major factors that affect prices, including inputs such as spectrum, infrastructure, or video content, as well as the quality of the service being offered to consumers and quality-enhancing investment. This *Report* further recognizes that some markets are interrelated, and so assesses competition between some of these markets, such as between fixed and mobile broadband and between multichannel video programming distributors (MVPDs), online video distributors (OVDs), and broadcast television stations.

10. ***The Broadband Data Collection (BDC), FCC Form 477, and Network Deployment***. As noted above, the Commission is required to assess the state of communications capability deployment, including advanced telecommunications capability. As the Commission has repeatedly stated, having accurate and reliable broadband deployment data is critical, not only to the Commission, but also to other federal policymakers, state policymakers, and consumers.[10]

11. In August 2019, the Commission adopted new requirements for broadband availability mapping to collect more granular, precise coverage data,[11] and in March 2020, Congress enacted the Broadband DATA Act.[12] This Act bolstered the Commission's data collection improvement effort, but also established additional requirements for the Commission to adopt rules and carry out other steps for the collection and publication of data on the quality and availability of broadband Internet access

[10] *See, e.g., Establishing the Digital Opportunity Data Collection,* WC Dockets Nos. 19-195 and 11-10, Second Report and Order and Third Further Notice of Proposed Rulemaking, 35 FCC Rcd 7460, 7461, para. 1 (2020) (*BDC Second Order and Third Further Notice)*; *Establishing the Digital Opportunity Data Collection; Modernizing the FCC Form 477 Data Program,* WC Dockets Nos. 19-195 and 11-10, Report and Order and Second Further Notice of Proposed Rulemaking, 34 FCC Rcd 7505, 7549, para. 112 (2019) (*BDC Order and Second Further Notice*); *Modernizing the FCC Form 477 Data Program*, WC Docket No. 11-10, Further Notice of Proposed Rulemaking, 32 FCC Rcd 6329, 6331-32, para. 8 (2017) (*2017 Data Collection Improvement Further Notice*).

[11] *See BDC Report and Order and Second Further Notice*.

[12] Broadband Deployment Accuracy and Technological Availability Act, Pub. L. No. 116-130, 134 Stat. 228 (2020) (codified at 47 U.S.C. §§ 641-46) (Broadband DATA Act).

service.[13] In July 2020 and January 2021, the Commission adopted additional new requirements for the Broadband Data Collection (BDC) consistent with the Broadband DATA Act,[14] and in January 2021, the Commission received an appropriation from Congress for the implementation of the data collection. Chairwoman Rosenworcel established the Broadband Data Task Force (Task Force) in February 2021 to lead the cross-agency effort to implement improvements to the Commission's broadband data and mapping tools.[15]

12. During 2021 and 2022, the Commission has continued to develop and refine the BDC and provide guidance regarding the requirements,[16] including through the release of a number of items that furthered the Commission's ongoing effort to improve broadband availability data.[17] These efforts have included contracting for the development of the Broadband Serviceable Location Fabric (Fabric), system development, project management consulting services, system testing, a mobile speed test app, and technical assistance; internal policy development; conducting a rulemaking on the mobile challenge, crowdsourcing, and verification processes; and inter-governmental and consumer outreach. In February 2022, the Task Force and the Office of Economics and Analytics (OEA) announced that the first BDC filing window for the collection of coverage data as of June 30, 2022, would open on June 30, 2022 and

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[13] 47 U.S.C. §§ 641-46. Under the Broadband DATA Act, the Commission must establish rules: (1) requiring the collection of granular data from providers on the availability and quality of service of broadband internet access service, which the Commission will use to create publicly available coverage maps; (2) adopting processes for challenging and verifying the coverage maps and submitted data; and (3) instructing mobile providers to submit propagation maps depicting current 4G LTE mobile broadband coverage, along with propagation model details, that consider the effect of clutter and demonstrate minimum specified parameters. *Id.* § 642 (b)(5), (a)(1)(B)(i), (b)(2)(B). The Broadband DATA Act also requires the Commission to create a common dataset of all locations where fixed broadband Internet access service can be installed. *Id.* § 642 (b)(1)(A)(i).

[14] *See Establishing the Digital Opportunity Data Collection*, WC Docket Nos. 19-195 and 11-10, Third Report and Order, 36 FCC Rcd 1126, 1127, para. 2 (2021) (*BDC Third Report and Order*).

[15] In March 2021, the Task Force launched a new webpage—www.fcc.gov/BroadbandData—to serve as a central location for information regarding the Broadband Data Collection. The webpage also provides access to a new portal through which consumers can share their experiences with broadband services in their area.

[16] Throughout this period, the Task Force and other Commission staff have held numerous briefing sessions with interested stakeholders from federal and state legislators, state, local, and Tribal governments, other federal and state agencies, consumers, and industry to seek input and address concerns and interests, and to keep all stakeholders informed of the Commission's plans and progress.

[17] *See, e.g.*, *Broadband Data Task Force, Wireline Competition Bureau, and Office of Economics and Analytics Announce Data Specifications for Bulk Fixed Availability Challenge and Crowdsource Data*, WC Docket Nos. 19-195 and 11-10, Public Notice (BDTF/WCB/OEA Sept. 15, 2022); *Broadband Data Task Force, Wireline Competition Bureau, and Office of Economics and Analytics Announce Data Specifications for Bulk Fabric Challenge Data*, WC Docket Nos. 19-195 and 11-10, Public Notice (BDTF/WCB/OEA July 1, 2022); *Broadband Data Task Force Issues Guidance to State, Local, and Tribal Governmental Entities for Filing Verified Broadband Availability Data as Part of the Broadband Data Collection*, WC Docket Nos. 19-195 and 11-10, Public Notice, DA 22-417 (WCB/WTB/OEA/OET Apr. 14, 2022); *Broadband Data Task Force and Office of Economics and Analytics Publish Additional Data Specifications for the Submission of Mobile Speed Test and Infrastructure Data Into the Broadband Data Collection*, WC Docket No. 19-195, Public Notice, DA 22-242 (OEA Mar. 9, 2022); *Broadband Data Task Force and Office of Economics and Analytics Publish Data Specifications for the Broadband Data Collection*, WC Docket No. 19-195, Public Notice, DA 22-229 (OEA Mar. 4, 2022); *Establishing the Digital Opportunity Data Collection; Modernizing the FCC Form 477 Data Program*, WC Docket Nos. 19-195 and 11-10, Order, 36 FCC Rcd 10053 (2021).

run through September 1, 2022.[18] The new Broadband Maps based on the first BDC filing windows were published on November 18, 2022 (for data as of June 30, 2022).[19]

13. As directed by Congress in the Broadband DATA Act, the Commission has also started two separate challenge processes to improve the data and the maps.[20] First, starting in September 2022,[21] parties have been able to file bulk challenges to improve the location data contained in the Fabric.[22] Improvements to the Fabric are included in the most recent version; since the week of December 27, 2022, providers have been matching their fixed broadband availability data with the new Fabric in preparation for the next BDC filing window for data as of December 31, 2022, which will open on January 3, 2023.[23] Next, shortly after the first maps were published in November 2022, the Commission began accepting individual challenges to the Fabric data and challenges to the broadband availability data reflected in that first map. Through these challenge processes, stakeholders including consumers, States, Tribes, local government entities, and ISPs can submit data to improve the accuracy of the Fabric and the BDC broadband availability data. Given that the BDC is still in its early stages, with one collection round complete and the challenge processes in their early stages, we do not rely on the BDC data as the primary source of data for this *Report*. For purposes of our assessment in this *Report*, we therefore continue to rely primarily on FCC Form 477 data.[24] In the next *Report*, we expect to rely on the BDC for our analysis of broadband availability.

[18] *Broadband Data Task Force and Office of Economics and Analytics Announce Inaugural Broadband Data Collection Filing Dates*, WC Docket Nos. 11-10 and 19-195, Public Notice, DA 22-182, at 1-2, paras. 3, 22 (BDTF/OEA Feb. 22, 2022).

[19] *See Inaugural Filing Window for Broadband Data Collection Has Opened; Filers May Begin Submitting Broadband Availability Data*, WC Docket Nos. 11-10, 19-195, Public Notice, DA 22-696 (WCB/WTB/OEA June 30, 2022).

[20] The Broadband DATA Act mandates that the BDC include a challenge process so that consumers, state, local, and Tribal governmental entities, and other entities or individuals may submit data to verify the accuracy of BDC submissions. 47 U.S.C. § 642(b)(5). Details of the challenge processes are publicly available. *BDC Second Order and Third Further Notice*, 35 FCC Rcd at 7503-06, paras. 104-09; *BDC Third Report and Order*, 36 FCC Rcd at 1146-51, 1164-75 paras. 47-60, 97-125; and *Establishing the Digital Opportunity Data Collection*, Order, DA 22-241 (WTB/OEA/OET Mar. 9, 2022) (*BDC Mobile Technical Requirements Order*). Given the timeline for the challenge process, it was not possible to incorporate processed challenge data into this *Report*.

[21] *Broadband Data Task Force Announces the Start of the Broadband Serviceable Location Fabric Bulk Challenge Process*, Public Notice, DA 22-913 (BDTF/WCB/OEA Sept. 1, 2022).

[22] The Fabric is a common dataset of all locations in the United States where fixed broadband Internet access service (BIAS) is or can be installed. 47 U.S.C. § 642(b)(1)(A)(i). The Fabric is to contain geocoded information for each location, to serve as the foundation for which all fixed BIAS availability data are reported and overlaid, and the Commission is required to update it at least every 6 months. *Id.* § 642(b)(1)(B).

[23] We note that for the Dec. 2021 FCC Form 477 filing, AT&T Wireless, T-Mobile, UScellular, Verizon Wireless, and their subsidiaries voluntarily reported FCC Form 477 4G mobile wireless deployment data using the same parameters and assumptions as required in the BDC.

[24] *See, e.g., Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion*, GN Docket No. 19-285, 2020 Broadband Deployment Report, 35 FCC Rcd 8986, 8997-98, para. 24 (2020) (*2020 Broadband Deployment Report*); *2020 Communications Marketplace Report*, 36 FCC Rcd at 2991, para. 67; *2018 Communications Marketplace Report* 33 FCC Rcd at 12651, para. 184. The FCC Form 477 deployment data are available to the public, which increases the transparency of our analysis and permits the public to independently assess our broadband service deployment data. The Commission has collected FCC Form 477 deployment data since 2014; thus, these data have provided a consistent yardstick against which to measure year-over-year broadband deployment.

A. The Fixed Broadband Services Marketplace

14. We first examine the state of competition in the fixed broadband services marketplace. In this section, we examine the various fixed technologies that ISPs currently deploy, describe the service providers, and provide information on connections/subscribers and adoption rates. Further, we consider competition in fixed broadband, including a discussion of investment trends, pricing, speed, and the number of households that have access to multiple providers. In addition, we describe findings from the latest Measuring Broadband America (MBA) report, which provides a snapshot of fixed broadband Internet access service performance in the United States.

15. We measure fixed deployment using data at the census block level. For purposes of the analysis in this *Report*, a census block is classified as served if the FCC Form 477 data indicate that service is available in the census block, even if not to every location.[25] Therefore, it is not necessarily the case that every household, housing unit, or person will have coverage from a given service provider[26] in a census block that this analysis indicates is served.[27] As the Commission has previously explained, given the data, this analysis likely overstates the coverage experienced by some consumers, especially in large or irregularly-shaped census blocks.[28] Our analysis of deployment for both fixed (and mobile) services uses census block data developed by the U.S. Census Bureau and Commission staff estimates.[29]

1. Overview of the Fixed Broadband Marketplace

16. In examining the fixed marketplace, we will consider various factors, such as trends in technologies, speed, and pricing. Actual speeds consumers experience vary by connection technology, and, when given a choice, most consumers subscribe to technologies that are capable of providing faster speeds.[30] Since the last *Report*, the number of fixed terrestrial residential connections capable of meeting a download speed threshold of 100 Mbps increased from approximately 66.4 million to 82.9 million, an

[25] *See, e.g.*, *2020 Communications Marketplace Report*, 36 FCC Rcd at 2992, para. 69.

[26] In addition, a provider that reports offering service at a given speed in a particular census block may not offer service at that speed to all locations in the census block. Accordingly, the number of providers presented in this *Report* does not necessarily reflect the number of choices available to a particular household and does not purport to measure competition.

[27] A household consists of all the people who occupy a housing unit. A house, an apartment or other group of rooms, or a single room is regarded as a housing unit when it is occupied or intended for occupancy as separate living quarters; that is, when the occupants do not live with any other persons in the structure and there is direct access from the outside or through a common hall. U.S. Census Bureau, *Subject Definitions*, https://www.census.gov/programs-surveys/cps/technical-documentation/subject-definitions html#household (last visited Oct. 6, 2022).

[28] *See, e.g.*, *2020 Broadband Deployment Report*, 35 FCC Rcd at 8998, para. 26; *Inquiry Concerning Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion*, GN Docket No. 18-238, 2019 Broadband Deployment Report, 34 FCC Rcd 3857, 3869, para. 25 & n.92 (*2019 Broadband Deployment Report*).

[29] Commission staff developed population estimates for 2011-2020 and for 2021 by updated Census Bureau-level population and household-level data. These estimates are based on annual U.S. Census mid-year county- (or county-equivalent) level population and housing unit estimates for the 50 states, the District of Columbia, and Puerto Rico. These data are used in conjunction with U.S. Census Bureau Topological Integrated Geographic Encoding and Referencing (TIGER) data to indicate new roads, that is, new housing development, to distribute population amongst the census blocks comprising each county (or county-equivalent). FCC, *Staff Block Estimates*, https://www.fcc.gov/reports-research/data/staff-block-estimates (last visited Oct. 3, 2022) (Staff Block Estimates).

[30] Since the *2020 Communications Marketplace Report*, the proportion of residential subscribers choosing higher speed services increased significantly. *See infra* section II.A.1.c.

increase of approximately 25%.[31] Further, approximately 64% of households are located in census blocks that have at least two options for services meeting a 100/20 Mbps speed threshold; and approximately 4% of households are located in census blocks that have at least two options for services meeting a 940/500 speed threshold.[32] We note that pricing is a difficult metric to capture, as it is dependent on various product characteristics and can change with time or the bundle offer. This *Report* provides a snapshot of prices for Internet-only packages. We show that as broadband speeds increase, so do prices across cable, DSL, fiber, and fixed wireless technologies.

a. Technologies Deployed

17. Consumers access the Internet through a variety of fixed technologies, including cable broadband service, copper (including DSL), fiber to the premise, terrestrial fixed wireless service, and satellite service. These services differ in their availability, and also in characteristics such as speed, latency, reliability, and price.[33] In this *Report*, as discussed above, we primarily use FCC Form 477 data because the BDC has only undergone one collection round and the challenge and verification processes have been underway for a relatively short period. Further, and unless otherwise explicitly stated, the data we use in our analysis of the fixed marketplace are for the 50 states, the District of Columbia, and Puerto Rico only.[34] For purposes of our analysis, a census block is classified as served if the FCC Form 477 deployment data indicate that service can be provided to some, even if not all, locations in the census block. To give context to consumer purchase patterns of these technologies, we also provide an overview of consumer subscription to these services. Figure II.A.1 shows household deployment estimates and residential connections by technology for any speed reported.[35]

[31] Staff calculations are based on FCC Form 477 data as of December 31, 2019 and December 31, 2021 (for the 50 states, the District of Columbia, and Puerto Rico).

[32] *See infra* Fig. II.A.28. Some ISPs advertise 1 GB service; however, these services are not symmetric in terms of download and upload speeds. Further, 1 GB service is often marketed as providing speeds "up to" 1 GB. For example, Verizon Fios 1 GB service has maximum advertised speeds of 940/880 Mbps. *See* FCC Form 477 Data, as of Dec. 31, 2021; *see also* FCC, *Eleventh Measuring Broadband America Fixed Broadband Report* at 11 (2021), https://data.fcc.gov/download/measuring-broadband-america/2021/2021-Fixed-Measuring-Broadband-America-Report.pdf (*Eleventh Measuring Broadband America Fixed Broadband Report*). The *Eleventh Measuring Broadband America Fixed Broadband Report* is provided in Appx. C. When reporting speed throughout this *Report*—e.g., 25/3 Mbps—the first number is the download speed and the second number is the upload speed.

[33] Latency refers to the time it takes for a data packet to travel back and forth through the network.

[34] We exclude American Samoa, Guam, the Northern Mariana Islands, and the U.S. Virgin Islands from our analysis because the U.S. Census Bureau does not plan to release block-level 2020 data until July 2023. *See* U.S. Census, *2020 Island Areas Censuses Data Products* (July 13, 2022), https://www.census.gov/programs-surveys/decennial-census/decade/2020/planning-management/release/2020-island-areas-data-products.html.

[35] The FCC Form 477 deployment data are grouped into the following categories: cable (technology codes 40, 41, 42, 43, and 44); Data Over Cable Service Interface Specifications 3.1 (DOCSIS 3.1) (technology code 43); wireline (technology codes 10, 11, 12, 20, 30, and 90); other copper (technology code 30); fiber (technology code 50); satellite (technology code 60); and terrestrial fixed wireless (technology code 70). We include residential connections to other copper (technology code 30), all other (technology code 0) and electric power line (technology code 90) in copper to maintain confidentiality of filer connection data. Other copper includes all copper-wire based technologies other than xDSL (Ethernet over copper and T-1 are examples). FCC Form 477 Local Telephone Competition and Broadband Reporting Instructions for filings as of December 31, 2019 and Beyond, at 30. As of December 31, 2021, there are no reported FCC Form 477 data for DOCSIS 4.0 (technology code 44). The FCC Form 477 residential connection data include only one response category for cable services. This means that we cannot separately report residential connections to a DOCSIS 3.1 technology from residential connections to older cable technologies. The maximum reported speed for deployed services and connections data is capped at 10 gigabytes. As of year-end 2021, there were 130 million households in the United States. *See* Staff Block Estimates.

Fig. II.A.1
Deployment (millions) and Total Residential Connections (millions) of Fixed Services in the United States, by Technology, for Any Reported Speed (Dec. 31, 2021)

Technology	Deployment		Residential Connections	Residential Take Rate
	Households	Percentage		
Cable	109.984	84.8%	71.802	64.3%
DOCSIS 3.1	101.606	78.4%		
Copper (incl. DSL)	114.042	88.0%	15.211	13.3%
Other Copper	1.807	1.4%		
Fiber (FTTP)	62.224	48.0%	24.165	38.8%
Satellite Services	129.659	100.0%	1.692	1.3%
Terrestrial Fixed Wireless	110.127	84.9%	2.672	2.4%

Source: FCC Form 477 year-end deployment and connections; Staff Block Estimates.

18. *Cable Broadband Service*. Cable broadband service delivers broadband using infrastructure originally deployed for cable television. The majority of residential consumers subscribe to cable services. Since the last *Report*, the number of residential connections to cable services increased from 67.1 million to 71.8 million.[36] This service is provisioned over coaxial cables that deliver cable TV programming and Internet service on separate channels (or frequencies). Currently, most providers of cable broadband service have deployed a hybrid fiber-coaxial (HFC) technology that transmits signals over a fiber from the provider's facility to an optical node near the consumer.[37] These providers typically use coaxial cable to send the signal from the optical node to the customer's end location. Data Over Cable Service Interface Specifications 3.1 (DOCSIS 3.1), the latest cable standard deployed, is deployed to census blocks containing approximately 78% of U.S. households. In terms of speed, the weighted mean advertised download speed for cable broadband subscribers participating in the Commission's MBA program was approximately 178 Mbps as of October 2020, and participants, on average, experienced speeds that met or exceeded their advertised download speed.[38] The weighted mean maximum advertised download speed for residential cable broadband connections reported in the December 2021 FCC Form 477 data was approximately 325 Mbps. DOCSIS 4.0, which will enable services in excess of multiple Gbps, is expected to be rolled out by cable providers in late 2022 and early 2023.[39]

19. *Copper*. Copper, including traditional DSL, is the oldest last mile broadband technology still in use. It is commonly used by traditional telephone companies, and transmits data via a modem over traditional copper telephone lines to consumers.[40] Since the last *Report*, residential connections to copper services fell from 17.9 million to 15.2 million, a reduction of almost 15%.[41] Although widely available because it is built on the existing telephone network, this service is generally slower than other types of broadband services.[42] Copper-based services, such as DSL service, are limited by the distance between

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[36] *See infra* Fig. II.A.10; *2020 Communications Marketplace Report,* 36 FCC Rcd at 3001, para. 86, Fig. II.B.1. The number of residential fixed connections reported in Fig. II.A.10 may differ from those in the last *Report* because some filers have updated their connections data and the figures in this year's *Report* only include data for the states, the District of Columbia, and Puerto Rico. *2020 Communications Marketplace Report*, 36 FCC Rcd at 3001, para. 86, Fig. II.B.1.

[37] *2020 Communications Marketplace Report*, 36 FCC Rcd at 3001, para. 87.

[38] *See infra* Appx. C: *Eleventh Measuring Broadband America Fixed Broadband Report* at 8, 13, 15.

[39] Jeff Baumgartner, Broadband World News, *Comcast tests 4-Gig speeds on DOCSIS 4.0 modem prototype*, (Jan. 13, 2022), https://www.broadbandworldnews.com/document.asp?doc_id=774597.

[40] *2020 Communications Marketplace Report*, 36 FCC Rcd at 3001, para. 88.

[41] *See infra* Fig. II.A.10.

[42] *See infra* Appx. C: *Eleventh Measuring Broadband America Fixed Broadband Report* at 13.

the telephone provider's central office and the consumer's home such that the speed of the service decreases as the distance between these two endpoints increases.[43] The weighted mean advertised download speed for residential DSL subscribers participating in the Commission's MBA program was 21 Mbps; however, participants, on average, experienced speed that did not meet their advertised download speed.[44] The weighted mean maximum advertised download speed for residential DSL connections reported in the December 2021 FCC Form 477 data was approximately 30 Mbps.

20. *Fiber*.[45] Since the last *Report*, residential fiber-to-the-premises (FTTP) connections increased from 16.3 million to 24.2 million, a 49% increase in two years.[46] FTTP uses optical fiber to deliver a signal from the operator's equipment to the residential customer.[47] This service can offer the consumer the highest speed among all currently available services because the fiber connects directly to the consumer's residence.[48] The weighted mean advertised download speed for residential fiber connections participating in the Commission's MBA program was 447 Mbps and participants, on average, experienced speeds that met or exceeded their advertised download speed.[49] The weighted mean maximum advertised download speed for residential fiber connections reported in the December 2021 FCC Form 477 data was approximately 518 Mbps.

21. *Fixed Satellite Service (FSS)*. FSS is the transmitting and receiving of communications signals from earth stations, including customer stations, that are located at fixed points on earth. One of the benefits of satellite technology is its ability to deliver services in remote areas that are unserved or underserved by terrestrial services, and satellite can play a key role in delivering services in disaster areas and humanitarian efforts, such as the humanitarian crisis resulting from the war in Ukraine.[50] Hybrid networks that combine satellite and terrestrial transport are designed to provide broadband service to consumers that reside outside the footprint of cable and fiber networks.[51] Since the last *Report*, residential connections declined from 1.8 million to 1.7 million, a 6% decrease in two years.[52] The weighted mean maximum advertised download speed for residential subscriber data reported in the December 2021 FCC Form 477 data was approximately 28 Mbps.

22. *Terrestrial Fixed Wireless Broadband*. Terrestrial fixed wireless providers deliver broadband service to consumers using licensed, unlicensed, and shared access spectrum, while often

[43] *2020 Communications Marketplace Report*, 36 FCC Rcd at 3002, para. 88. FTTN and FTTC services are reported in FCC Form 477 as DSL service because this service is ultimately delivered to the end-user via twisted-pair copper wiring. FCC, *FCC Form 477 Local Telephone Competition and Broadband Reporting Instructions for Filings as of December 31, 2019 and Beyond* at 30 (2021) (FCC Form 477 Reporting Instructions).

[44] *See infra* Appx. C: *Eleventh Measuring Broadband America Fixed Broadband Report* at 8, 13, 15.

[45] Fiber-to-the-node (FTTN) and fiber-to-the-curb (FTTC) services rely on a fiber-optic connection from a local central office to the neighborhood (node or curb) and then a twisted-pair copper wiring from the node or utility pole to the consumer's home. These services are typically slower than FTTP services because the connection to the consumer is over twisted-pair copper, and are reported in FCC Form 477 as a DSL service. *See 2020 Communications Marketplace Report*, 36 FCC Rcd at 3002, para. 89; FCC Form 477 Reporting Instructions at 30.

[46] *See infra* Fig. II.A.10.

[47] *2020 Communications Marketplace Report*, 36 FCC Rcd at 3002, para. 89.

[48] *See* Diana Goovaerts, Fierce Telecom, Fierce Fundamentals, *What is fiber broadband?* (May 16, 2022), https://www.fiercetelecom.com/broadband/fierce-fundamentals-what-fiber-broadband.

[49] *See infra* Appx. C: *Eleventh Measuring Broadband America Fixed Broadband Report* at 8, 13, 15.

[50] EchoStar Comments at 3, 5; SIA Comments at 15-16.

[51] EchoStar Comments at 3-4; SIA Comments at 9-10; SES and 03B Reply at 2-5; *see also* n.645.

[52] *See infra* Fig. II.A.10.

relying on fiber optics to form parts of the rest of their network infrastructure.[53] Terrestrial fixed wireless providers receive broadband content from an external distribution point via fiber or microwave connections,[54] and then they deliver service to a customer's fixed antenna from wireless transmitters on towers.[55] Since the last *Report*, residential connections increased from 1.5 million to 2.7 million, a 76% increase in two years.[56] The weighted mean maximum advertised download speed for residential fixed wireless connections reported in the December 2021 FCC Form 477 data was approximately 63 Mbps. Moreover, consumers are gaining additional options with the rollout of 5G services.[57]

(i) Coverage by Technology

23. Figure II.A.2 shows how each fixed broadband technology covers the U.S. population by census block over time. FTTP and DOCSIS 3.1, two technologies that have considerable download speed capabilities, have shown significant growth over the last six years.[58] In addition, there has been a sharp increase in the population residing in a census block with terrestrial fixed wireless technology between December 2020 and December 2021.

[53] WISPA Comments at 3, 8; *2020 Communications Marketplace Report*, 36 FCC Rcd at 3003, para. 91.

[54] WISPA Comments at 8; WISPA Comments, Attach. B at 7-8.

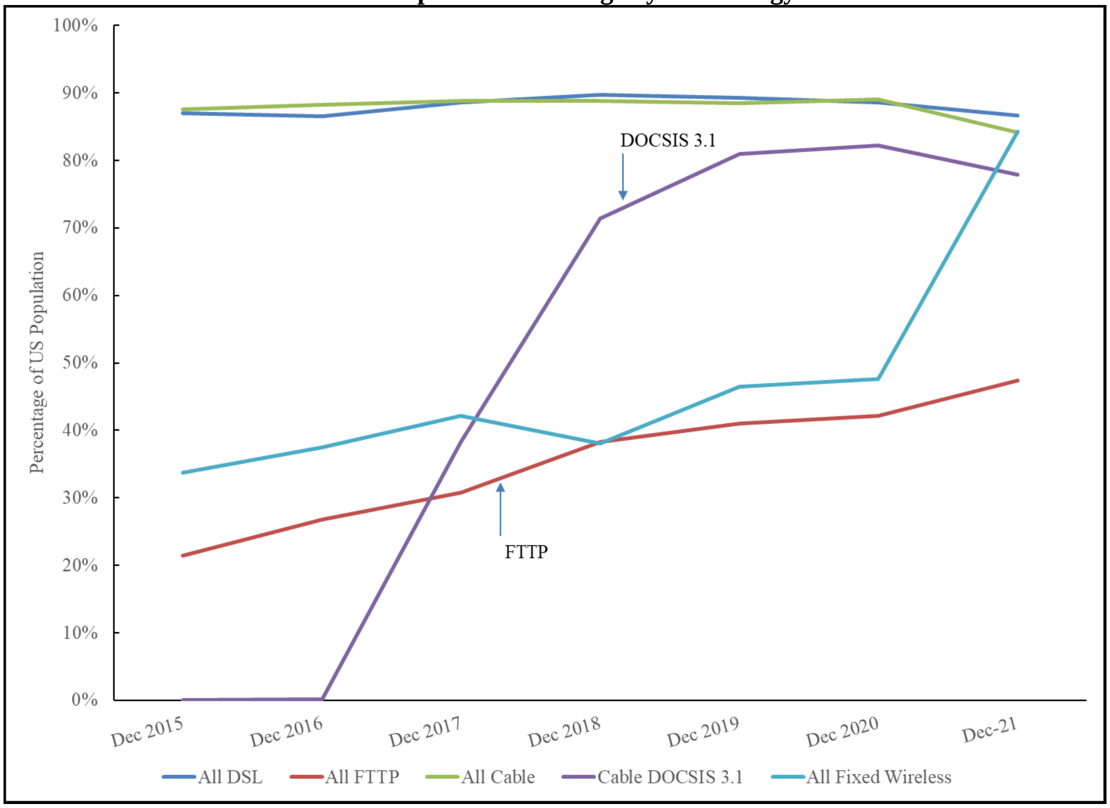
[55] WISPA Comments at 8; WISPA Comments, Attach. B at 7-8.

[56] *See infra* Fig. II.A.10.

[57] FSF Comments at 6-7; CTIA Comments at 14-17.

[58] According to USTelecom, U.S. fixed broadband providers invested approximately $86 billion in capital expenditures in 2021, up from nearly $80 billion in 2020. Overall, broadband providers have invested more than $2 trillion in capital expenditures since 1996. USTelecom, 2021 Broadband Capex Report (July 2022), https://www.ustelecom.org/research/2021-broadband-capex-report/.

Fig. II.A.2
U.S. Population Coverage by Technology

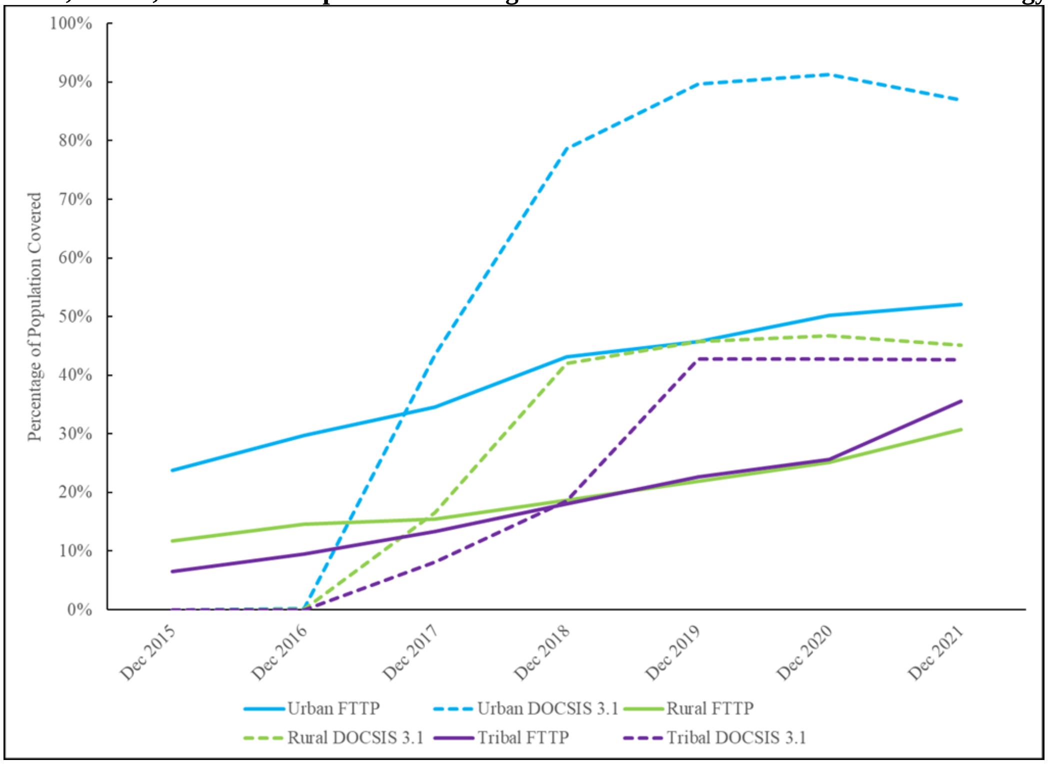


Source: FCC Form 477; 2020 Census data.

24. Access to FTTP and DOCSIS 3.1 is significantly lower in rural areas compared to urban areas. Figure II.A.3 shows the change in population coverage of FTTP and DOCSIS 3.1 technology in rural, urban, and Tribal lands. The growth rate of FTTP coverage is similar in rural and urban areas; each area's FTTP coverage has increased by a factor of two since 2015. Approximately 52% of the population living in an urban census block has access to FTTP technology, compared to approximately 31% of the population living in rural census blocks. Compared to other technologies, DOCSIS 3.1 covers the largest number of individuals in the United States as of December 2020, and DOCSIS 3.1 has seen the largest increase in growth over the last five years. The widespread deployment of this technology is likely one of the drivers of the increase in access to faster speeds, as it is capable of download speeds of up to 10 GB. However, there is some disparity in where providers deploy this technology. Figure II.A.3 shows 87% of the population living in urban census blocks have access to this technology, while approximately only 45% of the population living in rural census blocks and 43% of the population on Tribal lands have access.[59]

[59] These deployment patterns correspond to speed availability metrics from the *Fourteenth Broadband Deployment Report*, that shows approximately 95% of the urban population, 56% of the rural population, and 50% of the tribal population have access to 250/25 Mbps. *See Inquiry Concerning Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion*, GN Docket No. 20-269, Fourteenth Broadband Deployment Report, 36 FCC Rcd 836, 858, para. 38 (2021) (*Fourteenth Broadband Deployment Report*).

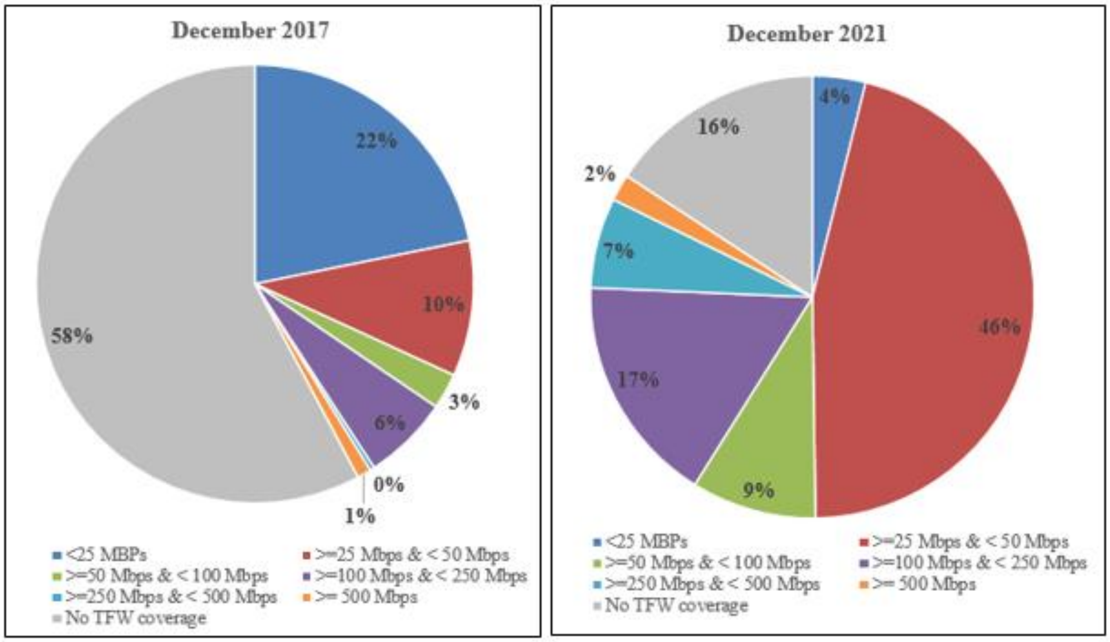
Fig. II.A.3
Rural, Urban, and Tribal Population Coverage for FTTP and Cable DOCSIS 3.1 Technology



Source: FCC Form 477; 2010 and 2020 Census data.

25. Figure II.A.4 shows that terrestrial fixed wireless technologies have expanded throughout the United States since 2017. As of December 2021, approximately 84% of the U.S. population lived in a census block that had access to terrestrial fixed wireless technology, compared to approximately 42% in December 2017. In addition to this technology becoming more widespread, the download speeds available through this technology also have increased; however, the speeds available may vary within each census block. Figure II.A.4 shows that in 2017, approximately 22% of the U.S. population lived in census blocks that had access to fixed wireless download speeds of 25 Mbps or less; however, by 2021, that number had fallen to just 4%. Conversely, the percentage of the U.S. population that lived in census blocks had access to download speeds between 25 Mbps and 50 Mbps had more than quadrupled. Notably in 2017, only about 1% of the U.S. population in a census block covered by terrestrial fixed wireless technology had access to download speeds between 250 Mbps and 500 Mbps; however, by 2021, that had increased seven-fold.

Fig. II.A.4
Percentage of U.S. Population Covered by Terrestrial Fixed Wireless by Download Speed



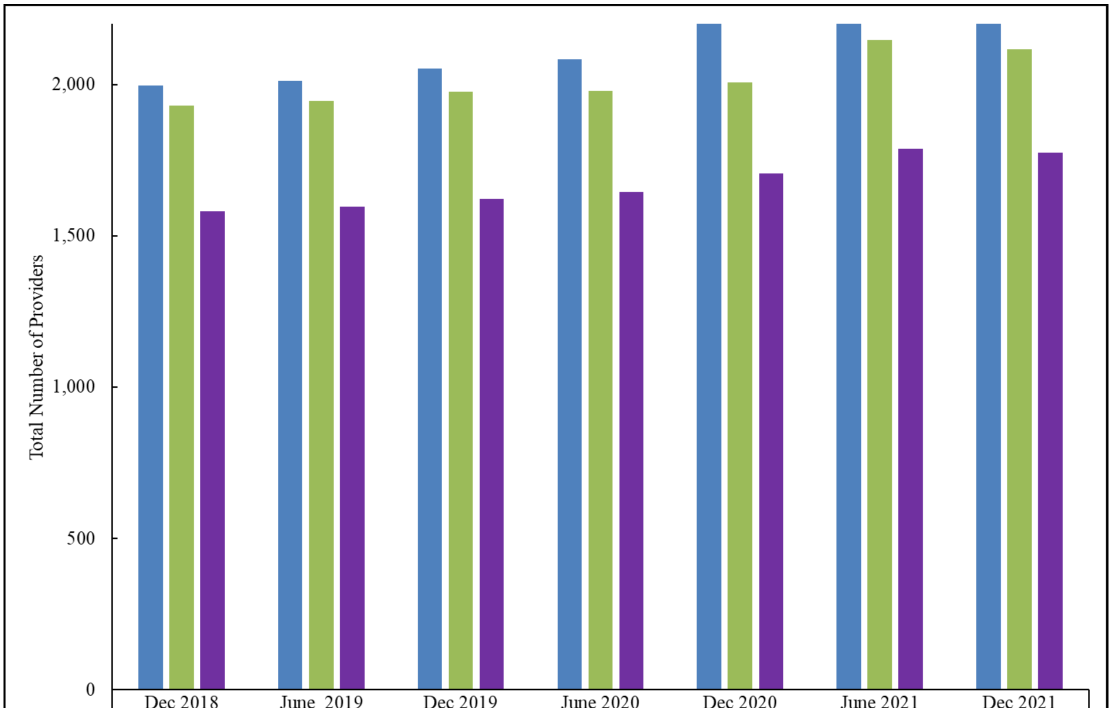
Source: FCC Form 477; 2020 Census data.

b. Service Providers

26. As of December 2021, there were 2,201 entities of varying sizes and deployment footprints that reported providing fixed broadband technology services to residential consumers at speeds exceeding 200 kbps in at least one direction.[60] Figure II.A.5 presents the total number of providers of fixed broadband services, as well as the number of fixed broadband providers in rural and urban areas, from December 2018 through December 2021. The total number of providers has increased by approximately 10% since December 2018. The growth in the number of providers is similar in urban and rural areas. Between December 2018 and December 2021, the number of providers in urban areas and rural areas increased by approximately 12% and approximately 10%, respectively.

[60] The provider information in this section excludes providers who provide FSS only.

Fig. II.A.5
Total Number of Providers of Residential Fixed Services over Time (Dec. 31, 2021)

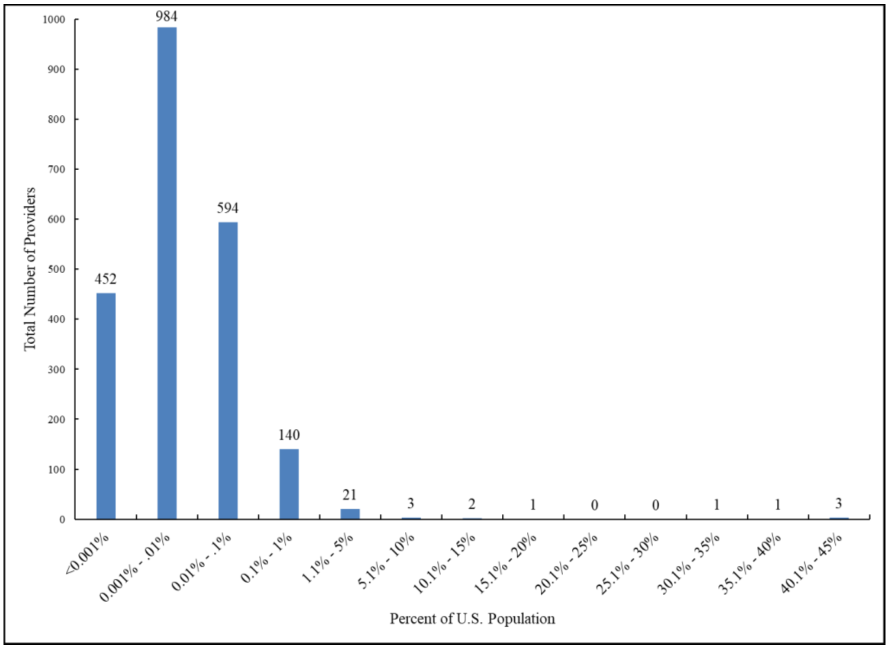


	Dec 2018	June 2019	Dec 2019	June 2020	Dec 2020	June 2021	Dec 2021
Total	1,996	2,012	2,052	2,084	2,204	2,219	2,201
Rural	1,931	1,947	1,976	1,979	2,008	2,148	2,117
Urban	1,581	1,596	1,623	1,644	1,707	1,788	1,776

Source: FCC Form 477 deployment data for residential consumers; 2010 and 2020 Census.

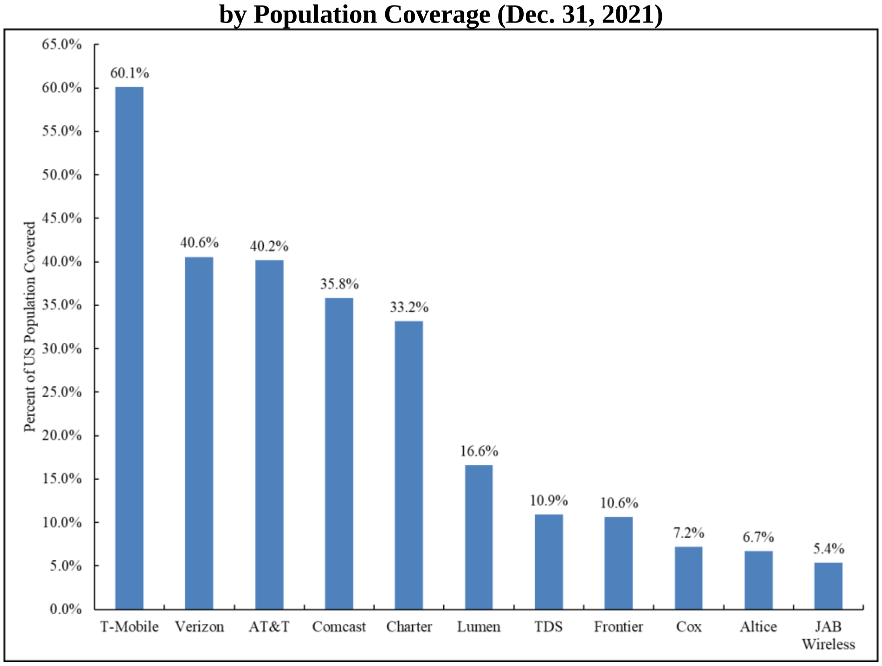
27. *Top 11 Providers—Providers that cover at least 5% of the U.S. population*. While there are over 2,000 providers of residential services, there is considerable variation in provider size and deployment footprint. The overwhelming majority of providers cover less than 1% of the U.S. population. Figure II.A.6 shows that in December 2021, only 11 providers covered at least 5% of the U.S. population, based on their reported deployment data; this is an increase from nine providers in December 2019. As presented in Figure II.A.7, these providers are: T-Mobile, Verizon, AT&T, Comcast, Charter, Lumen Technologies (CenturyLink), TDS, Frontier, Cox Communications, Altice USA, and Jab Wireless (Rise). T-Mobile covered approximately 60% of the U.S. population through their fixed wireless technology, making it the provider with the largest footprint of fixed broadband. Both Verizon and AT&T covered approximately 40% of the U.S. population, and Comcast and Charter covered approximately 36% and 33%, respectively. There is a large falling-off in deployment coverage after the top five: Lumen Technologies (CenturyLink) covered approximately 17% of the population, followed by TDS and Frontier at approximately 11%. The remaining three providers each covered between approximately 5% and 7% of the U.S. population.

Fig. II.A.6
Total Number of Providers of Residential Fixed Services of the United States by Population Coverage (Dec. 31, 2021)



Source: FCC Form 477 deployment data for residential consumers; 2020 Census.

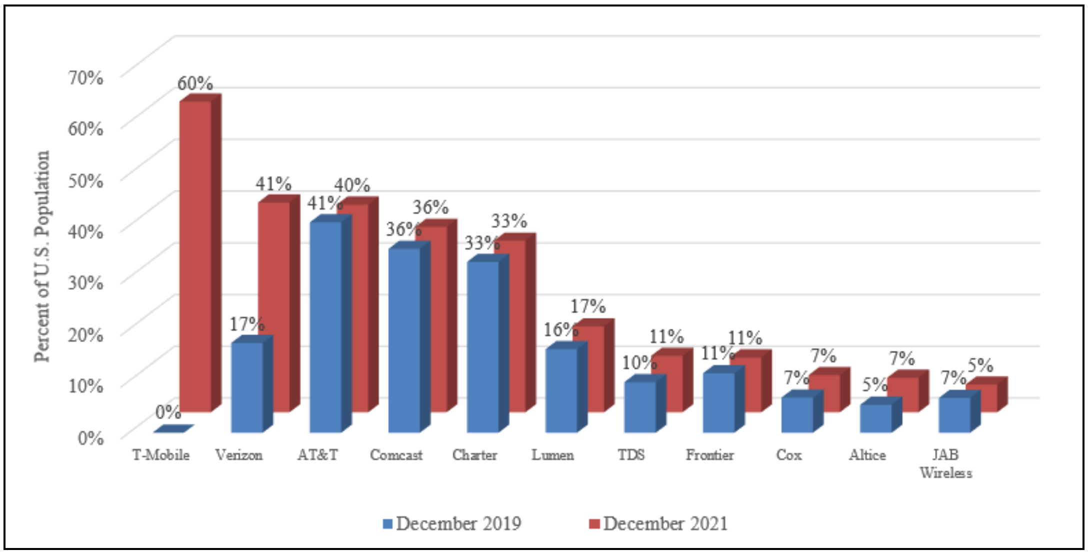
Fig. II.A.7
Top 11 Provider Footprints for Residential Fixed Services in the United States by Population Coverage (Dec. 31, 2021)



Source: FCC Form 477 deployment data for residential consumers; 2020 Census data.

28. *The Top 11 Providers Over Time—Population Coverage*. Figure II.A.8 shows the change in population coverage over the last two years for each of the top 11 providers, as described above. For the most part, population coverage has remained consistent over this time frame, with a few significant exceptions. For example, T-Mobile jumped from no population coverage in December 2019 to approximately 60% population coverage in December 2021 through newly providing terrestrial fixed wireless services. Verizon increased its population coverage from approximately 17% to 41% over this time frame, also largely due to substantially increasing its terrestrial fixed wireless deployment.

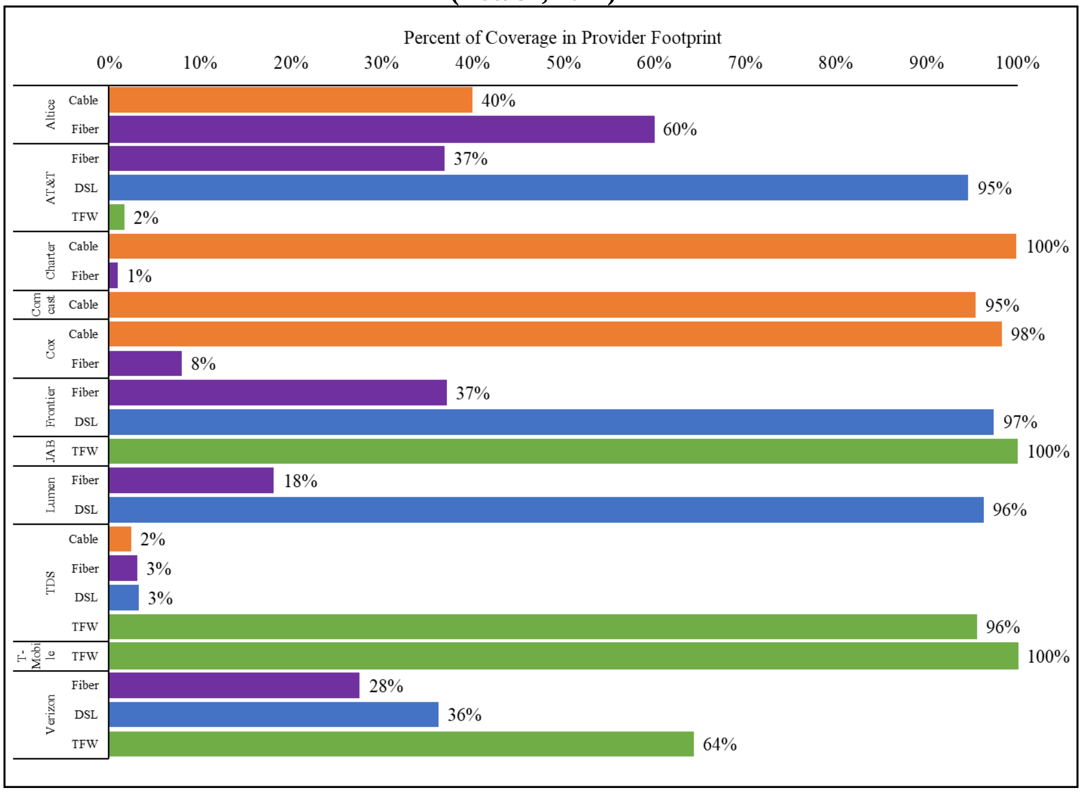
Fig. II.A.8
Provider Population Coverage for Residential Fixed Services in the United States
Dec. 2019 vs. Dec. 2021



Source: FCC Form 477 deployment data for residential consumers; 2010 and 2020 Census.

29. *The Top 11 Providers—Provider Footprint by Technology*. As seen in Figure II.A.9, T-Mobile's entire fixed footprint is through terrestrial fixed wireless technology, whereas Comcast and Charter almost exclusively provide fixed broadband through cable. In contrast, AT&T provides broadband access with a combination of technologies, covering approximately 95% of its service area with DSL in addition to covering approximately 37% of its service area with fiber, and approximately 2% through terrestrial fixed wireless technology. Lumen Technologies (CenturyLink) and Frontier also each use a combination of technologies, covering almost their entire service areas with DSL while covering approximately 18% and 37% of their service areas with fiber. Verizon covers almost 28% of its footprint with fiber, approximately 36% of its footprint with DSL, and approximately 64% of its footprint with terrestrial fixed wireless technology. Figure II.A.9 shows a detailed breakdown of the technology composition of each provider's deployment footprint.

Fig. II.A.9
Technology Composition of Provider Footprint for Residential Fixed Services in the United States (Dec. 31, 2021)[61]



Source: FCC Form 477 deployment data for residential consumers; 2020 Census. TFW is terrestrial fixed wireless.

c. Residential Connections

30. This section reports residential fixed connections (subscriptions) in the United States, and includes all technologies for which the FCC Form 477 data are collected. Connection data are collected at the census tract level. Figure II.A.10 shows the number of fixed residential connections for all technologies and for any reported speed for year-end 2018 to year-end 2021. Since 2018, the number of residential fixed connections in the United States has increased over 14%, from approximately 101.3 million connections in 2018 to over 115.5 million connections in 2021. During this time period, residential cable, FTTP and fixed wireless connections also increased, while residential copper-based services, including DSL connections, continued to decline. In contrast, residential satellite connections had periods of growth and decline during this reporting period. Since 2018, FTTP residential connections grew approximately 70%, and terrestrial fixed wireless grew approximately 101%. Cable services continue to be the technology with the largest portion of residential fixed broadband connections. In December 2021, approximately 62% of fixed residential connections were cable, 21% were FTTP, 13% were copper-based, and the remaining 4% were split between satellite, terrestrial fixed wireless, and other technologies.

[61] A provider may offer more than one fixed connection technology in some areas, thus the percentages for a provider may total over 100%.

Fig. II.A.10
Fixed Residential Connections (millions) for Any Reported Speed 2018-2021[62]

	2018	2019	2020	2021
Cable	63.774	67.100	72.497	71.802
FTTP (Fiber)	14.202	16.270	18.378	24.165
Copper (including DSL)[63]	20.184	17.943	16.958	15.211
Terrestrial Fixed Wireless	1.330	1.522	1.943	2.672
Satellite	1.786	1.795	1.752	1.692
Total Fixed	101.277	104.629	111.528	115.541

Source: FCC Form 477 year-end residential connections.

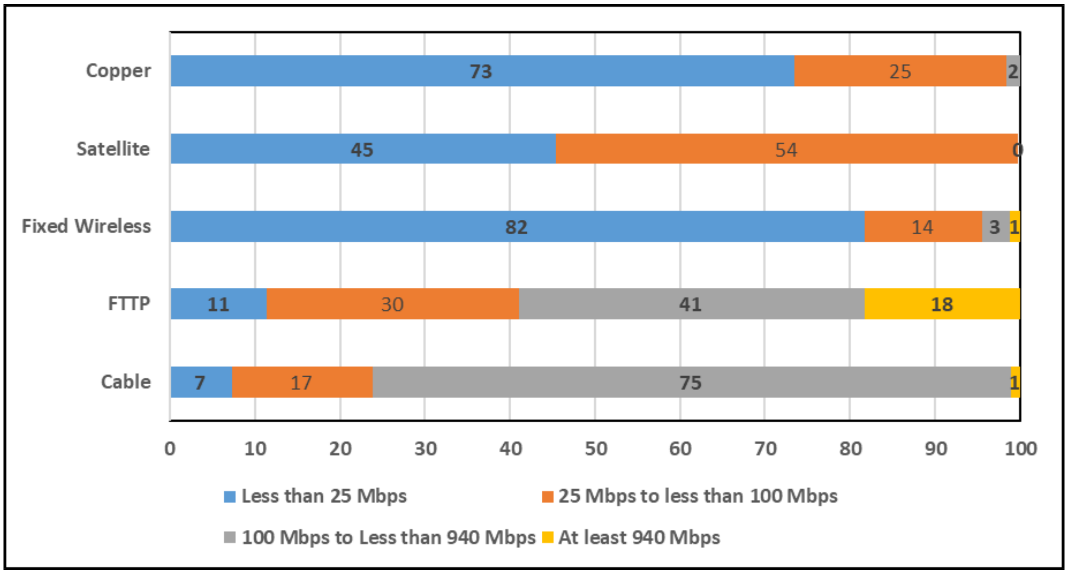
31. Figures II.A.11 and II.A.12 report the percentage of residential connections by technology and download speed as of December 31, 2018 and December 31, 2021, respectively. For purposes of this analysis, we examine maximum advertised download speeds for four speed thresholds: less than 25 Mbps, 25 Mbps to less than 100 Mbps, 100 Mbps to less than 940 Mbps, and at least 940 Mbps.[64] Between 2018 and 2021, the percentage of connections meeting the at least 940 Mbps speed threshold increased from over 18% to approximately 40% for FTTP services, and from approximately 1% to almost 9% for cable services.

[62] FCC Form 477 defines an Internet access connection as a wired line or wireless channel that terminates at an end-user location or mobile device and enables the end user to receive information from and/or send information to the Internet at information transfer rates exceeding 200 kilobits per second (kbps) in at least one direction. This definition, for purposes of the FCC Form 477, is established in section 1.7001(a)(1) of the Commission's rules. 47 CFR 1.7001(c)(1). The number of residential fixed connections reported in Fig. II.A.10 may differ from those in Fig. II.B.1 of the last *Report*. Some filers have updated their connections data and the figures in this year's *Report* include Puerto Rico while the prior report excluded all U.S. territories. *2020 Communications Marketplace Report*, 36 FCC Rcd at 3001, para. 86, Fig. II.B.1.

[63] Copper includes all copper-wire-based technologies and power line technologies. These technologies are combined into a single category to maintain confidentiality.

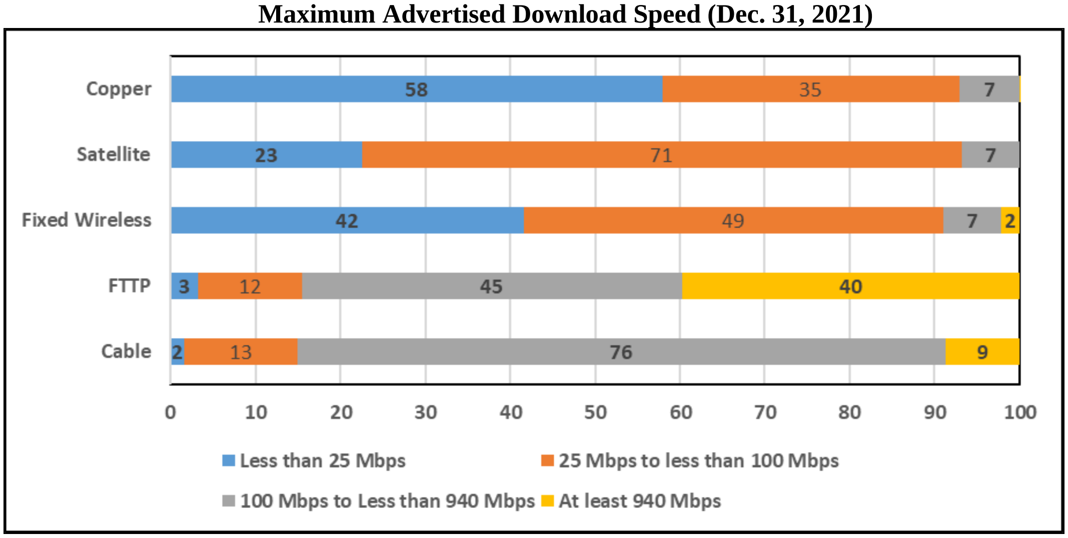
[64] For purposes of this *Report*, we use a download speed of 940 Mbps because that is the maximum advertised download speed reported by two of the largest providers of residential broadband service. In terms of residential broadband coverage, Verizon is ranked second and Lumen Technologies (CenturyLink) is ranked sixth.

Fig. II.A.11[65]
Percentage of Residential Connections by Technology and Maximum Advertised Download Speed (Dec. 31, 2018)



Source: FCC Form 477 residential connections.

Fig. II.A.12
Percentage of Residential Connections by Technology and Maximum Advertised Download Speed (Dec. 31, 2021)



Source: FCC Form 477 residential connections.

32. Figure II.A.13 reports the distribution of all fixed residential connections by maximum advertised download and upload speed for the United States, urban areas, and rural areas.[66] For purposes

[65] In Figs. II.A.11 and II.A.12, copper includes all copper-wire based technologies and power line technologies. These technologies are combined into a single category to maintain confidentiality.

[66] Census tracts that are not urban are designated as rural census tracts. Because many census tracts are composed of urban and rural census blocks, the categorization of census tracts into urban and rural categories will result in some

(continued….)

of this analysis, we use the same methodology to identify urban census tracts as used by the Commission in the urban rate survey.[67] As shown in Figure II.A.13, the download/upload speed combination increased between 2018 and 2021 for all percentiles. Between 2018 and 2021, the 50th percentile (median) speed combination purchased by residential consumers increased from 100/10 Mbps to 200/10 Mbps for all census tracts, whereas the 50th percentile speed combination purchased by residential consumers in rural areas increased from 25/3 Mbps to 100/10 Mbps and the 50th percentile speed combination purchased by residential consumers in urban areas increased from 100/10 Mbps to 200/10 Mbps.

Fig. II.A.13
Distribution of Fixed Residential Connections in the United States by Consumer's Service's Download/Upload Speed Combination and Year (2018-2021)

Year	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile
All Census Tracts					
2018	10 / 1 Mbps	25 / 3 Mbps	100 / 10 Mbps	150 / 10 Mbps	250 / 20 Mbps
2019	12 / 1 Mbps	30 / 4 Mbps	100 / 10 Mbps	200 / 10 Mbps	400 / 20 Mbps
2020	15 / 10 Mbps	50 / 5 Mbps	150 / 10 Mbps	300 / 10 Mbps	940 / 880 Mbps
2021	24 / 2 Mbps	50 / 50 Mbps	200 / 10 Mbps	400 / 20 Mbps	1,000 / 35 Mbps
Rural Census Tracts					
2018	3 / 3 Mbps	10 / 1 Mbps	25 / 3 Mbps	100 / 10 Mbps	150 / 10 Mbps
2019	5 / 1 Mbps	10 / 2 Mbps	30 / 4 Mbps	100 / 10 Mbps	200 / 10 Mbps
2020	6 / 1 Mbps	14 / 6 Mbps	50 / 10 Mbps	150 / 5 Mbps	300 / 20 Mbps
2021	10 / 1 Mbps	25 / 3 Mbps	100 / 10 Mbps	300 / 10 Mbps	800 / 15 Mbps
Urban Census Tracts					
2018	12 / 2 Mbps	40 / 20 Mbps	100 / 10 Mbps	150 / 15 Mbps	250 / 25 Mbps
2019	15 / 5 Mbps	50 / 10 Mbps	100 / 100 Mbps	200 / 20 Mbps	400 / 20 Mbps
2020	24 / 3 Mbps	75 / 5 Mbps	200 / 5 Mbps	300 / 300 Mbps	940 / 880 Mbps
2021	30 / 5 Mbps	100 / 5 Mbps	200 / 10 Mbps	500 / 10 Mbps	1,000 / 35 Mbps

Source: FCC Form 477 year-end residential connections.

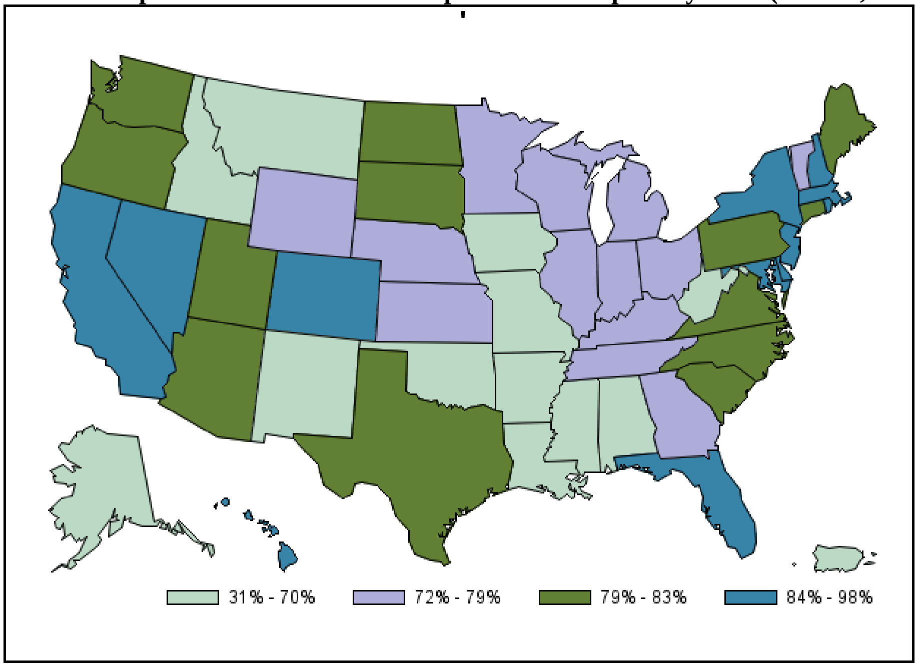
33. Figures II.A.14, II.A.15, and II.A.16 report subscribership ratio (the ratio of total fixed residential connections for all technologies to total households, regardless of whether the services are deployed in the area) for each state, the District of Columbia, and Puerto Rico, as of December 31, 2021. Figure II.A.14 shows the subscribership ratio for services with at least 25 Mbps download speed, Figure

(Continued from previous page)
urban census blocks being included in "rural" census tracts and some rural census blocks being included in "urban" census tracts.

[67] For year-end 2018-2020 FCC Form 477 data that are submitted according to 2010 Census block geographies, we define as "urban" all 2010 Census urban areas and urban clusters that sit within a Metropolitan Statistical Area. *See Connect America Fund*, WC Docket No. 10-90, Order, 28 FCC Rcd 4242, 4244, para. 10 (WCB/WTB 2013). For year-end 2021 FCC Form 477 data, we use the definition used in the urban rate survey being completed this year. *See Urban Rate Survey Timeline for 2023*, Public Notice, DA 22-859, 1 & n.2 (explaining that the release of the 2020 U.S. Census data required a new definition of "urban"). However, the U.S. Census Bureau redrew census tract boundaries, modified its definition of an urban area, and has not yet published the boundaries of these urban areas. *See* U.S. Census Bureau, *Census Relationship Files*, https://www.census.gov/geographies/reference-files/time-series/geo/relationship-files html#tract (last visited Oct. 18, 2022) (explaining how census tract geographies changed between the 2010 and 2020 Census). Thus, for purposes of this *Report*, we follow the Commission's methodology for this year's urban rate survey and define an urban tract as a 2020 census tract in which at least 80% of housing units are within a 2010 census urban area with a population of 50,000 or more. Reported speeds are rounded to the nearest Mbps.

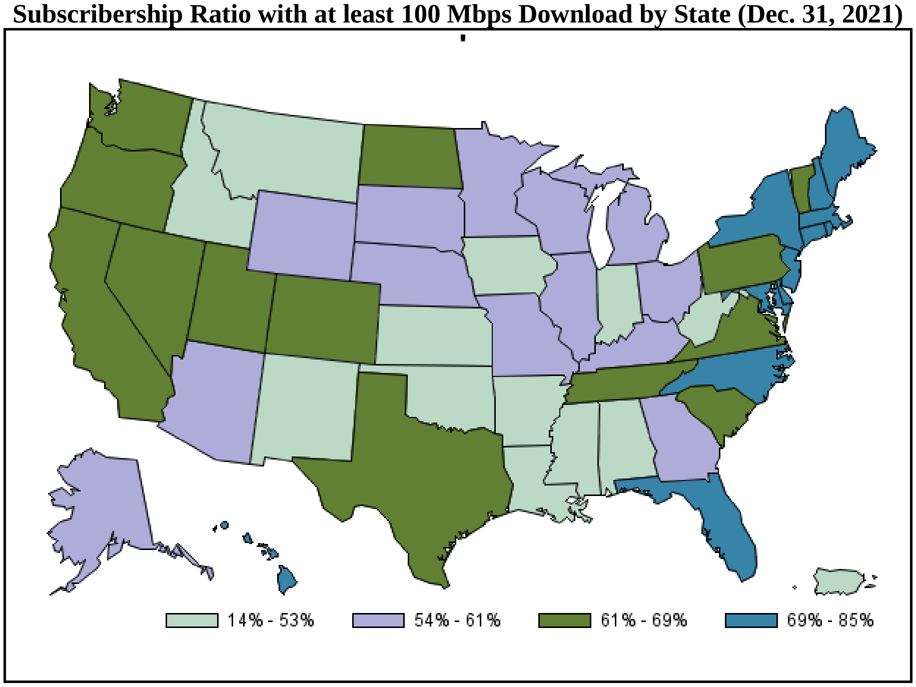
II.A.15 shows the subscribership ratio for services with at least a 100 Mbps download speed, and Figure II.A.16 shows the subscribership ratio for services with at least a 940 Mbps download speed.

Fig. II.A.14
Subscribership Ratio with at least 25 Mbps Download Speed by State (Dec. 31, 2021)



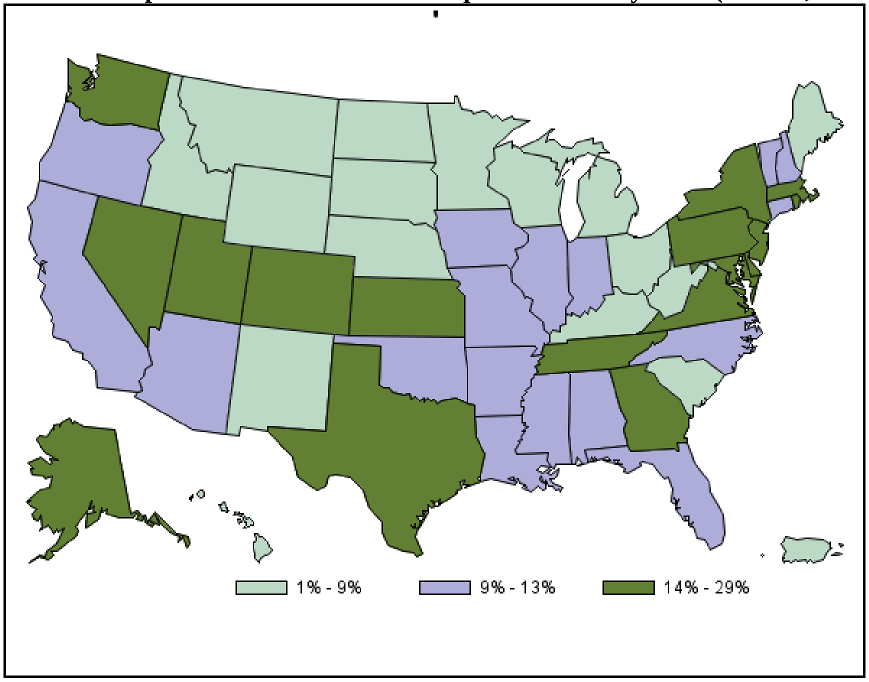
Source: FCC Form 477 residential connections; Staff Block Estimates.

Fig. II.A.15
Subscribership Ratio with at least 100 Mbps Download by State (Dec. 31, 2021)



Source: FCC Form 477 residential connections; Staff Block Estimates.

Fig. II.A.16
Subscribership Ratio with at least 940 Mbps Download by State (Dec. 31, 2021)



Source: FCC Form 477 residential connections; Staff Block Estimates.

d. Adoption Rates

34. Our assessment of adoption of broadband services in the United States from 2018 to 2021 is based upon FCC Form 477 subscriber/connection data that are collected at the census tract level, and FCC Form 477 deployment data that are collected at the census block level. For this analysis, we aggregate data up to the geographic level reported in each figure; e.g., the United States, the tract level, or the county. We evaluate the adoption of fixed terrestrial services at speeds of 25/3 Mbps, 100/20 Mbps, and 940/500 Mbps.[68] The reported adoption rates are the number of residential fixed terrestrial connections divided by the number of households located in the census blocks in which the FCC Form 477 deployment data indicate that fixed terrestrial services are deployed and meet the reported speed threshold.[69] For purposes of this analysis, we use the same methodology to identify urban tracts as used

[68] *See infra* Appx. B-1 (presenting adoption rates for fixed terrestrial services by state, the District of Columbia and Puerto Rico).

[69] In contrast to the adoption rates, the subscribership ratios reported in Figs. II.A.14, II.A.15, and II.A.16 are defined as residential connections divided by total households in the area, regardless of whether services are deployed in the area that meet the reported speed threshold.

by the Commission in the urban rate survey.[70] In addition, for purposes of this *Report*, we define a census tract as Tribal lands if more than 50% of the land area in the census tract is designated as Tribal lands.[71]

35. Figure II.A.17 reports adoption rates based on year-end data from 2018 to 2021 for the United States, urban and non-urban areas, and Tribal lands. Figure II.A.17 shows year-to-year increases in the adoption of broadband services across the vast majority of areas, including Tribal lands. As was also evident in the last *Report*, the adoption rate for higher speed services is greater on Tribal lands in rural areas than on Tribal lands in urban areas.[72] This may be the result of the sometimes relatively imprecise categorization of geographic areas as urban or rural at the census tract level (the lowest level for which subscribership data is available) as compared to the census block level. The results of this imprecision may be magnified when applied to a smaller set of census tracts, such as those on Tribal lands.

36. Figure II.A.18 reports average county-level adoption rates for fixed terrestrial services by quartile ranking for median household income, population density, the poverty rate and the proportion of

[70] We aggregate deployment data up to the census tract to identify urban and rural areas. A census tract is designated as "Urban" if the tract was designated as urban in the urban rate survey. A census tract is designated as "Rural" if the census tract was not designated as urban in the urban rate survey. Because many census tracts are composed of urban and rural census blocks, the categorization of census tracts into urban and rural categories will result in some urban census blocks being included in "rural" census tracts and some rural census blocks being included in "urban" census tracts.

[71] For purposes of the analysis of Tribal lands in this *Report*, we use the definition that was used in the *2020 Commercial Marketplace Report* and in the Commission's *Broadband Deployment Reports* since 2012. *See 2020 Communications Marketplace Report*, 36 FCC Rcd at 3014, para. 103 & n.329; *Inquiry Concerning Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion*, GN Docket No. 11-121, Eighth Broadband Progress Report, 27 FCC Rcd 10342, 10414-15 (2012). We acknowledge that the Commission has used other definitions of Tribal lands. *See, e.g., Transforming the 2.5 GHz Band*, WT Docket No. 18-120, Report and Order, 34 FCC Rcd 5446, 5465-66, paras. 51-55 (2019) (*2.5 GHz Report and Order*); *Bridging the Digital Divide for Low-Income Consumers*, Fourth Report and Order, Order on Reconsideration, Memorandum Opinion and Order, WC Docket No. 17-287, Notice of Proposed Rulemaking, and Notice of Inquiry, 32 FCC Rcd 10475 (2017); *Connect America Fund et al.*, Report and Order, WC Docket No. 10-90, Further Notice of Proposed Rulemaking, and Order on Reconsideration, 33 FCC Rcd 11893, 11910-11, para. 55 & n.122 (2018); *Wireless Telecommunications Bureau Announces Procedures for 2.5 GHz Rural Tribal Priority Window*, WT Docket No. 18-20, Public Notice, 35 FCC Rcd 308, 313, para. 19 (WTB 2020). However, for purposes of this *Report*, we maintain our definition as previously employed.

As identified by the U.S. Census Bureau, Tribal lands fall into one of the following American Indian Area/Alaska Native Area/Hawaiian Home Land Class Code categories: (1) Joint Use Areas; (2) legal federally recognized American Indian area consisting of reservation and associated off-reservation trust land; (3) legal federally recognized American Indian area consisting of reservation only; (4) legal federally recognized American Indian area consisting of off-reservation trust land only; (5) statistical American Indian area defined for a federally recognized Tribe that does not have reservation or off-reservation trust land, specifically a Tribal designated statistical area (TDSA) or Oklahoma Tribal Statistical Area (OTSA); (6) Alaskan Native village statistical area; and (7) Hawaiian Home Lands established by the Hawaiian Homes Commission Act of 1921. We exclude state recognized areas from the analysis of Tribal lands. Tribal Statistical Areas are largely located in Oklahoma, but they also include areas in California, New York, and Washington.

Because our subscriber data are submitted at the census tract level, some census tracts will contain a mixture of census blocks on Tribal lands and census blocks that are not on Tribal lands. For example, for 2021, the Tribal lands area category in the figures below contain 94% of households and 85% of the land area of census blocks that are designated as Tribal lands, and 6% of households and 15% of the land area of census blocks that are not designated as Tribal lands. Moreover, because connections data are collected at the census tract level, we have no ability to determine whether the residential connections are for households located on census blocks designated as urban, non-urban (rural), or Tribal lands.

[72] *See 2020 Communications Marketplace Report*, 36 FCC Rcd at 3014-15, para. 103, Fig. II.B.12.

the population that resides in a rural area.[73] The data are further disaggregated by speed tier.[74] In general, these data suggest that the average household adoption rate in a county increases with median household income and population density, and decreases with increases in the poverty rate and rural population rate.[75]

[73] This demographic analysis is based upon county-level adoption rates and the most recently available ACS Data; i.e., ACS Five-Year Estimates for 2016-2020 for county-level data for the 50 states, District of Columbia, and Puerto Rico. Median household income is based on 2020 data and is measured in 2020 Inflation-Adjusted Dollars. The household poverty rate is defined as the number of households living below the federal poverty rate divided by the total number of households ACS includes in the poverty calculation. The ACS Five-Year Estimates for 2017-2021 will not be released in time to be included in this *Report*. U.S. Census Bureau, *2021 Release Schedule*, https://www.census.gov/programs-surveys/acs/news/data-releases/2021/release-schedule html (last visited June 29, 2022). Population density is defined as the total population residing in the county as of 2020 divided by the square miles of land in the county, where the estimate of land area is based upon the 2020 Census. At this time, the Census Bureau has not yet identified urban and rural 2020 census blocks. We employed the 2020 Crosswalk data and the 2010 Summary file that indicates the UAtype Census variable for each 2010 census block to create a proxy urban/rural identifier for the 2020 Census blocks. A 2010 census block with a UAtype variable value of U (urbanized area) or C (Urban Cluster) is an urban census block. A 2010 census block with a UAtype variable value of 9 is a rural census block. We designate a 2020 census block as urban if any 2010 "urban" census block intersects a 2020 block. For a description of the crosswalk between the 2010 and the 2020 census blocks, *see* U.S. Census Bureau, *2020 Census Block Relationship Files Record Layouts*, https://www.census.gov/programs-surveys/geography/technical-documentation/records-layout/2020-census-block-record-layout.html (last visited Oct. 3, 2022). The rural population rate is defined as the total population residing in the county residing in the "rural" census blocks as categorized for this *Report* divided by the total population in the county based on the 2020 Census.

[74] We note that this analysis is based upon the best data currently available and may not accurately reflect how adoption may be associated with the subscriber's demographic data. Our connections data are based upon the data submitted by the providers, and we do not know the demographics of the providers' customers.

[75] The adoption of fixed terrestrial broadband varies across demographic groups and households with less income are less likely to subscribe to a fixed broadband service for their home. *See* Pew Research Center, *Internet/Broadband Fact Sheet* (Apr. 7, 2021), https://www.pewresearch.org/internet/fact-sheet/internet-broadband/?menuItem=2ab2b0be-6364-4d3a-8db7-ae134dbc05cd. Incomes tend to be lower in rural areas, and subscription to home broadband services is generally lower in rural areas. Counties with a higher proportion of rural population will tend to have lower population density because fewer people live in these counties than in counties with more urban areas. In Fig. II.A.18, the quartile with the lowest population density will likely correspond to the quartile with the highest rural population rate. Thus, the observation that the average overall adoption rate for fixed terrestrial services increases with population density is akin to the observation that the average overall adoption rate for fixed terrestrial services decreases as the rural population rate increases.

Fig. II.A.17[76]
Overall Adoption Rate for Fixed Terrestrial Services at Different Speed Tiers

	2018	2019	2020	2021
25/3 Mbps				
United States	64.6%	68.9%	75.6%	79.4%
Rural Areas	40.5%	45.1%	49.8%	66.7%
Urban Areas	69.2%	73.6%	81.1%	85.2%
Tribal Lands	44.0%	46.5%	52.3%	58.6%
Rural Areas	29.3%	32.1%	37.4%	49.3%
Urban Areas	57.1%	60.7%	68.5%	83.1%
100/20 Mbps				
United States	15.6%	20.9%	27.5%	32.7%
Rural Areas	6.6%	10.6%	15.9%	26.4%
Urban Areas	16.9%	22.5%	29.4%	35.3%
Tribal Lands	9.9%	15.8%	23.3%	24.5%
Rural Areas	7.7%	15.5%	24.1%	26.7%
Urban Areas	11.2%	16.0%	22.7%	20.1%
940/500 Mbps				
United States	7.5%	9.4%	16.1%	15.9%
Rural Areas	3.9%	5.0%	6.6%	14.2%
Urban Areas	7.7%	9.8%	17.1%	16.3%
Tribal Lands	7.7%	7.9%	14.6%	14.9%
Rural Areas	13.4%	14.5%	13.5%	15.1%
Urban Areas	4.6%	4.2%	15.3%	14.5%

Source: FCC Form 477 year-end residential deployment and connections; Staff Block Estimates.

[76] The historical figures in Fig. II.A.17 can differ from those reported in the last *Report* because some filers have submitted revised subscriber and/or deployment data, and the tables are based on slightly different geographic areas. This table includes Puerto Rico whereas the table in the last *Report* excluded all U.S. territories. In addition, as explained above, we segment urban areas from rural areas by a different method in this *Report*. In this *Report*, we use the same methodology to identify urban tracts as used by the Commission in the urban rate survey. *2020 Communications Marketplace Report,* 36 FCC Rcd at 3015, para. 103, Fig. II.B.12.

Fig. II.A.18
Average County Overall Adoption Rate for Fixed Terrestrial Services by County Level Demographic Variable (Dec. 31, 2021)

	25/3 Mbps	100/20 Mbps	940/500 Mbps
Median Household Income ($2020)			
First Quartile (Lowest Median Household Income)	42.4%	18.6%	8.8%
Second Quartile	54.7%	21.8%	8.8%
Third Quartile	60.8%	23.7%	8.1%
Fourth Quartile (Highest Median Household Income)	73.1%	30.5%	12.2%
Population Density			
First Quartile (Lowest Population Density)	50.4%	24.1%	6.8%
Second Quartile	46.6%	20.7%	9.1%
Third Quartile	59.7%	21.5%	9.4%
Fourth Quartile (Highest Population Density)	74.2%	28.4%	12.1%
Household Poverty Rate			
First Quartile (Lowest Household Poverty Rate)	68.4%	28.5%	9.9%
Second Quartile	61.8%	24.5%	9.8%
Third Quartile	56.2%	22.3%	9.9%
Fourth Quartile (Highest Household Poverty Rate)	44.5%	19.3%	8.3%
Rural Population Rate			
First Quartile (Lowest Rural Population Rate)	72.6%	28.5%	11.3%
Second Quartile	60.3%	22.5%	9.2%
Third Quartile	50.1%	20.1%	9.1%
Fourth Quartile (Highest Rural Population Rate)	47.8%	23.5%	8.1%

Source: FCC Form 477 year-end residential deployment and connections data; Staff Block Estimates; 2020 Census land area estimates; ACS Five-Year Estimates for 2016-2020.

2. Competitive Trends in Fixed Broadband

37. In this section, we consider pricing and data caps, churn, speed, and whether consumers have access to multiple providers.

a. Pricing

38. Pricing for fixed services depends on several factors, including competition, speed tier, technology, geographic area, contract length, and whether the broadband service is bundled with other services. To undertake our pricing analysis in this *Report*, we collected plan information directly from the providers' webpages. In the future, we expect similar data collections to be facilitated by the *Broadband Consumer Labels Order*, that adopts rules that require ISPs to display, at the point of sale, labels that disclose certain information about broadband prices, introductory rates, data allowances, and broadband speeds, as well as to include links to information about their network management practices, privacy

policies, and the Commission's ACP.[77] However, given the difficulty of the current data collection, we focused this analysis on the stand-alone Internet plans of the top 11 fixed broadband providers in the United States: Altice, AT&T, Lumen Technologies (CenturyLink), Charter, Comcast, Cox, Frontier, JAB Wireless, TDS, T-Mobile, and Verizon. Plan information was gathered directly from the provider's website, and in many cases these plans are not available throughout the provider's service area.[78] In addition, there are likely subscribers on Internet-only plans that are not advertised on the website and would therefore be excluded from this analysis.[79] Providers list multiple price points for a product; in most cases the listed price includes a discount for paying with a credit card and/or paperless billing, and in some cases it is difficult to discern what the price would be without these discounts. Further, providers often will publish a promotional and non-promotional price.[80] For this collection, we report non-promotional prices that include discounts for paying with a credit card or using paperless billing. A study conducted by Consumer Reports found that "among the 18,359 consumer bills on which an internet price could be identified, the median cost of high-speed internet service was $74.99 per month. Approximately half of the households were paying between $60 and $90 per month."[81] These findings are similar to the range of prices we collected for internet-only service plans.

39. Figure II.A.19 shows the monthly price and download speed for stand-alone Internet plans offered by these 11 providers. The data indicate a positive relationship between price and download speed—as download speeds increase, so do prices. The least expensive Internet-only plan is provided by Altice at a price of $40 per month for download speeds of 300 Mbps, while the most expensive Internet-

[77] *Empowering Broadband Consumers Through Transparency*, Report and Order and Further Notice of Proposed Rulemaking, FCC 22-86, at 2, para. 3 (Nov. 17, 2022) (*Broadband Consumer Labels Order*).

[78] Altice, *Optimum Internet Plans, Speeds & Prices*, https://www.localcabledeals.com/optimum/internet (last visited Sept. 2, 2022); AT&T, *AT&T Internet Services*, https://www.att.com/internet/internet-service-plans/ (last visited Sept. 2, 2022); Lumen Technologies (CenturyLink), *Fiber Internet with unlimited data*, https://www.centurylink.com/internet/ (last visited Sept. 2, 2022); Charter Spectrum, *Enjoy Faster Starting Speeds with Spectrum Internet* (last visited Sept. 2, 2022); Comcast, *Xfinity Internet Deals*, https://www.xfinity.com/learn/deals/internet (last visited Sept. 2, 2022); Cox, *Cox Internet-only Service*, https://www.cox.com/residential/internet/internet-only-plans html (last visited Sept. 2, 2022); Frontier, *Transform Your Connected Home*, https://www.buyfrontiernow.com/fiber/ (last visited Sept. 2, 2022); JAB Wireless, *Check if service is available in your area!*, https://www.risebroadband.com/residential/ (last visited Sept. 2, 2022); TDS, *Popular TDS Internet Speeds*, https://tdstelecom.com/shop/internet-services.html (last visited Sept. 2, 2022); T-Mobile, *Reliable Internet $50/month*, https://www.t-mobile.com/home-internet (last visited Sept. 2, 2022); Verizon, *Get Fios Internet and Save*, https://www.verizon.com/home/fios-fastest-internet (last visited Sept. 2, 2022); Spectrum, *Bundle for Best Deals on TV, Internet and Phone*, https://www.spectrum.com/packages (last visited Sept. 2, 2022); Comcast, *Xfinity Internet Deals*, https://www.xfinity.com/learn/deals/internet (last visited Sept. 2, 2022); Cox, *Cox Internet-only Service*, https://www.cox.com/residential/internet/internet-only-plans.html (last visited Sept. 2, 2022); Frontier, *Transform Your Connected Home*, https://www.buyfrontiernow.com/fiber/ (last visited Sept. 2, 2022); JAB Wireless, *Check if service is available in your area!*, https://www.risebroadband.com/residential/ (last visited Sept. 2, 2022); TDS, *Popular TDS Internet Speeds*, https://tdstelecom.com/shop/internet-services html (last visited Sept. 2, 2022); T-Mobile, *Reliable Internet $50/month*, https://www.t-mobile.com/home-internet (last visited Sept. 2, 2022); Verizon, *Get Fios Internet and Save*, https://www.verizon.com/home/fios-fastest-internet (last visited Sept. 2, 2022).

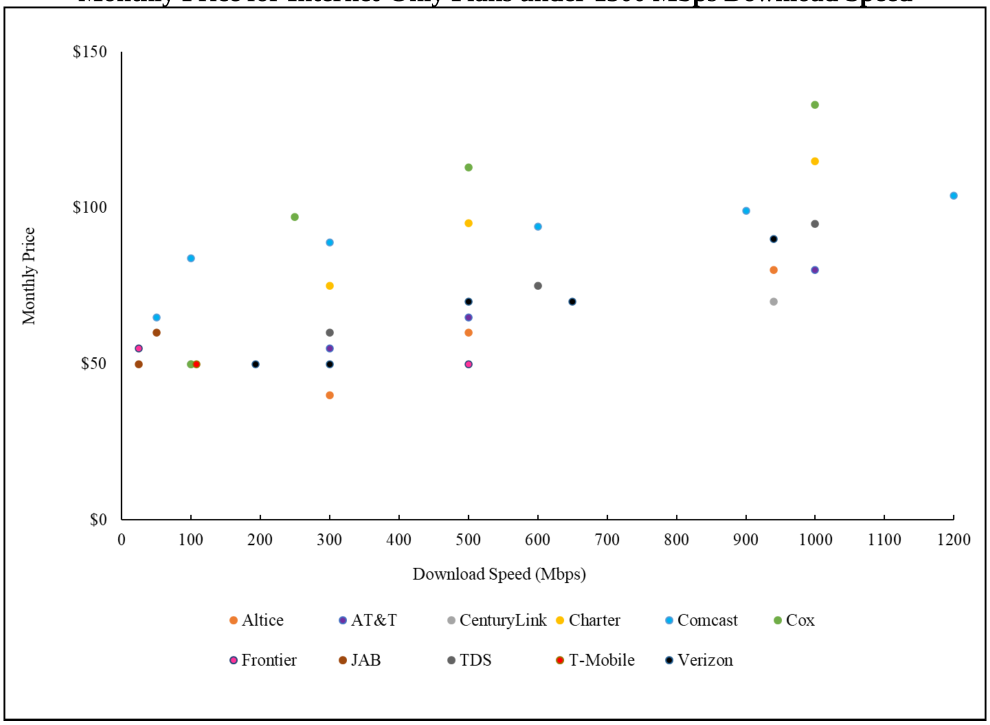
[79] Some service providers require an address for price information. FCC staff used sample address information to obtain pricing information for JAB Wireless (also known as Rise Broadband) and TDS. TDS had more plans advertised on their website, but they were excluded from this analysis because they did not have an associated price point available on the website and those plans were not returned in the address checked.

[80] Certain providers do label the price as promotional, but only guarantee this price for 12 to 24 months. Because the renewal prices were unavailable, in these cases, the price advertised is considered non-promotional.

[81] Jonathan Schwantes, Consumer Reports, *Broadband Pricing: What Consumer Reports Learned From 22,000 Internet Bills* (Nov. 17, 2022), https://advocacy.consumerreports.org/wp-content/uploads/2022/11/FINAL report-broadband.november-17-2022-2.pdf.

only plan is provided by Cox at a monthly price of $133 for download speeds of 1000 Mbps. Figure II.A.19 excludes plans that exceed 1500 Mbps, but we note that Comcast, AT&T, and Frontier offer limited availability plans with speeds above 1500 Mbps. Comcast offers plans with 2 Gbps and 6 Gbps download speeds for approximately $130 and $300 per month, respectively, AT&T offers plans with 2 Gbps and 5 Gbps download speeds for $110 and $180 per month, respectively, and Frontier offers a plan with 2 Gbps download speeds for $150 per month.

Fig. II.A.19
Monthly Price for Internet-Only Plans under 1500 Mbps Download Speed



Source: Staff analysis of service provider websites. Data collected as of Sept. 2, 2022.

40. Many service providers offer introductory promotional rates for new customers, which can be considerably discounted from the plan's regular monthly price. Figure II.A.20 provides information on the number of plans offered on the provider's website, the number of plans offered with a discount, and the average discount percentage across all discounted plans offered by the provider. Six of the 11 providers offer discounts on their stand-alone Internet plans. Across the six providers that offer discounts, the average discount was approximately 29%.

Fig. II.A.20
Average Discount Percentage for the Largest Ten Providers of Fixed Services

Provider	Number of plans found on provider's website	Number of plans on provider's website with discount	Average discount percentage	Details
Altice	6	0	N/A	A one-time rebate is available, ranging from $50 to $200, and a monthly rebate of $5 is available
AT&T	9	0	N/A	Rebates of $5 and rewards valued at $150 are available
Lumen Technologies (CenturyLink)	2	0	N/A	No Promotions with no extra charges other than the installation fee of $450
Charter	3	3	27%	A one-year contract required for discounts on 100 and 300 Mbps plans; a two-year contract required for 500 and 1000 Mbps plans
Comcast	8	4	36%	Two-year contract required to receive promotional price
Cox	4	3	32%	Discounts only available for plans with download speeds of 250 to 1000 Mbps
Frontier	3	2	8%	One-year contract required to receive promotional price
JAB	2	2	42%	Promotional prices last for 12 months
TDS	3	3	27%	Two-year contract required for discount
T-Mobile	1	0	N/A	A promotional price of $30 is available if the subscriber has a mobile line and chooses autopay
Verizon	5	0	N/A	Promotional prices for fixed wireless plans are available if the subscriber has a mobile line and chooses autopay

Source: Staff analysis of service provider websites. Data collected as of Sept. 6, 2022.

41. Figures II.A.21[82] through II.A.24 show the monthly price for stand-alone Internet plans offered by the top 11 Internet providers for the following technologies: DOCSIS, DSL, fiber, and terrestrial fixed wireless. Of all the technologies, fiber plans generally have the highest advertised download speeds with the lowest speed being the 300 Mbps plan offered by multiple providers. AT&T's 5000 Mbps plan is the most expensive fiber plan priced at $180 per month, and Frontier's 500 Mbps plan and Verizon's 300 Mbps plan are the least expensive fiber plans priced at $50. Only two of the 11 providers offer plans through DSL technology: Lumen Technologies (CenturyLink) offers download speeds up to 100 Mbps at $50 per month, and Frontier offers speeds up to 25 Mbps for $50 per month. The provider section of this report shows AT&T and Verizon have significant DSL deployments, yet each provider's website indicates that their current offers are for plans on a 100% fiber-optic network and that they no longer offer DSL products to new subscribers.[83] However, subscribers remain on grandfathered DSL plans.[84] Four service providers offer plans through cable technology: Comcast has the most expensive cable plan, priced at $299 for download speeds up to 6000 Mbps, while Altice has the least expensive cable plan at $40 for download speeds up to 300 Mbps. For terrestrial fixed wireless technology, Verizon offers download speeds up to 650 Mbps and AT&T offers download speeds up to 25 Mbps priced at $70, which are the most expensive terrestrial fixed wireless plans, while T-Mobile offers download speeds up to 108 Mbps, JAB Wireless offers download speeds up to 25 Mbps, and Verizon offers download speeds up to 193 Mbps priced at $50, which are the least expensive terrestrial fixed wireless plans.[85]

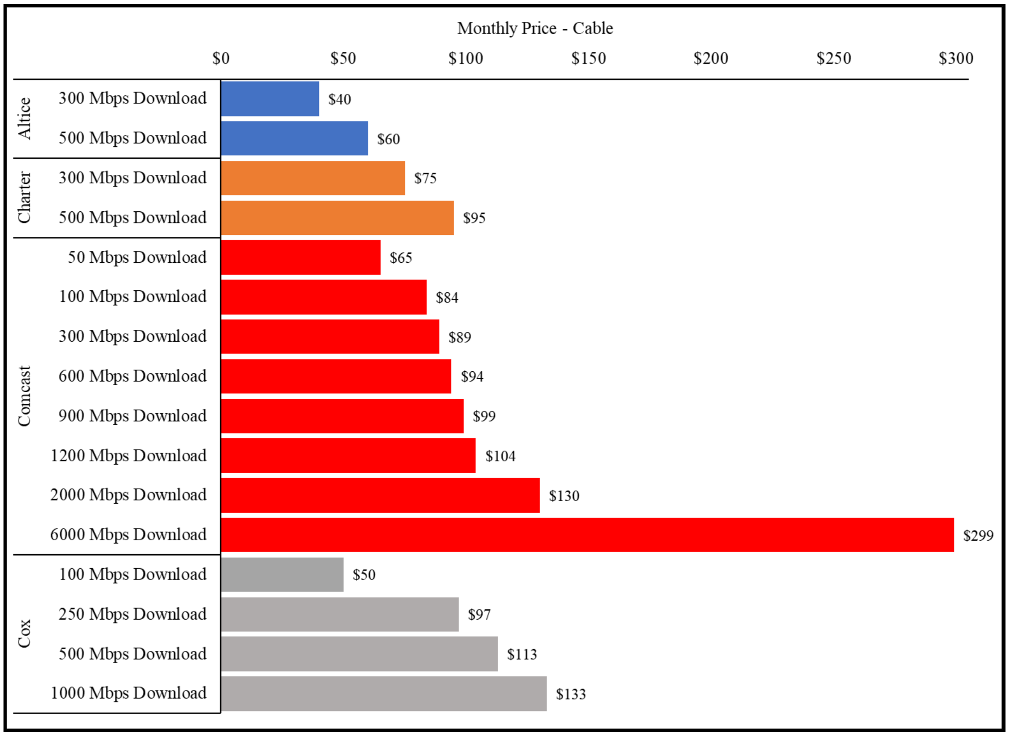
[82] In some cases, the technology of the plans as presented in Fig. II.A.21 was not specified on the website, and in those cases the predominant technology of the provider was assumed. For example, Comcast did not specify if the Internet-only plan offered was available through DOCSIS or FTTP or both, and in those cases it was assumed the plans were through DOCSIS technology.

[83] Verizon, *Get Verizon Fios*, https://www.verizon.com/home/fios-fastest-internet/ (last visited Oct. 2, 2022); AT&T, *AT&T Fiber*, https://www.att.com/internet/fiber/ (last visited Oct. 2, 2022).

[84] FCC Form 477 data shows that many service providers have other technologies deployed that are not associated with a plan advertised on their website.

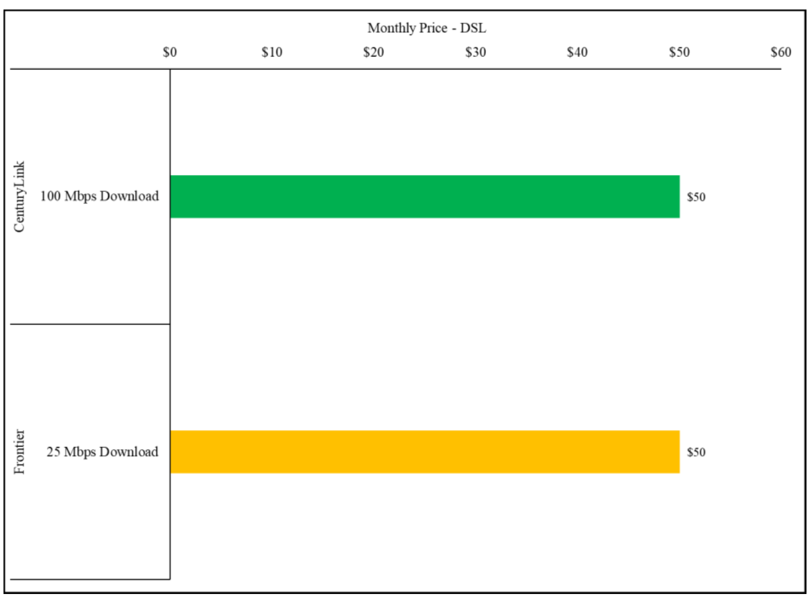
[85] Verizon indicates speeds for their fixed wireless products range between 85 and 300 Mbps or 300 and 1000 Mbps, depending on the plan; thus, we refer to these plans as offering approximately 193 and 650 Mbps, respectively, because they are the midpoints between the two bounds of the given range. Verizon, *Important Information about Verizon Broadband Internet Access Services*, https://www.verizon.com/support/broadband-services/ (last visited Oct. 2, 2022). T-Mobile indicates speeds for their fixed wireless product range between 33 and 182 Mbps; thus, we refer to this plan as offering approximately 108 Mbps because it is the midpoint between the two bounds of the range. T-Mobile, *Policies Open Internet*, https://www.t-mobile.com/responsibility/consumer-info/policies/internet-service (last visited Oct. 2, 2022).

Fig. II.A.21
Monthly Prices for Stand-Alone Internet Offered by the Largest 11 Providers: Through DOCSIS



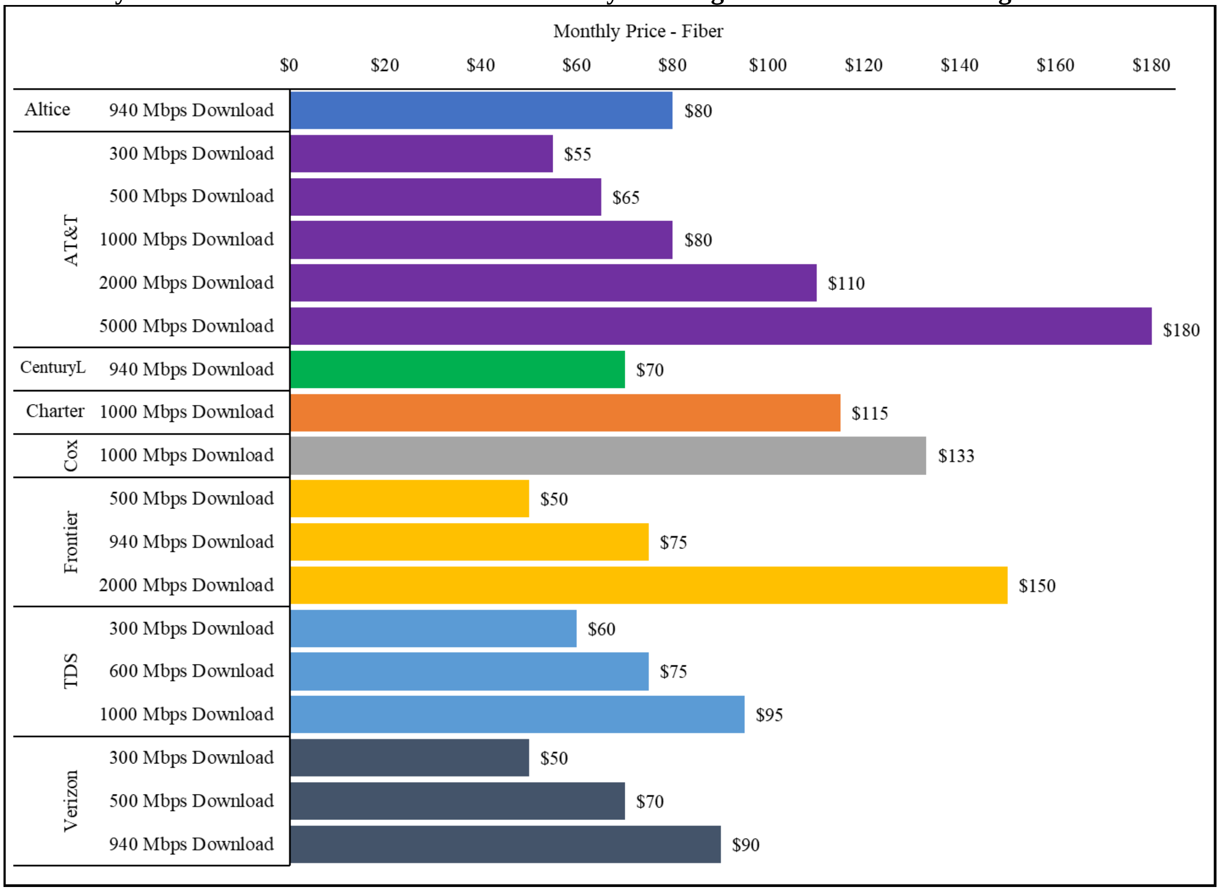
Source: Staff analysis of service provider websites. Data collected as of Sept. 2, 2022.

Fig. II.A.22
Monthly Prices for Stand-Alone Internet Offered by the Largest 11 Providers: Through DSL



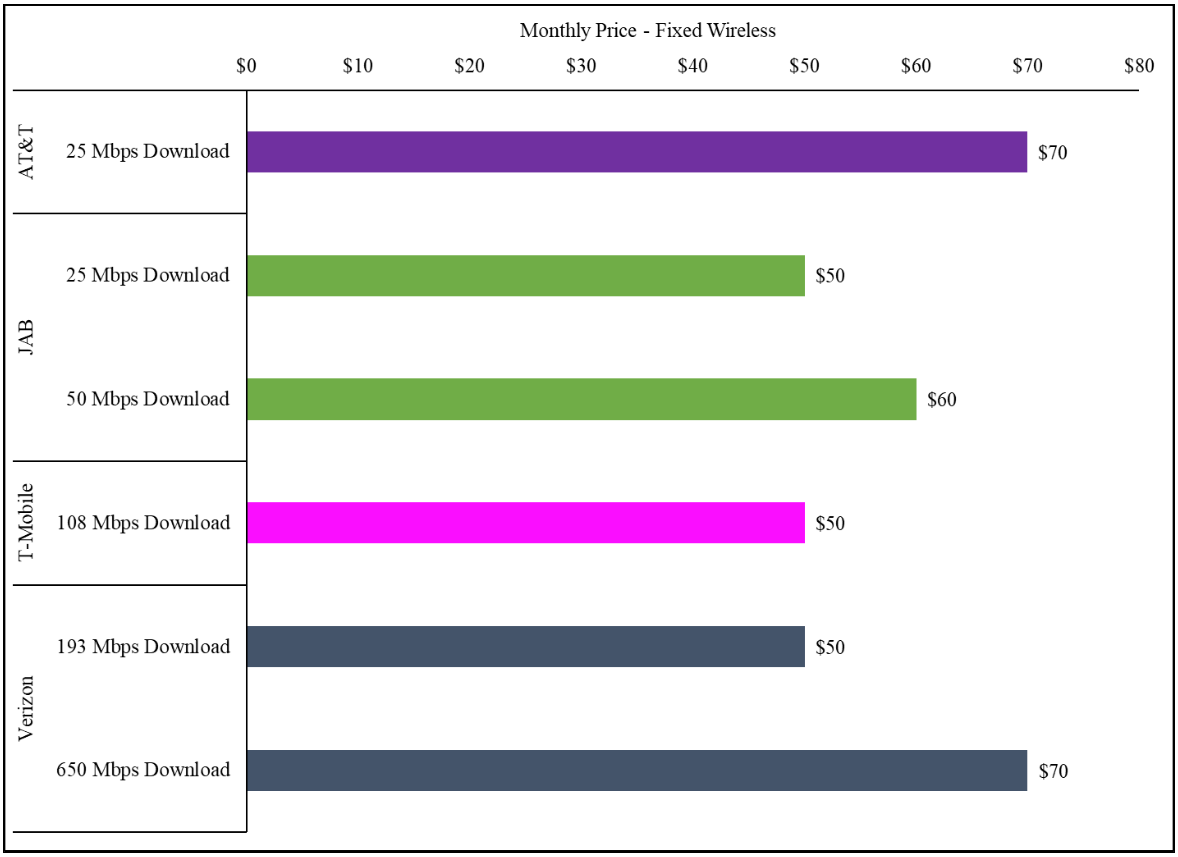
Source: Staff analysis of service provider websites. Data collected as of Sept. 2, 2022.

Fig. II.A.23
Monthly Prices for Stand-Alone Internet Offered by the Largest 11 Providers: Through FTTP



Source: Staff analysis of service provider websites. Data collected as of Sept. 2, 2022.

Fig. II.A.24
Monthly Prices for Stand-Alone Internet Offered by the Largest 11 Providers: Through Terrestrial Fixed Wireless



Source: Staff analysis of service provider websites. Data collected as of Sept. 2, 2022.

b. Data Caps

42. Many fixed providers offer service plans that enforce a data cap, which means those who subscribe to that plan will be limited in the amount of data they can use each month. Those plans could be less expensive for consumers than unlimited plans depending on their data usage. Once a customer reaches their data cap, they are either charged for additional data they use or are subject to their speeds being reduced or throttled. BroadbandNow reports 133 fixed internet providers and one satellite provider that utilize data caps on at least one of their service plan offerings.[86] Figure II.A.25 shows the 15 providers with the largest population coverage from BroadbandNow's list of providers with data caps; the largest five (excluding satellite) that specify data caps on at least one service offering are: Ultra Home Internet, EarthLink, AT&T, Comcast (Xfinity), and Cox Communications. There are 133 providers with data caps who offer service plans through cable, DSL, FTTP, or terrestrial fixed wireless technologies.[87]

[86] BroadbandNow, *Internet Providers with Data Caps* (Nov. 14, 2022), https://broadbandnow.com/internet-providers-with-data-caps.

[87] 79 of these providers offer terrestrial fixed wireless service, while 34 offer cable service.

Fig. II.A.25
The Largest 15 Service Providers with Data Caps

Company	Population Covered (in Millions)	Technologies	Data Cap Amount
HughesNet *	308.7	Satellite	10 – 100 GB
Ultra Home Internet	120.5	Fixed Wireless	25 – 100 GB
EarthLink 5G Home Internet	120.5	Fixed Wireless	50 – 150 GB
AT&T Internet *	120.4	DSL, Fixed Wireless	350 – 1000 GB
Comcast (Xfinity) *	107.8	Cable	1200 GB
Cox Communications *	21.6	Cable	1280 GB
Wide Open West (WOW!) *	7.1	Cable	1000 – 3000 GB
Mediacom Cable	6.5	Cable	200 – 6000 GB
Sparklight (formerly Cable One)	4.3	Cable, Fiber	350 – 1500 GB
Ranch Wireless	3.2	Fixed Wireless	30 – 375 GB
Astound Broadband Powered by Wave *	2.1	Cable	400 – 1000 GB
Phoenix Broadband	1.5	Fixed Wireless	50 GB
All Points Broadband	1.2	Fixed Wireless	100 GB
Vyve Broadband	1.2	Cable	1000 – 2000 GB
DLS Internet Services	1.0	Fixed Wireless	50 – 175 GB
Armstrong	1.0	Cable, Fiber	600 – 2500 GB

Source: Broadband Now. * Providers that BroadbandNow has noted as having data caps that may vary by region.

43. Data cap amounts vary by service plan and provider. Figure II.A.26 illustrates the average minimum data cap by technology. Of the 72 providers who offer only terrestrial fixed wireless, the starting data cap amount averages 325 GB per month, the lowest of the four fixed broadband technologies. The next lowest is for the 25 providers who only offer cable services, which averages 477 GB per month. Conversely, there are 14 providers who offer only FTTP and utilize data caps, and the average starting data cap amount for these providers is 714 GB per month.

Fig. II.A.26
Average Minimum Data Cap Amount by Technology

Technology	Average Data Cap Amt (minimum range of GB)	Total Providers
Cable only	477	25
DSL only	638	6
FTTP only	714	14
Fixed Wireless only	325	72
Satellite only	10	1
Multiple Technologies	400	16
Total	415	134

Source: Broadband Now.

c. Churn

44. Customer churn is the percentage of customers who stop paying for a service or product over a specific time period. Companies aim for lower churn rates because higher customer churn leads to

a reduction in revenue. A study conducted by Recurly Research, for example, determined the churn rate for subscription based services or products averaged 5.57% per month.[88] However, the average churn rates for the fixed broadband market tend to be lower than the typical subscription-based product. Analysys Mason reports "fixed broadband monthly churn rates in Western European markets tend to hover at around 0.9–1.2%, while those in high-income Asian markets are generally 0.8–1.0%," yet, "fixed broadband churn in North America is higher than that in other developed markets;" specifically, "churn was 1.8% in Canada between 2015 and 2019."[89] This is in line with Frontier Communications' reported churn of 1.52% in 2021, which was a decline from their 2019 churn of 2.07%.[90]

45. Many factors impact customer churn in the fixed broadband market. Contract length and automatic payment options are two factors that impact churn, and both are common features in the U.S. fixed broadband market. Providers can also use bundles as a strategy to reduce churn for fixed broadband. In March of 2021, Comcast reported that their streaming strategy led to a "15 to 20% reduction in churn for a broadband customer only with Flex versus a broadband customer without."[91] One study found that bundling reduces churn in markets "where a significant amount of turnover in services and/or service providers exists."[92]

46. Quality and competition are two additional factors that impact churn rates. A report by Analysys Mason found that "churn rates are higher in markets with high levels of competition and a wide choice of retail service providers, all other things being equal."[93] Subscribers receiving higher quality services are more likely to be satisfied and thus less likely to switch to a new provider. For the United States and Europe, an Analysys Mason survey indicates that "the benefits of higher speeds in terms of churn reduction grew between 2019 and 2020,"[94] and in the United States, subscribers with higher download speeds are less inclined to churn due to higher satisfaction and reliability scores.[95]

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[88] Recurly Research, *What is a Good Churn Rate*, https://recurly.com/research/churn-rate-benchmarks/ (last visited Nov. 10, 2022). We note that the "study examined a sample of over 1,900 subscription sites processing subscription billing on the Recurly platform. The study period ran over 19 months (January 2021 to July 2022). Transaction data aggregated and anonymized; no personally-identifiable data was used in the study. Churn rates are monthly, calculated by dividing the number of subscribers who churn during the month by the number of subscribers at the beginning of the month. Study uses median, 25th, and 75th percentile values which eliminate outliers and provide a more accurate representation of the data. The involuntary churn number excludes sites that may choose to leave a subscription active despite declined payments." *Id.*

[89] Analysys Mason, *There is Still Scope for Many Operators to Reduce Their Fixed Broadband Churn Rates* (July 16, 2021), https://www.analysysmason.com/research/content/articles/fixed-churn-reduction-rdmb0/ (Analysys Mason 2021 Report). We note that the "fixed broadband churn refers to the number of disconnections from the operator during the period divided by the average number of subscribers during the period, expressed on a monthly basis. Where an operator reports annualized churn we have converted the reported figure to monthly churn using the formula monthly% = 1-((1-annual%)^(1/12)). Operators generally do not include a subscriber moving house and continuing to take a service from the same operator at their new address as churn." *Id.*

[90] Statista, *Customer Monthly Churn Rate of Frontier Communications from 2014 to 2021*, https://www.statista.com/statistics/692110/frontier-communications-monthly-churn/ (last visited Nov. 10, 2022).

[91] Bernie Arnason, Telecompetitor, *Comcast CFO: Our Streaming Strategy is Reducing Broadband Churn* (Mar. 10, 2021), https://www.telecompetitor.com/comcast-cfo-our-streaming-strategy-is-reducing-broadband-churn/.

[92] Prince, J. and Greenstein, S., *Does Service Bundling Reduce Churn?*, Journal of Economics & Management Strategy, 23: 839-875 (2014).

[93] Analysys Mason 2021 Report.

[94] Inigo Barker, Analysys Mason, *Connected Consumer Survey 2020: Fixed Broadband Retention and Satisfaction in Europe and the USA* (Apr. 27, 2021), https://www.analysysmason.com/research/content/reports/fixed-broadband-europeusa-rdmb0/.

[95] *Id.*

d. Measuring Broadband America (MBA) Report

47. Our assessment of non-price competition in fixed broadband services also considers quality measures including the actual speed of service experienced by consumers, consistency of actual speeds experienced as compared to advertised speeds, latency, and packet loss. Each of these measures focuses on a different aspect of the consumer experience. Every page, image, and video on the Internet comes to home devices as small pieces of data or packets. Upload and download speed refer to throughput, the rate at which packets reach their destination within a specific time period. Different types of online applications require different minimum speeds. The speed experienced by a consumer may fluctuate during the day, typically due to variations in traffic demand and the resulting stress on different parts of the network infrastructure. Consistency measures examine how dramatic these fluctuations are across a particular network. Moreover, a significant reduction in speed for more than a few seconds can reduce video resolution or cause intermittent lapses in service. Latency is the time it takes for a data packet to travel from one point on the network to another. Consumers using services with high latency may experience reduced quality for interactive services; e.g., video chat, video conferencing, and online multiplayer games. Finally, packet loss measures the fraction of data packets sent that fail to be delivered to the intended destination. If packet loss occurs with interactive services and streaming applications, it may affect the consumer's quality of service.

48. The discussion below summarizes results from the Commission's recently released *Eleventh Measuring Broadband America Report*.[96] The *Eleventh Measuring Broadband America Report* provides a snapshot of fixed broadband Internet access service performance in the United States. The *Eleventh Measuring Broadband America Report* is based on data collected from 12 ISP/technology configurations between September 2 and September 24, 2020 (inclusive) and September 26 and October 2, 2020 (inclusive).[97] We measure the network performance delivered on selected service tiers to a representative sample set of the population. The volunteer panelists are drawn from subscribers of the ISPs that collectively serve a large percentage of the residential fixed broadband consumers in the United States.[98] The results presented in the *Eleventh Measuring Broadband America Report* suggest that consumer experience varies noticeably with the connection technology.[99]

[96] *See Eleventh Measuring Broadband America Fixed Broadband Report*. The MBA program is a rigorous, ongoing, nationwide study of consumer broadband performance that relies upon a sample that aims to include those tiers that constitute the top 80% of the subscriber base per ISP. *Eleventh Measuring Broadband America Fixed Broadband Report* at 7. The *Eleventh Measuring Broadband America Fixed Broadband Report* is based on data gathered from 2,488 volunteer panelists across the United States and includes only panelists that are subscribed to the tiers that were tested as part of the sample plan. *Id.* at 22.

[97] *Eleventh Measuring Broadband America Fixed Broadband Report* at 7. An isolated server outage forced the exclusion of data on September 25 to avoid anomalous results. *Id.* at 7 & n.1. The *Eleventh Measuring Broadband America Fixed Broadband Report* is based upon data for ten ISPs: Altice Optimum, Lumen Technologies (CenturyLink), Charter, Cincinnati Bell, Comcast, Cox, Frontier, Mediacom, Verizon, and Windstream. *Id*. at 11. The participants in the *Eleventh Measuring Broadband America Fixed Broadband Report* provide service by DSL, cable, or fiber (FTTP). *Id.* at 11. Hawaiian Telecom also participated in the Fixed MBA program, but the number of panelists receiving its service was insufficient to result in a statistically valid dataset and thus, this report excludes measurement results for this ISP. *Id.* at 21. Participation in the program by ISPs is voluntary. For purposes of satisfying the Commission's transparency requirements that apply to ISPs, fixed providers that choose to participate in the MBA program may disclose their results as a sufficient representation of the actual performance their customers can expect to experience.

[98] *Eleventh Measuring Broadband America Fixed Broadband Report* at 7. The measurements that provide the underlying data for the report were conducted between MBA measurement devices and MBA measurement servers. The measurement devices (known as whiteboxes) were situated in the homes of the panelists that receive services from the participating ISPs. *Id.* at 22.

[99] *Id.* at 15-19.

49. *Actual Speed*. The *Eleventh Measuring Broadband America Report* presents an actual speed for each provider, for each of the advertised tiers that were included in the study.[100] As reported, this actual speed is the median speed experienced by the sampled panelists within a specific speed tier, by ISP. Further, overall performance is calculated for each ISP/technology configuration by determining the ratio of the median speed for each tier to the advertised tier speed and then calculate the weighted average of these based on the subscriber count per tier.[101] The analysis shows that consumers' actual broadband service speeds for most ISPs are close to or exceed the advertised speed.[102] Of the 12 ISP/technology configurations included in this report, nine met or exceeded their advertised download speeds, two reached at least 90% of their advertised speed, and one performed below 90% of its advertised download speed.[103]

50. *Consistency*. Consistency of speed may be more important to consumers using applications such as video content that are both high-bandwidth and sensitive to variations in actual speed.[104] The *Eleventh Measuring Broadband America Report* considers two metrics of speed consistency. The first metric is the percentage of an ISP's sampled panelists who experience an actual monthly average download speed that was greater than 95% of the pertinent advertised speed. The results show that consumers' actual broadband service speeds for cable and fiber ISPs provide more consistent speeds than DSL ISPs based on this metric.[105] Cable and fiber ISPs provided speeds equal to or better than 95% of their advertised speeds to 89-98% and 53-98% of their subscribers, respectively.[106] However, between 3% to 75% of DSL ISP subscribers experienced speeds greater than or equal to 95% of their respective ISP's advertised download speeds during peak hours.[107]

51. The second metric, the "80/80 consistent speed" metric, considers how speeds experienced by an ISP's sampled panelists vary during the day. The "80/80 consistent speed metric" measures the percentage of the advertised speed that at least 80% of subscribers experience at least 80% of the time over peak periods. Cable and fiber ISPs performed better than DSL ISPs with respect to their provision of consistent speeds. Cable and fiber ISPs provided greater than 95% of the advertised speed during peak usage period to more than 80% of their panelists for more than 80% of the time.[108] In contrast, the 80/80 consistent download speed for a DSL provider was 46% of the advertised speed.[109]

52. *Latency*. The differences in median latency among services offered by the participating wireline ISPs are relatively small. Median latencies ranged from 8 ms to 28 ms in our measurements

[100] The service tiers that are included in *Eleventh Measuring Broadband America Fixed Broadband Report* represent the top 80% (therefore, "most popular") of an ISP's set of tiers based on subscriber numbers. *Eleventh Measuring Broadband America Fixed Broadband Report* at 11. The measurement tests for download speed (upload speed) measures the download speed (upload load) of each whitebox over a 10-second period, once per hour during peak hours (7:00 pm to 11:00 pm) and once during each of the following periods midnight to 6:00 am, 6:00 am to noon, and noon to 6:00 pm. *Id.* at 24.

[101] *Id.* at 11.

[102] *Id.* at 15. The ISP/technology configurations are: DSL (Lumen Technologies (CenturyLink), Cincinnati Bell DSL, Frontier DSL, and Windstream); Cable (Altice Optimum, Charter, Comcast, Cox, and Mediacom); and FTTP (Lumen Technologies (CenturyLink), Cincinnati Bell Fiber, Frontier Fiber, and Verizon Fiber). *See Id.* at 11.

[103] *Id.* at 15.

[104] *Id.* at 16.

[105] *Id.* at 15-17.

[106] *Id.* at 16. The ranges given represent differing results by ISP.

[107] *Id.*. The ranges given represent differing results by ISP.

[108] *Id.* at 17.

[109] *Id.*

(with the exception of one provider which had median latencies of 37 ms).[110] Measured DSL latencies (between 21 ms to 37 ms) were slightly higher than those for cable (12 ms to 26 ms) and median latencies for fiber ISPs were lowest of the ISPs (8 ms to 13 ms).[111]

53. *Packet Loss*. The MBA program denotes a packet as lost if the latency exceeds three seconds or if the packet is never received, and that a 1% standard for packet loss is the point at which highly interactive applications such as Voice over Internet Protocol (VoIP) would experience significant degradation in quality according to industry publications and International Telecommunications Union (ITU) standards.[112] ISPs using fiber technologies have the lowest packet loss (0% to 5%), while ISPs using copper-based technologies, e.g., DSL, have the highest packet loss (4% to 8%).[113]

54. *MBA Performance During COVID-19 Pandemic.* Examining test results from March 1, 2020 (pre-pandemic benchmark) through April 30, 2020 show some degradation of service for download speed, upload speed and latency, but no degradation of service with respect to packet loss. Most of the ISPs experienced between a 2% to 4% reduction in average measured download speed compared to the benchmark.[114] Test results for upload speeds showed all participating ISP performing within +/- 3% of the average on March 1, 2020 (the pre-pandemic benchmark).[115] Test results for latency show a general deterioration of latency during this test period by most of the ISPs and up to 10% for some of the ISPs.[116]

e. FCC Form 477 and Speed

55. *Breakdown of the Maximum Advertised Speed Reported by Providers with the Largest Footprints.* Based upon FCC Form 477 deployment data, we present a breakdown of the maximum advertised download speed data, by technology, for the ten providers with the largest footprints in the United States. For purposes of this figure, we report only those technologies that account for at least 5% of the provider's footprint, and we segment the reported maximum download speeds for residential services into the five categories: less than 25 Mbps; at least 25 Mbps and less than 100 Mbps; at least 100 Mbps and less than 400 Mbps; at least 400 Mbps and less than 940 Mbps; and at least 940 Mbps.[117] As shown in Figure II.A.27, only six (Altice, AT&T, Charter, Comcast, Cox, and Frontier) of the top ten providers offer services approaching 1 Gbps service to more than one-third of households in their respective footprints. The data indicate that Charter, Comcast, and Cox are capable of providing services approaching 1 Gbps across their respective cable footprints. AT&T can provide services meeting this speed threshold to 37% of the households within its fiber footprint, and Frontier can provide services meeting this speed threshold to 35% of the households within its fiber footprint. T-Mobile can provide

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[110] *Id.* Satellite providers no longer participate in the program; however, the *Eighth Measuring Broadband America Fixed Broadband Report* stated that, "Technology-determined latencies are typically small for terrestrial broadband services and are thus unlikely to affect the perceived quality of applications. The higher latencies of geostationary satellite-based broadband services may impair the perceived quality of such highly interactive applications." FCC, *Eighth Measuring Broadband America Fixed Broadband Report* at 8 (2018), https://www fcc.gov/reports-research/reports/measuring-broadband-america/measuring-fixed-broadband-eighth-report.

[111] *Eleventh Measuring Broadband America Fixed Broadband Report* at 18.

[112] *Id.* at 18.

[113] *Id.* at 19.

[114] *Id.* at 59.

[115] *Id.* at 60.

[116] *Id.* at 61-62.

[117] We report 400 Mbps download as a breakpoint because, as of December 31, 2021, 400 Mbps download is the 75% percentile for residential connections. *See supra* Fig. II.A.13. We report 940 Mbps download as a breakpoint because it is the maximum advertised download speed reported by two of the largest providers of residential broadband services. Staff analysis of provider data.

service of at least 25 Mbps to less than 100 Mbps service to approximately 99% of its fixed wireless footprint.

Fig. II.A.27
Percentage of Top Ten Fixed Terrestrial Provider's Residential Footprint by Technology and Reported Maximum Advertised Download Speed in the United States (Dec. 31, 2021)

	Technology	Less than 25 Mbps	At least 25 Mbps & less than 100 Mbps	At least 100 Mbps & less than 400 Mbps	At least 400 Mbps & less than 940 Mbps	At least 940 Mbps
Altice	Cable	1%	1%	7%	0%	34%
	Fiber	0%	0%	0%	0%	58%
AT&T Inc.	Copper	31%	24%	41%	0%	0%
	Fiber	0%	0%	0%	0%	37%
Charter Communications	Cable	0%	0%	0%	0%	100%
Comcast Corporation	Cable	0%	0%	0%	0%	95%
	Fiber	0%	0%	0%	0%	5%
Cox Communications, Inc.	Cable	0%	0%	0%	0%	98%
	Fiber	0%	0%	0%	0%	8%
Frontier Communications Corporation	Copper	58%	27%	12%	0%	0%
	Fiber	0%	0%	0%	0%	35%
Lumen Technologies (CenturyLink)	Copper	36%	34%	27%	0%	0%
	Fiber	0%	0%	1%	0%	18%
Telephone and Data Systems, Inc.	Fixed Wireless	96%	0%	0%	0%	0%
T-Mobile USA, Inc.	Fixed Wireless	1%	99%	0%	0%	0%
Verizon Communications Inc.	Copper	37%	0%	0%	0%	0%
	Fiber	0%	0%	1%	0%	26%
	Fixed Wireless	0%	49%	16%	0%	0%

Source: FCC Form 477 year-end deployment data; Staff Block Estimates. The sum of the percentages for some providers (e.g., AT&T, Cox, Verizon) will exceed 100% because these filers have deployed more than one technology in the same geographic areas. We report technologies that account for at least 5% of the providers' residential footprint.

f. Access to Multiple Providers

56. We provide an assessment of the number of fixed broadband provider options available to consumers in the United States using year-end FCC Form 477 deployment data from 2018 to 2021.[118]

[118] ACA Connects Comments at 8 (suggesting that we present historical data covering a longer time period). We reject ACA Connects' argument that we should project potential gains in competition. *See* ACA Connects Comments at 9-12. We have insufficient information to conduct this type of analysis, and moreover, we do not agree that it is reasonable to base the calculation of the share of households subject to various levels of competition for the periods between June 2021 and Dec. 2025 on the assumption that the share of households not having access

(continued….)

Our analysis considers options for fixed terrestrial services meeting three minimum speed thresholds—25/3 Mbps, 100/20 Mbps, and 940/500 Mbps.[119] Using these data and ACS demographic data,[120] we also analyze the demographics of areas where consumers have access to multiple broadband providers. As noted by the Commission, a provider indicating that it provides service in a census block does not mean that the provider can provision services to all locations in the census block, or that it can provide the speed to all locations in the census block.[121] Accordingly, the number of providers reported in the figures below does not necessarily reflect the number of choices available to a particular household and does not purport to measure actual head-to-head competition.

57. Figure II.A.28 reports estimates of the percentage of U.S. households who live in census blocks where FCC Form 477 data indicate that zero, one, two, and three or more providers of fixed terrestrial broadband services are deployed.[122]

(Continued from previous page)

to that level of competition continues to decrease at the same percentage rate that it has decreased over the last two years for which actual data are available. *See* ACA Connects Comments, Attach. at 11. In addition, we reject their argument that we should bootstrap consumers' options for faster service based on the availability of providers offering slower speed services (i.e., consumers of 100/20 Mbps service who would switch to 25/3 Mbps service as the price of 100/20 Mbps service increases). ACA Connects offers no evidence that a significant portion of consumers of 100/20 Mbps service would switch to 25/3 Mbps service in the event of a small but significant price increase for 100/20 Mbps service. Moreover, Form 477 residential connections data show that 90% of residential connections are to services faster than 25/2 Mbps, 75% of residential connections are to services faster than 50/50 Mbps and 50% of residential connections are to services faster than 200/10 Mbps. *See supra* Fig. II.A.13.

[119] *See* USTelecom Comments at 6-10 (reporting the percentage of housing units with two or more options of fixed broadband services meeting various speed thresholds).

[120] For this analysis, we examine population density, the number of households, and median household income. We rely upon the 2016-2020 ACS 5-Year Estimates for median household income (in 2020 inflation-adjusted dollars) reported at the census block group level. The 2017-2021 ACS 5-Year Estimates will not be released in time for use for this *Report*. *See* U.S. Census Bureau, *2021 Data Release New and Notable*, https://www.census.gov/programs-surveys/acs/news/data-releases/2021/release.html (last visited Oct. 6, 2022).

[121] *See, e.g.*, *2020 Communications Marketplace Report*, 36 FCC Rcd at 2992-93, para. 69; *2018 Communications Marketplace Report*, 33 FCC Rcd at 12651, para. 184; FCC, Internet Access Services: Status as of June 30, 2019 at 6 (2022), https://www fcc.gov/internet-access-services-reports.

[122] The FCC Form 477 year-end data from 2018 to 2020 are based on the 2010 census geographies; whereas the FCC Form 477 year-end 2021 are based on 2020 census block geographies. Due to this discrepancy, it is not possible to hold constant the underlying configuration of census blocks or the characteristics of the census blocks. We therefore caveat our results for changes between 2021 and earlier periods. The percentage of households with an estimated number of fixed terrestrial provider options in a census block is measured as the number of households covered by the specific number of providers (e.g., zero, one, two, and at least three) within the geographic area divided by the total number of households with access to the service in the census block. Throughout this section, percentages provided may not sum to exactly 100% due to rounding. We separately provide estimates of the percentage of the population with multiple provider options for fixed terrestrial broadband services, for each state, the District of Columbia, and Puerto Rico, as of December 31, 2021. *See infra* Appx. B-2, Appx. B-3, and Appx. B-4. For these figures, we aggregate census blocks within a state by competitor count category, i.e., we group census blocks within each state by the number of competitors in the census block and then sum the households in these census blocks by competitor count category. The census blocks within a state are aggregated by the number of provider options (zero, one, two, and at least three).

Fig. II.A.28
Percentage of U.S. Households Living in Census Blocks with Multiple Provider Options for Fixed Terrestrial Services (2018 - 2021)

Provider Options	2018	2019	2020	2021
25/3 Mbps				
Zero	5.4%	4.3%	2.4%	1.6%
One	27.1%	22.3%	10.8%	8.5%
Two	45.9%	44.5%	33.3%	20.6%
At Least Three	21.6%	29.0%	53.5%	69.3%
100/20 Mbps				
Zero	11.6%	10.2%	8.3%	5.4%
One	39.4%	36.9%	34.3%	30.5%
Two	34.2%	41.1%	41.6%	42.8%
At Least Three	14.8%	11.8%	15.7%	21.3%
940/500 Mbps				
Zero	72.3%	67.8%	63.9%	54.9%
One	25.4%	29.5%	31.1%	41.0%
Two	2.2%	2.5%	4.6%	3.7%
At Least Three	0.2%	0.2%	0.5%	0.4%

Sources: FCC Form 477 year-end deployment data; Staff Block Estimates.

58. *Provider options in rural and urban areas and on Tribal lands.* We next evaluate the percentage of households that that have a choice among multiple fixed terrestrial broadband service providers in rural and urban areas, and on Tribal lands.[123] As shown in Figure II.A.29, for services meeting a 100/20 Mbps speed threshold, the data suggest improvements in the proportion of households with at least two provider options. However, there is a significant difference in the percentage of households with at least two provider options in urban areas compared to those in rural areas and on Tribal lands.[124] While almost 72% of the households living in census bocks in urban areas have at least two provider options for 100/20 Mbps service, less than 30% of households living in census blocks in rural areas and less than 34% of households on Tribal lands have at least two options in their census blocks for this service tier. Currently, for services meeting a 940/500 Mbps threshold, 4.5% of households in census blocks in urban areas have at least two options, compared to 2.6% of households in rural areas and 3.6% of households on Tribal lands.

[123] The FCC Form 477 year-end data from 2018 to 2020 are based on the 2010 census geographies; accordingly, we use the 2010 Census urban/rural designation for these data. The FCC Form 477 year-end 2021 data are based on 2020 census blocks; however, the U.S. Census Bureau has not yet released urban/rural designations for the 2020 census data. Thus, for purposes of this analysis, we designate a 2020 census block as urban if any "urban" 2010 census block intersects the 2020 block. *See infra* Section III.A.1 (for an explanation of the method we used to segment urban and rural areas for year-end 2021 data). Because of the change in census geographies during our data collection period, caution should be exercised when interpreting the change in the number of provider options between 2020 and 2021 for urban and rural areas. Our assessment of Tribal lands is conducted by examining the census blocks that have been identified by the U.S. Census Bureau as federally recognized Tribal lands for the decennial Census in place for the time period covered by the FCC Form 477 data (i.e., year-end data for 2018 to 2020 were collected using 2010 census block geographies, whereas year-end data for 2021 were collected using 2020 census block geographies).

[124] *See* INCOMPAS Comments at 5-8.

Fig. II.A.29
Percentage of U.S. Households Living in Census Blocks in Rural Areas, Urban Areas, and Tribal Lands with Multiple Provider Options for Fixed Terrestrial Services (2018-2021)

Provider	2018	2019	2020	2021
25/3 Mbps				
Rural Areas				
Zero	22.0%	17.1%	8.9%	7.1%
One	44.0%	40.3%	23.7%	22.3%
Two	25.8%	29.5%	32.1%	28.2%
At Least Three	8.2%	13.1%	35.3%	42.5%
Urban Areas				
Zero	1.3%	1.0%	0.7%	0.3%
One	22.8%	17.8%	7.6%	5.4%
Two	51.0%	48.2%	33.6%	18.9%
At Least Three	25.0%	33.0%	58.1%	75.4%
Tribal Lands				
Zero	25.6%	19.3%	11.8%	7.7%
One	36.4%	35.4%	24.2%	18.6%
Two	23.7%	27.9%	26.0%	23.9%
At Least Three	14.3%	17.4%	37.9%	49.9%
100/20 Mbps				
Rural Areas				
Zero	41.5%	37.5%	31.6%	23.0%
One	45.1%	46.0%	47.1%	47.1%
Two	11.8%	14.4%	18.2%	23.9%
At Least Three	1.7%	2.1%	3.1%	6.0%
Urban Areas				
Zero	4.1%	3.4%	2.5%	1.4%
One	38.8%	34.6%	31.1%	26.7%
Two	45.2%	47.8%	47.6%	47.1%
At Least Three	11.8%	14.2%	18.9%	24.8%
Tribal Lands				
Zero	48.8%	43.7%	38.0%	23.4%
One	37.6%	37.7%	38.9%	43.0%
Two	13.1%	17.7%	21.6%	30.0%
At Least Three	0.5%	0.9%	1.4%	3.5%
940/500 Mbps				
Rural Areas				
Zero	89.4%	86.1%	81.8%	73.3%

Provider	2018	2019	2020	2021
One	10.1%	13.2%	16.9%	24.1%
Two	0.4%	0.7%	1.3%	2.4%
At Least Three	0.0%	0.0%	0.0%	0.2%
Urban Areas				
Zero	68.0%	63.2%	59.3%	50.7%
One	29.3%	33.5%	34.7%	44.8%
Two	2.6%	3.0%	5.4%	4.0%
At Least Three	0.2%	0.2%	0.6%	0.5%
Tribal Lands				
Zero	88.0%	84.7%	79.0%	71.5%
One	11.3%	14.5%	19.1%	24.9%
Two	0.7%	0.8%	1.9%	3.3%
At Least Three	0.0%	0.0%	0.0%	0.3%

Sources: FCC Form 477 year-end data; FCC Staff Block Estimates.

59. Figures II.A.30 to II.A.32 present a demographic analysis of the average percentage of households with coverage by zero, one, two, and three or more providers; broken out by population density quartile, median household income quartile, and household count quartile.[125] We present this analysis for 25/3 Mbps, 100/20 Mbps, and 940/500 Mbps. We observe that the number of provider options increases with the number of housing units in the census block group, population density, and median household income. In general, the census block groups in rural areas will tend to have the lowest population density and the lowest number of households and are likely to have the largest percentage of the households with zero provider options, i.e., no deployment of the reported service.

[125] For these figures, we include only the areas for which we have complete data. We aggregate census blocks within a census block group by provider count category; that is, we group census blocks within a census block group by the number of providers and then sum the households in these census blocks by provider count category. The census blocks within census block group are aggregated by the number of competing providers offering a particular category of service (zero, one, two, and at least three). The census block group is the smallest geographic area for which income data are available. We use the 2016-2020 ACS 5-Year Estimates for income measures for census block groups. Median household income is based on 2020 data and is measured in 2020 inflation-adjusted dollars. Population density is the total population residing in the census block group as of 2020 divided by the square miles of land in the census block group, with the estimate of land area based on the 2020 Census. Household count is the number of households in the census block group. *See also infra* Appx. F-7 (reporting population density, per capita income, and percent of the population covered for deployment of 25/3 Mbps, 100/20 Mbps, and 940/500 Mbps by state, county, and county equivalent).

Fig. II.A.30
Average Percentage of Households Living in Census Blocks with Multiple Provider Options for 25/3 Mbps by Census Block Group Demographic Variable (Dec. 31, 2021)

	Zero	One	Two	At Least Three
Population Density				
First Quartile (Lowest Pop. Density)	7.1%	22.4%	28.5%	42.0%
Second Quartile	0.5%	8.1%	23.8%	67.6%
Third Quartile	0.2%	4.8%	18.8%	76.2%
Fourth Quartile (Highest Pop. Density)	0.2%	3.2%	15.3%	81.4%
Median Household Income ($2020)				
First Quartile (Lowest Median Household Income)	2.9%	11.8%	23.2%	62.1%
Second Quartile	2.6%	11.6%	22.5%	63.2%
Third Quartile	1.5%	9.1%	20.9%	68.5%
Fourth Quartile (Highest Median Household Income)	0.5%	5.2%	19.3%	75.0%
Household Count				
First Quartile (Lowest Household Count)	3.3%	12.8%	24.3%	59.5%
Second Quartile	2.2%	10.3%	22.3%	65.2%
Third Quartile	1.6%	8.8%	21.0%	68.5%
Fourth Quartile (Highest Household Count)	0.9%	6.5%	18.8%	73.8%

Source: FCC Form 477 year-end data; Staff Block Estimates; ACS 2016-2020 Five Year Estimates.

Fig. II.A.31
Average Percentage of U.S. Households Living in Census Blocks with Multiple Provider Options for 100/20 Mbps by Census Block Group Demographic Variable (Dec. 31, 2021)

	Zero	One	Two	At Least Three
Population Density				
First Quartile (Lowest Pop. Density)	21.9%	48.8%	23.5%	5.8%
Second Quartile	2.4%	36.8%	45.5%	15.3%
Third Quartile	1.0%	27.1%	49.9%	22.0%
Fourth Quartile (Highest Pop. Density)	0.5%	15.7%	46.9%	37.0%
Median Household Income ($2020)				
First Quartile (Lowest Median Household Income)	7.8%	37.4%	36.6%	18.2%
Second Quartile	8.9%	35.4%	38.4%	17.3%
Third Quartile	6.2%	31.7%	42.3%	19.7%
Fourth Quartile (Highest Median Household Income)	2.2%	23.3%	49.5%	25.0%
Household Count				
First Quartile (Lowest Household Count)	9.3%	36.1%	37.8%	16.8%
Second Quartile	7.3%	33.0%	40.5%	19.2%
Third Quartile	5.7%	31.8%	42.1%	20.4%
Fourth Quartile (Highest Household Count)	3.5%	27.6%	45.3%	23.6%

Source: FCC Form 477 year-end data; Staff Block Estimates; ACS 2016-2020 Five Year Estimates.

Fig. II.A.32
Average Percentage of U.S. Households Living in Census Blocks with Multiple Provider Options for 940/500 Mbps by Census Block Group Demographic Variable (Dec. 31, 2021)

	Zero	One	Two	At Least Three
Population Density				
First Quartile (Lowest Pop. Density)	75.6%	22.4%	1.8%	0.2%
Second Quartile	58.3%	38.2%	3.2%	0.3%
Third Quartile	50.6%	45.1%	3.8%	0.5%
Fourth Quartile (Highest Pop. Density)	42.5%	52.6%	4.3%	0.6%
Median Household Income ($2020)				
First Quartile (Lowest Median Household Income)	63.8%	33.6%	2.3%	0.2%
Second Quartile	61.1%	35.8%	2.7%	0.4%
Third Quartile	56.6%	39.5%	3.4%	0.5%
Fourth Quartile (Highest Median Household Income)	44.8%	50.0%	4.7%	0.5%
Household Count				
First Quartile (Lowest Household Count)	60.5%	36.5%	2.6%	0.3%
Second Quartile	57.7%	38.9%	3.0%	0.4%
Third Quartile	56.7%	39.7%	3.2%	0.4%
Fourth Quartile (Highest Household Count)	52.1%	43.1%	4.3%	0.5%

Source: FCC Form 477 year-end data; Staff Block Estimates; ACS 2016-2020 Five Year Estimates.

60. *Alternative estimates of the number of provider options*. Because of the limitations of the FCC Form 477 data, we provide alternative estimates of the number of provider options available to households in an attempt to present a more comprehensive assessment. To reduce the effect of the factors that could result in an understatement or overstatement of the proportion of households with a choice of multiple providers,[126] we incorporate information from our confidential subscriber data before assessing the number of providers in each census block. In Figure II.A.33, we present alternative estimates of the number of provider options for 25/3 Mbps, 100/20 Mbps, and 940/500 Mbps based on three scenarios that include *all* fixed technologies.[127] These alternative estimates include satellite service, as well as any of the other fixed technologies, to the extent that the service meets the speed threshold and the scenario criteria. For comparison purposes, Scenario I presents fixed broadband coverage for all reported technologies, and takes the filer's data as released by the Commission. The two remaining scenarios

[126] Our assessment of deployment requires only filer in the census block. However, a census block is classified as served if the FCC Form 477 data indicate that service is available in a census block, even if not to every location. It is not necessarily the case that every household will have coverage from a given provider in census block that the analysis indicates is served. The Commission has found that this type of analysis could overstate the coverage experienced by some consumers, especially in large or irregularly shaped census blocks. *See, e.g.*, *2020 Broadband Deployment Report,* 35 FCC Rcd at 8998, para. 26; *2019 Broadband Deployment Report*, 34 FCC Rcd at 3869, para. 25 & n.92.

[127] These estimates include fixed satellite services. The estimates for Scenarios II and III rely on confidential residential connections (subscriber) data.

include the filer's block-level data only if the filer's residential connections data meet the minimum penetration rate for the scenario.[128] Scenario II compares each filer's FCC Form 477 deployment data to its residential connections data and excludes the filer's deployment data from the block if the filer does not attain a 1% penetration rate.[129] Scenario III increases the penetration rate in Scenario II from 1% to 5%. Scenarios II and III analyze penetration rates without regard to subscription speed to account for consumers opting to subscribe to slower speed services than the maximum advertised speed offered by a provider.[130] We reiterate that, in Scenarios II and III, our decision to exclude a filer's FCC Form 477 deployment data does not mean that such service is not available in particular census block, only that the filer failed to attain the relevant penetration rate for purposes of these alternate estimates.

61. The first column of Figure II.A.33 replicates the last column of Figure II.A.28 for comparison purposes. Comparing Scenario I to Scenario II and Scenario III shows the impact of penetration adjustments on the estimates of the number of provider options when a filer failed the penetration rate criteria for the scenario and its deployment data are excluded. For example, comparing Scenario I to Scenario II for 100/20 Mbps suggests that the percentage of households living in census blocks with at least two provider options would fall from 64.9% to 53.6%, while comparing the Scenario I to Scenario III suggests that the percentage would fall from 64.9% to 50.5%. We note, however, that these alternate scenarios have not been included in previous versions of this report; therefore, we are unable to provide any historical context regarding the extent to which individual results may have varied across time.

[128] Because there are fewer technology codes reported for the subscriber data than for the deployment data for copper and cable technologies, we recode the deployment data for copper-based technology codes 10, 11, 12, 20 and 30 to technology code 10, and we recode the cable modem technology codes 40, 41, 42, and 43 to technology code 40.

[129] We define the penetration rate as the filer's total number of residential connections in the tract divided by the filer's number of deployed households meeting the speed threshold in the census tract.

[130] *See supra* Fig. II.A.17, reporting Overall Adoption Rates for the United States; *see also infra* Fig. III.A.6, reporting alternative deployment estimates. The percentages reported in Fig. III.A.6 are based on population whereas the percentages reported in Fig. II.A.33 are based on households.

Fig. II.A.33
Alternative Estimates for the Percentage of Households Living in Census Blocks with Multiple Provider Options for Fixed Services (Dec. 31, 2021)

Provider Options	From Fig. II.A.28 (Excludes Satellite)	Scenario I: All Technologies	Scenario II: All Technologies; 1% Penetration Rate	Scenario III: All Technologies; 5% Penetration Rate
25/3 Mbps				
Zero	1.6%	0.0%	1.0%	2.6%
One	8.5%	0.0%	18.4%	30.3%
Two	20.6%	1.3%	51.1%	56.4%
At Least Three	69.3%	98.7%	29.5%	10.7%
100/20 Mbps				
Zero	5.4%	5.3%	6.9%	7.5%
One	30.5%	29.8%	39.6%	41.9%
Two	42.8%	42.9%	45.6%	44.5%
At Least Three	21.3%	22.0%	8.0%	6.0%
940/500 Mbps				
Zero	54.9%	54.9%	59.0%	60.8%
One	41.0%	41.0%	38.3%	37.1%
Two	3.7%	3.7%	2.5%	2.1%
At Least Three	0.4%	0.4%	0.1%	0.1%

Scenario I: Includes all technologies, including satellite services, and uses the filer data as released by the Commission.
Scenario II: Compares each filer's FCC Form 477 deployment data to its confidential residential connections data, and excludes the filer's deployment data from the block analysis if the filer does not attain a 1% penetration rate in the tract to which the block belongs. (Penetration rate= filer's total residential connections in the tract/Filer's deployed households in the census tract that meet the speed threshold).
Scenario III: Increases the test penetration rate to 5%.

Source: FCC Form 477 year-end deployment and confidential residential connections data; Staff Block Estimates for 2021 (2020 Census Blocks).

B. The Mobile Wireless Marketplace

62. In the period covered by this *Report*, consumers have relied more heavily on wireless services than ever and mobile wireless services increasingly are an essential part of Americans' daily lives. In addition to the three facilities-based nationwide mobile wireless service providers, the mobile wireless marketplace consists of numerous regional and local facilities-based providers, mobile virtual network operators (MVNOs) that purchase mobile wireless services wholesale, cable providers that rely on a hybrid wholesale/hotspot arrangement to offer service, and mobile satellite providers that currently focus primarily on niche services like tracking services for aircraft and ships and operations in remote locations. In addition, as one condition for the Commission's approval of the merger between T-Mobile and Sprint, the parties agreed to divest Boost, T-Mobile's MVNO subsidiary, to DISH; and DISH in turn committed to building its own independent nationwide 5G mobile network.

63. In this section, we consider various competitive factors in the mobile wireless marketplace. For example, while the prices of wireless services have remained largely stable since 2020,[131] there was a notable decrease in the wireless churn rates for nationwide service providers in early

[131] *See infra* section II.B.4.

2020.[132] The churn rates started trending up again in mid-2021, but remained at a relatively low level compared with previous years for two of the three nationwide providers.[133] A number of factors may have contributed to this decline in churn rates, including the beginning of the COVID-19 pandemic in 2020, the T-Mobile-Sprint merger, and improved network quality due to the rapid build out of 5G networks. The Commission will pay close attention to competitive indicators and trends as the mobile wireless marketplace continues to evolve, including those indicators that reflect the competitive effects of mergers and acquisitions.[134] In this section, we present available 2021 data for all mobile wireless services, including voice, messaging, and broadband, and we also present certain information as of mid-2022. Further, we summarize the recent major transactions that have had and will continue to have an effect on the competitive landscape.

1. Overview of the Mobile Wireless Marketplace

a. Service Providers

64. *Facilities-Based Service Providers.* As of December 31, 2021, there were three facilities-based mobile wireless service providers in the United States that this *Report* refers to as "nationwide service providers": AT&T, T-Mobile, and Verizon Wireless. Although none of these three nationwide service providers has a network that is truly ubiquitous, the three service providers have networks that they report cover a substantial majority of the country—each reports covering at least 93% of the U.S. population and at least 58% of U.S. road miles with their 4G Long-Term Evolution (LTE) networks, and at least 67% of the U.S. population and at least 25% of road miles with their 5G networks.[135] Collectively, these three nationwide service providers account for over 453 million connections.[136] UScellular, currently the fourth largest facilities-based service provider in the United States, is best characterized as a multi-regional service provider. It has deployed wireless networks and customer service operations in portions of 21 states,[137] and, as of December 31, 2021, it accounted for approximately five million connections.[138] Two other larger regional service providers are: C Spire,

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[132] *See infra* section II.B.1.c.

[133] *Id*.

[134] To mitigate the likelihood of public interest harm, the Commission on occasion accepts pricing commitments as part of a transaction's conditions. *See, e.g.*, *Applications of T-Mobile US, Inc. and Sprint Corporation for Consent to Transfer Control of Licenses and Authorizations*, WT Docket No. 18-197, Memorandum Opinion and Order, Declaratory Ruling, and Order of Proposed Modification, 34 FCC Rcd 10578, 10801-28, Appx. G (2019) (*T-Mobile-Sprint Order*) ("New T-Mobile will make available the same or better rate plans as those offered by T-Mobile or Sprint as of today's date for three years following the merger[, which ended in November 2022]."); *Application of Verizon Communications Inc. and América Móvil, S.A.B. de C.V. for Consent To Transfer Control of International Section 214 Authorization*, GN Docket 21-112, Memorandum Opinion and Order, FCC 21-121, at 57-64, Appx. B (Nov. 22, 2021) (*Verizon-TracFone Order*) ("Verizon, directly or through its affiliates, will continue to offer Lifeline services for at least seven years from the close of the transaction over the same service area where TracFone currently offers Lifeline service[, until November 2028] . . . . Verizon will continue to offer and advertise existing TracFone Lifeline rate plans for at least three years after the transaction closes unless the plan no longer meets Lifeline MSS standards[, at least November 2024]."); *see also Applications of Charter Communications, Inc., Time Warner Cable Inc., and Advance/Newhouse Partnership For Consent to Assign or Transfer Control of Licenses and Authorizations*, MB Docket No. 15-149, Memorandum Opinion and Order, 31 FCC Rcd 6330, 6539-62, para. 9, Appx. B (2016) (*Charter/Time Warner Cable Order*) ("[F]or seven years[, until May 2023], we prohibit New Charter from imposing data caps or charging usage-based pricing for its residential broadband service.").

[135] *See infra* section II.B.6.a.

[136] *See infra* Fig. II.B.3.

[137] United States Cellular Corp., 2021 SEC Form 10-K at 1 (filed Feb. 17, 2022). UScellular is a majority-owned (82%) subsidiary of Telephone and Data Systems, Inc. *Id.*

[138] *Id*.

which provides service to nearly one million subscribers in the southeastern United States,[139] and Claro, which provides service to just over one million subscribers in Puerto Rico.[140] There are also dozens of other facilities-based mobile wireless service providers throughout the United States, many of which provide service in a single, often rural, geographic area.[141]

65. *MVNOs.* Traditionally, MVNOs have not owned any network facilities, but instead purchase mobile wireless services on a wholesale basis from facilities-based service providers and resell these services to consumers.[142] In 2021, Verizon purchased the largest of these companies–TracFone, previously an América Móvil subsidiary.[143] With the sale of TracFone to Verizon, and setting aside Boost Mobile (discussed below), the largest remaining traditional MVNO is Consumer Cellular, which has approximately four million customers.[144] Other major MVNOs include Google's Google Fi, which has an estimated two million customers,[145] and Ultra Mobile, which has an estimated two to three million customers across its brands, including Mint Mobile.[146]

66. *DISH*. On July 1, 2020, T-Mobile divested its Boost Mobile brand and its approximately nine million customers to DISH,[147] as a condition imposed by the Commission and the U.S. Department of Justice on their approval of T-Mobile's merger with Sprint.[148] Through 2021, Boost operated solely as

[139] C Spire, *About C Spire, C Spire Celebrates 30 Years of Customer Inspiration This Month* (Feb. 13, 2018), https://www.cspire.com/company_info/about/news_detail.jsp?entryId=29600003.

[140] América Móvil, América Móvil's Fourth Quarter of 2021 Financial and Operating Report at 27 (Feb. 8, 2022), https://www.americamovil.com/investors/reports-and-filings/quarterly-results/default.aspx.

[141] Examples of regional facilities-based service providers include Appalachian Wireless, Carolina West Wireless, Cellcom, Choice Wireless, GCI, Nex-Tech Wireless, and Sagebrush Cellular. *Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, Including Commercial Mobile Services*, WT Docket No. 17-126, Twentieth Report, 32 FCC Rcd 8968, 8975, para. 14 & n.50 (2017) (*Twentieth Wireless Competition Report*).

[142] *2020 Communications Marketplace Report*, 36 FCC Rcd at 2951, para. 12. The Commission is not able to provide an exact figure of the number of MVNOs that currently offer services. There are several reasons for this. First, as resellers of service offered by facilities-based service providers, MVNOs are not licensees and typically do not file section 214 applications. Second, MVNOS do not take their own telephone numbers. Finally, as the Commission has found in prior wireless competition reports, "[c]omprehensive data on MVNO subscribers are generally not reported by either MVNOs or facilities-based providers that host MVNOs. Estimates of the number of MVNOs operating in the United States vary considerably. Many MVNOs are privately held companies that do not publicly report financial or subscriber data." *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. 11-186, Sixteenth Report, 28 FCC Rcd 3700, 3739, para. 32 (2013).

[143] Verizon Wireless, *Verizon Completes Tracfone Merger* (Nov. 23, 2021), https://www.verizon.com/about/news/verizon-completes-tracfone-wireless-inc-acquisition.

[144] Consumer Cellular, *Fact Sheet*, https://www.consumercellular.com/assets/press/Consumer_Cellular_Fact_Sheet.pdf (last visited Sept. 14, 2022).

[145] prepaidcompare, *Google Fi Profile*, https://prepaidcompare net/profiles/google-fi html (last visited Aug. 8, 2022).

[146] Mike Dano, Light Reading, *Mint Mobile, Backed by Ryan Reynolds, Is Up for Sale* (June 24, 2022), https://www.lightreading.com/5g/mint-mobile-backed-by-ryan-reynolds-is-up-for-sale/d/d-id/778513.

[147] DISH, *DISH Enters Retail Wireless Market with Close of Boost Mobile, Advances Build of the Nation's First Standalone 5G Network* (July 1, 2020), http://about.dish.com/2020-07-01-DISH-enters-retail-wireless-market-with-close-of-Boost-Mobile-advances-build-of-the-nations-first-standalone-5G-network.

[148] *T-Mobile-Sprint Order*, 34 FCC Rcd at 10591-92, 10661, paras. 33-34, 189; *see also* DISH, *DISH to Become National Facilities-based Wireless Carrier* (July 26, 2019), http://about.dish.com/2019-07-26-DISH-to-Become-National-Facilities-based-Wireless-Carrier.

an MVNO,[149] which made it the largest MVNO in the United States after Verizon acquired TracFone.[150] The MVNO agreement between T-Mobile and DISH allows DISH to use T-Mobile's wireless network to provide service to its customers, offers DISH the option to construct and use its own network, and requires T-Mobile to interconnect with DISH's network.[151] In addition, in July 2021, DISH entered into an agreement with AT&T to provide wholesale services to DISH's wireless customers.[152]

67. Unlike traditional MVNOs, however, DISH committed to building its own independent 5G network,[153] using its AWS-4, Lower 700 MHz, and H Block spectrum licenses.[154] On June 15, 2022, DISH claimed that it had met its commitment to the Commission to cover at least 20% of the U.S. population with 5G coverage, using Open RAN by June 14, 2022.[155] DISH asserts that its Project Genesis service, which operates on its own facilities-based network in addition to relying on its facilities-based partners when necessary, is available in more than 120 cities.[156]

68. *Cable.* In recent years, cable providers have also entered the mobile wireless market through MVNO arrangements, as well as beginning to deploy their own facilities-based networks. These service offerings rely on combining the mobile networks of facilities-based partners with hotspot or small-cell networks that send traffic through the cable provider's infrastructure.[157] In 2016, both Comcast[158] and Charter,[159] the nation's two largest cable providers, activated MVNO options they held with Verizon Wireless. Comcast launched its Xfinity Mobile wireless service in the spring of 2017,

[149] *T-Mobile-Sprint Order*, 34 FCC Rcd at 10591-92, paras. 33-34.

[150] Verizon Wireless, *Verizon Completes Tracfone Merger* (Nov. 23, 2021), https://www.verizon.com/about/news/verizon-completes-tracfone-wireless-inc-acquisition.

[151] *T-Mobile-Sprint Order*, 34 FCC Rcd at 10592-93, para. 34.

[152] Monica Alleven, Fierce Wireless, *DISH Signs $5B MVNO Deal with AT&T* (July 19, 2021), https://www.fiercewireless.com/operators/dish-signs-5b-mvno-deal-at-t.

[153] *T-Mobile-Sprint Order*, 34 FCC Rcd at 10594, 10740, paras. 37, 369; *see also* DISH, *DISH Enters Retail Wireless Market with Close of Boost Mobile, Advances Build of the Nation's First Standalone 5G Network* (July 1, 2020), http://about.dish.com/2020-07-01-DISH-enters-retail-wireless-market-with-close-of-Boost-Mobile-advances-build-of-the-nations-first-standalone-5G-network.

[154] *T-Mobile-Sprint Order*, 34 FCC Rcd at 10829-41, Appx. H.

[155] DISH, *DISH's Smart 5G Wireless Network is Now Available to Over 20 Percent of the U.S. Population* (June 15, 2022), https://about.dish.com/2022-06-15-DISHs-Smart-5G-TM-Wireless-Network-is-Now-Available-to-Over-20-Percent-of-the-U-S-Population.

[156] *Id*.

[157] Chris Mills and Fiona Armstrong, Tutela, *Special Report: State of MVNOs*, at 18 (Oct. 2019), https://www.tutela.com/blog/usa-state-of-mvnos-19 ("The most immediate solution for wireless traffic offload are the networks of public or semi-public hotspots operated by the cable companies. Comcast . . . claims to operate a network of 18 million 'xfinitywifi' hotspots nationwide"); *see also id.* at 21 ("Altice Mobile is also well positioned to exploit future technology improvements and spectrum deployments to embrace the 'hybrid MVNO' model. Altice operates the core network, device SIMs, and in some cases has infrastructure agreements in place with Sprint for small cells.").

[158] Colin Gibbs, Fierce Wireless, *Comcast to Launch Wireless Service in 2017 with Verizon MVNO, 15M Wi-Fi Hotpots* (Sept. 20, 2016), http://www.fiercewireless.com/wireless/comcast-to-launch-wireless-service-2017-verizon-mvno-15m-wi-fi-hotspots. As of the end of 2021, this service had not yet utilized spectrum owned by the cable operators, but may in the future, at which point they might become Hybrid MVNOs similar to the one launched by DISH. *See* Diana Goovaerts, Fierce Wireless, *Comcast Doesn't Want to Put a Label on CBRS Work with Charter* (Sept. 24, 2021), https://www fiercewireless.com/operators/comcast-doesn-t-want-to-put-a-label-cbrs-work-charter.

[159] Diana Goovaerts, Fierce Video, *Rutledge: Charter Has Asked Verizon to Activate MVNO Agreement* (Sept. 21, 2016), https://www fiercevideo.com/cable/rutledge-charter-has-asked-verizon-to-activate-mvno-agreement.

which grew to more than 4 million subscribers by year-end 2021.[160] Charter began offering its Spectrum Mobile service in the summer of 2018, which grew to approximately 3.6 million customers by year-end 2021.[161] Altice,[162] another cable provider, launched its Optimum Mobile service in September 2019, and had acquired 186,000 subscribers by the end of 2021.[163] In July 2022, Cox Communications, the nation's fourth-largest cable company, began registering customers for a pilot launch of an MVNO service expected to launch in late 2022.[164]

69. *T-Mobile-Sprint Transaction.* In April 2018, T-Mobile and Sprint announced their intent to merge.[165] Because the proposed transaction involved the transfer of multiple spectrum licenses and authorizations, it was subject to Commission review to determine whether the transaction would serve the public interest, convenience, and necessity.[166] Accordingly, the Commission initiated a proceeding to examine the extent to which this merger of two firms that compete in many of the same geographic and product markets might lessen competition, and whether any potential harms would be outweighed by the potential benefits of the transaction.

70. *T-Mobile Merger Conditions*. In November 2019, the Commission approved the applications for the transfer of control of licenses, authorizations, and spectrum leases from Sprint to T-Mobile, reducing the number of nationwide providers from four to three.[167] As part of its approval, the Commission imposed as conditions various commitments made by T-Mobile.[168] These conditions included 5G buildout commitments, drive-testing commitments to verify whether the buildout commitments were met, in-home broadband commitments, and a pricing commitment to make available the same or better rate plans for three years.[169] On June 1, 2021, T-Mobile submitted its first annual progress report.[170] On May 23, 2022, the Wireless Telecommunications Bureau (WTB) released a public

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[160] Linda Hardesty, Fierce Wireless, *Comcast Sees $157M Wireless Profits in 2021, Downplays Fiber Competition* (Jan. 27, 2022), https://www.fiercewireless.com/wireless/comcast-sees-157m-wireless-profits-2021-downplays-fiber-competition.

[161] Diana Goovaerts, Fierce Wireless, *Charter Tops Comcast with 380k Wireless Net Adds in Q4* (Jan. 28, 2022), https://www.fiercewireless.com/wireless/charter-tops-comcast-380k-wireless-net-adds-q4.

[162] Altice describes itself as an "infrastructure-based Mobile Virtual Network Operator," as it operates its own core network infrastructure to provide wireline broadband, though it does not have its own for its mobile offering. The distinction in Altice's ability to leverage its own facilities has allowed it to obtain numbers directly under waiver. *See Numbering Policies for Modern Communications; Number Resource Optimization*, WC Docket No. 13-97; CC Docket No. 99-200, Order, 33 FCC Rcd 12501 (WCB 2018).

[163] Diana Goovaerts, Fierce Wireless, *Altice USA Near New MVNO Deal with T-Mobile* (Feb. 17, 2022), https://www.fiercewireless.com/wireless/altice-usa-nears-new-mvno-deal-t-mobile.

[164] Mobile World Live, *Cox Communications Readies MVNO Launch* (July 20, 2022), https://www.mobileworldlive.com/featured-content/home-banner/cox-communications-tees-up-mvno-fall-launch/.

[165] Press Release, T-Mobile, T-Mobile and Sprint to Combine, Accelerating 5G Innovation & Increasing Competition (Apr. 29, 2018), https://www.t-mobile.com/news/press/5gforall.

[166] 47 U.S.C. §§ 214(a), 310(d).

[167] *T-Mobile-Sprint Order*, 34 FCC Rcd at 10578.

[168] *Id*, at 10746-47, paras. 387-93.

[169] *Id.* at 10801-28, Appx. G.

[170] First Annual Progress Report on T-Mobile's 5G Network, Rural 5G Coverage, and In-Home Broadband Commitments, WT Docket No. 22-211, Nancy J. Victory, Counsel for T-Mobile US, Inc., to Joel Taubenblatt, Acting Chief, Wireless Telecommunications Bureau (June 1, 2021).

notice that opened a new docket for the purpose of monitoring compliance with these conditions.[171] On May 31, 2022, T-Mobile submitted its second annual progress report.[172]

71. *DISH Compliance*. When WTB opened the T-Mobile compliance docket, it also opened a new docket concerning DISH's compliance with the conditions associated with the *T-Mobile-Sprint Order*.[173] As part of this order, the Commission concluded that significant public interest benefits would flow from DISH's deployment of 5G broadband services over its spectrum holdings and that the acquisition of Sprint's Boost Mobile would help DISH achieve that deployment.[174] The DISH commitments, which were imposed as conditions, included the monitoring of DISH's nationwide 5G network deployment buildout and coverage requirements as well as verification and enforcement.[175] On July 14, 2022, DISH filed its buildout status report, in which it claimed that it is offering 5G broadband service to over 20% of the U.S. population.[176]

72. *Verizon-TracFone Order*. In November 2021, the Commission approved Verizon's application for the transfer of control of TracFone's international section 214 authorization to Verizon.[177] After an extensive review, the Commission found that the proposed transaction, as modified by Verizon's enforceable commitments, would make Verizon and TracFone stronger providers of prepaid and Lifeline services.[178] The Commission adopted conditions to ensure the continued provision of Lifeline service by TracFone—"one of the most significant participants in the Lifeline program."[179] For example, the Commission imposed conditions to "protect low-income consumers from price increases and to ensure that TracFone remains a supportive Lifeline participant."[180]

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[171] *Docket Established for Monitoring T-Mobile's Compliance with Conditions Imposed in the T-Mobile-Sprint Transfer of Control Order*, WT Docket Nos. 18-197 and 22-211, Public Notice, DA 22-571 (WTB May 23, 2022).

[172] Second Annual Progress Report on T-Mobile's 5G Network, Rural 5G Coverage, and In-Home Broadband Commitments, WT Docket No. 22-211, Nancy J. Victory, Counsel for T-Mobile US, Inc., to Joel Taubenblatt, Acting Chief, Wireless Telecommunications Bureau (May 31, 2022).

[173] *Docket Established for Monitoring DISH's Compliance with Conditions Granting an Extension of Time to Complete Construction of Facilities and Buildout Commitments*, WT Docket Nos. 18-197 and 22-212, Public Notice, DA 22-572 (WTB May 23, 2022).

[174] *T-Mobile-Sprint Order*, 34 FCC Rcd at 10739-45, paras. 364-83.

[175] *Id.* at 10747, paras. 394-98, Appx. H.

[176] DISH Network Corporation 5G Buildout Status Report, WT Docket No. 22-212 (July 14, 2022) (complying with the June 14, 2022 AWS H Block, AWS-4, and Lower 700 MHz E Block deployment obligations set forth in the *T-Mobile-Sprint Order*).

[177] *Verizon-TracFone Order* at 2, paras. 1-2.

[178] *Id.* at 2-3, paras. 3-4; *see also* FCC, Press Release, FCC Grants Approval of Verizon-TracFone Transaction Subject to Conditions to Protect Consumers at 1 (Nov. 22, 2021), https://www.fcc.gov/document/fcc-approves-verizon-tracfone-consumer-protections (Verizon-TracFone Press Release).

[179] *Verizon-TracFone Order* at 2-3, paras. 1-4.

[180] *Id.* at 2, para. 4. These conditions included, among other things, requiring Verizon to: (i) continue to offer TracFone's Lifeline-supported services over the same service areas for at least seven years; (ii) continue to offer and advertise existing Lifeline plans, with no added co-pays to TracFone's existing no-cost Lifeline plans, for at least three years; (iii) make available to existing and new Lifeline prepaid customers a 5G plan and offer a range of cost-effective 5G devices to existing and new Lifeline customers; and (iv) establish and maintain a dedicated website with information about the Lifeline program and a dedicated customer service line for Lifeline customers. *Id.* at 50-51, paras. 131-35.

b. Connections/Subscribers and Market Share

73. To estimate the number of mobile wireless subscribers/connections, this *Report* uses Numbering Resource Utilization/Forecast (NRUF) data,[181] which track how many phone numbers have been assigned to mobile wireless devices,[182] and CTIA—The Wireless Association (CTIA) data.[183] As shown in Figure II.B.1 below,[184] NRUF estimates of mobile wireless connections at year-end 2020 were approximately 439 million, an increase of around 2% from year-end 2019. At year-end 2021, NRUF estimates of mobile wireless connections were approximately 457 million, an increase of around 4% from year-end 2020. CTIA estimates of mobile wireless connections at year-end 2020 were approximately 469 million, an increase of around 6% from year-end 2019, and at year-end 2021 the figure was approximately 499 million, an increase of approximately 6% from year-end 2020.

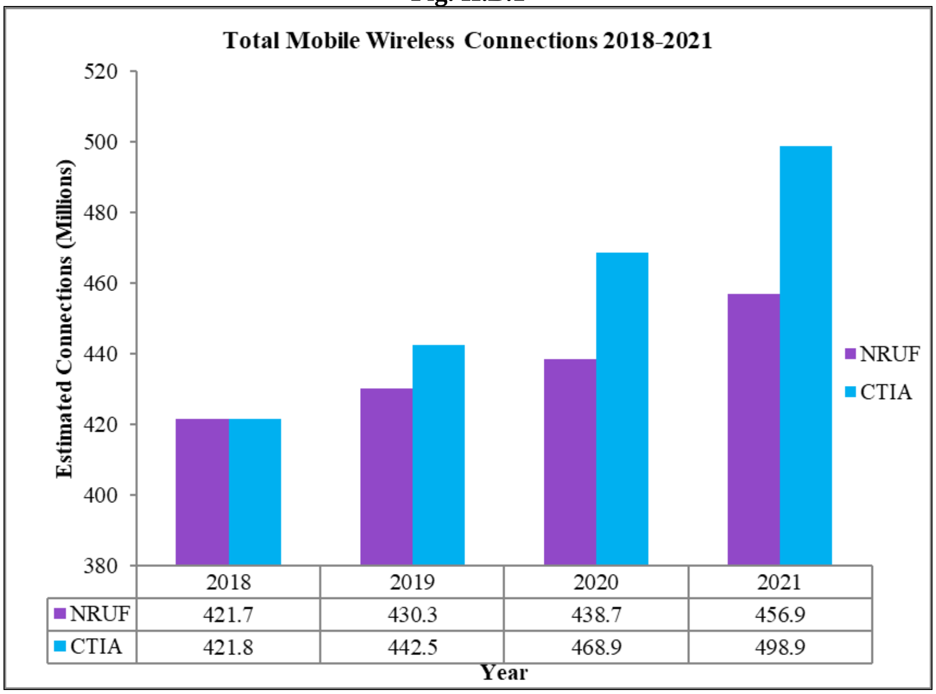
[181] NRUF data indicate the number of phone numbers that a wireless service provider has assigned in a particular rate center (there are approximately 18,000 rate centers in the country). *See* 47 CFR § 52.15(e)(5). Rate centers are geographic areas used by local exchange carriers for a variety of reasons, including the determination of toll rates. Harry Newton, Newton's Telecom Dictionary at 660 (19th ed. 2003). The Commission calculates the total number of wireless subscribers from the total number of assigned phone numbers reported by wireless service providers in their required NRUF reports. For purposes of geographical analysis, the rate center data can be associated with a geographic point, and all points that fall within a county boundary can be aggregated together and associated with much larger geographic areas based on counties. We note that the aggregation to larger geographic areas, such as to whole counties or groups of counties, reduces the level of inaccuracy inherent in combining non-coterminous areas, such as rate center areas and counties.

[182] While NRUF provides a measure of the number of wireless connections or connected devices that have assigned telephone numbers, the data have limitations, like providing only the quantity of mobile wireless connections that have a telephone number, rather than the number of consumers subscribed to mobile broadband or voice service. *Twentieth Wireless Competition Report*, 32 FCC Rcd at 8977-78 & n.65. If a mobile broadband or voice subscriber uses a device that does not have a telephone number assigned to it (e.g., a tablet), then that subscriber will not be recorded. *See 2017 Data Collection Improvement Further Notice*, 32 FCC Rcd at 6337, para. 26 & n.38. These data also do not reflect when consumers move to a different state and retain the same telephone number. *See BDC Order and Second Further Notice*, 34 FCC Rcd at 7530-31, para. 60.

[183] Different sources refer to their data as connections or subscribers, and when discussing the different data, we will use the terminology most currently used by the source and, where possible, provide a definition of this term. For example, CTIA explains its use of the terms "subscribers" and "connections" as follows: "Traditionally, the term 'subscribers' was used as a term of art, reflecting the number of revenue-generating units, equally describable as 'wireless connections'—the equivalent of wired telephone 'lines.' The term 'subscriber' does not indicate a unique individual person. Indeed, the growing number and variety of non-traditional devices and machine-to-machine (M2M) applications mean that the term 'subscribers' is increasingly less descriptive of a growing share of the universe of active units." CTIA, CTIA's Wireless Industry Indices Report, Year-End 2021 Results at 17 (CTIA Year-End 2021 Wireless Industry Indices Report).

[184] For details of total mobile wireless connections over time, *see* Appx. D-1 of this *Report*.

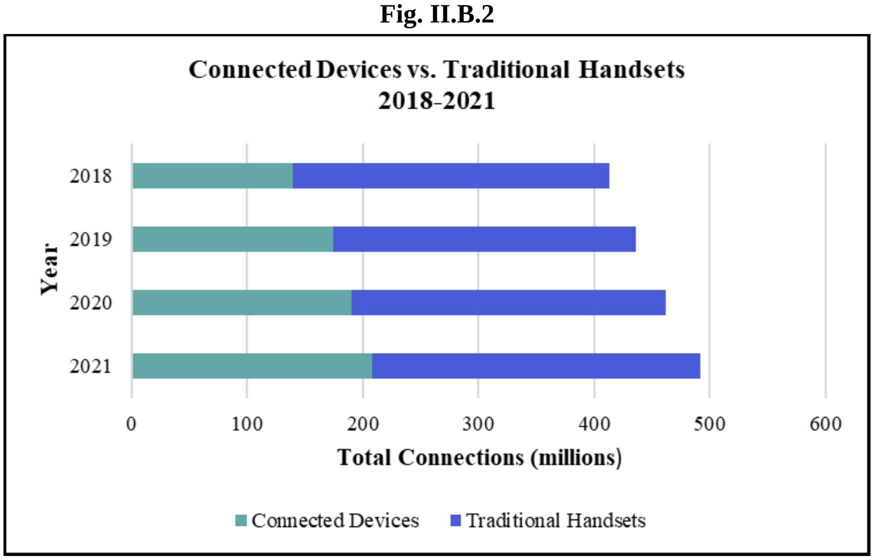
Fig. II.B.1



Source: NRUF; CTIA Year-End 2021 Wireless Industry Indices Report.

74. Figure II.B.2 presents data on the use of connected devices compared with traditional handsets (i.e., phones). Connected devices, which include data-only devices such as tablets, laptops, and wireless modems, as well as connected cars, wearables, and other IoT devices, have been an integral driver of the growth in connections over the past several years. In 2021, they accounted for approximately 42% of all wireless connections, up from approximately 34% in 2018.

Fig. II.B.2



Source: CTIA Year-End 2018-2021 Wireless Industry Indices Reports.

75. Figure II.B.3 presents data on total mobile wireless connections for the largest publicly traded service providers operating in the United States, including an estimate of their respective market shares as of year-end 2021.[185]

Fig. II.B.3
Reported Total Connections for Publicly Traded Facilities–Based Mobile Wireless Service Providers (in thousands): 2018–2021

Service Providers	EOY 2018	EOY 2019	EOY 2020	EOY 2021	EOY 2021 (% Market Share)
AT&T	151,921	165,889	182,558	201,791	44.0
Verizon Wireless	117,999	119,761	120,880	142,806	31.2
T-Mobile	63,656	67,894	102,064	108,719	23.7
UScellular	4,988	4,899	4,911	4,893	1.1
Sprint	54,495	54,165	0	0	0.0
Top Providers Total	**393,059**	**412,608**	**410,413**	**458,209**	

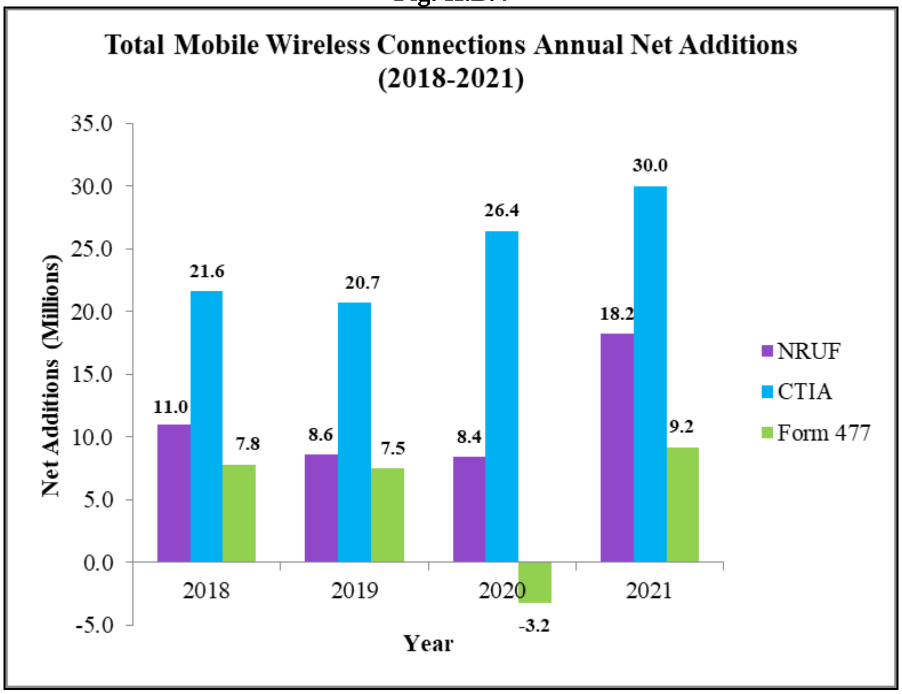
Source: Quarterly and Annual Reports from AT&T, Sprint, T-Mobile, UScellular, and Verizon. Totals were calculated from all reported wireless connections for all U.S. segments from company filings (e.g., Consumer, Business, etc.). Total estimated connections figure includes data only for the service providers reported in this table.

76. Estimates of the number of net additions in 2020 and 2021 vary by source, which is likely due to differences in the way connections are measured. As shown in Figure II.B.4, in 2020, there were approximately 8.4 million net additions based on NRUF data, compared with 26.4 million based on CTIA data. In contrast, mobile voice subscriber data as reported by service providers on FCC Form 477 show that subscribers fell by approximately 3.2 million in 2020. In 2021, NRUF showed 18.2 million additions, CTIA showed 30 million additions, and FCC Form 477 showed 9.2 million additions.[186]

[185] The size of a company, typically measured by service revenues or subscribers, relative to the total size of the industry determines its market share. *See, e.g.*, The MIT Dictionary of Modern Economics at 268 (4th ed. 1992).

[186] Based on preliminary December 2021 FCC Form 477 data, the total number of mobile voice telephone subscriptions at year-end 2021 was approximately 362 million, as compared to approximately 353 million at year-end 2020 (Preliminary Dec. 2021 FCC Form 477 Voice Subscriptions). We again note that the year-end FCC Form 477 data are preliminary only, are subject to corrections as appropriate by the service provider, and the final data will be published in due course by the agency. *See, e.g.*, FCC, Office of Economics and Analytics, *Voice Telephone Services: Status as of June 30, 2021* (Aug. 1, 2022), https://www.fcc.gov/voice-telephone-services-report (*June 30, 2021 Voice Telephone Services Report*). These data do not include non-voice devices.

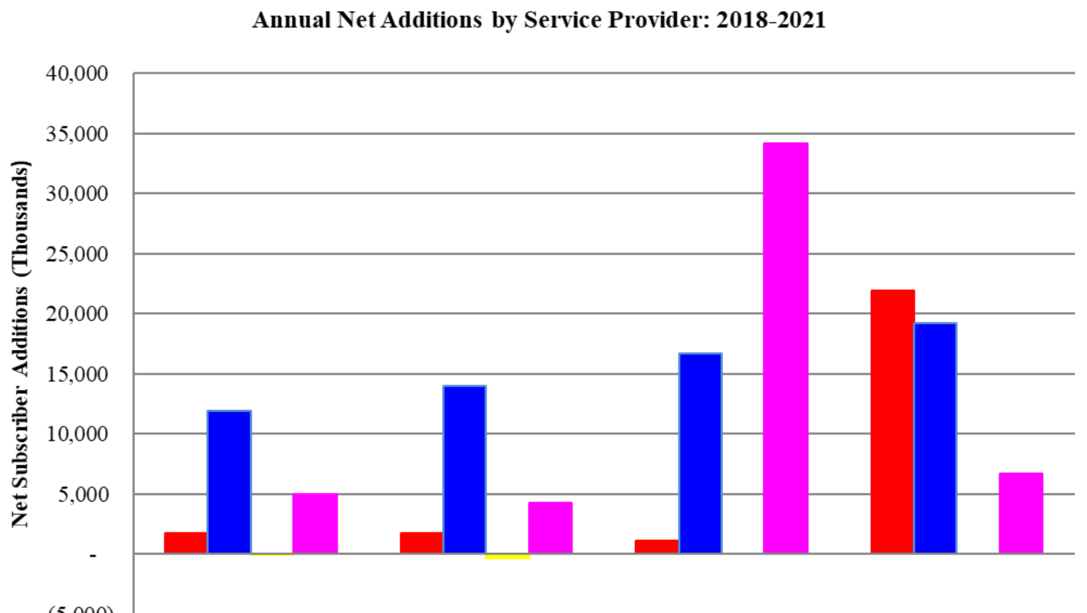
Fig. II.B.4



Source: NRUF; CTIA Year-End 2021Wireless Industry Indices Report; FCC Form 477.

77. Figure II.B.5 shows net subscriber additions by the nationwide service providers from 2018 through 2021. T-Mobile's 2020 subscriber additions reflect the effect of its merger with Sprint, while Verizon Wireless's 2021 subscriber additions reflect Verizon's acquisition of TracFone. AT&T's subscriber additions reflect its increasing number of connected devices.

Fig. II.B.5



	2018	2019	2020	2021
Verizon Wireless	1,742	1,762	1,119	21,926
AT&T	11,935	13,968	16,669	19,233
Sprint	(86)	(330)	-	-
T-Mobile	4,941	4,238	34,170	6,665

Source: Quarterly and Annual Reports from AT&T, Sprint, T-Mobile, UScellular, and Verizon. Totals were calculated from all reported wireless connections for all U.S. segments from company filings (e.g., Consumer, Business, etc.).

78. *Market Concentration.* High market concentration levels in any market may raise some concern that a market is not competitive.[187] To measure mobile wireless market concentration, the Commission employs the Herfindahl-Hirschman Index (HHI), widely used in competition analysis.[188] The HHI is calculated by summing the squared market shares of all firms in the given market. In this *Report*, we calculate HHIs based on the NRUF data by Economic Area (EA) to maintain continuity with past reports and to ensure that we do not compromise the confidential information found in the NRUF data. As of year-end 2017, prior to the announcement of the T-Mobile-Sprint merger in April 2018, the weighted average HHI (weighted by population across the 172 EAs in the United States) for mobile

[187] The increased market concentration arising from a transaction involving the transfer of subscribers is an indicator of potential harm to competition, and in antitrust analysis, triggers a presumption that the merger is likely to enhance market power. U.S. Department of Justice and the Federal Trade Commission, Horizontal Merger Guidelines at § 5.3, 19 (2010), http://www.justice.gov/atr/public/guidelines/hmg-2010.pdf (*2010 DOJ/FTC Horizontal Merger Guidelines*).

[188] To the extent that this section uses the term "markets," we do not intend it to be interpreted as synonymous with the antitrust concept of the "relevant market," which the Commission defines in the context of secondary market transactions review. *See, e.g.*, *T-Mobile-Sprint Order*, 34 FCC Rcd at 10601, para. 55.

wireless services was 3,106.[189] As of year-end 2021, the weighted average HHI for mobile wireless services by EA was 3,596.[190]

c. Churn

79. Churn measures the percentage of connections that are disconnected from mobile wireless service during a given time period.[191] The churn rate is a business metric that measures the turnover of a service provider's subscriber base. A low churn rate indicates low customer attrition. A service provider's churn rate depends on many factors, such as the distribution of its customers between postpaid and prepaid service plans,[192] customer satisfaction with their service provider,[193] and switching costs.[194] High levels of industry churn can indicate that consumers are not only willing but are also able to switch easily between service providers. For 2021, CTIA reported an annual industry-wide churn rate of 16.7%, and a monthly rate of 1.39%.[195] Figure II.B.6 shows the weighted average churn rates of prepaid and postpaid service plans, according to UBS, for the nationwide providers by quarter. There was a notable decline in the churn rates for all nationwide mobile wireless providers from 2019 to 2020 that persisted through the first half of 2021. Although the churn rate for Verizon Wireless has since rebounded, churn has remained relatively low for both AT&T and T-Mobile.[196]

[189] *2020 Communications Marketplace Report*, 36 FCC Rcd at 2961, para. 25.

[190] Antitrust authorities in the United States generally classify markets into three types: Unconcentrated (HHI < 1500), Moderately Concentrated (1500 < HHI < 2500), and Highly Concentrated (HHI > 2500). *2010 DOJ/FTC Horizontal Merger Guidelines* at § 5.3, 19. In January 2022, DOJ and FTC launched a public inquiry aimed at modernizing the merger guidelines, specifically seeking "information on whether concentration thresholds should be adjusted to improve the efficiency and effectiveness of enforcement." U.S. Department of Justice, Press Release, Office of Public Affairs, Justice Department and Federal Trade Commission Seek to Strengthen Enforcement Against Illegal Mergers (Jan. 18, 2022), https://www.justice.gov/opa/pr/justice-department-and-federal-trade-commission-seek-strengthen-enforcement-against-illegal.

[191] CTIA defines churn as "a measure of the number of subscribers disconnecting from service during the period." CTIA Year-End 2021 Wireless Industry Indices Report at 36. Churn is calculated by dividing the aggregate number of wireless connections that terminated service, including both voluntary and involuntary disconnects, during a time period by the average of total number of wireless connections at the beginning and the end of that time period. For an annual calculation, if a service provider has an average monthly churn rate of 2%, the service provider would lose 24% of its subscribers over the course of a year. Service providers publish their monthly churn rate information as part of their quarterly filings with the SEC.

[192] Prepaid service plans tend to have higher churn rates than postpaid service plans. Therefore, if a service provider had a relatively large share of prepaid consumers in their customer mix, that service provider would have a higher weighted average churn rate than a service provider with a small foothold in the prepaid market.

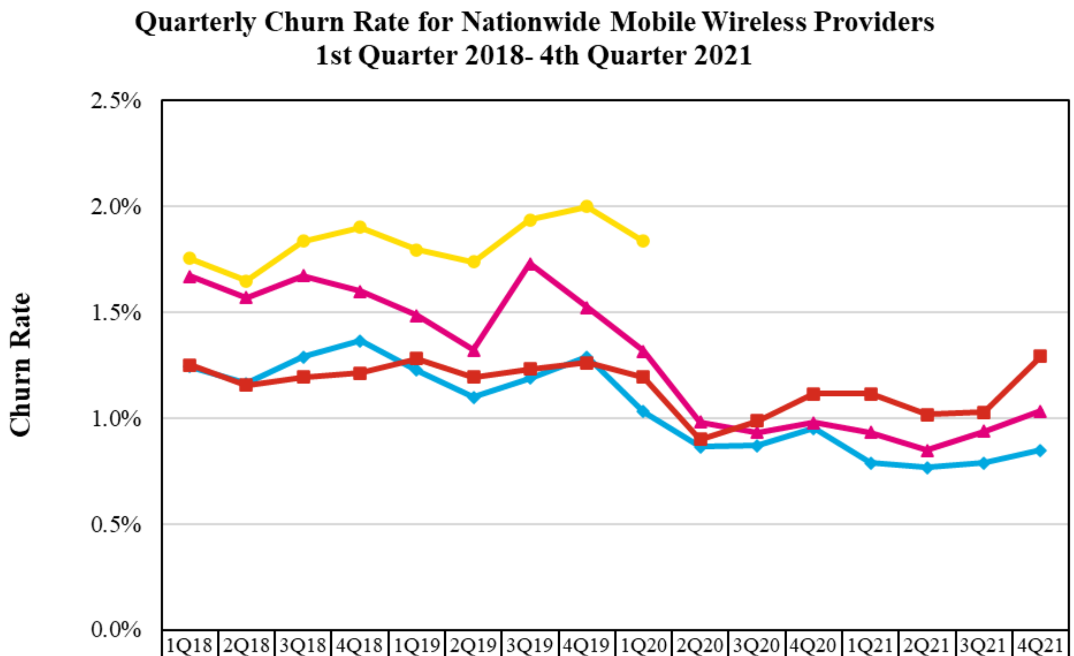
[193] The top reasons for customers to leave a wireless service provider include high prices ("too expensive"), inferior plan features (find "a better plan"), and slow speeds ("slow data speed"). *See* Letter from Roger Entner, Recon Analytics, to Marlene H. Dortch, Secretary, FCC, WC Docket No. 22-203, Attach. A at 4 (filed Aug. 26, 2022) (*Recon Analytics Ex Parte*).

[194] *2020 Communications Marketplace Report*, 36 FCC Rcd at 2691, para. 26.

[195] CTIA Year-End 2021 Wireless Industry Indices Report at 37. For prepaid services, CTIA reported an annual industry-wide churn rate of 30.2% and a monthly churn rate of 2.52%. *Id.* at Appx. C, 15-6.

[196] *See* Emily Bary, MarketWatch, *AT&T tops earnings expectation as wireless churn matches record low* (July 22, 2021), https://www marketwatch.com/story/at-t-tops-earnings-expectation-as-wireless-churn-matches-record-low-11626952315; *see also* Iskra Petrova, Phone Arena, *T-Mobile celebrates low churn rate for Q2 2021* (Aug. 13, 2021), https://www.phonearena.com/news/t-mobile-low-churn-rate-q2-2021_id134320.

Fig. II.B.6



	1Q18	2Q18	3Q18	4Q18	1Q19	2Q19	3Q19	4Q19	1Q20	2Q20	3Q20	4Q20	1Q21	2Q21	3Q21	4Q21
AT&T	1.2%	1.2%	1.3%	1.4%	1.2%	1.1%	1.2%	1.3%	1.0%	0.9%	0.9%	1.0%	0.8%	0.8%	0.8%	0.8%
Sprint	1.8%	1.6%	1.8%	1.9%	1.8%	1.7%	1.9%	2.0%	1.8%							
T-Mobile	1.7%	1.6%	1.7%	1.6%	1.5%	1.3%	1.7%	1.5%	1.3%	1.0%	0.9%	1.0%	0.9%	0.8%	0.9%	1.0%
Verizon	1.3%	1.2%	1.2%	1.2%	1.3%	1.2%	1.2%	1.3%	1.2%	0.9%	1.0%	1.1%	1.1%	1.0%	1.0%	1.3%

Source: UBS Investment Research. Published with permission of UBS.

d. Data Usage

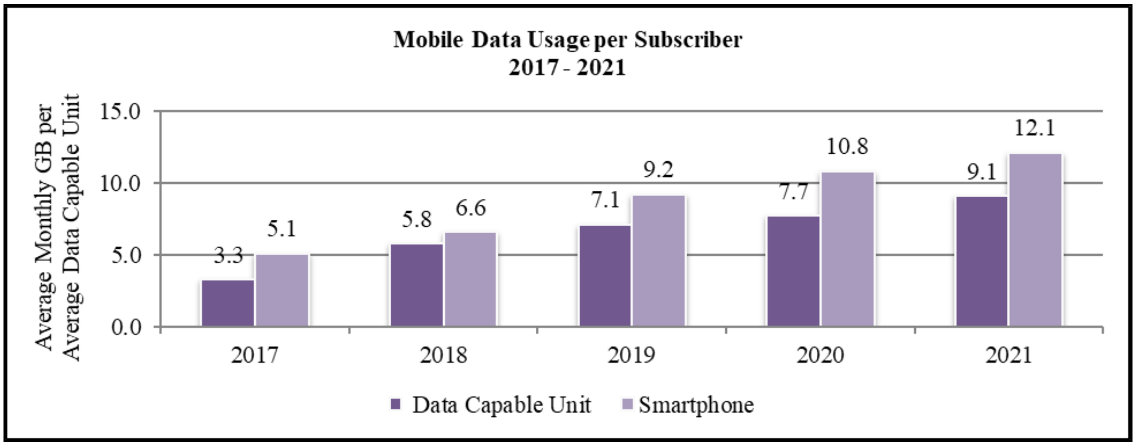
80. As shown in Figure II.B.7, monthly data usage per smartphone subscriber rose to an average of 12.1 GB per subscriber per month, an increase of approximately 12% from year-end 2020 to year-end 2021.[197] Figure II.B.8 further shows that total network annual data usage increased by approximately 26% from 2020 to 2021, while total messaging traffic[198] and total minutes of voice use both experienced declines, falling approximately 19% and approximately 9%, respectively.[199]

[197] CTIA Year-End 2021 Wireless Industry Indices Report at 63.

[198] *Id.* at 67. This provider-reported messaging traffic does not include traffic from OTT messaging applications and services, which would only appear in the total data traffic figures, thereby contributing to the total MB of data traffic. *Id.* at 63.

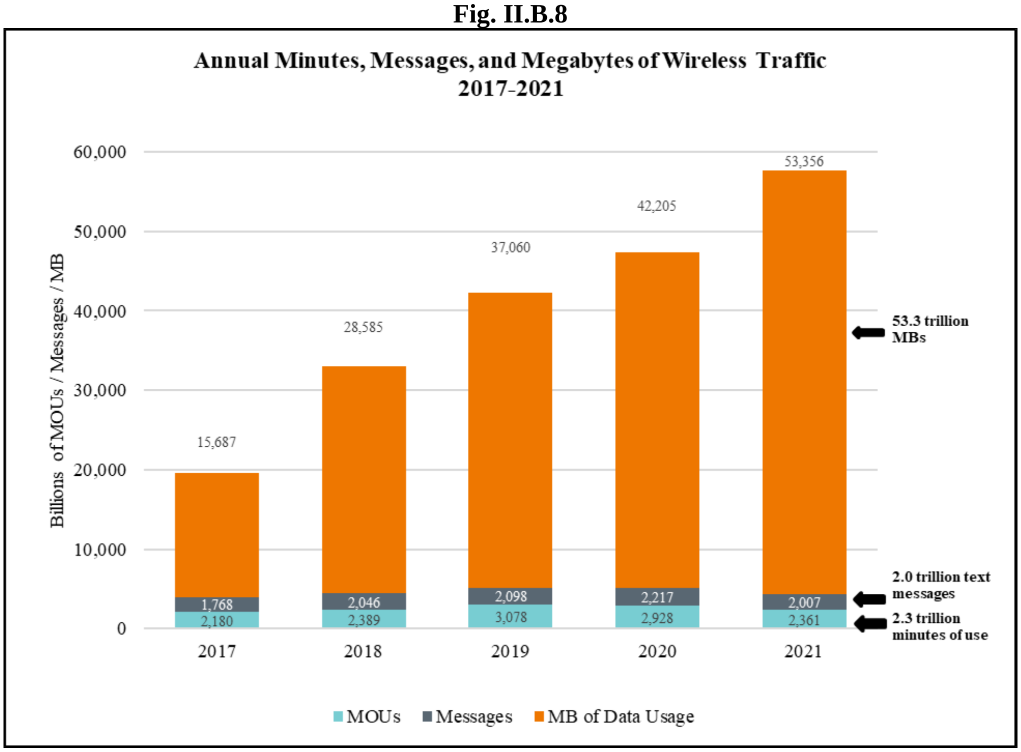
[199] *Id.* at 67.

Fig. II.B.7



Source: CTIA Year-End Wireless Industry Indices Report at 63.

Fig. II.B.8



Source: CTIA Year-End Wireless Industry Indices Report at 67, Chart 28.

81. This growth in data usage is primarily driven by the increase in data demanded per device. According to a 2021 Pew survey, smartphone and tablet ownership were 85% and 53%, respectively, largely unchanged from the 81% and 52% ownership figures reported in 2019.[200] Pew reported that 15% of American adults are "smartphone-only" Internet users—they own a smartphone, but do not have traditional fixed home broadband service—a two-point decrease from 2019, and a five-point

[200] Pew Research Center, *Mobile Fact Sheet* (Feb 8, 2021), http://www.pewinternet.org/fact-sheet/mobile/ (Pew Mobile Fact Sheet).

decrease from the 20% surveyed in 2018, which was the peak rate found by Pew.[201] In comparison, the U.S. Census Bureau's ACS found that, as of 2019, approximately 10% of total U.S. households subscribed to a cellular data plan with no other type of Internet subscription.[202] Many consumers also choose to depend on some combination of fixed and mobile broadband access while discontinuing their landline telephone services. In fact, according to preliminary data from the Centers for Disease Control and Prevention (CDC), as of December 2021, the percentage of U.S. adults living in households that were identified as having wireless-only telephone service (no landline telephone service) was approximately 69%.[203] For children, the CDC found that an even greater number, approximately 79%, live in wireless-only households.[204] Further, a Recon Analytics survey estimated that the median age when a child first receives a cellphone is approximately 10 years old.[205]

2. Mobile Wireless Spectrum

82. Spectrum is a critical input in the provision of mobile wireless services.[206] It can affect whether, when, and where existing service providers and potential entrants will be able to expand capacity or deploy networks.[207] Incumbent service providers may need additional spectrum to increase their coverage or capacity, while new entrants need access to spectrum to enter a geographic area at all. Spectrum bands vary in breadth and in their propagation characteristics, and these variations have implications for how spectrum is deployed.[208] The effective supply of spectrum capacity available for mobile wireless service depends on several aspects of spectrum policy, including allocation and licensing policies, as well as interference and technical rules.[209] Increasing the total supply of spectrum bandwidth that the Commission allocates and licenses to mobile wireless service providers can increase network

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[201] *See* Pew Mobile Fact Sheet.

[202] U.S. Census Bureau, *2019 American Community Survey 1-Year Estimates, Types of Computers and Internet Subscriptions*, https://data.census.gov/cedsci/table?q=S2801%3A%20TYPES%20OF%20COMPUTERS%20AND%20INTERNET%20SUBSCRIPTIONS&tid=ACSST1Y2019.S2801&hidePreview=true (last visited Sept. 7, 2022). We note that Pew surveys U.S. adults while ACS relies on sampling households, which is a likely source of divergence for these respective statistics.

[203] CDC, NCHS, Stephen J. Blumberg and Julian V. Luke, *Wireless Substitution: Early Release of Estimates from the National Health Interview Survey, July-December 2021* at 4 (2022), https://www.cdc.gov/nchs/data/nhis/earlyrelease/wireless202205.pdf.

[204] *Id.*

[205] Letter from Roger Entner, Lead Analyst, Recon Analytics, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 22-203, Attach. 4, at 5 (filed Aug. 26, 2022) (*Recon Analytics Ex Parte*).

[206] Non-spectrum inputs in the provision of mobile wireless services include cellular base stations and towers to carry transmissions and backhaul, which routes voice and data traffic from base stations to mobile switching centers. Backhaul may be provided via wireless spectrum, copper, or fiber, though we note copper may lack sufficient capacity for current data demands.

[207] *2020 Communications Marketplace Report*, 36 FCC Rcd at 2964, para. 29; *Policies Regarding Mobile Spectrum Holdings Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*, WT Docket No. 12-269, GN Docket No. 12-268, Report and Order, 29 FCC Rcd 6133, 6134, para. 2 (2014) (*Mobile Spectrum Holdings Report and Order*).

[208] Spectrum below 1 GHz (low-band spectrum) has certain propagation advantages for network deployment over long distances, and for penetrating buildings and urban canyons, while mid-band (and high-band) spectrum allow for the better transmission of large amounts of information as the spectrum bandwidths are larger. *Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6135, para. 3.

[209] *2020 Communications Marketplace* Report, 36 FCC Rcd at 2964, para. 29; *2018 Communications Marketplace Report*, 33 FCC Rcd at 12584-85, para. 31.

capacity and reduce the degree of frequency reuse required to achieve a given level of capacity.[210] The efforts of the Commission to make available more spectrum to meet consumer demand for mobile broadband services and to fuel innovation and investment in the mobile wireless market are detailed in sections VI and VII below.

83. Subject to Commission approval, licensees may transfer licenses, in whole or in part (through partitioning and/or disaggregation), on the secondary market.[211] In reviewing proposed transfers of control of spectrum, the Commission uses an initial spectrum screen[212] to help identify, for case-by-case review, local markets where changes in spectrum holdings resulting from the transaction may raise competitive concerns.[213] In addition, the Commission has determined that increased aggregation of below-1-GHz spectrum would be treated as an "enhanced factor" under its case-by-case review of license transfers if post-transaction the acquiring entity would hold approximately one-third or more of the currently suitable and available spectrum below 1 GHz.[214]

84. In the past decade, in the context of its review of secondary market transactions, as well as in rulemakings, the Commission periodically has determined that additional spectrum was suitable and available for mobile wireless use, and therefore subject to inclusion in the spectrum screen.[215] The current

[210] *See* Theodore Rappaport, Wireless Communications: Principles and Practice at 58 (2d ed. 2002).

[211] As part of its secondary market policies, the Commission also permits mobile wireless licensees to lease all or a portion of their spectrum usage rights for any length of time within the license term and over any geographic area encompassed by the license.

[212] The Commission includes spectrum that it finds suitable and available for the provision of mobile wireless services in the spectrum screen. *See, e.g.*, *T-Mobile-Sprint Order*, 34 FCC Rcd at 10607-08, paras. 70-72; *Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6169, para. 71.

[213] *See, e.g.*, *T-Mobile-Sprint Order*, 34 FCC Rcd at 10607-08, paras. 70-72; *Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6221-22, para. 225. In the case of transfer of business units, the Commission's initial Herfindahl-Hirschman Index (HHI) screen identifies, for further case-by-case market analysis, those markets in which, post-transaction: (1) the HHI would be greater than 2800 and the change in HHI would be 100 or greater; or (2) the change in HHI would be 250 or greater, regardless of the level of the HHI. *See, e.g.*, *T-Mobile-Sprint Order*, 34 FCC Rcd at 10614-15, para. 87 & n.277; *Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6140-41, para. 13 & n.34.

[214] *See, e.g.*, *T-Mobile-Sprint Order*, 34 FCC Rcd at 10614-15, para. 87; *Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6240, paras. 282-88.

[215] *See Facilitating Shared Use in the 3100-3550 MHz Band*, WT Docket No. 19-348, Second Report and Order, Order on Reconsideration, and Order of Proposed Modification, 36 FCC Rcd 5987, 6025-26, paras. 108-09; *Expanding Flexible Use of the 3.7 to 4.2 GHz Band*, GN Docket No. 18-122, Report and Order and Order of Proposed Modification, 35 FCC Rcd 2343, 2383-84, paras. 87-88; *2.5 GHz Report and Order*, 34 FCC Rcd at 5481, 5482-83, para. 96 & n.279, paras. 99-100; *Incentive Auction Closing and Channel Reassignment*, AU Docket No. 14-252 et al., Public Notice, 32 FCC Rcd 2786 (WTB 2017); *Applications of SprintCom, Inc., Shenandoah Personal Communications, LLC, and NTELOS Holdings Corp. for Consent To Assign Licenses and Spectrum Lease Authorizations and To Transfer Control of Spectrum Lease Authorizations and an International Section 214 Authorization*, WT Docket No. 15-262, Memorandum Opinion and Order, 31 FCC Rcd 3631, 3637-38, paras. 15-16 (WTB/IB 2016); *Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6172-90, paras. 82-134; *Applications of AT&T Mobility Spectrum LLC, New Cingular Wireless PCS, LLC, Comcast Corporation, Horizon Wi-Com, LLC, NextWave Wireless, Inc., and San Diego Gas & Electric Company for Consent To Assign and Transfer Licenses*, WT Docket No. 12-240, Memorandum Opinion and Order, 27 FCC Rcd 16459, 16470-71, para. 31 (2012); *Amendment of Part 27 of the Commission's Rules to Govern the Operation of Wireless Communications Services in the 2.3 GHz Band*, WT Docket No. 07-293, Report and Order, 25 FCC Rcd 11710, 11711, para. 1 (2010); *Applications of Sprint Nextel Corporation and Clearwire Corporation for Consent To Transfer Control of Licenses, Leases, and Authorizations*, WT Docket No. 08-94, Memorandum Opinion and Order, 23 FCC Rcd 17570, 17598-99, paras. 70, 72 (2008); *Applications of AT&T Inc. and Dobson Communications Corporation for Consent To Transfer Control of Licenses and Authorizations*, WT Docket No. 07-153, Memorandum Opinion and Order, 22 FCC Rcd 20295, 20307-08, para. 17 (2007).

suitable and available spectrum included in the spectrum screen, with an associated spectrum trigger of 385 megahertz, is shown in Figure II.B.9.[216]

Fig. II.B.9
Spectrum Included in the Spectrum Screen

Spectrum Band	***Megahertz (Amount)***
600 MHz	70
700 MHz	70
Cellular	50
SMR	14
Broadband PCS	130
AWS-1	90
AWS-3	65
AWS-4	40
H Block	10
WCS	20
BRS	67.5
EBS	116.5
3.7 GHz	280
3.45 GHz	100
Total Amount of Spectrum	***1123.0***

85. Regarding high-band spectrum, the Commission has made available nearly 19 gigahertz of licensed and unlicensed mmW spectrum. The 57-71 GHz band is available for unlicensed use,[217] and an additional 4950 megahertz is available for licensed use, as shown in Figure II.B.10 below.[218] The Commission adopted a separate threshold for mmW spectrum holdings, with an associated trigger of 1850 megahertz, as an initial analytical tool to aid in identifying certain markets for further review in proposed secondary market transactions.[219]

[216] 3.7 GHz and 3.45 GHz spectrum are not available for use in Hawaii, Alaska, and the territories. In these areas, the total amount of suitable and available spectrum is 743 megahertz, and the associated spectrum screen trigger is 250 megahertz.

[217] *See* 47 CFR § 15.255.

[218] *See Use of Spectrum Bands Above 24 GHz For Mobile Radio Services, et al.*, Third Report and Order, Memorandum Opinion and Order, and Third Further Notice of Proposed Rulemaking, 33 FCC Rcd 5576 (2018) (*Spectrum Frontiers Third Report and Order*); *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services*, GN Docket No. 14-177, Second Report and Order, Second Further Notice of Proposed Rulemaking, Order on Reconsideration, and Memorandum Opinion and Order, 32 FCC Rcd 10988, 10990, para. 2 (2017) (*Spectrum Frontiers Second Report and Order*); *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services, et. al.*, GN Docket No. 14-177, Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd 8014 (2016) (*Spectrum Frontiers Report and Order*).

[219] *See, e.g.*, *T-Mobile-Sprint Order*, 34 FCC Rcd at 10614-15, para. 87; *Application of Verizon Communications Inc. and Straight Path Communications, Inc. for Consent To Transfer Control of Local Multipoint Distribution Service, 39 GHz, Common Carrier Point-to-Point Microwave, and 3650-3700 MHz Service Licenses*, Memorandum Opinion and Order, 33 FCC Rcd 188, 194-95, paras. 18-19 (WTB 2018); *Spectrum Frontiers Second Report and Order*, 32 FCC Rcd at 11009-11, paras. 70, 74 & n.189; *Spectrum Frontiers Report and Order*, 31 FCC Rcd at 8082, para. 185.

Fig. II.B.10
Spectrum Included in the mmW Spectrum Threshold

Spectrum Band	*Megahertz (Amount)*
24 GHz	700
28 GHz	850
Upper 37 GHz	1000
39 GHz	1400
47 GHz	1000
Total Amount of Spectrum	***4950***

86. *Service Providers' Spectrum Holdings.* Figure II.B.11 presents average megahertz holdings by service provider in the mmW spectrum bands. Figures II.B.12 and II.B.13 present spectrum holdings by service provider in the spectrum bands included in the spectrum screen.[220] As of July 2022, the three nationwide service providers, AT&T, T-Mobile, and Verizon Wireless, together held approximately 78% of all the spectrum included in the spectrum screen, measured on a MHz-POPs basis. Figure II.B.14 shows the population-weighted average megahertz spectrum holdings of licensees by frequency band.[221]

Fig. II.B.11
Population-Weighted Average Megahertz Holdings by Licensee, by mmW Frequency Band

	24 GHz	28 GHz	Upper 37 GHz	39 GHz	47 GHz	TOTAL
AT&T	254	-	4	784	-	1,042
DISH	17	29	8	0.4	609	663.4
T-Mobile	335	123	-	321	381	1,160
UScellular	26	24	4	26	-	80
Verizon Wireless	7	618	975	124	-	1,724
Other	60	56	9	145	10	280

[220] The population-weighted average megahertz for each provider is calculated by multiplying that provider's spectrum in a county by the county's population (MHz-POPs), summing for all counties, and then dividing by the 2010 total U.S. population.

[221] We consider population-weighted spectrum holdings in order to account for customer density in different geographic areas. A spectrum license in Los Angeles or New York City, for example, covers more customers than a spectrum license over the same amount of land area in White Sands, New Mexico.

Fig. II.B.12
Percentage Spectrum Holdings, Measured on a MHz-POPs Basis by Licensee, by Frequency Band

Spectrum	600 MHz	700 MHz	Cellular	SMR	PCS	H Block	AWS-1	AWS-3	AWS-4	WCS	BRS	EBS	3.45	3.7 GHz
AT&T	0.0%	42.2%	44.6%	0.0%	29.0%	0.0%	16.1%	33.4%	0.0%	99.0%	0.0%	0.0%	40.1%	28.5%
DISH	26.3%	6.6%	0.0%	0.0%	0.0%	100.0%	0.0%	34.7%	100.0%	0.0%	0.0%	0.0%	31.0%	0.0%
T-Mobile	44.9%	15.0%	0.1%	96.5%	51.0%	0.0%	41.5%	5.4%	0.0%	0.0%	93.1%	79.9%	11.9%	9.8%
VZW	0.1%	31.1%	47.9%	0.0%	17.2%	0.0%	40.4%	20.2%	0.0%	0.0%	0.0%	0.0%	0.0%	57.4%
UScellular	2.5%	3.3%	3.8%	0.0%	1.1%	0.0%	0.8%	1.7%	0.0%	0.0%	0.0%	0.0%	3.8%	1.8%
Other	26.1%	1.7%	3.7%	3.5%	1.7%	0.0%	1.4%	4.6%	0.0%	1.0%	6.9%	20.1%	13.2%	2.5%

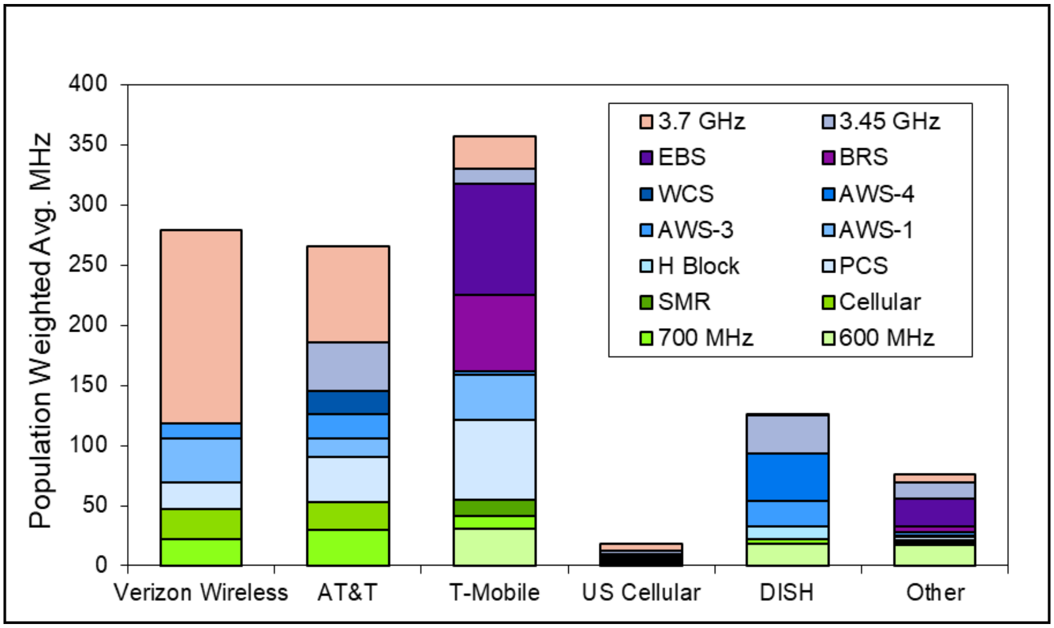
Staff estimates as of July 2022. Numbers may not sum to 100% due to rounding. Abbreviations for spectrum bands: Cellular, SMR (Specialized Mobile Radio Service), PCS (Personal Communications Service), BRS (Broadband Radio Service), and EBS (Educational Broadband Service).

Fig. II.B.13
Population-Weighted Average Megahertz Holdings by Licensee, by Frequency Band

Spectrum	600 MHz	700 MHz	Cellular	SMR	PCS	H Block	AWS-1	AWS-3	AWS-4	WCS	BRS	EBS	3.45 GHz	3.7 GHz	TOTAL
AT&T	0.0	29.6	23.6	0.0	37.8	0.0	14.5	20.3	0.0	19.7	0.0	0.0	39.3	79.8	264.6
DISH	17.9	4.6	0.0	0.0	0.0	10.0	0.0	21.1	40.0	0.0	0.0	0.0	30.4	0.0	124.0
T-Mobile	30.5	10.5	0.0	13.8	66.4	0.0	37.3	3.3	0.0	0.0	62.8	93.1	11.7	27.4	356.8
UScellular	1.7	2.3	2.0	0.0	1.4	0.0	0.7	1.0	0.0	0.0	0.0	0.0	3.7	4.9	17.7
VZW	0.1	21.8	25.4	0.0	22.4	0.0	36.3	12.3	0.0	0.0	0.0	0.0	0.0	160.7	279
Other	17.7	1.2	1.9	0.5	2.2	0.0	1.2	2.8	0.0	0.2	4.7	23.4	12.9	7.1	75.8

Staff estimates as of July 2022. The total for AWS-3 sums to 60.8 megahertz because some licenses have not been granted.

Fig. II.B.14
Spectrum Holdings by Band Weighted by Population



Staff estimates as of July 2022.

87. *CBRS*. The Commission has made continued efforts to improve the efficient use of limited spectrum resources, including through spectrum sharing mechanisms. One notable example is the Commission's adoption of innovative rules to allow shared federal and non-federal use of the 3.5 GHz band. In 2015, the Commission adopted rules to create a three-tiered access and authorization framework.[222] The Incumbent Access users, including authorized federal users in the 3550-3700 MHz band, Fixed Satellite Service earth stations in the 3600-3650 MHz band, and for a finite period, grandfathered wireless broadband licensees in the 3650-3700 MHz band, were designated with the first-tier protection from harmful interference from Citizens Broadband Radio Service (CBRS) users. The CBRS consists of two tiers—Priority Access Licenses (PALs) and General Authorized Access (GAA). While PALs, which are licensed on a county-by-county basis through competitive bidding to access one or more unspecified 10-megahertz licenses, receive protection from GAA operations, licensees must protect and accept interference from Incumbent Access tier users. GAA is licensed-by-rule and must avoid causing harmful interference to higher tier users and must accept interference from all other users.[223] PALs and GAA operations are authorized by a Spectrum Access System (SAS) which dynamically coordinates and assigns specific frequencies among CBRS users in the 3.5 GHz band.[224]

[222] *Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, GN Docket No. 12-354, Report and Order and Second Further Notice of Proposed Rulemaking, 30 FCC Rcd 3959 (2015) (*3.5 GHz First Order*).

[223] *3.5 GHz First Order*, 30 FCC Rcd at 3962, para. 4.

[224] *Id*. at 3962, paras. 4-5.

88. The CBRS spectrum sharing framework allows users to access the full 150 megahertz on a dynamic basis to help unlock the potential of the mid-band spectrum.[225] This revolutionary innovation has created many use cases, including wireless service providers enhancing their networks in dense urban areas, cable operators that have wholesale MVNO agreements with facilities-based providers, but also provide facilities-based off-loading to their wholesale providers, and enterprises using the spectrum to build their own 4G or 5G private wireless networks.[226] CBRS also offers opportunities for fixed Wireless Internet Service Providers (WISPs) and Fixed Wireless Access networks.[227] Some WISPs reported fixed wireless speeds of at least 100 Mbps in rural areas over distances as great as six miles using CBRS spectrum.[228] A RootMetrics' CBRS Spotlight Report further documented strong performance gains that wireless providers can achieve when adding CBRS to existing spectrum.[229] For instance, in Philadelphia, Verizon's median download speed on CBRS of 135.1 Mbps was over twice as fast as its non-CBRS median download speed of 64.2 Mbps, and its maximum download speed on CBRS of 692.1 Mbps was nearly 300 Mbps faster than its maximum speed of 404.9 Mbps without CBRS.[230] The cumulative 2020-2025 CBRS 5G Radio Access Network investments are expected to approach $500 million to $1 billion, according to the Dell'Oro Group.[231]

89. *Unlicensed Spectrum Use*. The demand for wireless broadband continues to grow over time. A large proportion of this mobile data traffic is delivered on an unlicensed basis through Wi-Fi, Bluetooth and similar protocols. According to Cisco, 59% of mobile data traffic will be offloaded to Wi-Fi by 2022.[232] Verizon stated that Wi-Fi offloading would be between 70% and 75% of mobile data traffic, and Charter reported that 80% of its wireless data was transmitted over Wi-Fi.[233]

90. In order to meet the increasing consumer demand for low-cost wireless connectivity, the Commission, on April 23, 2020, adopted the *6 GHz Order and Further Notice*, which makes 1,200 megahertz of spectrum in the 6 GHz band (5.925–7.125 GHz) available for unlicensed use.[234] By making

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[225] Mohamed Daoud et al., *On the Performance of CBRS Fixed Wireless Access: Coverage and Capacity Field Study* at 5 (2019), https://www.nctatechnicalpapers.com/Paper/2019/2019-on-the-performance-of-cbrs-fixed-wireless-access.

[226] Linda Hardesty, Fierce Wireless, *What is CBRS?* (June 23, 2020), https://www fiercewireless.com/private-wireless/what-cbrs.

[227] Blinq Networks, *What the CBRS Transition Means for Wireless Internet Service Providers*, https://blinqnetworks.com/what-the-cbrs-transition-means-for-wireless-internet-service-providers-wisps/#:~:text=One%20of%20the%20promising%20use,using%20low%2Dcost%20LTE%20solutions (last visited Sept. 7, 2022).

[228] Joan Engebretson, Telecompetitor, *WISPs Get CBRS Range as Great as Six Miles at 100 Mbps Speeds* (Sept. 22, 2020), https://www.telecompetitor.com/wisps-get-cbrs-range-as-great-as-six-miles-at-100-mbps-speeds/.

[229] Kurt Schaubach, Federated Wireless, *Rootmetrics' CBRS Spotlight Report Shows Major Performance Increase* (Mar. 11, 2021), https://www federatedwireless.com/blog/this-just-in-cbrs-spells-high-performance/.

[230] *Id.*

[231] Monica Alleven, Fierce Wireless, *CBRS 5G RAN forecast approaches $1B by 2025* (July 27, 2021), https://www.fiercewireless.com/private-wireless/cbrs-5g-ran-forecast-approaches-1b.

[232] Cisco Systems, Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2017-2022 at 17 (2019), https://s3.amazonaws.com/media mediapost.com/uploads/CiscoForecast.pdf.

[233] New America, *The Rise of 5G and the Imperative of Gigabit-Fast Wi-Fi at 5 and 6 GHz*, https://www.newamerica.org/oti/reports/59-ghz-band/the-rise-of-5g-and-the-imperative-of-gigabit-fast-wi-fi-at-5-and-6-ghz/ (last visited Aug. 29, 2022).

[234] *Unlicensed Use of the 6 GHz Band*, ET Docket No. 18-295, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 3852 (2020) (*6 GHz Order and Further Notice*), *review denied in part and granted in part sub nom. AT&T Services, Inc. v. FCC*, 21 F.4th 841 (D.C. Cir. 2021).

this spectrum available for unlicensed use, the Commission serves the American public's need for additional network capacity while safeguarding the licensed systems that will continue to use the 6 GHz band.[235] The *6 GHz Order and Further Notice* authorizes two different types of unlicensed operations—standard-power and low-power indoor operations.[236] Standard-power access points are authorized by using an automated frequency coordination (AFC) system.[237] These access points can be deployed anywhere as part of hotspot networks, rural broadband deployments, or network capacity upgrades where needed. Low-power indoor access points are authorized across the entire 6 GHz band.[238] These access points are ideal for connecting devices in homes and businesses, such as smartphones, tablet devices, laptops, and Internet-of-Things (IoT) devices, to the Internet.[239] These new rules accelerate the adoption of Wi-Fi 6, which increases data rates, capacity, and power efficiency to support network environments with many connected devices.[240] By enabling unlicensed devices to transmit with bandwidths of up to 320 megahertz, the 6 GHz unlicensed rules lay the groundwork for the next generation of Wi-Fi, Wi-Fi 7.[241] Wi-Fi 7 will provide data rates of up to 5.8 Gbps while decreasing the latency and increasing reliability to support cutting-edge applications, such as industrial automation, artificial reality/virtual reality, advanced video conferencing, and virtual work.[242] 6 GHz band unlicensed will play a major role in the growth of IoT;[243] connecting appliances, machines, meters, wearables, and other consumer electronics, as well as industrial sensors for manufacturing.[244] As has occurred with Wi-Fi in the 2.4 GHz and 5 GHz bands, 6 GHz unlicensed devices are becoming a part of most peoples' everyday lives.[245]

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[235] *6 GHz Order and Further Notice*, 35 FCC Rcd at 3854, para. 4.

[236] *Id.* at 3854, para. 3.

[237] *Id.*

[238] *Id.*

[239] *Id.*

[240] *See* Jacob Kastrenakes, The Verge, *Wi-Fi is getting its biggest upgrade in 20 years* (Apr. 23, 2020), https://www.theverge.com/2020/4/23/21231623/6ghz-wifi-6e-explained-speed-availability-fcc-approval; *see also* Gavin Phillips, Make Use Of, *What is 6GHz Wi-Fi? Is It the Same as Wi-Fi 6E?* (Jan. 8, 2022), https://www.makeuseof.com/what-is-6ghz-wifi/; Wi-Fi Alliance, *Discover Wi-Fi, Wi-Fi Certified 6*, https://www.wi-fi.org/discover-wi-fi/wi-fi-certified-6 (last visited Aug. 29, 2022).

[241] 47 CFR § 15.407(a)(10); Simon Hill, Wired, *What is Wi-Fi 7? Everything you need to Know* (May 24, 2022), https://www.wired.com/story/what-is-wi-fi-7/.

[242] Monica Paolini, Fierce Wireless, *Wi-Fi 7: The Next Generation in the Evolution of Wi-Fi* (Sept. 28, 2022), https://www.fiercewireless.com/sponsored/wi-fi-7-next-generation-evolution-wi-fi; Qualcomm, *Our innovative Wi-Fi-7 solutions set the standards for next-generation Wi-Fi*, https://www.qualcomm.com/products/technology/wi-fi/features/wi-fi-7 (last visited Nov. 11, 2022); Intel, *Wi-Fi 7: The Next Era in Wireless*, https://www.intel.com/content/www/us/en/products/docs/wireless/wi-fi-7.html (last visited Nov. 11, 2022).

[243] Wi-Fi Alliance, *Wi-Fi 6 and Wi-Fi 6E drive global market opportunities* (May 11, 2022), https://www.wi-fi.org/news-events/newsroom/wi-fi-6-and-wi-fi-6e-drive-global-market-opportunities ("Since its introduction in 2019, Wi-Fi Certified 6 has seen rapid adoption, surpassing 50 percent market share in three years compared to four years for Wi-Fi 5. This accelerated adoption is driven by demand for high performance Wi-Fi in phones, tablets, and PCs, and advanced features and capabilities are bringing new opportunities for IoT, service provider deployments, and dense public areas to deliver better experiences.").

[244] *6 GHz Order and Further Notice*, 35 FCC Rcd at 3854, para. 4; Intel, *Developing Solutions for the Internet of Things*, https://www.intel.com/content/dam/www/public/us/en/documents/white-papers/developing-solutions-for-iot.pdf (last visited Aug. 24, 2022).

[245] *6 GHz Order and Further Notice*, 35 FCC Rcd at 3854, para. 3.

91. In December 2019, the Commission adopted an NPRM that proposed rule changes to allow unlicensed and innovative uses like next-generation Wi-Fi in the 5.850-5.925 GHz band.[246] The Commission allocated this 75 megahertz of spectrum for Dedicated Short-Range Communications (DSRC) over 20 years ago.[247] Since that time, the technology has not enjoyed widespread commercial adoption or deployment.[248] On November 18, 2020, the Commission adopted the *5.9 GHz Report and Order*, designating the lower 45 megahertz of the band for unlicensed use and the upper 30 megahertz of spectrum for Intelligent Transportation System services, in particular Cellular Vehicle-to-Everything technology.[249] The Commission allowed for immediate indoor, unlicensed use of the lower 45 megahertz,[250] while also creating a regulatory process for outdoor operations contingent upon protection for federal incumbents.[251] Considering the existing Wi-Fi spectrum in the adjacent 5 GHz band, the Commission's action allows for the deployment of a high-throughput 160-megahertz channel that enables gigabit connectivity for schools, hospitals, small businesses, and other consumers.[252] On August 12, 2022, the D.C. Circuit Court of Appeals upheld the *5.9 GHz Report and Order* and the Commission's broad authority to manage the nation's airwaves in the public interest.[253]

3. Wireless Infrastructure

92. Wireless infrastructure facilities constitute another major input in the provision of mobile wireless services.[254] In addition to towers and other tall structures, such as lattice towers, guyed towers, monopoles, rooftops, water towers, and steeples, wireless infrastructure also includes distributed antenna systems (DAS) and small cells.[255] In order to expand or to improve coverage in existing service areas, and to accommodate newer technologies, mobile service providers have deployed additional cell sites.

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[246] *See Use of the 5.850-5.925 GHz Band*, ET Docket No. 19-138, Notice of Proposed Rulemaking, 34 FCC Rcd 12603 (2019) (*5.9 GHz NPRM*).

[247] *5.9 GHz NPRM*, 34 FCC Rcd at 12604, para. 3.

[248] *Id.* at 12604-05, para. 4.

[249] *Use of the 5.850-5.925 GHz Band*, ET Docket No. 19-138, First Report and Order, Further Notice of Proposed Rulemaking, and Order of Proposed Modification, 35 FCC Rcd 13440 (2020) (*5.9 GHz Report and Order*); *see also* FCC, Press Release, FCC Modernizes 5.9 GHz Band for Wi-Fi and Auto Safety (Nov. 18, 2020), https://docs.fcc.gov/public/attachments/DOC-368228A1.pdf.

[250] *5.9 GHz Report and Order*, 34 FCC Rcd at 13466, para. 21.

[251] *Id.* at 13477, para. 86.

[252] Claus Hetting, Wi-Fi Now, *FCC adopts new 5.9 GHz rules unlocking gigabit Wi-Fi in 5 GHz* (Nov. 22, 2020), https://wifinowglobal.com/news-and-blog/fcc-adopts-new-5-9-ghz-rules-unlocking-gigabit-wi-fi-in-5-ghz/.

[253] *ITS America v. FCC*, No. 21-1130 (D.C. Cir. 2022).

[254] Another component is the backhaul connections that link a mobile wireless service provider's cell sites to the mobile switching centers that provide connections to the provider's core network, the public switched telephone network, or the Internet, carrying wireless voice and data traffic for routing and onward transmission. Backhaul facilities are generally provided by incumbent local exchange carriers (ILECs), competitive local exchange carriers (CLECs), competitive fiber and microwave wholesalers, cable providers, tower companies, and independent backhaul operators. *See, e.g.*, *Twentieth Wireless Competition Report*, 32 FCC Rcd 8968, 8997-98, para. 42 & n.135; *see also* American Tower 2021 Annual Report, Part I at 1 ("We also hold . . . fiber . . . that we lease primarily to communications service providers and third-party tower operators."); Crown Castle 2021 Annual Report, Part I at 4 ("We refer to our towers, fiber and small cells assets collectively as "communications infrastructure").

[255] For a full description of DAS and small cells, *see Twentieth Wireless Competition Report*, 32 FCC Rcd at 8997, para. 42 & n.133, n.134.

According to CTIA, cell sites in commercial use increased from 323,448 in 2017 to 349,344 in 2018, 395,562 in 2019, 417,215 in 2020, and 418,887 at year-end 2021.[256]

93. Mobile service providers have increased deployment of small cells and DAS sites to fill local coverage gaps, to densify networks and increase local capacity, and to build their 5G networks.[257] Mobile service providers deploy small cells in cities across the country, often through attaching small-scale antenna/radios near the top of light or small utility poles.[258] Small cells mostly have fiber backbones.[259] CTIA estimates that 80% of future wireless infrastructure deployments will be in the form of small cells.[260] New deployments and upgrades of small cells and DAS in the United States are expected to increase from 811,000 in 2020 to 1,161,000 in 2027.[261]

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[256] CTIA Year-End 2021 Wireless Industry Indices Report, Chart 19, at 54. The reported cell sites include small cells and DAS which may be located on rooftops, monopoles, and other pre-existing structures as well as on lattice towers. In addition, multiple cell sites can be collocated in the same "tower" site. Therefore, the reported cell sites should not be equated with "towers." *Id*.

[257] *Twentieth Wireless Competition Report*, 32 FCC Rcd at 8998, para. 43; *see also* T-Mobile 2021 Annual Report, Part I, at 7 ("102,000 macro cell sites and 41,000 small cell/distributed antenna system sites") and at 50 ("We have committed to an annual volume commitment to execute and deliver 35,000 small cell contracts, including upgrades to existing locations, over the next five years); AT&T 2021 Annual Report, at 24 ("The industry-wide deployment of 5G technology . . . will involve significant deployment of "small cell" equipment."); Verizon Q4 2021 Earnings Call Transcript, at 4 (Jan. 25, 2022) ("We also brought more than 15,000 additional 5G Ultra Wideband small cells in service"), https://www.verizon.com/about/investors/quarterly-reports/4q-2021-earnings-conference-call-webcast; Crown Castle Q4 2021 Earnings Call, Edited Transcript, at 3 (Jan. 27, 2022) ("[W]e secured commitments for more than 50,000 new small cell nodes. This is in addition to the 55,000 small cell nodes we have on air today"), https://investor.crowncastle.com/static-files/c657e5ae-3e19-4724-bfee-50e80e795d73.

[258] *See 2020 Communications Marketplace Report*, 36 FCC Rcd at 2970 & n.107; *see also* City of San Jose, *Broadband Strategy and Small Cell Deployment* ("Small cells are small radio antenna equipment installed on streetlights, rooftops, and other locations as a primary way to deliver 5G (Fifth Generation) mobile technology"), https://www.sanjoseca.gov/your-government/department-directory/office-of-the-city-manager/civic-innovation/broadband-strategy-and-small-cell-deployment-5147 (last visited May 6, 2022); City of Fremont, California, *Small Cell Project* ("has two executed Master License Agreements (MLA) and is continuing to work with local wireless service providers to allow the installation of small cells on City-owned street lights"), https://www.fremont.gov/government/departments/engineering/development-utilities/small-cell-project (last visited Oct. 6, 2022); City of Naperville's (IL), *Small Cell Location map*, https://experience.arcgis.com/experience/0f705ec3ad7d415db8c3fa4e4e4aa82b/ (last visited May 6, 2022); City of Carmel (IN), *Small Cell Location map*, https://carmelgis.carmel.in.gov/maps/apps/webappviewer/index.html?id=76464dbd4e5b4410b93c316cd4f86e89 (last visited May 6, 2022); Crown Castle, *Small Cells 101* ("Small cells are . . . usually attached to existing infrastructure in the public right of way like utility poles or streetlights"), https://www.crowncastle.com/communities/small-cell-information (last visited May 6, 2022).

[259] *See, e.g.*, Fiber Optic Association, *Reference Guide* ("Small cells are designed to operate on fiber backbones"), https://www.thefoa.org/tech/ref/appln/SmallCells.html (last visited Apr. 22, 2022); *see also* Crown Castle, *Small Cells 101* ("Small cells are always connected by fiber optic cable"), https://www.crowncastle.com/communities/small-cell-information (last visited Apr. 22, 2022).

[260] CTIA, *The Wireless Industry Data (Topic=Small Cell)*, https://www.ctia.org/the-wireless-industry/infographics-library?topic=60 (last visited May 6, 2022).

[261] *See* Small Cell Forum, *SCF market forecast*, at 9, Fig. 1-2 (2022), https://scf.io/en/documents/050_-_Small_cells_market_forecast.php.

94. Today, there are more than 130 tower and DAS operators in the United States,[262] and a majority of towers are now owned or operated by independent tower companies rather than by mobile wireless service providers.[263] In most cases, tower operators and property owners lease antenna, rooftop, and other site space to multiple wireless service providers.[264] The three largest publicly traded neutral host providers are American Tower, Crown Castle, and SBA Communications. According to one estimate, as of April 2022, these three infrastructure providers owned or operated approximately 99,759 towers (not including DAS and small cells).[265] At the end of December 2021, Crown Castle and SBA had an average of 2.3 and 1.8 tenants per tower site, respectively.[266] The three tower companies also have significant capacity available for additional antennas or tenants.[267]

95. *Virtualized RAN (vRAN).* A wireless communication system's Radio Access Network (RAN) is the network component that links wireless handsets and other devices to the core network. A major area of research is virtualization of the RAN components of a wireless network, vRAN. Traditional RAN depends heavily on hardware embedded with particular network functionalities. vRAN virtualizes network functions on a software platform based on general purpose processers.[268] This virtualization reduces the hardware required for sites, lowers maintenance costs, and facilitate upgrades.[269] With greater flexibility about where exactly functionalities are in the network, network management can be more

[262] Wireless Estimator, *Top 100 Tower Companies in the U.S.*, http://wirelessestimator.com/top-100-us-tower-companies-list/ (last visited May 6, 2022).

[263] Major nationwide wireless service providers have sold their towers to neutral third-party tower companies. *See 2020 Communications Marketplace Report*, 36 FCC Rcd at 2971 & n.112.

[264] *See, e.g.*, American Tower 2021 Annual Report, Part I, at 1 ("Our primary business is the leasing of space on communications sites to wireless service providers . . . ."); *see also* Crown Castle 2021 Annual Report, Part I, at 4 ("Our core business is providing access, including space or capacity, to our shared communications infrastructure via long-term contracts"); Verizon Wireless 2021 Annual Report, at 61 ("We lease network equipment including towers, DAS, small cells . . . ."); T-Mobile 2021 Annual Report, at 50 (leasing towers from Crown Castle).

[265] Wireless Estimator, *Top 100 Tower Companies in the U.S.*, https://wirelessestimator.com/top-100-us-tower-companies-list/ (last visited Oct. 6, 2022) (Crown Castle at 40,567, American Tower at 42,965, and SBA at 17,395, not including DAS and small cells); *see also* American Tower 2021 Annual Report, Part I, at 1 (43,308 sites in the United States and Canada as of Dec. 31, 2021); Crown Castle 2021 Annual Report, at 4 (more than 40,000 towers and other structures such as rooftops); SBA Communications, Annual Report, at 3 (2022), https://d18rn0p25nwr6d.cloudfront net/CIK-0001034054/e94e5a45-8db4-4c01-9aac-9bfe3b7b0deb.pdf (SBA 2021 Annual Report) (17,356 sites as of Dec. 31, 2021).

[266] Crown Castle 2021 Annual Report, at 8 (average of 2.3 tenants per tower), https://investor.crowncastle.com/static-files/8e62e78b-eacc-4aed-8d36-e13f2d475b8a; SBA 2021 Annual Report, Item 1, at 1 (average of 1.8 tenants per tower).

[267] American Tower 2021 Annual Report, Part I, at 5 ("We believe that the majority of our towers have capacity for additional tenants and that substantially all of our towers that are currently at or near full structural capacity can be upgraded or augmented to meet future tenant demand with relatively modest capital investment."); SBA 2021 Annual Report, Item 1, at 1 ("Most of our towers have significant capacity available for additional antennas."); and Crown Castle 2021 Annual Report, Part I, at 1 ("We seek to increase our site rental revenues by adding more tenants on our shared communications Infrastructure.").

[268] *See Promoting the Deployment of 5G Open Radio Access Networks*, GN Docket No. 21-63, Notice of Inquiry, 36 FCC Rcd 5947, 5949, para. 5 (2021) (*Open RAN Notice of Inquiry*).

[269] IBM, *What is vRAN?* (Mar. 31, 2021), https://www.ibm.com/cloud/blog/what-is-vran; Young Lee, Hyunjeong Lee & Jai-Jin Lim, Samsung, *vRAN Value Proposition and Cost Modeling* (Oct. 15, 2020), https://www.samsung.com/global/business/networks/insights/white-papers/vran-value-proposition-and-cost-modeling/.

efficient, flexible, and automated.[270] Examples of vRAN include Ericsson's Cloud RAN software solution[271] and Nokia's AirScale Cloud RAN.[272] In May 2022, Ericsson announced a joint tech hub with Intel to develop cloud RAN.[273] Verizon has also completed trials of vRAN with Samsung technology which Verizon intends to use in its 5G expansion.[274]

96. *Open RAN.* Traditional RAN hardware is proprietary to their vendors and has no interoperability with components from other vendors. Wireless service providers are therefore traditionally locked into a single vendor for a local area.[275] Open RAN is an alternative architecture in which all components follow standards that allow interoperability with other Open RAN components.[276] The elimination of vendor lock-in allows greater flexibility in network design and maintenance, which could increase performance.[277] It could also potentially reduce costs by allowing more competition in the component market.[278] Open RAN also can facilitate virtualized RAN (vRAN) by allowing network architecture that would not be possible under proprietary closed solutions.[279] There have been ongoing developments in Open RAN standards and products in recent years, including by Nokia, Ericsson, Qualcomm, and Samsung.[280]

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[270] IBM, *What is vRAN?* (Mar. 31, 2021), https://www.ibm.com/cloud/blog/what-is-vran.

[271] Sibel Tombaz & Gunnar Le Grand, Ericsson, *Tech Unveiled: Ericsson Cloud RAN (2022)*, https://www.ericsson.com/48dca5/assets/local/campaigns/tech-unveiled/doc/tech-unveiled-cloudran-ebook.pdf.

[272] Nokia, *Airscale Cloud RAN*, https://www nokia.com/networks/mobile-networks/airscale-radio-access/cloud-ran/ (last visited June 13, 2022).

[273] Ericsson, *Ericsson and Intel launch global Cloud RAN Tech Hub* (May 17, 2022), https://www.ericsson.com/en/press-releases/2022/5/ericsson-and-intel-launch-global-cloud-ran-tech-hub.

[274] Verizon, *Verizon and Samsung complete fully virtualized 5G data session on C-band spectrum* (July 27, 2021), https://www.verizon.com/about/news/verizon-samsung-5g-data-session-c-band-spectrum.

[275] *See, e.g.*, ARM Comments, GN Docket No. 21-63, at 4 (rec. Apr. 28, 2021); CCA Comments, GN Docket No. 21-63, at 3 (rec. Apr. 28, 2021); ITI Comments, GN Docket No. 21-63, at 5 (rec. Apr. 28, 2021); Mavenir Comments, GN Docket No. 21-63, at 19 (rec. Apr. 28, 2021); ONF Comments, GN Docket No. 21-63, at 19 (rec. Apr. 28, 2021); ORPC Comments, GN Docket No. 21-63, at 10 (rec. Apr. 28, 2021); TIP Comments, GN Docket No. 21-63, at 17 (rec. Apr. 28, 2021); TIA Comments, GN Docket No. 21-63, at 2 (rec. Apr. 28, 2021); VMware Comments, GN Docket No. 21-63, at 7 (rec. Apr. 28, 2021); Cisco Reply, GN Docket No. 21-63, at 9 (rec. May 28, 2021); CTIA Reply, GN Docket No. 21-63, at 1 (rec. May 28, 2021); VMware Reply, GN Docket No. 21-63, at 1-2 (rec. May 28, 2021).

[276] *Open RAN Notice of Inquiry*, 36 FCC Rcd at 5949, para. 5; CTIA Comments at 19.

[277] *See, e.g.*, CTIA Comments at 19; Airhop Comments, GN Docket No. 21-63, at 4; ARM Comments, GN Docket No. 21-63, at 4; AT&T Comments, GN Docket No. 21-63, at 11; CTIA Comments, GN Docket No. 21-63, at 9; Fujitsu Comments, GN Docket No. 21-63, at 6; HPE Comments, GN Docket No. 21-63, at 7; Google Comments, GN Docket No. 21-63, at 3; Samsung Comments, GN Docket No. 21-63, at 3-4; Telefonica Comments, GN Docket No. 21-63, at 3; Verizon Comments, GN Docket No. 21-63, at 11; VMware, GN Docket No. 21-63, Comments at 7; OTI Reply, GN Docket No. 21-63, at 1; Vmware Reply, GN Docket No. 21-63, at 2.

[278] *See, e.g.*, CCA Comments, GN Docket No. 21-63, at 3; CommScope Comments, GN Docket No. 21-63, at 2; Dell Comments, GN Docket No. 21-63, at 5; Fujitsu Comments, GN Docket No. 21-63, at 6, 12; NTT Comments, GN Docket No. 21-63, at 10; ONF Comments, GN Docket No. 21-63, at 5; ORPC Comments, GN Docket No. 21-63, at 23; Rakuten Comments, GN Docket No. 21-63, at 3; Samsung Comments, GN Docket No. 21-63, at 3; Telefonica Comments, GN Docket No. 21-63, at 3; Xlinx Comments, GN Docket No. 21-63, at 7; Altiostar Reply, GN Docket No. 21-63, at 2; Dell Reply, GN Docket No. 21-63, at 1; OTI Reply, GN Docket No. 21-63, at 2.

[279] Nokia, *Update: Open RAN explained* (Mar. 30, 2022), https://www nokia.com/about-us/newsroom/articles/open-ran-explained/; CTIA Comments at 20.

[280] CTIA Comments at 20-21.

97. Currently, the largest Open RAN deployment in the United States is DISH's 5G network.[281] Beginning in 2020, Inland Cellular has also deployed Open RAN in rural areas of Idaho.[282] Cellcom had also deployed Open RAN on its Wisconsin network, but then had to decommission the Open RAN components because of supply issues.[283] In August 2022, Verizon asserted it would likely begin using Open RAN-compliant equipment in 2022 and "definitely" by 2023.[284] In May 2022, AT&T asserted that it is "running proof of concept tests" for Open RAN and will first deploy Open RAN equipment in small cells and private wireless networks.[285]

98. *Integrated Access and Backhaul (IAB).* Integrated access and backhaul is the use of wireless spectrum for backhaul instead of wired connections.[286] IAB allows more efficient use of spectrum, especially 5G millimeter wave, and can eliminate the need for costly or infeasible wired connections to fill coverage gaps.[287] IAB may allow 5G millimeter wave to act as a fiber replacement, which may become more important with further network densification.[288] Verizon and Ericsson have completed a proof-of-concept trial that implements 5G using IAB, circumventing the need for a fiber connection.[289]

4. Pricing Levels and Trends

99. Mobile service providers continue to offer nationwide pricing plans throughout their service areas, with little variation in monthly recurring charges between rural and non-rural markets.[290]

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[281] DISH, Press Release, DISH's Smart 5G™ Wireless Network is Now Available to Over 20 Percent of the U.S. Population (June 15, 2022), https://about.dish.com/2022-06-15-DISHs-Smart-5G-TM-Wireless-Network-is-Now-Available-to-Over-20-Percent-of-the-U-S-Population.

[282] Jeanne Whalen, Washington Post, *A remote corner of Idaho has become the best hope for the U.S. challenge to Huawei* (June 29, 2020), https://www.washingtonpost.com/business/2020/06/29/huawei-alternative-oran-idaho/; *see also* Letter from Eugina Jordan, VP, Parallel Wireless, to Marlene Dortch, Secretary, FCC, GN Docket No. 21-63, at 2 (filed Nov. 15, 2021).

[283] Mike Dano, Light Reading, *One of America's first open RAN networks is being dismantled* (Apr. 28, 2022), https://www.lightreading.com/open-ran/one-of-americas-first-open-ran-networks-is-being-dismantled/d/d-id/777101.

[284] Mike Dano, Light Reading, *Verizon promises O-RAN deployment 'definitely' by 2023* (Aug. 15, 2022), https://www.lightreading.com/open-ran/verizon-promises-o-ran-deployment-definitely-by-2023/d/d-id/779709.

[285] Mike Dano, Light Reading, *AT&T testing open RAN, but CTO won't offer deployment timelines* (May 17, 2022), https://www.lightreading.com/open-ran/atandt-testing-open-ran-but-cto-wont-offer-deployment-timelines/d/d-id/777632.

[286] Henrik Ronkainen, Jonas Edstam, Anders Ericsson, & Christer Östberg, *Integrated access and backhaul*, Ericsson Technology Review #07-2020, (2020), https://www.ericsson.com/49e6f6/assets/local/reports-papers/ericsson-technology-review/docs/2020/introducing-integrated-access-and-backhaul.pdf; Peter Cohen, *What is 5G Integrated Access and Backhaul (IAB)?* (Mar. 25, 2022), https://www rcrwireless.com/20220325/5g/what-is-5g-integrated-access-and-backhaul-iab.

[287] Henrik Ronkainen, Jonas Edstam, Anders Ericsson, & Christer Östberg, *Integrated access and backhaul*, Ericsson Technology Review #07-2020 (2020), https://www.ericsson.com/49e6f6/assets/local/reports-papers/ericsson-technology-review/docs/2020/introducing-integrated-access-and-backhaul.pdf; Peter Cohen, *What is 5G Integrated Access and Backhaul (IAB)?* (Mar. 25, 2022), https://www rcrwireless.com/20220325/5g/what-is-5g-integrated-access-and-backhaul-iab.

[288] CTIA Comments at 24-25.

[289] Verizon, Press Release, Deploying the 5G Ultra Wideband Network Just Got a Little Easier (July 7, 2020), https://www.verizon.com/about/news/deploying-5g-ultra-wideband-network-easier.

[290] *2020 Communications Marketplace Report*, 36 FCC Rcd at 2972-93, para. 37. As mobile service providers offer nationwide pricing plans throughout their service area, with little pricing disparity between rural and urban markets,

(continued….)

The majority of mobile wireless subscribers in the United States are "postpaid" subscribers, billed each month after service has been provided, while fewer are "prepaid" subscribers, who pay for services in advance of receiving them.[291]

a. Postpaid Service

100. In 2021, service providers continued the trend of offering unlimited data plans,[292] with major providers offering tiered unlimited data plans.[293] In addition, major service providers introduced a high-end rate plan that offers unlimited data without throttling or usage restrictions.[294] Certain providers also continued to not count certain types of data towards deprioritization and data limits (T-Mobile's "Binge On" program, for example).[295]

101. Since the *2020 Communications Marketplace Report*, particular emphasis has been given by nationwide providers to their highest-end multi-line unlimited plans. T-Mobile, for example, introduced a new unlimited plan in February 2021, Magenta MAX.[296] Magenta MAX is an upgraded version of Magenta Plus.[297] In contrast to Magenta Plus, the MAX plan delivers unlimited Premium

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it is unnecessary to undertake a separate standalone rate survey authorized in the 2011 Order that modernized the universal service program for awarding support to mobile service providers in high-cost areas. *See Connect America Fund*, Report and Order and Further Notice of Proposed Rulemaking, 26 FCC Rcd 17663, 17694, 17708-09, paras. 85, 113, 114 (2011) (*USF/ICC Transformation Report and Order and Further Notice*).

[291] The prepaid and postpaid versions of a given pricing plan or promotion still differ somewhat, largely because prepaid subscribers may lack the credit background or income necessary to qualify for postpaid service. To prevent credit losses and mitigate the credit risk associated with the prepaid segment, service providers require advance payment for both prepaid service and handsets. *2020 Communications Marketplace Report*, 36 FCC Rcd at 2972-93, para. 37.

[292] While a majority of unlimited plans are offered to postpaid subscribers, some providers now also offer unlimited plans to their prepaid subscribers. *See, e.g.*, AT&T, *AT&T Prepaid Unlimited*, https://www.att.com/prepaid/plans/ (last visited Aug. 23, 2022); T-Mobile, *T-Mobile Essentials Prepaid*, https://prepaid.t-mobile.com/unlimited-prepaid (last visited Aug. 23, 2022); Verizon, *Unlimited Plus*, https://www.verizon.com/plans/prepaid/ (last visited Aug. 23, 2022). We note that while "unlimited," such plans may have data allowances, which, if reached, can lead to deprioritization.

[293] Postpaid subscribers who use up their plan's data allowance in a given month generally experience data deprioritization only during network congestion. *See, e.g.*, T-Mobile, *Magenta*, https://www.t-mobile.com/cell-phone-plans/magenta (last visited June 7, 2022); Verizon Wireless, *5G Do More Unlimited FAQs*, https://www.verizon.com/support/do-more-unlimited-faqs/ (last visited June 7, 2022); AT&T, *AT&T Unlimited Extra® Plan*, https://www.att.com/plans/wireless/ (last visited June 7, 2022).

[294] Sue Marek, Fierce Wireless, *Marek's Take: Unlimited data without restrictions is making a comeback* (Aug. 4, 2021), https://www fiercewireless.com/wireless/marek-s-take-unlimited-data-without-restrictions-making-a-comeback.

[295] *2020 Communications Marketplace Report*, 36 FCC Rcd at 2973, para. 38. On all T-Mobile plans, during congestion, a small fraction of customers using more than 50 GB (Essential plan) or more than 100 GB (on Magenta plans) a month may notice reduced speeds until the next bill cycle due to prioritization. *See* T-Mobile, *Unlimited video streaming with Binge On*, https://www.t-mobile.com/offers/binge-on-streaming-video (last visited June 7, 2022).

[296] T-Mobile, *See Ya Speed Bumps. T-Mobile Unleashes 5G with New Magenta MAX Plan* (Feb. 22, 2021), https://www.t-mobile.com/news/un-carrier/magenta-max; T-Mobile, *Plans*, https://www.t-mobile.com/cell-phone-plans (last visited May 6, 2022).

[297] Magenta Plus offered unlimited 4G LTE smartphone data; unlimited talk and text; unlimited smartphone mobile hotspot data (tethering) at 2G speeds; and 200 MB domestic roaming off-network. The plan also offered unlimited HD streaming in the United States; 20 GB of 4G LTE mobile hotspot data with unlimited 3G data; twice the data speeds abroad; unlimited in-flight Wi-Fi on Gogo-enabled flights to, from, or within the United States; voicemail to

(continued….)

Data—4G and 5G—on one's smartphone. This means that a subscriber's device cannot be slowed down based on how much data she uses. Magenta MAX comes with 40 GB of mobile hotspot data included for $57 per line per month for three lines with autopay and monthly taxes and fees included. AT&T, in July 2021, updated its largest plan, AT&T Unlimited Elite to include unlimited high-speed data, advanced security, 40 GB of hotspot data, and HBO Max in 4K UHD resolution for $50 per line for four lines.[298]

102. In January 2022, Verizon Wireless introduced a new lineup of 5G unlimited plans starting at $35 per line for four lines; these include: 5G Start, 5G Do More, 5G Play More, and 5G Get More. Verizon Wireless's largest plan, 5G Get More, includes unlimited premium network access, along with 720p high definition (HD) video streaming, and 50 GB hotspot data for $90 (1 line) per month.[299] UScellular continues to offer its unlimited plans: Basic, Everyday, and Even Better starting at $30 per line for four lines.[300]

b. Prepaid Service

103. The three nationwide service providers also offer prepaid service under their own prepaid brands in addition to selling mobile wireless service wholesale to MVNOs. Verizon Wireless has the largest share of prepaid subscribers among the nationwide service providers, after the completion of Verizon's acquisition of the largest MVNO, TracFone.[301] TracFone has multiple prepaid brands, including Net10 Wireless, Straight Talk, Clearway, Walmart Family Mobile, SIMPLE Mobile, Total Wireless, SafeLink, Page Plus, and GoSmart Mobile, which target different market and demographic segments, such as premium, Hispanic, or low-income subscribers.[302] To varying degrees, the other two nationwide service providers also pursue a multi-brand prepaid strategy.[303]

104. DISH promotes the Boost Mobile brand.[304] DISH will have access to the T-Mobile network for seven years, including the ability to serve DISH customers between T-Mobile's nationwide network and DISH's forthcoming standalone wireless network. In addition to its agreement with T-

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text; and name ID (identify calls from unknown numbers). T-Mobile, *Our Magenta Plans*, https://www.t-mobile.com/content/dam/t-mobile/assets/pdf/T-Mobile_Rate_Card_November_2019.pdf (last visited June 7, 2022).

[298] AT&T, *AT&T Unlimited Elite® Customers stay in the Fast Lane with Unlimited High Speed Data, 5G Included and More* (July 12, 2021), https://about.att.com/story/2021/att_unlimited_elite.html.

[299] Verizon Wireless, *The power of Verizon 5G Ultra Wideband coming to 100 million people in U.S. this month* (Jan. 4, 2022), https://www.verizon.com/about/news/power-verizon-5g-ultra-wideband-coming?URL=https%3A%2F%2Fwww.verizon.com%2Fabout%2Fnews%2Fpower-verizon-5g-ultra-wideband-coming&CMP=afc_h_p_cj_na_ot_21_99_affiliate-8532386_11557999___vg___p_22631048___t_w___d_D&cjevent=10bcade5e2c511ec8272a6aa0a82b836&promotion_code=JUNCT/W04&AID=11557999&PID=8532386&SID=___vg___p_22631048___t_w___d_D&cjdata=MXxOfDB8WXww.

[300] UScellular's new Everyday Unlimited Plan comes with bonus features such as HD video streaming, roaming in Mexico and Canada, 15 GB of hotspot access, 25 GB of priority data and one free movie night per month/line through the company's new entertainment partner, Redbox, for $40 per line/month for four lines. UScellular, *Plans*, https://www.uscellular.com/plans (last visited June 2, 2022).

[301] Verizon Wireless, *Verizon completes TracFone Wireless, Inc. acquisition* (Nov. 23, 2021), https://www.verizon.com/about/news/verizon-completes-tracfone-wireless-inc-acquisition.

[302] TracFone Wireless, *Brands*, http://www.tracfonewirelessinc.com/en/brands/ (last visited May 17, 2022).

[303] AT&T prepaid brands include AT&T Prepaid and Cricket. T-Mobile prepaid brands include Metro by T-Mobile (formerly MetroPCS).

[304] DISH, *DISH enters retail wireless market with close of Boost Mobile, advances build of the nation's first standalone 5G network* (July 1, 2020), http://about.dish.com/2020-07-01-DISH-enters-retail-wireless-market-with-close-of-Boost-Mobile-advances-build-of-the-nations-first-standalone-5G-network.

Mobile, DISH signed a long-term strategic Network Services Agreement (NSA) with AT&T, making AT&T the primary network services partner for DISH MVNO customers. Through this agreement, DISH will provide current and future customers of its retail wireless brands, including Boost Mobile, Ting Mobile, and Republic Wireless,[305] access to coverage and connectivity on AT&T's wireless network, in addition to the new DISH network. AT&T is also providing transport and roaming services as part of the agreement, to support DISH's network.[306]

105. Further, as postpaid offerings have shifted away from term contracts and equipment subsidies, facilities-based service providers have adopted pricing plans and promotions for their high-end prepaid monthly service offerings that are similar to their postpaid offerings. For example, in January 2021, Verizon Wireless introduced a new unlimited plan that offers 5G Ultra Wideband connectivity starting at $75 per month with the potential to lower those costs to $60 per month with autopay and loyalty discounts. The plan includes 10 GB of 5G Nationwide and a 4G LTE Mobile Hotspot.[307] In July 2021, T-Mobile's Metro by T-Mobile offered customers that switch and upgrade to Metro by T-Mobile a $25 a month plan with a trade-in for one line of unlimited talk, text, and high-speed smartphone data including unlimited 5G.[308] AT&T's Cricket Wireless removed the 8 Mbps speed caps on its $30, $40, and $55 a month plans and added 5G access on all of its plans in October 2021.[309] In November 2021, DISH's Boost Mobile offered its customers a $100 per year 1 GB plan that includes unlimited talk and text.[310] Generally, prepaid subscribers who reach the limit of their high-speed data allowance in a given month may continue to use their handsets for data service on an unlimited basis, but at reduced speeds.[311] For example, Cricket Wireless reduces data download speeds to a maximum of 128 kbps after the customer's high-speed data allowance is used.[312]

c. Price Indicators for Mobile Wireless Services

106. As can be seen from the discussion above, it is difficult to directly compare prices between providers or over time, because providers offer a variety of plans, frequently under multipart pricing and bundling schemes. Plans also vary in non-price terms and features, such as the consequences

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[305] Monica Alleven, Fierce Wireless, *Dish signs $5B MVNO deal with AT&T* (July 19, 2021), https://www.fiercewireless.com/operators/dish-signs-5b-mvno-deal-at-t; DISH, *DISH selects Tucows as technology partner, acquires Ting Mobile assets* (Aug. 3, 2020), https://about.dish.com/2020-08-03-DISH-selects-Tucows-as-technology-partner-acquires-Ting-Mobile-assets; DISH, *DISH to acquire Republic Wireless* (Mar. 8, 2021), https://about.dish.com/2021-03-08-DISH-to-acquire-Republic-Wireless.

[306] DISH, *DISH and AT&T Sign Strategic Network Services Agreement* (July 19, 2021), https://about.dish.com/2021-07-19-DISH-and-AT-T-Sign-Strategic-Network-Services-Agreement.

[307] Verizon Wireless, *Verizon Prepaid Unlimited plan now offers 5G Ultra Wideband and 5G Nationwide* (Jan. 25, 2021), https://www.verizon.com/about/news/verizon-prepaid-unlimited-plan-5g-ultra-wideband-nationwide.

[308] T-Mobile, *#5GforAll Comes to Prepaid: Switch to Metro by T-Mobile, Get a FREE 5G Phone Plus Save Half Off Boost and Cricket's Top Plans* (July 28, 2021), https://www.t-mobile.com/news/offers/switch-to-metro-by-t-mobile-get-a-free-5g-phone.

[309] Monica Alleven, Fierce Wireless, *AT&T's Cricket lifts 8 Mbps speed cap, adds 5G* (Oct. 29, 2021), https://www.fiercewireless.com/operators/at-t-s-cricket-lifts-8-mbps-speed-cap-adds-5g.

[310] DISH, *Boost Mobile launches its first Carrier Crusher plans: leading with a full year of service for just $100* (Nov. 18, 2021), https://about.dish.com/2021-11-18-Boost-Mobile-launches-its-first-Carrier-Crusher-plans-leading-with-a-full-year-of-service-for-just-100.

[311] *2020 Communications Marketplace Report*, 36 FCC Rcd at 2975, para. 43.

[312] Cricket Wireless, *Mobile Broadband Information* (Jan. 7, 2022), https://www.cricketwireless.com/legal-info/mobile-broadband-information html.

of reaching usage limits.[313] Figure II.B.15 presents monthly postpaid prices for the three nationwide service providers' basic, mid-level, and premium unlimited plans, including now-common discounts for automatic payments.[314] Basic unlimited postpaid plans generally offer little more than unlimited talk, text, and data, and speeds that are deprioritized during network congestion. Mid-level postpaid plans typically offer some combination of increased data before deprioritization, some high-speed mobile hotspot data, cloud data storage, discounted or free subscription to online video and/or music streaming services (e.g., Apple Music, Netflix, or Disney+), and improved video streaming quality. Premium postpaid plans typically offer increased mobile hotspot data limits, video quality, and other varying features across the providers. Figure II.B.16 shows the current monthly prices for major prepaid service providers. Unlimited service is also the primary offering of prepaid plans, although postpaid users frequently are given priority over prepaid users on a given network during times of peak congestion.[315] Further, both postpaid and prepaid users may also experience deprioritized speeds during periods of peak network congestion after they have exceeded certain monthly data thresholds, depending on their plan type. Notably since the last report, consumers of premium postpaid plans typically no longer experience deprioritized speeds, regardless of monthly consumption. The limits are shown in Figures II.B.17 and II.B.18.

Fig. II.B.15
Monthly Postpaid Unlimited Prices for Top 3 Service Providers

	Plan Type					
	Basic		**Mid-Level**		**Premium**	
Provider	1 Line	4 Lines	1 Line	4 Lines	1 Line	4 Lines
AT&T	$65	$140	$75	$160	$85	$200
T-Mobile	$60	$105	$70	$140	$85	$170
Verizon Wireless	$70	$140	$80	$180	$90	$220

[313] It is therefore difficult to identify sources of information that track mobile wireless service prices in a comprehensive and consistent manner. In addition, data on subscribership is not available at the plan level. Thus, a comparison of average prices would require assumptions regarding the number of customers who subscribe to each plan that each company offers, which would not likely be accurate due to a lack of data. *See, e.g.*, *2020 Communications Marketplace Report*, 33 FCC Rcd at 12572, para. 18.

[314] In addition, T-Mobile incorporates taxes and fees into its advertised prices for its Magenta and Magenta Max plans. As these fees vary by locality, we are unable to fully account for the differences in pricing in Fig. II.B.15 in this *Report*.

[315] For example, Metro in its Terms and Conditions indicates that "[t]o the services we sell, we also prioritize the data of most Metro by T-Mobile Rate Plans after the data for other T-Mobile or Sprint branded rate plans, but before customers who are prioritized as heavy data users." *See* Metro by T-Mobile, *Metro by T-Mobile Terms and Conditions of Service*, https://www.metrobyt-mobile.com/terms-conditions-service (last visited Aug. 15, 2022); *see also* Cricket, *Mobile Broadband Information* (Jan 7, 2022), https://www.cricketwireless.com/legal-info/mobile-broadband-information.html ("Congestion Management may affect certain customers on the Cricket Core Plan [sic] that provides unlimited data access. Customers may experience reduced data speeds and increased latency during periods of network congestion as compared to other customers using the same cell site.").

Fig. II.B.16
Monthly Prepaid Unlimited Prices for Top 4 Service Providers[316]

	Plan Type			
	Basic		Premium	
Provider	**1 Line**	**4 Lines**	**1 Line**	**4 Lines**
Boost Mobile	$50	$140	$60	$180
Cricket	$55	$100	$60	$130
Metro	$40	$100	$60	$120
Straight Talk	$45	N/A	$65	N/A

Source: The prices for unlimited data plans in Figures II.B.15 and II.B.16 were taken from service providers' websites on Aug. 15, 2022.

Fig. II.B.17
Data Deprioritization Limits for Top 3 Postpaid Service Providers[317]

	Plan Type		
Provider	**Basic**	**Mid-Level**	**Premium**
AT&T	Congestion	50 GB	No Limit
T-Mobile	50 GB	100 GB	No Limit
Verizon Wireless	Congestion	50 GB	No Limit

Fig. II.B.18
Data Deprioritization Limits for Top 4 Prepaid Service Providers

	Plan Type	
Provider	**Basic**	**Premium**
Boost Mobile	35 GB	35 GB
Cricket	Congestion	Congestion
Metro	35 GB	35 GB
Straight Talk	Congestion	Congestion

Source: The deprioritization limits in Figures II.B.17 and II.B.18 were taken from service providers' websites on Aug. 15, 2022.

107. Since the *2020 Communications Marketplace Report*, the prices for wireless service generally have held steady. The single-line pricing for all three nationwide postpaid service providers has remained constant for all tiers of service relative to 2020. Multi-line service has also remained the same

[316] Prices include any per line charges indicated by the service provider, but exclude fees and taxes. Prices do not include any additional charges such as for equipment installment plans, insurance, international use, or mobile hotspots. If a service provider includes any such feature as part of its unlimited data plan without extra charge, the above price would include this feature. Further, the above prices do not include any one-time charges paid, such as activation fees and termination fees, nor promotions that are advertised as short-term. Prices and the features of the plans are subject to change.

[317] "Congestion" indicates that users are deprioritized when there is congestion on the network, regardless of the amount of data a customer has consumed in a given month. "No Limit" indicates that users are never deprioritized, regardless of the amount of data they have consumed in a given month.

for AT&T and Verizon Wireless, while falling for T-Mobile.[318] For prepaid service, Boost pricing has remained the same, and Straight Talk's is not directly comparable as it has introduced multiple tiers of plans at different price points (between $45 and $65) which straddle its 2020 pricing of $55. Metro pricing has dropped for both single line and multi-line accounts in its basic tier of service, and for multiple lines only in its premium tier. Cricket is the only provider to have a rate increase between the two periods, with its single-line plans increasing by $5 per month; however, its multiple-line prices have remained the same.[319]

108. *Consumer Price Index (CPI).* The CPI is a measure of the average change over time in the prices consumers pay for a fixed market basket of goods and services. As documented in previous *Reports*, the Wireless Telephone Services CPI[320] shows that mobile wireless prices have declined significantly since the mid-1990s.[321] However, according to the CPI, the price (in constant dollars) of mobile wireless services increased in 2020 for the first time since 2009, by 2.0%, and again in 2021, by a smaller 1.7%. During those same two years, the broader Telephone Services CPI increased by 3.2% and 2.4%, while the overall CPI increased by approximately 1.3% and 2.9%.[322]

109. *Average Revenue Per Unit.* Various measures of Average Revenue per Unit (ARPU) are frequently used as a proxy for price, particularly in industries with multiple pricing plans and complicated rate structures, such as mobile wireless services.[323] As shown in Figure II.B.19 below, which is based on

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[318] *See 2020 Communications Marketplace Report*, 36 FCC Rcd at 2976, Fig. II.A.18. Single-line pricing for AT&T ranged from $65-$85, and 4 lines from $140-$200; for T-Mobile, a single line ranged from $60-$85, and 4 lines from $120-$200; and for Verizon Wireless, a single line ranged from $70-$90, while four lines ranged from $140- $220. Neither the current *Report* nor prior reports attempts or have attempted to completely account for all features offered by every plan, nor any fees that may be in addition to the monthly service rates. In addition, T-Mobile committed to not raise prices on its plans as part of the T-Mobile-Sprint transaction for a period of three years, and the conditions expired in November 2022. *See T-Mobile-Sprint Order*, 34 FCC Rcd at 10745, para. 385 ("We also impose as a condition the Applicants' price commitment, further ensuring that the transaction will not result in consumer price increases.").

[319] *See 2020 Communications Marketplace* Report, 36 FCC Rcd at 2976, Fig. II.A.19. Single-line pricing for Boost ranged from $50-$60, and 4 lines from $140-$18; for Cricket, a single line ranged from $50-$55, and 4 lines from $100-$130; for Metro, a single line ranged from $50-60, and 4 lines from $140-$150; and for Straight Talk, a single line was priced at $55, with no discount for four lines. Neither the current *Report* nor prior reports attempts or have attempted to completely account for all features offered by every plan, nor any fees that may be in addition to the monthly service rates.

[320] All CPI figures were taken from U.S. Bureau of Labor Statistics (BLS) databases. U.S. Bureau of Labor Statistics, *Home Page*, http://www.bls.gov (last visited Aug. 29, 2022). The index used in this analysis, the CPI for All Urban Consumers (CPI-U), represents about 93% of the total U.S. population. U.S. Bureau of Labor Statistics, *Consumer Price Index: Frequently Asked Questions*, https://www.bls.gov/cpi/questions-and-answers.htm (last visited Aug. 29, 2022). The CPI category "Telephone Services" has two components: Wireless telephone services and Residential telephone services (previously known as "Landline telephone services"). Additional information can be found at U.S. Bureau of Labor Statistics, *Consumer Price Index: How the Consumer Price Index Measures Price Change for Telephone Services*, https://www.bls.gov/cpi/factsheets/telephone-services htm (last visited Aug. 29, 2022).

[321] *See, e.g.*, *2020 Communications Marketplace* Report, 36 FCC Rcd at 2977, para. 36; *2018 Communications Marketplace Report*, 33 FCC Rcd at 12574, para. 19.

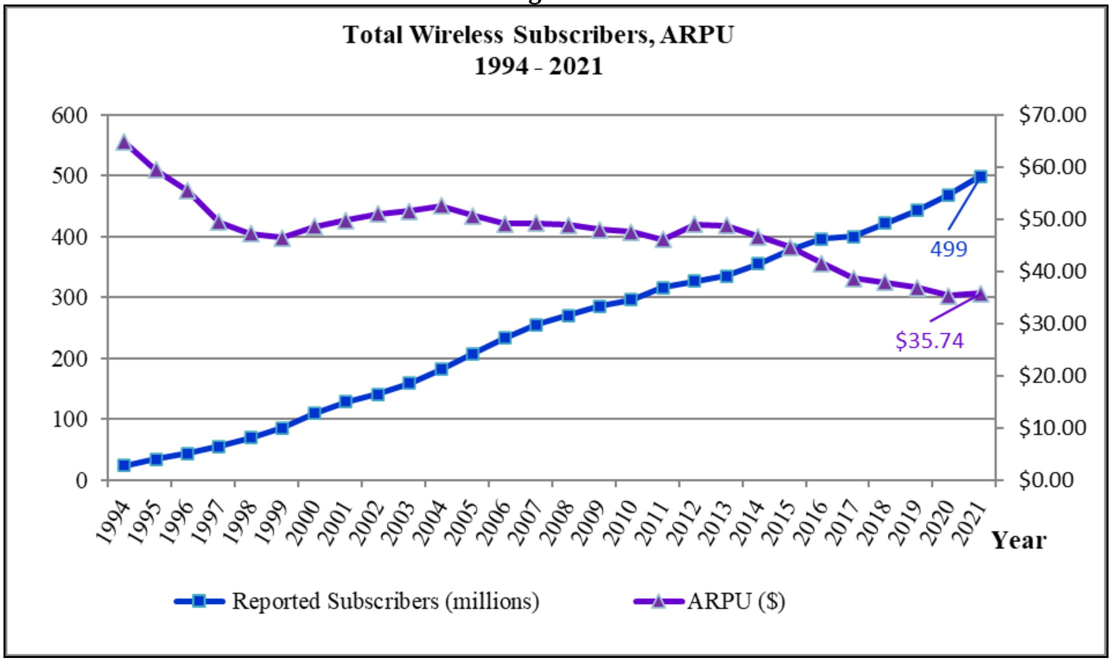
[322] For changes in the CPI over time, *see infra* Appx. D-2 of this *Report*.

[323] *See 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*, Seventeenth Report, 29 FCC Rcd 15311, 15328, para. 35 & n.52 (WTB 2014) (*Seventeenth Wireless Competition Report*); Patrick McCloughan and Sean Lyons, *Accounting for ARPU: New evidence from international panel data*, Telecommunications Policy 30, 521-32 (2006); Eun-A Park and Krishna Jayakar,

(continued….)

CTIA data, from 2019 to 2021 industry ARPU declined from $36.86 to $35.74, a decline of approximately 3%.[324] Recent changes by service providers, such as the removal of overage charges, the move toward unlimited data plans, multiple line pricing, and Equipment Installment Plans (EIPs) have all contributed to the reported decline in ARPU.[325]

Fig II.B.19



Source: CTIA Year-End 2021 Wireless Industry Indices Report.

110. *Revenue Share by Service Provider*. As shown in Figure II.B.20, AT&T and Verizon Wireless experienced slightly increasing service revenues from 2018 through 2021. Sprint's service revenues fell in each reporting period. T-Mobile experienced a large increase in revenues from 2019 to 2020, primarily due to its acquisition of Sprint, and T-Mobile also generally experienced significant growth every year from 2016 to 2019. Verizon Wireless reported significantly higher revenues than AT&T and T-Mobile, with AT&T and T-Mobile reporting near identical wireless service revenues in 2021.

(Continued from previous page)
Competition between Standards and the Prices of Mobile Telecommunication Services: Analysis of Panel Data, TPRC 2015 (Aug. 15, 2015).

[324] CTIA reported an industry average measure of ARPU which is derived "using the average (reported) active revenue-generating device figures for each service period, and total reported service revenues." CTIA Year-End 2021 Wireless Industry Indices Report at 45.

[325] Fig. II.B.19 presents more than 25 years of subscribers/connections and ARPU. For additional details on ARPUs from 1993 to 2021, *see infra* Appx. D-3 of this *Report*.

Fig. II.B.20
Service Revenues and Shares Among Nationwide Wireless Service Providers ($ millions)
2018–2021

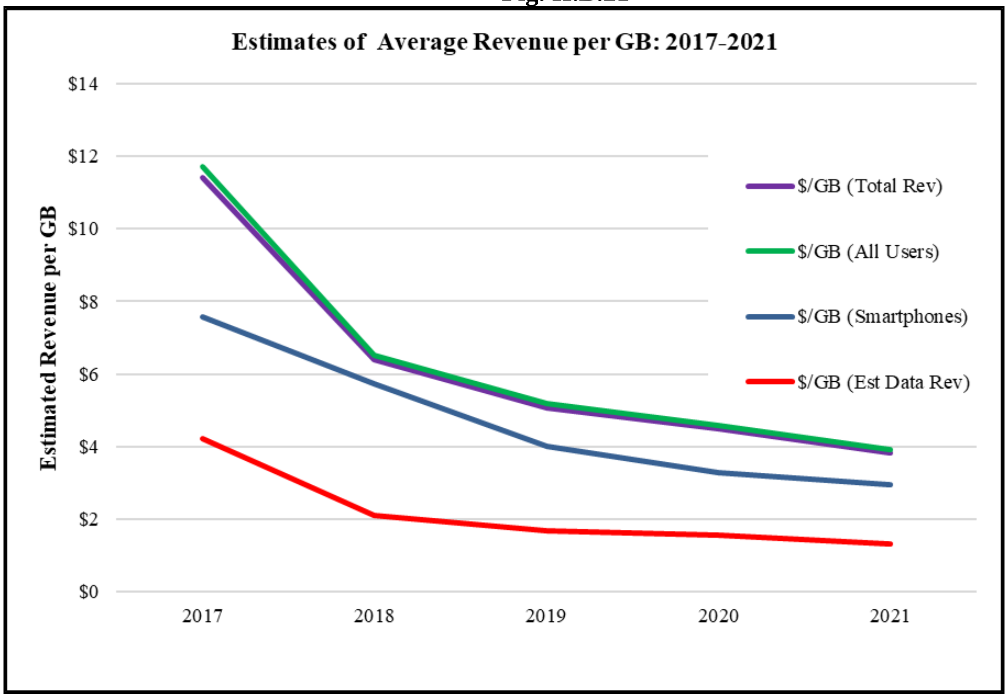
Service Providers	2018		2019		2020		2021	
	Revenue	Revenue Share	Revenue	Revenue Share	Revenue	Revenue Share	Revenue	Revenue Share
AT&T	54,295	27.02%	55,331	27.10%	55,542	28.05%	57,590	27.37%
T-Mobile	31,992	15.92%	34,500	16.90%	50,395	25.45%	58,369	27.74%
Verizon Wireless	91,518	45.55%	92,368	45.25%	92,058	46.50%	94,449	44.89%
Sprint	23,131	11.51%	21,951	10.75%	0	0.00%	0	0.00%

Source: Annual and Quarterly SEC Filings from AT&T, T-Mobile, Verizon, and Sprint. Note: Verizon's Business Group does not completely separate wireless service revenues from other revenues in its filings, and accordingly their revenues are likely overstated. However, over 95% of business connections are wireless, so we expect the majority of business revenue to be associated with wireless connections.

111. *Estimated Average Revenue Per GB.* Given the variation in data plans, including shared plans, the lack of information on how much data users consume across these different plans, and the fact that revenues specific to data consumption are no longer reported by service providers, we lack the necessary information to measure precisely the price per GB of mobile broadband data. By making certain assumptions,[326] however, we can provide various industry-wide estimates of the average revenues per GB. Figure II.B.21 below shows four different estimates of the average revenue per GB, based on data from CTIA and the U.S. Census Bureau. All four estimates indicate that average revenue per GB has been declining. Specifically, as of year-end 2021, these estimates show a decrease of approximately 10% to 17% compared to 2020, and a decrease of approximately 61% to 69% compared to 2017.

[326] To derive $/GB (Total Rev), we divide the Total Service Revenues by the Total Wireless Data Traffic, assuming that 100% of service revenues are attributable to data. CTIA Year-End 2021 Wireless Industry Indices at 40, 12. To derive $/GB (All Users) and $/GB (Smartphones) we divide ARPU by the monthly average GB data usage, and we calculate this metric both for all users and for smartphone users only. This assumes that 100% of revenues are attributable to data and that average revenue is the same for both smartphone users and non-smartphone users. CTIA Year-End 2021 Wireless Industry at 45, 15. Finally, for $/GB (Est. Data Rev), we estimate the percentage of total revenues that are attributable to data by dividing Internet Access Service Revenues by Total Revenues for NAICS 5172. U.S. Census Bureau, *Service Annual Survey Latest Data (NAICS-basis): 2020* (Nov. 23, 2021), https://www.census.gov/data/tables/2020/econ/services/sas-naics.html (navigate to "Table 4: Estimated Sources of Revenue for Employer Firms: 2013 through 2020"). The 2021 data percentage was estimated based on the average growth rate across 2017 to 2020. We then applied these percentages to the CTIA data (Total Service Revenues/Total Wireless Data Traffic). CTIA Year-End 2021 Wireless Industry Indices at 40, 12. This does not take into account the fraction of revenues that are made up of messaging.

Fig. II.B.21



Source: CTIA Year-End 2021 Wireless Industry Indices Report; U.S. Census Bureau, 2020 Annual Service Survey.

5. Non-Price Factors

a. Investment

112. In the past five years, according to CTIA,[327] mobile wireless service providers invested nearly $147 billion in their networks, with service providers reporting $34.7 billion in capital investment in 2021, up 16.2% from $29.9 billion in 2020.[328] Based on the most current UBS data, in 2021, wireless service providers' capital investments totaled $34.8 billion, of which the three nationwide providers accounted for $33 billion.[329] In the last few years, as shown in Figure II.B.22, the nationwide providers combined have steadily increased their capital investment. In 2018, the four nationwide providers—AT&T, T-Mobile, Sprint, and Verizon—spent 17.3% of their revenues on capital expenditure.[330] According to UBS, in 2021, T-Mobile invested 20.8% of its wireless service revenue on capital expenditure, surpassing Verizon at 17.7% and AT&T at 15.3%.[331] Meanwhile, DISH, a new wireless entrant, spent $960 million in wireless capital expenditure in 2021.[332] In terms of spectrum investment, in

[327] CTIA Year-End 2021 Wireless Industry Indices Report, at 48; CTIA Comments at 8-9.

[328] CTIA Comments at 9.

[329] UBS and CTIA numbers may differ as they use different methodologies for accounting for Capital Expenditure. CTIA's data are based on their voluntary survey of all wireless providers (with a very high response rate). UBS uses quarterly and annual filings from publicly traded service providers along with their wireless model to calculate industry investment.

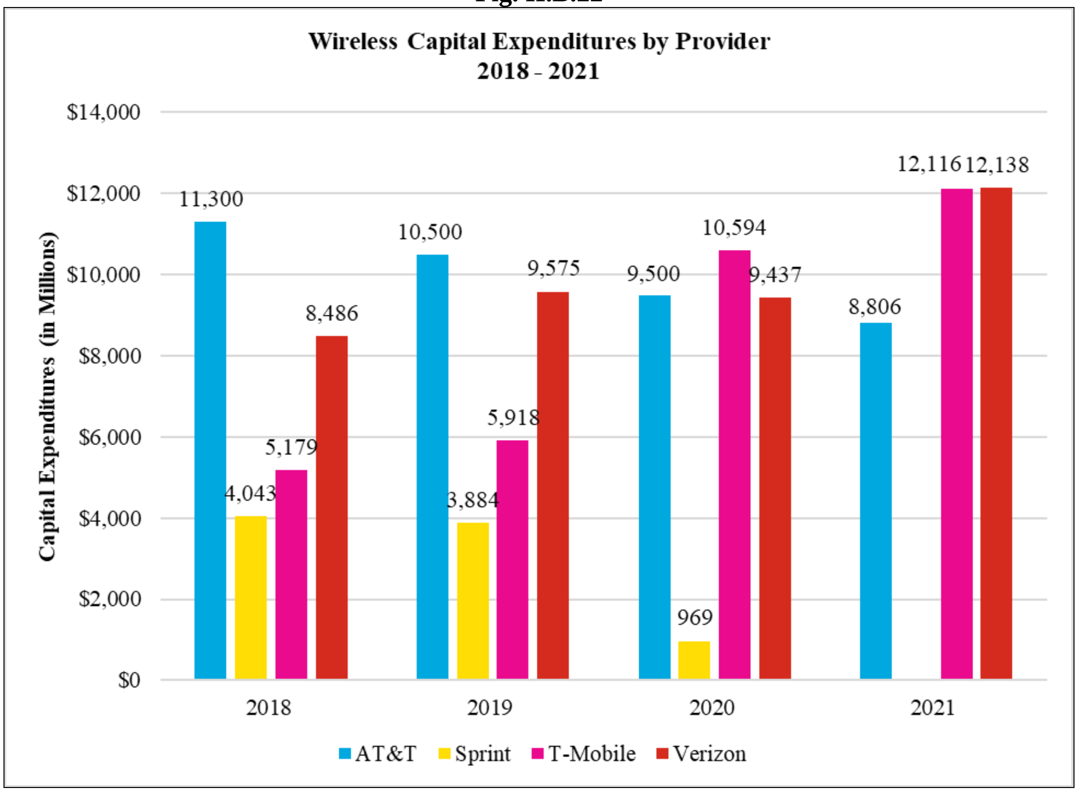
[330] UBS Investment Research. UBS Data, 2018-2021

[331] *Id.*

[332] *Id.*

the last three years the wireless industry invested more than $108 billion in spectrum auctions,[333] including $81 billion in the 3.7 GHz band auction.[334]

Fig. II.B.22



Source: UBS Investment Research. Published with permission of UBS.

113. The heightened level of capital investment has helped speed up wireless deployments. According to CTIA, the wireless industry built more cell sites in 2020 than in the prior three years combined.[335] DISH, a new wireless provider, planned to spend $10 billion to build the first nationwide cloud-native 5G network.[336] On July 14, 2022, DISH filed its buildout status report to the Commission, asserting that, as of June 14, 2022, DISH offered broadband coverage to over 72 million people in the United States, or approximately 22% of the U.S. population,[337] to meet its construction requirements.[338] Regional and rural providers have also accelerated their 5G deployments. For example, UScellular is

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[333] CTIA Comments at 9-10.

[334] *Auction of Flexible-Use Service Licenses in the 3.7-3.98 GHz Band Closes; Winning Bidders Announced for Auction 107*, AU Docket No. 20-25, Public Notice, 36 FCC Rcd 4318 (2021) (*Auction 107 Closing Public Notice*).

[335] CTIA Comments at 11-12.

[336] Mike Dano, Fierce Wireless, *Ergen's 5G build-out ambitions for Dish could pass $10B* (May 23, 2018), https://www.fiercewireless.com/5g/ergen-s-5g-buildout-ambitions-for-dish-could-pass-10b.

[337] DISH Network Corporation 5G Buildout Status Report, at 1.

[338] *See Applications of American H Block Wireless L.L.C., DBSD Corporation, Gamma Acquisition L.L.C., and Manifest Wireless L.L.C. for Extension of Time*, WT Docket No. 18-197, Order of Modification and Extension of Time to Construct, 35 FCC Rcd 9599, Attach. A (WTB 2020).

expanding 5G connectivity across 21 states, Appalachian Wireless is deploying standalone 5G in Kentucky and the eastern region, Cellcom is deploying 5G in Wisconsin, and GCI has launched 5G in Anchorage.[339]

b. Innovation and Technological Change

114. In the two years since the last *Communications Marketplace Report*, 5G coverage has grown from limited deployments in specific areas to an increasingly important part of U.S. wireless service providers' networks. AT&T, for example, stated that as of March 2022, its 5G network covered 255 million people in 16,000 cities and towns.[340] Verizon asserted that it expects to cover 175 million Americans by the end of 2022 with its 5G network.[341] In June 2022, T-Mobile reported its 5G network using low-band spectrum (Extended Range 5G) covered 315 million Americans, while its 5G network using high-band spectrum (Ultra Capacity 5G) covered 225 million Americans.[342] As of June 2022, DISH asserted it had launched 5G in 120 cities.[343] Smaller providers are also launching 5G networks. UScellular, for example, claims it intends to expand its 5G network using mid-band spectrum over 23 states.[344] In April 2022, Appalachian Wireless reported that it is planning to deploy 5G in "Kentucky and the Eastern US" in 2022.[345] As of April 2022, Cellcom had deployed 5G on 45 Wisconsin cell towers.[346] GCI has deployed 5G in Anchorage, Alaska and plans expansion of 5G to other parts of Alaska.[347]

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[339] CTIA Comments at 12.

[340] AT&T, *AT&T Lays Out Long-Term Growth Strategy, Financial Outlook* (Mar. 11, 2022), https://about.att.com/story/2022/analyst-and-investor-day.html.

[341] 175 million is approximately 53% of the 331 million Americans reported in the 2020 U.S. Census. Verizon Wireless, Press Release, Verizon 5G Ultra Wideband expected to cover 175 million people by the end of 2022 (Mar. 3, 2022), https://www.verizon.com/about/news/verizon-5g-ultra-wideband-175-million-people-2022; Brynn Epstein & Daphne Lofquist, U.S. Census Bureau, *First 2020 Census Data Release Shows U.S. Resident Population of 331,449,281* (Apr. 26, 2021), https://www.census.gov/library/stories/2021/04/2020-census-data-release html#.

[342] T-Mobile, Press Release, T-Mobile Delivers Industry Leading Growth in Postpaid Accounts and Customers in Q1 2022 Fueled by 5G Network Leadership (Apr. 27, 2022), https://www.t-mobile.com/news/business/t-mobile-q1-2022-earnings.

[343] As part of DISH's acquisition of Boost Mobile as part of the T-Mobile/Sprint transaction, DISH committed to cover 20% of the U.S. population with 5G by June 14, 2022. *See supra* section II.B.1.a; *T-Mobile-Sprint Order*, 34 FCC Rcd at 10740, para. 369; DISH, Press Release, DISH's Smart 5G™ Wireless Network is Now Available to Over 20 Percent of the U.S. Population (June 15, 2022), https://about.dish.com/2022-06-15-DISHs-Smart-5G-TM-Wireless-Network-is-Now-Available-to-Over-20-Percent-of-the-U-S-Population.

[344] UScellular, Press Release, UScellular Advances 5G Mid-Band Spectrum Strategy with C-Band Purchase (Mar. 11, 2021), https://investors.uscellular.com/news/news-details/2021/UScellular-advances-5G-mid-band-spectrum-strategy-with-C-Band-purchase/default.aspx.

[345] Mike Dano, Light Reading, *Small US Carriers march toward 5G* (Apr. 12, 2022), https://www.lightreading.com/5g/small-us-carriers-march-toward-5g/d/d-id/776752.

[346] Mike Dano, Light Reading, *From the invention of the telephone to 5G, Nsight perseveres* (Feb. 16, 2022), https://www.lightreading.com/5g/from-invention-of-telephone-to-5g-nsight-perseveres/d/d-id/775302.

[347] Ericsson, Press Release, GCI partners with Ericsson to turn up 5G sites in Alaska (Apr. 20, 2020), https://www.ericsson.com/en/press-releases/6/2020/gci-partners-with-ericsson-to-turn-up-5g-sites-in-alaska; GCI, Press Release, GCI expands 5G wireless coverage along Seward Highway (Mar. 25, 2021), https://www.anchoragepress.com/bulletin/gci-expands-5g-wireless-coverage-along-seward-highway/article_eeafb0da-8dc9-11eb-a9e5-b31e73421560 html; GCI, Press Release, GCI launches first 5G wireless sites in the Matanuska Valley (Dec. 16, 2021), https://news.gci.com/news-releases/gci-launches-first-5g-wireless-sites-in-the-matanuska-valley.

115. Ericsson estimates that as of 2021, 20% of North American mobile subscriptions were associated with a 5G-capable device with access to a 5G-enabled network.[348] While 5G deployments have grown substantially, the industry is still actively developing technologies to improve 5G performance and the technologies that will follow it. In this section, we discuss several important areas of research and development.

116. *Standalone (SA) 5G*. AT&T and Verizon have deployed 5G networks with a 4G-LTE core, known as Non-Standalone (NSA) 5G.[349] NSA 5G uses a 5G RAN, the network component that connects devices to the rest of the network, while using a pre-existing 4G LTE backbone (the "core") to interconnect different parts of the network together.[350] In contrast, standalone (SA) 5G integrates 5G RAN and a 5G core.[351] An NSA 5G network avoids a complete rework of the existing 4G-LTE network at the cost of reduced 5G functionality.[352] As of October 2021, AT&T was still studying how to implement a SA 5G Core.[353] While Verizon has activated some SA core traffic as of December 2021, Verizon has asserted full commercialization of its SA 5G core will not be completed until some point in 2022.[354] In contrast, T-Mobile has had an SA 5G core since 2020[355] and has deployed voice over 5G since June 2022.[356] Likewise, DISH's 5G network has an SA core using Nokia technology.[357] Appalachian Wireless's 5G network will also be standalone.[358]

117. *Massive Multiple-Input and Multiple-Output (MIMO) Technology*. At higher frequency bands, 5G-NR has enabled widespread adoption of Massive MIMO, in which the base station antenna consists of many active antenna elements.[359] While conventional antennas with two transmit and two

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[348] Ericsson, Ericsson Mobility Report, at 10 (2021), https://www.ericsson.com/4ad7e9/assets/local/reports-papers/mobility-report/documents/2021/ericsson-mobility-report-november-2021.pdf.

[349] Peter Cohen, RCR Wireless, *Standalone 5G vs. Non-Standalone 5G* (Sept. 7, 2021), https://rcrwireless.com/20210907/5g/standalone-5g-vs-non-standalone-5g.

[350] Deanna Darah, Tech Target, *5G NSA vs. SA: How does each deployment mode differ?* https://www.techtarget.com/searchnetworking/feature/5G-NSA-vs-SA-How-does-each-deployment-mode-differ# (last visited Oct. 6, 2022).

[351] *Id*.

[352] Peter Cohen, RCR Wireless, *Standalone 5G vs. Non-Standalone 5G* (Sept. 7, 2021), https://rcrwireless.com/20210907/5g/standalone-5g-vs-non-standalone-5g.

[353] Sue Marek, Fierce Wireless, *AT&T's Fuetsch says company is still testing standalone 5G* (Oct. 18, 2021), https://www.fiercewireless.com/wireless/at-t-s-fuetsch-says-company-still-testing-standalone-5g.

[354] Matt Kapko, SDxCentral, *Verizon Bumps 5G Standalone Core to 2022* (Dec. 22, 2021), https://www.sdxcentral.com/articles/news/verizon-bumps-5g-standalone-core-to-2022/2021/12/.

[355] T-Mobile, Press Release, T-Mobile Launches World's First Nationwide Standalone 5G Network (Aug. 4, 2020), https://www.t-mobile.com/news/network/standalone-5g-launch.

[356] T-Mobile, Press Release, T-Mobile Advances Standalone 5G Capabilities with Commercial Launch of Voice Over 5G (June 3, 2022), https://www.t-mobile.com/news/press/t-mobile-advances-standalone-5g-capabilities-with-commercial-launch-of-voice-over-5g.

[357] Linda Hardesty, Fierce Wireless, *Dish picks Nokia for containerized 5G SA core* (Sept. 14, 2020), https://www.fiercewireless.com/5g/dish-picks-nokia-for-containerized-5g-sa-core.

[358] Mike Dano, Light Reading, *Small US Carriers march toward 5G* (Apr. 12, 2022), https://www.lightreading.com/5g/small-us-carriers-march-toward-5g/d/d-id/776752.

[359] *See* CTIA Comments at 22-23; Samsung, *Massive MIMO for New Radio* (Dec. 2020), https://images.samsung.com/is/content/samsung/assets/global/business/networks/insights/white-papers/1208_massive-mimo-for-new-radio/MassiveMIMOforNRTechnicalWhitePaper-v1.2.0.pdf; David Astely et al., *Meeting 5G network requirements with Massive MIMO*, 102922 Ericsson Technology Review (2022),

(continued….)

receive elements or four transmit and four receive elements are common today, sixty-four transmit and sixty-four receive elements of massive MIMO antennas are now commercially available.[360] Massive MIMO antennas allow more multiple paths for data transmission to enhance spatial diversity, and it also employs "beamforming" to steer a narrow beam to specific users, which lowers interference and improves signal quality.[361] Massive MIMO therefore provides significant improvements to network capacity, coverage and user experience.[362] In February 2022, Nokia and AT&T announced they were collaborating on developing a version of massive MIMO with an improved 5G uplink.[363]

118. *Carrier Aggregation.* Wireless service providers have begun using different spectrum bands simultaneously to provide service in a process called "carrier aggregation."[364] For example, carrier aggregation technology can coordinate between a low-band uplink and a high or a mid-band downlink, improving coverage, capacity, and speed.[365] Wireless service providers are using carrier aggregation for 5G.[366] T-Mobile states that it has achieved downloads of 3 Gbps using 5G carrier aggregation in a June 2022 test.[367]

119. *Dynamic Spectrum Sharing (DSS).* Dynamic spectrum sharing refers to technologies that allow multiple users or multiple technologies to share spectrum dynamically over time. One form of dynamic spectrum sharing uses wireless service providers using algorithmic systems to allocate spectrum between 4G and 5G in real-time. DSS facilitates the simultaneous operation of both 4G and 5G networks, as lower frequency spectrum can be used for both 4G and 5G by switching between the two, depending on network needs.[368] DSS is especially useful for providers transitioning into 5G with a large 4G-LTE user base, that continues to rely on their LTE spectrum bands.[369] DSS implementation does not require

(Continued from previous page)
https://www.ericsson.com/4917a1/assets/local/reports-papers/ericsson-technology-review/docs/2022/the-role-of-massive-mimo-in-5g-networks.pdf; Henrik Asplund et al., Massive MIMO handbook 2022 (1st ed. 2022), https://foryou.ericsson.com/Massive-MIMO-handbook-extended-version-download.html.

360 CTIA Comments at 22-23.

361 Mutaz Shukair, Qualcomm, *How 5G massive MIMO transforms your mobile experiences* (June 19, 2019), https://www.qualcomm.com/news/onq/2019/06/how-5g-massive-mimo-transforms-your-mobile-experiences.

362 *Id*.

363 Nokia, Press Release, Nokia and AT&T collaborating to improve 5G uplink with distributed massive MIMO #MWC22 (Feb. 28, 2022), https://www nokia.com/about-us/news/releases/2022/02/28/nokia-and-att-collaborating-to-improve-5g-uplink-with-distributed-massive-mimo-mwc22/.

364 CTIA Comments at 23.

365 Ericsson, *Carrier aggregation in 5G*, https://www.ericsson.com/en/ran/carrier-aggregation (last visited Oct. 6, 2022).

366 Monica Alleven, Fierce Wireless, *Mobile poised to launch 2.5 GHz 5G carrier aggregation* (Dec. 2, 2021), https://www.fiercewireless.com/5g/t-mobile-poised-launch-25-ghz-5g-carrier-aggregation; Monica Alleven, Fierce Wireless, *Dish dials up 5G carrier aggregation tests at 600 MHz* (Apr. 8, 2022), https://www.fiercewireless.com/tech/dish-dials-5g-carrier-aggregation-tests-600-mhz.

367 T-Mobile, Press Release, T-Mobile Tops 3 Gbps with World's First Standalone 5G Carrier Aggregation Achievement (June 14, 2022), https://www.t-mobile.com/news/network/t-mobile-tops-3-gbps-with-worlds-first-standalone-5g-carrier-aggregation-achievement.

368 Samsung, *Dynamic Spectrum Sharing*, at 3-8 (Jan. 2021), https://images.samsung.com/is/content/samsung/assets/global/business/networks/insights/white-papers/0122_dynamic-spectrum-sharing/Dynamic-Spectrum-Sharing-Technical-White-Paper-Public.pdf; Ericsson, *Ericsson Spectrum Sharing – A better way to build 5G Spectrum*, https://www.ericsson.com/en/ran/spectrum-sharing (last visited Oct. 6, 2022).

369 *Id*.

costly hardware replacement or upgrades because DSS is software-based.[370] In 2021, Global Wireless Solutions reported that Verizon deployed DSS in 229 of the 498 markets it tested, and in 23% of 5G tasks it tested.[371] In contrast, Global Wireless Solutions reported that AT&T used DSS in only 22 of the 298 markets it tested, and for only 5% of 5G tasks it tested.[372]

120. *Spectrum Sharing Between Users*. In addition to sharing within a wireless service provider, there is active research on the viability of sharing between service providers. With the growing demand for spectrum, spectrum utilization can be improved by finding ways to accommodate multiple users for the same bands.[373] Currently, the major sharing regimes include priority access tiers, like the Citizens Broadband Radio Service (CBRS) band, where spectrum is used by one user at a time but users with higher priority may preempt access by lower priority users.[374] Major sharing regimes also include simultaneous access, like Bluetooth and 2.4 GHz Wi-Fi, where multiple devices use the same spectrum at the same time.[375] In October 2020, the U.S. Department of Defense (DOD) issued a Request for Information about spectrum sharing between multiple users. In December 2021, the DOD deployed an experimental private 5G cellular network at Hill Air Force Base to investigate spectrum sharing.[376] In September 2021, Silicon Flatirons held a conference about spectrum sharing, and its subsequent report stated that participants "largely agreed that increased use of and reliance on dynamic spectrum sharing (at least in some form) is inevitable."[377]

121. *Internet of Things (IoT)*. The 5G standards emphasize low latency and high reliability, which make 5G networks practical for use in the IoT, the use of communication networks for communications between equipment and machines.[378] 5G-enabled IoT has a variety of potential industrial uses, allowing managers to automate many of the tasks that require devices to operate at the same time, including inspections, artificial intelligence/augmented reality technical assistance, buildings and facility management, connected vehicles, smart agriculture, and shipping and logistics.[379] IoT also demonstrates strong potential in healthcare with growing interest in medical devices that facilitate remote patient

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370 Celona, *Dynamic Spectrum Sharing: How It Works and Why It Matters* (Oct. 14, 2020), https://www.celona.io/5g-lan/dynamic-spectrum-sharing-how-it-works-why-it-matters.

371 Global Wireless Solutions, *2021 US Nationwide Test of Mobile Networks,* https://gwsolutions.com/best-wireless-network-in-usa/ (last visited Oct. 6, 2022).

372 *Id*.

373 National Institutes of Standards and Technology, *Spectrum Sharing* (Apr. 5, 2022), https://www.nist.gov/advanced-communications/spectrum-sharing.

374 *Id*.

375 *Id*.

376 U.S. Department of Defense, Press Release, DoD Kicks Off 5G Dynamic Spectrum Sharing Experimentation at Hill AFB (Dec. 2, 2021), https://www.defense.gov/News/Releases/Release/Article/2859222/dod-kicks-off-5g-dynamic-spectrum-sharing-experimentation-at-hill-afb/.

377 Gabriel Lennon & Graham Stevenson, Outcomes Report: A Spectrum Policy Initiative Conference "Frontiers in Spectrum Sharing" at 2 (2022), https://siliconflatirons.org/wp-content/uploads/2022/01/FY-22-Spectrum-Policy-Conference-Report_Final-1.pdf.

378 Constant Wette Tchouati, Steven Rochefort & George Sarmonikas, *Monitoring IoT application performance with machine* QoE, 103 Ericsson Technology Review at 8 (2021), https://www.ericsson.com/493a09/assets/local/reports-papers/ericsson-technology-review/docs/2021/etr-magazine-2021-01.pdf.

379 CTIA Comments at 30-33; Rishi Vaish & Sky Matthews, *5G Will Accelerate a New Wave of IoT Applications*, https://newsroom.ibm.com/5G-accelerate-IOT (last visited Oct. 6, 2022); Brian McGlynn, Davra, *The Impact of 5G on the Internet of Things*, https://davra.com/5g-internet-of-things/ (last visited Oct. 6, 2022).

monitoring and hospital management.[380] The Consumer Technology Association forecasts that 14.7 million connected health monitoring devices, 44 million fitness trackers and smart watches, and 2.4 million connected exercise devices will ship in 2022.[381]

122. *Smart Cities.* Smart Cities, IoT on a large scale for urban management, has had several prominent deployments. For example, FloodNet in New York City uses IoT devices to monitor flood conditions.[382] U.S. cities are developing smart city systems to improve traffic management.[383] Other active Smart City initiatives also include Austin, Chattanooga, Denver, Little Rock, Minneapolis, Raleigh, and San Antonio.[384]

123. *Edge Computing.* Edge computing refers to placement of computational resources close to end users in networks.[385] The proximity to the users allows computation with "low latency, high bandwidth, device processing and data offload, as well as trust computing and storage."[386] This makes edge computing complementary to 5G, as 5G reduces latency from the device to the radio tower, and edge computing reduces latency from the radio tower to computing resources.[387] Many applications of edge computing are IoT-based and can be bundled with 5G private networks.[388] Specific examples of edge computing include predictive maintenance in the gas and oil industries, remote workforce support, e-commerce optimization, artificial intelligence, and telehealth/real-time healthcare analysis.[389] Corning Incorporated, an optical cable manufacturer, is using Verizon's On Site 5G (5G private network) and 5G Edge (edge computing) "to experiment with high-speed, high-volume data collection on the factory floor, quality assurance, and on-premises inference using machine learning."[390]

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[380] CTA Comments at 5-6; CTIA Comments at 34-35; Ben Forgan, *How IoT is Transforming Healthcare*, Forbes (Mar. 31, 2021), https://www forbes.com/sites/forbestechcouncil/2021/03/31/how-iot-is-transforming-healthcare/?sh=3bafaa4767e5; Andrew Meola, *IoT Healthcare in 2022: Companies, medical devices, and use cases*, Insider Intelligence (Apr. 15, 2022), https://www.insiderintelligence.com/insights/iot-healthcare/.

[381] CTA Comments at 6-7.

[382] FloodNet, *Real-Time and Historical FloodNet Data*, https://www.floodnet.nyc/ (last visited Oct. 6, 2022).

[383] CTA Comments at 8; CTIA Comments at 30-31, 34-36. One prominent example of traffic oriented Smart City initiative is Smart Columbus in Columbus Ohio. Smart Columbus, *Connected Vehicle Environment*, https://smart.columbus.gov/projects/connected-vehicle-environment (last visited Oct. 6, 2022).

[384] Phil Goldstein, StateTech, *7 Smart Cities to Watch in 2022 and Beyond* (Apr. 14, 2022), https://statetechmagazine.com/article/2022/04/7-smart-cities-watch-2022-and-beyond.

[385] Ericsson, *Edge Computing – a must for 5G success*, https://www.ericsson.com/en/edge-computing (last visited Oct. 6, 2022); BBVA, *What is edge computing and how does it complement 5G?* (Jan. 7, 2021), https://www.bbva.com/en/what-is-edge-computing-and-how-does-it-complement-5g/.

[386] Ericsson, *Edge Computing – a must for 5G success*, https://www.ericsson.com/en/edge-computing (last visited Oct. 6, 2022).

[387] Stephanie Overby, The Enterprisers Project, *Edge computing and 5G: A reality check* (June 9, 2021), https://enterprisersproject.com/article/2021/6/edge-computing-and-5g-reality-check; Deloitte, *Take 5: Edge computing and 5G use cases*, https://www2.deloitte.com/us/en/pages/consulting/articles/what-is-5g-edge-computing html (last visited Oct. 6, 2022).

[388] Ericsson, Edge computing and deployment strategies for communication service providers at 2 (Feb. 2020), https://www.ericsson.com/491f17/assets/local/reports-papers/white-papers/edge-computing-wp.pdf

[389] Stephanie Overby, The Enterprisers Project, *Edge computing: 5 examples of how enterprises are using it now* (Mar. 17, 2021), https://enterprisersproject.com/article/2021/3/edge-computing-5-examples-how-enterprises-using.

[390] Verizon Wireless, Press Release, Verizon Business launches On Site 5G a private 5G network for enterprise & public sector (June 10, 2021), https://www.verizon.com/about/news/verizon-business-launches-on-site-5g.

124. *Artificial Intelligence (AI) and Machine Learning*. While the phrase Artificial Intelligence (AI) has been defined in a number of ways, it generally refers to computational technology that is highly effective at performing a task and taking account of the environment in which that task is taken.[391] Most modern implementations of AI leverage machine learning (ML), computational learning from data, and thus the two are often conflated.[392] In networks connecting many devices, users can improve the efficiency of those devices by collecting data and using AI/ML to determine how to manage those devices optimally. AI/ML can thus a play key role in managing IoT networks.[393] AI/ML's need for plentiful real-time computing resources make AI/ML and edge computing complementary.[394] In fact, International Data Corporation Research Vice President Dave McCarthy claims that "AI is 'the most common workload' in edge computing."[395]

125. Wireless networks themselves are well suited for AI/ML management as they generate vast amounts of data on their operations and require significant management. AI/ML could address the growing complexity of 5G networks by automating many network management tasks.[396] AI could help manage network slicing in 5G.[397] AI and ML have the potential to improve spectral and energy efficiency in networks which are becoming more serious issues as bandwidth and computations increase with growing network traffic.[398] Qualcomm, for example, has developed AI and ML predictive algorithms to replace traditional measurement processes in wireless networks.[399] In addition, Qualcomm proposes that

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[391] For example, one AI textbook lists eight different historical definitions of AI in its introductory chapter. Stuart Russell & Peter Norvig, Artificial Intelligence: A Modern Approach 2 (3d ed. 2010).

[392] "'In just the last five or ten years, machine learning has become a critical way, arguably the most important way, most parts of AI are done,' said MIT Sloan professor Thomas W. Malone, the founding director of the MIT Center for Collective Intelligence. 'So that's why some people use the terms AI and machine learning almost as synonymous … most of the current advances in AI have involved machine learning.'" Sara Brown, *Machine learning, explained*, MIT Sloan School of Management (Apr. 21, 2021), https://mitsloan.mit.edu/ideas-made-to-matter/machine-learning-explained.

[393] *See, e.g.*, Constant Wette Tchouati, Steven Rochefort, & George Sarmonikas, *Monitoring IoT application performance with machine QoE*, 103 Ericsson Technology Review at 12 (2021), https://www.ericsson.com/493a09/assets/local/reports-papers/ericsson-technology-review/docs/2021/etr-magazine-2021-01.pdf; Rishi Vaish & Sky Matthews, IBM, *5G Will Accelerate a New Wave of IoT Applications*, https://newsroom.ibm.com/5G-accelerate-IOT (last visited Oct. 6, 2022).

[394] BBVA, *What is edge computing and how does it complement 5G?* (Jan. 7, 2021), https://www.bbva.com/en/what-is-edge-computing-and-how-does-it-complement-5g/.

[395] Stephanie Overby, The Enterprisers Project, *Edge computing: 5 examples of how enterprises are using it now* (Mar. 17, 2021), https://enterprisersproject.com/article/2021/3/edge-computing-5-examples-how-enterprises-using.

[396] Diarmund Corcoran, Andreas Ermedahl, & Catrin Granbom, *Artificial intelligence in RAN*, 103 Ericsson Technology Review 42-43 (2021), https://www.ericsson.com/493a09/assets/local/reports-papers/ericsson-technology-review/docs/2021/etr-magazine-2021-01.pdf; Diarmund Corcoran et al., *AI-enabled RAN automation* 10-2021 Ericsson Technology Review 2-3 (2021), https://www.ericsson.com/4aafdb/assets/local/reports-papers/ericsson-technology-review/docs/2021/ai-enabled-ran-automation.pdf.

[397] Ericsson, *Network Slicing*, https://www.ericsson.com/en/network-slicing (last visited Oct. 6, 2022).

[398] Ratnakar Rao V. R., Samsung Research, *Roles of Standards in AI for Wireless* (May 4, 2022), https://research.samsung.com/blog/Role_of_Standards_in_AI_for_Wireless; Konstantinos Vandikas et al., *Ensuring energy-efficient networks with artificial intelligence*, 4-2021 Ericsson Technology Review 2 (2021), https://www.ericsson.com/4972d5/assets/local/reports-papers/ericsson-technology-review/docs/2021/ensuring-energy-efficient-networks-with-ai.pdf.

[399] Arash Behboodi & Daniel Dijkman, Qualcomm, *Bringing AI research to wireless communications and sensing [video]* (May 25, 2022), https://www.qualcomm.com/news/onq/2022/05/bringing-ai-research-to-wireless-communication-and-sensing.

AI-powered wireless networks should take advantage of low-latency 5G to distribute computation across the network.[400] AT&T Labs is researching how to use AI and ML to optimize wireless networks.[401] The O-RAN Alliance standard for Open RAN incorporates AI and ML in their specification for the RAN Intelligent Controller.[402] The planned fourth 5G standard from 3GPP, Release 18 or "5G Advanced," features AI/ML as "one of the four flagship Rel-18 projects" and "the top category in terms of defining the 'Advanced' aspect."[403]

c. Mobile Wireless Devices and Handset Unlocking

126. In addition to competing on price and network quality, mobile service providers also compete using device promotions, differentiated service plans, bundled services, and advertising campaigns. By offering these diversified product packages providers are able to appeal to different subsets of consumers. As noted in section II.B.4, plans may differ in features such as data limits and throttling thresholds, hotspot data availability, cloud storage, streaming quality, and international service availability. Providers may also bundle their plans with subscriptions to certain video streaming services.[404]

127. From July 2021 to June 2022, thirteen mobile wireless handset manufacturers distributed approximately 238 mobile wireless handset models, including 85 5G-capable handset models, to mobile wireless service providers in the United States.[405] Five of these handset manufacturers each offered at least ten handset models.[406] Efforts to ensure the accessibility of such handsets are ongoing—an independent Hearing Aid Compatibility (HAC) Task Force is preparing a detailed report for submission to the Commission on the feasibility of requiring 100% of covered handsets to be hearing aid compatible.[407] When offering device promotions, mobile wireless service providers frequently offer device discounts for customers porting their numbers from competitors, or customers who add new lines

[400] John E. Smee & Jilei Hou, Qualcomm, *5G+AI: The ingredients fueling tomorrow's tech innovations* (Feb. 3, 2020), https://www.qualcomm.com/news/onq/2020/02/5gai-ingredients-fueling-tomorrows-tech-innovations.

[401] AT&T, *Analytics and AI-based automation*, https://about.att.com/sites/labs/our-work/analytics-ai-automation (last visited Oct. 6, 2022).

[402] Chih-Lin I & Sachin Katti, O-RAN, *O-RAN ALLIANCE Introduces 48 New Specifications Released Since July 2021*, https://www.o-ran.org/blog/o-ran-alliance-introduces-48-new-specifications-released-since-july-2021 (last visited Oct. 6, 2022).

[403] Bevin Fletcher, Fierce Wireless, *Next 3GPP standard tees up 5G Advanced* (Dec. 17, 2021), https://www.fiercewireless.com/tech/next-3gpp-standard-tees-5g-advanced.

[404] *See, e.g.*, T-Mobile, *Get Netflix deals on us with your plan*, https://www.t-mobile.com/offers/netflix-on-us (last visited Oct. 6, 2022); Verizon, *Your next phone, now free*, https://www.verizon.com/promos/switch-and-save/ (last visited Oct. 6, 2022).

[405] These figures are based on data from hearing aid compatibility reports filed by handset manufacturers in July 2022 for the reporting period from July 1, 2021 to June 30, 2022, available at the FCC Hearing Aid Compatibility status reporting site: FCC, *Hearing Aid Compatibility Reports: Device Manufacturers Summary*, https://www.fcc.gov/wireless/systems-utilities/universal-licensing-system/hearing-aid-compatibility-status-reporting-1 (last visited Oct. 6, 2022) (with the file name "List of All Handsets Offered by Manufacturers"). These reports include information (such as handset maker, model name, starting available date and end available date) for each handset model offered by the reporting handset manufacturer during the reporting period.

[406] Apple, Motorola, Samsung, TCL, and Zebra Technologies offered 10, 85, 36, 54, and 10 handset models, respectively.

[407] *Wireless Telecommunications Bureau Reminds Wireless Handset Manufacturers and Service Providers of Upcoming Changes to Hearing Aid Compatibility Deployment Benchmarks*, WT Docket Nos. 15-285 and 20-3, Public Notice, DA 21-1215 (WTB Sept. 28, 2021).

to their accounts.[408] For example, in August 2022, AT&T, T-Mobile, and Verizon Wireless all offered promotions involving the Apple iPhone 13.[409] AT&T offered up to a $700 discount on any iPhone 13 with an eligible device trade-in, with the discount being applied in the form of credits paid over a 36 month period.[410] Similarly, Verizon Wireless offered up to an $800 discount on the purchase of an iPhone 13, with an eligible trade in and the discount applied via 36 monthly billing credits.[411] Finally, T-Mobile offered up to an $800 discount paid over 24 monthly billing credits to customers adding a new service line and selecting a Magenta Max plan.[412]

128. *Mobile Device Unlocking.* Mobile broadband providers have the ability to lock the devices they sell to consumers on their own networks, in order to prevent the use of the device on other providers' networks.[413] Device locking leads to switching costs for consumers who are tethered to a specific provider.[414] Mobile device unlocking facilitates consumer choice among mobile broadband providers by freeing consumers from having to replace their handset to use another network, thereby reducing switching costs.[415] According to Public Knowledge, Open Technology Institute, and Consumer Reports, consumers still bear the costs of phone locking, and phone locking is a barrier to competition.[416]

129. In 2013, WTB negotiated an industry agreement on mobile device unlocking.[417] In accord with this agreement, CTIA added a section to its "Consumer Code for Wireless Service" that included device unlocking policies.[418] While this Consumer Code is voluntary, providers who choose to

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[408] *See*, *e.g.*, Verizon Wireless, *Disney + on us*, https://www.verizon.com/solutions-and-services/disneyplus/ (last visited Oct. 6, 2022).

[409] Charlie Osborne & Jason Cipriani, ZDNET, *Want an iPhone? We found the best deals on new and older models* (Sept. 10, 2022), https://www.zdnet.com/article/best-iphone-deals-available.

[410] AT&T, *Apple iPhone 13*, https://www.att.com/buy/phones/apple-iphone-13.html (last visited Oct. 6, 2022).

[411] Verizon Wireless, *Apple iPhone 13*, https://www.verizon.com/smartphones/apple-iphone-13/ (last visited Oct. 6, 2022).

[412] T-Mobile, *Apple iPhone 13*, https://www.t-mobile.com/cell-phone/apple-iphone-13 (last visited Oct. 6, 2022).

[413] *See* FCC, *Cell Phone Unlocking FAQs* (Dec. 31, 2019), https://www fcc.gov/consumers/guides/cell-phone-unlocking-faqs (Commission's guide to cell phone unlocking).

[414] *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, 14610-11, para. 152 (2015) (*Eighteenth Mobile Wireless Competition Report*) ("The ability to unlock a handset in order to activate it on another service providers network enables consumers to exercise greater choice in choosing or switching providers and lowers switching costs.").

[415] *Eighteenth Mobile Wireless Competition Report*, 30 FCC Rcd at 14610-11, para. 152; *see also* FCC, *Cell Phone Unlocking FAQs* (Dec. 31, 2019), https://www.fcc.gov/consumers/guides/cell-phone-unlocking-faqs ("When cell phone users change between compatible wireless service providers, they have the option of 'unlocking' their phones to use on their new service provider's network, giving consumers greater freedom and flexibility while increasing incentives for service providers to innovate.").

[416] Public Knowledge, OTI, and Consumer Reports Reply at 13 ("Phone locking harms competition, frustrates users, and creates e-waste.").

[417] Letter from Steve Largent, President and CEO, CTIA, to Thomas E. Wheeler, Chairman, and Commissioners, FCC (Dec. 12, 2013), https://www fcc.gov/document/ctia-letter-carrier-unlocking-voluntary-agreement-fcc-statements (on Carrier Unlocking Agreement).

[418] CTIA, *Consumer Code for Wireless Service*, https://www.ctia.org/the-wireless-industry/industry-commitments/consumer-code-for-wireless-service (last visited Sept. 23, 2022) (CTIA Consumer Code).

adopt the code agree to unlock phones when the postpaid service contract or financing plan is fulfilled.[419] For prepaid phones, providers agree to unlock devices within one year after activation.[420] In addition, if the device is not automatically unlocked, providers will notify customers when their device is eligible for unlocking.[421] Further, participating service providers will post on their websites a clear, concise, and easily found policy on mobile device unlocking.[422] The participating CTIA member service providers are required to implement all of the unlocking disclosure policies within a year of signing the agreement, and all of the major service providers fulfilled this commitment by February 11, 2015.[423]

130. While adherence to the CTIA Consumer Code is voluntary, compliance with the unlocking polices in the Consumer Code is required for many providers by virtue of their annual eligible telecommunications (ETC) certifications.[424] All ETCs requesting federal high-cost or low-income universal service support must annually file reports providing financial and operational information that is used to validate support disbursed to ETCs from the high-cost and Lifeline support mechanisms.[425] ETCs that receive low-income support are further required to certify that they comply with applicable service quality and consumer protection standards.[426] Many ETCs take advantage of a "safe harbor" that allows the companies to certify that they will comply with the CTIA Code in lieu of otherwise demonstrating how they meet these standards.[427] ETCs that rely upon this safe harbor must annually certify their compliance with the unlocking provisions in the CTIA Consumer Code.[428] Besides ETCs, an additional method of enforcement comes through licensing of the 700 MHz C Block. The Commission's rules prohibit device locking by any provider using that spectrum, and the Commission has taken steps to enforce these provisions.[429]

131. *eSIM Technology and Consumers*. The next generation of cellphones (iPhones, Samsung Galaxy,[430] etc.) all use newer eSIM technologies that do not require a physical SIM in the device. The

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[419] CTIA Consumer Code (navigate to the "Postpaid Unlocking Policy" subsection of the "Mobile Wireless Device Unlocking" section).

[420] *Id.*

[421] CTIA Consumer Code (navigate to the "Notice" subsection of the "Mobile Wireless Device Unlocking" section).

[422] CTIA Consumer Code (navigate to the "Disclosure" subsection of the "Mobile Wireless Device Unlocking" section).

[423] Roger C. Sherman & Kris Monteith, FCC, *Wireless Providers Fulfill Commitment to Let Consumers Unlock Mobile Phones* (Feb. 11, 2015), https://www fcc.gov/blog/wireless-providers-fulfill-commitment-let-consumers-unlock-mobile-phones.

[424] *Seventeenth Wireless Competition Report*, 29 FCC Rcd at 15374, para. 124 (noting implementation of unlocking policies in the CTIA Consumer Code by providers that committed to comply with the code as part of their ETC designation).

[425] 47 U.S.C. § 254; 47 CFR §§ 54.313, 54.422.

[426] 47 CFR §§ 54.202(a)(3), 54.422(b)(3).

[427] *Id.* § 54.202(a)(3); *Federal-State Joint Board on Universal Service*, CC Docket No. 96-45, Report and Order, 20 FCC Rcd 6371, 6383-84, para. 28 (2005).

[428] *See, e.g.*, *TracFone Wireless, Inc.*, Order and Consent Decree, DA 15-696 (July 1, 2015) (resolving an investigation into Tracfone's apparent non-compliance with the CTIA Consumer Code's unlocking provisions by adoption of a compliance plan and a $400,000 per month offset to the Lifeline program).

[429] 47 CFR § 27.16(e); *Cellco Partnership d/b/a Verizon Wireless*, Order and Consent Decree, DA 12-1228 (July 31, 2012) (*Verizon Order and Consent Decree*) (resolving investigation into Verizon's device locking policies by adoption a compliance plan and payment of $1,250,000).

[430] Mushfiq Rahman, US Mobile, *Always up-to-date list of eSim compatible devices* (Sept. 7, 2021), https://www.usmobile.com/blog/list-of-esim-compatible-devices/.

eSIM allows consumers with unlocked devices to switch between providers with minimal effort and time. Currently, all three major national providers support eSIMs; however, consumer awareness of this technology is low.[431]

132. *Verizon-TracFone and Handset Unlocking.* As the 700 MHz C Block licensee throughout the United States, Verizon is required to comply with the prohibition against device locking by licensees offering service in this band, subject to a 60-day waiver to combat handset-related fraud.[432] Prior to its acquisition by Verizon, TracFone, an MVNO, was not subject to these unlocking requirements.[433] However, post-transaction, Verizon planned to migrate all TracFone customers to its network.[434] As such, in addition to its other transaction-specific commitments, Verizon committed to unlocking obligations aimed at extending its 60-day unlocking policy to all 700 MHz C Block devices purchased from TracFone.[435] As part of this, Verizon committed to notify all TracFone customers of its new unlocking policies.[436]

d. Advertising

133. Mobile wireless providers also compete for customers through extensive advertising and marketing. Service providers' marketing campaigns have highlighted aspects such as network quality and 5G capabilities,[437] pricing,[438] differentiating services,[439] and device promotions.[440] In 2021, AT&T spent $2.2 billion on advertising, excluding marketing expenditures on Warner Media;[441] T-Mobile also spent

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[431] Linda Hardesty, Fierce Wireless, *Big U.S. carriers now support eSIM, but they're not marketing it* (June 9, 2021), https://www fiercewireless.com/wireless/big-u-s-carriers-now-support-esim-but-they-re-not-marketing-it.

[432] 47 CFR § 27.16(e); *Verizon Order and Consent Decree*. In 2019, the Commission granted Verizon a partial waiver of section 27.16(e) of the Commission's rules to allow Verizon to better combat identity theft and other forms of handset-related fraud. *Service Rules for the 698-746, 747-762 and 777-792 MHz Bands*, WT Docket No. 06-150, Order, 34 FCC Rcd 5134, 5134, para. 1 (WTB 2019).

[433] *Verizon-TracFone Order* at 46-47, para. 122.

[434] *Id.* at 43-44, para. 112. Pre-transaction, Verizon already served approximately 64%, or 13.3 million, of TracFone's more than 20 million customers. *Id*. at 43, para. 111.

[435] *Id.* at 47, para. 124. In particular, within 30 days of the close of the transaction, Verizon would extend its 60-day unlocking policy subject to a two-year waiver of the automatic unlocking requirement to allow manual unlocking for those TracFone devices that do not have automatic unlocking capabilities currently.

[436] *Id.* at 47, para. 124.

[437] ispot.tv, *T-Mobile TV Spot,'iPhone 13: Hide & Seek: New Line' Song by Tina Turner*, https://www.ispot.tv/ad/bN46/iphone-13-hide-and-seek-new-line-song-by-tina-turner (last visited Oct. 6, 2022); ispot.tv, *AT&T Wireless 5G TV Spot 'LaMelo Covers for Lily' Featuring LaMelo Ball*, https://www.ispot.tv/ad/bOlz/at-and-t-wireless-5g-lamelo-covers-for-lily-featuring-lamelo-ball (last visited Oct. 6, 2022).

[438] ispot.tv, *T-Mobile TV Spot 'Please Listen: Switch and Get $100' Featuring Ben Barnes*, https://www.ispot.tv/ad/bMCU/t-mobile-please-listen-switch-and-get-1000-featuring-ben-barnes (last visited Oct. 6, 2022).

[439] ispot.tv, *T-Mobile TV Spot 'iPhone 13: Hide & Seek: New Line and Apple TV+' Song by Tina Turner,'* https://www.ispot.tv/ad/bN4X/t-mobile-iphone-13-hide-and-seek-new-line-and-apple-tv-song-by-tina-turner (last visited Oct. 6, 2022).

[440] ispot.tv, *AT&T Wireless TV Spot 'Lily + Matthew: Interview' Featuring Matthew Stafford*, https://www.ispot.tv/ad/b1k1/at-and-t-wireless-lily-matthew-interview-featuring-matthew-stafford (last visited Oct. 6, 2022); ispot.tv, *Verizon TV Spot 'Show the Love: Customers for Years and Switcher',* https://www.ispot.tv/ad/bylk/verizon-show-the-love-customers-for-years-and-switchers (last visited Oct. 6, 2022).

[441] AT&T Inc., SEC Form 10-K, at 37, 123 (filed Feb. 16, 2022).

$2.2 billion;[442] and Verizon Wireless spent $3.4 billion.[443] By comparison, in 2019, AT&T spent $3.2 billion on advertising, excluding marketing expenditures on Warner Media;[444] T-Mobile spent $1.6 billion;[445] and Verizon Wireless spent $3.1 billion.[446]

e. Mobile Applications

134. The wide adoption of mobile devices in the global market has contributed to the development and growth of applications (apps) that are designed for mobile operating systems.[447] In 2021, annual mobile app downloads reached 230 billion worldwide, a 5% increase from the previous year.[448] The average American spent 4.1 hours per day on mobile devices in 2021, more than the 3.1 hours they spent each day watching TV.[449] In 2020, 88% of the time Americans devoted to Internet activities on mobile devices was spent using apps, excluding web browsers.[450] The increasingly important role that mobile devices play in the modern economy not only directly impacts the mobile apps market, but also has wider implications for e-commerce. In this section, we discuss the major mobile app platforms, revenue and business models in the mobile app industry, and provide some download and usage statistics for mobile apps.

135. The predominant mobile operating systems worldwide are Android and iOS.[451] Globally, most mobile applications for these operating systems can be purchased in either the Google Play Store (Android) or the Apple App Store (iOS). These two app stores are the largest "native" app distribution platforms in terms of the number of applications available to download.[452] However, smaller native app

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[442] T-Mobile US, Inc., SEC Form 10-K, at 69 (filed Feb. 11, 2022).

[443] Verizon Communications Inc., SEC Form 10-K, at 101 (filed Feb. 11, 2022).

[444] AT&T Inc., SEC Form 10-K, at 37, 123 (filed Feb. 16, 2022).

[445] T-Mobile US, Inc., SEC Form 10-K, at 69 (filed Feb. 11, 2022).

[446] Verizon Communications Inc., SEC Form 10-K, at 101 (filed Feb. 11, 2022).

[447] BuildFire, *Mobile App Download Statistics & Usage Statistics (2022)*, https://buildfire.com/app-statistics/ (last visited Oct. 6, 2022) (there are 6.3 billion smartphone users and 1.14 billion tablet users worldwide).

[448] data.ai, State of Mobile 2022 at 2 (2022), https://www.data.ai/en/go/state-of-mobile-2022/ (230 billion new app downloads from "iOS, Google Play, Third-Party Android in China").

[449] *Id.* Across the top 10 markets analyzed in the study, the average time consumers spent in apps topped 4 hours 48 minutes in 2021—up 30% from 2019. *Id.*

[450] Yoram Wurmser, Insider Intelligence, *The Majority of Americans' Mobile Time Spent Takes Place in Apps* (July 9, 2020), https://www.insiderintelligence.com/content/the-majority-of-americans-mobile-time-spent-takes-place-in-apps.

[451] Federica Laricchia, Statista, *Mobile operating systems' market share worldwide from January 2012 to August 2022* (Aug. 30, 2022), https://www.statista.com/statistics/272698/global-market-share-held-by-mobile-operating-systems-since-2009/.

[452] In this context, native app distribution platforms are app stores that are developed for use on at least one of the major mobile operating systems; i.e., Android and iOS, or on open-source operating systems. *See* Alexander S. Gillis, *native app*, https://www.techtarget.com/searchsoftwarequality/definition/native-application-native-app (last visited Oct. 6, 2022). For the number of apps available to download in various native app stores, see L. Ceci, Statista, *Number of apps available in leading app stores as of 2nd quarter 2022* (Aug. 11, 2022), https://www.statista.com/statistics/276623/number-of-apps-available-in-leading-app-stores/ (for the Google Play Store, Apple App Store, and Amazon Appstore); Radu Tyrsina, Windows Report, *How many apps are in the Microsoft Store?* (Apr. 26, 2021), https://windowsreport.com/state-windows-8-apps-windows-store/ (for the Microsoft Store). Data regarding the number of apps available to download are not readily available for OpenStore, the PureOS Store, the Samsung Galaxy Store, and The Snap Store.

stores also exist in the market, including the Amazon Appstore, the Microsoft Store, OpenStore, the PureOS Store, the Samsung Galaxy Store, and The Snap Store.[453] Non-native app distribution platforms, such as Appland, Applivery, F-Droid, and Rootpk, are also present in the market.[454]

136. *Revenues.* App developers employ several types of business models to generate revenue, including in-app advertisements, upfront download fees, in-app purchases, and subscription services.[455] In 2021, global revenue from Android and iOS apps exceeded $133 billion, a 19% increase over 2020 totals.[456] Sensor Tower reports that in 2021, mobile games generated more revenue than any other app category, at $89.6 billion.[457] This figure represents 67.4% of all app spending in 2021, and an increase of 12.6% from 2020.[458]

137. The Apple App Store and Google Play Store are the two largest app platforms. Outside of China, these two platforms control more than 95% of the market.[459] In 2021, the Apple App Store generated $85.1 billion in revenue, accounting for 62.9% of global app revenue.[460] This was a 17.7% increase over 2020 revenue.[461] Likewise, the Google Play Store generated $47.9 billion in revenue during 2021, an increase of 23.5% since 2020.[462] App stores generally charge developers a percentage-based commission on both apps and in-app purchases of digital goods, services, and subscriptions in exchange for hosting apps in their stores.[463] In 2020, Apple updated its fee structure so that developers with annual

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[453] Amazon, *Amazon Appstore*, https://www.amazon.com/mobile-apps/b?ie=UTF8&node=2350149011 (last visited Oct. 6, 2022); Microsoft, *Microsoft Store app*, https://apps microsoft.com/store/apps (last visited Oct. 6, 2022); OpenStore, *Ubuntu Touch Apps*, https://open-store.io/ (last visited Oct. 6, 2022); Purism, *PureOS Store*, https://software.pureos.net/ (last visited Oct. 6, 2022); Samsung, *Galaxy Store*, https://www.samsung.com/us/apps/galaxy-store/ (last visited Oct. 6, 2022); Canonical, *The app store for Linux*, https://snapcraft.io/ (last visited Oct. 6, 2022) (to access The Snap Store).

[454] Appland, *App Store Platform + Content + Services*, https://www.applandinc.com/ (last visited Oct. 6, 2022); Applivery, *Enterprise Mobility Management*, https://www.applivery.com/ (last visited Oct. 6, 2022); F-Droid, *What is F-Droid?*, https://f-droid.org/ (last visited Oct. 6, 2022); Rootpk, *Independent app store*, https://rootpk.com/ (last visited Oct. 6, 2022).

[455] Apple, *Choosing a business model*, https://developer.apple.com/app-store/business-models/ (last visited Oct. 6, 2022).

[456] Sensor Tower is a data analytics company specializing in mobile applications. Stephanie Chan, Sensor Tower, *Global Consumer Spending in Mobile Apps Reached $133 Billion in 2021, Up Nearly 20% from 2020* (Dec. 2021), https://sensortower.com/blog/app-revenue-and-downloads-2021.

[457] Stephanie Chan, Sensor Tower, *Global Consumer Spending in Mobile Apps Reached $133 Billion in 2021, Up Nearly 20% from 2020* (Dec. 2021), https://sensortower.com/blog/app-revenue-and-downloads-2021.

[458] *Id*.

[459] David Curry, Business of Apps, *App Store Data (2022)*, https://www.businessofapps.com/data/app-stores/ (last visited Oct. 6, 2022).

[460] Grand View Research, *Mobile Application Market Size, Share, & Trends Analysis Report By Store Type (Google Store, Apple Store, Others), By Application, By Region, And Segment Forecasts, 2022-2030*, https://www.grandviewresearch.com/industry-analysis/mobile-application-market#:~:text=Store%20Type%20Insights,of%20global%20revenue%20in%202021 (last visited Oct. 6, 2022).

[461] Stephanie Chan, Sensor Tower, *Global Consumer Spending in Mobile Apps Reached $133 Billion in 2021, Up Nearly 20% from 2020* (Dec. 2021), https://sensortower.com/blog/app-revenue-and-downloads-2021.

[462] *Id*.

[463] The sales of physical goods are exempt from service fees. Ian Carlos Campbell & Julia Alexander, The Verge, *A guide to platform fees* (Aug. 24, 2021), https://www.theverge.com/21445923/platform-fees-apps-games-business-marketplace-apple-google.

revenues less than $1 million faced a 15% fee, while developers with revenues greater than $1 million faced a 30% fee.[464] Google has implemented a similar fee structure in which developers face a 15% fee on their first $1 million in revenue, and a 30% fee on any revenue above $1 million.[465]

138. *Downloads*. Globally, as of the second quarter of 2022, the Google Play Store and the Apple App Store had approximately 3.5 million and 2.2 million applications available to download, respectively.[466] Figure II.B.23 shows that the five categories in the Apple App Store containing the largest number of apps available to download worldwide as of April 2022 were Games, Business, Education, Utilities, and Lifestyle,[467] whereas Figure II.B.24 shows that the five largest categories in the Google Play Store were Games, Education, Business, Music & Audio, and Tools.[468] Moreover, global users downloaded approximately 27.0 billion and 8.2 billion applications from the Google Play Store and the Apple App Store, respectively, during the third quarter of 2022,[469] with social media and messaging apps dominating the top ten list of the most downloaded apps through the second quarter of 2022.[470] Specifically, as shown in Figure II.B.25, seven of the top ten most downloaded mobile apps were social media or messaging apps, with shopping, video editing, and music streaming apps claiming the remaining three spots.[471] In addition, globally, as of June 2022, 96.8% of the applications in the Google Play Store could be downloaded for free compared with 93.9% of those in the Apple App Store.[472]

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[464] Prior to 2020, all developers were subject to a 30% service fee. Press Release, Apple, *Apple announces App Store Small Business Program* (Nov. 18, 2020), https://www.apple.com/newsroom/2020/11/apple-announces-app-store-small-business-program/.

[465] Google, *Service fees*, https://support.google.com/googleplay/android-developer/answer/112622?hl=en (last visited Oct. 6, 2022).

[466] L. Ceci, Statista, *Number of apps available in leading app stores as of 2nd quarter 2022* (Aug. 11, 2022), https://www.statista.com/statistics/276623/number-of-apps-available-in-leading-app-stores/. It is unclear from online sources whether the application numbers provided include non-mobile apps (i.e., applications used on tablets, laptops, etc.) in addition to mobile apps (i.e., applications used on phones).

[467] David Curry, Business of Apps, *Most Popular Apple App Store Categories*, Business of Apps (Aug. 31, 2022), https://www.businessofapps.com/data/app-stores/.

[468] *Id*.

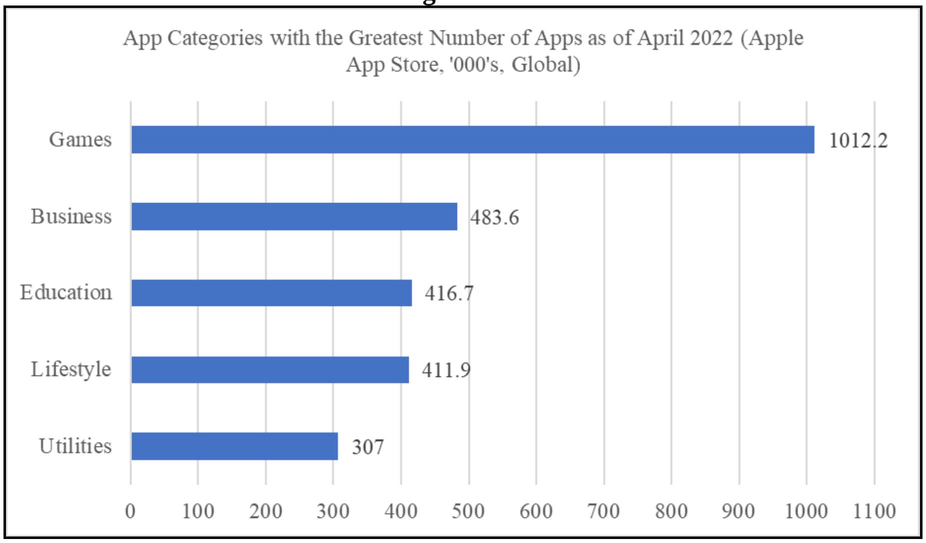
[469] L. Ceci, Statista, *Number of iOS and Google Play app downloads as of Q3 2022 (*Oct. 6, *2022*), https://www.statista.com/statistics/695094/quarterly-number-of-mobile-app-downloads-store/. It is unclear from online sources whether the download numbers provided include non-mobile apps (i.e., applications used on tablets, laptops, etc.) in addition to mobile apps (i.e., applications used on phones).

[470] Data.ai, *Top Apps & Games, Q2 2022 Rankings*, https://dataai.infogram.com/1pyy9e0y15xevdc37jp100zyz9iymmvkekl (last visited Oct. 6, 2022).

[471] *Id*.

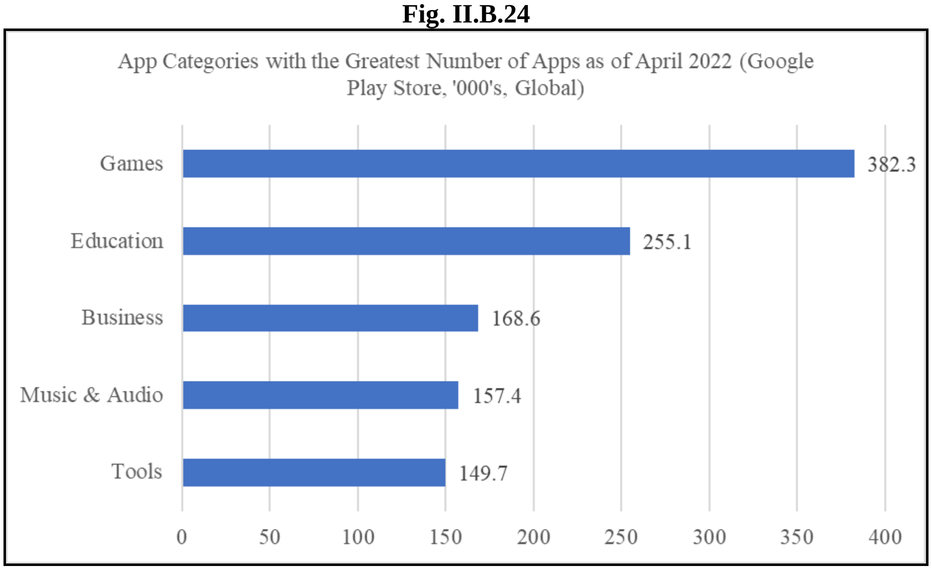
[472] L. Ceci, Statista, *Distribution of free and paid Android apps 2022* (July 13, 2022), https://www.statista.com/statistics/266211/distribution-of-free-and-paid-android-apps/; L. Ceci, Statista, *Distribution of free and paid iOS apps 2019-2022* (July 13, 2022), https://www.statista.com/statistics/1020996/distribution-of-free-and-paid-ios-apps/.

Fig. II.B.23



Source: Business of Apps.

Fig. II.B.24



Source: Business of Apps.

Fig. II.B.25
Ranking of Most Downloaded Apps Worldwide (Q2 2022)

Rank	Name of App	Category
1	Instagram	Social Media
2	Facebook	Social Media
3	TikTok	Social Media
4	WhatsApp Messenger	Messaging
5	Snapchat	Social Media
6	Telegram	Messaging
7	Facebook Messenger	Messaging
8	Meesho	Shopping
9	CapCut	Video Editing
10	Spotify	Music Streaming

Source: data.ai.

139. *Usage*. Although there were approximately 80 apps on average installed on each smartphone in 2022, the average person only used nine mobile apps per day and 30 apps per month.[473] About 25% of apps were used only once after being downloaded, and the churn rate was 71% within the first 90 days.[474] Meanwhile, mobile app usage varies across age groups as young adults tend to spend more time on mobile apps than do older generations.[475] In the United States, as of 2021, the most-used apps for Gen Z included Instagram, TikTok, Snapchat, and Netflix.[476] Millennials, meanwhile, preferred Facebook, Messenger, Amazon, and WhatsApp.[477] During the same time, Gen X and Baby Boomers used the Weather Channel, Amazon Alexa, NewsBreak, and Ring apps the most.[478]

f. Speed of Service

140. Network speed is a key characteristic of mobile wireless performance. As such, the Commission has recognized the importance of accurate and timely data on download and upload speeds.[479] The mobile broadband speeds and network performance that consumers experience can vary greatly with a number of factors, including the service provider's received signal quality, cell traffic

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[473] BuildFire, *Mobile App Download Statistics & Usage Statistics (2022)*, https://buildfire.com/app-statistics/ (last visited Oct. 6, 2022).

[474] *Id.*

[475] Maitrik Kataria, Simform, *App Usage Statistics 2021 that'll Surprise You* (Jan. 5, 2021), https://www.simform.com/blog/the-state-of-mobile-app-usage/.

[476] Sarah, Perez, TechCrunch, *App Annie: Global app stores' consumer spend up 19% to $170B in 2021, downloads grew 5% to 230B* (Jan. 12, 2022), https://techcrunch.com/2022/01/12/app-annie-global-app-stores-consumer-spend-up-19-to-170b-in-2021-downloads-grew-5-to-230b/ ("Gen Z is represented by those aged 16-24; Millennials are represented by those aged 25-44; Gen X and the Baby Boomers are represented by those aged 45+").

[477] *Id.*

[478] *Id.*

[479] *See, e.g., Fourteenth Broadband Deployment Report*, 36 FCC Rcd at 852-53, paras. 29-30.

loading and network capacity in different locations, terrain, weather conditions, as well as the capabilities of consumers' devices.[480] Therefore, there are various methodologies that measure mobile network speeds. The two most prevalent methodologies for measuring speed rely on crowdsourced data and structured sample data. Crowdsourced data are user-generated data produced by consumers who voluntarily download speed test applications on their mobile devices, while structured sample data, by contrast, are generated from tests that control for the location and time of the tests as well as for the devices used in the test.[481] This *Report* presents speed data using Ookla Speedtest data (crowdsourced), Opensignal data (crowdsourced), and RootMetrics (structured sample).[482]

141. Figures II.B.26 and II.B.27 present the nationwide mean and median 4G LTE download and upload speeds by service provider based on Ookla data[483] for the second half of 2020 through the second half of 2021.[484] Figures II.B.28 and II.B.29 present the nationwide mean and median 5G download and upload speeds by service provider, for the second half of 2020 through the first half of

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[480] For additional discussion of the various factors, *see, e.g.*, *Twentieth Wireless Competition Report*, 32 FCC Rcd at 9033, para. 87.

[481] For a detailed discussion of crowdsourcing and structured sample data, *see Twentieth Wireless Competition Report*, 32 FCC Rcd at 9033-34, para. 88. Many apps that collect crowdsourced data collect data via background or automated tests, as well as through user-initiated tests. We note that crowdsourced data have certain limitations. For example, bias may be introduced into speed test data because tests are performed only at specific times and places, potentially providing a less accurate snapshot of mobile broadband performance. Further, "the methods by which different speed test apps collect data can vary and may not use techniques that control for certain variables." *See, e.g.*, *BDC Second Order and Third Further Notice*, 35 FCC Rcd at 7487-88, para. 65.

[482] While speed metrics based on the FCC Speed Test (available for both Android phones and the iPhone) were reported in the *Seventeenth Wireless Competition Report* through the *Nineteenth Wireless Competition Report*, we stopped reporting these metrics in the *Twentieth Wireless Competition Report* and do not report them in this *Report* due to certain anomalies found in the underlying data. We may include data from the FCC Speed Test in future reports. An in-depth discussion of the MBA program's FCC Speed Test is available in the *Seventeenth Wireless Competition Report. Seventeenth Wireless Competition Report*, 29 FCC Rcd at 15467, Appx. VI., paras. 7-9; *see also* FCC, *Measuring Mobile Broadband*, https://www.fcc.gov/general/measuring-mobile-broadband-performance (last visited Oct. 6, 2022).

[483] Ookla gathers crowdsourced mobile speed data through the use of its Speedtest mobile app. Speedtest, *Speedtest Apps for Mobile*, http://www.speedtest net/mobile/ (last visited Oct. 6, 2022). An in-depth discussion of the Ookla Speedtest is available in the *Seventeenth Wireless Competition Report. Seventeenth Wireless Competition Report*, 29 FCC Rcd at 15465-66, Appx. VI., paras. 1-6. The upload and download speeds were calculated by Ookla and provided to the Commission for use in this *Report*. The updated Ookla figures in this *Report* present sample count which is the number of tests in the cleaned sample on which the mean and median upload and download speeds are based. In contrast, the corresponding figures in previous reports, including the *2020 Communications Marketplace Report*, present the total number of tests (the number of tests in the uncleaned dataset)

[484] On August 2, 2020, T-Mobile combined brand operations with Sprint. T-Mobile, Press Release, T-Mobile Unveils Latest Un-carrier Move: Scam Shield — A Massive Set of Free Solutions to Protect Customers From Rampant Scams and Robocalls (July 16, 2020), https://www.t-mobile.com/news/un-carrier/scam-shield-protects-customers-from-scams-robocalls. While T-Mobile stopped accepting new Sprint customers at this time, it continues to maintain the Sprint network for existing Sprint customers. T-Mobile, *Sprint is now part of the family*, https://www.t-mobile.com/brand/t-mobile-sprint-merger-updates?icid=MGPO_TMO_P_20NEWTMO_LTD35TK1G23BLQ85V21324#day0-faq (last visited Oct. 6, 2022) (navigate to the "Got questions?" subsection). Therefore, crowdsourced speed tests will continue to identify customers on the Sprint network, and will continue to do so until all customers are migrated to the T-Mobile network. However, beginning in 2021, the Ookla data presented in this *Report* no longer differentiates between the Sprint and T-Mobile networks.

2022.[485] Finally, Figure II.B.30 presents the increase over time for mean and median 4G LTE download speeds for all providers, from the first half of 2014 through the first half of 2022.[486] Based on Ookla data, Figure II.B.30 indicates that the median LTE download speed increased from 11.0 Mbps to 30.4 Mbps, an increase of approximately 176%, over this time period.

Fig. II.B.26
Ookla Speedtest–Estimated 4G LTE Download Speeds by Service Provider, Nationwide

Service Provider	2H2020			1H2021			2H2021		
	Mean Down load Speed (Mbps)	Median Down load Speed (Mbps)	Sample Count ('000s)	Mean Down load Speed (Mbps)	Median Down load Speed (Mbps)	Sample Count ('000s)	Mean Down load Speed (Mbps)	Median Down load Speed (Mbps)	Sample Count ('000s)
AT&T	49.04	36.06	755	49.07	35.56	488	47.63	33.67	368
Sprint	40.42	24.85	201	-	-	-	-	-	-
T-Mobile	38.43	27.82	549	42.03	30.28	527	43.28	31.29	364
Verizon Wireless	38.02	27.07	902	40.10	27.92	620	37.75	25.43	457

Source: Ookla SPEEDTEST intelligence data, © 2022 Ookla, LLC. All rights reserved. Published with permission of Ookla.

Fig. II.B.27
Ookla Speedtest–Estimated 4G LTE Upload Speeds by Service Provider, Nationwide

Service Provider	2H2020			1H2021			2H2021		
	Mean Upload Speed (Mbps)	Median Upload Speed (Mbps)	Sample Count ('000s)	Mean Upload Speed (Mbps)	Median Upload Speed (Mbps)	Sample Count ('000s)	Mean Upload Speed (Mbps)	Median Upload Speed (Mbps)	Sample Count ('000s)
AT&T	8.91	6.40	755	8.67	5.77	488	8.01	5.02	368
Sprint	3.67	2.32	201	-	-	-	-	-	-
T-Mobile	12.31	8.12	549	10.03	5.84	527	9.06	5.27	364
Verizon Wireless	9.20	5.71	902	9.24	5.76	620	8.31	4.97	457

Source: Ookla SPEEDTEST intelligence data, © 2022 Ookla, LLC. All rights reserved. Published with permission of Ookla.

[485] Although most figures in this *Report* present data as of the end of 2021, the 5G speed figures include some 2022 data. This is due to the rapid and recent developments in 5G deployment.

[486] Over time, Ookla has updated its data cleaning and aggregation rules. In Fig. II.B.30, the legacy rules are reflected through the first half of 2016, and updated cleaning rules are reflected in the second half of 2016 and on.

Fig. II.B.28
Ookla Speedtest–Estimated 5G Download Speeds by Service Provider, Nationwide

Service Provider	2H2020			1H2021			2H2021			1H2022		
	Mean Download Speed (Mbps)	Median Download Speed (Mbps)	Sample Count ('000s)	Mean Download Speed (Mbps)	Median Download Speed (Mbps)	Sample Count ('000s)	Mean Download Speed (Mbps)	Median Download Speed (Mbps)	Sample Count ('000s)	Mean Download Speed (Mbps)	Median Download Speed (Mbps)	Sample Count ('000s)
AT&T	92.84	78.50	108	96.95	76.18	178	91.19	70.69	275	96.49	70.25	325
T-Mobile	85.32	69.69	255	123.72	91.76	403	204.22	164.01	531	226.22	189.73	515
Verizon Wireless	151.77	61.35	194	215.61	72.13	272	279.15	78.93	358	230.51	108.32	442

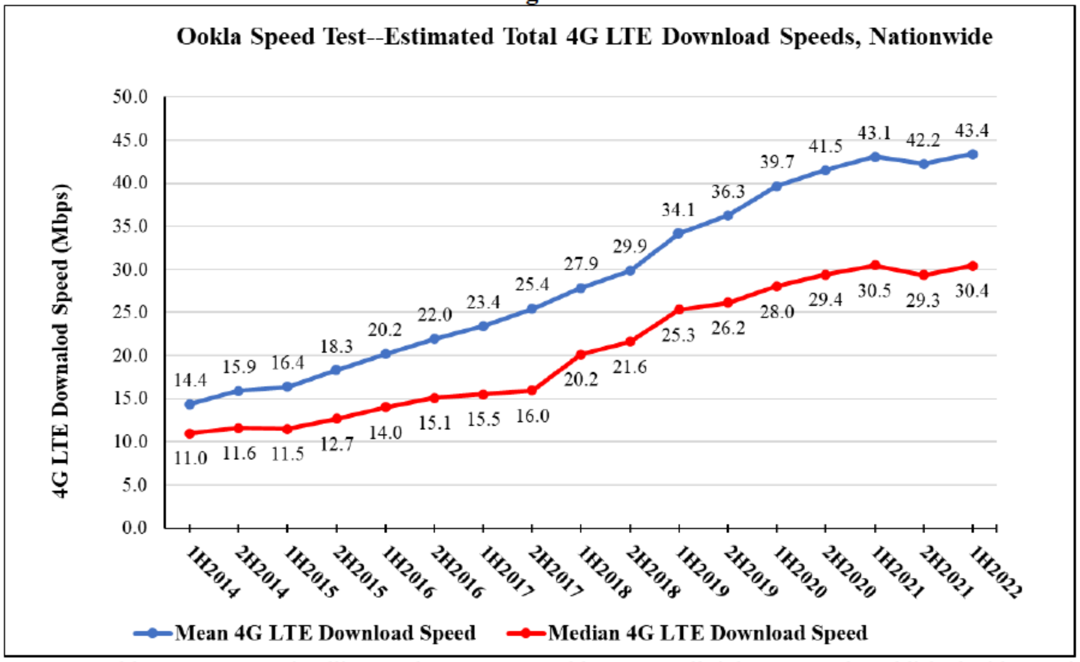
Source: Ookla SPEEDTEST intelligence data, © 2022 Ookla, LLC. All rights reserved. Published with permission of Ookla.

Fig. II.B.29
Ookla Speedtest–Estimated 5G Upload Speeds by Service Provider, Nationwide

Service Provider	2H2020			1H2021			2H2021			1H2022		
	Mean Upload Speed (Mbps)	Median Upload Speed (Mbps)	Sample Count ('000s)	Mean Upload Speed (Mbps)	Median Upload Speed (Mbps)	Sample Count ('000s)	Mean Upload Speed (Mbps)	Median Upload Speed (Mbps)	Sample Count ('000s)	Mean Upload Speed (Mbps)	Median Upload Speed (Mbps)	Sample Count ('000s)
AT&T	17.35	15.05	108	17.83	13.82	178	14.13	11.15	275	12.74	9.27	325
T-Mobile	23.71	20.33	255	24.26	18.77	403	24.13	19.14	531	23.12	17.41	515
Verizon Wireless	21.69	17.65	194	24.03	18.02	272	23.15	17.22	358	20.48	15.32	442

Source: Ookla SPEEDTEST intelligence data, © 2022 Ookla, LLC. All rights reserved. Published with permission of Ookla.

Fig. II.B.30



Source: Ookla SPEEDTEST intelligence data, © 2022 Ookla, LLC. All rights reserved. Published with permission of Ookla.

142. Figures II.B.31 and II.B.32 below present nationwide average download and upload speeds for the second half of 2020 through the second half of 2021 from Opensignal.[487] We present nationwide average 5G download and upload speeds from Opensignal in Figures II.B.33 and II.B.34, and 5G Availability in Figure II.B.35.

Fig. II.B.31
Opensignal–Estimated Download Speeds, Nationwide[488]

Service Provider	2H2020	1H2021	2H2021
	Average Download Speed (Mbps)	Average Download Speed (Mbps)	Average Download Speed (Mbps)
AT&T	33.2	35.2	35.3
T-Mobile	28.8	31.8	54.1
Verizon Wireless	28.9	28.7	30.2

Source: Opensignal, © 2022 Opensignal.

[487] Opensignal gathers crowdsourced mobile speed data through the use of its mobile app as well as through partner apps. The partners they work with are strategically selected to cover a wide range of users, demographics, and devices. Opensignal, *Methodology Overview*, https://www.opensignal.com/methodology-overview (last visited Oct. 6, 2022).

[488] Fig. II.B.31 presents Opensignal's Download Speed Experience. Measured in Mbps, Opensignal's Download Speed Experience represents the typical everyday speeds a user experiences across an operator's mobile data networks. Opensignal, *Methodology Overview*, https://www.opensignal.com/methodology-overview (last visited Oct. 6, 2022).

Fig. II.B.32
Opensignal–Estimated Upload Speeds, Nationwide[489]

Service Provider	2H2020	1H2021	2H2021
	Average Upload Speed (Mbps)	Average Upload Speed (Mbps)	Average Upload Speed (Mbps)
AT&T	5.7	6.1	6.7
T-Mobile	9.9	9.3	10.5
Verizon Wireless	7.7	7.9	8.2

Source: Opensignal, © 2022 Opensignal.

Fig. II.B.33
Opensignal–Estimated 5G Download Speeds, Nationwide[490]

Service Provider	2H2020	1H2021	2H2021	1H2022
	5G Download Speed (Mbps)	5G Download Speed (Mbps)	5G Download Speed (Mbps)	5G Download Speed (Mbps)
AT&T	53.8	52.3	49.1	53.6
T-Mobile	58.1	87.5	150.0	171.0
Verizon Wireless	47.4	52.3	56.2	72.8

Source: Opensignal, © 2022 Opensignal.

Fig. II.B.34
Opensignal–Estimated 5G Upload Speeds, Nationwide[491]

Service Provider	2H2020	1H2021	2H2021	1H2022
	5G Upload Speed (Mbps)	5G Upload Speed (Mbps)	5G Upload Speed (Mbps)	5G Upload Speed (Mbps)
AT&T	8.0	8.8	9.9	10.0
T-Mobile	14.0	15.1	17.9	17.8
Verizon Wireless	11.9	14.2	14.1	14.0

Source: Opensignal, © 2022 Opensignal.

[489] Fig. II.B.32 presents Opensignal's Upload Speed Experience. Measured in Mbps, Opensignal's Upload Speed Experience measures the average upload speeds for each operator observed by our users across their mobile data networks. Opensignal, *Methodology Overview*, https://www.opensignal.com/methodology-overview (last visited Oct. 6, 2022).

[490] Fig. II.B.33 presents Opensignal's 5G Download Speed, defined as the average download speed observed by Opensignal users with active 5G connections. Opensignal, *Methodology Overview*, https://www.opensignal.com/methodology-overview (last visited Oct. 6, 2022).

[491] Fig. II.B.34 presents Opensignal's 5G Upload Speed, defined as the average upload speed observed by Opensignal users with active 5G connections. Opensignal, *Methodology Overview*, https://www.opensignal.com/methodology-overview (last visited Oct. 6, 2022).

Fig. II.B.35
Opensignal–Estimated 5G Availability, Nationwide[492]

Service Provider	2H2020	1H2021	2H2021	1H2022
	5G Availability (%)	5G Availability (%)	5G Availability (%)	5G Availability (%)
AT&T	18.8	22.5	16.5	18.7
T-Mobile	30.1	36.3	35.4	40.6
Verizon Wireless	9.5	10.5	9.5	10.6

Source: Opensignal,

143. RootMetrics mobile wireless indices within the United States for the second half of 2020 through the second half of 2021 are presented in Figure II.B.36.[493]

Fig. II.B.36
RootMetrics–National Speed Index Data

	2H2020			1H2021			2H2021		
Service Provider	Speed Index	Data Index	Text Index	Speed Index	Data Index	Text Index	Speed Index	Data Index	Text Index
AT&T	94.9	96.3	96.8	97.5	97.6	96.7	97.4	97.4	96.8
T-Mobile	84.6	89.8	91.5	91.4	93.6	92.3	94.0	94.6	92.3
Verizon Wireless	95.9	97.1	96.5	95.7	97.1	96.8	94.6	96.4	96.5

Source: RootMetrics Data,

6. Network Coverage

144. In this section, we rely on the FCC Form 477 data for our analysis. As explained above, we expect the BDC to be a considerable improvement over the FCC Form 477 data, but the BDC is still in its early stages. As a result, we use the FCC Form 477 data for this *Report*'s analysis of wireless network coverage but expect to rely on the BDC for the next *Report's* analysis.

145. We measure mobile network coverage using the actual-area methodology, which analyzes FCC Form 477 mobile broadband data on a sub-census-block level and calculates the percentage of each census block covered by each service provider by technology.[494] Unlike the centroid

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[492] Fig. II.B.35 presents Opensignal's 5G Availability. 5G Availability shows the proportion of time Opensignal users with a 5G device and a 5G subscription had an active 5G connection. Opensignal, *Methodology Overview*, https://www.opensignal.com/methodology-overview (last visited Oct. 6, 2022).

[493] RootMetrics, *A simple premise for a sophisticated methodology*, http://rootmetrics.com/en-US/methodology (last visited Oct. 6, 2022). RootMetrics performs drive tests and stationary tests in specific locations, using leading Android-based smartphones for each network. RootScores are scaled from 0 to 100. An in-depth discussion of the RootMetrics dataset is available in the *Seventeenth Wireless Competition Report*. *Seventeenth Wireless Competition Report*, 29 FCC Rcd at 15467-68, Appx. VI., paras. 10-11.

[494] Facilities-based providers of mobile service submit polygons in a shapefile format representing geographic coverage nationwide (including U.S. territories) for each transmission technology (e.g., 5G-NR, 4G LTE, CDMA-based, GSM-based), indicating the geographic areas in which users should expect to receive the minimum upload and download speeds advertised by the service provider for the deployed technologies. The FCC Form 477 reporting requirements exclude providers of terrestrial wireless "hot spot" services, like local-area Wi-Fi or Wi-Fi within public places. FCC Form 477, *Local Telephone Competition and Broadband Reporting Instructions* (May

(continued….)

methodology,[495] in which entire census blocks are either classified as covered or not, the actual-area methodology estimates the area of the census block that is covered.[496] However, because we currently do not know the distribution of the population at the sub-census-block level, we must approximate the population covered by each technology. To do this, we assume, for purposes of this *Report*, that the population of a census block is uniformly distributed such that the fraction of the population covered in a block is proportional to the fraction of the actual area covered. We then sum the estimated covered population across blocks to estimate the total covered population within the United States. Likewise, we assume that the fraction of the road miles covered in a block is proportional to the fraction of the actual area covered.[497]

146. Our analysis of deployment for mobile 4G LTE services uses 2020 U.S. Census block population estimates and census block definitions, in contrast to the 2010 U.S. Census population estimates and census block definitions used in the previous *Reports*.[498] Road miles have been calculated for each 2020 census block in line with methodologies used in previous *Reports*.[499]

a. Mobile Wireless Coverage

147. *4G LTE Coverage*. Figure II.B.37 presents 4G LTE mobile broadband coverage by number of service providers. It shows that, as of December 2021, over 94% of the U.S. population lived in areas with 4G LTE coverage by at least three service providers. These areas account for approximately 63% of road miles and 40% of the total area of the United States. Coverage by at least four service providers was smaller, with coverage of approximately 14% of the population, 15% of road miles, and 10% of the land area.

(Continued from previous page)
21, 2020), https://transition fcc.gov/form477/477inst.pdf.

495 The centroid methodology considers a census block covered if the geometric center point, or centroid, is covered. The methodology estimates coverage of population, land, and road miles by aggregating the totals for "covered" census blocks. *Twentieth Wireless Competition Report*, 32 FCC Rcd at 9016-17, para. 71. In practice, actual-area and centroid methodologies yield similar results at the national level. *Twentieth Wireless Competition Report*, 32 FCC Rcd at 9017-18, para. 72. In this *Report,* we provide mobile wireless coverage maps as well as our results based on the centroid analysis in Appx. D. We include the continental United States, Hawaii, Alaska, and Puerto Rico, and exclude all water-only blocks in our analysis.

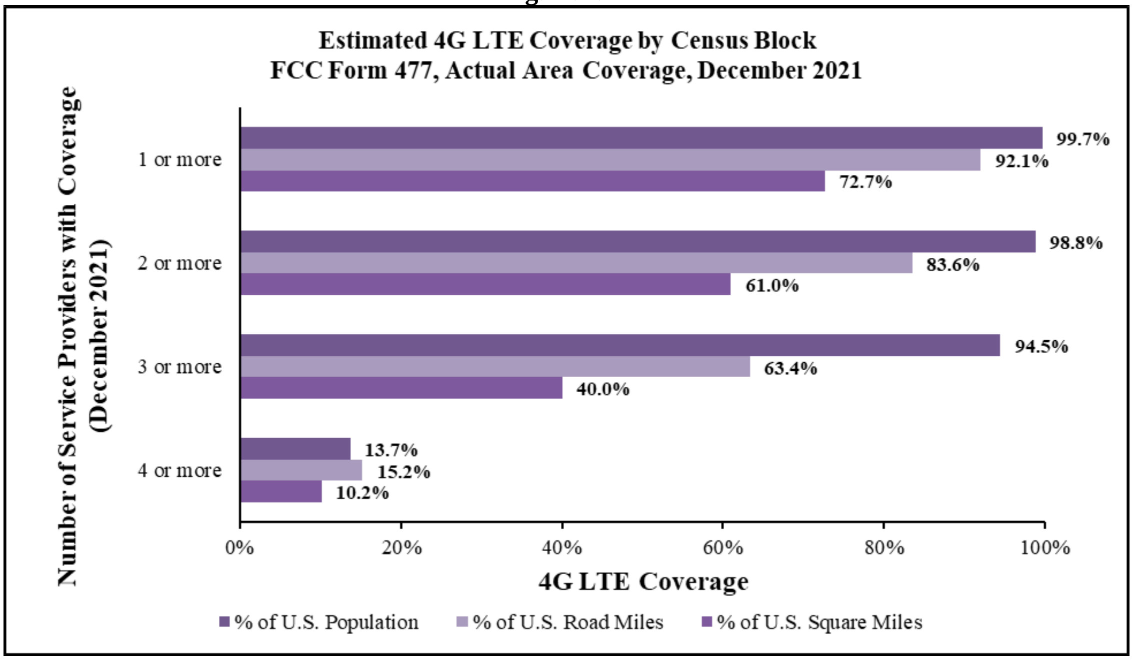
496 This sub-census-block analysis can determine the unique combination of service providers serving a particular percentage of the area in a census block with a certain technology. As this analysis was done at each technology level, the set of unique combinations that it produces are valid for each individual technology, but not across multiple technologies. Essentially, we can distinguish the unique percentages covered by various service providers at the sub-census-block level using a particular technology (e.g., 4G LTE), but we currently cannot determine how this interplays with other technologies (e.g., with 2G or 3G technologies).

497 In order to fully take advantage of the increase in precision offered by the actual-area coverage methodology, spatially accurate representations of population and road miles would be necessary. We do not have access to such information for the current *Report*, however.

498 U.S. Census Bureau, *TIGER/Line® Shapefiles*, https://www.census.gov/cgi-bin/geo/shapefiles/index.php (last visited July 28, 2022).

499 Roads were included in the count of road miles if the road was in one of the following U.S. Census categories: Primary Road (S1100), Secondary Road (S1200), Local Neighborhood Road, Rural Road, City Street (S1400), Vehicular Trail [4WD] (S1500), Service Drive usually along a limited access highway (S1640), and Private Road for service vehicles (S1740). Roads on top of the boundary of two census blocks had their length split evenly between the blocks.

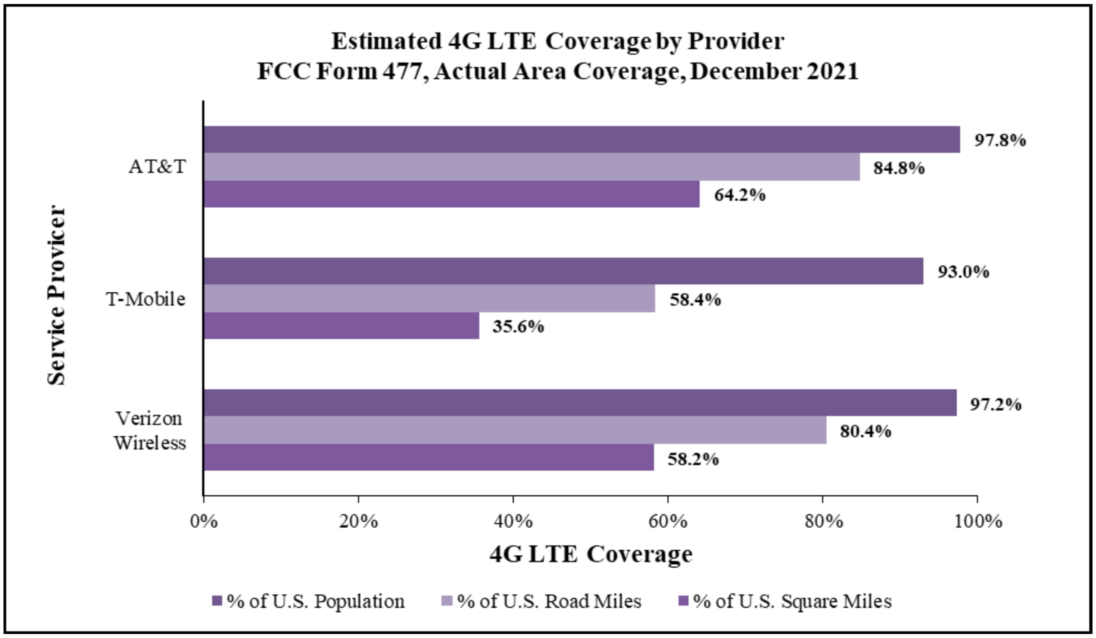
Fig. II.B.37



Source: Based on actual area coverage analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

148. Figure II.B.38 presents estimates of 4G LTE mobile broadband coverage by individual mobile broadband service provider. AT&T covered over 97% of the population, over 84% of the road miles, and over 64% of the land area with 4G LTE. Verizon Wireless both covered over 97% of the population, over 80% of the road miles, and over 58% of the land area with 4G LTE. T-Mobile covered approximately 93% of the U.S. population, 58% of the road miles, and 36% of the land area with 4G LTE.

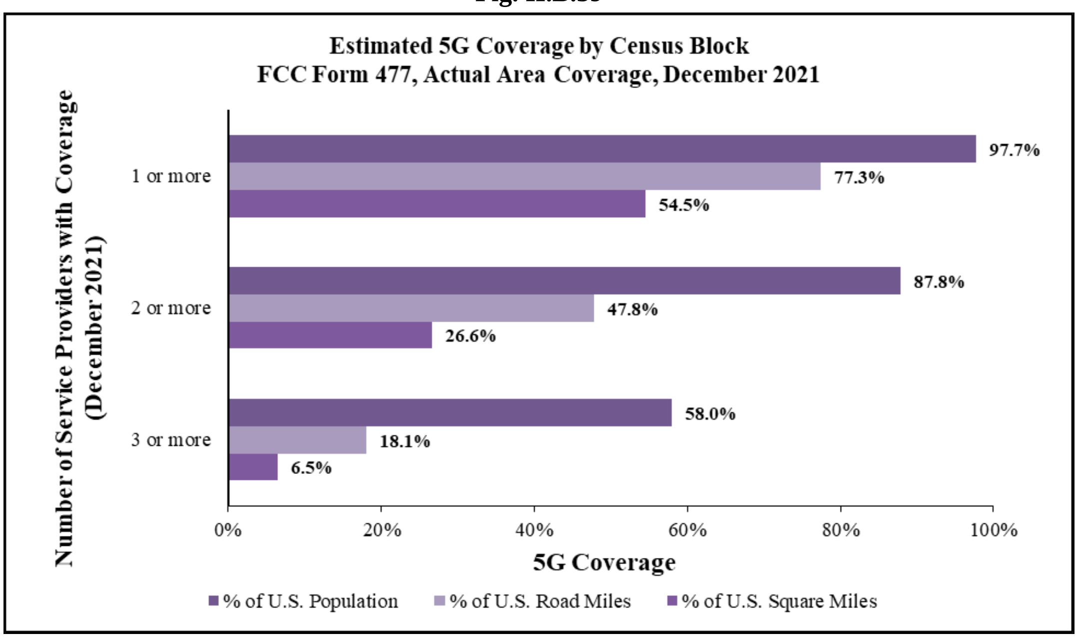
Fig. II.B.38



Source: Based on actual area coverage analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

149. *5G Coverage.* Figure II.B.39 presents 5G coverage by number of service providers. Approximately 98% of the population, 77% of road miles, and 55% of square miles were covered by at least one 5G service provider. In contrast, approximately 88% of the population, 48% of road miles, and 27% of square miles were covered by at least two providers of 5G. Finally, approximately 58% of the population, 18% of road miles, and 7% of square miles were covered by at least three 5G providers.

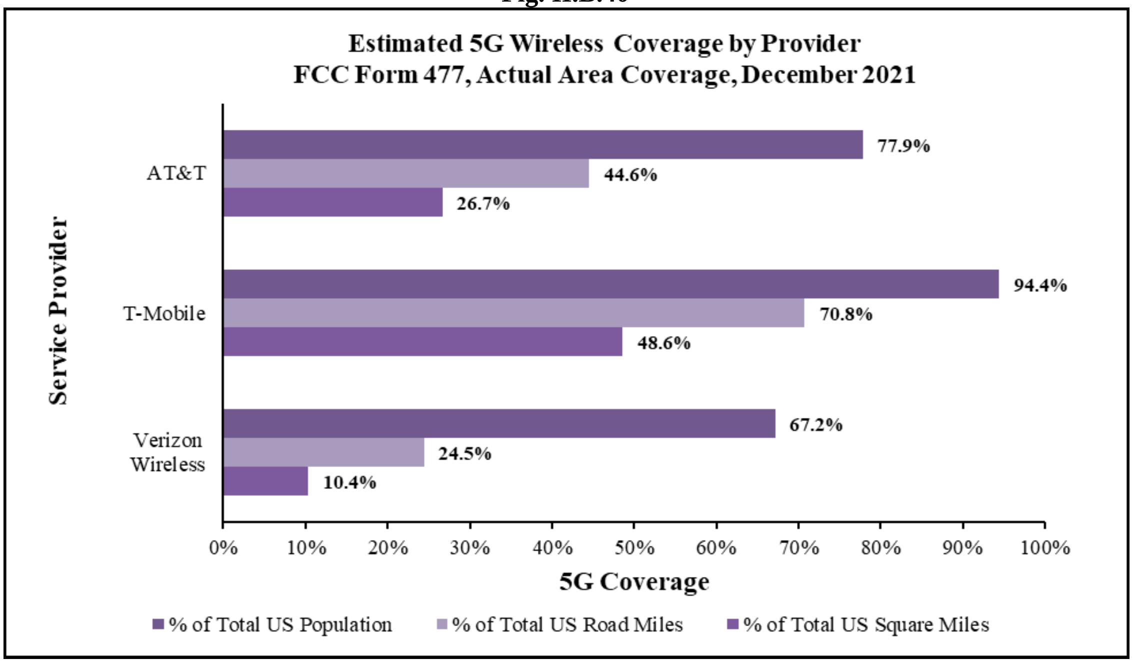
Fig. II.B.39



Source: Based on actual area coverage analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

150. Figure II.B.40 reports 5G coverage by the three nationwide providers. T-Mobile had the most 5G coverage among the three; in fact, T-Mobile's 5G coverage exceeds its LTE coverage. T-Mobile's 5G network covered approximately 94% of the population, 71% of road miles, and 49% of square miles. AT&T's 5G network covered approximately 78% of the population, 45% of road miles, and 27% of square miles. Finally, Verizon Wireless's 5G network covered approximately 67% of the population, 25% of road miles, and 10% of square miles.

Fig. II.B.40



Source: Based on actual area coverage analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

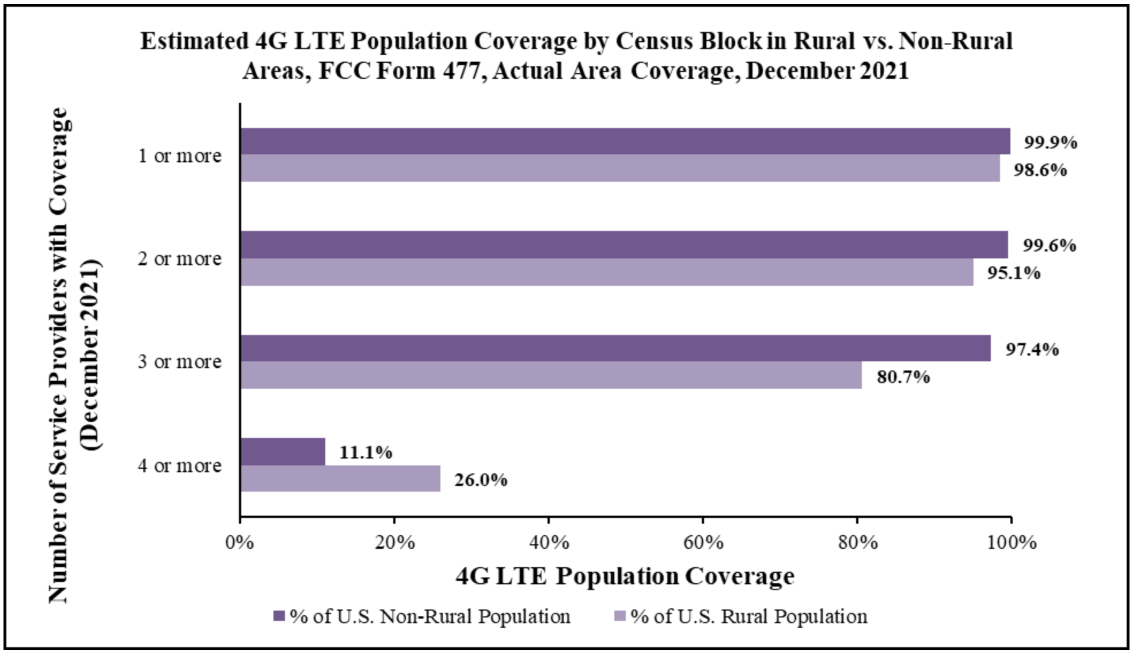
151. *Rural/Non-Rural Comparisons.* Since 2004, the Commission has used a "baseline" definition of a rural county as one with a population density of 100 people per square mile or less.[500] We use this same definition to analyze coverage in rural versus non-rural areas for our mobile broadband coverage analysis. To determine whether counties are rural or non-rural, we first excluded all water-only census blocks within each county. We then divided the county population by the total geographic area of the county to determine the population density. For those counties with a population density of 100 people per square mile or less, all census blocks within those counties were considered rural. Under this definition and using 2020 U.S. Census population data, approximately 59 million people, or approximately 18% of the U.S. population, live in rural counties. These counties comprise approximately 3 million square miles, or approximately 84%, of the geographic area of the United States. We count a census block as rural if it is in a rural county and as non-rural if it is in a non-rural county.

152. Figure II.B.41 presents 4G LTE population coverage in rural and non-rural census blocks by number of service providers. Our estimates show that approximately 97% of the non-rural population was covered by at least three 4G LTE service providers, while approximately 81% of the rural population was covered by at least three 4G LTE service providers. By comparison, approximately 11% of the non-rural American population had 4G LTE coverage from four or more service providers, while approximately 26% of the rural population was covered by at least four 4G LTE service providers. The

[500] *See Facilitating the Provision of Spectrum-Based Services to Rural Areas and Promoting Opportunities for Rural Telephone Companies To Provide Spectrum-Based Services*, WT Docket No. 02-381, Report and Order and Further Notice of Proposed Rule Making, 19 FCC Rcd 19078, 19086-88, paras. 10-12 (2004).

fact that rural areas were more likely to have four providers of 4G LTE than non-rural areas reflects the greater presence of regional service providers (i.e., not AT&T, T-Mobile, or Verizon Wireless) in rural areas.

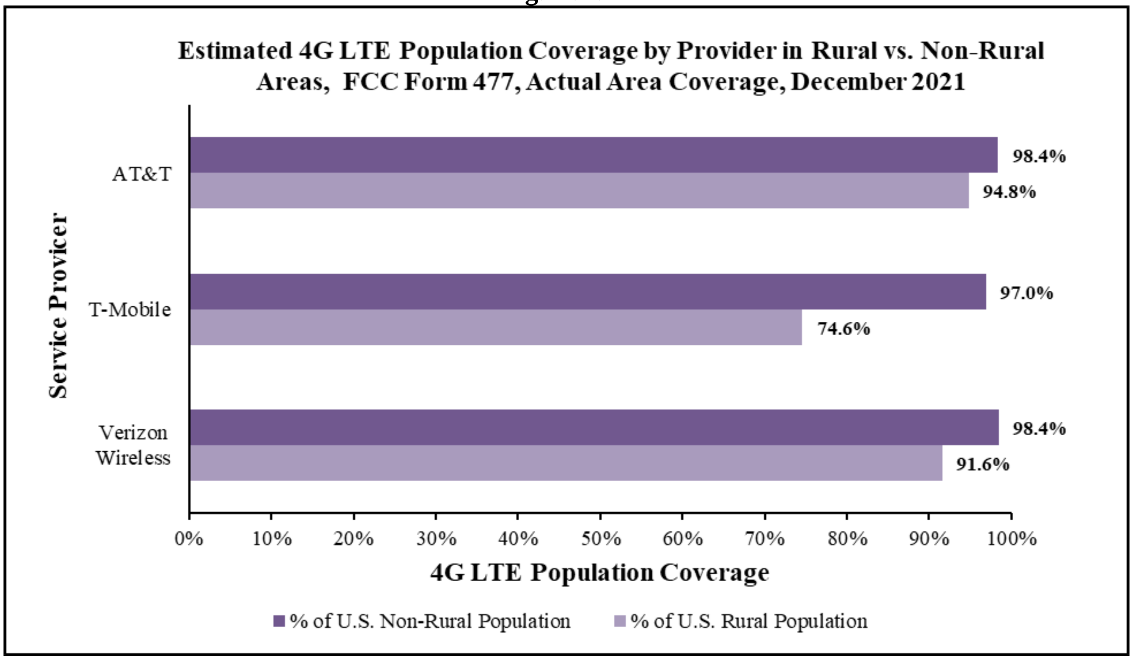
Fig. II.B.41



Source: Based on actual area coverage analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

153. Figure II.B.42 presents 4G LTE coverage by individual service provider of both the rural and non-rural U.S. population. Our estimates show that each of the three nationwide service providers covered at least 97% of the non-rural population with 4G LTE. Regarding 4G LTE coverage in rural areas, AT&T covered approximately 95%, Verizon Wireless covered approximately 92%, and T-Mobile covered approximately 75%.

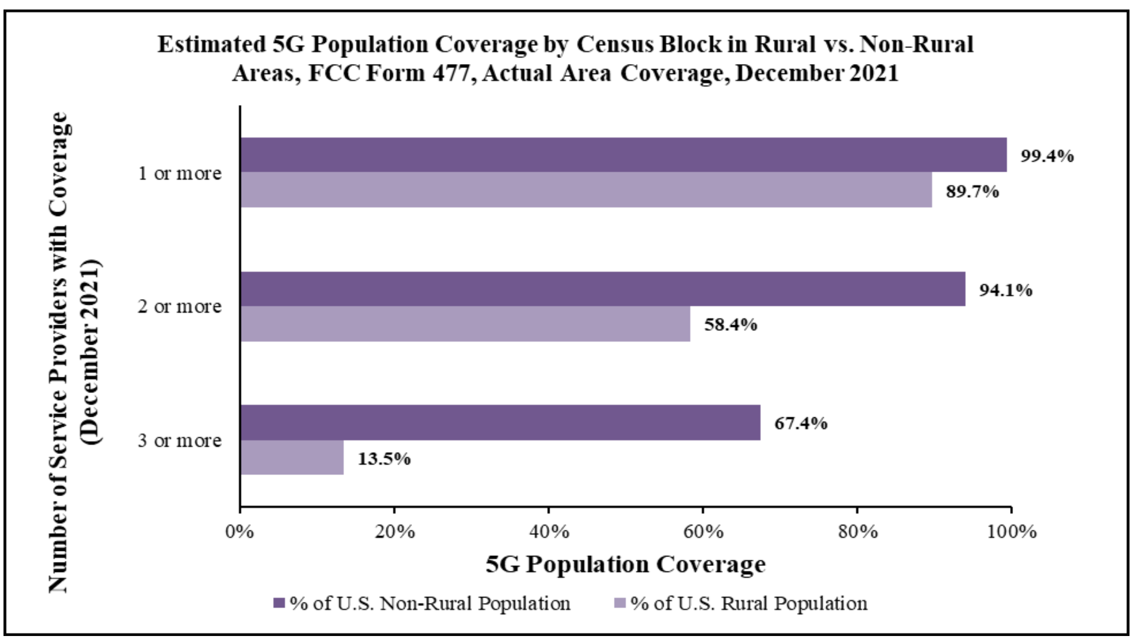
Fig. II.B.42



Source: Based on actual area coverage analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

154. Figure II.B.43 reports 5G population coverage in rural and non-rural areas. At least one 5G services providers covered almost 100% the non-rural population and approximately 90% of the rural population. At least two 5G service providers covered approximately 94% of the non-rural population and 58% of the rural population. At least three 5G service providers covered approximately 67% of the non-rural population and 14% of the rural population.

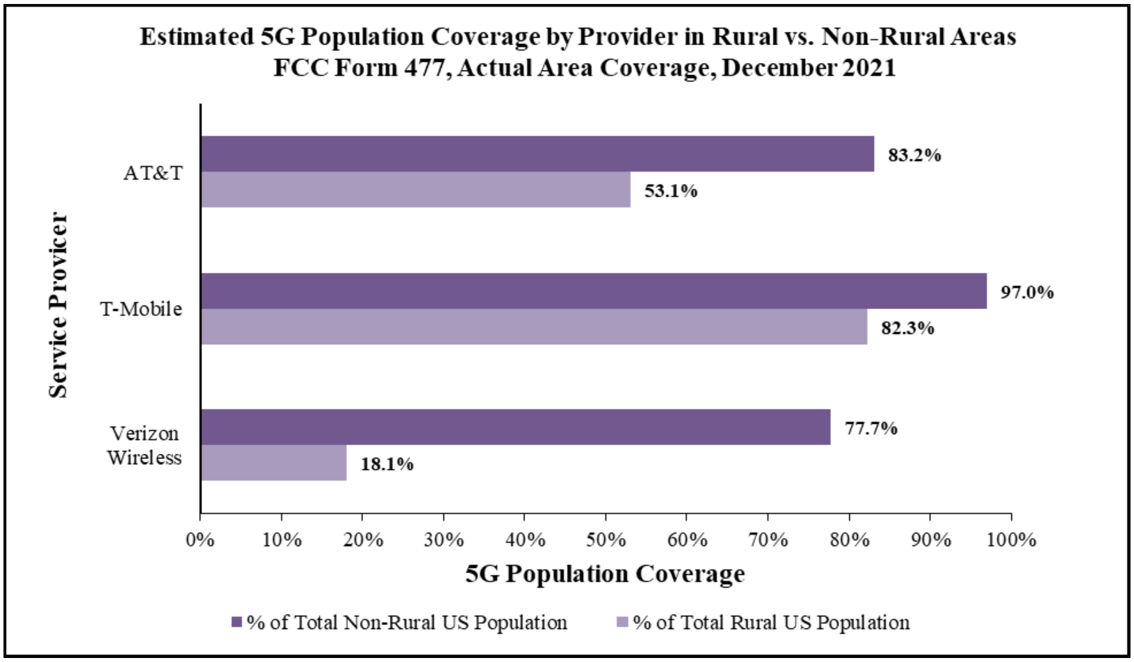
Fig. II.B.43



Source: Based on actual area coverage analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

155. Figure II.B.44 presents 5G rural and non-rural coverage by service providers. T-Mobile covered approximately 82% of the rural population and approximately 97% of the non-rural population with 5G. AT&T covered approximately 53% of the rural and approximately 83% of the non-rural population with 5G. Finally, Verizon Wireless covered approximately 18% of the rural and approximately 78% of the non-rural population with 5G.

Fig. II.B.44



Source: Based on actual area coverage analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

7. Relationship between Fixed and Mobile Broadband Service

156. In this section, we provide an assessment of the relationship between fixed and mobile broadband services. We first describe the distribution of fixed and mobile broadband subscriptions, including trends in how consumers access the Internet. We then describe differences in service attributes of fixed and mobile broadband, including plan characteristics, that could lead consumers to subscribe to both fixed and mobile broadband or only subscribe to one service. Finally, we discuss technological and strategic developments that likely affect or may affect competition between fixed and mobile broadband services.

157. Many households continue to subscribe to both fixed and mobile broadband service,[501] suggesting that these separate services offer benefits that are either complementary or independent of each other.[502] Technological innovation in and increased deployment of both the mobile wireless and fixed broadband services markets have broadened consumers' possible choices of how to access the Internet.

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[501] U.S. Census Bureau, American Community Survey, 2020 ACS 1-Year Public Use Microdata Sample with Experimental Weights, https://www.census.gov/programs-surveys/acs/data/experimental-data/2020-1-year-pums html (last visited June 16, 2022) (overlap between households subscribing to both fixed and mobile broadband service can be assessed using the "HISPEED" and "BROADBND" variables, as discussed below).

[502] *See Fourteenth Broadband Deployment Report*, 36 FCC Rcd at 841, para. 11 (stating that "fixed broadband and mobile wireless broadband services are not substitutes in all cases"). In its comments, INCOMPAS supports the idea that fixed and mobile broadband services are complementary, citing research from Pew Research and Leichtman Research Group. INCOMPAS comments at 9; Andrew Perrin, Pew Research, *Mobile Technology and*

(continued….)

158. *Distribution of fixed and mobile broadband subscribers.* Based on one-year 2020 estimates from the U.S. Census Bureau's American Community Survey (ACS),[503] 88.8% of households in the United States paid for at least one type of Internet service subscription.[504] Among households that pay for an Internet subscription, 91.7% paid for a cellular data plan for a smartphone or other mobile device, while 12.6% of all households with paid Internet subscriptions relied on a mobile data plan as their only means of access.[505] In comparison, 87.1% of households subscribed to residential fixed broadband Internet service in 2020, while 7.9% of households with paid Internet subscriptions relied on fixed broadband as their only means of access. As Figure II.B.45 shows, in a reversal of the trend, the mobile-only percentage has decreased somewhat from roughly 13.5% in 2017,[506] whereas the high speed fixed-only percentage has continued to decrease year over year from a peak of roughly 11.6% in 2017.[507] Correspondingly, the number of households subscribing to only one type of Internet access has continued to decline.[508]

(Continued from previous page)
Home Broadband 2021 (June 3, 2021), https://www.pewresearch.org/internet/2021/06/03/mobile-technology-and-home-broadband-2021/; Leichtman Research Group, Press Release, 87% of U.S. Households Get an Internet Service at Home (Dec. 28, 2021), https://www.leichtmanresearch.com/87-of-u-s-households-get-an-internet-service-at-home/; Leichtman Research Group, Press Release, About 2,950,000 Added Broadband From Top Providers In 2021 (Mar. 7, 2022), https://www.leichtmanresearch.com/wp-content/uploads/2022/03/LRG-Press-Release-3-7-2022.pdf.

[503] We note that the U.S. Census Bureau used "experimental weights" when constructing the 2020 one-year ACS estimates due to complications arising from the COVID-19 pandemic. Following their recommendation, we proceed with caution and recognize that the 2020 one-year estimates may not be as reliable as previous iterations of ACS data. *See* U.S. Census Bureau, *American Community Survey Experimental Data FAQ*, https://www.census.gov/programs-surveys/acs/data/experimental-data/faq.html (last visited June 16, 2022).

[504] The ACS asks participants who indicate that they gain access to the Internet at their "house, apartment, or mobile home" by "paying a cell phone company or Internet service provider" whether they, "or a member of [their] household have access to the Internet using" a "broadband (high speed) Internet service such as cable, fiber optic, or DSL service installed in [the] household," "cellular data plan for a smartphone or other mobile device," or other means, including satellite or dial-up Internet. *See* U.S. Census Bureau, American Community Survey, *Why We Ask Questions About Computer and Internet Use*, https://www.census.gov/acs/www/about/why-we-ask-each-question/computer/ (last visited June 16, 2022). Answers to this survey question do not necessarily correspond with the Commission's current definition of advanced telecommunications capability. We note that an additional three million households (2.4%) connected to the Internet without a paid subscription.

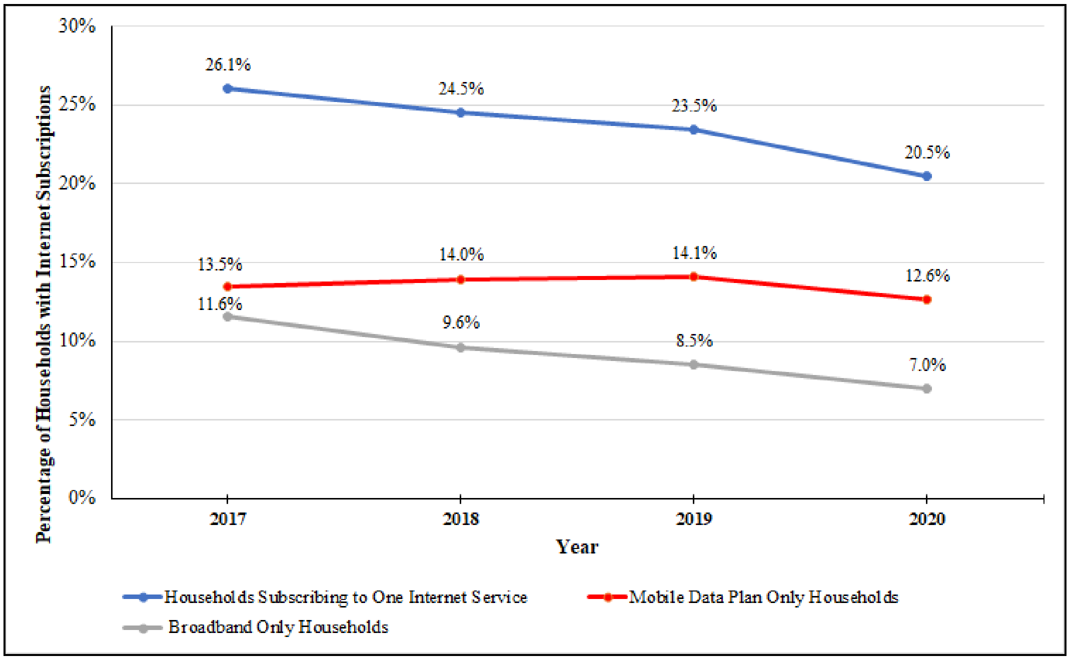
[505] Estimates based on the ACS 1-Year Estimates—Public Use Microdata Sample for year 2020. U.S. Census Bureau, American Community Survey, *2020 ACS 1-Year Public Use Microdata Sample with Experimental Weights*, https://www.census.gov/programs-surveys/acs/data/experimental-data/2020-1-year-pums.html (last visited June 16, 2022) (American Community Survey 2020 Microdata).

[506] We note that this shift in trend could be related to the COVID-19 pandemic when telecommuting and use of remote services became a more common practice, potentially causing additional households to subscribe to fixed services.

[507] American Community Survey 2020 Microdata.

[508] *Id*.

Fig. II.B.45
Percentage of Internet-Connected Households Subscribing to Only One Type of Service



Source: U.S. Census Bureau, American Community Survey, 2020 ACS 1-Year Estimates - Public Use Microdata Sample. Note: "Households Subscribing to One Internet Service" includes "Mobile Data Plan Only," "Fixed Broadband Only," as well as "Satellite Only," and "Other Only" subscriptions.

159. Figure II.B.46 compares the number of households with mobile broadband, fixed broadband, or any type of paid Internet subscription, to, respectively, households that pay for services other than mobile broadband, households that pay for services other than fixed broadband, or households that do not have Internet service. The figure indicates growth in subscribership across all three categories and helps to explain the overall decline in single subscription households.

Fig. II.B.46
Total Number and Percentage of Households Accessing the Internet by Technology[509]

		2017	2018	2019	2020
Cellular Data Plan for a Smartphone or Other Device	Yes	87,137,750	92,022,014	95,803,806	101,319,642
	No	13,594,218	11,747,750	10,589,173	9,121,266
		86.5%	88.7%	90.0%	91.7%
Broadband Internet Service Such as Cable, Fiber, or DSL	Yes	82,742,020	84,693,323	86,927,655	91,651,623
	No	17,989,948	19,076,441	19,465,324	18,789,266
		82.1%	81.6%	81.7%	83.0%
Paid Access to the Internet	Yes	100,731,968	103,769,764	106,392,979	110,440,908
	No	15,941,035	14,468,294	13,392,836	10,950,769
		86.3%	87.8%	88.8%	91.0%

Source: U.S. Census Bureau, American Community Survey, 2020 ACS 1-Year Estimates—Public Use Microdata Sample.

160. The decrease in mobile-only users is consistent with data from a 2021 Mobile Technology and Home Broadband report published by Pew Research.[510] Pew Research reported that 23% of adults surveyed indicated that they did not subscribe to home fixed broadband,[511] down from 27% in 2019.[512] Of the 23% of survey participants who did not subscribe to home broadband in 2021, 15% were smartphone-only Internet users, while the remaining 8% of all individuals who did not use the Internet.[513] In a similar trend to the ACS data, the 15% of Americans designated as smartphone-only Internet users in 2021 represents a decline compared to 2019.[514] Despite the decrease in smartphone-only users between reports, the share of smartphone only users is still significantly higher than the 8% of smartphone-only users when Pew was originally tracking such users in 2013.[515] As Figure II.B.47 shows, the percentage of

[509] The first two categories, "Internet Subscribing Households with Mobile Data" and "Internet Subscribing Households with Fixed Broadband" consists of households that paid for an Internet service. The third category, "Paid Internet Subscription Using Any Technology," consists of either households who paid for one or more Internet subscriptions ("Yes") or those who did not have Internet access ("No").

[510] Pew released reports in 2019 and 2021, but did not release a Mobile Technology and Home Broadband report in 2020. The 2019 report uses survey data collected between January 8, 2019 and February 7, 2019, while the 2021 report uses data collected between January 25, 2021 and February 8, 2021. Monica Anderson, Pew Research, *Mobile Technology and Home Broadband 2019* at 3 (2019), https://www.pewresearch.org/internet/wp-content/uploads/sites/9/2019/06/PI_2019.06.13_Mobile-Technology-and-Home-Broadband_FINAL2.pdf; Andrew Perrin, Pew Research, *Mobile Technology and Home Broadband 2021* (2021), https://www.pewresearch.org/internet/wp-content/uploads/sites/9/2021/06/PI_2021.06.03_Mobile-Broadband_FINAL.pdf.

[511] Andrew Perrin, Pew Research, *Mobile Technology and Home Broadband 2021* at 8 (2021), https://www.pewresearch.org/internet/wp-content/uploads/sites/9/2021/06/PI_2021.06.03_Mobile-Broadband_FINAL.pdf (*Mobile Technology and Home Broadband 2021*).

[512] Monica Anderson, Pew Research, *Mobile Technology and Home Broadband 2019* at 3 (2019), https://www.pewresearch.org/internet/wp-content/uploads/sites/9/2019/06/PI_2019.06.13_Mobile-Technology-and-Home-Broadband_FINAL2.pdf (*Mobile Technology and Home Broadband 2019*).

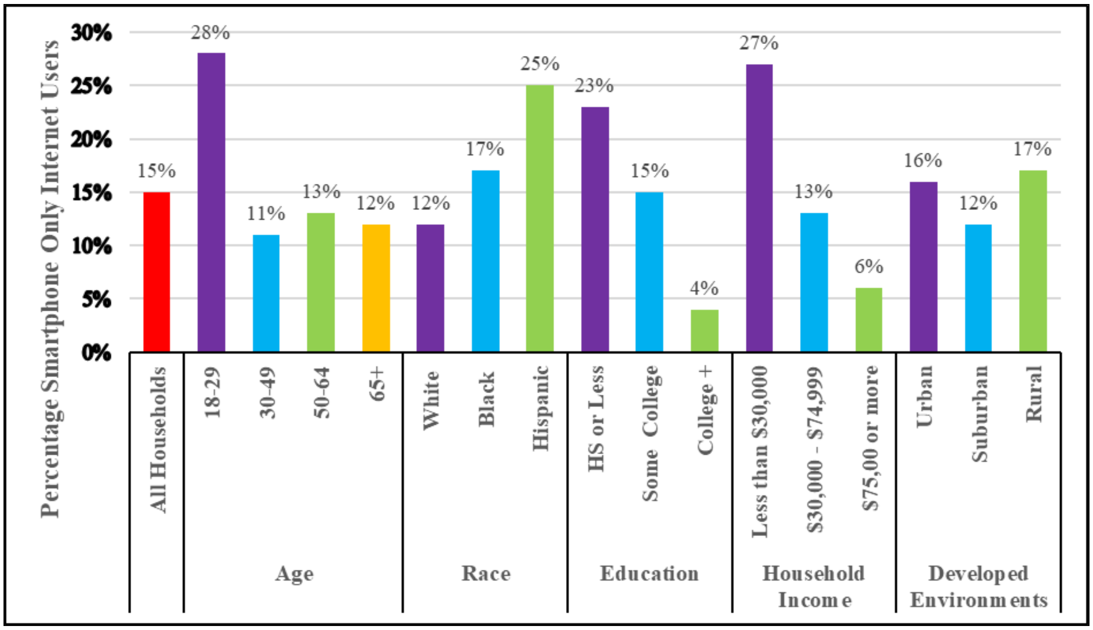
[513] *Mobile Technology and Home Broadband 2021* at 4.

[514] *Mobile Technology and Home Broadband 2019* at 5.

[515] Pew Research Center, *Mobile Fact Sheet* (Apr. 7, 2021), https://www.pewresearch.org/internet/fact-sheet/mobile/ (showing smartphone dependency over time).

smartphone-only Internet users is higher among groups with lower levels of broadband adoption, including survey participants who were younger, black or Hispanic, or in lower income brackets.[516]

Fig. II.B.47
Smartphone-Only Internet Users by Demographic, Income, and Geographic Group



Source: Pew Research Center, Mobile Technology and Home Broadband 2021, replicated from figure entitled "15% of Americans are smartphone dependent."

161. *Service Attributes of Fixed and Mobile Broadband.* A majority of Internet users subscribe to both fixed and mobile service. For instance, approximately 82.5% of mobile service subscribing households also subscribe to fixed broadband at home.[517] The decision of households to subscribe to both services may be driven by differences in quality and other plan characteristics.

162. In its comments, INCOMPAS emphasized that fixed broadband (particularly fiber) delivers faster speeds and the ability to consume content without data caps, whereas mobile broadband offers the convenience of Internet access outside the home.[518] For example, in mid-2022, many mobile wireless "unlimited" plans stipulated that, during times where a cell is experiencing network congestion, those subscribers' traffic would be de-prioritized at that cell if they consumed beyond a limit that was typically set around 50 GB per month.[519] By comparison, many major fixed broadband providers either do not have a data cap or cap access at or close to 1 TB, typically charging $10 for additional 50 GB

[516] *Mobile Technology and Home Broadband 2021* at 5.

[517] U.S. Census Bureau, American Community Survey, https://www.census.gov/programs-surveys/acs/data/experimental-data/2020-1-year-pums.html (last visited June 16, 2022).

[518] INCOMPAS Comments at 8-9.

[519] Eli Blumenthal, CNET, *The Best Unlimited Data Plans for 2022 (June 2022)* (June 16, 2022), https://www.cnet.com/tech/mobile/best-unlimited-data-plans/. *See, e.g.*, T-Mobile, *Why Did I Receive an SMS about using 50GB of Data?*, https://www.t-mobile.com/offers/mydatausage (providing deprioritization practice at a congested tower under the "What happens if I do access a congested tower after I've used 50GB of data?" tab) (last visited Sept. 29, 2022); Verizon, *Unlimited*, https://www.verizon.com/plans/unlimited/ (last visited Sept. 29, 2022); AT&T, *Unlimited Data Plans*, https://www.att.com/plans/unlimited-data-plans/ (last visited Sept. 29, 2022).

increments.[520] To put this comparison into perspective, an ultra-high definition program is estimated to consume between 7 GB and 10 GB per hour, so that as few as five hours of ultra-high definition content could lead to mobile consumers' data being de-prioritized for the remainder of the month, whereas 100 hours of viewing of ultra-high definition content would be required to reach the typical fixed broadband data cap.[521]

163. Among mobile wireless service providers, prices for unlimited plans were typically set at $45 or more for the first line among nationwide facilities-based post-paid mobile wireless providers and $30 or more among nationwide facilities-based pre-paid providers, with a lower per-line cost for additional lines.[522] By comparison, prices among terrestrial fixed wireless providers were more localized and varied with the advertised speed. Whereas terrestrial fixed wireless prices typically apply to all devices at the connected premise (either through a physical connection or via Wi- Fi), mobile hotspots that allow access to devices other than those added to the mobile wireless subscription typically cost more, require a higher priced (premium) plan, or are limited in speed (e.g., to 3G) or data allowance.[523]

164. Speed tests also demonstrate that fixed broadband speeds are typically faster than mobile broadband speeds. In section II.B.5.d, we find that speed tests showed nationwide mean and median 4G LTE download speeds of, respectively, 43.4 Mbps and 30.4 Mbps in the first half of 2022. While such speeds are comparable to fixed broadband speeds in parts of the United States, they are well below advertised speeds available in many locations.[524] However, speed tests conducted on 5G networks were significantly faster than 4G LTE tests conducted during the same time period. In the first half of 2022, mean and median 5G download speeds for the three nationwide providers ranged from 96.5 to 230.5 Mbps and 70.3 to 189.7 Mbps, respectively.[525] The Free State Foundation states that mean mobile broadband speeds in 2022 are comparable to mean fixed speeds in 2020.[526] INCOMPAS asserts that higher speeds, larger data allowances, and less frequent or the lack of throttling may lead subscribers to use Wi-Fi connected fixed broadband networks when available.[527]

165. *Technological and Strategic Developments*. Technological advancements and entry from non-traditional providers of mobile broadband and fixed broadband could alter the relationship between fixed and mobile broadband services. Two such developments are the transition to 5G technologies and entry by cable companies into the mobile broadband market.

166. The Commission has previously found that mobile wireless providers continue to improve their networks, notably through the deployment of 5G technologies, which may have

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[520] Kevin Parrish and Peter Holslin, High Speed Internet, *Which Internet Service Providers Have Data Caps?*, https://www.highspeedinternet.com/resources/which-internet-service-providers-have-data-caps.

[521] Netflix, Help Center, *How to control how much data Netflix uses*, https://help.netflix.com/en/node/87 (last visited Oct. 24, 2022); James K. Willcox, *How Easy Is It to Burn Through a 1TB Data Cap?* (Oct. 19, 2016), https://www.consumerreports.org/telecom-services/how-easy-to-burn-through-1TB-data-cap/.

[522] Eli Blumenthal, CNET, *The Best Unlimited Data Plans for 2022 (June 2022)* (June 16, 2022), https://www.cnet.com/tech/mobile/best-unlimited-data-plans/.

[523] AT&T, *Unlimited Data Plans*, https://www.att.com/plans/unlimited-data-plans/ (last visited Sept. 29, 2022); T-Mobile, *Plan Details*, https://www.t-mobile.com/plan-details (last visited Sept. 29, 2022); Verizon, *Unlimited*, https://www.verizon.com/plans/unlimited/ (last visited Sept. 29, 2022).

[524] Tyler Cooper, Broadband Now, *The State of Broadband in America, Q3 2021* (Nov. 8, 2021), https://broadbandnow.com/research/q3-broadband-report-2021.

[525] *See supra* Fig. II.B.28.

[526] FSF Comments at 13.

[527] INCOMPAS Comments at 9.

performance characteristics similar to fixed services in certain environments.[528] As 5G networks become more widely available and consumers further transition to 5G-capable devices, mobile connections are expected to become faster and more reliable.[529] Existing mobile broadband service providers are continuing to deploy 5G networks throughout the United States.[530] In some instances, traditional mobile wireless providers have leveraged their networks and begun offering expanded fixed wireless services.[531] Moreover, the Commission has taken a number of actions to spur the development and deployment of 5G networks.[532]

167. In addition, as FSF notes, major cable providers, which had not previously provided mobile broadband, have begun offering mobile services using hybrid-MVNO strategies.[533] While such providers hold a relatively small market share, some have seen their subscribership increase. For instance, Comcast has increased the number of its wireless broadband subscribers from 2.1 million at the end of 2019 to 4.0 million by the end of 2021, and Charter has increased its mobile subscribership from 1.1 million in 2019 to 3.6 million in 2021.[534] By bundling their mobile broadband services with their fixed broadband and other offerings, non-traditional competitors can provide their customers with plan options that traditional facilities-based mobile wireless providers do not offer to many of their customers. At the same time, because certain cable MVNOs have only offered mobile broadband to existing residential broadband subscribers to date, their effect on nationwide mobile broadband is limited.

C. Voice Telephone Services

168. Although the public switched telephone network used to be the only means to connect, there now exist many other voice service options for consumers in the United States.

169. *Fixed Voice*. There are two fixed technologies through which retail voice subscriptions are provided: traditional switched access and interconnected VoIP subscriptions. Interconnected voice services are divided between fixed and mobile voice services. Fixed is further divided into traditional switched access connections and interconnected Voice over Internet Protocol (VoIP). VoIP is voice carried simply as data over an Internet Protocol network and can be a voice service that is bundled with the underlying broadband connection or offered independent of the necessary data service (over-the-top, or OTT).

170. Our most recent FCC Form 477 data show that there are 29 million end-user switched access lines, including 11.9 million residential lines. In addition, there are 68 million interconnected

[528] *Fourteenth Broadband Deployment Report*, 36 FCC Rcd at 841, para. 11 (stating "[W]e are optimistic that increased deployment of 5G may allow mobile services to serve as an alternative to fixed services.").

[529] *See, e.g.*, GSMA—Global System for Mobile Communications Association, *Understanding 5G: A Guide for local communities* at 3 (Sept. 2021), https://www.gsma.com/publicpolicy/resources/understanding-5g-a-guide-for-local-communities.

[530] Tim Fisher, Lifewire, *Where Is 5G Available in the US? (Updated for 2022)*, https://www.lifewire.com/5g-availability-us-4155914 (last visited June 16, 2022).

[531] For example, in April 2022, T-Mobile reported that they served one million fixed wireless customers and that more than 40 million households were eligible for the service. T-Mobile, *T-Mobile Smokes the Competition, Reaching 1 Million Fixed Wireless Customers Just a Year After Commercial Launch* (Apr. 20, 2022), https://www.t-mobile.com/news/network/t-mobile-reaches-1-million-fixed-wireless-customers.

[532] *See infra* section VI.B.

[533] FSF Comments at 8.

[534] *See* Comcast, SEC Form 10K at 4 (filed Jan. 30, 2020), https://www.cmcsa.com/node/34166/html (for 2.1 million figure); Comcast, SEC Form 10K at 3 (filed Feb. 2, 2022), https://www.cmcsa.com/node/38386/html (for 4.0 million figure); Charter, SEC Form 10K at 3 (filed Jan. 31, 2020), https://ir.charter.com/static-files/b3b4f462-9b3d-4119-81a6-f395e108c5fe (for 1.1 million figure); Charter, SEC Form 10K at 4 (filed Jan. 28, 2020) https://ir.charter.com/static-files/63606f63-1b11-4d60-91a0-5395f1552592 (for 3.6 million figure).

VoIP subscriptions, including 31 million residential subscriptions.[535] Of these combined 97.6 million fixed retail voice telephone service subscriptions, 44% were residential connections, and 56% were business connections.[536] The relative growth trends show that fixed switched access continues to decline while interconnected VoIP services continue to increase. The number of fixed retail switched-access lines declined over the past three years at a compound annual rate of 12.3%, while interconnected VoIP subscriptions increased at a compound annual growth rate of 0.7%.[537] The number of fixed switched access providers also decreased, with 931 providers reporting fixed end-user switched access lines in December 2021, down from 952 in December 2020.[538] There were 1,787 providers of interconnected VoIP subscriptions in December 2021, up from 1,671 a year earlier.[539] As of December 2021, residential fixed voice connections were about 28% switched access and 72% interconnected VoIP, with residential switched access connections comprising only 12.2% of all fixed retail voice connections.[540]

171. *Over-the-Top* (OTT). Fixed VoIP carriers distinguish OTT VoIP, where the consumer uses an independent data service over a broadband connection, from all other types of interconnected VoIP.[541] The FCC Form 477 data show 17.9 million OTT VoIP subscriptions and far more non-OTT VoIP, numbering 50.4 million subscriptions.[542] Mobile VoIP presents a more complicated picture, given the plethora of communications apps in smartphone app ecosystems. Information on how customers use these apps for voice communication are not reported on FCC Form 477, as many of them do not permit users to make or receive calls connecting to numbers on the public switched telephone network, and therefore are not classified as interconnected VoIP.[543] The dynamic nature of this subsector makes it difficult to quantify the number of users.

172. *Mobile Voice*. FCC Form 477 data indicate that there were over 362 million mobile subscriptions in the United States, representing an increase in mobile voice subscriptions at a compound annual growth rate of 1.3% over the previous three years.[544] The number of households that eschew fixed subscriptions altogether in favor of relying solely on mobile voice services has been increasing. Approximately 68.7% of adults lived in a wireless-only household in late 2021, with adults in lower age-groups more likely to live in wireless-only households.[545] In the 25-29 age group, over 87% of adults lived in wireless-only households; 86.4% of those aged 30-34 lived in wireless-only households; 79.6% of those aged 35-44 lived in wireless-only households; 66.2% of those aged 45-64 lived in wireless-only

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[535] The totals and percentages that are reported in this section are preliminary only, are subject to corrections as appropriate by the service provider, and the final data will be published in due course by the agency. *See, e.g.*, *June 30, 2021 Voice Telephone Services Report*.

[536] Preliminary Dec. 2021 FCC Form 477 Voice Subscriptions.

[537] *Id.* The compound annual growth rate is a smoothed rate of growth calculated in three steps: (1) divide the ending value by the beginning value; (2) raise the result of that division to a power equal to one divided by the number of years in the period (in this case, 3 years, so the power is 1/3); and (3) subtract 1 from Step (2).

[538] Preliminary Dec. 2021 FCC Form 477 Voice Subscriptions.

[539] *Id.*

[540] *Id.*

[541] *Id.*

[542] *Id.*

[543] 47 C.F.R. § 9.3. Examples of these services are apps such as Skype, Facebook Messenger, Facetime, and WhatsApp.

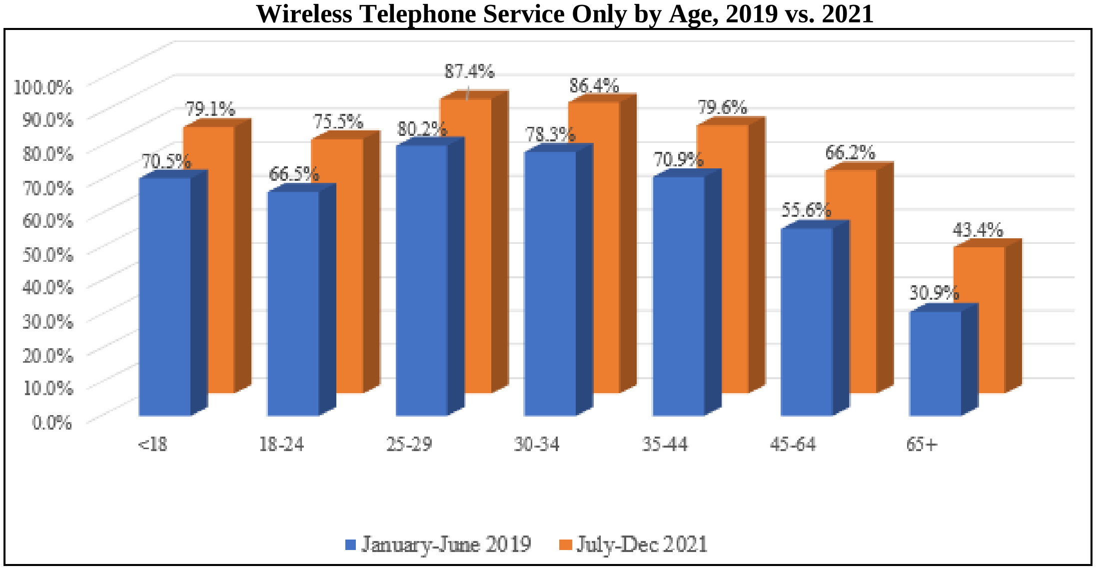
[544] Preliminary Dec. 2021 FCC Form 477 Voice Subscriptions.

[545] U.S. Department of Health and Human Services, National Center for Health Statistics, Wireless Substitution: Early Release of Estimates From the National Health Interview Survey, July-December 2021 (2022).

households; and 43.4% of those 65 and older lived in wireless-only households.[546] Approximately 0.6% of households had neither wireless nor fixed voice subscriptions, as of late 2021.[547]

173. Figure II.C.1 shows the percentage of Americans living in a household with only a wireless connection in early 2019 versus late 2021 by age category. More people continue to live in a wireless-only home across all age groups. The 65 and over age category has experienced the largest change over the last two years; previously only 30.9% of this group lived in a wireless-only home compared to 43.4% in the most recent data.[548]

Fig. II.C.1
Percentage of Individuals Living in Households with Wireless Telephone Service Only by Age, 2019 vs. 2021



Source: National Center for Health Statistics, National Health Interview Survey.

D. The Satellite Marketplace

1. Overview of Commercial Satellite Services

174. In the United States and globally, satellites provide telecommunications infrastructure for communications, including voice, video, audio, and data services, as well as other services.[549] Satellites require both spectrum and orbital slots, which are licensed and authorized by the Commission for services

[546] *Id*.

[547] *Id*.

[548] *Id*.

[549] Further discussions of basic features of satellites, satellite orbits, and satellite communications systems can be found in NASA, *Basics of Space Flight: Section 1: Environment, Chapter 5: Planetary Orbits*, https://solarsystem nasa.gov/basics/chapter5-1/ (last visited Oct. 20, 2022); European Space Agency, *Types of Orbits*, https://www.esa.int/Enabling_Support/Space_Transportation/Types_of_orbits (last visited Oct. 20, 2022); Space Foundation, The Space Briefing Book (2019), https://www.spacefoundation.org/wp-content/uploads/2019/10/SpaceFoundation_Space101.pdf; Louis J. Ippolito Jr., Satellite Communications Systems Engineering: Atmospheric Effects, Satellite Link Design and System Performance (2nd ed. 2017) (Ippolito, 2017); Howard Hausman, Fundamentals of Satellite Communications, Part 1 (2008), https://www.ieee.li/pdf/viewgraphs/fundamentals_satellite_communication_part-1.pdf (Hausman, 2008); GAO, TELECOMMUNICATIONS: Competition, Capacity, and Costs in the Fixed Satellite Services Industry (2011), https://www.gao.gov/products/GAO-11-777.

over the United States, and the authorization of which must be coordinated internationally with the ITU. Both satellites serving the United States, and the earth stations in the United States that access them, are regulated by the Commission. This ensures that spectrum and orbital slots are safely and efficiently put to use, and eliminates or reduces the potential harm caused by spectrum interference and orbital debris.

175. Satellites differ significantly in their delivery of communications services, when compared to terrestrial alternatives. Satellite services compete to a certain extent in larger terrestrial communications markets, aided by the advantages of their geographically widespread (nearly ubiquitous) service, low cost of adding customers (especially for one-way service in video and audio distribution), and ability to provide disaster and redundant services when terrestrial networks are unavailable. In addition, there are a number of smaller niche markets, such as maritime, aviation, and remote markets, which are served primarily by satellites.[550] Satellites also conduct Earth observations, including imaging, and scientific experiments, among other things. Developments in In-space Servicing, Assembly, and Manufacturing (ISAM) could also spur the introduction of new kinds of services and activities in space.[551]

176. Communication satellites function as relay stations in space that receive signals from an earth station and then re-transmit the signal to a distant point, often located thousands of miles from the point of signal origination.[552] Satellites operate in either a geostationary satellite orbit (GSO), also referred to as a geostationary Earth orbit (GEO) or in a non-geostationary satellite orbit (NGSO).[553] NGSO satellites operate at varying altitudes,[554] while GSO satellites operate on an equatorial plane with zero inclination at approximately 22,300 miles above the Earth, and rotate around the Earth at the same speed that the Earth rotates.[555] As a result, a satellite in geostationary orbit appears as a stationary point in the sky relative to a receiving and transmitting earth station. Because they effectively hover above a fixed location from a high altitude, GSO satellites cover a large fixed area of the Earth, with three satellites able to provide communications for most of the Earth.[556] NGSO satellites include a number of orbital

[550] This includes such services as voice, broadband connectivity, and entertainment programming for planes and ships and remote areas; tracking services and IoT access for equipment globally; connectivity for fishing, including real-time catch data; and IoT applications like artificial lift monitoring for offshore and energy drilling.

[551] *See Space Innovation, Facilitating Capabilities for In-space Servicing, Assembly, and Manufacturing*, IB Docket 22-271 and 22-272, Notice of Inquiry, FCC 22-66, at 4-9 (Aug. 8, 2022) (*Space Innovation Notice of Inquiry*).

[552] An earth station (also known as a ground station or earth terminal) is a station located either on the Earth's surface or within the major portion of the Earth's atmosphere and intended for communication: (1) with one or more space stations; or (2) with one or more stations of the same kind by means of one or more reflecting satellites or other objects in space. 47 CFR § 25.103 (*Earth station*). The Commission's definition is identical to the definition established by the International Telecommunication Union (ITU). ITU, Radio Regulations—Articles at 13 (Article 1, 1.63) (ed. 2016), http://search.itu.int/history/HistoryDigitalCollectionDocLibrary/1.43.48.en.101.pdf (ITU Radio Regulations).

[553] The term "geosynchronous orbits" is sometimes used interchangeably with "geostationary orbits, " but more technically, it describes the broader category of orbits at altitude 22,300 miles that rotate the earth in 24 hours, but may not be in the equatorial plane (i.e., has an inclined orbit) and thus will not remain at a fixed point in the sky (such that the latitude changes over time but not the longitude). *Third Report and Analysis of Competitive Market Conditions with Respect to Domestic and International Satellite Communications Services; Report and Analysis of Competitive Market Conditions with Respect to Domestic and International Satellite Communications Services*, IB Docket Nos. 09-16, 10-99, Third Report, 26 FCC Rcd 17284, 17288, para. 8 & n.9 (2011) (*Third Satellite Competition Report*).

[554] There are approximately 565 GSO satellites and 4,900 NGSO satellites in space globally as of May 1, 2022, according to one database. Union of Concerned Scientists, *UCS Satellite Database* (updated May 1, 2022), https://www.ucsusa.org/resources/satellite-database.

[555] Hausman (2008) at 17.

[556] However, latitudes above 77° cannot get reception from GSO satellites. Hausman (2008) at 14.

configurations, such as highly-elliptical orbits (HEO), medium-earth orbits (MEO), and low-earth orbits (LEO).[557]

177. Satellites in geostationary orbit generally are high capacity and bandwidth and typically also have large coverage area. However, they can be disadvantaged by their high latency (i.e., response time)[558] and sometimes the need for larger ground antennas with more power. Compared to NGSO satellites, individual GSO satellites are typically much larger and more expensive to build, and more costly to launch into their high orbit.

178. Satellites in non-geostationary orbits, especially those in lower orbits, typically are lower capacity and bandwidth. Because of the limited coverage area for a single satellite, particularly for those operating in LEO, a large constellation of satellites is often needed to maintain continuous coverage, sometimes in the hundreds or thousands of satellites. However, in providing communications services, they typically offer the benefit of low latency service requiring smaller earth stations and handsets. Moreover, an NGSO constellation may provide more widespread coverage because GSO satellites do not reach higher latitudes. NGSO satellites are often much smaller and less expensive to build, and less costly to launch into lower orbits.[559] As mentioned above, however, NGSO systems often contemplate constellations of hundreds or thousands of satellites. In the past, NGSO satellites' rapid movement across the sky required the use of omnidirectional antennas, leading to low throughput, increased interference concerns relative to other satellites, and reduced spectrum availability. Some of the newest generation of NGSO satellite systems, however, allow for a more efficient use of spectrum with the use of earth station electronic directional antennas which can track them, potentially increasing throughput and more importantly effectively eliminating interference with other users of the same spectrum, thus allowing them to use and share FSS spectrum.[560]

179. To provide commercial communications satellite services to serve the United States requires, among other things: the manufacturing and launch of one or more satellites; ground stations and network operations center(s) providing backhaul and management service to the satellites; customer

[557] LEOs are defined by the National Aeronautics and Space Administration (NASA) as orbits with an altitude below 1,200 miles above the Earth. NASA, *Low-Earth Orbit Economy, LEO Economy FAQs*, https://www.nasa.gov/leo-economy/faqs (last visited Sept. 1, 2022). MEOs are generally defined as any orbit between LEOs and GSOs, although they typically range from 6,000 to 12,000 miles above the Earth. HEOs are highly elliptical orbits ranging from a very low point at perigee (as low as 100 miles above the Earth) to a very high point at apogee (as high or higher than GEOs, 23,000 miles above the Earth). Unlike GSOs, they can cover high latitudes and polar regions, with two satellites able to provide continuous coverage. Ippolito, 2017 at 25-27.

[558] Because it takes time for an electronic signal to travel from an earth station to the satellite and back to another earth station, users of high orbit satellites such as GSO satellites will experience a noticeable delay in receiving responses; i.e., about a quarter of a second for a trip up to a GSO satellite 22,300 miles above the earth and back. Hausman (2008) at 15. For some applications, such as audio and video conversations, or gaming and two-way data interactivity, high latency reduces the quality of service for consumers. The only alternative to shortening this time and reducing latency is to use satellites in lower Earth orbits, which yield latency comparable to a ground-based terrestrial network. Hausman (2008) at 15.

[559] Hausman (2008) at 23, 29; Ippolito (2017) at 26.

[560] Systems using FSS spectrum are required to use directional earth station transmission antennas to eliminate interference with other FSS users. Unlike Mobile Satellite Service (MSS) spectrum, with its use of omnidirectional antennas, which prevents others from using the same frequencies due to interference, FSS spectrum can be reused (i.e., shared) repeatedly through the use of directional antennas. *Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters*, IB Docket No. 16-408, Report and Order and Further Notice of Proposed Rulemaking, 32 FCC Rcd 7809, 7817, 7821-22, 7826, paras. 25-26, 39, 52 & n.118 (2017) (*NGSO FSS Order*); *Space Exploration Holdings, LLC, Application for Approval for Orbital Deployment and Operating Authority for the SpaceX NGSO Satellite System, et. al*., IBFS File No. SAT-LOA-20161115-00118, Call Sign S2983, et al., Memorandum Opinion, Order and Authorization, 33 FCC Rcd 3391, 3401-02, paras. 26-27 (2018) (*SpaceX Authorization*).

premise equipment or handsets; and customer antennas capable of communicating with the satellite(s).[561] Satellites typically require several years to build and launch, and most of their investment is upfront. NGSO satellites are often launched as part of a constellation, especially systems designed to provide near-global coverage, and/or continuous connectivity. A constellation can allow for one satellite to "hand off" the connection to another as it moves out of range.[562] GSO satellites typically can have a lifespan of 15-20 years or longer, while individual NGSO satellites typically have a shorter lifespan.[563] Satellite operators are required to have a plan to safely retire their satellites, to prevent the satellites from becoming a source of orbital debris.[564]

2. Spectrum for Satellite Services

180. The Commission allocates spectrum for two general types of satellite services—Fixed Satellite Service (FSS) and Mobile Satellite Service (MSS). The Commission also allocates spectrum for more specialized commercial and scientific services, including Direct Broadcast Satellite (DBS), Satellite Digital Audio Radio Service (SDARS), Earth Exploration Satellite Service (EESS), and other services. For purposes of this *Report*, we describe five major types of services provided by the commercial satellite services industry.

181. *FSS*. FSS is the transmitting and receiving of communications signals to earth stations, including customer stations, that traditionally are located at fixed points on earth. The Commission has allocated specific spectrum bands for FSS, including the C-, Ku-, and Ka-bands.[565] More recently, there

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[561] GAO, TELECOMMUNICATIONS: Competition, Capacity, and Costs in the Fixed Satellite Services Industry, passim (2011), https://www.gao.gov/products/GAO-11-777.

[562] Satellites in lower Earth orbits do not have fixed coverage areas because they are moving relative to the ground. Connectivity is maintained for a ground customer by connecting to the nearest satellite, and then as that satellite moves out of range, handing that connection off to another satellite coming into range. Because of their lower orbits and high speed, visibility of each satellite from a ground station can be limited to a short time, so larger constellations are needed to provide continuous connectivity. Hausman (2008) at 29.

[563] Debra Werner, SpaceNews, *How long should a satellite last: five years, ten years, 15, 30?* (Mar, 24, 2018), https://spacenews.com/how-long-should-a-satellite-last/.

[564] Orbital debris, also known as space debris, consists of artificial objects orbiting the Earth that are not functional spacecraft, and can be created under a variety of scenarios involving satellite systems. *Mitigation of Orbital Debris in the New Space Age*, IB Docket No. 18-313, Notice of Proposed Rulemaking, 33 FCC Rcd 11352,11353, para. 2 (2018) (*Orbital Debris NPRM*); *see also Mitigation of Orbital Debris in the New Space Age*, IB Docket No. 18-313, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 4156 (2020) (*Orbital Debris Report and Order and Further Notice*); *Mitigation of Orbital Debris in the New Space Age*, IB Docket No. 22-271 and IB Docket No. 18-313, Second Report and Order, FCC 22-74, at 2 (Sep. 30, 2022) (*Orbital Debris Second Report and Order*); NASA Astromaterials Research & Exploration Science, NASA Orbital Debris Program Office, *Frequently Asked Questions*, https://orbitaldebris.jsc.nasa.gov/faq/ (last visited Aug. 26, 2022); NASA, *What is Orbital Debris?*, https://www nasa.gov/audience/forstudents/5-8/features/nasa-knows/what-is-orbital-debris-58.html (last visited Aug. 26, 2022).

[565] 47 CFR § 25.103. The conventional C-band refers to the 3700-4200 MHz (space-to-Earth) and 5925-6425 MHz (Earth-to-space) FSS frequency bands, while the extended C-band refers to the 3600-3700 MHz (space-to-Earth), 5850-5925 MHz (Earth-to-space), and 6425–6725 MHz (Earth-to-space) FSS frequency bands. The conventional Ku-band refers to the 11.7-12.2 GHz (space-to-Earth) and 14.0-14.5 (Earth-to-space) FSS frequency bands, while the extended Ku-band refers to the 10.95-11.2 GHz (space-to-Earth), 11.45-11.7 GHz (space-to-Earth), and 13.75-14.0 GHz (Earth-to-space) FSS frequency bands. The conventional Ka-band refers to the 18.3-18.8 GHz (space-to-Earth), 19.7-20.2 GHz (space-to-Earth), 28.35-28.6 GHz (Earth-to-space), and 29.25-30.0 GHz (Earth-to-space) frequency bands, which the Commission has designated as primary for GSO FSS operation. 47 CFR § 25.103. Therefore, there is approximately 1475 MHz range of spectrum in the extended C-band, 1750 MHz in the extended Ku-band, and 2000 MHz in the Ka-band, for a total of 5225 MHz range of spectrum. We note that the Commission recently defined an extended Ka-band in the 17.3-18.3 GHz (space-to-Earth), 18.8-19.4 GHz (space-to-Earth), 19.6-19.7 GHz (space-to-Earth), 27.5-28.35 GHz (Earth-to-space) and 28.6-29.1 GHz (Earth-to-space) frequencies. *See*

(continued….)

also has been interest in use of the E-band and V-band frequencies.[566] Examples of FSS offerings include wholesale transponder services,[567] managed services (also known as enterprise services), and consumer broadband services.

182. Over the last twenty years, the Commission also has allowed the operation of Earth Stations in Motion (ESIMs) as an application of the FSS.[568] Earth Stations on Vessels, Vehicle-Mounted Earth Stations, and Earth Stations Aboard Aircraft—collectively designated as ESIMs—are mobile in nature, but nevertheless are permitted to operate in FSS spectrum because at any point in time, their emissions have the same characteristics as those of a fixed earth station transmitting from the same location, using a directional antenna focused on one satellite to avoid generating radio-frequency (RF) interference with other satellites and ground-based devices. Licensees increasingly use ESIMs to deliver broadband to ships, vehicles, trains, and aircraft using the same frequency bands, hardware, satellites, transponder beams, and gateways used to serve earth stations at fixed locations.[569]

183. In 2017, the Commission revised spectrum sharing requirements among NGSO FSS systems to permit NGSO systems with shared access to FSS spectrum, provided they used directional earth station antennas and avoided interference with existing GSO and NGSO systems using the FSS spectrum.[570] This has facilitated the deployment of competing NGSO FSS systems. On December 15,

(Continued from previous page)
Amendment of Parts 2 and 25 of the Commission's Rules to Enable GSO Fixed-Satellite Service (Space-to-Earth) Operations in the 17.3-17.8 GHz Band, to Modernize Certain Rules Applicable to 17/24 GHz BSS Space Stations, and to Establish Off-Axis Uplink Power Limits for Extended Ka-Band FSS Operations; Amendment of Parts 2 and 25 of the Commission's Rules to Enable NGSO Fixed-Satellite Service (Space-to-Earth) Operations in the 17.3-17.8 GHz Band, IB Docket Nos. 20-330 and 22-273, Report and Order and Notice of Proposed Rulemaking, FCC 22-63 (Aug. 3, 2022) (*17 GHz Report and Order*).

[566] The term "E-band" refers to frequencies in the 71.0-76.0 GHz and 81.0-86.0 GHz bands. The Commission has not yet adopted service rules for these frequencies. *See, e.g., Space Exploration Holdings, LLC,* Application for Orbital Deployment and Operating Authority for the SpaceX Gen2 NGSO Satellite System, IBFS File No. SAT-LOA-20200526-00055 (filed May 26, 2020). We use the term "V-band" to refer to frequencies ranging from 37.5 GHz to 52.4 GHz. We note that on August 4, 2021, the Satellite Division initiated a new processing round for additional applications and petitions for declaratory ruling concerning operations in the 37.5-40.0 GHz, 40.0-42.0 GHz, 47.2-50.2 GHz, and 50.4-51.4 GHz frequency bands by non-geostationary orbit fixed-satellite service (NGSO FSS) systems, pursuant to section 25.157 of the Commission's rules. *See Cut-Off Established for Additional NGSO-Like Satellite Systems in the 37.5-40.0 GHz, 40.0-42.0 GHz, 47.2-50.2 GHz, and 50.4-51.4 GHz Bands*, Report No. SPB-288, DA 21-941 (Aug. 4, 2021).

[567] A transponder is the part of a satellite that receives signals transmitted from earth stations to the antennas onboard a satellite and then retransmits these signals to the Earth. *See* Dennis Roddy, Satellite Communications 199 (4th ed. 2006). The number of transponders onboard any given satellite may vary, ranging approximately from 24 to 72. U.S. Government Accountability Office, Telecommunications: Competition, Capacity, and Costs in the Fixed Satellite Services Industry at 5 (Sept. 2011), https://www.gao.gov/assets/330/322861.pdf.

[568] *See Procedures to Govern the Use of Satellite Earth Stations on Board Vessels in the 5925-6425 MHz/3700-4200 MHz Bands and 14.0-14.5 GHz/11.7-12.2 GHz Bands*, IB Docket No. 02-10, Report and Order, 20 FCC Rcd 674 (2005); *see also Amendment of Parts 2 and 25 of the Commission's Rules to Allocate Spectrum and Adopt Service Rules and Procedures to Govern the Use of Vehicle-Mounted Earth Stations in Certain Frequency Bands Allocated to the Fixed-Satellite Service*, IB Docket No. 07-101, Report and Order, 24 FCC Rcd 10414 (2009).

[569] *Amendment of Parts 2 and 25 of the Commission's Rules to Facilitate the Use of Earth Stations in Motion Communicating with Geostationary Orbit Space Stations in Frequency Bands Allocated to the Fixed Satellite Service*, IB Docket No. 17-95, Report and Order and Further Notice of Proposed Rulemaking, 33 FCC Rcd 9327, 9328, para. 2 (2018) (*ESIMs Report and Order and Further Notice*).

[570] Shared access permits two or more satellite systems to use the same spectrum band as long as they avoid interference with each other. *NGSO FSS Order*, 32 FCC Rcd at 7821-22, 7826, at paras. 39, 52 & n.118; *see also SpaceX Authorization*, 33 FCC Rcd at 3401-02 at paras. 26-27 (. . . [W]e recently adopted changes to the

(continued….)

2021, the Commission proposed revisions to the spectrum sharing requirements among NGSO FSS systems to facilitate the deployment of NGSO FSS systems capable of providing broadband services with higher speeds and lower latency than previous satellite offerings.[571]

184. *MSS*.[572] MSS generally involves transmitting and receiving communications signals from mobile earth stations[573] located on land, on sea, or on airplanes.[574] MSS operates in a 70 megahertz range of spectrum allocated in the L-band, in a 40 megahertz range in the 2 GHz MSS band, in a 33 megahertz range in the Big LEO band, and in a four megahertz range in the Little LEO band.[575] Voice and data services are conducted in the L-band, Big LEO band, and 2 GHz bands, while the Little LEO band is limited to non-voice services.[576] Examples of MSS applications include voice, low-speed data, and tracking services for aircraft and ships, as well as handsets operating in remote locations on land.

185. *Earth Exploration Satellite Service (EESS)*. The EESS is a radiocommunication service in specified spectrum bands between earth stations and one or more space stations that collects information relating to the characteristics of the Earth from active or passive sensors on earth satellites and distributes that information to earth stations.[577] Many different frequency bands are allocated for the provision of EESS, including, for example, 1215-1300 MHz, 1400-1427 MHz, 2025-2110 MHz, 2200-2290 MHz, and 8025-8400 MHz. The frequency band allocations for EESS include frequency bands used for sensing purposes and for communicating with earth stations, including downlinking data. EESS satellites can be used for observations of the Earth, e.g., for observing disaster sites, crop growth, and local weather almost anywhere on Earth.

186. *Satellite Digital Audio Radio Service (SDARS)*. SDARS is a radiocommunication service in the 2.3 GHz band in which audio programming is digitally transmitted by one or more space stations

(Continued from previous page)
Commission's rules that will apply a spectrum sharing mechanism to all NGSO FSS systems that have sharing capabilities (e.g., directional earth station antennas), regardless of the frequency bands used.").

[571] *Revising Spectrum Sharing Rules for Non-Geostationary Orbit, Fixed-Satellite Service Systems; Revision of Section 25.261 of the Commission's Rules to Increase Certainty in Spectrum Sharing Obligations Among Non-Geostationary Orbit Fixed-Satellite Service Systems*, IB Docket No. 21-456, Order and Notice of Proposed Rulemaking, FCC 21-123, at 1-2, 6 (Dec. 15, 2021) (*Non-GSO Spectrum Sharing Order and NPRM*).

[572] MSS generally refers to services provided to mobile earth stations using MSS frequency bands. The newer ESIMs, discussed above, refer to services provided to earth stations in motion using FSS frequency bands.

[573] MSS ground station antennas are typically omnidirectional, and for the low earth orbits require less power. *O3b Limited*; *Request for Modification of U.S. Market Access for O3b Limited's Non-Geostationary Satellite Orbit System in the Fixed-Satellite Service and in the Mobile-Satellite Service*, IBFS File Nos. SAT-MOD-20160624-00060, SAT-AMD-20161115-00116, SAT-AMD-20170301-00026, and SAT-AMD-20171109-00154, Order and Declaratory Ruling, 33 FCC Rcd 5508, 5516, para. 21 & n.59 (2018) (*O3b Modification Order*)

[574] 47 CFR § 25.103.

[575] There are MSS allocations in the 1525-1559 MHz (space-to-Earth) band and the 1626.5-1660.5 MHz (Earth-to-space) band of the L-band, and in the 2000-2020 MHz and 2180-2200 MHz bands of the 2 GHz band. Other frequency bands with MSS allocations have been given specific labels in the Commission rules: the Big LEO bands (1610-1626.5 MHz and 2483.5-2500 MHz) and the Little LEO bands (137-138 MHz, 400.15-401 MHz, and 148-150.5 MHz). 47 CFR § 25.103. Due to encumbrances, not all of the allocated spectrum is available for use by MSS providers.

[576] *See, e.g.*, *Terrestrial Use of the 2473-2495 MHz Band for Low-Power Mobile Broadband Networks; Amendments to Rules for the Ancillary Terrestrial Component of Mobile Satellite Service Systems*, IB Docket No. 13-213, RM-11685, Report and Order, 31 FCC Rcd 13801, 13802 & n.2 (2016) (noting distinction between Big LEO systems that operate with voice and higher data-rate capabilities, and Little LEO systems, which do not provide voice service and generally operate with lower data-rate capabilities).

[577] *See* ITU Radio Regulations at 12 (Article 1, 1.51); 47 CFR § 2.1.

directly to fixed, mobile, and/or portable stations.[578] Satellite-delivered radio programming is supplied nationwide by SiriusXM, presently the only SDARS operator in the nation.[579]

187. *Direct Broadcast Satellite (DBS) Service*. DBS service is a radiocommunication service in which signals transmitted or retransmitted by Broadcasting Satellite Service space stations in the 12.2–12.7 GHz band are intended for direct reception by subscribers or the general public.[580] DBS satellite operators (e.g., DISH Network and DIRECTV) provide nationwide video programming to video customers in direct competition with terrestrial television companies.

3. Satellite Industry Current Status and Participants

a. Satellite Industry Revenues

188. Figure II.D.1 below provides aggregated U.S. satellite services revenues from the Satellite Industry Association (SIA) for 2013 to 2021 with respect to consumer, fixed, mobile and remote sensing satellite services.[581]

[578] 47 CFR § 25.103 (*Satellite Digital Audio Radio Service* (*SDARS*)).

[579] In 2021, SiriusXM's total revenue was $8.7 billion, which represents an increase of 8% over total revenue in 2020 and of 73% over total revenue in 2016. SiriusXM, *SiriusXM Reports Fourth Quarter and Full-Year 2017 Results* (Jan. 31, 2018), https://investor.siriusxm.com/financial-information/financial-results; SiriusXM, *SiriusXM Reports Fourth Quarter and Full Year 2021 Results* (Feb. 1, 2022), https://investor.siriusxm.com/financial-information/financial-results.

[580] 47 CFR § 25.103 (*Direct Broadcast Satellite (DBS) Service*).

[581] SIA Comments, Appx. B: SIA State of the Satellite Industry Report, Global and U.S. Satellite Services Revenue. SIA estimates that the U.S. share of global satellite services revenue of $118.3b in 2021 was 38%. The data include U.S. satellite services providers' revenues only, and not foreign providers to the U.S. market. SIA's estimate of global satellite services revenue includes revenue derived from direct-to-consumer retail services (e.g., satellite TV, radio, and broadband), fixed and mobile satellite services, and Earth observation services. *Id.*; *see also* OECD, OECD Handbook on Measuring the Space Economy, at 20 (2nd ed. 2022), https://doi.org/10.1787/8bfef437-en.

Fig. II.D.1 U.S. Satellite Services Revenue (2013-2021)									
Service	**Total Revenue (Billions, U.S.$)**								
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Consumer	44.0	46.0	48.0	46.4	45.5	43.5	42.8	40.2	39.5
Satellite TV (DBS/DTH)[582]	38.6	40.1	41.7	39.7	38.3	35.5	34.0	31.4	30.1
Satellite Radio (SDARS)	3.8	4.2	4.6	5.0	5.4	5.8	6.2	6.3	6.6
Satellite Broadband	1.6	1.7	1.7	1.7	1.8	2.2	2.4	2.5	2.8
Fixed	3.7	3.8	4.1	4.4	5.0	5.2	5.3	4.1	3.6
Managed Services[583]	3.4	3.5	3.8	4.1	4.7	4.9	5.1	4.1	3.6
Transponder Agreements[584]	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.0	0.0
Mobile	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.7	0.8
Remote Sensing	0.6	0.7	0.7	0.8	1.0	1.0	1.2	1.3	1.3
Total	48.7	50.9	53.3	52.1	52.1	50.3	49.7	46.3	45.2

Source: 2017-2021 data based on SIA Comments at Appx. B; SIA *Ex Parte* at Appx. B 2013-2016 data based on *2018 Communications Marketplace Report*, 33 FCC Rcd at 12673, Figure F-1; SIA Comments, IB Docket No. 18-251 at Appx. B (for 2013-2016 Remote Sensing figures).

189. While certain sectors of the satellite industry, such as satellite TV, managed services, and transponder arrangements, have declined recently in size, other sectors are growing in size and importance, specifically satellite radio, satellite broadband, mobile, and remote sensing. The biggest change is the drop in satellite TV revenues, by a total of $8.5 billion or 22% from 2013 to 2021. Meanwhile, there has been a significant increase in the annual revenues of satellite radio (74%), satellite broadband (75%), mobile services (100%), and remote sensing services (117%) over this time period.[585] These changes are due in part to investments in new satellites and new technologies for accessing them to take advantage of satellites' natural advantages in providing wide geographic coverage and serving as a unique observational platform. They also reflect changes in competing terrestrial facilities markets, especially the buildout of domestic wireline and wireless networks and increases in capacity of submarine

[582] DTH refers to television service provided in the FSS, rather than BSS, allocation. *See Policies and Rules for the Direct Broadcast Satellite Service*, IB Docket No. 98-21, Report and Order, 17 FCC Rcd 11331, 11333, para. 3 (2002).

[583] The revenue represented for "Managed Services" includes fixed and mobility VSAT, mobility, maritime, and in-flight broadband connectivity over FSS bands. *See* SIA Comments at 20.

[584] The revenue represented for "Transponder Agreements" includes industry verticals including media & broadcasting, telecom, and governments. *See* SIA Comments at 20.

[585] The percentage increases in annual revenue from 2013 to 2021, presented in Fig. II.D.1, are approximate, due to rounding of the source numbers.

cables, as well as changes in consumer demand, such as cord-cutting reducing demand for MVPD services, including DBS.

190. *Facilities-based Operators and Resellers*. The satellite services market is served by satellite operators and resellers. Satellite operators build, launch, and manage their own fleet of satellites. They provide a combination of wholesale services, involving the sale of raw transponder capacity on their satellites, retail services directly to consumers and businesses, and basic communications and observation services to other wholesalers and resellers and businesses.[586] Some operators provide transponders for lease through arrangements that are tailored for specific applications required by the customer, such as video distribution.[587] Operators may also supply a complete, end-to-end communications solution to customers, referred to as managed services.[588] Consumer retail services provided by operators include satellite broadband service, Digital Audio Radio Service (SDARS), and satellite television (e.g., DBS). Customers of enterprise services include terrestrial telecommunications companies, television networks, and resellers of satellite transponder capacity. Satellite resellers purchase satellite services and resell them to businesses and consumers. They often combine resold satellite services with their own arrangements for network management and integration, equipment, customer support, and terrestrial communications.[589]

b. Satellite Markets

191. In this section, we discuss: mobile markets for customers lacking a fixed location or requiring low latency services from NGSO satellites; fixed location markets, for customers with fixed locations; and Earth observation services. We note that satellite markets are going through major changes due to technological innovation, increased demand for broadband services and mobile use, and unveiling of new products and services. Formerly, markets were divided into fixed location applications, typically characterized by high bandwidth service but limited in value by high latency and the need for large fixed ground antennas; and mobile applications, with the benefits of mobility, low latency, and small ground antennas, but typically having very low bandwidth available for each customer. The new ESIMs and NGSO FSS initiatives, which the Commission has supported and enabled with revised regulations, are blurring the traditional distinctions between mobile and fixed satellite services by combining the best features of both types of services. ESIMs allow mobile users to access the full bandwidth of FSS satellites, while NGSO FSS applications offer the potential of lowering latency to non-noticeable levels for fixed location and ESIM broadband users, and allow the use of inexpensive low power ground stations. Bandwidth, latency, mobility and convenience are improving for certain classes of customers, thus strengthening satellites' positions in markets less well served by terrestrial communications networks, and improving their ability to provide robust competition with terrestrial networks in the future.

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[586] Intelsat, SEC Form 10-K at 12 (filed Mar. 30, 2021). Intelsat, SES, Hughes, ViaSat, Iridium, Eutelsat, and Telesat are examples of facilities-based satellite operators. Facilities-based operators may also lease some excess capacity from each other to expand their geographic coverage or meet the unique transmission requirements of specific customers.

[587] Intelsat, SEC Form 10-K at 12-15 (filed Mar. 30, 2021).

[588] *Id.*; SES, Annual Report 2021 at 21, https://www.ses.com/sites/default/files/2022-03/20220301_SES_AR2021_final.pdf.

[589] Some satellite resellers, often called integrators, combine leased satellite capacity with other value-added services for their customers. GAO, TELECOMMUNICATIONS: Competition, Capacity, and Costs in the Fixed Satellite Services Industry, at 9 (2011), https://www.gao.gov/products/GAO-11-777. Examples of resellers include Digisat International Inc., Speedcast International Ltd/Globecomm/ Ultisat, Inc., and Artel, LLC. Digisat, *Satellite Communications Network Management Solutions*, https://www.digisat.org/managed-network-services (last visited Aug. 22, 2022); Speedcast, *What we do*, https://www.speedcast.com/about-us/what-we-do/ (last visited Aug. 22, 2022); Artel, LLC, *Company*, https://www.artelllc.com/company/ (last visited Aug. 22, 2022). We note that we have limited reliable information about resellers or other suppliers and the types of satellite services provided by these entities in the communications marketplace.

192. *Mobile Satellite Customer Markets.* Satellites traditionally have served mobile markets, with customers lacking a fixed location or needing low latency service, using MSS spectrum. This includes maritime, aviation, global tracking, satellite telephony, and low-speed data services. MSS spectrum is often used by NGSO satellites in LEO or MEO orbits. Omnidirectional low power antennas are typically used for MSS service.[590] The spectrum allocated for each MSS customer is generally very limited because much less spectrum has been allocated for MSS purposes, and it is shared globally with other MSS customers. In 2021, MSS generated approximately $800 million in U.S. revenues.[591] Currently, six satellite operators provide MSS in the United States:[592] Inmarsat, Ligado,[593] Iridium, Globalstar, ORBCOMM, and Swarm.[594]

193. Due to technological differences, MSS services vary significantly in characteristics, such as cost, geographic availability, required customer equipment, data bandwidth and allowances, two-way capabilities, latency, network reliability, and ease of use. Inmarsat, the largest MSS operator, provides extensive voice, video, and data communications services to mobile earth stations using GSO satellites in the L-, Ka-, and S-bands, five of which have been granted access to the U.S. market.[595] Ligado provides a variety of mobile satellite services that includes communications, and asset monitoring and tracking, using the SkyTerra 1 GSO satellite in the L-band.[596]

194. NGSO LEO systems offer much lower latency due to their low Earth orbit compared to GSO systems, which is useful for satellite voice telephony and interactive data applications, and requires smaller antennas.[597] The Big LEO systems of Iridium and Globalstar provide low-latency voice and data services to portable handsets and other devices. Iridium, with its constellation of 66 operational satellites, provides low-latency mobile voice, data, and IoT communications services with fully global coverage.[598] Iridium provides services to industries such as emergency services, maritime, aviation, government,

[590] *O3b Modification Order*, 33 FCC Rcd at 5516, para. 21 & n.59.

[591] Mobile satellite 2021 revenues were approximately 1.7% of the total U.S. satellite services revenue. *See* SIA Comments at 20.

[592] FCC, *Space Station Approval List*, https://www.fcc.gov/approved-space-station-list (last visited Oct 21, 2022).

[593] *Ligado Amendment to License Modification Applications*, IBFS File Nos. SES-MOD-20151231-00981, SAT-MOD-20151231-00090, and SAT-MOD-20151231-00091 et al., IB Docket No. 11-109, Order and Authorization, 35 FCC Rcd 3772 (2020).

[594] *See* Globalstar, 2021 SEC Form 10-K at 10 (filed Feb. 25, 2022); Inmarsat, *Satellites*, https://www.inmarsat.com/en/about/technology/satellites.html (last visited July 12, 2022); Ligado, *Covering a Continent with the Ligado SkyTerra 1 Satellite*, https://ligado.com/wp-content/uploads/SkyTerra1_InfoSheet_0819.pdf (last visited July 12, 2022); Iridium, *Iridium Global Network*, https://www.iridium.com/network/ (last visited July 12, 2022); Globalstar, *Satellite Technology powered by The Globalstar Satellite Network*, https://www.globalstar.com/en-us/about/our-technology (last visited July 12, 2022); ORBCOMM, *Satellite IoT and M2M*, https://www.orbcomm.com/en/partners/connectivity/satellite (last visited July 12, 2022); Swarm, *Global Affordable Connectivity*, https://swarm.space/ (last visited Nov. 11, 2022).

[595] Inmarsat Plc, 2018 Annual Report and Financial Statements at 1, https://www.inmarsat.com/en/about/plc-archive/results-centre.html (last visited July 12, 2022); FCC, *Space Station Approval List*, https://www.fcc.gov/approved-space-station-list (last visited Oct. 21, 2022); Inmarsat, *Satellites*, https://www.inmarsat.com/en/about/technology/satellites.html (last visited Aug. 29, 2022).

[596] Ligado Networks, *Covering North America: What Ligado's Satellite Network Can Do for You*, https://ligado.com/wp-content/uploads/LS_Satellite_2018_CNA-Brch.pdf (last visited Aug. 29, 2022); Ligado Networks, *Covering a continent with Ligado's SkyTerra 1*, https://ligado.com/wp-content/uploads/SkyTerra-1-Product-Sheet.pdf (last visited Aug. 29, 2022).

[597] Ippolito (2017) at 25.

[598] Iridium Communications, Inc., SEC Form 10-K at 2 (filed Feb. 17, 2022); Iridium, *Iridium NEXT*, https://www.iridium.com/idr-file/306527 (last visited Aug. 29, 2022).

utilities, oil and gas, mining, recreation, forestry, heavy equipment, construction, transportation, and military.[599] Globalstar uses its fleet of 24 operational first and second generation satellites to provide two-way voice and data and one-way IoT low-latency services for much of North America, Europe, South America, Australia, and limited parts of Asia and Africa.[600] ORBCOMM's Little LEO system provides data services, including M2M and IoT, that remotely track, monitor, and control fixed and mobile assets.[601] Little LEO systems are restricted to non-voice low data rate services because of the relatively small uplink bandwidth and the fact that they must operate in spectrum shared with terrestrial mobile operations.[602] Swarm, a division of SpaceX, offers inexpensive global IoT service with its constellation of up to 150 very small satellites.[603]

195. Ships and planes were traditionally served by MSS operators providing low-capacity service. The development of ESIM services with the use of specialized directional antennas has allowed maritime and aviation vessels to access the services of FSS satellites. ESIMs use directional antennas that enhance throughput and enable them to transmit and receive very high data-rate broadband communications with satellites while in motion.[604] FSS operators provide broadband services to aircraft and maritime vessels, which include government organizations, commercial entities, and individual clients.[605] For example, Intelsat and Telesat offer broadband services for maritime vessels (including maritime enterprise VSAT services[606] and broadband connectivity for cruise ships), as well as broadband

[599] Iridium Communications, Inc., SEC Form 10-K at 2-13 (filed Feb. 17, 2022).

[600] Globalstar, 2021 SEC Form 10-K at 3-10 (filed Feb. 25, 2022); Globalstar, *Satellite Technology powered by The Globalstar Satellite Network*, https://www.globalstar.com/en-us/about/our-technology (last visited July 12, 2022); Globalstar, *Coverage*, https://www.globalstar.com/en-us/products/coverage-maps (last visited Aug. 29, 2022).

[601] ORBCOMM, *Satellite IoT and M2M*, https://www.orbcomm.com/en/partners/connectivity/satellite (last visited Aug. 29, 2022); ORBCOMM, *ORBCOMM OG2*, https://www.orbcomm.com/en/partners/connectivity/satellite/og2 (last visited Nov. 16, 2022).

[602] *Third Satellite Competition Report*, 26 FCC Rcd at 17315, para. 71.

[603] Swarm, *Swarm website*, https://swarm.space/ (last visited Aug. 29, 2022); Swarm, *Swarm's 2021 Year in Review* (Dec. 28, 2021), https://swarm.space/swarms-2021-year-in-review/; Darrell Etherington, TechCrunch, *Here's what Swarm has been up to in the 10 months since being acquired by SpaceX* (July 29, 2022), https://techcrunch.com/2022/07/29/heres-what-swarm-has-been-up-to-in-the-10-months-since-being-acquired-by-spacex/.

[604] ESIMs enable the provision of very high data rate broadband communications, navigational, situational awareness, and other services to mobile platforms that often cannot be served using other communications technologies. *See ESIMs Report and Order and Further Notice*, 33 FCC Rcd at 9328-29, para. 3. The Commission continues to distinguish ESIMs, which operate in FSS spectrum, from mobile earth stations, which operate in MSS spectrum. *ESIMs Report and Order and Further Notice*, 33 FCC Rcd at 9328-30, paras. 3-4, 10 (defining ESIMs to collectively designate the three types of FSS earth stations that the Commission authorizes to transmit while in motion: Earth Stations on Vessels (ESVs), Vehicle-Mounted Earth Stations (VMESs), and Earth Stations Aboard Aircraft (ESAAs)); 47 CFR § 25.103 (*Mobile Earth Station*) (defining mobile earth station as "[a]n earth station in the Mobile-Satellite Service intended to be used while in motion or during halts at unspecified points.").

[605] "[S]atellites are playing an increasingly profitable role in the aviation industry. The London School of Economics projects that airline broadband will encompass a $30B market by 2035. Connected aircraft could also save airlines $15B annually in operating costs, according to the same study." *See* SIA Comments at 8; *see also generally* Alexander Grous, *Sky High Economics* (2017), http://eprints.lse.ac.uk/87438/1/Grous_Sky%20High_Author.pdf.

[606] Vessels can connect to the global communications network with VSAT technology, which provides crew and passengers with high-speed Internet access and phone service. iDirect, *ViaSatellite, The Coming Wave of Maritime VSAT Growth*, https://www.satellitetoday.com//long-form-stories/maritime-vsat/ (last visited July 12, 2022).

connectivity for in-flight entertainment and Wi-Fi services for the aeronautical industry.[607] SES and ViaSat provide broadband service on commercial airlines and cruise ships.[608] Hughes/EchoStar also provides broadband service on commercial airlines.[609]

196. *Fixed Satellite Customer Markets.* Satellites traditionally served fixed locations using GSO satellites and spectrum allocated to the FSS. Before the development of ESIMs, only earth stations with fixed locations were permitted to access GSO satellites with FSS spectrum, because directional antennas focused on a single satellite were required for the earth station to avoid RF interference with other satellites' operations.[610] Intelsat,[611] SES, Eutelsat, Telesat, Hughes/EchoStar,[612] and ViaSat are the major providers of satellite FSS-based spectrum services in the United States.[613] Telesat provides satellite services to the U.S. government, and provides Ka-band satellite capacity to ViaSat, which uses the capacity to provide broadband services in the United States.[614] ViaSat and Hughes/EchoStar both provide wholesale and retail commercial broadband services to customers in the United States.[615] Intelsat, Telesat, SES, ViaSat, and EchoStar have high-throughput satellites serving North America.[616] SES provides services using both GSO and MEO satellites.[617]

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[607] *See e.g.*, Intelsat, 2020 SEC Form 10-K at 8-20 (filed Mar. 20, 2021) (Intelsat 2020 SEC Form 10-K); Telesat Canada, 2021 SEC Form 20-F at 68 (filed Mar. 18, 2022) (Telesat Canada 2021 SEC Form 20-F).

[608] SES launched SES-17 in 2021 to provide aviation service over the Americas and Atlantic. SES, 2021 Annual Report at 18, https://www.ses.com/sites/default/files/2022-03/20220301_SES_AR2021_final.pdf (SES 2021 Annual Report) (last visited July 13, 2022); ViaSat, 2021 SEC Form 10-K at 4-5 (filed May 31, 2022) (ViaSat 2021 SEC Form 10-K).

[609] Hughes, *Aeronautical Broadband Solutions*, https://www hughes.com/what-we-offer/mobility-solutions/aero (last visited July 13, 2022).

[610] *O3b Modification Order*, 33 FCC Rcd at 5516, para. 21 & n.59.

[611] Intelsat S.A. filed for Ch.11 bankruptcy protection and voluntary reorganization May 13 2020. Intelsat 2020 SEC Form 10-K at 7-8 (filed March 20, 2021) (Intelsat 2020 SEC Form 10-K); Caleb Henry, SpaceNews, *Intelsat declares bankruptcy as means to fund C-band spectrum clearing* (May 14, 2020), https://spacenews.com/intelsat-declares-bankruptcy-as-means-to-fund-c-band-spectrum-clearing/. , https://help.netflix.com/en/node/87

[612] EchoStar provides its consumer broadband and managed services through its wholly-owned subsidiary, Hughes Network Services. EchoStar, *EchoStar Corporation Completes Hughes Communications, Inc. Acquisition* (June 8, 2011), *https://ir.echostar.com/news-releases/news-release-details/echostar-corporation-completes-hughes-communications-inc*.

[613] Intelsat 2020 SEC Form 10-K at 7-26 (filed Mar. 20, 2021) (Intelsat 2020 SEC Form 10-K); SES 2021 Annual Report at 16-19, https://www.ses.com/sites/default/files/2022-03/20220301_SES_AR2021_final.pdf (SES 2021 Annual Report) (last visited July 13, 2022); Eutelsat, *Satellites*, https://www.eutelsat.com/en/satellites html (last visited July 18, 2022); Telesat Canada 2021 SEC Form 20-F at 53-76 (filed Mar. 18, 2022) (Telesat Canada 2021 SEC Form 20-F); EchoStar Comments at 2; ViaSat 2021 SEC Form 10-K at 4-12 (filed May 31, 2022) (ViaSat 2021 SEC Form 10-K).

[614] Telesat Canada 2021 SEC Form 20-F at 60-63 (filed Mar. 18, 2022) (Telesat Canada 2021 SEC Form 20-F); ViaSat 2021 SEC Form 10-K at 19 (filed May 31, 2022) (ViaSat 2021 SEC Form 10-K).

[615] ViaSat 2021 SEC Form 10-K at 4-5; EchoStar Comments at 2.

[616] Through the use of small beams, high-throughput satellites are capable of reusing the same frequency band multiple times over their coverage area. This allows the use of more spectrum for each of their small beams, making higher throughput available anywhere in their coverage area. Hughes, *JUPITER, High-Throughput Satellite Fleet*, https://www.hughes.com/what-we-offer/satellite-assets/jupiter-fleet (last visited Aug. 30, 2022); SES 2021 Annual Report at 14.

[617] SES combines GEO and MEO satellite constellations to provide service. In 2019, SES launched and completed its O3b Ka-band constellation of 20 satellites in medium earth orbit, to provide lower latency broadband connectivity for mobile use. SES 2021 Annual Report at 16-18.

197. Some FSS operators,[618] as well as third-party integrators purchasing the use of satellite facilities,[619] supply managed network services, which are a complete, end-to-end communications system that includes leased satellite bandwidth, ground facilities, terrestrial transmission links, and management of the end-to-end communications service. Customers of managed satellite services include United States and foreign government agencies, government contractors, media companies, and commercial entities.[620]

198. FSS operators in the United States provide transponder capacity for lease through complex contracts for variable quantities of bandwidth, frequency, orbital location, geographic coverage, power, and length of service of the transponders required by the customer.[621] Many wholesale customers of FSS operators only lease transponder capacity and self-supply their own earth stations and terrestrial links. Applications of leased transponder capacity include point-to-point transponder capacity for use by providers of media services, point-to-multipoint transmission of video programming to multichannel cable programming distributors, and the transport of point-to-point telecommunications transmissions to terrestrial telecommunications operators and corporate users.[622] Also, satellite provision of backhaul services is expected to grow in the coming years.[623]

199. Satellite broadband providers such as Hughes/EchoStar and ViaSat play a role in closing the connectivity gap across the United States, especially in the most rural and remote areas of the country, where it may be uneconomical to build terrestrial networks.[624] As of year-end 2021, satellite operators served a combined 1.7 million subscribers in the United States, and approximately three million subscribers globally and, as their infrastructure expands, operators are increasing the speeds made available to consumers.[625]

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[618] *See, e.g.*, SES, *Managed Network Services*, https://www.ses.com/find-service; (last visited July 19, 2022); Hughes, *Hughes Managed Services*, https://www.hughes.com/what-we-offer/managed-network-services (last visited July 19, 2022); Intelsat, *The Intelsat Customer Experience,* https://www.intelsat.com/about-us/customer-experience/ (last visited July 19, 2022).

[619] Examples of third-party providers of managed services include Digisat International Inc., Speedcast International Limited, and Artel, LLC. *See* Digisat, *Satellite Communications Network Management Solutions*, https://www.digisat.org/managed-network-services (last visited July 19, 2022); Speedcast, *Managed Network Solutions*, https://www.speedcast.com/our-solution/all-solutions/ (last visited July 19, 2022); Artel, *HISPASAT's Amazonas Nexus Satellite will embed the Pathfinder 2 mission for the United States Space Force* (June 24, 2020) https://www.artelllc.com/hispasats-amazonas-nexus-satellite-will-embed-the-pathfinder-2-mission-for-the-united-states-space-force/.

[620] *See, e.g.*, *Third Satellite Competition Report*, 26 FCC Rcd at 17304, paras. 41-42 (noting that value-added resellers provide managed services to government and corporate clients—e.g., U.S. Army, Federal Bureau of Investigation, commercial shipping—that need communications in "thin markets" or need to extend the reach of their corporate networks); *see also* SES 2021 Annual Report at 21; Intelsat, 2020 SEC Form 10-K at 12; GAO, TELECOMMUNICATIONS: Competition, Capacity, and Costs in the Fixed Satellite Services Industry at 9 (2011), https://www.gao.gov/products/GAO-11-777.

[621] *See Third Satellite Competition Report*, 26 FCC Rcd at 17292-99, paras. 15-35 (discussing complexities of output produced by commercial satellite operators). The pricing of transponder services and the specific attributes of the service to be supplied to the customer are bilaterally negotiated between the customer and the satellite operator. *Id.* at 17291-92, para. 14; *see also* GAO, TELECOMMUNICATIONS: Competition, Capacity, and Costs in the Fixed Satellite Services Industry at 9-10 (2011), https://www.gao.gov/products/GAO-11-777.

[622] *See Third Satellite Competition Report*, 26 FCC Rcd at 17296-97, paras. 26-28.

[623] *See* Mark Holmes, ViaSatellite, *Telcos Talk Bluntly About Satellite's Backhaul Future* (July 2020), http://interactive.satellitetoday.com/via/july-2020/telcos-talk-bluntly-about-satellites-backhaul-future/.

[624] SIA Comments at 9-11.

[625] *See supra* Fig. II.A.10; SIA Comments at 7, 11-14.

200. Recent and planned launches of next-generation GSO satellites by Inmarsat, Telesat, and Hughes, will offer higher-speed and larger capacity broadband offerings.[626] Low latency NGSO satellite constellations by SES/O3b, SpaceX/Starlink,[627] OneWeb,[628] Kepler, and Kuiper are resulting in more widespread lower-latency satellite broadband service as deployment of such systems progresses.[629] Some of these constellations have significant numbers of operational satellites in space, or are in advanced stages of development.[630]

(i) Earth Observation Stations

201. EESS satellites are increasingly used to gather Earth observation information for commercial purposes, including information to observe the weather, measure key factors important to climate change, assess needs in disaster recovery, monitor strategic assets, and observe crop growth. Twelve companies operate or plan to operate Earth observation satellites that the Commission authorized as EESS: Astro Digital U.S. Inc; BlackSky Global LLC; Capella Space Corp; dMY Technology Group, Inc. (aka Planet Labs); HawkEye 360, Inc.; ICEYE US; Loft Orbital Solutions; Maxar License (formerly DigitalGlobe); R2 Space, Inc; Spire Global, Inc; Theia Holdings A, Inc; and Umbra Lab Inc.[631] Some of these companies operate or plan to operate large numbers of satellites. For example, Planet Labs (aka dMY Technologies) has approximately 200 satellites currently in orbit,[632] and Spire Global has over 100 satellites in orbit.[633]

202. EESS providers generally operate satellites in low earth orbit to provide earth observations, either by capturing optical images of the Earth, or using synthetic-aperture radar for two-dimensional and three-dimensional imaging,[634] or radio location and RF signal detection and measurements, for various purposes. Many combine their image data with other datasets, and provide analytics for modeling and analysis. For example, Planet Labs captures frequent high-resolution optical

[626] SIA Comments at 11-12.

[627] SpaceX has over 2500 satellites in low earth orbit for its Starlink service, which uses the Ku-, Ka- and E-band. *See* SIA Comments at 13; Stephen Clark, Spaceflight Now, *Falcon 9 rocket deploys SpaceX's 3,000th Starlink internet satellite* (Aug. 10, 2022), https://spaceflightnow.com/2022/08/10/falcon-9-rocket-deploys-spacexs-3000th-starlink-internet-satellite/.

[628] On July 25, 2022, OneWeb and Eutelsat announced their intention to merge. OneWeb, Press Release, Eutelsat and OneWeb to combine: a leap forward in satellite connectivity (July 25, 2022), https://oneweb net/resources/eutelsat-and-oneweb-combine-leap-forward-satellite-connectivity.

[629] SIA Comments at 11-14.

[630] For example, as of June 1, 2022, SpaceX had launched more than 2,500 satellites. *SpaceX Services, Inc. Application for Blanket Authorization of Next-Generation KU-Band Earth Stations in Motion, SpaceX Services, Inc. Application for Blanket Authorization of High-Performance Ku-Band Earth Stations in Motion, Kepler Communications, Inc. Application for Blanket Authorization of KU-Band Earth Stations on Vessels*, Order and Authorization, DA 22-695, at 1 (IB June 30, 2022) (*SpaceX ESIM and Kepler ESV Order*). As of October 23, 2022, OneWeb had a constellation of 462 satellites. *See* One Web, Press Release, 36 OneWeb satellites successfully launched by ISRO/ NSIL from Sriharikota (Oct. 23, 2022), https://oneweb net/resources/36-oneweb-satellites-successfully-launched-isro-nsil-sriharikota.

[631] FCC, *Space Station Approval List*, https://www.fcc.gov/approved-space-station-list (last visited Oct. 21, 2022).

[632] Planet Labs PBC, 2021 SEC Form 10-K (filed Apr. 14, 2022).

[633] Spire Global, 2021 SEC Form 10-K at 7 (filed Mar. 30, 2022).

[634] NASA Earthdata, *What is Synthetic Aperture Radar?*, https://www.earthdata.nasa.gov/learn/backgrounders/what-is-sar (last visited Sept. 1, 2022); Capella, *SAR Made Easy*, https://www.capellaspace.com/ (last visited Sept. 1, 2022).

images of the Earth for purposes that include agriculture and disaster relief.[635] Spire Global satellites collect radio and vessel location data for ship tracking and weather measurement.[636] Maxar (formerly DigitalGlobe), using four satellites in LEO, provides optical high-resolution high-accuracy imaging, geospatial information and data analytics to the U.S. government and other customers.[637] BlackSky has small satellites in LEO that capture earth observation data that BlackSky combines with its AI software platform for analysis.[638] ICEYE, which specializes in flood monitoring and other disaster assistance, uses its Synthetic Aperture Radar (SAR) satellites to monitor daily ground conditions.[639] Capella uses its SAR satellites to provide all weather Earth observation.[640] HawkEye 360 provides precise mapping of RF emissions and space-based RF analytics.[641] According to SIA estimates, in 2021, Earth observation revenues in the United States were $1.3 billion, an increase of 85% from 2015.[642]

4. Satellite Industry Dynamics and Key Characteristics

203. In many communications markets, satellite services compete directly with terrestrial services. However, because of satellite's technological and organizational differences, satellite services are often able to provide a differentiated, and in certain aspects, a complementary, service to terrestrial communications services. Here, we discuss both the strengths and limitations of satellite services. We briefly describe the key features of satellite service that differentiate them from terrestrial alternatives in the areas of coverage and reach as a space platform, cost, capacity, quality, customer convenience, and the time and risk involved in building and launching satellites.

204. *Coverage and reach as a space platform*. As a space platform, satellites have some special and some unique capabilities and problems. Satellites can have very long range, and provide near ubiquitous coverage, especially satellites in high earth orbit. Satellites can reach remote regions, so long as there is line of sight to the satellite for FSS service, and provide relatively inexpensive long-distance service.[643] Satellites are thus able to provide service to remote and rural locations that are too difficult and expensive for terrestrial networks to reach.[644] Satellites also have the potential to fill coverage gaps in

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[635] Michael Baylor, NASA Spaceflight, *Planet Labs Targets a Search Engine of the World* (Jan. 29, 2018), https://www.nasaspaceflight.com/2018/01/planet-labs-targets-search-engine-world/; GIS Geography, *Planet Labs Imagery: The Entire Earth, Everyday* (last updated Apr. 21, 2018), https://gisgeography.com/planet-labs-imagery/. Planet Labs claims to "image the entire Earth's landmass every day at medium- and high-resolution" Planet Labs claims to "have over 2,000 images on average for every point on Earth's landmass, creating a non-replicable historical archive for analytics, machine learning, and insights." Planet Labs, *Corporate Overview*, https://investors.planet.com/overview/default.aspx (last visited Aug. 30, 2022).

[636] Lora Kolodny, CNBC, *A Start-Up Fighting Pirates with Satellites Just Raised $70 Million* (Nov. 16, 2017), https://www.cnbc.com/2017/11/16/spire-global-raises-70-million-to-stop-pirates-with-satellites html; Spire Global, 2021 SEC Form 10-K (filed 3/30/22) at 7-10; Spire, *GNSS-RO & GPS-RO*, https://spire.com/data/weather/?spirepedia=gnss-ro-gps-ro (last visited Aug. 30, 2022).

[637] Maxar, 2021 SEC Form 10-K at 3-7 (filed Feb. 22, 2022).

[638] BlackSky, 2021 SEC Form 10-K at 4 (filed Mar. 31, 2022).

[639] ICEYE, ICEYE website, https://www.iceye.com/ (last visited Aug. 22, 2022).

[640] Capella Space, *Capella Space Open Data Gallery*, https://www.capellaspace.com/gallery/ (last visited Nov. 16, 2022).

[641] HawkEye 360, *About – Revolutionizing RF Analytics*, https://www he360.com/about-us-rf-analytics/ (last visited Sept. 2, 2022).

[642] *See supra* Fig. II.D.1; SIA Comments at 20.

[643] For satellite service from GSOs, the cost is mostly independent of the distance involved, unlike many terrestrial ground-based networks requiring middle and last mile build-out or submarine cable.

[644] SIA Comments at 9-11, 13-14.

terrestrial based services. For example, T-Mobile has announced plans to use satellite service for text communications, while Apple has plans to initiate emergency communications using satellites.[645]

205. Another advantage of being a space platform is that a satellite can easily observe the Earth, enabling weather and ground monitoring and photography. A satellite is also unaffected by terrestrial developments and disasters, making it useful for providing redundant (backup) service to terrestrial systems, especially following a disaster. However, satellites are susceptible to problems specific to space, including orbital debris and solar flares, and communications may be affected by cloudy and wet weather on Earth for some services. In addition, being in space means that maintenance and repairs are very difficult or impossible to provide.

206. *Cost*. There is generally a high fixed cost to designing, manufacturing, and launching a satellite, which is a significant barrier to entry.[646] Conversely, the cost of adding additional customers can be very low once the satellite is operational in space.[647] For one-way communications of one-to-many distribution services such as audio (SDARS) and video (DBS), this cost of adding customers can be close to zero, just requiring ground equipment to reach the customer, as these customers all access the same signal. This allows them to expand service easily and profitably.[648]

207. *Capacity*. There are capacity limitations in the number of satellites that can be launched and operated, the availability of orbital slots for GSO satellites, the amount of traffic each satellite is capable of handling, and in the bandwidth (download and upload speed) each satellite can provide to each customer. The satellite industry is constantly looking for ways to loosen these constraints through technological improvements in antennas, satellite size, and spectrum usage.[649] GSO satellite service, in particular, is limited by the number of orbital slots available. Limited spectrum availability is a particular problem for satellite communications because of the long distances involved, increasing the likelihood of RF interference with other communications, including other satellites and ground stations. The use of directional antennas and spacing of GSO satellites is used to reduce this RF interference and allow the reuse of FSS spectrum between satellites.

208. In the current marketplace, satellite capacity limits the number of customers that satellite operators can serve. In addition, due to the limited spectrum available to them, they have limited bandwidth and speeds for two-way and individual communications services. This bandwidth and capacity can be increased through larger satellites and careful reuse of spectrum, among other measures. Recent and upcoming increases in satellite size, antenna technology, and improvements in spectrum use have allowed the next generation of FSS satellites to offer broadband quality download speeds, and to handle larger numbers of customers in more regions of the United States.

209. *Quality*. The quality of satellite services can be negatively impacted by high latency and jitter, especially for higher Earth orbits. High latency, which slows down response time, can negatively impact customer experiences with certain communications applications, especially two-way

[645] *See, e.g.*, T-Mobile, Press Release, T-Mobile Takes Coverage Above and Beyond With SpaceX (Aug. 25, 2022), https://www.t-mobile.com/news/un-carrier/t-mobile-takes-coverage-above-and-beyond-with-spacex; Chris Velazco, *How T-Mobile and SpaceX are teaming up to give you coverage from space* (Aug. 30, 2022), https://www.washingtonpost.com/technology/2022/08/30/spacex-t-mobile-starlink-satellite/; Jesse Hollington, *iPhone 14 satellite connectivity: how it works, what it costs, and more* (Nov. 11, 2022), https://www.digitaltrends.com/mobile/apple-iphone-14-emergency-sos-satellite-how-work-cost-availability/.

[646] GAO, TELECOMMUNICATIONS: Competition, Capacity, and Costs in the Fixed Satellite Services Industry at 30 (2011), https://www.gao.gov/products/GAO-11-777.

[647] SIA Comments at 10. This would be described in economics as a high fixed cost, low marginal cost industry with significant economies of scale.

[648] *Id.* at 13-14.

[649] *Id.* at 11-14.

communications. Lower Earth orbit satellites, such as NGSO systems, however, have much lower latency. In addition, local ground weather can affect the reception of certain satellite services, depending on the frequency bands used.[650]

210. *Customer Convenience*. Customer convenience can be a significant factor in determining the usefulness and uptake of satellite services. Customers of satellite services may find the flexibility of location of satellite services convenient, allowing them to take service anywhere in the United States. with limited hand-off problems and loss of reception,[651] even in remote areas.[652] However, the need for a large antenna or handset, with a large power source for some satellite services, can be inconvenient, especially when compared with the smaller handsets needed for terrestrial mobile wireless service.

211. *Time and Risk Involved in Satellite Launches.* The time needed to build and launch satellites, and the risk involved, can be a significant issue for satellite operators considering market entry or expansion. It can take years to build and launch a satellite, and there is a significant risk that the satellite launch will not be successful, or that the satellite will be damaged or will malfunction at some point. This substantially raises the costs and market risks of entering the satellite services market and of expanding service. Satellite operators argue that they need regulatory certainty in terms of spectrum, orbital slots, and access to Federal support programs for rural and underserved areas, in order to safely plan their expansion plans.[653]

E. The Video Marketplace

1. Overview of the Video Programming Marketplace

212. In the United States, consumers can access video programming content from multiple sources, only some of which are licensed or regulated by the Commission. Some video providers, like broadcast television stations, have been in the marketplace for over 70 years,[654] whereas other providers, like online video providers, have entered the market more recently. There are three primary categories of participants in the video marketplace: multichannel video programming distributors (MVPDs), online video distributors (OVDs), and broadcast television stations. While these three primary categories of market participants remain, in the past two years, competition among both these participants and video programming options have evolved.

213. MVPDs use wireline or satellite technologies to deliver video programming to consumers. MVPDs sell channel packages, which typically include linear channels from cable networks and retransmitted broadcast television stations, as well as video-on-demand (VOD) content.[655] Traditional MVPDs include cable providers like Comcast and Charter, telephone company providers like Verizon Fios, two direct broadcast satellite (DBS) providers—DISH and DIRECTV—as well as numerous smaller cable and telephone company MVPDs. Continuing a downward trend that began in

[650] Rain on the transmission path can degrade and attenuate signals for spectrum above 3 GHz, including C-band, Ku-band, Ka-band, and V-band. Ippolito (2017) at 101-05.

[651] Reception may be lost in areas without clear line of sight to satellites, such as in mountainous areas.

[652] SDARs, for example, allows cars to receive the same audio service anywhere in the United States.

[653] EchoStar Comments at 5-7; SES and O3b Reply at 1-2, 7-8.

[654] Commercial television began in the late 1940s. *See* Mitchell Stephens, *History of Television*, https://stephens.hosting.nyu.edu/History%20of%20Television%20page html (last visited Oct. 6, 2022).

[655] Linear channels offer specific video programs at a specific time of day in a manner akin to broadcast television. VOD programs are stored electronically by the provider and can be viewed by the consumer at any time; i.e., on demand. *See, e.g., Annual Assessment of the Status of Competition in the Market for the Delivery of Video Programming,* MB Docket No. 14-16, Notice of Inquiry, 29 FCC Rcd 1597, 1603, para. 15 & n.23 (2014) ("A linear channel is one that distributes programming at a scheduled time. Non-linear programming, such as video-on-demand ('VOD') . . . is available at a time of the viewer's choosing.").

2013, MVPDs lost 6.7 million video subscribers between 2020 and 2021, ending 2021 with 69.1 million video subscribers. As many MVPDs also provide broadband Internet, voice, and mobile wireless services, MVPDs continue to compete by offering discounted services to consumers who purchase video services as part of a bundle that includes some combination of other service offerings.[656]

214. OVDs deliver video content to consumers via the Internet.[657] They use a variety of business models, including advertising-supported video offerings; a subscription model for access to an entire video library; and a transactional approach in which consumers pay to view a movie or television episode on a per-program basis. While OVDs often provide access to programming from third-party producers, major OVDs are increasing the amount of original and owned content they provide as a means of differentiating themselves from competitors. In addition, many large video content owners have elected to use their own OVD services, instead of third-party platforms, to make their content available online. OVDs include Netflix, Hulu, Amazon Prime Video, HBO Max, YouTube TV, Disney+, and TikTok, as well as numerous other providers tending to focus on niche audiences. Over the past two years, OVDs have continued to proliferate, and many OVDs have grown rapidly relative to traditional MVPDs. In addition, virtual multichannel video programming distributors (vMVPDs), such as DIRECTV Stream and Disney's Hulu + Live TV, deliver packages of streaming linear channels via the Internet to subscribers similar to those offered by traditional MVPDs. vMVPDs continue to grow and attract consumers away from traditional MVPDs.

215. Broadcast television stations offer linear video programming channels over-the-air to households that receive this programming using a television set connected to an antenna. Although many broadcast television stations are affiliated with commercial broadcast networks (e.g., ABC, CBS, FOX, and NBC), participants in this category also include independent commercial stations and noncommercial educational stations.[658] Programming aired on broadcast television stations includes local programming produced by stations, network programming, and syndicated programming. Stations derive their revenue from the sale of advertisements during the programming and from fees paid by MVPDs for the carriage of the station's signal, called retransmission consent fees. Advertising revenue accounts for approximately 60% of revenue earned by all stations, while retransmission consent revenue accounts for the remaining 40% of revenue. While advertising revenue has remained relatively flat in recent years, retransmission consent revenue has grown substantially as the fees negotiated between broadcast stations and MVPDs have increased.[659]

2. Multichannel Video Programming Distributors

a. Providers and Subscribers

216. At the end of 2021, seven MVPDs each had over one million video subscribers. These MVPDs include four cable companies (Comcast, Charter, Altice, and Cox), DISH (a DBS MVPD), DIRECTV (a combined DBS and wireline MVPD),[660] and Verizon Fios (a telephone company MVPD).[661]

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[656] *See infra* section II.E.2.b.

[657] For purposes of this section, we define OVD as "an entity that distributes video programming (1) by means of the Internet or other Internet Protocol (IP)-based transmission path; (2) not as a component of an MVPD subscription or other managed video service; and (3) not solely to customers of a broadband Internet access service owned or operated by the entity or its affiliates." *2020 Communications Marketplace Report*, 36 FCC Rcd at 3048, para. 152 & n.440.

[658] Major independent stations include, for example, WGN-TV in Chicago, KCAL-TV in Los Angeles, and WHDH-TV in Boston.

[659] *See infra* section II.E.4.d.

[660] In August 2021, AT&T spun off DIRECTV, AT&T TV, and U-verse to DIRECTV. *See* Catie Keck, The Verge, *AT&T has officially spun off DirecTV, which is now its own business* (Aug. 3, 2021), https://www.theverge.com/2021/8/3/22608577/att-directv-tpg-deal-u-verse-att-tv-new-company.

Nine cable MVPDs and two telephone company MVPDs each had between 100,000 and 1 million video subscribers.[662] In addition, many small cable and telephone company MVPDs served smaller numbers of customers.[663]

217. Cable MVPDs generally serve non-overlapping franchise areas, and as a result, most consumers have access to only one cable MVPD, and cable MVPDs do not generally compete directly with one another for the same subscribers.[664] DIRECTV and DISH have national footprints and almost all consumers have access to both DBS MVPDs.[665] Telephone company MVPDs rarely compete with one another for the same subscribers; however, they almost always overbuild areas already served by at least one cable company.[666] As such, most consumers have access to one cable MVPD and two DBS MVPDs, and some consumers additionally have access to a telephone company MVPD.

218. MVPD subscribership has been declining since 2013.[667] Figure II.E.1 shows that collectively, the number of traditional MVPD subscribers fell from 75.9 million at the end of 2020 to 69.2 million at the end of 2021, which represents a loss of 6.7 million video subscribers.[668] Further, between 2020 and 2021, cable MVPDs lost 3 million subscribers, DBS MVPDs lost 2.6 million subscribers, and telephone company MVPDs lost 1.1 million subscribers.[669] At the end of 2021, 51.3% of U.S. households subscribed to a traditional MVPD.[670] According to Leichtman Research Group, households subscribing to MVPD and vMVPD services tend to be older and/or have higher incomes than households that do not subscribe to these services.[671] Leichtman Research Group also found that subscribers to MVPD and vMVPD services have stronger preferences for sports and news, relative to non-subscribers.[672]

(Continued from previous page)
[661] *See* S&P Global, *Top Cable MSOs* (last accessed May 26, 2022) (*Top Cable MSOs*); Ian Olgeirson and Mau Rodriguez, S&P Global, *Multichannel Trends: 2021 US multichannel video declines hit 8.9%, virtual growth slows* (Mar. 14, 2022) (*2021 US Multichannel Video Declines*). We do not provide URLs for S&P Global articles and data throughout this section because it is a paid subscription service that cannot be publicly accessed.

[662] The nine cable MVPDs were Mediacom, Astound Broadband, Breezeline, Cable One, Armstrong Utilities, Midcontinent Communications, WideOpenWest, Service Electric Cable TV, Blue Ridge Cable Technologies. *Top Cable MSOs*. The telephone company MVPDs were Frontier Communications and Cincinnati Bell. *2021 US Multichannel Video Declines*.

[663] *Top Cable MSOs*.

[664] Where cable overbuilders exist (e.g., Astound Broadband), consumers have access to more than one cable MVPD. The available data, however, do not permit us to calculate how many homes have access to two cable MVPDs.

[665] We recognize that physical features (e.g., tall buildings, terrain, and trees) prevent some housing units from receiving DBS signals. *See 2020 Communications Marketplace Report*, 36 FCC Rcd at 3049, para. 155 & n.447.

[666] S&P Global, *Cable/Telco Broadband Overlap* (last accessed June 1, 2022). Although we distinguish telco MVPDs from cable MVPDs for descriptive purposes for this marketplace report, we note that telco MVPDs are cable operators for regulatory purposes. *See Promoting Innovation and Competition in the Provision of Multichannel Video Programming Distribution Services*, MB Docket No. 14-261, Notice of Proposed Rulemaking, 29 FCC Rcd 15995, 16026-29, paras. 71-77 (2014).

[667] S&P Global, *U.S. Multichannel Industry Benchmarks* (last accessed May 26, 2022) (*Multichannel Benchmarks*).

[668] *2021 US Multichannel Video Declines*. This follows a loss of 7.3 million video subscribers between 2019 and 2020. *Id.*

[669] *Multichannel Benchmarks*.

[670] *2021 US Multichannel Video Declines*.

[671] Leichtman Research Group, *Research Notes 1Q 2022* (Apr. 2022), https://www.leichtmanresearch.com/wp-content/uploads/2022/04/LRG-Research-Notes-1Q-2022.pdf (Leichtman Research Notes Q1 2022).

[672] *Id*.

Fig. II.E.1
MVPD Video Subscribers (in millions)

	2020	2021	Net Change	Percentage Change
Cable	46.0	43.0	-3.0	-6.7%
DBS	21.9	19.3	-2.6	-12.0%
Telephone Company	7.9	6.8	-1.1	-13.8%
Total	**75.9**	**69.2**	**-6.7**	**-8.8%**

Source: S&P Global, *Multichannel Industry Benchmarks* (last accessed Sept. 9, 2022).

219. Figure II.E.2 shows the relative shares of MVPD subscribers for cable, DBS, and telephone companies. In 2021, over 60% of MVPD subscribers subscribed to cable while nearly 30% subscribed to DBS and approximately 10% subscribed to telephone companies. While the total number of MVPD subscribers declined from 75.9 million in 2020, to 69.2 million in 2021, cable's market share increased while the shares for DBS and telephone company MVPDs fell.

Fig. II.E.2
Percentage of MVPD Subscribers

Year	Cable	DBS	Telephone
2020	60.6%	28.9%	10.4%
2021	62.2%	27.9%	9.9%

Source: S&P Global, *U.S. Multichannel Industry Benchmarks* (last accessed Sept. 9, 2022).

220. Figure II.E.3 shows the number of subscribers and market shares for the largest traditional MVPDs at the end of 2021. These MVPDs served approximately 94% of all traditional MVPD subscribers.

Fig. II.E.3
Largest Traditional MVPDs

	2021 Subscribers (in millions)	2021 Market Share
Comcast (Cable)	18.2	26.1%
Charter (Cable)	15.8	22.7%
DIRECTV (DBS)	11.1	16.3%
DISH (DBS)	8.2	12.1%[673]
Verizon (Telephone)	3.6	5.3%
Altice (Cable)	2.9	4.1%
Cox (Cable)	2.6	3.8%
AT&T U-verse[674] (Telephone)	1.9	2.9%
Mediacom (Cable)	0.6	0.8%

Source: John Fletcher, *Multichannel operator demographics*, S&P Global (May 12, 2022). S&P Global, *Market Intelligence: Multichannel distributor video subscriber market share, 2017-2021* (June 1, 2022).

221. Some cable companies consider their MVPD service to be a loss leader, with broadband being the business focus.[675] NTCA argues that "the ability to offer quality video services is an essential component of the business case for broadband deployment . . . and can serve as a driver of broadband adoption in rural areas."[676] Other cable operators assert that the MVPD service remains an important business, even as it gets harder to remain profitable with increasing programming costs.[677] Fourth-quarter 2021 programming costs for Comcast, Charter, and Altice averaged $62.75 per MVPD subscriber per month, a 38% increase since the first-quarter of 2016.[678] ACA Connects contends that programming costs for small and rural MVPDs are significantly higher than those paid by large MVPDs.[679]

b. Channel Packages and Bundling

222. MVPDs typically offer a variety of channel packages at different prices. For example, in mid-2022, DIRECTV offered four packages with channel counts ranging from 160 to more than 330, which were priced from $64.99 to $139.99 per month.[680] Similarly, Verizon offered three packages with channel counts ranging from 125 to more than 425, which were priced from $70.00 to $110.00 per

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[673] The market share estimate for DISH excludes Sling TV. S&P Global, *Multichannel distributor video subscriber market share, 2017-2021* (June 1, 2022).

[674] AT&T's U-verse video service is no longer available for new customers. AT&T, *AT&T U-verse TV Official Site | Important U-verse Update*, https://www.att.com/u-verse-tv/ (last visited Oct. 6, 2022).

[675] Matt Daneman, Communications Daily, *Cable Not Seen Axing Linear Video Anytime Soon, Despite Ongoing Subscriber Slides* (May 31, 2022).

[676] NTCA Comments at 15.

[677] *Id.*

[678] S&P Global, *US Cable Results, Q4'21: Top public MSOs' financial and subscriber data* (Apr. 18, 2022) *(Q4'21 Top Public MSOs*).

[679] ACA Connects Comments at 18-19.

[680] DIRECTV, *Satellite TV Packages: Plans, Channels, & Prices*, https://www.directv.com/satellite/packages/ (last visited Oct. 6, 2022).

month.[681] Although no two channel packages are exactly alike, there is substantial overlap in the packages offered by competing MVPDs. Traditional MVPDs tend to offer all major cable and broadcast networks, similar premium channels, and little in the way of exclusive content.[682] Because of their programming similarities, households typically subscribe to only one MVPD.

223. MVPDs also generally offer access to some channels and VOD programs over the Internet both inside and outside the home.[683] Some MVPDs also offer an online channel package as a vMVPD separate from their MVPD service. For example, DIRECTV offers DIRECTV Stream and DISH offers Sling TV.[684] Some MVPDs offer online channel packages from third-party video programming providers along with their Internet service offerings. For example, Verizon offers YouTube TV.[685] These online channel packages are examined more fully in our discussion of OVDs below.

224. MVPDs offer discounted rates to consumers who purchase video services as part of a bundle that may include some combination of video, Internet, voice, and mobile wireless services.[686] At the end of 2020, 7.5% of video subscribers from the largest cable MVPDs purchased only video service, 43.6% of video subscribers purchased two services, and 49% purchased at least three services.[687] According to S&P Global, the high concentration of video customers subscribing to one or more additional services suggests that cord cutting for cable MVPDs would have been greater without broadband and other bundled services.[688]

c. Pricing

225. The prices displayed to consumers on MVPD websites, in mailings, or in television advertisements typically target new subscribers, and are often only available for a limited time, with

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[681] Verizon, *Fios Mix and Match: Custom Internet, TV and Phone Packages, Plans and Bundles*, https://www.verizon.com/home/bundles/fios/ (last visited Oct. 6, 2022).

[682] The NFL Sunday Ticket, offered exclusively by DIRECTV since 1994, is perhaps the most well-known exception to this observation. *See* Stephen Silver, The National Interest, *How DirecTV Can Survive Losing NFL Sunday Ticket* (May 13, 2022), https://nationalinterest.org/blog/buzz/how-directv-can-survive-losing-nfl-sunday-ticket-202382.

[683] For viewing over the Internet, MVPDs use an authentication process to ensure that users subscribe to an MVPD.

[684] DIRECTV, *Satellite TV & Streaming Services*, https://www.directv.com/ (last visited Oct. 6, 2022); Sling TV, *Live TV Streaming*, https://www.sling.com/ (last visited Oct. 6, 2022).

[685] Verizon, *Verizon Fios TV Packages & Plans – More Than Digital Cable TV*, https://www.verizon.com/home/fiostv/ (last visited Oct. 6, 2022).

[686] Rob Webber, Money Saving Pro, *The best deals for TV, internet & phone bundles*, https://www.moneysavingpro.com/internet/tv-internet-phone-bundles/ (last visited Oct. 6, 2022).

[687] Tony Lenoir, S&P Global, *Multichannel Trends: Bundle subs under pressure as triple-plays dip below 2-product combos in 2020* (Mar. 15, 2021).

[688] *Id*.

prices increasing once the promotional period ends.[689] For example, in August 2022, DIRECTV and Comcast offered new subscribers price discounts for 12 months with a 24-month agreement.[690]

226. In addition to the advertised prices, MVPDs explain that the monthly bill may include additional fees for programming from local broadcast television stations or regional sports networks or for equipment rental. For example, in August 2022, equipment, installation, taxes and fees, a Broadcast TV Fee (up to $24.95 per month), a Regional Sports Fee (up to $19.15 per month), and other applicable charges were not included in the advertised price for Comcast's TV packages.[691] Any fees over-and-above prominently displayed advertised prices are typically included in the advertisements and listed on a subscriber's monthly billing statement.[692]

227. Subscriptions to traditional MVPD channel packages generally include the use of a set-top box. Some MVPDs include one set-top box with the subscription and charge monthly rental fees for additional set-top boxes, which vary in price depending on their high definition (HD) and digital video recorder (DVR) features. Some MVPDs have integrated access to streaming services like Netflix, Hulu, YouTube, and Amazon Prime Video into their set-top boxes, which gives MVPD subscribers the ability to access these streaming services without having to purchase additional streaming equipment.[693] The largest MVPDs offer application software that can be downloaded to PCs, smartphones, and some smart TVs.[694] A few MVPDs also provide apps for streaming devices (e.g., Roku, Amazon Fire, Google Chromecast, and Apple TV+), which allow subscribers to stream MVPD programming to additional TVs, without the need for additional set-top boxes.[695]

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[689] This practice is common in subscription and other repeat purchase markets, in which firms exercise market power over consumers who face switching costs, while also seeking to attract existing customers of rival firms. Consumer switching costs could include transaction costs, learning costs, or contractual costs. *See, e.g.*, Paul Klemperer, *Markets with consumer switching costs*, 102 The Quarterly Journal of Economics, 375-94 (1987); Curtis R. Taylor, *Supplier surfing: Competition and consumer behavior in subscription markets*, 34 RAND Journal of Economics, 223-46 (2003).

[690] DIRECTV, *Satellite TV Packages: Plans, Channels, & Prices*, https://www.directv.com/satellite/packages/ (as of Aug. 5, 2022); Comcast, *Xfinity X1: Our Best Live TV & More*, https://www.xfinity.com/learn/digital-cable-tv/x1 (as of Aug. 5, 2022).

[691] Comcast, *Xfinity X1: Our Best Live TV & More*, https://www.xfinity.com/learn/digital-cable-tv/x1 (as of Aug. 5, 2022).

[692] For example, Comcast's website offers the Select+ Internet and TV bundle for $89.99 per month. Right below the price, however, it says "Pricing & Other Info." When clicked a box opens that provides additional details including information about equipment fees, broadcast fees, and regional sports fees. Comcast, *Xfinity X1: Our Best Live TV & More*, https://www.xfinity.com/learn/digital-cable-tv/x1 (last visited Oct. 6, 2022). Section 1004(a) of the Television Viewer Protection Act of 2019 (TVPA) amended the Act to require MVPDs to "give consumers a breakdown of all charges related to the MVPD's video service" before contracting with a consumer for service and also provides consumers 24 hours in which to cancel such service without penalty. H.R. Rep. No. 116-329, 116th Cong., 1st Sess. 2019 at 4. Section 642(a)(1) of the Act, as added by the TVPA, specifically requires that MVPDs provide "the total monthly charge for the [service] . . . including any related administrative fees, equipment fees, or other charges . . . ." 47 U.S.C. § 562(a)(1) (as added by section 1004(a) of the TVPA, Pub. L. No. 116-94, 133 Stat. 2534 (2019)).

[693] For example, in August 2022, the Comcast Xfinity set-top box included 22 streaming video services and four streaming music services. Comcast, *Streaming Services Available on Xfinity X1 and Flex*, https://www.xfinity.com/learn/digital-cable-tv/streaming-services?INTCMP=X1Learn_StreamingApps_Explore_LearnApps (last visited Oct. 6, 2022).

[694] NCTA Comments at 31.

[695] For example, the Charter Spectrum TV App allows customers to control their TV, view their channel lineup, stream live and VOD programming, and program their DVR. Charter, *Spectrum TV App: Stream TV Live or On-*

(continued….)

d. Video Revenue

228. Video revenues for the largest MVPDs are shown in Figure II.E.4. Although the bulk of MVPD video revenue comes from subscriptions, MVPDs also earn revenue by selling advertising. S&P Global reports that cable MVPDs earned net local advertising revenue of $4.3 billion in both 2020 and 2021.[696] Average monthly video revenue per traditional MVPD subscriber continued to increase from $95.14 at the end of 2020 to $99.60 at the end of 2021.[697]

Fig. II.E.4
MVPD Video Revenue (billions)

	2020	2021	Percentage Change
Comcast	$21.9	$22.1	0.6%
Charter	$17.4	$17.6	1.1%
AT&T/DIRECTV[698]	$28.6	$15.5	-45.8%
DISH[699]	$12.9	$12.9	0.2%

Source: Comcast 2021 SEC Form 10-K at 76 (filed Feb. 2, 2022); Charter 2021 SEC Form 10-K at 34 (filed Jan. 28, 2022); AT&T 2021 SEC Form 10-K at 29 (filed Feb. 16, 2022); and DISH 2021 SEC Form 10-K at 53 (filed Feb. 24, 2022).

e. Content Ownership

229. Some traditional MVPDs have ownership interests in cable, broadcast, and regional sports networks that allow them to vertically integrate their ownership of a distribution network with ownership of video programming. For example, Comcast owns cable networks USA, E!, Syfy, Bravo, MSNBC, CNBC, Oxygen, Golf Channel, Universal Kids, The Olympic Channel, Universo, and CNBC World; regional sports networks in Baltimore/Washington, Boston, Chicago, Philadelphia, Portland (Oregon), Sacramento, and San Francisco; the NBC and Telemundo broadcast networks; 11 NBC-affiliated broadcast stations, 30 Telemundo-affiliated broadcast stations; film studios including the brands Universal Pictures, Illumination, DreamWorks Animation, Focus Features, Working Title; and the Peacock streaming service.[700] In contrast to this approach, AT&T recently separated its distribution networks (DIRECTV, U-verse, and AT&T TV) from its video programming assets (WarnerMedia), which it merged with Discovery in April 2022.[701]

(Continued from previous page)
Demand, https://www.spectrum.com/cable-tv/spectrum-tv-app?opredirect=apps-spectrum-tv-app (last visited Oct. 6, 2022).

[696] Multichannel Benchmarks.

[697] *See* Q4'21 Top Public MSOs.

[698] AT&T's DBS, wireline, and online video services were spun off to DIRECTV in August 2021. The decline in AT&T's reported revenue reflects both a decline in video subscribers and, more importantly, a change in accounting for AT&T's remaining investment in DIRECTV under the equity method. AT&T retained 70% of DIRECTV. AT&T 2021 SEC Form 10-K at 83, 92 (filed Feb. 16, 2022).

[699] DISH video revenue includes Sling TV. *See* DISH 2021 SEC Form 10-K at 53 (filed Feb. 24, 2022).

[700] Comcast 2021 SEC Form 10-K at 6-8 (filed Feb. 2, 2022).

[701] AT&T, Press Release, DIRECTV to Own and Operate Former AT&T Video Operations (Aug. 2, 2021), https://about.att.com/story/2021/att_directv.html; AT&T, Press Release, AT&T and Discovery Close WarnerMedia Transaction (Apr. 8, 2022), https://about.att.com/story/2022/close-warnermedia-transaction.html.

230. Common ownership of entities that *deliver* video programming to consumers and entities that *produce and supply* video programming for delivery may have implications for competition and programming diversity in the MVPD market. Thus, Congress enacted various provisions related to vertical integration between cable operators and programming networks (e.g., program access, program carriage, channel occupancy limit provisions).[702] The Commission reviews some vertical mergers between MVPDs and owners of video content (or vertical aspects of mergers that are otherwise primarily horizontal).[703] In its reviews of such mergers, the Commission seeks to identify and evaluate the potential harms and benefits that might arise.

f. Commercial Availability of Equipment Used to Access MVPD Programming and Services

231. Consistent with section 629 of the Telecommunications Act of 1996,[704] and in response to a 2017 report from the Government Accountability Office, the Commission committed to gather data, solicit comments, and analyze issues relevant to whether there is a need for further regulations to ensure the commercial availability of devices to access MVPD programming.[705] Accordingly, the *2022 CMR*

[702] 47 U.S.C. §§ 533, 536, 548. In 1992, many of the most popular cable programming networks were owned by cable operators. Congress was concerned that cable operators had the ability and incentive to thwart the competitive development of additional programming networks by refusing to carry unaffiliated networks or by insisting on an ownership stake in return for carriage. *See id*. § 536. Congress was also concerned that cable operators had the ability and incentive to thwart competition in the video distribution market by withholding their most popular programming networks from rival MVPDs. *See id*. § 548.

[703] *See, e.g., Applications of Charter Communications, Inc., Time Warner Cable Inc., and Advance/Newhouse Partnership For Consent to Assign or Transfer Control of Licenses and Authorizations*, MB Docket No. 15-149, Memorandum Opinion and Order, 31 FCC Rcd 6327 (2016); *Applications of AT&T Inc. and DIRECTV for Consent to Assign or Transfer Control of Licenses and Authorizations*, MB Docket No. 14-90, Memorandum Opinion and Order, 30 FCC Rcd 9131 (2015); *Applications of Comcast Corporation, General Electric Company and NBC Universal, Inc. For Consent to Assign Licenses and Transfer Control of Licensees*, MB Docket No. 10-56, Memorandum Opinion and Order, 26 FCC Rcd 4238 (2011); *Applications of General Motors Corporation, Hughes Electronics Corporation and The News Corporation LTD*, MB Docket No. 03-124, Memorandum Opinion and Order, 19 FCC Rcd 473 (2004); *Applications for Consent to the Transfer of Control of Licenses and Section 214 Authorizations by Time Warner Inc., and America Online, Inc., et al.*, CS Docket No. 00-30, Memorandum Opinion and Order, 16 FCC Rcd 6547 (2001).

[704] This provision requires the Commission to "adopt regulations to assure the commercial availability—to consumers of multichannel video programming and other services offered over multichannel video programming systems—of converter boxes, interactive communications equipment, and other equipment used by consumers to access multichannel video programming and other services offered over multichannel video programming systems, from manufacturers, retailers, and other vendors not affiliated with any multichannel video programming distributor." 47 U.S.C. § 549(a).

[705] In 2016, the Commission proposed regulations for navigation devices (i.e., set-top boxes) that consumers use to access MVPD video services. *Expanding Consumers' Video Navigation Choices; Commercial Availability of Navigation Devices*, MB Docket No. 16-42, CS Docket No. 97-80, Notice of Proposed Rulemaking and Memorandum Opinion and Order, 31 FCC Rcd 1544 (2016). In 2017, the Government Accountability Office (GAO) concluded that the Commission's proposed regulations did not sufficiently analyze "the extent to which Internet-based providers affect consumer choice for video programming and what that change means for the importance of consumer choice for devices in the context of the Act." U.S. Government Accountability Office, GAO-17-785, FCC Should Conduct Additional Analysis to Evaluate Need for Set-Top Box Regulation, at 22 (2017) (*2017 GAO Report*). Following the *2017 GAO Report*, the Commission indicated that it would use future *Communications Marketplace Reports* to gather data, solicit comments, and perform analysis on issues relevant to whether there is a need for further regulations to ensure the commercial availability of devices to access MVPD programming. Letter from Michelle Carey, Chief, Media Bureau, FCC, to Mark Goldstein, Director, Physical Infrastructure Issues, Government Accountability Office (filed Sept. 21, 2017). The 2016 Notice of Proposed Rulemaking was terminated in 2020. *See Expanding Consumers' Video Navigation Choices; Commercial*

(continued….)

Public Notice sought data and comment to "help the Commission analyze how the ongoing evolution in the video programming market affects competition in the related market for set-top boxes and devices, including how it affects the extent to which consumer choice for devices to access MVPD content remains a relevant aspect of the competitive environment."[706] As detailed below, our review of relevant comments and other available information revealed three developments: (1) a decline in MVPD subscriptions, and, therefore, the number of leased set-top-boxes; (2) increased use of apps to stream MVPD programming on Internet-connected televisions, computers, and smartphones; and (3) increased availability of vMVPDs that provide programming similar to traditional MVPDs but do not require leased set-top boxes.

232. The Commission received two filings relevant to set-top boxes and devices.[707] In its filing, NCTA argues that in today's video marketplace, "there is no longer any legitimate basis for concern that consumers are effectively forced to rent set-top boxes from MVPDs to be able to access video content."[708] NCTA contends that there are alternatives to MVPD-leased set-top boxes for viewing MVPD programming.[709] According to NCTA, all of the nation's largest MVPDs support apps that MVPD subscribers can use to access MVPD programming on Internet-connected devices.[710] NCTA explains that the ability to view MVPD programming on these devices "contrast starkly with the marketplace conditions in 1996 that led Congress to direct the Commission to assure the retail availability of navigation devices."[711] In 1996, NCTA notes, "cable operators were considered to be the dominant providers of Pay-TV service, there was generally only one type of display device (a TV) to watch cable video content, and there was only one way to render scrambled or encrypted cable video on those TVs (a set-top box device obtained from the cable operator)."[712] NCTA further notes that today, only 37% of televisions are connected to an MVPD set-top box.[713] To the extent concerns about an MVPD subscriber's ability to obtain retail devices to access MVPD programming were legitimate over two decades ago, NCTA argues that "those concerns are no longer relevant given the overall competitive video and video device marketplace."[714]

233. FSF's filing notes that consumers purchase a range of devices to access video content, including MVPD programming, "in ways well beyond the wildest dreams of the lawmakers who passed Section 629 over a quarter-century ago."[715] Accordingly, FSF contends that "the sunset provision set forth in Section 629(e) of the 1996 Act has been satisfied."[716]

(Continued from previous page)
Availability of Navigation Devices, MB Docket No. 16-42, CS Docket No. 97-80, Report and Order, 35 FCC Rcd 10209 (2020).

[706] *See 2022 CMR Public Notice* at 8.

[707] *See* NCTA Comments; FSF Comments.

[708] NCTA Comments at 30.

[709] *Id*.

[710] *Id*. at 30-31.

[711] *Id*. at 31.

[712] *Id*. at 31-32.

[713] *Id*. at 32.

[714] *Id*.

[715] FSF Comments at 25.

[716] *Id*. at 24-25.

234. The primary function of a set-top box is to deliver MVPD programming to a television.[717] Set-top boxes are not designed to deliver MVPD programming to smartphones. Most large MVPDs provide apps for smartphones and some provide apps for streaming devices (e.g., Roku, Amazon Fire TV, and Apple TV+) that serve as functional alternatives to set-top boxes for viewing MVPD programming on a television. Charter and Comcast provide apps that allow MVPD subscribers to stream MVPD programming to both smartphones and streaming devices that connect to a television.[718] DISH and DIRECTV provide apps that allow MVPD subscribers to stream MVPD programming to smartphones, but they do not appear to provide apps for streaming devices that connect to a television.[719] DISH makes clear its requirement that an additional leased box is necessary for each additional television.[720]

235. S&P Global notes that the "relevance of traditional multichannel set-top boxes is waning with the confluence of falling subscribers and rising alternative devices."[721] The number of set-top boxes used by MVPD subscribers has declined from a peak of 258 million in 2016 to an estimated 162 million at the end of 2021.[722] Although many MVPD subscribers still lease set-top boxes, they now have additional options for viewing MVPD programming on a television. Specifically, some MVPDs provide apps for streaming devices that allow subscribers to watch MVPD programming on additional televisions without the need for leasing additional equipment. Also, vMVPDs enable subscribers to view programming substantially like traditional MVPD programming on a television without the need to lease any equipment.

3. Online Video Distributors

236. OVDs are entities that distribute video programming to consumers over the Internet, not as a component of an MVPD subscription, and not solely to customers of an ISP owned or operated by the entity or its affiliates.[723] Because OVDs use existing broadband infrastructure, they have a large universe of potential customers for whom they can compete. OVD content typically is available to U.S. consumers on a nationwide basis, although in some cases, geographic availability of OVD content can be limited (e.g., OVDs that offer cable and broadcast channels).[724]

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[717] According to PC Mag, "Many cable TV companies also offer Internet service, but their set-top boxes are only for TV." PC Mag, *Definition of set-top box*, https://www.pcmag.com/encyclopedia/term/set-top-box (last visited Oct. 6, 2022).

[718] Charter, *Spectrum TV App: Stream TV Live or On-Demand*, https://www.spectrum.com/cable-tv/spectrum-tv-app (last visited Oct. 6, 2022); Comcast, *Xfinity Stream App on Xfinity TV Partner Devices FAQs*, https://www.xfinity.com/support/articles/xfinity-stream-app-faqs (last visited Oct. 6, 2022).

[719] *See, e.g.*, DISH, *DISH Anywhere App – Watch TV & Movies with DISH TV Mobile App*, https://www.dish.com/availability/ways-to-watch/tv-mobile-app (last visited Oct. 6, 2022); DIRECTV, *DIRECTV App – Watch Live TV on Your Mobile Phone or Tablet*, https://www.directv.com/satellite/technology/app/ (last visited Oct. 6, 2022); Comcast, *For You – Xfinity Stream*, https://www.xfinity.com/stream/ (last visited Oct. 6, 2022).

[720] DISH says that equipment fees apply for additional televisions. DISH, *DISH Satellite TV - Official Site*, https://www.dish.com/ (last visited Oct. 6, 2022).

[721] Ian Olgeirson, S&P Global, *US cable, telco, DBS set-tops lose traction in 2021 forecast* (July 14, 2021).

[722] *Id*.

[723] Although online video includes both professional and amateur content, our focus is on content similar to the programming offered by cable and broadcast networks.

[724] For example, geographic availability may depend on contractual arrangements with cable networks, broadcast stations, and other content owners. *See 2020 Communications Marketplace Report*, 36 FCC Rcd at 3057, para. 176. Availability may also require building, or contracting with, content distribution networks (CDNs) to enhance the speed and quality of video content delivered to consumers. *Id.*

a. OVD Service Offerings

237. OVDs include many participants that employ a variety of business models and strategies. We discuss four types of service provided by OVDs: Advertising-based Video On Demand (AVOD); Subscription Video On Demand (SVOD); Transactional Video On Demand (TVOD); and virtual Multichannel Video Programming Distributor (vMVPD).[725]

238. *Advertising-based Video On Demand.* AVOD providers allow consumers to access video programming online free of charge and generate revenue from advertisements included with their content.[726] Some AVOD services are owned by large media or technology companies. For example, Google's YouTube offers a wide variety of content, including user-created videos, professionally produced video content, music videos, and clips from TV shows and movies.[727] TikTok, which has been growing rapidly, allows users to share and watch short videos.[728] Several AVOD providers offer movies and TV shows, including NBCUniversal's Vudu,[729] Amazon's Freevee,[730] Fox's Tubi,[731] and Crackle.[732] Paramount Global's ad-supported Pluto TV service provides multi-device access to about 200 linear channels of content, including movies, TV shows, news, and sports, as well as on-demand movies.[733] In addition, broadcast networks have branded AVOD services, including NBC News Now, CBS News Streaming Network, and CBS Sports HQ, which feature live news programming and sports video clips.[734] NBCUniversal's Peacock service provides access to live and on-demand programming, including some original content.[735] Roku, which provides digital media hardware, has been expanding its ad-supported service, The Roku Channel.[736] Beginning in early 2023, Netflix says it will offer a portion of its

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[725] The information in this section is current as of June 2022. We note that OVD offerings and prices continue to change.

[726] *See* Seth Shafer, S&P Global, *Economics of Internet: State of US online video: AVOD 2021* (Nov. 30, 2021) (*Shafer AVOD*); Imagen, *What are SVOD, TVOD, AVOD?*, https://imagen.io/resources/what-are-svod-tvod-avod/ (last visited Oct. 6, 2022) (*What are SVOD, TVOD, AVOD?*); Uscreen, *SVOD, AVOD, TVOD—How to Pick a Monetization Model for Your VOD*, https://www.uscreen.tv/video-business-school/svod-tvod-avod-monetization-models/ (last visited Oct. 6, 2022) (*Uscreen SVOD, AVOD, TVOD*).

[727] YouTube, YouTube website, https://www.youtube.com/ (last visited Oct. 6, 2022); *see also Shafer AVOD*.

[728] Zheping Huang, Bloomberg, *TikTok Turns On the Money Machine* (June 23, 2022), https://www.bloomberg.com/news/features/2022-06-23/tiktok-becomes-cash-machine-with-revenue-tripling-to-12-billion.

[729] Vudu, *Movies On Us*, https://www.vudu.com (last visited Oct. 6, 2022). Vudu is part of NBCUniversal's Fandango Media subsidiary. Warner Brothers Entertainment holds a minority stake in Fandango Media. Fandango, *Corporate Ownership*, https://www.fandango.com/info/corporate-ownership (last visited Oct. 6, 2022). NBCUniversal is itself owned by Comcast. Comcast 2021 SEC Form 10-K at 1 (filed Feb. 2, 2022).

[730] Amazon, *freevee*, https://www.amazon.com/adlp/freevee-about (last visited Oct. 6, 2022).

[731] Tubi TV, tubi website, https://tubitv.com/home (last visited Oct. 6, 2022).

[732] Crackle, Crackle website, https://www.crackle.com/ (last visited Oct. 6, 2022).

[733] Pluto TV, *Drop In. Watch Free.*, https://pluto.tv/welcome (last visited Oct. 6, 2022); Pluto TV, *Channel Lineup*, https://plutotvreview.com/pluto-tv-channels-list-complete/ (last visited Oct. 6, 2022).

[734] NBC, *NBC News Now*, https://www nbcnews.com/now (last visited Oct. 6, 2022); CBS, *CBS News Streaming Network*, https://www.cbsnews.com/live/ (last visited Oct. 6, 2022); CBS, *CBS Sports HQ*, https://www.cbssports.com/cbs-sports-hq/ (last visited Oct. 6, 2022).

[735] Peacock, *Choose a Plan*, https://www.peacocktv.com/plans/all-monthly (last visited Oct. 6, 2022). *See* Blair Marnell, Digital Trends, *What is Peacock?* (Feb. 3, 2021), https://www.digitaltrends.com/movies/what-is-peacock/ (What is Peacock?).

[736] The Roku Channel, The Roku Channel website, https://therokuchannel roku.com/ (last visited Oct. 6, 2022).

programming on an advertisement-supported basis, by partnering with Microsoft to launch an advertisement-supported VOD service.[737]

239. *Subscription Video On Demand.* SVOD providers charge consumers a recurring subscription fee for access to the provider's video content.[738] While it is not possible to list all providers in this report, large SVOD services include Netflix and Amazon Prime Video, both of which provide access to large libraries of video content such as TV shows, movies, documentaries, and original content.[739] These services are similarly priced. Netflix costs from $9.99 to $19.99 per month,[740] while consumers can subscribe to Amazon Prime Video as a standalone service for $8.99 per month or as part of an Amazon Prime membership, which costs $14.99 per month or $139 per year.[741] Amazon Prime Video also provides access to some live events, including Thursday night NFL games, as part of its membership.[742]

240. Disney controls three SVOD services: Hulu, ESPN+, and Disney+. Like Netflix and Amazon Prime Video, Hulu provides access to a library of movies, TV shows, and other video content, including original programming.[743] A Hulu subscription costs $6.99 per month with ads or $12.99 per month without ads.[744] ESPN+ provides access to live sporting events and sports-related programing for $6.99 per month or $69.99 per year.[745] Disney+, which launched in November 2019, offers TV shows and movies from Disney, programming Disney acquired from 20th Century Fox in March 2019, and original programming for $7.99 per month or $79.99 per year.[746]

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[737] Todd Spangler, Variety, *Netflix Aims to Launch Cheaper, Ad-Supported Plan in Early 2023* (July 19, 2022), https://variety.com/2022/digital/news/netflix-ad-supported-plan-launch-1235320040/.

[738] *See What are SVOD, TVOD, AVOD*?; *Uscreen SVOD, AVOD, TVOD*.

[739] In August 2021, Netflix's streaming catalog size was 5,000 movies and 2,400 television series. Amazon Prime Video had 6,000 movies and 1,800 TV series. *See* Seth Shafer, S&P Global, *Economics of Internet: State of US online video: SVOD 2021* (Nov. 23, 2021) (*Shafer SVOD*).

[740] Prices vary according to how many simultaneous users are permitted and the picture quality of streamed content. Netflix, *Plans and Pricing*, https://help.netflix.com/en/node/24926 (last visited Oct. 6, 2022).

[741] Amazon, *The Amazon Prime Membership Fee*, https://us.amazon.com/gp/help/customer/display html?nodeId=G34EUPKVMYFW8N2U (last visited Oct. 6, 2022). Amazon Prime members also receive other benefits such as free shipping on eligible items. Amazon, *Amazon Prime Benefits*, https://www.amazon.com/gp/help/customer/display html?ref =hp left v4 sib&nodeId=GD4TCHHFTXXX328Y (last visited Oct. 6, 2022).

[742] Amazon, *Prime Video*, https://www.amazon.com/gp/video/offers/ (last visited Oct. 6, 2022); Amazon, *Live Events Help: Frequently Asked Questions*, https://www.amazon.com/b?ie=UTF8&node=19343854011 (last visited Oct. 6, 2022).

[743] Disney owns a two-thirds stake in Hulu, while Comcast, through NBCUniversal, owns a one-third stake. In May 2019, Comcast ceded full operational control of Hulu to Disney, with Disney committing to purchase Comcast's minority stake in Hulu in 2024. Alex Sherman, CNBC, *Hulu is facing an existential crisis as Disney approaches a 2024 deadline to buy Comcast's 33% stake* (July 6, 2022), https://www.cnbc.com/2022/07/06/hulu-faces-existential-crisis-as-disney-decides-how-to-move-forward html.

[744] Hulu, *Choose your plan*, http://signup hulu.com/plans (last visited Oct. 6, 2022).

[745] ESPN+, *ESPN+ Programming*, http://dtcimedia.disney.com/espn-plus/programming (last visited Oct. 6, 2022); ESPN+, *Stream Live Sports plus ESPN+ Originals*, https://plus.espn.com/ (last visited Oct. 6, 2022).

[746] Disney+, hulu Disney+ ESPN+ website, https://www.disneyplus.com/ (last visited Oct. 6, 2022); Mike Sorrentino and Joan E. Solsman, CNET, *Disney Plus: Everything to Know (from Lightyear to the Cheaper Tier* (June 22, 2022), https://www.cnet.com/tech/services-and-software/disney-plus-streaming-service-everything-to-know-all-prices/.

241. Other major media companies operate SVOD services as well. In addition to its free ad-supported option, NBCUniversal's Peacock also offers two additional options: a larger library of entertainment for $4.99 per month with ads or the same library for $9.99 per month without ads.[747] Paramount Global's Paramount+ provides access to a library of CBS shows and original content, as well as live channels such as local CBS stations, CBS News Streaming Network, and NFL on CBS. Subscribers pay $4.99 per month for the ad-supported Paramount+ service and $9.99 monthly for an ad-free plan.[748] SHOWTIME can be bundled with Paramount+ for $9.99 per month (with ads) or $12.99 per month (no ads).[749] Warner Bros. Discovery's HBO Max offers original content from HBO, including series, documentaries, specials, and movies, with shows like *Friends* and *The Big Bang Theory*, and movies from Studio Ghibli.[750] HBO Max costs $9.99 (with ads) or $14.99 per month (without ads).[751]

242. In addition, certain technology companies operate SVOD services. Apple offers Apple TV+, which costs $4.99 per month.[752] Apple bundles three months of free subscription to Apple TV+ with the purchase of a variety of Apple devices.[753] Google's YouTube Premium provides ad-free access to YouTube, YouTube Music (YouTube's music streaming service), and some original content for $11.99 per month.[754]

243. Certain SVOD services focus on niche content. For example, BritBox provides access to British television shows from ITV and the BBC for $6.99 per month or $69.99 per year.[755] In addition, SVOD services from many sports leagues and organizations, such as the NBA, NHL, and MLB provide online access to live and archived events and programs.[756]

244. *Transactional Video On Demand*. Unlike the subscription models that offer access to a catalog of programs for a set monthly price, TVOD providers allow consumers to purchase specific video content (movies, TV shows, or live events) on a transactional or per-program basis.[757] Electronic-sell-through transactions provide consumers with permanent access to video content, while download-to-rent

[747] *See* Peacock, *Choose a Plan*, https://www.peacocktv.com/plans/all-monthly (last visited Oct. 6, 2022).

[748] Paramount+, *Pick Your Plan*, https://www.paramountplus.com/account/signup/pickplan/ (last visited Oct. 6, 2022). CBS All Access became Paramount+ on March 4, 2021.

[749] Paramount+, *What is the Paramount+ and SHOWTIME bundle?*, https://help.paramountplus.com/s/article/PD-What-is-the-SHOWTIME-add-on-for-Paramount-subscribers (last visited Oct. 6, 2022).

[750] HBO Max, HBO Max website, https://www hbomax.com/ (last visited Oct. 6, 2022).

[751] *Id.*

[752] Apple, *Apple TV+*, https://www.apple.com/apple-tv-plus/ (last visited Oct. 6, 2022).

[753] *Id.*

[754] YouTube, *YouTube Premium*, https://www.youtube.com/premium (last visited Oct. 6, 2022); YouTube, *Watch YouTube Originals*, https://www.youtube.com/@youtubeoriginals (last visited Oct. 6, 2022); YouTube *Using YouTube Premium benefits*, https://support.google.com/youtube/answer/6308116 (last visited Oct. 6, 2022). YouTube Premium subscribers can also download videos to watch offline and play videos on a mobile device while using other apps or when the screen is off. *Id.*

[755] BritBox, *Welcome to BritBox*, https://www.britbox.com/us/ (last visited Oct. 6, 2022).

[756] *See, e.g.*, NBA, *Watch the NBA On Demand*, https://www nba.com/watch/pricing (last visited Oct. 6, 2022); NHL, *Watch live games online with NHL GameCenter LIVE*, https://www nhl.com/news/watch-live-games-online-with-nhl-gamecenter-live/c-500925 (last visited Oct. 6, 2022); MLB.TV, *The Home of Streaming Baseball*, https://www.mlb.com/live-stream-games/ (last visited Oct. 6, 2022). WWE streaming video is now available from Peacock. Peacock, *WWE*, https://www.peacocktv.com/sports/wwe (last visited Oct. 6, 2022).

[757] *See What are SVOD, TVOD, AVOD?*; *Uscreen, SVOD, AVOD, TVOD*.

transactions give consumers access to video content for a limited period of time.[758] Examples include Amazon's Video Store,[759] Apple's iTunes Store,[760] and Google Play.[761]

245. *Virtual Multichannel Video Programming Distributor*. Like traditional MVPDs, vMVPDs offer consumers access to a package of streaming linear channels.[762] While MVPDs make use of cable, fiber, or satellite infrastructure to deliver their pay television products, vMVPDs, like other OVDs, deliver programming to consumers via the Internet.[763] In 2015, these services launched in select metropolitan markets with comparatively limited access to local broadcast stations, sports, and news.[764] Today, however, vMVPDs often include local broadcast channels and a wide variety of cable networks. vMVPDs tend to market themselves to consumers who wish to "cut the cord" and no longer subscribe to a traditional MVPD.[765] In general, vMVPDs are available to consumers on a wide variety of devices.[766]

246. vMVPD prices vary according to many factors, including the number and types of channels offered, and the availability of local broadcast stations. Some vMVPDs provide fewer channels for a lower cost. For example, Philo subscribers pay $25 per month for VOD content and many live TV channels, but the service does not include sports or broadcast channels.[767] DISH's Sling TV offers three channel packages. Two offer differentiated channel sets at $35 per month, while the third includes all channels in both packages and costs $50 per month. In addition, a variety of add-on channel packages are

[758] *See What are SVOD, TVOD, AVOD?*

[759] Amazon, *Prime Video: Store*, https://www.amazon.com/b/?_encoding=UTF8&filterId=OFFER_FILTER%3DTVOD&node=2858778011&ref=insider_ar_video_pvqa (last visited Oct. 6, 2022).

[760] Apple, *Buy movies and TV shows from the Apple TV app*, https://support.apple.com/en-us/HT203375 (last visited Oct. 6, 2022).

[761] Google Play Help, *Watch Google Play movies & TV shows*, https://support.google.com/googleplay/answer/2851683?co=GENIE.Platform%3DiOS&hl=en (last visited Oct. 6, 2022).

[762] *See, e.g.*, Susan Engleson, Comscore, *When Linear TV and Digital Collide: The Rise of the Virtual MVPD* (Aug. 14, 2018), https://www.comscore.com/Insights/Blog/When-Linear-TV-and-Digital-Collide-The-Rise-of-the-Virtual-MVPD.

[763] *Id*.

[764] *See* Seth Shafer, S&P Global, *Economics of Internet: State of US online video: virtual multichannel* (Oct. 22, 2019). Sony's PlayStation Vue launched in March 2015 and was one of the first vMVPDs, but the service ceased operations in January 2020. Sarah Perez, TechCrunch, *Why Sony's PlayStation Vue Failed* (Jan. 30, 2020), https://techcrunch.com/2020/01/30/why-sonys-playstation-vue-failed/.

[765] *See, e.g.*, Brad Adgate, Forbes, *Virtual MVPD Subscriber Growth Is Slowing* (Dec. 9, 2019), https://www.forbes.com/sites/bradadgate/2019/12/09/virtual-mvpd-subscriber-growth-is-slowing/#6f65a8bb7016 ("virtual MVPDs . . . have been marketed as replacement cable/satellite systems"); Sling TV, *The best of cable, for less*, https://www.sling.com/value/cable-tv-alternatives (last visited Oct. 6, 2022) ("Between the low monthly cost, versatile lineup options and wide variety of supported streaming devices, it's no wonder that Sling is often called the best alternative to cable").

[766] *See* Kym Nator, S&P Global, *Economics of Internet: State of US online video: virtual multichannel 2021* (Nov. 24, 2021) (Nator Virtual Multichannel).

[767] *See* Philo, *Live and On Demand TV*, https://try.philo.com/ (last visited Oct. 6, 2022). Users can add premium channels from Epix and Starz at additional cost. *Id.*

available with prices ranging from $6 to $11 per month.[768] These packages include some non-local news and sports content, and local broadcast channels.[769]

247. More expansive vMVPD offerings include Hulu + Live TV. This service combines access to Hulu's SVOD library with more than 65 live and on-demand TV channels for $69.99 per month.[770] It includes news and sports programming and local broadcast stations, and regional sports networks are available in select markets. For $64.99 per month, YouTube TV offers access to more than 85 channels, including sports and news programming. YouTube TV also offers a Spanish-language package for $34.99 per month.[771] DIRECTV, which AT&T spun off into a separate entity on August 2, 2021,[772] offers DIRECTV Stream channel packages ranging in price from $69.99 per month to $149.99 per month.[773] The service includes local channels and regional sports networks.[774] FuboTV offers three plans: Pro (117 channels for $69.99 per month), Elite (172 channels for $79.99 per month), and Latino (41 channels for $32.99 per month).[775] FuboTV also offers local ABC, CBS, Fox, and NBC stations in many markets.[776] Many vMVPD offerings available today look similar to traditional MVPD offerings, but vMVPDs typically pay more per subscriber to acquire programming than do traditional MVPDs.[777]

248. *Bundles and Combinations*. Some OVDs are offered in bundles or in combination with other services. For example, consumers can bundle all three Disney OVD products—Hulu, ESPN+, and Disney+—for $13.99 per month (with ads) or $19.99 (no ads).[778] DIRECTV Stream subscribers get three months of Showtime, Epic, Starz, and Cinemax free to encourage them to subscribe to these channels as add-ons.[779] Amazon Prime members also can add on-demand or live programming from providers like SHOWTIME, STARZ, Paramount+, PBS, Major League Baseball, and many other channels for an additional $3 to $25 per month.[780] Amazon's Twitch, a platform for live video streaming, includes a

[768] Sling TV, *Personalize your channel lineup*, https://www.sling.com/service (last visited Oct. 6, 2022).

[769] Sling TV, *New to Sling? Let's talk about local channels*, https://www.sling.com/programming/local-channels (last visited Oct. 6, 2022).

[770] Hulu, *Watch Thousands of TV Shows and Movies on Hulu*, http://hulu.com/content (last visited Oct. 6, 2022). Subscribers also receive unlimited cloud DVR storage for a storage period of up to nine months. *Id.*

[771] YouTube, *YouTube TV*, https://tv.youtube.com/welcome/ (last visited Oct. 6, 2022). YouTube TV subscribers can record programming with unlimited storage space. *Id.*

[772] Catie Keck, The Verge, *AT&T has officially spun off DirecTV, which is now its own business* (Aug. 3, 2021), https://www.theverge.com/2021/8/3/22608577/att-directv-tpg-deal-u-verse-att-tv-new-company.

[773] DIRECTV, *The Supreme TV Experience*, https://www.directv.com/stream/ (last visited Oct. 6, 2022).

[774] DIRECTV, *DIRECTV Stream Channel Lineup*, https://www.directv.com/stream/channel-lineup/ (last visited Oct. 6, 2022).

[775] FuboTV, *Live Sports and TV Without Cable*, https://www.fubo.tv/welcome (last visited Oct. 6, 2022). Plans also provide 500 hours of Cloud DVR and the ability to watch on multiple screens simultaneously. *Id.*

[776] FuboTV, *What local ABC, CBS, FOX, NBC, and CW stations does fuboTV carry?*, https://support fubo.tv/hc/en-us/articles/115005151127-What-local-ABC-CBS-FOX-NBC-and-CW-stations-does-fuboTV-carry- (last visited Oct. 6, 2022).

[777] *See* Nator Virtual Multichannel.

[778] Disney+, *hulu Disney+ ESPN+*, https://www.disneyplus.com/ (last visited Oct. 6, 2022). This bundle does not include Hulu + Live TV. *Id.*

[779] DIRECTV, *The Supreme TV Experience*, https://www.directv.com/stream/ (last visited Oct. 6, 2022).

[780] Amazon, *What is Prime Video? - Amazon Prime Insider*, https://www.amazon.com/primeinsider/video/prime-video-qa.html (last visited Oct. 6, 2022); *see also* David Katzmaier, CNET, *Amazon Prime Video Channels: All the TV channels you can add to your Prime account* (Sept. 17, 2021), https://www.cnet.com/tech/services-and-software/amazon-prime-video-channels-all-the-tv-channels-you-can-add-to-your-prime-account/.

"Watch Parties" feature that allows streamers with subscriptions to Prime Video to watch movies together as part of a social online experience.[781]

b. Original Content and Content Ownership

249. As the OVD marketplace has evolved, providers have included more original content. While estimates vary, figures show that OVD spending on original content has generally increased over the past five years. Figure II.E.5 shows original content spending for select OVDs. Among OVDs, Netflix is by far the leader in original content spending. As of January 2021, Netflix had 790 original shows, while HBO Max and Amazon Prime Video had the next largest inventories with 190 and 120 original shows, respectively.[782] Some recent reports indicate that OVDs may cut back on original content spending in the future.[783]

Fig. II.E.5
Original Content Spending, Select OVD Providers (in $ millions)

Provider	2020	2021	Percentage Change	2022	Percentage Change
Netflix	$4,309	$5,422	25.8%	$6,512	20.1%
Amazon	$1,102	$1,489	35.2%	$1,904	27.8%
Disney+	$283	$822	190.0%	$1,893	130.3%
Apple TV+	$277	$671	142.1%	$1,157	72.4%
HBO Max	$134	$523	289.9%	$948	81.4%
Paramount+	$217	$398	83.6%	$818	105.7%
Hulu	$461	$534	15.9%	$659	23.5%
Peacock	$56	$194	243.5%	$525	171.2%

Source: Deana Myers, *Streamer success may come with huge content expense*, S&P Global (Apr. 28, 2022).
Note: Figures for 2022 and certain months in 2021 are budgeted amounts.

250. Spending by Amazon and Netflix on original content as a percentage of overall content spending has also been generally increasing. Figure II.E.6 shows that Amazon's spending on original content has increased from approximately 14% of its overall content spending in 2016 to a projected 20% in 2022. Similarly, Netflix spent approximately 18% on original content in 2016, but was budgeted to spend 41% on original content in 2022.

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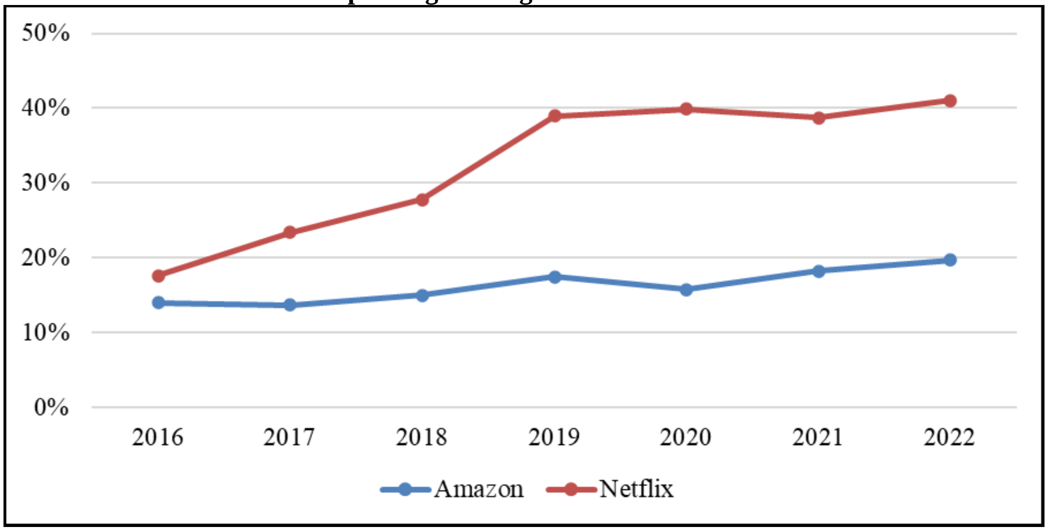
781 *See* Joseph Yaden, DigitalTrends, *What Is Twitch* (Oct. 25, 2020), https://www.digitaltrends.com/gaming/what-is-twitch/; Twitch, *Watch Parties*, https://help.twitch.tv/s/article/watch-parties?language=en_US (last visited Oct. 6, 2022).

782 Travis Clark, Business Insider, *How Netflix, Disney Plus, HBO Max, and more compare in the amount of 'exclusives' and 'originals' they offer* (Feb. 10, 2021), https://www.businessinsider.com/top-streaming-services-for-exclusives-originals-netflix-disney-plus-2021-2.

783 Lucas Shaw, Bloomberg, *The Age of Peak TV Is Ending. An Age of Austerity Is Beginning* (July 4, 2022), https://www.bloomberg.com/news/newsletters/2022-07-04/the-age-of-peak-tv-is-ending-an-age-of-austerity-is-beginning; Joe Bel Bruno, The Wrap, *Streaming Wars on a Budget? How Hollywood Plans to Scale Back Content Spending | Chart* (May 16, 2022), https://www.thewrap.com/why-streamers-are-cutting-content-spending/.

Fig. II.E.6
Share of Content Spending on Original Content: Amazon and Netflix



Source: Deana Myers, *Amazon's content budget projected to near $10B by 2024*, S&P Global (Jul. 1, 2020); Deana Myers, *Netflix content spend increases as new players enter market*, S&P Global (Aug. 26, 2019); Deana Myers, *Streamer success may come with huge content expense*, S&P Global (Apr. 28, 2022). Note: Figures for 2022 and certain months in 2021 are budgeted amounts.

251. Today, many large content owners elect to use their own OVD services, instead of third-party platforms, to make their content available online. For example, in advance of the Disney+ launch, Disney announced that it would pull all Disney and Pixar movie titles from Netflix, and that Disney+ would be the home for all Disney movies going forward.[784] After the company's acquisition of 21st Century Fox (later rebranded 21st Century), Disney-owned Hulu became the exclusive streaming home of FX network content.[785] *The Office*, which is owned by NBCUniversal's TV studio, started streaming exclusively on Peacock in 2021.[786] The agreement by which NBCUniversal and Comcast gave Disney full control of Hulu allows both Hulu and Peacock to offer NBC programming, but gives NBCUniversal the right to pull programming off of Hulu.[787] Some popular shows owned by Warner Brother's Television—including *Friends* (which was pulled from Netflix at the beginning of 2020) and *The Big Bang Theory*—now stream exclusively on Warner Bros. Discovery's HBO Max.[788]

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[784] Michelle Castillo, CNBC, *Disney will pull its movies from Netflix and start its own streaming services* (Aug. 9, 2017), https://www.cnbc.com/2017/08/08/disney-will-pull-its-movies-from-netflix-and-start-its-own-streaming-services.html.

[785] *See* Julia Alexander, The Verge, *Disney is using FX to ensure people don't forget about Hulu* (Nov. 17, 2019), https://www.theverge.com/2019/11/7/20954171/disney-hulu-fox-fx-series-movies-searchlight-streaming-wars-netflix-hbo; Adam B. Vary, Variety, *Disney Drops Fox Name, Will Rebrand as 20th Century Studios, Searchlight Pictures* (Jan. 17, 2020), https://variety.com/2020/film/news/disney-dropping-fox-20th-century-studios-1203470349/.

[786] *See* Joan E. Solsman, CNET, *Peacock: What's Paywalled, What's Free and What Else to Know* (July 29, 2022), https://www.cnet.com/tech/services-and-software/peacock-whats-paywalled-whats-free-and-what-else-to-know/.

[787] *Id.*

[788] Andrea Francese, Showbiz Cheat Sheet, *This is the Real Reason 'The Big Bang Theory' Isn't Streaming on Netflix in the United States and Probably Never Will* (Jan. 6, 2020), https://www.cheatsheet.com/entertainment/this-is-the-real-reason-the-big-bang-theory-isnt-streaming-on-netflix-in-the-united-states-and-probably-never-will.html/.

252. This trend is not universal, however. For example, shows co-produced by Universal Television (an NBCUniversal subsidiary) and Wolf Entertainment, including *Law and Order: SVU*, several seasons of *Law and Order* and *Law and Order: Criminal Intent*, as well as *Chicago Fire*, *Chicago P.D.*, and *Chicago Med*, will stream on NBCUniversal's OVD offering Peacock, but that deal is not exclusive, allowing those series to stream on other platforms as well.[789] At least two shows produced by Warner Bros. Television—*The George Lopez Show* (which was broadcast on ABC) and *Two and a Half Men* (which was broadcast on CBS)—are available on Peacock, but not HBO Max.[790]

c. OVD Usage, Subscribers, and Revenue

253. OVDs can be accessed on a wide variety of Internet-connected devices. Nonetheless, big screen devices account for 77% of streaming video viewing.[791] From the first quarter of 2021 to the first quarter of 2022, viewing of OVD services on smart TVs grew 34%, while desktop computer and gaming console video viewing declined 15%.[792] While changes constantly occur across services and channels, video watching behavior as a whole shows considerable inertia. Total hours spent on digital entertainment and total hours spent watching TV has changed little over the past two years despite the COVID-19 pandemic.[793]

254. *Advertising-based Video On Demand*. Figure II.E.7 shows widespread usage of AVOD services among U.S. consumers. In 2021, about 80% of U.S. households were consuming AVOD, excluding video served on social-media sites.[794] Among individual websites and services, YouTube dominates AVOD. A variety of other companies, however, are moving into this service with niche offerings. Video-sharing is now ubiquitous on social media. Video contributes to time spent on the social-media sites, generates data on user interests, and thus indirectly supports advertising around video (out of stream advertising). TikTok, a video-focused social media site, has seen enormous growth. As of May 2021, TikTok had about 138 million monthly active users in the United States.[795] In the third quarter of 2021, about 20% of U.S. Internet-using households used TikTok.[796]

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[789] Jennifer Maas, The Wrap, *'Two and a Half Men' to Stream Exclusively on NBCUniversal's Peacock, Instead of HBO Max* (Jan. 16, 2020), https://www.thewrap.com/two-and-a-half-men-peacock-streaming-nbcuniversal-not-hbo-max/.

[790] *Id.*

[791] *See* Jon Lafayette, Broadcasting+Cable, *Streaming Rises, With Viewing Shifting to Big Screens From Connected Devices* (May 19, 2022), https://www nexttv.com/news/streaming-rises-with-viewing-shifting-to-big-screens-from-connected-devices.

[792] *Id*.

[793] *See* Keith Nissen, S&P Global, *Q1'22 US Consumer Insights survey report: TV viewing habits are slow to change* (May 5, 2022).

[794] *Shafer AVOD* (estimating 104.3 AVOD U.S. households in 2021); U.S. Census Bureau, *Table HH-1* (Nov. 2021) https://www2.census.gov/programs-surveys/demo/tables/families/time-series/households/hh1.xls (estimating 129.9 million households in the United States in 2021).

[795] *See* Tweet from Matthew Ball, *Here's TikTok MAUs per @FatTailCapital* (May 26, 2021), http://web.archive.org/web/20210526220350/https://twitter.com/ballmatthew/status/1397674482609889281.

[796] *See* Seth Shafer, S&P Global, *Consumer Insights: More Americans are tuning into TikTok* (Feb. 14, 2022).

Fig. II.E.7
U.S. Usage of Leading Advertising-Based Video on Demand (AVOD) Services, September 2021

AVOD Service	Percentage That Reported Using Service
YouTube	65%
Peacock (free versions)	25%
TikTok	20%
The Roku Channel	20%
Tubi	19%
Pluto TV	18%
Freevee (Amazon)	14%
Crackle	11%
Vudu Movies On Us	8%
Samsung TV Plus	8%
LG Channels	5%
VIZIO WatchFree	4%

Source: Seth Shafer, *Economics of Internet: 2022 outlook for US OTT market,* S&P Global (Mar. 2, 2022); Seth Shafer, *Consumer Insights: More Americans are tuning into TikTok*, S&P Global (Feb. 14, 2022).

255. Revenue for AVOD providers continues to increase. Figure II.E.8 shows AVOD revenue figures for instream advertisements (advertisements shown within video content) as well as AVOD-viewing households. Instream AVOD advertisement revenue grew from an estimated $19.4 billion in 2020 to an estimated $25.8 billion in 2022.[797]

Fig. II.E.8
U.S. AVOD Advertising Revenue (in $ billions) and Households (in millions)

	2020	2021	Percentage Change	2022	Percentage Change
Instream Advertising Revenue	$19.4	$23.2	19.2%	$25.8	11.3%
AVOD Households	99.4	104.3	5.0%	108.1	3.7%

Source: Shafer AVOD.

256. *Subscription Video On Demand*. Figure II.E.9 shows that SVOD subscribership is increasing. SVOD subscriptions jumped 31% from the fourth quarter of 2019 to the fourth quarter of 2020, probably spurred by pandemic restrictions. Netflix reported an unexpected decline in subscribers in

[797] *Shafer AVOD*. Revenue for out of stream advertisements (advertisements not connected to a content video stream; e.g., video ads in social media feeds/streams, and pause, menu, and lock screens) are no longer tracked as part of AVOD revenue. Therefore, ad revenue earned by YouTube, TikTok, and other social media platforms are not included in these totals. YouTube's ad revenue was $28.8 billion in 2021. Alphabet Inc. 2021 SEC Form 10-K at 33 (filed Feb. 2, 2022). TikTok's U.S. net advertising revenue, mainly from advertising oriented toward young demographics, was $2.1 billion in 2021 and is projected to be $6.0 billion in 2022. Sara Lebow, eMarketer, *TikTok's ad revenues climb as it gains on major digital ad players* (Apr. 8, 2022), https://www.emarketer.com/content/tiktok-ad-revenues-gains-major-digital-ad-players.

the first quarter of 2022.[798] This decline may be a result of Netflix ending service in Russia following Russia's military actions in Ukraine and inflation, but experts associate more general weakness in Netflix's business with increased competition and Netflix's content and business strategies.[799]

Fig. II.E.9
U.S. SVOD Subscriptions (in millions)

	Q4 2019	Q4 2020	Q4 2021
Subscriptions	221.9	290.8	333.1

Source: S&P Global, *Q4'21 leading US video provider rankings* (Apr. 8, 2022).

257. Households commonly subscribe to more than one SVOD service. Almost 20% of respondents to the Kagan Consumer Insights March 2022 Survey indicated that they subscribed to two SVOD services and 54% indicated that they subscribed to three or more.[800] Among persons who subscribe to a paid video service, 58% subscribed to three or more such services in 2022, up from 32% in 2019.[801] In 2022, the young, active demographic as defined by the survey used 5.9 SVOD services, while mainstream consumers use 3.2 SVOD services.[802] SVOD revenue is also increasing. SVOD revenue was $30.2 billion in 2021, an increase of 28% from $23.5 billion in 2020.[803] Projected revenue for 2022 is $34.0 billion, an increase of 13% from the previous year.[804]

258. *Transactional Video On Demand*. Online rental of video content by U.S. consumers rose 45.8% from 2019 to 2020, probably as a result of the COVID-19 pandemic. However, as Figure II.E.10 indicates, online video rental subsequently declined in 2021. That decline is projected to continue, to a lesser extent, in 2022.

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[798] Netflix, *Letter to Shareholders, First Quarter 2022* (Apr. 19, 2022), https://s22.q4cdn.com/959853165/files/doc_financials/2022/q1/FINAL-Q1-22-Shareholder-Letter.pdf.

[799] *See, e.g.*, Michael Tedder, TheStreet, *Why is Netflix Losing Subscribers? Media experts weigh in on the struggling streaming giant* (Apr. 25, 2022), https://www.thestreet.com/investing/why-is-netflix-losing-subscribers; Ben Thompson, Stratechery, *Why Netflix Should Sell Ads* (Apr. 4, 2022), https://stratechery.com/2022/why-netflix-should-sell-ads/.

[800] Brian Bacon, S&P Global, *Consumer Insights: US SVOD user trends and demographics, Q1 '22* (Apr. 7, 2022).

[801] Nielsen, *State of Play* (Apr. 2022), https://www.nielsen.com/insights/2022/state-of-play/.

[802] Keith Nissen, S&P Global, *Consumer Insights: US consumers who watch the least TV have the most SVOD subscriptions* (May 9, 2022). In the survey, active persons are defined as persons who perform the following lifestyle activities frequently (at least once per week): Exercise—at home or at a gym, read book, read a newspaper, dine out at a restaurant, play a sport, purchase groceries online, or order restaurant food online.

[803] *Shafer SVOD*.

[804] *Id.*

Fig. II.E.10
U.S. Online Rental of Video Content

	2019	2020	Percentage Change	2021	Percentage Change	2022	Percentage Change
Rentals (in millions)	390.0	568.5	45.8%	481.0	-15.4%	468.9	-2.5%
Revenue (in $ billions)	$1.8	$2.8	56.9%	$2.3	-17.8%	$2.3	-3.5%

Source: Deana Myers, *Economics of Internet: State of transactional online video: Rental, electronic sell-through*, S&P Global (Nov. 22, 2021).

259. Figure II.E.11 indicates that from 2020 to 2021, online sales of movie and TV titles to U.S. consumers dropped sharply, reversing sharp growth from 2019 to 2020. Slow growth is projected to resume from 2021 to 2022.

Fig. II.E.11
U.S. Online Sale of Video Content

	2019	2020	Percentage Change	2021	Percentage Change	2022	Percentage Change
Movie Title Purchases (in millions)	120.5	138.5	14.9%	122.6	-11.5%	123.8	1.0%
Movie Title Revenue (in $ billions)	$1.6	$1.9	15.1%	$1.7	-11.4%	$1.7	1.1%
TV Title Purchases (in millions)	390.6	402.3	3.0%	394.3	-2.0%	396.3	0.5%
TV Title Revenue (in $ billions)	$0.7	$0.7	3.0%	$0.7	-1.9%	$0.7	0.6%
Total Revenue (in $ billions)	**$2.3**	**$2.6**	**11.5%**	**$2.3**	**-8.8%**	**$2.4**	**0.9%**

Source: Deana Myers, *Economics of Internet: State of transactional online video: Rental, electronic sell-through*, S&P Global (Nov. 22, 2021).

260. *Virtual Multichannel Video Programming Distributor*. Figure II.E.12 shows that both subscribers and revenues for vMVPD providers have been increasing rapidly. The pattern is similar to the recent growth of AVOD and SVOD, with growth in 2022 projected to be less than the growth between 2020 and 2021.

Fig. II.E.12
U.S. vMVPD Subscribers and Revenue

	2020	2021	Percentage Change	2022	Percentage Change
Subscribers (in millions)	9.6	13.1	36.3%	14.1	13.5%
Revenue (in $ billions)	$7.29	$10.56	44.9%	$12.68	20.1%

Source: Ian Olgeirson, John Fletcher and Mau Rodriguez, *Video bundles plumb new depths as Q1'22 losses mount*, S&P Global (May 6, 2022); *Kym Nator, Economics of Internet: State of US online video: virtual multichannel 2021, S&P Global (Nov. 24, 2021).* Subscribers are for the first quarter of each year.

261. Finally, we provide subscriber figures for select SVOD and vMVPD providers. Provider size and growth percentages vary widely. In mid-2022, Disney company streaming subscribers (Hulu,

Disney+, and ESPN+ subscribers) worldwide surpassed Netflix subscribers worldwide.[805] Change in streaming video providers happens more quickly than changes in MVPD and broadcast video providers.

Fig. II.E.13
Total Subscribers, Select SVOD and vMVPD Providers (in millions)

OVD	Q4 2020	Q4 2021	Percentage Change
Amazon	91.6	108.0	17.9%
Netflix	66.5	67.5	1.5%
Hulu	39.4	45.2	14.7%
Disney+	32.7	38.6	18.0%
HBO / HBO Max	18.3	25.1	37.2%
ESPN+	12.1	21.3	76.0%
Starz	9.5	11.0	15.8%
Showtime	9.3	14.5	55.9%
Paramount+	8.6	N/A	---
Hulu + Live TV	4.0	4.3	7.5%
Sling TV	2.5	2.5	0.0%
FuboTV	0.5	1.0	100.0%
YouTube TV	3.0	3.9	30%

Source: S&P Global, *Q4'21 leading US video provider rankings* (Apr. 8, 2022). Data as of March 2022. YouTube TV figures are for Q3 2020 and 2021.

4. Broadcast Television Stations

262. Broadcast television stations offer linear video programming channels over-the-air to households. In addition, households may also receive broadcast television station programming channels from MVPDs and, in some cases, OVDs. Many commercial stations air programming they produce themselves, such as local news; syndicated programming; and licensed broadcasts of other programming, such as movies. Television stations affiliated with broadcast networks also run programs from their affiliated network.[806] Commercial broadcast television stations generate revenue from two main sources: advertising sales and payments negotiated with MVPDs and OVDs for the right to retransmit station signals.

a. Station Licensing and Ownership

263. The Commission licenses broadcast television stations consistent with the Communications Act.[807] Licenses were formerly granted pursuant to comparative hearings among

[805] Sara Fisher, Axios, *Disney surpasses Netflix in global paid streaming subscribers* (Aug. 10, 2022), https://www.axios.com/2022/08/10/disney-surpasses-netflix-global-paid-subscribers.

[806] Ken Basin, The Business of Television 12 (2018) (Basin (2018)).

[807] 47 U.S.C. § 151 *et seq.*; *see also* 47 CFR §§ 73.601-73.699, 73.1001-73.4280. In this section, we focus on full-power broadcast television stations. In addition to these stations, the Commission licenses Class A and low-power television stations, as well as television translator and satellite stations which are used to increase the geographic reach of the associated main station.

interested applicants.[808] Today, the Commission awards commercial broadcast television licenses by auction. The most recent auction concluded in June 2022. It raised $33 million in net bids, with seven bidders winning a total of 18 construction permits for full power television stations.[809] Non-commercial stations are awarded by a comparative system.[810] Figure II.E.14 shows that the number of licensed broadcast television stations has remained stable in recent years.

Fig. II.E.14
Number of Licensed Broadcast Television Stations

	2018	2019	2020	2021	2022
Commercial UHF	1,011	1,013	1,001	996	999
Commercial VHF	364	370	371	378	374
Non-Commercial	390	378	387	384	384
Total Stations	1,765	1,761	1,759	1,758	1,757

Source: FCC Broadcast Totals as of Mar. 31, 2018; Mar. 31, 2019; Mar. 31, 2020; Mar. 31, 2021; Mar. 31, 2022.[811]

264. Whereas Figure II.E.14 shows the number of television stations in the United States, each viewer can only access the stations in his or her market. Figure II.E.15 is a scatterplot of the number of stations per market by market size (measured in TV households), where each point represents a market.[812] The data show that the number of television stations available increases with market size. While the median market has seven stations, because the population is concentrated in the largest markets, the majority of TV households have access to at least twelve stations. In addition, many television broadcast stations use digital transmission technologies to offer multiple programming streams (digital multicast channels) to viewers.[813] This suggests that the number of stations shown in Figure II.E.15 is a lower bound for the number of broadcast channels available in each market.

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[808] KPMG, History of Broadcast License Application Process at 4 (Nov. 2000), https://transition.fcc.gov/opportunity/meb_study/broadcast_lic_study_pt1.pdf.

[809] *Auction of Construction Permits for Full Power Television Stations Closes; Winning Bidders Announced for Auction 112*, AU Docket No. 21-449, Public Notice, DA 22-659, at 1 (MB/OEA June 23, 2022).

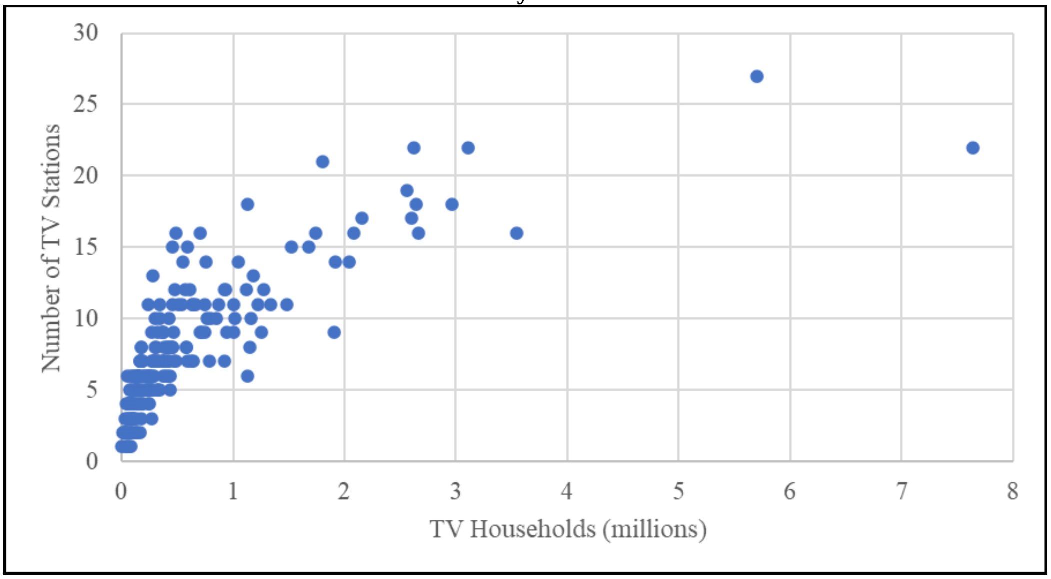
[810] *See Reexamination of the Comparative Standards for Noncommercial Educational Applicants*, MM Docket No. 95-31, Report and Order, 15 FCC Rcd 7386, 7393-7420, paras. 16-79 (2000) (*NCE Comparative Standards Report and Order*).

[811] FCC, Press Release, Broadcast Station Totals as of March 31, 2018 (Apr. 9, 2018), https://docs.fcc.gov/public/attachments/DOC-350110A1.pdf; FCC, Press Release, Broadcast Station Totals as of March 31, 2019 (Apr. 2, 2019), https://docs.fcc.gov/public/attachments/DOC-356801A1.pdf; FCC, Press Release, Broadcast Station Totals as of March 31, 2020 (Apr. 6, 2020), https://docs.fcc.gov/public/attachments/DOC-363515A1.pdf; FCC, Press Release, Broadcast Station Totals as of March 31, 2021 (Apr. 5, 2021), https://docs.fcc.gov/public/attachments/DOC-371337A1.pdf; *Broadcast Station Totals as of March 31, 2022*, Public Notice, DA 22-365 (MB Apr. 5, 2022), https://docs.fcc.gov/public/attachments/DA-22-365A1.pdf.

[812] Fig. II.E.15 defines broadcast television markets using Nielsen's designated market area (DMA) definitions. Each DMA is a group of counties that form an exclusive geographic area in which the home market television stations capture a dominance of total hours viewed. There are 210 DMAs, covering the entire continental United States, Hawaii, and parts of Alaska. The DMA boundaries and DMA data are owned solely and exclusively by Nielsen. Nielsen, *DMA Regions*, https://markets.nielsen.com/us/en/contact-us/intl-campaigns/dma-maps/ (last visited Oct. 6, 2022).

[813] Brad Adgate, Forbes, *TV Stations are Launching Multicast Networks as an Opportunity to Reach Cord Cutters,* (June 10, 2021), https://www.forbes.com/sites/bradadgate/2021/06/10/tv-stations-are-launching-multicast-networks-as-an-opportunity-to-reach-cord-cutters/?sh=475adc6e7136.

Fig.II.E.15
Television Stations by Market Size



Source: BIA/Kelsey MEDIA Access Pro Online Television Analyzer Database as of June 24, 2022; Nielsen, *Nielsen Universe Estimates, by DMA, TV Households by Market Section, January 1, 2022* (Sept. 2021).

265. Most television stations are owned by companies that own multiple stations, called station groups. Figure II.E.16 shows information about the 12 largest station groups in the United States by share of TV households reached. Each station group listed reaches more than 20% of TV households. The table lists the number of stations owned by each group and the number of markets in which the station group owns at least one station. The share of TV households reached by the station group is the total number of TV households living in markets where the station group owns at least one station divided by the total number of TV households in the United States.

Fig.II.E.16
Largest Broadcast Television Station Groups by TV Households Reached

Station Group	Stations	Markets	Share of TV Households Reached
The E.W. Scripps Company	97	74	71.3%
Nexstar Media Group, Inc.	163	116	62.2%
Univision Communications Inc.	40	25	44.7%
TEGNA Inc.	64	51	39.3%
Fox Corporation	30	18	38.7%
Paramount Global	28	17	37.7%
Comcast Corporation	31	21	37.1%
Sinclair Broadcast Group, Inc.	111	82	36.3%
Gray Television, Inc.	157	112	36.1%
Weigel Broadcasting Co.	15	13	29.0%
WRNN-TV Associates Limited Partnership	11	9	24.8%
The Walt Disney Company	8	8	22.1%

Source: S&P Global, *Top TV Station Owners* (last accessed May 31, 2022); Nielsen, *Nielsen Universe Estimates, by DMA, TV Households by Market Section, January 1, 2022* (Sept. 2021).

b. Distribution and Delivery

266. Broadcast television stations reach viewers by broadcasting signals directly over-the-air to homes, as well as through carriage agreements with MVPDs and OVDs, which retransmit the signals of stations to households subscribing to their services. The over-the-air reach of a broadcast television station is determined largely by the height of its transmission tower and the power of its transmitter. Buildings, hills, and other objects, however, may interfere with over-the-air signals.[814] When a broadcast station negotiates with MVPDs and OVDs for carriage of its programming, it is in the business of content distribution—similar to a cable network. When a broadcast station delivers programming over-the-air, it is in the business of content delivery—similar to facilities-based MVPDs.[815]

267. MVPDs offering service within a Designated Market Area (DMA) typically carry the local broadcast television stations assigned to the DMA, and each MVPD rebroadcasts the stations' signals to its subscribers in the DMA. This is because broadcast stations typically hold exclusive rights to broadcast network programming in a DMA. Thus, unlike cable networks that are available nationwide, most broadcast television stations' signals are retransmitted by MVPDs only within the station's assigned DMA. Rebroadcast of television stations' signals by vMVPDs follows a similar pattern—subscribers located in a DMA receive signals of local broadcast television stations from the same DMA.[816]

[814] *2020 Communications Marketplace Report*, 36 FCC Rcd at 3072, para. 205.

[815] *Id.* at 3073, para. 207. Although we discuss the wider business of television broadcasting, we focus on competition in the market for the delivery of video programming. We therefore consider most closely the role played by the over-the-air broadcast service.

[816] *Id.* at 3072-73, para. 206.

c. Programming and Content Ownership

268. *Programming.* Broadcast television stations air network programming, programming produced by the station, and syndicated programming.[817] The major broadcast television networks (ABC, CBS, FOX, and NBC) brand and market a slate of programming, usually acquired from in-house studios, network-affiliated studios, and third-party studios.[818] The major Spanish-language broadcast television networks are Telemundo and Univision.[819] To obtain network programming, broadcast stations enter into affiliation agreements with broadcast networks. In many affiliation agreements, the network sells most of the advertising time during the programming it provides to the station.[820] Further, a station may pay a fee to the broadcast network. The fee the station pays the network is commonly known as reverse compensation or a reverse retransmission fee as it is usually tied to the retransmission consent payments the station receives from MVPDs.[821] In 2021, broadcast TV stations paid an estimated $4.2 billion to major broadcast networks in such fees.[822]

269. Despite COVID-related budget cuts, in 2020, 1,116 television stations aired local news, an increase of 18 from 2019. About 700 of these stations produced local news while the other stations aired local news produced by another station.[823] Large television station groups like Gray and E.W. Scripps have news bureaus in Washington, D.C. that link national news to local concerns; Nexstar's national news bureau is located in Chicago.[824] A Knight Foundation and Gallup Poll survey showed that people tend to judge the credibility of news based on its source, not its content.[825] Several surveys underscore the influence of local news during the COVID-19 pandemic. For example, local news coverage was shown to influence whether people were likely to social distance and wear masks.[826] In terms of political information, research shows that people who live in markets with relevant in-state local television news coverage are 9% more likely to recall correctly the party of their senators and 11% more likely to recall correctly the party of their governor than people whose local news is broadcast from a market that is out-of-state.[827]

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[817] Basin (2018) at 12.

[818] *Id*.

[819] Both Univision- and Telemundo-affiliated broadcast stations reach about 60% of U.S. TV households. S&P Global, *TV Stations by Market and Affiliation* (last accessed June 24, 2022).

[820] Basin (2018) at 9.

[821] Bond and Pecaro, *Reverse Compensation: Broadcaster → Network*, http://www.bondpecaro.com/images/Retransmission_Fees-Reverse_Compensation.pdf (last visited Oct. 6, 2022); Basin (2018) at 13.

[822] S&P Global, *Reverse retrans projections by network, 2011-2027* (July 21, 2022). This total includes payments for the networks: FOX, MyNetworkTV, CBS, the CW, ABC, NBC, and Telemundo.

[823] Bob Papper, *2021 RTDNA/Newhouse School at Syracuse University Newsroom Survey: Local New Business Trends and Threats* (2021), https://www rtdna.org/uploads/files/2021%20RTDNA-Syracuse%20Research%20-%20News%20Business%20Trends%20and%20Threats(1).pdf.

[824] Nexstar Media Group, Inc., *Nexstar Networks*, https://www.nexstar.tv/networks/ (last visited Oct. 6, 2022); Gray Television, *Gray News Washington Bureau*, https://www.graydc.com/ (last visited Oct. 6, 2022); Scripps, *Scripps Washington Bureau*, https://scripps.com/scripps-washington-bureau/ (last visited Oct. 6, 2022).

[825] Gallup/Knight Foundation, *NewsLens 2020: How Americans process the news: an experimental platform that measures attitudes toward different news sources* (2021), https://knightfoundation.org/wp-content/uploads/2021/05/Newslens-2020.pdf.

[826] Eunji Kim, Michael E. Shepherd, Joshua D. Clinton, *The Effect of Big-City News on Rural America During the COVID-19 Pandemic*, 117 PNAS (Proceedings of the National Academy of Sciences) 22009 (Sept. 8, 2020).

[827] Daniel J. Moskowitz, *Local news, information and the nationalization of US elections*, 115 (1) American Political Science Review 126 (2021).

270. Syndicated programming is the third type of content carried by broadcast stations. Syndicated programming includes reruns of programming previously broadcast by a network, sometimes known as "second-run syndication," and first-run original content produced by third-party studios or production companies.[828] First-run syndication agreements are similar to network affiliation agreements. Stations pay studios a mix of cash licensee fees and advertising time. The studio that produces the show sells the advertising time.[829]

271. *Ownership of Content.* In addition to owning broadcast stations and other properties, Disney, Paramount Global, Fox, Comcast, and Univision each has an interest in at least one broadcast network (ABC, CBS and the CW, FOX, NBC and Telemundo, and Univision, respectively).[830] All of these companies except FOX also own large movie or television production studios.[831] In addition, several other broadcast groups also produce and own programming.[832] Owning video content allows its owner to generate revenue from fees to license the content internationally or domestically.

d. Broadcast Television Revenue

272. *Advertising Revenue.* Broadcast television stations air advertising spots during breaks in programming. Network affiliation agreements specify the number of advertising minutes allocated to the network and to the local station. The station controls most of the advertising presented alongside its own programming or licensed syndicated programming. The network controls most of the advertising presented alongside network programming.[833] Another source of revenue is product integration or product placement, which generally refers to the paid use, depiction, or mention of a product within a television show. Unlike traditional advertising, product placement is not separately demarcated from the show, but integrated into the program itself.[834]

273. The price of an advertising spot is generally determined by the size and demographic composition of the program's audience.[835] Local broadcast stations particularly rely on revenue from election years when political advertisers buy quantities of advertising time targeted at specific geographic markets. Local news programming, and the advertising presented alongside it, are vital to broadcast stations.[836] In 2021, Nexstar reported that it earned 44% of its advertising revenue from spots aired during local news programming.[837]

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[828] Basin (2018) at 12.

[829] *Id*. at 15.

[830] Disney 2021 SEC Form 10-K at 3 (filed Oct. 2, 2021), ViacomCBS 2021 SEC Form 10-K at I-1 (filed Feb. 15, 2022), Fox Corporation 2021 SEC Form 10-K at 1 (filed Aug. 10, 2021), Comcast 2021 SEC Form 10-K at 1 (filed Feb. 2, 2022), Grupo Televisa 2021 SEC Form 20-F at 29 (filed Apr. 29, 2022).

[831] Disney 2021 SEC Form 10-K at 3 (filed Oct. 2, 2021), ViacomCBS 2021 SEC Form 10-K at I-1 (filed Feb. 15, 2022), Comcast 2021 SEC Form 10-K at 1 (filed Feb. 2, 2022), Grupo Televisa 2021 SEC Form 20-F at 29 (filed Apr. 29, 2022).

[832] *See, e.g.,* Gray 2021 SEC Form 10-K at 4 (filed Feb. 25, 2022); Fox 2021 SEC Form 10-K at 3 (filed Aug. 10, 2021); E.W. Scripps SEC Form 10-K at 4 (filed Feb. 25, 2022); TEGNA SEC Form 10-K at 3 (filed May 2, 2022).

[833] Basin (2018) at 15.

[834] *See, e.g.*, *Id.* at 16; Adrian Horton, The Guardian, *John Oliver places fake sponsored content on to local news: 'Far too easy'* (May 24, 2021), https://www.theguardian.com/tv-and-radio/2021/may/24/john-oliver-fake-sponsored-content-local-news#:~:text=So%2Dcalled%20%E2%80%9Cbrandigation%20placement%E2%80%9D,widespread%20practice%20on%20local%20stations.

[835] Basin (2018) at xxii, 9.

[836] *Id.* at 15.

[837] Nexstar 2021 SEC Form 10-K at 5 (filed Feb. 28, 2022).

274. Both local and national businesses buy advertising spots from broadcast television stations. Advertising spots are sold to local advertisers directly through a station's local sales staff while national advertisers generally work with national advertising sales representative firms to buy advertising time.[838] Figure II.E.17 shows annual gross revenues for broadcast stations for the period 2017-2021. Total advertising revenue was about $20.6 billion in 2021. Local advertising revenue makes up the largest share of advertising revenue. Advertising revenue has remained relatively flat over the past five years, but its share of total gross revenue has fallen from 69% in 2017 to about 60% in 2021.

275. *Retransmission Consent Revenue.* Many broadcast television stations generate revenue by granting MVPDs and OVDs the right to carry their signals. Pursuant to section 325 of the Communications Act, MVPDs may not retransmit a broadcast television station's signal without the station's express permission.[839] If a station elects transmission consent, the station and MVPD negotiate a carriage agreement, which often includes monetary or other types of compensation for the television station.[840] If a carriage agreement cannot be negotiated, the MVPD must stop retransmitting the station's broadcast signal and viewers lose access to the station through the MVPD, in what is known as a blackout. Figure II.E.17 also shows retransmission consent revenue over the period 2017-2021. Retransmission consent revenue increased by 42%, from $9.5 billion to $13.5 billion, from 2017 to 2021. As noted above, a station may pay a portion of its retransmission consent fees to its affiliated broadcast network in what is called reverse compensation or reverse retransmission fees.[841] In 2021, stations paid about $4.2 billion to broadcast networks in such fees.[842]

Fig. II.E.17
Broadcast Television Station Industry Gross Revenue Trends (billions)

	2017	2018	2019	2020	2021
Total advertising	$21.3	$23.5	$21.9	$21.0	$20.6
Local	$12.2	$12.1	$12.3	$9.9	$11.4
National	$5.9	$5.8	$5.9	$4.9	$5.3
Political	$0.9	$3.0	$1.0	$3.6	$0.9
Online	$2.3	$2.5	$2.7	$2.7	$3.0
Retransmission Consent	$9.5	$11.1	$12.0	$13.0	$13.5
Total	**$30.8**	**$34.6**	**$33.8**	**$34.1**	**$34.1**

Source: S&P Global, *US TV station industry total revenue projections, 2009-2026* (June 2021).

5. Competition in Video

276. We now discuss various aspects of competition among MVPDs, OVDs, and broadcast television stations. In doing so, we present data on household subscription to, and use of, multiple video services, as well as total subscription figures for the top video services. Finally, we examine competition in advertising by presenting advertising revenue estimates by sector.

[838] *Id.*

[839] 47 U.S.C. § 325(b). Every three years, commercial television stations must elect either the right to grant consent for the MVPDs in the DMA to retransmit the station's signal or the right to receive mandatory carriage by those MVPDs. *Id.* § 325(b)(3)(B); 47 CFR §§ 76.56(b), 76.64.

[840] *2020 Communications Marketplace Report*, 36 FCC Rcd at 3076, para. 216.

[841] Bond and Pecaro, *Reverse Compensation: Broadcaster → Network*, http://www.bondpecaro.com/images/Retransmission_Fees-Reverse_Compensation.pdf (last visited Oct. 6, 2022); Basin (2018) at 13.

[842] S&P Global, *Reverse retrans projections by network, 2011-2027* (July 21, 2022). This total includes payments for the networks: FOX, MyNetworkTV, CBS, the CW, ABC, NBC, and Telemundo.

277. *Time, Location, and Device Flexibility.* Many consumers value the ability to watch video programming at any time and in any place. In response to consumer preferences, MVPDs, which traditionally offered linear video programming channels to view on a television set in the home, today also offer VOD content and DVR services as discussed above. In addition, many MVPDs allow subscribers to watch programming on devices other than a television set anywhere that has an Internet connection. Among OVDs, vMVPDs also offer linear programming channels with some VOD programming and DVR capabilities, while AVOD, SVOD, and TVOD services are built around VOD programming. OVDs also offer location and device flexibility, as noted above, as OVDs are available via an Internet connection and many are available on multiple devices. Broadcast stations offer linear video programming channels over-the-air and therefore cannot provide time, location, or device flexibility. However, consumers who view these stations through an MVPD or OVD may have additional flexibility.

278. *Programming.* Because MVPDs, which often hold significant content assets, usually make their networks available to other MVPDs and vMVPDs, exclusive content is typically not a point of competition between MVPDs or between MVPDs and vMVPDs. MVPDs and vMVPDs, however, differentiate their services from other OVDs and broadcast television stations by offering a full complement of live sports programming.[843] As noted above, surveys show that subscribers to MVPD and vMVPD services have stronger preferences for sports and news, relative to non-subscribers.[844] While some live sports programming is offered by SVODs,[845] these services offer a limited variety of sports and a limited number of games. Broadcast television stations offer a variety of sports programming through network programming, but many games are aired only on national cable networks and regional sports networks.

279. As discussed above, to draw customers to their services, OVDs such as Netflix, Amazon Prime Video, HBO Max, and Disney+ offer exclusive programming—both new TV shows and movies and already released video programming—on their services. When video programming owners, like Disney, Comcast, and AT&T, developed their own online video services, they pulled back popular video programming licensed to competitive OVDs to offer it exclusively on their own services.[846] In addition, many OVDs develop exclusive original programming. In 2021, as shown in Figure II.E.5 above, Netflix spent an estimated $5.4 billion on original content, while Amazon Prime Video and Disney+ spent $1.5 billion and $822 million, respectively.

280. The ascendance of OVDs is affecting content distribution decisions.[847] For example, more expensive original series, especially scripted shows, are now more likely to go to OVDs rather than cable or broadcast networks, while unscripted shows, like game shows, which are cheaper to produce, are filling more time on cable and broadcast TV.[848] In its 2021 disclosure to investors, Disney stated that, departing from past practice, it may release movies simultaneously on its OVD services and in theaters. It also stated that it may refrain from selling its content and instead keep programming for its OVD services. Further, Disney stated that some content may be distributed exclusively on its OVD.[849]

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[843] MVPDs and vMVPDs offer national broadcast and cable networks as well as regional sports networks which air live sports programming.

[844] Leichtman Research Notes Q1 2022.

[845] Amazon, *Live Events Help: Frequently Asked Questions*, https://www.amazon.com/b?ie=UTF8&node=19343854011 (last visited Oct. 6, 2022).

[846] Tali Arbel, AP News, *AT&T pulls 'Friends' from Netflix for its streaming service*, AP News (July 9, 2019), https://apnews.com/557110226d10440c905f9563e70c4bc2.

[847] *See* DIRECTV Comments at 10-11.

[848] Rob Woen, *TV Talk: Media Companies Prioritize Streaming Services Over Cable* (Jan. 28, 2021), https://triblive.com/aande/movies-tv/tv-talk-media-companies-prioritize-streaming-services-over-cable/.

[849] Disney 2021 SEC Form 10-K at 4 (filed Nov. 24, 2021).

281. *Pricing and Contracts.* As discussed above, MVPD subscriptions are declining. Many subscribers who cancel their MVPD subscriptions cite rising prices as a cause.[850] As noted above, in addition to the service price advertised by MVPDs, subscribers may be charged fees for installation, equipment, regional sports networks, broadcast stations, and other services. In contrast, OVDs generally do not charge additional fees.[851] Further, OVDs generally offer flexible cancellation[852] and some OVDs offer free service trials.[853] Many MVPDs, on the other hand, offer service under long-term contracts, and consumers often pay a fee to terminate the contract before its end date.[854]

282. *Consumer Access.* Consumer access to video providers depends on the geographic market and type of service. For over-the-air television, the number of available stations depends both on the number of stations allocated to the consumer's DMA and the consumer's ability to receive a useable over-the-air signal from the station.[855] In addition, most households have access to at least one cable provider and two DBS providers, and some also have access to a telephone company MVPD. To obtain service from an OVD, a consumer must have Internet access.

283. *Video Subscription and Use Data.* At the end of 2021, 15% of U.S. TV households watched over-the-air television, and 80% of these over-the-air households also subscribed to an OVD. Another 27% of TV households relied only on OVDs for video service, an increase from 9% in 2018, and 57% of TV households subscribed to cable television in addition to other video services, a drop from 76% in 2018.[856] In 2021, 78% of all U.S. households subscribed to at least one of the three top SVODs, Netflix, Amazon Prime Video, and/or Hulu. The survey also found that 58% of U.S. households subscribed to more than one of the top three SVODs, compared to 55% in 2020, 51% in 2019, and 28% in 2016.[857]

284. Information on overall viewership shows that viewership of OVD services grew, while viewership of broadcast and cable television fell from July 2021 to July 2022. In July 2022, both OVD and cable services captured about one-third of total viewing time while about 22% of viewing time was spent watching broadcast television. Viewership of OVD services increased by about 6.5 percentage points from July 2021 while viewership of cable and broadcast television fell by three and two percentage points, respectively.[858]

285. Figure II.E.18 shows year-end subscribers for the period 2017-2021 for selected video providers including major MVPDs and OVDs. In 2021, Amazon Prime Video and Netflix had approximately 108 million and 68 million subscribers, respectively. The next most popular video

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[850] Keith Nissen, S&P Global, *US, Europe video cord cutting: Same trend, different reasons* (Oct. 18, 2021).

[851] Michael Timmerman, Clark, *Cable vs. Streaming: Does Cutting the Cord Really Save You Money?* (June 30, 2020), https://clark.com/technology/tvsatellite-cable/cable-streaming-price-comparison/.

[852] *Id.*

[853] *See, e.g.*, HBO Max, *Watch Free Episodes from HBO Max*, https://www.hbomax.com/collections/watch-free/ (last visited Oct. 6, 2022); Hulu, *Free Trials on Hulu*, https://help.hulu.com/s/article/free-trials (last visited Oct. 6, 2022).

[854] Chantel Buchi, Reviews.org, *How to Avoid TV Cancellation Fees* (Apr. 28, 2022), https://www reviews.org/tv-service/television-cancellation-fees/.

[855] FCC, *DTV Reception Maps*, https://www fcc.gov/media/engineering/dtvmaps (last visited Oct. 6, 2022).

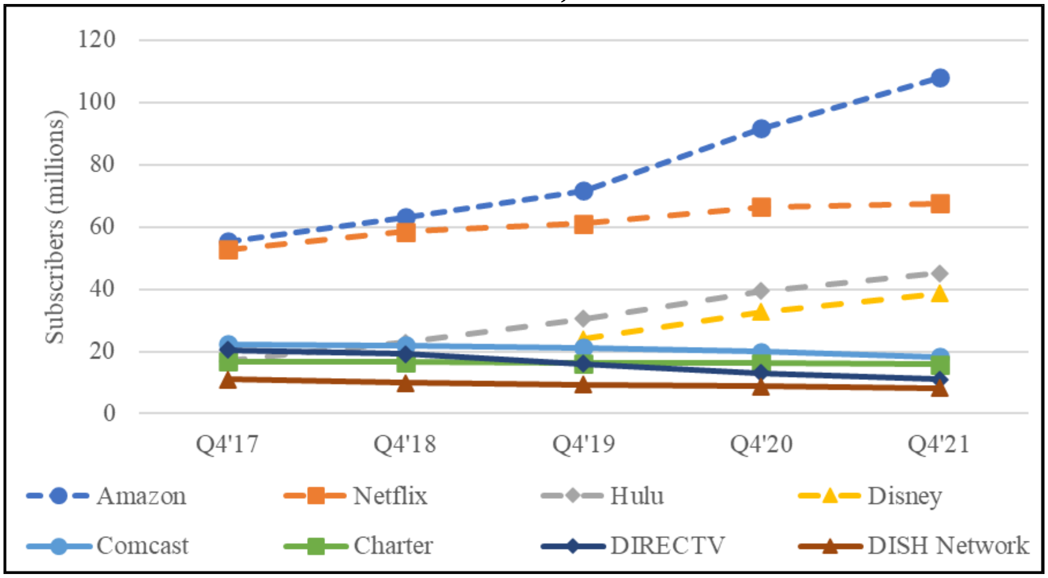
[856] Nielsen, *OTA+OTT: The New TV Bundle* (May 31, 2022), https://www.nielsen.com/us/en/insights/article/2022/ota-ott-the-new-tv-bundle/.

[857] Leichtman Research Group, *Research Notes 3Q 2021* (Sept. 2021), https://www.leichtmanresearch.com/wp-content/uploads/2021/09/LRG-Research-Notes-3Q-2021.pdf.

[858] Nielsen, *Streaming claims largest piece of TV viewing pie in July* (Aug. 2022), https://www.nielsen.com/insights/2022/streaming-claims-largest-piece-of-tv-viewing-pie-in-july/.

provider, Hulu, had about 45 million subscribers. Disney+, which entered the market in 2019, had about 39 million subscribers. MVPDs (Comcast, Charter, DIRECTV, and DISH) saw subscriber declines from 2017 to 2021, while OVDs (Amazon, Netflix, Hulu, and Disney+) saw subscriber increases over the same period.

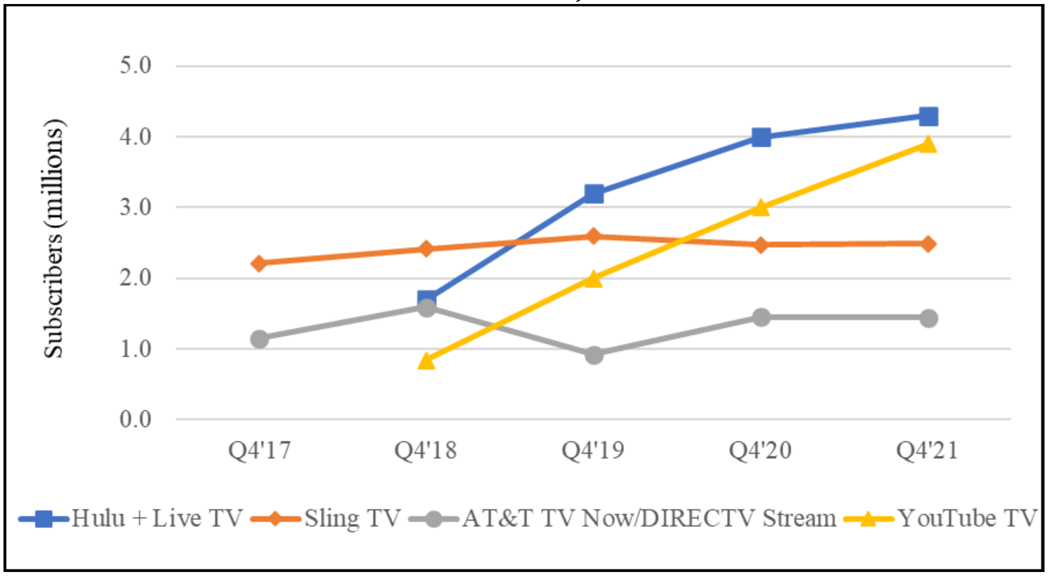
Fig. II.E.18
Video subscribers, 2017-2021



Source: S&P Global, *Q4'21 leading US video provider rankings* (Apr. 8, 2022). Note: Amazon subscribers include all Prime members, including those who do not use video.

286. Similarly, Figure II.E.19 shows vMVPD subscribers over the period 2017-2021. Subscribers to Hulu + Live TV and YouTube TV more than doubled over the full period, while subscribers to AT&T Now/DIRECTV Stream and Sling TV had more modest increases. Hulu + Live TV was the only vMVPD with more than 4 million subscribers in 2021.

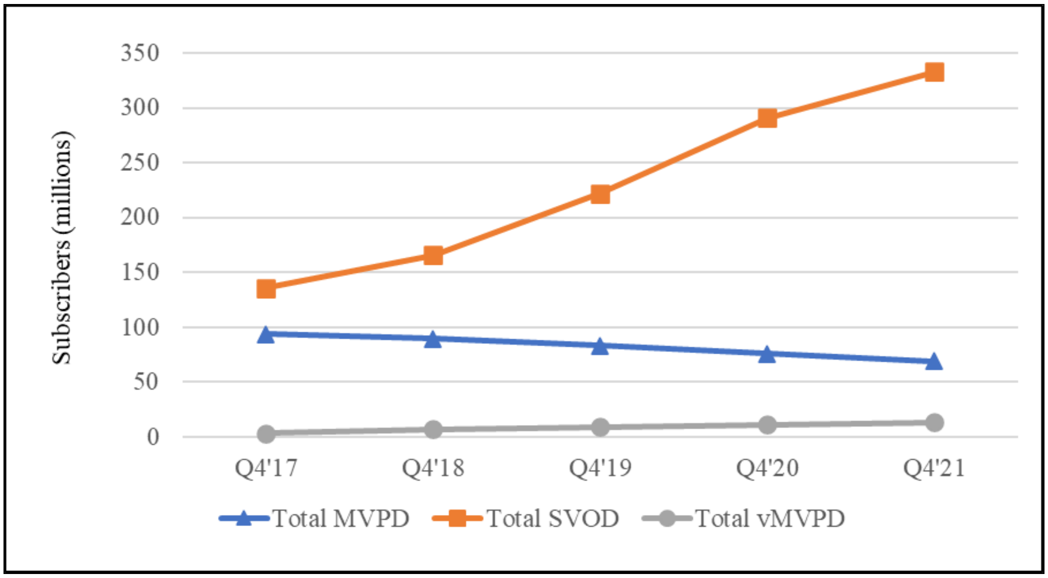
Fig. II.E.19
vMVPD Subscribers, 2017-2021



Source: S&P Global, *Q4'21 leading US video provider rankings* (Apr. 8, 2022). Note: YouTube TV data for 2020 and 2021 is for Q3, not Q4.

287. Figure II.E.20 aggregates the information in Figures II.E.18 and II.E.19 to show total video subscriptions by service type. As discussed in previous sections, MVPDs subscriptions have declined over the past five years while OVD (SVOD and vMVPD) subscriptions have risen. In the fourth quarter of 2021, there were 69.1 million MVPD subscriptions, 13.2 million vMVPD subscriptions, and 333.1 million SVOD subscriptions. In spite of gains since 2015, by 2021, the number of vMVPD subscriptions remained relatively small compared to the number of MVPD and SVOD subscribers.

Fig. II.E.20
Video Subscriptions by Service Type



Source: S&P Global, *Q4'21 leading US video provider rankings* (Apr. 8, 2022); S&P Global, *Multichannel Industry Benchmarks* (last accessed Aug. 4, 2022).

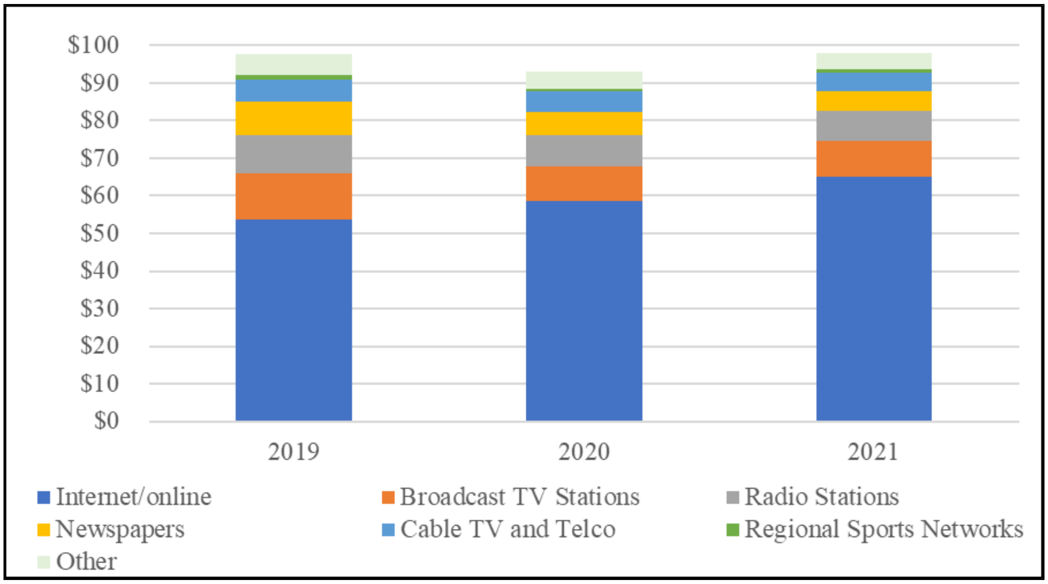
288. Consistent with the trends reported above, the Bureau of Labor Statistics (BLS) reported that average household spending on cable and satellite services decreased from $672.14 in 2018 to $574.75 in 2021 while spending on rental, streaming, and downloading video increased from $50.22 to $113.94 over the same period. In 2021, just under half of all households reported purchasing cable and satellite services while about one-third of households reported expenditure on rental, streaming, and downloading video.[859]

289. *Advertising Revenue.* Figure II.E.21 provides a breakdown of local advertising revenue by sector over the period 2019-2021.[860] Over this time period, online local advertising revenue increased 21% and its share of local advertising revenue rose to 67%. While local advertising revenue for all other sectors declined, newspapers suffered the largest percentage decline in local advertising revenue, falling from $8.8 billion to $5.2 billion. In 2021, local advertising revenue earned by broadcast television stations and cable TV and telecommunications companies fell to $9.7 billion and $5.0 billion, respectively. In contrast, online local advertising revenue grew to $65 billion.

[859] U.S. Bureau of Labor Statistics, *Consumer Expenditure Survey*, https://www.bls.gov/cex/tables/top-line-means htm (last visited Oct. 6, 2022).

[860] Local advertising refers to advertising sold to businesses with a physical presence in the local market, while national advertising refers to advertising sold to national brands.

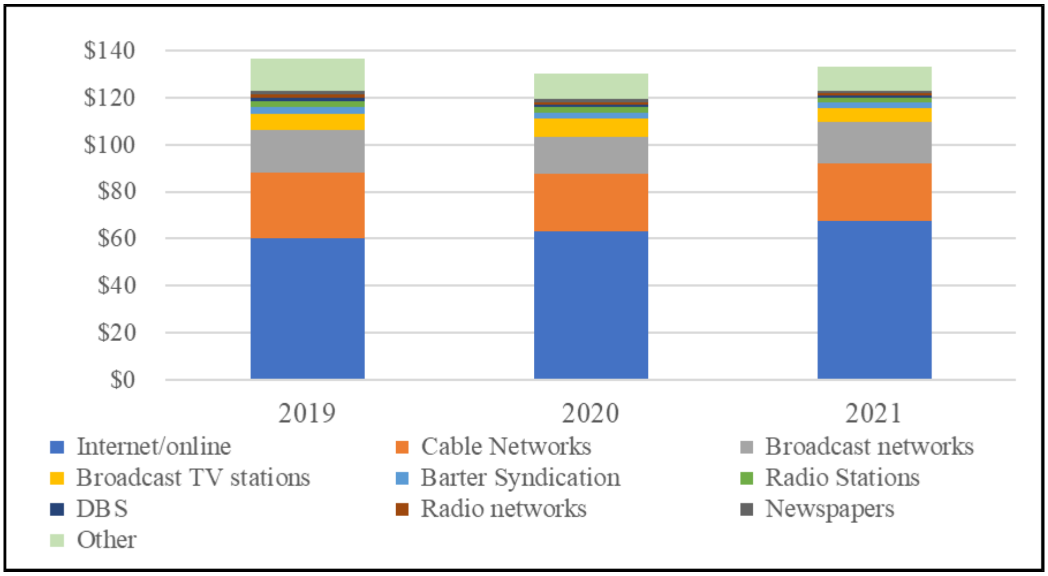
Fig. II.E.21
Local Advertising Gross Revenues by Sector (billions)
(2019-2021)



Source: S&P Global, *US Advertising Revenue by Sector, 2020-2030* (Feb. 2021); S&P Global, *US Advertising Revenue by Sector*, *2019-2029* (Jan. 2020).

290. Figure II.E.22 provides a breakdown of national advertising revenue by sector over the period 2019-2021. National advertising revenue earned by online platforms increased from $60.2 billion to $67.4 billion from 2019 to 2021. National advertising earned by cable networks fell from $28.1 billion to $24.6 billion, while national advertising revenue earned by broadcast networks fell from $18.1 billion to $17.9 billion, and national advertising revenue earned by broadcast television stations fell from $6.9 billion to $5.8 billion.

Fig. II.E.22
National Advertising Gross Revenue by Sector (billions)
(2019-2021)



Source: S&P Global, *US Advertising Revenue by Sector, 2020-2030* (Feb. 2021); S&P Global, *US Advertising Revenue by Sector, 2019-2029* (Jan. 2020). Note: Other includes business publications, farm publications, outdoor/out of home, satellite radio, and yellow pages.

6. Report on Cable Industry Prices

291. In the context of the discussion of MVPDs in the video marketplace, we report on the average rates charged by cable operators for basic cable service and other cable programming, as well as cable equipment to access such programming,[861] as required by section 623(k) of the Communications Act of 1934, as amended by the Cable Television Consumer Protection Act of 1992 (Cable Act)[862] and the RAY BAUM's Act of 2018.[863] Consistent with the statute, the Commission is required to compare the rates of operators subject to effective competition to the rates of operators not subject to effective competition under a statutorily defined standard (hereinafter referred to as "effective competition").[864] In

[861] A "cable operator" (or operator) refers to an entity that operates a wireline system and is an MVPD that makes available for purchase, by subscribers or customers, multiple channels of video programming. 47 U.S.C. § 522(5). "Service tier" (or service) refers to a cable service for which a separate rate applies. *Id.* § 522(l7). Regarding the statutory provision for regulation of rates, operators must provide a separately available "basic cable service" (or basic service) to which customers must subscribe before accessing any other tier of service. *Id.* § 543(b)(7)(A). "Other cable programming" service means any video programming other than programming offered with the basic service or programming offered on a per channel or per program basis. *Id.* § 543(l)(2).

[862] Section 623(k), adopted as section 3(k) of the Cable Act, Pub. L. No. 102-385, 106 Stat. 1460, codified at 47 U.S.C. § 543(k).

[863] *See* RAY BAUM'S Act of 2018.

[864] Commission findings of effective competition generally are made in reference to a cable community identified by a cable community unit identifier (CUID). The Commission assigns a unique CUID to each operator for each community the operator serves. As discussed in Appx. E, the Commission recently changed its process and presumption for determining effective competition. In 2015, the Commission adopted a rebuttable presumption that cable operators in all cable communities are subject to effective competition. *See Amendment to the Commission's Rules Concerning Effective Competition, Implementation of Section 111 of the STELA Reauthorization Act*, MB Docket No. 15-53, Report and Order, 30 FCC Rcd 6574 (2015). As a result of this change, operators in nearly all

(continued….)

addition, section 110 of the STELA Reauthorization Act of 2014 requires the Commission to report on retransmission consent fees paid by cable systems to broadcast stations or groups.[865] The following presents an overview of the Commission's findings as of January 1, 2022 and fulfills these statutory directives. The Commission's complete *Report on Cable Industry Prices*, containing additional data, information, and findings, can be found in Appendix E.

292. *Average price over all communities.* Cable prices increased over the twelve months ending January 1, 2022, at a lower rate compared to the average annual increases over the past five years. The monthly price for cable subscribers who take only basic service grew by 7.0%, to $42.63, over the year ending January 1, 2022. Over the five years ending January 1, 2022, basic prices rose by an average of 11.2% per year. Prices for expanded basic service increased by 5.2%, to $101.54 over the year ending January 1, 2022. This compares to the average annual increase of 6.2% over the last five years. To account for growth in the number of channels offered with cable services, we also report price per channel (service and equipment lease price divided by number of channels).[866] Over the year ending January 1, 2022, price per channel for basic and expanded basic service grew by 5.3% and 9.2% to $1.09 and 90 cents per channel, respectively. In comparison to cable prices, the rate of general inflation measured by the CPI rose by 7.5% over the twelve months ending January 1, 2022, and at an average annual rate of 2.6% over the last five years.[867]

293. *Average price in communities with a finding of effective competition compared to average price in communities without a finding*. This year there is only one community, serving less than 0.1% of U.S. cable subscribers, without a finding of effective competition.[868] Therefore, we no longer compare prices in effective competition communities to prices in noncompetitive communities. As noted in section II.E.2.a, most households are served by at least three MVPDs.[869] Since operators in nearly all

(Continued from previous page)
communities became subject to effective competition. In addition, in October 2019, the Commission found, for the first time, that a cable operator was subject to effective competition from a local exchange carrier (LEC)-affiliated OVD under the LEC effective competition test. *See Petition for Determination of Effective Competition in 32 Massachusetts Communities and Kauai, HI (HI0011)*, MB Docket No. 18-283, Memorandum Opinion and Order, 34 FCC Rcd 10229 (2019). Rates of an operator subject to effective competition are not subject to regulation by a local franchising authority (LFA). 47 U.S.C. § 543(a)(2); 47 CFR § 76.905(a). An LFA may elect to regulate the rate of basic service of an operator not subject to effective competition. *Id.*

[865] *See* section 110 of the STELA Reauthorization Act of 2014 (STELAR). Section 110 of STELAR, Pub. L. No. 113-200, 128 Stat. 2059 (codified at 47 U.S.C. § 543(k)(2)). Specifically, STELAR instructs the Commission to include in its now biennial *Report on Cable Industry Prices* "the aggregate average total amount paid by cable systems in compensation under section 325 [of the Communications Act of 1934, as amended,]" and to report such information "in a manner substantially similar to the way other comparable information is published" in the report. 47 U.S.C. § 543(k)(2).

[866] The 2022 survey was revised to count the number of HD channels, whereas previous surveys also counted standard definition channels. This year's channel counts, therefore, are about half as large as the channel counts reported in the previous survey. Correspondingly, estimates of average price per channel this year are about twice those reported in the previous survey.

[867] U.S. Bureau of Labor Statistics, *Consumer Price Index for All Urban Consumers: All Items in U.S. City Average (CPIAUCNS)*, https://fred.stlouisfed.org/series/CPIAUCNS (last visited Oct. 6, 2022).

[868] *See infra* Appx. E, Fig. 1.

[869] Most households are served by at least one cable operator and two direct broadcast satellite (DBS) operators. *See supra* section II.E.2.a.

communities are subject to effective competition, this price comparison no longer provides any useful information.[870]

294. *Broadcast retransmission consent compensation fees*. From 2020 to 2021,[871] annual fees paid per subscriber increased, on average, by 20.3%, rising from $168.83 to $203.03. Average monthly retransmission consent fees per subscriber per broadcast station increased by 17.7%, increasing from $1.70 to $2.00 over the same period. Over the period 2013-2021, the compound average annual increase in fees per subscriber was 30.6%.

F. The Audio Market

1. Overview of the Audio Programming Market

295. Consumers can access audio programming from multiple sources—from terrestrial broadcast radio stations, which have existed in the marketplace for over a century, to more recent marketplace entrants, such as entities that use the Internet to deliver audio content to consumers. Distinguishing features of audio providers include the method of delivery (including access using various consumer devices), the ability to download programming rather than solely stream programming or listen live, and the type and quantity of content offered. The major participants in today's marketplace for the delivery of audio programming can be divided into three categories: terrestrial radio broadcasters, satellite radio providers, and online audio providers.[872]

296. Terrestrial radio broadcasters use terrestrial radio stations licensed by the Commission to broadcast audio programming over-the-air to consumers, who primarily use radios to receive the stations' programming. Participants in this category include AM, FM, and low-power FM (LPFM) radio stations. There are thousands of terrestrial radio stations in the United States, providing linear channels of music, news, sports, entertainment, educational programming, and other content.[873] As discussed below, some terrestrial radio programming is also available online via computers, smartphones, smart speakers, and other devices with access to the Internet. Terrestrial radio revenue depends primarily on advertising and has generally remained steady, except for a sharp dip in 2020 associated with the COVID-19 pandemic.

297. SiriusXM is the only provider of satellite radio in the United States today and depends on both advertising and subscription revenue. The company uses satellite technology to offer subscription-based audio programming to consumers. Most subscribers access satellite radio programming in cars using specially designed receivers that either come standard or can be installed by the factory/dealer. Consumers can also use computers, smartphones, and other devices to access this content over the Internet. SiriusXM provides multiple linear channels of programming, including exclusive content and features.[874]

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[870] Further, we cannot make a statistically valid comparison between prices in the effective competition group and prices in the noncompetitive group. When comparing average values between two groups, it is necessary to account for sampling error and this cannot be done if one of the groups has only one sampling unit.

[871] The data for retransmission consent fees are collected somewhat differently than the rest of the data in the *Report on Cable Industry Prices*. Retransmission consent fee data are collected for complete years, whereas all other data are collected as of a certain date (January 1) of the survey year and the previous year. As a result, the retransmission consent fee data are for the complete years 2020 and 2021 (the latest two years for which annual retransmission consent data were available at the time of the 2022 survey), whereas the other data in the survey are snapshots as of January 1, 2021 or January 1, 2022.

[872] These three categories do not include music channels on cable and satellite TV or recorded music, such as CDs.

[873] Linear channels provide specific audio content or programs at a specific time of day. By contrast, podcasts and downloaded audio programming can be listened to it at any time.

[874] SiriusXM, SiriusXM website, https://www.siriusxm.com (last visited Oct. 6, 2022).

298. Online audio providers use the Internet to deliver audio programming to consumers. Consumers, in turn, access this programming using computers, smartphones, smart speakers, and other devices. Certain online audio providers offer linear audio channels similar to those offered by terrestrial radio stations. Others, such as Pandora, allow listeners to search by artist or music genre and to avoid advertisements by paying subscription fees. Certain providers also allow users to access and download audio content and listen to it at any time (e.g., podcasts). Online audio providers include larger, well-known entities such as Apple Music and Spotify, as well as numerous other providers, some of which focus on specialty content for niche audiences. Online audio providers rely on both paid subscriptions and advertising for revenue; however, in recent years there has been a shift toward greater reliance on paid subscriptions.

2. Terrestrial Radio Broadcasters

299. Terrestrial radio broadcasters, which include full power AM and FM radio stations and LPFM stations,[875] have long been the mainstay of the audio programming market. Most radio stations broadcast analog signals over-the-air to consumers, with some stations also transmitting high-quality digital audio to consumers.[876] FM stations that broadcast digital signals are able to provide multiple streams of programming to consumers, as well as other data, such as song information, weather updates, traffic reports, and other news. Consumers, however, must have a receiver with both an analog tuner and a digital tuner to receive all broadcast signals.[877]

300. Terrestrial radio stations must receive authorization from the Commission before they construct and operate in the United States and are subject to both the Communications Act of 1934, as amended, and regulations promulgated by the Commission thereunder.[878] In allocating and authorizing terrestrial radio stations, the Commission is charged with ensuring that such stations are distributed across the country and licensed to communities in a manner that serves the public interest.[879] In addition, licensees of terrestrial broadcast stations must comply with certain obligations and rules to ensure that the

[875] The Commission created the LPFM radio service in January 2000. LPFM stations operate at a much lower power, and serve a much smaller area, than full power FM stations. FCC, *Low Power FM (LPFM) Broadcast Radio Stations*, https://www fcc.gov/media/radio/lpfm (last visited Oct. 6, 2022). LPFM stations are authorized for noncommercial educational broadcasting only and must be licensed to government or non-profit educational institutions; non-profit organizations, associations, or entities with an educational purpose; or government or nonprofit entities providing local public safety or transportation service. LPFM license applicants must be based in the community in which they intend to broadcast. *See* 47 CFR § 73.853; FCC, *Low Power FM Radio* (*LPFM*), https://www.fcc.gov/consumers/guides/low-power-fm-lpfm-radio (last visited Oct. 6, 2022). LPFM stations typically provide opportunities for local and niche programming. *See* Mariella Rudi, *A Homegrown Radio Station Is Keeping Venice Weird*, Los Angeleno (Aug. 15, 2019), https://losangeleno.com/strange-days/venice-fm.

[876] Digital audio transmission and reception are more resistant to interference and eliminate many imperfections of analog radio transmission and reception, offering better sound quality than analog. FM digital radio can provide clear sound comparable in quality to CDs, and AM digital radio can provide sound quality equivalent to that of standard analog FM. FCC, *Digital Radio*, https://www fcc.gov/consumers/guides/digital-radio (last visited Oct. 6, 2022).

[877] *Id*.

[878] 47 U.S.C. § 301. The Commission licenses broadcast spectrum to applicants and approves any assignment or transfer of control of broadcast licenses. *Id*. §§ 303(c), 308(a), 309(a), 310(d). In addition, certain obligations and rules are imposed on licensees to ensure that the licensed spectrum is used to serve the public interest during each license term. *See, e.g.*, *id*. § 307(c); 47 CFR §§ 73.1020, 73.3555.

[879] 47 U.S.C. §§ 303, 307.

licensed spectrum is used to serve the public interest.[880] Licenses for broadcast radio stations have an eight-year term, but licenses can be renewed by the Commission upon application by the licensee.[881]

301. As Figure II.F.1 shows, the number of AM, FM, and LPFM radio stations in the United States has remained relatively steady in recent years. New stations are possible only through new allocations and award of licenses, either via auction, in the case of commercial stations,[882] or a comparative system for non-commercial stations.[883]

Fig. II.F.1
Number of Licensed Broadcast Radio Stations[884]

	2018	2019	2020	2021	2022
AM	4,633	4,613	4,580	4,546	4,508
FM Commercial	6,741	6,762	6,726	6,682	6,763
FM Non-Commercial	4,125	4,139	4,172	4,213	4,119
Low Power FM	2,150	2,171	2,159	2,114	2,049
Total Stations	17,649	17,685	17,637	17,555	17,439

302. *Revenue*. The primary source of revenue for commercial terrestrial radio stations is advertising. To secure the highest rates and to compete for advertising market share, stations strive to gain the largest audience of listeners possible. Broadcast stations receive advertising revenue from entities seeking to reach consumers listening to programming over-the-air, as well as those listening on

[880] *See, e.g.*, 47 CFR §§ 73.1020, 73.3555.

[881] 47 U.S.C. § 309(k); 47 CFR § 73.1020.

[882] *See NCE Comparative Standards Report and Order*, 15 FCC Rcd at 7427-33, paras. 101-11. The Balanced Budget Act of 1997 amended section 309(j) of the Communications Act "to require the Commission to use competitive bidding to resolve application conflicts, but exempted NCE stations from this process." *Reexamination of the Comparative Standards for Noncommercial Educational Applicants*, MM Docket No. 95-31, Memorandum Opinion and Third Order on Reconsideration, 23 FCC Rcd 17423, 17424, para. 3 (2008) (citing Balanced Budget Act of 1997, Pub. L. No. 105-33, Title III, 111 Stat. 251 (1997), amending 47 U.S.C. § 307(j)).

[883] *See NCE Comparative Standards Report and Order*, 15 FCC Rcd at 7393-7420, paras. 16-79. The Commission recently adopted changes to its rules and procedures for considering competing applications for new and major modifications to noncommercial educational (NCE) FM radio stations. *Reexamination of the Comparative Standards and Procedures for Licensing Noncommercial Educational Broadcast Stations and Low Power FM Stations*, MB Docket No. 19-3, Report and Order, 34 FCC Rcd 12519 (2019); *Reexamination of the Comparative Standards and Procedures for Licensing Noncommercial Educational Broadcast Stations and Low Power FM Stations*, MB Docket No. 19-3, Order on Reconsideration, 35 FCC Rcd 10180 (2020); *see also Media Bureau Announces NCE FM New Station Filing Procedures and Requirements for November 2-9, 2021, Window*, MB Docket No. 20-343, Public Notice, DA 21-885 (MB July 23, 2021).

[884] FCC, Press Release, Broadcast Station Totals as of March 31, 2018 (Apr. 9, 2018), https://docs.fcc.gov/public/attachments/DOC-350110A1.pdf; FCC, Press Release, Broadcast Station Totals as of March 31, 2019 (Apr. 2, 2019), https://docs.fcc.gov/public/attachments/DOC-356801A1.pdf; FCC, Press Release, Broadcast Station Totals as of March 31, 2020 (Apr. 6, 2020), https://docs.fcc.gov/public/attachments/DOC-363515A1.pdf; FCC, Press Release, Broadcast Station Totals as of March 31, 2021 (Apr. 5, 2021), https://www.fcc.gov/document/broadcast-station-totals-march-31-2021; *Broadcast Station Totals as of March 31, 2022*, Public Notice, DA 22-365 (MB Apr. 5, 2022).

online platforms.[885] Figure II.F.2 shows the top 10 largest radio station owners, ranked by revenue. These owners control stations that are not confined to particular geographic regions; rather, their stations are spread across various geographical markets in the United States.

Fig. II.F.2
Top 10 Radio Station Owners

Ultimate Parent	Stations	Markets	Total Ad Revenue (in $ millions)
iHeartMedia, Inc.	745	149	$2,229
Audacy, Inc.	217	47	$1,158
Cumulus Media Inc.	355	85	$537
Beasley Broadcast, Inc.	56	14	$226
Terrier Media Buyer, Inc.	45	10	$203
Townsquare Media, Inc.	224	52	$189
Hubbard Broadcasting, Inc.	33	8	$188
Urban One, Inc.	46	13	$183
Univision Communications, Inc.	48	15	$169
Salem Media Group, Inc.	65	33	$136

Source: S&P Global, *Top Radio Station Owners* (last accessed June 17, 2022).

303. Figure II.F.3 shows total U.S. broadcast radio revenue from 2005 to 2021. Total broadcast radio revenue was virtually flat between 2010 and 2019, going from $17.3 billion in 2010 to $17.8 billion in 2019, for an average annual growth rate of approximately 0.32%.[886] However, total broadcast radio revenue dropped to $13.7 billion in 2020, and then rose to $14.8 billion in 2021, resulting in a net decline of approximately 17% from 2019 to 2021, due largely to the drop in demand for advertising due to the COVID-19 pandemic.[887] Figure II.F.3 also shows that the radio revenue never fully recovered from the decline experienced during the recession following the 2008 financial crisis.

304. Further, Figure II.F.3 breaks down radio revenues between over-the-air radio (which includes network, national spot, and local spot advertising) and online radio (which includes online versions of radio broadcasts). Online broadcast radio has had more substantial revenue growth than over-the-air radio, i.e., a 13.1% increase between 2010 and 2019. The share of revenue from online advertising grew from 3.6% in 2010 to 8.2% in 2021. Online radio is an area of potential growth for radio advertising revenue, especially given various new devices for accessing online radio including smartphones, tablets, and smart speakers. In addition, several large owners of radio stations have recently heavily invested in podcasting.[888]

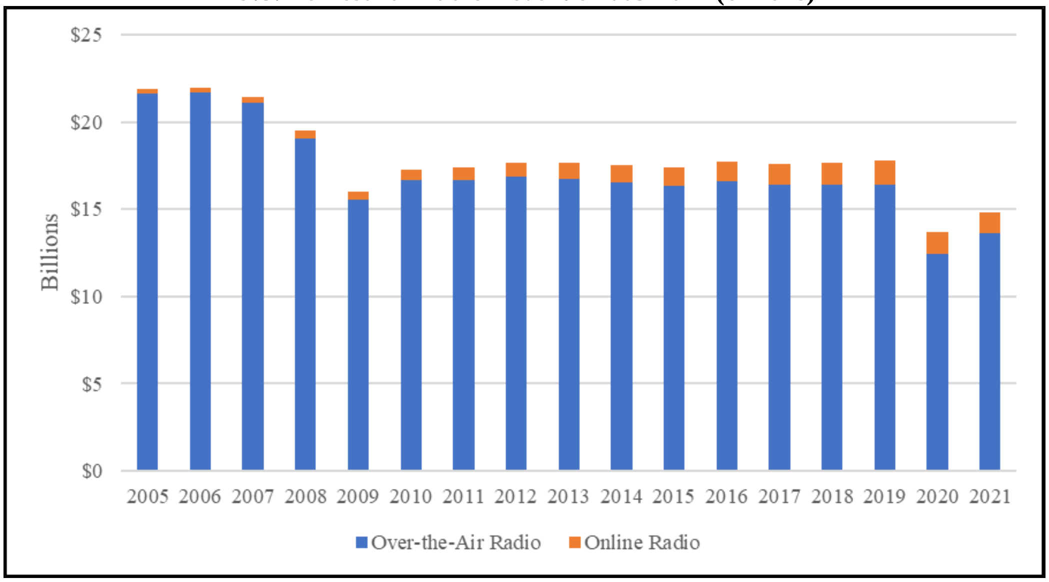
[885] musicFIRST Coalition and Future of Music Coalition note that terrestrial broadcast radio stations in small markets struggle to compete with "larger companies who command a dominant role in multiple platform categories including but not limited to terrestrial radio." musicFIRST/FMC Comments at 4.

[886] Total U.S. radio revenues include network, national spot, local spot, digital/online, and off-air radio advertising. Revenue for off-air advertising includes event sponsorship (e.g., concerts and contests).

[887] Justin Nielson, S&P Global, *US TV and radio station ad projections 2022-32: Political offsets dwindling core* (July 15, 2021).

[888] *See* Justin Nielson, S&P Global, *Radio/TV Station Annual Outlook 2021* (Aug. 3, 2021).

Fig. II.F.3
U.S. Terrestrial Radio Revenue 2005-2021 (billions)



Source*:* S&P Global, *US TV and Radio And Projections, 1970-2031* (last accessed June 17, 2022).

305. *Programming.* Types of radio programming include categories of music and talk. In addition, programming may be live or recorded. Further, because terrestrial stations are located in specific geographic markets, programming may target local listeners in those markets.[889] Alternatively, some stations may choose to broadcast non-local programming that is not specifically targeted to listeners living in a particular market. Since producing a show for one market is likely more costly (per listener) than distributing the same show across stations in many markets, cost considerations may favor non-local programming. On the other hand, promoting a local on-air personality as the "face" of a station may be an important way for a station to distinguish itself from other stations in its market. Some stakeholders have argued that stations that are part of a group of stations whose owner is not local to that market broadcast less programming produced in that market and may be less sensitive to the needs and interests of that market.[890]

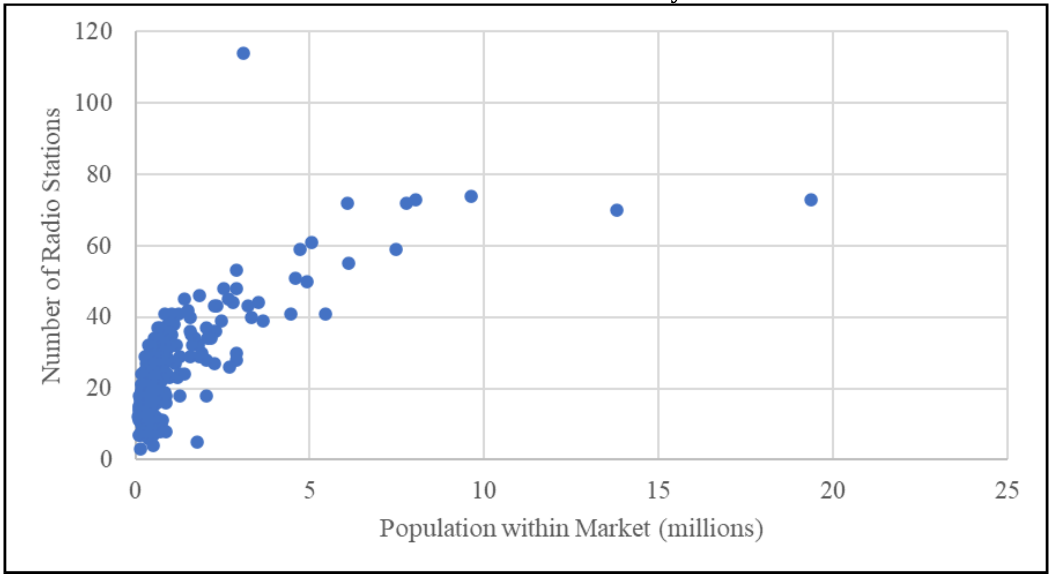
306. Multiple radio stations are generally available to listeners within each geographic market.[891] Figure II.F.4 shows a scatterplot of the number of stations within a market against the market size, measured by population. The number of radio stations available generally increases as the market size increases, suggesting more choices in markets with higher populations. Not shown in the table, however, are additional choices that listeners have, including satellite and online radio, as discussed below.

[889] Because stations have a duty to serve the needs of their local communities, localism has been a cornerstone of broadcast regulations for decades. *Broadcast Localism*, MB Docket No. 04-233, Report on Broadcast Localism and Notice of Proposed Rulemaking, 23 FCC Rcd 1324, 1328, para. 5 (2008).

[890] Advocates of musicians and radio personnel have argued that the consolidation of ownership among AM/FM radio stations has led to reduced local staffing, including DJs and other personnel knowledgeable about local programming, in favor of syndicated programming that is selected and distributed from a central office. *See* musicFIRST/FMC Comments at 13-18.

[891] Terrestrial radio markets are generally named for the largest city within the geographic region, which includes areas outside the city. Such geographical markets for terrestrial radio are identified by The Nielsen Company. Nielsen, *Radio Market Survey Population, Rankings & Information* (Fall 2022), https://www nielsen.com/wp-content/uploads/sites/2/2022/10/Radio-Market-Populations-Fall-2022.pdf.

Fig. II.F.4
Number of Terrestrial Radio Stations by Market Size



Source: BIA/Kelsey MEDIA Access Pro Online Radio Analyzer Database as of August 3, 2022. Note: The market with the largest number of stations is Puerto Rico.

307. We have noted in various proceedings that AM broadcasting services face persistent interference issues.[892] Such interference may have an effect on station format choice. AM stations favor talk formats relative to music formats, which are more common on FM stations, due to the superior sound quality of the FM service. This is illustrated in Figure II.F.5, which presents the distribution of programming formats across AM, FM, and LPFM stations. More than 60% of FM stations have a music format, while only approximately 35% of AM stations have a music format. However, as Figure II.F.5 shows, AM stations favor Spanish and Ethnic, News, Sports, and Talk formats relative to FM stations. The share of stations with a Religion format, which involves both music and talk, is similar for AM and FM stations. Stations with a Public and Education format predominantly use FM frequencies, reflecting the fact that most non-commercial educational stations are FM stations.[893] Approximately 1.5% of FM stations are designated Public and Education format, while there are only four AM stations within that format.

308. Figure II.F.5 also presents the distribution of programming formats for LPFM stations, which have much smaller geographic reach than conventional FM stations.[894] Because LPFM stations are authorized for non-commercial educational broadcasting only, they may provide programming of interest to listeners and community stakeholders that other FM or AM stations do not. As Figure II.F.5 shows, nearly half of LPFM stations are classified as Music stations. However, the music LPFM stations are predominantly classified in the Miscellaneous format, as opposed to music formats such as Rock and

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[892] *See Revitalization of the AM Service*, MB Docket No. 13-249, First Report and Order, Further Notice of Proposed Rulemaking, and Notice of Inquiry, 30 FCC Rcd 12145 (2015).

[893] *See* FCC, *The Licensing of TV and Radio Stations*, *The Public and Broadcasting*, https://www.fcc.gov/media/radio/public-and-broadcasting#NCECOMM (last visited Oct. 6, 2022).

[894] LPFM stations are authorized to operate with an effective radiated power no more than 100 watts. The approximate service range of a 100 watt LPFM station is 3.5 miles radius. FCC, *Low Power FM (LPFM) Broadcast Radio Stations*, https://www.fcc.gov/media/radio/lpfm (last visited Oct. 6, 2022).

Country.[895] Further, about one-third of LPFM stations provide religious community programming (considerably more, in percentage terms, than AM or FM stations), reflecting local churches' or local religious organizations' use of the medium. Additionally, about 5% of LPFM stations are classified as Public and Education format.

Fig. II.F.5
Programming Formats for Terrestrial Radio

Format	AM	FM	LPFM
Music	34.7%	63.3%	46.9%
Spanish and Ethnic	13.6.%	5.8%	11.3%
Religion	16.4%	22.3%	35.9%
Public and Education	0.1%	1.4%	4.8%
News	17.9%	4.9%	0.5%
Sports	11.7%	1.4%	0.1%
Talk	5.6%	0.8%	0.4%

Source: BIA/Kelsey MEDIA Access Pro Online Radio Analyzer Database as of April 12, 2022. Notes: These data include 4,404 AM stations, 10,624 FM stations, and 2,088 LPFM stations. The Music category is constructed by combining the following BIA music format categories: Adult Contemporary, Album Oriented Rock/Classic Rock, Alternative, Classical, Contemporary Hit Radio/Top 40, Country, Easy Listening/Beautiful Music, Jazz/New Age, Middle of the Road, Miscellaneous, Nostalgia/Big Band, Oldies, Rock, and Urban.

3. Satellite Radio

309. In 1995, the Commission allocated spectrum in the 2310–2360 MHz band for satellite digital audio radio service (SDARS).[896] In 1997, the Commission established rules for the service.[897] SDARS provides nationally distributed subscription radio service and requires a significant investment of capital for operation.[898] Two SDARS licensees—Sirius and XM—purchased their licenses at auction, successfully launched their satellite systems, and commenced commercial service to the public.[899] In 2008, Sirius and XM merged and formed SiriusXM,[900] which is currently the only provider of SDARS in

[895] Approximately 75% of music LFPM stations are classified in the Miscellaneous music format. These stations play a wider range of music than what might fall into a particular category, such as Country, Rock, or Adult Contemporary. Thus, programming decisions on these stations likely are not restricted by a particular format or marketing strategy.

[896] *Amendment of the Commission's Rules with Regard to the Establishment and Regulation of New Digital Audio Radio Services*, GN Docket No. 90-357, Report and Order, 10 FCC Rcd 2310, 2310, para. 1 (1995).

[897] *See Establishment of Rules and Policies for the Digital Audio Radio Satellite Service in the 2310-2360 MHz Frequency Band*, GN Docket No. 90-357, Memorandum Opinion and Order and Further Notice of Proposed Rulemaking, 12 FCC Rcd 5754 (1997).

[898] *See Establishment of Rules and Policies for the Digital Audio Radio Satellite Service in the 2310-2360 MHz Frequency Band*, IB Docket No. 95-91, Second Further Notice of Proposed Rulemaking, 22 FCC Rcd 22123, 22150, Appx. B (2007) (*SDARS Second Further Notice*).

[899] XM began nationwide commercial service on Nov. 12, 2001; Sirius began commercial service on Feb. 14, 2002. *See SDARS Second Further Notice,* 22 FCC Rcd at 22123, para. 1 & n.4.

[900] *See Applications for Consent to the Transfer of Control of Licenses from XM Satellite Radio Holdings Inc. to Sirius Satellite Radio Inc.*, MB Docket No. 07-57, Memorandum Opinion and Order and Report and Order, 23 FCC Rcd 12348, 12349, para. 1 (2008).

the audio marketplace. SiriusXM acquired Pandora Media, a streaming service, on February 1, 2019.[901] SiriusXM reports that it had 34.0 million U.S. subscribers and 6.3 million Pandora self-pay subscribers at the end of 2021.[902]

310. *Revenue*. SiriusXM historically has relied on subscription fees as its primary revenue source.[903] However, since its acquisition of Pandora, a streaming service which has substantial advertising revenue, advertising has accounted for a larger share of SiriusXM's revenues. In 2021, the SiriusXM unit (which excludes Pandora) reported $6.6 billion in revenue, a 4% increase from the prior year.[904] Subscription revenue was the largest source of revenue, constituting $6.1 billion, while advertising revenue represented $188 million.[905] Pandora's subscriber and advertising revenues for 2021 were $530 million and $1.5 billion, respectively.[906] SiriusXM's total revenue, including Pandora, was $8.7 billion for 2021.[907]

311. *Programming and Subscription Plans*. SiriusXM offers over 150 channels via satellite and online streaming, as well as over 250 additional channels that are available only through online streaming.[908] These channels provide content and features not available from other sources. SiriusXM offers consumers three principal subscription packages: Music & Entertainment ($17.99/month), Platinum ($22.99 per month), and Music Showcase ($12.99 per month).[909] All three packages offer access to all of SiriusXM's music channels while the Platinum and Music and Entertainment packages also offer exclusive artist-dedicated channels, comedy channels, news channels, college sports, and traffic and weather.[910] These channels are available online and in vehicles and follow a linear format, so that, like terrestrial stations, programs are scheduled to play at specific times. And while such linear programming does not include interactive features, the acquisition of Pandora has allowed SiriusXM to also offer customized music stations online.

4. Online Audio Providers

312. In addition to terrestrial broadcast radio stations and satellite-delivered radio service, audio programming delivered via the Internet has emerged as a third category in the audio marketplace. Generally, online audio providers may be classified as non-interactive or interactive, with the latter involving user choice, such as choosing specific songs and downloading content. In addition, as discussed above, both terrestrial radio broadcasters and SiriusXM have supplemented their traditional offerings with online audio services.

[901] SiriusXM, Press Release, SiriusXM Completes Acquisition of Pandora (Feb. 1, 2019), https://investor.siriusxm.com/news-events/press-releases/detail/1084/siriusxm-completes-acquisition-of-pandora. As a streaming service, Pandora will be discussed in the following section on online audio providers.

[902] SiriusXM, Press Release, SiriusXM Reports Fourth Quarter and Full-Year 2021 Results (Feb. 1, 2022), https://investor.siriusxm.com/news-events/press-releases/detail/734/siriusxm-reports-fourth-quarter-and-full-year-2021-results. Self-pay subscribers are distinct from users who do not pay but instead listen to advertising.

[903] SiriusXM Holdings Inc. 2021 SEC Form 10-K at 3 (filed Feb. 1, 2022).

[904] *Id.* at 36.

[905] SiriusXM also earned $352 million in revenue from other sources. *Id.*

[906] *Id*.

[907] *Id*.

[908] *See* SiriusXM, *SiriusXM Select, View the Channel Lineup*, https://www.siriusxm.com/packages/siriusselect (last visited Oct. 6, 2022).

[909] SiriusXM, *Popular Plans*, https://www.siriusxm.com/plans (last visited Oct. 6, 2022).

[910] *Id*.

313. *Service Offerings.* Online audio providers generally offer various service options including paid services without ads and free services with ads. In general, these providers make their content available on various mobile applications and smart speakers.[911] Spotify offers free service with advertising and several Premium packages that offer ad-free listening and the ability to download music and programming for play offline. Spotify's Premium packages are Individual ($9.99 per month), Duo ($12.99 per month), Family ($15.99 per month), and Student ($4.99 per month).[912] Apple Music offers similar plans for the Individual ($9.99 per month) and Family ($14.99 per month).[913] SiriusXM also offers three standalone non-satellite (i.e., online audio) streaming plans: Streaming Platinum ($10.99 per month), Streaming Music & Entertainment ($7.99 per month), and Streaming Music Showcase ($4.99 per month).[914] Pandora continues to offer plans for listening to music and podcasts online. Pandora offers a free, ad-supported service offering music and podcasts, ad-free programming with Pandora Plus ($4.99 per month), and Pandora Premium ($9.99 per month), which allows the creation and sharing of playlists.[915]

314. *Revenue, Subscribers, and Usage.* Online audio providers' sources of revenue include both paid subscriptions and ad-supported options that are free to consumers. However, in recent years, a shift toward paid subscriptions led to less reliance on advertising. This trend demonstrates a willingness by consumers to pay for monthly subscriptions to such popular streaming services as Apple Music, Spotify, Amazon Music, and Pandora. In 2020, streaming music contributed to 85% of total U.S. music industry revenue, according to the Recording Industry Association of America (RIAA).[916] RIAA also reports that paid subscriptions grew by 14% year over year to $3.8 billion and accounted for 67% of total U.S. music revenues and 79% of total U.S. streaming music revenue in the first half of 2020.[917] A recent report estimated 2020 global subscription revenue for Spotify, Apple Music, and Pandora Plus to be $7.85 billion, $6.4 billion, and $0.46 billion, respectively.[918] A recent report found that the online audio brands used most often in the United States by persons aged 12 years and older include Spotify (35%), YouTube Music (18%), Pandora (15%), Apple Music (12%), Amazon Music (9%), and iHeart Radio (6%).[919] Further, the number of U.S. subscribers to Spotify, Apple Music, and Amazon Music are estimated to be 148 million, 81.5 million, and 65.5 million, respectively.[920]

315. *Programming.* Online audio providers allow listeners to access a wide range of music. Two of the most popular streaming services, Spotify and Apple Music, provide listeners with access to

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[911] Edison's Infinite Dial 2022 report finds that 88% of the U.S. population aged 12 years and older owns a smartphone, 53% owns a tablet, 35% owns smart speakers, and 18% owns a smartwatch. Edison Research, The Infinite Dial 2022 at 6-9 (2022), http://www.edisonresearch.com/wp-content/uploads/2022/03/Infinite-Dial-2022-Webinar-revised.pdf (Infinite Dial 2022).

[912] Spotify, *Listen without limits. View Plans*, https://www.spotify.com/us/premium/#plans (last visited Oct. 6, 2022).

[913] Apple Music, *Hear sound all around*, https://www.apple.com/apple-music/ (last visited Oct. 6, 2022).

[914] SiriusXM, *Popular Plans*, https://www.siriusxm.com/plans (last visited Oct. 6, 2022).

[915] Pandora, *Choose How You Want to Listen*, https://www.pandora.com/plans (last visited Oct. 6, 2022).

[916] Peter Leitzinger, S&P Global, *Economics of Digital Music and Radio 2020* (Jan. 14, 2021) (Economics of Digital Music and Radio).

[917] *Id*.

[918] John Fletcher, Rob Parungo, & Theodore Vincent Calaor, S&P Global, *Economics of Mobile Music* (July 2, 2020) (Economics of Mobile Music).

[919] Infinite Dial 2022 at 41.

[920] Economics of Mobile Music.

music libraries of 70 million or more songs.[921] Users of premium plans may create their own playlists or genre stations, where they may discover new music within a small preference niche. Because major competing online audio providers generally all offer a wide range of music and related programming, subscribers tend to use only a single streaming service.[922] The widespread availability of most songs through a variety of services and sources has created a challenge for music services seeking to differentiate themselves.

316. *Podcasting*. Podcasting, which offers a large variety of spoken word programming, has provided an important avenue for differentiation among online audio providers. Podcasts can be streamed at any time, in contrast to audio programs on linear channels. Podcasts feature a wide range of content and personalities, with subjects that include scientific research, slice of life journalism, self-help, fringe topics, comedy, stories, and many others. Broadcast radio station owners, SiriusXM, and pure online audio providers have been expanding in this growing audio platform.[923] This expansion into podcasting allows these audio providers to attract subscribers and create key points of differentiation.[924] Digital music and radio services such as Spotify, Pandora, and Apple Music have pursued acquisitions to expand their podcasting programming and attract subscribers.[925] For example, Spotify has signed exclusive podcast talent, such as Joe Rogan and the Kardashians, and has acquired The Ringer, an online sports-focused platform with over 30 podcasts.[926] In addition to increased listenership, advances in advertising such as ad insertion technology and audience targeted data have assisted growth in podcasting.[927]

317. According to Edison's recent Infinite Dial report, the number of people who have listened to a podcast reached 177 million in 2022 (62% of the U.S. population aged 12 years and older).[928] The same report also shows that the share of the population who have listened to a podcast in the last month grew from 17% in 2015 to 41% in 2021.[929] However, Edison's report also indicates that the time spent listening to podcasts as an overall share of audio listening has not grown recently, but rather has declined modestly from 6% in 2021 to 5% in 2022.[930] The Interactive Advertising Bureau reported that ad revenue from podcasts reached $1.4 billion in the United States in 2021.[931]

[921] Lexy Savvides & Vanessa Hand Orellana, CNET, *Apple Music vs. Spotify: Comparing the top music streaming services* (Sept. 25, 2021), https://www.cnet.com/tech/services-and-software/apple-music-vs-spotify-comparing-the-music-streaming-giants-best-2021/#:~:text=Spotify%20says%20it%20has%20a,Music%20is%20over%2075%20million.

[922] A survey from S&P Global suggests that, unlike listeners consuming radio from a variety of terrestrial broadcast stations, most users of online music services tend to use just one service, especially those who use a pay music service. The survey found that of those that subscribed to a pay music service, 74% subscribed to one service only. *See* Brian Bacon, S&P Global, *Online Music User Profiles* (July 12, 2018).

[923] Peter Leitzinger, S&P Global, *Streaming Music Services Invest in Podcasting to Bolster Future Revenue* (Jan. 6, 2021) (Streaming Music Services Invest in Podcasting).

[924] *Id.*

[925] Economics of Digital Music and Radio.

[926] *Id.*

[927] Streaming Music Services Invest in Podcasting.

[928] Infinite Dial 2022 at 51.

[929] *Id.*

[930] *Id.* at 55.

[931] International Advertising Bureau, *U.S. Podcasting Advertising Revenue Study* (May 2022), https://www.iab.com/wp-content/uploads/2022/05/IAB-FY-2021-Podcast-Ad-Revenue-and-2022-2024-Growth-Projections_FINAL.pdf.

5. Competition in Audio Programming

318. Although providers in these three main categories of audio services all deliver audio programming to consumers, there are significant differences in the availability, reach, consumer engagement, and cost of the services. In recent years, the popularity of terrestrial broadcast radio has decreased somewhat while certain online audio programming sources have become more popular. In 2018, Edison Research's Share of Ear report presented the distribution of time spent listening to audio sources for Americans 13 years and older as follows: 46% AM/FM radio, 14% streaming audio, 12% owned music, 11% YouTube, 7% SiriusXM satellite radio, 5% TV music channels, 3% podcasts, and 2% other sources.[932] However, a more recent Share of Ear report indicated that, in 2021, the total share of time spent listening to AM/FM radio was 38%, and the share of time spent listening to podcasts had risen to 5%.[933] The report also noted that in 2021, listeners were spending as much time listening to audio programming on mobile devices (32%) as on AM/FM receivers (33%).[934]

319. *Music as Input*. As noted above, the ubiquity of music creates a challenge for music providers seeking to differentiate themselves. Streaming services allow their subscribers access to a much larger range and quantity of music than listeners can expect to hear on a terrestrial broadcast station, which is constrained to a linear format. The large range and quantity of music provided by online audio providers likely also exceeds what listeners can experience with satellite radio when the latter is confined to a linear format, despite the relatively large number of channels offered. In addition to their large libraries, online audio providers offer their subscribers the flexibility to choose particular songs anytime, create playlists, or listen to stations with song lists chosen by algorithms.

320. *Regulations*. Different audio marketplace participants are subject to different regulatory regimes. For example, because they use the public airwaves, both terrestrial broadcast radio and SDARS must comply with certain Commission regulations. These obligations are not identical and so do not impose identical regulatory costs on these licensees. Online audio providers, in contrast, do not hold Commission licenses for their services and thus do not incur the same Commission regulatory compliance costs.

321. *Music Licensing*. Different marketplace participants are subject to different music licensing conditions under law, which means they face different costs of gaining access to the music they distribute. For example, terrestrial broadcast radio stations—as non-subscription, non-interactive audio transmission—do not pay royalties to performers or sound recording copyright owners for the use of sound recordings over-the-air.[935] In contrast, SiriusXM pays a copyright royalty for the use of sound recordings, but the Digital Millennium Copyright Act granted pre-existing services such as SiriusXM a compulsory copyright license for sound recordings, the rate for which is set by the Copyright Royalty Board through a rate determination proceeding.[936] Interactive subscription services like Spotify must reach commercial agreements with music labels. Despite its higher licensing costs, Spotify's licensing cost as a percentage of its total revenue has declined from 83% in 2013 to 75% in 2019.[937]

[932] Edison Research, *Share of Ear* (2018), https://www.shareofear.com/#audiomesurement.

[933] Peter Leitzinger, S&P Global, *Broadcast Conference Focused on NextGen TV, Radio's Future* (May 5, 2022). Edison Research's Share of Ear report was not made available free of cost in 2021 or 2022.

[934] *Id*.

[935] *See* Citi-GPS, Putting the Band Back Together—Remastering the World of Music at 18 (2018), https://www.citivelocity.com/citigps/music-industry/; musicFIRST/FMC Comments at 18.

[936] Dana A. Scherer, Congressional Research Service, Money for Something: Music Licensing in the 21st Century at 22-23 (last updated Feb. 23, 2021), https://crsreports.congress.gov/product/pdf/R/R43984.

[937] Economics of Mobile Music.

322. *In Car Listening*. Before the advent of satellite radio and various streaming platforms, in-vehicle listeners of audio programming only had access to AM or FM radio. Easy access to AM/FM radio inside vehicles presented terrestrial radio with an advantage over other forms of media such as television and newspapers. However, new technology has allowed other sources of audio programming, specifically satellite radio and online audio providers, to gain a foothold, not just on new devices such as tablets and smartphones, but also within vehicles. SiriusXM's satellite radio hardware was installed into approximately 82% of new vehicles sold in the United States in 2021, an increase from approximately 78% in 2020.[938] In recent years, streaming services such as Spotify and Apple Music have also become available in vehicles, either integrated with cellular technology or through connection with customer smartphones.[939]

323. Further, in 2022, Edison Research found that 73% of adults aged 18 years and older listened to AM/FM radio while driving or riding in a car, 53% listened to owned digital music, 35% listened to a CD player, 32% listened to podcasts, and 22% listened to SiriusXM.[940] Despite the dominance of AM/FM radio, the survey results show that the share of respondents who listened to AM/FM radio fell from 81% in 2020 to 73% in 2022.[941] On the other hand, the share of the population that had ever listened to online audio programming in a car through a cell phone increased from 45% in 2020 to 49% in 2022.[942] Edison also reports that the share of the population that had listened to podcasts in cars increased from 28% to 32% over the same time period.[943]

324. *Mobile Devices*. Audio streaming services such as Spotify, Pandora, and Apple Music provide their diverse music libraries and podcasts through online applications. As noted above, some terrestrial broadcast stations also provide online access to their stations, and SiriusXM makes its satellite radio service available online. Further, iHeartMedia repurposes its broadcasts as podcasts, resulting in low-cost programming that contributes additional advertising revenue.[944] iHeartMedia has also released an application for discovering new podcasts using machine learning inputs such as music preferences, favorite stations, and liked songs.[945]

325. Some online audio providers have even stronger relationships (in some cases through direct ownership) with the most popular device manufacturers. A recent report noted that Apple's more than 1.5 billion mobile devices globally facilitated such offerings as Apple Music.[946] Spotify, in turn, has partnered with electronics manufacturer Samsung to integrate Spotify into Galaxy phones, tablets,

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[938] SiriusXM, *SiriusXM Reports Fourth Quarter and Full Year 2021 Results* (Feb. 1, 2022), https://investor.siriusxm.com/news-events/press-releases/detail/734/siriusxm-reports-fourth-quarter-and-full-year-2021-results.

[939] Peter Letzinger, S&P Global, *Connected Car Projections through 2024: Connectivity Growing as Cars Get Smarter* (July 11, 2019).

[940] Infinite Dial 2022 at 43. The results of this survey are based on the population of adults 18 years and older who have ridden in a car the previous month, which is 84% of the population.

[941] *Id*.

[942] Infinite Dial 2022 at 48.

[943] *Id.* at 45.

[944] Economics of Mobile Music.

[945] *Id*.

[946] *Id.*

watches, as well as Samsung's smart refrigerators, smart TVs, Galaxy Home smart speakers, and the Bixby digital assistant.[947]

326. *Smart Speakers*. Smart speakers have emerged as important devices for accessing audio programming in the home or office, and enhance many aspects of the daily lives of consumers, including those with disabilities.[948] These devices are voice activated and are able to connect with smartphones, tablets, smart switches, smart thermostats, smart doorbells, smart TVs and other smart entertainment devices, or computers via Wi-Fi and Bluetooth. Smart speakers are used for a variety of purposes, which include playing music, getting the news, listening to a podcast, setting a timer/alarm, operating other smart devices within the home, making announcements, being used as a house intercom system, and requesting miscellaneous information such as recipes. For music, consumers can choose to listen to a particular AM or FM station or a streaming service such as Spotify or Amazon music. A recent survey conducted jointly by NPR and Edison Research reported that, in 2022, 35% of Americans aged 18 years and older (approximately 100 million people) own at least one smart speaker, an increase from 32% in 2021.[949] The top three smart speakers are: Amazon Alexa (owned by 23% of the population), Google Nest (owned by 11% of the population), and Apple HomePod (owned by 2% of the population).[950] The joint NPR-Edison survey also reports that the number of smart speaker owners who listen to a podcast on their smart speaker in a typical week has increased by 22% over the past 5 years.[951] Further, the study reports that the share of time listening to audio programming through a smart speaker increased 400% from 2017 to 2022, and the share of time listening to podcasts through a smart speaker increased 200% over the same time period.[952] The study also reports that the share of smart speaker owners who have listened to news on their smart speaker increased from 55% in spring 2019 to 66% in spring 2022.[953]

327. We note that smart speakers are produced by companies that also own major audio streaming service platforms. For example, Amazon produces and sells its Echo smart speaker; Google and Apple manufacture and distribute the Google Nest and Apple HomePod smart speakers, respectively. This link is relevant, given that, as noted above, paid subscribers of streaming music or podcasting are likely to subscribe to just one service. Figure II.F.6 shows the share of all listeners who listen to a particular audio streaming service and the share of smart speaker owners who listen to the audio streaming service. The chart indicates that companies that both offer streaming services and produce smart speakers have some competitive advantage in the market for streaming audio services, but only to a modest degree. For example, 35% of total listeners subscribe to Spotify, which does not produce a smart speaker, while only 28% of smart speaker owners listen to Spotify. The pattern also holds for Pandora and iHeart, which also do not produce and market smart speakers. On the other hand, both Apple and Amazon, which offer streaming music services and manufacture smart speakers, enjoy higher shares among customers who own smart speakers than the shares of the total listeners to streaming services. However; the pattern does not hold for YouTube Music, whose share of all listeners (18%) is the same as its share among smart speaker owners.

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[947] Eli Blumenthal, USA Today, *Spotify stock pops after company links up with Samsung to take on Apple, Amazon and Google* (Aug. 9, 2018), https://www.usatoday.com/story/money/2018/08/09/spotify-and-samsung-partner-up-take-apple-amazon-and-google/949470002/.

[948] CTIA Comments at 46-47 (observing that the functionality in smart speakers/digital assistants started out as niche accessibility products and have now found adoption on a much wider mass market).

[949] Edison Research and National Public Radio, The Smart Audio Report (June 16, 2022), https://www.edisonresearch.com/smart-audio-report-2022-from-npr-and-edison-research/ (Smart Audio Report).

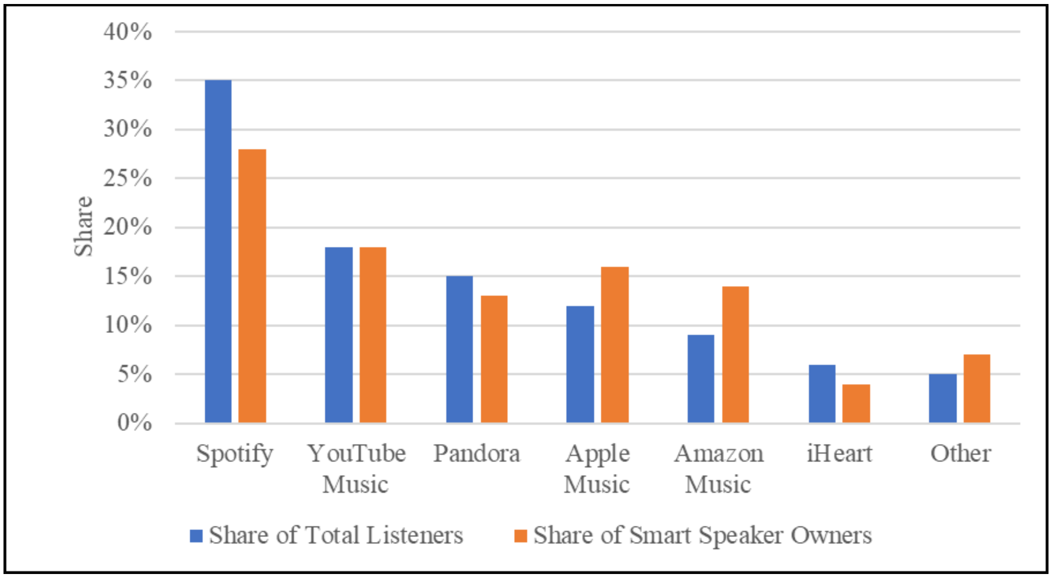
[950] Infinite Dial 2022 at 10.

[951] Smart Audio Report at 30.

[952] *Id.* at 23.

[953] *Id.* at 31.

Fig. II.F.6
Online Audio Services Used Most Often

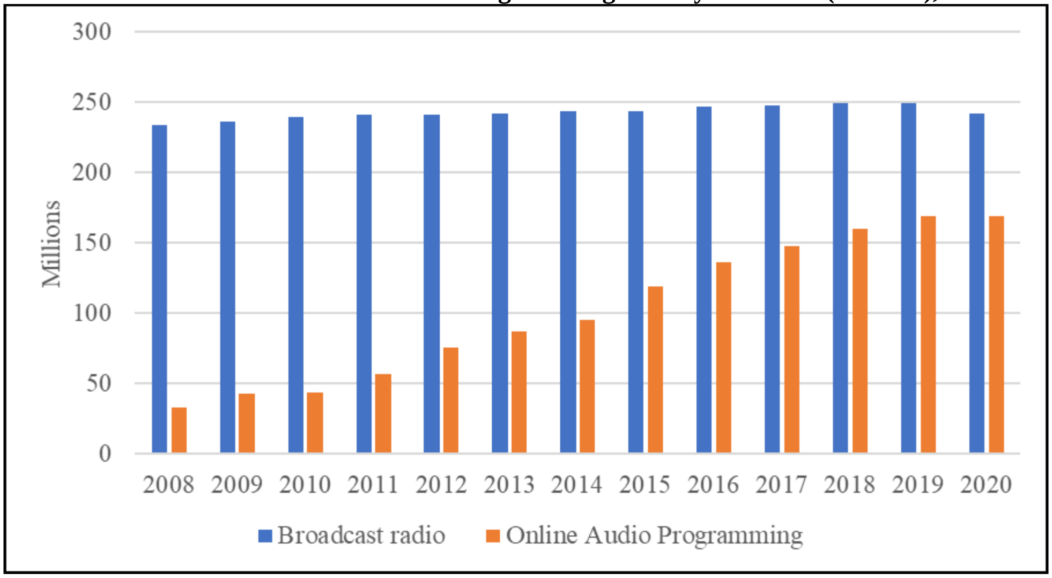


Source: Infinite Dial 2022 at 41.

328. *Overall Listenership.* While terrestrial broadcast radio remains dominant in some respects, as Figure II.F.7 illustrates, the gap in usage between broadcast and online audio programming has declined over time.[954] Figure II.F.7 shows the number of weekly listeners to broadcast radio in the United States remained relatively stable, while the audience for online audio programming grew steadily. According to this figure, over the past decade, the number of listeners to terrestrial broadcast radio grew annually around 0.55% on average, while the annual growth in online audio listeners was 29%. However, it is important to note that online audio programming includes AM or FM broadcasts accessed online.

[954] Economics of Digital Music and Radio.

Fig. II.F.7
U.S. Terrestrial Radio and Online Audio Programming Weekly Audience (millions), 2008-2020



Source: Economics of Digital Music and Radio.

III. ASSESSMENT OF BROADBAND DEPLOYMENT

329. We assess in this section the state of deployment of communications capabilities as required by RAY BAUM'S Act of 2018.[955] We also provide comparative international data on broadband services, and, where possible, a year-to-year measure of the extent of broadband service capability, including speeds and prices, in the United States and select communities and countries abroad.[956] Finally, this section provides a summary of regulatory developments in select communities and countries abroad.

A. Access to Advanced Telecommunications Capability

330. As noted above, we rely primarily on the FCC Form 477 deployment data to evaluate consumers' broadband options for fixed terrestrial and mobile services.[957] In future *Reports*, we expect to rely on the BDC data as they will then have been subject to appreciable verification through the challenge and other data-quality measures.[958]

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[955] This assessment is not intended to fulfill the Commission's statutory responsibility under section 706 of the Telecommunications Act of 1996 to "determine whether advanced telecommunications capability is being deployed to all Americans in a reasonable and timely fashion." 47 U.S.C. § 1302(b).

[956] 47 U.S.C. § 1303(b). The Broadband Data Improvement Act, Pub. L. No. 110-385, 122 Stat. 4096 (2008), is codified in Title 47, Chapter 12 of the United States Code. 47 U.S.C. § 1301, *et seq.*

[957] A provider that reports offering service in a particular census block may not offer service, or service at that speed, to all locations in the census block. Accordingly, the number of providers presented in this *Report* does not necessarily reflect the number of choices available to a particular household and does not purport to measure competition.

[958] *See* Broadband Data Collection proceeding, WC Docket Nos. 11-10, 19-195. FCC, *Broadband Data Collection*, https://www.fcc.gov/BroadbandData (last visited Aug. 17, 2022).

331. We provide deployment estimates for fixed terrestrial services at speeds of 25/3 Mbps, 100/20 Mbps,[959] and 940/500 Mbps based upon year-end data from 2018 to 2021.[960] Our analysis considers deployment in the states, the District of Columbia, and Puerto Rico. We exclude America Samoa, Guam, the Commonwealth of the Northern Mariana Islands, and the U.S. Virgin Islands from our analysis because, at the time of drafting this *Report*, the U.S. Census Bureau has not yet released block-level estimates for the 2020 Census, so we are unable to perform the analysis.[961]

332. *Satellite Services*. We find that FCC Form 477 deployment data for satellite broadband service may overstate the extent to which satellite broadband is available. The FCC Form 477 deployment data for satellite broadband indicate that satellite service offering 25/3 Mbps speeds is available to nearly all of the population.[962] However, other FCC Form 477 data indicate that satellite services have a relatively low subscription rate despite their apparent widespread availability, and satellite capacity limits the number of subscribers that can be served without service degradation.[963] Given this, and unless stated otherwise, our analysis in this section is based on all fixed terrestrial services and does not include satellite services.

333. *Terrestrial Fixed Wireless Services*. We find that the FCC Form 477 deployment data for terrestrial fixed wireless services indicate that these services are widely available and that subscription to these services has increased over time. However, the overall subscription rate remains relatively low.[964] Therefore, for purposes of this *Report*, we present two sets of deployment estimates: one including fixed wireless services and one excluding fixed wireless services. As demonstrated in the tables below, excluding fixed wireless services has the greatest impact in rural areas and Tribal lands.

334. *Mobile Services*. To evaluate mobile broadband deployment and availability, we rely on FCC Form 477 data,[965] supplemented with Ookla's Speedtest data. For purposes of this *Report*, we rely

[959] Cable consumers in urban and suburban areas are taking at least 100/20 Mbps service and that is the level of service (or higher) most advertised by providers. INCOMPAS Comments at 19.

[960] INCOMPAS asserts that the Commission should report faster speeds, including 1 Gbps. INCOMPAS Comments at 18-21.

[961] U.S. Census Bureau, Press Release, Next 2020 Island Areas Censuses Data Product To Be Released in October (July 13, 2022), https://www.census.gov/newsroom/press-releases/2022/2020-island-areas-censuses-data-product html. Block-level data will not be released until July 2023.

[962] The December 2021 FCC Form 477 data indicate that satellite service offering 25/3 Mbps speeds is available to close to 100% of the U.S. population.

[963] The FCC Form 477 data indicate that between December 2018 and December 2021, consumer subscriptions for satellite services at any speed declined slightly from approximately 1.8 million to approximately 1.7 million. The take rate for satellite services is just over 1.3%. While subscription to fixed wireless services nearly doubled during this time, from approximately 1.3 million to 2.7 million, the take rate for fixed wireless service was approximately 2.4%. *See supra* Fig. II.A.1 and Fig. II.A.10. While satellite coverage may enable operators to offer services to wide swaths of the country, overall satellite capacity may limit the number of consumers that can actually subscribe to satellite service at any one time. *2020 Communications Marketplace Report,* 36 FCC Rcd at 3101, para. 277.

[964] As of December 31, 2021, the adoption rate of services meeting a 10/1 Mbps speed threshold was 2% for fixed wireless services, 65% for cable services, and 38% for fiber-based services. *See* INCOMPAS Comments at 5 (citing research that fixed wireless may have 1.4 million subscribers compared to 75.6 million cable subscribers); *Id.* at 15 (stating that fixed wireless deployment may be overstated given low subscriber numbers for this technology).

[965] For fixed services, the Commission has been able to rely upon FCC Form 477 reported maximum advertised speeds to track actual speeds. However, we note that the relationship between actual speeds and the advertised or expected speed reported in the FCC Form 477 for mobile services is complex, because minimum advertised (or expected) speed is reported by the mobile providers, and different mobile providers estimate their minimum advertised (or expected) speed based on various points of their actual speed distribution. *2020 Communications Marketplace Report*, 36 FCC Rcd at 3101-02, para. 279 & n.792. By contrast, the Ookla data provide us with the actual speeds that consumers experience.

on three reported mobile speeds—4G LTE with a minimum advertised/expected speed of 5/1 Mbps, 5G with a minimum advertised/expected speed of 7/1 Mbps and 5G with a minimum advertised/expected speed of 35/3 Mbps. These data sets serve as a proxy for the likely consumer experience in a given area while providing objective data to assess deployment progress.

335. As the Commission has done in previous analyses of advanced telecommunications capability, we employ the centroid methodology[966] in evaluating the FCC Form 477 deployment data.[967] We evaluate 4G LTE deployment for the years 2018 to 2021. Beginning in 2020, the FCC Form 477 deployment data also collected data for 5G service with a minimum advertised speed of 7/1 Mbps and 35/3 Mbps. We incorporate these new data into our analysis of mobile services and our analysis of fixed terrestrial and mobile services. As in our previous *Reports*, we consider a census block to be covered by 4G LTE or 5G service if there is at least one service provider serving that census block, based on their FCC Form 477 submission.

336. We also present estimates based on Ookla Speedtest data to evaluate the availability of mobile broadband with a median actual speed of 10/3 Mbps or higher.[968] We rely on the Ookla data to supplement our FCC Form 477 analysis primarily because they provide us with a large set of observations of actual speeds that customers receive.[969] As the Commission has done previously, our analysis of the availability of mobile broadband services with a median speed of 10/3 Mbps includes actual speed test data in counties with at least 300 test observations.[970] The more densely populated counties have a higher

[966] If the geometric center point, or centroid, of a census block is within the coverage boundary of a coverage map, then we consider the block to be "covered."

[967] *See, e.g.*, *2020 Communications Marketplace Report*, 36 FCC Rcd at 3101-02, para. 279.

[968] The data collected by the Ookla Speedtest mobile app include test results for download speed, upload speed, and latency, as well as other information, such as the location of the test and operating system of the handset. *2020 Communications Marketplace Report*, 36 FCC Rcd at 3102, para. 280 & n.795; *see also* Ookla, *Speedtest*, https://www.speedtest.net/about (last visited Aug. 17, 2022). The Ookla data presented in this *Report* are based on tests that were executed in the second half of the year for 2018, 2019, 2020, and 2021 on the smartphone's cellular connection, and using 4G LTE technology for the years prior to 2020, and both 4G LTE and 5G technology for 2020 and 2021. Test data were excluded if they had missing GPS location data or if the reported download or upload speed was less than zero. Multiple tests by a single phone in the same locality and in the same hour were averaged (using the median). All Ookla speed tests are user-initiated.

The Commission considers both 4G LTE and 5G Ookla tests together in this analysis as both 4G LTE and 5G service can potentially qualify as advanced telecommunications capability. 4G LTE and 5G tests are weighed equally when calculating medians. We use the benchmark of 10 Mbps/3 Mbps also used in previous reports. The 2018 Broadband Deployment Report settled on median speeds of 10 Mbps/3 Mbps to show 4G LTE coverage after taking into account the record. *Inquiry Concerning Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion*, GN Docket No. 17-199, 2018 Broadband Deployment Report, 33 FCC Rcd 1660, 1670-74, paras. 27-34. The Fourteenth Broadband Deployment Report, released in 2021, retained the 4G LTE Benchmark of median speeds of 10 Mbps/3 Mbps. *Fourteenth Broadband Deployment Report*, 33 FCC Rcd at 843-44, para. 15.

[969] We note that, in general, crowd-sourced data can offer the advantage of generating a large volume of data at a very low cost, and of measuring actual consumer experience on a network in a wide variety of locations, indoor and outdoor. Crowd-sourced data, however, often are not collected pursuant to statistical sampling techniques, and may require adjustments to construct a representative sample from the raw data. For instance, crowd-sourced mobile data come from a self-selected group of users, and there is often little control for most tests regarding such parameters as when people implement the test, whether the test is performed indoors or outdoors, the geographic location of the tester, and the vintage of the consumer's device. *2020 Communications Marketplace Report*, 36 FCC Rcd at 3102-03, para. 28.

[970] *See 2020 Communications Marketplace Report*, 36 FCC Rcd at 3102-03, para. 280. This sample size threshold applies to each county for each time frame (2H2018, 2H2019, 2H2020, and 2H2021). If a county does not have at least 300 observations during one of these time frames, the county is not included in the actual speed analysis for the

(continued….)

likelihood of being included in this analysis because there generally are more observations in those geographical areas with a higher population density.[971] Although we do not have reliable on-the-ground speed data for every county in the United States, the Ookla data cover approximately 98% of the population of the United States, excluding the U.S. Territories, for which we do not have data.[972] Using the existing FCC Form 477 data combined with on-the-ground speed testing data provides the most reliable and comprehensive available data that are currently available on the extent of mobile coverage,[973] and our continued use of these same data allows for a consistent measure of progress over time.

1. Broadband Deployment Estimates

337. In Figures III.A.1 through III.A.3 below, we compare deployment[974] in the United States (the states, District of Columbia, and Puerto Rico) using year-end FCC Form 477 data from 2018 to 2021, the most recent year for which data are available.[975] For purposes of this *Report*, we also report results for federally recognized Tribal lands as identified by the 2010 Census and the 2020 Census. As we have done in prior *Reports*, we aggregate federally recognized Tribal lands into four Tribal lands categories (the Lower 48 States,[976] Tribal Statistical Areas,[977] Hawaiian Home Lands,[978] and Alaskan Villages[979]), and we report deployment for these four geographic categories separately and jointly.

(Continued from previous page)
period during which the number of observations falls below 300. The 300 observations threshold is a conservative threshold and is based on a general mean and median sample size analysis. We consider a county to have a sufficient sample size if there are at least 300 total observations in a given year, after the cleaning and trimming rules have been applied. County geography is assigned using the latitude and longitude coordinates that are collected during each Ookla speed test, via the device's GPS. This allows us to evaluate actual median upload and download speeds at the county level, in each year of the four-year time period, for counties in which approximately 98% of the U.S. population live (excluding the U.S. Territories). If a census block has mobile broadband coverage of at least 5/1 Mbps based on the FCC Form 477 minimum advertised speeds, it is assigned the median upload and download speeds that are calculated for the county in which it is located, which allows us to evaluate the mobile broadband speeds for each census block within the United States.

[971] Mobile wireless speeds vary both over time and over small local areas. Therefore, ascribing the median county Ookla speed to an entire county will sometimes overestimate or underestimate realized local speeds. Use of Ookla data alone would overestimate coverage as counties with only partial coverage would be represented as having 100% coverage. Use of FCC Form 477 data alone would necessitate reliance on the 5/1 Mbps speed.

[972] As previously noted, the percentage of the population in our analysis is based on the total U.S. population (states, District of Columbia, and Puerto Rico). The analysis based on Ookla data, however, does not include Puerto Rico. The Ookla speed data population in Fig. III.A.2c is a subset of the total U.S. population evaluated in Fig. III. A.2a and refers to the population in the counties for which we believe there are a statistically significant number of on-the-ground speed test observations. In 2021, for example, the U.S. population, excluding Puerto Rico, was 333.894 million, whereas in Fig. III.A.2c, we use 326.002 million as the population base. The population evaluated figure, 326.002 million, is the population for the United States, excluding Puerto Rico and the population in the counties without a sufficient number of reliable on-the-ground speed test data observations.

[973] *See 2020 Communications Marketplace Report*, 36 FCC Rcd at 3101-03, paras. 279-81 (discussing use of FCC Form 477 combined with Ookla data to account for limitations in both data sets).

[974] Unless otherwise noted, the deployment percentage estimate for fixed terrestrial services and mobile service is the population living in the census blocks with coverage for the service divided by the total population in the area being considered (e.g., United States, all rural areas, all urban areas, and Tribal lands).

[975] We do not include results for American Samoa, Guam, the Northern Mariana Islands, and the U.S. Virgin Islands because the U.S. Census Bureau has not yet released 2020 Census block-level population and household data. *See* U.S. Census Bureau, Press Release, Next 2020 Island Areas Censuses Data Product To Be Released in October (July 13, 2022), https://www.census.gov/newsroom/press-releases/2022/2020-island-areas-censuses-data-product.html (block-level data will not be released until July 2023).

[976] *2020 Communications Marketplace Report*, 36 FCC Rcd at 3103-04, para. 281 & n.802; *2018 Communications Marketplace Report*, 33 FCC Rcd at 12688, para. 247 & n.789. These areas include: (1) Joint Use Areas; (2) legal,
(continued….)

338. In this *Report*, we use both 2010 census-based geographies (year-end data for 2018, 2019 and 2020) and 2020 census-based geographies (year-end data for 2021). Due to this discrepancy, it is not possible to hold constant the underlying configuration of census blocks or the characteristics of the census blocks. We therefore caveat our results for changes between 2021 and earlier periods, as described further below.

339. Deployment is determined at the census block level, thus deployment based on the aggregation of block-level data as of December 31, 2021 does not represent identical geographies compared to deployment in earlier periods. The block relationship between a 2010 census block and a 2020 census block can be one-to-one,[980] one-to-many,[981] or many-to-one.[982] Therefore, some portion of a change in deployment between 2020 (or 2018 or 2019) and 2021 could be the result of a change in the block configuration.[983] Moreover, because of differences between the 2020 census blocks and the 2010 census blocks,[984] there can be anomalous results at the block level that are not apparent at a more aggregated level.

340. In order to assess deployment for the people living in census blocks in urban and rural areas as of 2021, we use a proxy variable to identify urban and rural areas. The FCC Form 477 year-end

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federally recognized American Indian Area consisting of reservation and associated off-reservation trust land; (3) legal, federally recognized American Indian Area consisting of reservation only; and (4) legal, federally recognized American Indian Area consisting of off-reservation trust land only.

[977] Tribal Statistical Areas are statistical American Indian Areas defined for a federally recognized Tribe that does not have reservation or off-reservation trust land; specifically a Tribal Designated Statistical Area (TDSA) or Oklahoma Tribal Statistical Area (OTSA). Tribal Statistical Areas are largely located in Oklahoma, but they also include areas in California, New York, and Washington.

[978] Hawaiian Home Lands were established by the Hawaiian Homes Commission Act of 1921.

[979] Alaskan Native Village Statistical Area.

[980] *See* 2020 Census Block Relationship Files Record Layouts for a description of the crosswalk between the 2010 and the 2020 census blocks. U.S. Census Bureau, *2020 Census Block Relationship Files Record Layouts*, https://www.census.gov/programs-surveys/geography/technical-documentation/records-layout/2020-census-block-record-layout html (last visited Sept. 13, 2022). The 2020 Census crosswalk data contain block assignment information for 11,155,486 2010 census blocks for the states, the District of Columbia and Puerto Rico. In a one-to-one relationship a 2010 census block is entirely coextensive with a 2020 census block. An analysis of the 2010 census block part flag variable and the 2020 census block part flag variable reveals that 5,026,787 of the 2010 census blocks have a one-to-one relationship to a 2020 census block. Measured in 2010 population, these 2010 blocks included 156.1 million residents of urban areas and 24.7 million residents of rural areas. FCC Staff analysis.

[981] In a many-to-one relationship, multiple 2010 census blocks may intersect a single 2020 census block. An analysis of the 2010 block part flag variable and the 2020 block part flag variable reveals that 5,101,864 of the 2010 census blocks have this type of mapping. Measured in 2010 population, these 2010 blocks included 54.9 million residents of urban areas and 20.6 million residents of rural areas. FCC Staff analysis.

[982] In a one-to-many relationship, a single 2010 census block may intersect multiple 2020 census blocks. Staff analysis of the 2020 crosswalk indicates that 1,026,835 of the 2010 census blocks have a one-to-many relationship with a 2020 census block. Measured in 2010 population, these 2010 blocks included 41.7 million residents of urban areas and 15.3 million residents of rural areas.

[983] We have insufficient information to assess what portion of the change in deployment is due to a change in network deployment.

[984] For the United States, the 2010 Census identifies 11.155 million census blocks which have an average land area of 0.317 square miles. In contrast, for this same geographic area, the 2020 Census identified 8.175 million census blocks with an average land area of 0.433 square miles. Similarly, the 2010 Census identified 74,002 census tracts with an average land area of 47.773 square miles in the United States. In contrast, for this same geographic area, the 2020 Census identified 85,395 census tracts with an average land area of 41.412 square miles.

data from 2018 to 2020 are based on the 2010 census geographies; accordingly, we use the 2010 Census urban/rural designation for these data. The FCC Form 477 year-end 2021 data are based on 2020 census blocks; however, the U.S. Census Bureau has not yet released urban/rural designations for the 2020 census data. Thus, for purposes of this *Report*, we designate a 2020 census block as urban if any "urban" 2010 census block intersects the 2020 block.[985] However, because the U.S. Census criteria for urban areas for the 2020 Census are not the same as the criteria for the 2010 Census,[986] the results we report for urban and rural areas for year-end 2021 will likely differ from results using the upcoming U.S. Census Bureau release of the list of urban areas for the 2020 Census.[987] We cannot predict the impact of the new urban/non-urban definition on the 2021 estimates until the Census Bureau releases the block level urban identifier for the 2020 Census blocks.

a. Deployment of Fixed Advanced Telecommunications Capability

341. Figure III.A.1a shows the deployment of fixed terrestrial broadband meeting at three speed thresholds: 25/3 Mbps, 100/20 Mbps and 940/500 Mbps.[988] As explained above, because of the change in census geographies during our data collection period, caution should be exercised when interpreting the change in deployment between 2020 and 2021 for urban and rural areas.

[985] We employed the 2020 Crosswalk data and the 2010 Summary file that include the Census UAtype variable for each 2010 census block. A 2010 census block with a UAtype variable value of U (urbanized area) or a value of C (Urban Cluster) is an urban census block. A 2010 census block with a UAtype variable value of 9 is a rural census block.

[986] U.S. Census Bureau, Urban Area Criteria for the 2010 Census Public Notice, 76 Fed. Reg. 53029 (Aug. 8, 2011); U.S. Census Bureau, Urban Area Criteria for the 2020 Census—Final Criteria, 87 Fed. Reg. 16706 (Mar. 24, 2022). Because the analysis presented in this *Report* will be completed prior to the release of the necessary data by the U.S. Census Bureau, the Commission will need to estimate 2020 urban/rural designations for the current *Report*. However, the official Census designations will be available for use in the *2024 Communications Marketplace Report*. *See* U.S. Census Bureau, *2020 Urban Area FAQs*, https://www2.census.gov/geo/pdfs/reference/ua/2020_Urban_Areas_FAQs.pdf (last visited Aug. 2, 2022).

[987] For the 2020 Census, the U.S. Census Bureau defines urban areas primarily based on housing unit density measured at the census block. The initial delineation is at the census-block level and requires 425 housing units per square mile (measured in terms on land area). In addition, an area will qualify as urban if it contains at least 2,000 housing units or has a population of at least 5,000. U.S. Census Bureau, Urban Area Criteria for the 2020 Census–Final Criteria, 87 Fed. Reg. at 16707. If we were to designate blocks as urban or non-urban (rural) based on the U.S. Census Bureau's basic requirements for an urban area (i.e., housing unit density of 425 housing units per square mile, 2,000 housing units or at least 5,000 people), our estimates for urban areas may be slightly different, and the percentage of the population with access may change. This is because the 2020 criteria may cause some areas that had been categorized as urban in the 2010 Census to be categorized as rural in the 2020 Census.

[988] *See infra* Appx. F-1a (reporting deployment of fixed terrestrial services (25/3 Mbps, 100/20 Mbps, and 940/500 Mbps) and 4G services with minimum advertised speed of 5/1 Mbps by state, District of Columbia, and Puerto Rico); Appx. F-1b (reporting deployment of fixed terrestrial services (25/3 Mbps, 100/20 Mbps, and 940/500 Mbps) and mobile 5G at 7/1 Mbps by state, District of Columbia, and Puerto Rico); Appx. F-1c (reporting deployment for fixed terrestrial services (excluding fixed wireless services) and 4G services by state, District of Columbia, and Puerto Rico); Appx. F-1d (reporting deployment of fixed terrestrial services (excluding fixed wireless) and Mobile 5G at 7/1 Mbps by state, District of Columbia, and Puerto Rico); Appx. F-7 (reporting deployment of 25/3 Mbps, 100/20 Mbps, and 940/500 by state, county and county equivalent); and Appx. F-8 (reporting deployment of 25/3 Mbps, 100/20 Mbps, and 940/500 by urban and rural areas within each state, county, or county equivalent).

Fig. III.A.1a
Population Living in Census Blocks with Deployment (millions) of Fixed Terrestrial Services at Different Speed Tiers (2018-2021)

	2018		2019		2020		2021	
	Pop.	%	Pop.	%	Pop.	%	Pop.	%
25/3 Mbps								
United States	312.116	94.5%	316.940	95.6%	324.765	97.6%	329.079	98.2%
Rural Areas	50.324	77.8%	54.039	82.8%	60.025	90.9%	57.755	92.3%
Urban Areas	261.792	98.5%	262.901	98.8%	264.739	99.3%	271.324	99.5%
Tribal Lands	2.922	72.3%	3.203	79.1%	3.545	86.8%	3.682	90.9%
25/3 Mbps – Excluding Fixed Wireless								
United States	304.793	92.3%	307.287	92.7%	312.040	93.8%	317.898	94.9%
Rural Areas	44.640	69.0%	46.511	71.2%	49.771	75.4%	49.267	78.8%
Urban Areas	260.153	97.9%	260.776	98.0%	262.269	98.4%	268.631	98.5%
Tribal Lands	2.685	66.5%	2.847	70.3%	3.047	74.6%	3.250	80.2%
100/20 Mbps								
United States	291.838	88.3%	297.077	89.6%	304.757	91.6%	315.736	94.2%
Rural Areas	37.620	58.1%	40.491	62.0%	44.862	68.0%	47.675	76.2%
Urban Areas	254.218	95.7%	256.586	96.4%	259.895	97.5%	268.061	98.3%
Tribal Lands	1.999	49.5%	2.221	54.8%	2.487	60.9%	2.998	74.0%
100/20 Mbps – Excluding Fixed Wireless								
United States	287.902	87.1%	294.108	88.7%	300.418	90.3%	310.616	92.7%
Rural Areas	36.323	56.1%	38.830	59.5%	42.157	63.9%	44.134	70.6%
Urban Areas	251.579	94.7%	255.278	95.9%	258.261	96.9%	266.482	97.8%
Tribal Lands	1.949	48.3%	2.133	52.6%	2.355	57.7%	2.906	71.7%
940/500 Mbps								
United States	91.473	27.7%	106.230	32.1%	119.456	35.9%	149.649	44.7%
Rural Areas	6.831	10.6%	9.038	13.8%	11.965	18.1%	16.666	26.6%
Urban Areas	84.643	31.9%	97.193	36.5%	107.492	40.3%	132.983	48.8%
Tribal Lands	0.453	11.2%	0.587	14.5%	0.820	20.1%	1.096	27.1%
940/500 – Excluding Fixed Wireless								
United States	88.975	26.9%	103.472	31.2%	115.510	34.7%	146.938	43.8%
Rural Areas	6.681	10.3%	8.907	13.6%	11.485	17.4%	16.428	26.3%
Urban Areas	82.293	31.0%	94.565	35.5%	104.025	39.0%	130.510	47.9%
Tribal Lands	0.453	11.2%	0.586	14.5%	0.817	20.0%	1.096	27.0%
Pop. Evaluated	330.362	100.0%	331.403	100.0%	332.650	100.0%	335.157	100.0%

Source: FCC Form 477 data; Staff Block Estimates.

342. *Tribal Lands.* Figure III.A.1b shows deployment for 25/3 Mbps, 100/20 Mbps, and 940/500 Mbps on Tribal lands, by rural and urban areas and by major Tribal lands category. These data suggest that while the gap in deployment between urban areas and rural areas on Tribal lands has narrowed for 25/3 Mbps and 100/20 Mbps, deployment on rural Tribal lands continues to lag behind deployment on urban Tribal lands.

Fig. III.A.1b
Population Living in Census Blocks with Deployment (millions) of Fixed Terrestrial Services at different Speed Tiers on Tribal Lands (2018-2021)

Area	2018		2019		2020		2021	
	Pop.	%	Pop.	%	Pop.	%	Pop.	%
25/3 Mbps								
Tribal Land	2.922	72.3%	3.203	79.1%	3.545	86.8%	3.682	90.9%
Rural Areas	1.121	53.2%	1.372	64.9%	1.669	77.7%	1.657	82.7%
Urban Areas	1.801	93.1%	1.831	94.5%	1.876	96.9%	2.025	98.8%
Alaskan Villages	0.177	66.5%	0.187	69.9%	0.192	71.3%	0.206	76.0%
Rural Areas	0.095	55.0%	0.104	60.2%	0.109	62.5%	0.106	63.5%
Urban Areas	0.083	87.3%	0.083	87.6%	0.083	87.5%	0.101	95.6%
Hawaiian Home Lands	0.030	89.1%	0.032	93.2%	0.032	93.7%	0.034	98.9%
Rural Areas	0.003	47.8%	0.004	65.0%	0.004	68.1%	0.006	94.7%
Urban Areas	0.027	98.2%	0.028	99.5%	0.028	99.5%	0.028	99.9%
Lower 48 States	0.643	56.9%	0.763	67.3%	0.874	76.6%	0.953	84.3%
Rural Areas	0.348	45.6%	0.439	57.2%	0.537	69.3%	0.557	77.4%
Urban Areas	0.295	80.6%	0.324	88.4%	0.338	92.3%	0.396	96.5%
Tribal Statistical Areas	2.072	79.4%	2.222	84.9%	2.447	92.7%	2.489	95.2%
Rural Areas	0.675	58.0%	0.825	70.6%	1.019	85.5%	0.988	89.0%
Urban Areas	1.396	96.6%	1.397	96.4%	1.428	98.7%	1.501	99.7%
25/3 Mbps – Excluding Fixed Wireless								
Tribal Land	2.685	66.5%	2.847	70.3%	3.047	74.6%	3.250	80.2%
Rural Areas	0.912	43.3%	1.048	49.5%	1.213	56.5%	1.268	63.3%
Urban Areas	1.772	91.7%	1.799	92.9%	1.834	94.8%	1.981	96.7%
Alaskan Villages	0.158	59.4%	0.164	61.5%	0.169	62.8%	0.185	68.2%
Rural Areas	0.076	44.3%	0.082	47.4%	0.086	49.6%	0.085	51.1%
Urban Areas	0.082	86.8%	0.082	87.1%	0.083	87.0%	0.100	95.0%
Hawaiian Home Lands	0.030	88.9%	0.032	92.9%	0.032	93.3%	0.034	98.9%
Rural Areas	0.003	46.4%	0.004	63.6%	0.004	66.3%	0.006	94.7%
Urban Areas	0.027	98.2%	0.028	99.5%	0.028	99.5%	0.028	99.9%
Lower 48 States	0.571	50.5%	0.645	56.9%	0.721	63.2%	0.796	70.4%
Rural Areas	0.287	37.6%	0.339	44.1%	0.398	51.4%	0.428	59.5%
Urban Areas	0.284	77.7%	0.306	83.7%	0.323	88.4%	0.368	89.7%
Tribal Statistical Areas	1.925	73.8%	2.006	76.6%	2.125	80.5%	2.235	85.4%
Rural Areas	0.546	47.0%	0.623	53.3%	0.725	60.8%	0.749	67.5%
Urban Areas	1.379	95.4%	1.383	95.5%	1.401	96.8%	1.485	98.7%
100/20 Mbps								
Tribal Land	1.999	49.5%	2.221	54.8%	2.487	60.9%	2.998	74.0%

Area	2018		2019		2020		2021	
	Pop.	%	Pop.	%	Pop.	%	Pop.	%
Rural Areas	0.568	27.0%	0.728	34.4%	0.926	43.1%	1.089	54.4%
Urban Areas	1.431	74.0%	1.494	77.1%	1.561	80.6%	1.910	93.2%
Alaskan Villages	0.149	56.1%	0.160	60.0%	0.165	61.3%	0.182	67.0%
Rural Areas	0.071	41.1%	0.081	47.0%	0.086	49.2%	0.086	52.0%
Urban Areas	0.079	83.2%	0.079	83.6%	0.080	83.6%	0.096	90.7%
Hawaiian Home Lands	0.030	88.7%	0.032	92.8%	0.032	93.2%	0.034	98.9%
Rural Areas	0.003	46.1%	0.004	63.2%	0.004	65.8%	0.006	94.7%
Urban Areas	0.027	98.1%	0.028	99.5%	0.028	99.5%	0.028	99.9%
Lower 48 States	0.424	37.6%	0.512	45.1%	0.577	50.6%	0.643	56.9%
Rural Areas	0.193	25.3%	0.254	33.0%	0.300	38.8%	0.321	44.7%
Urban Areas	0.231	63.1%	0.258	70.5%	0.277	75.7%	0.321	78.3%
Tribal Statistical Areas	1.395	53.5%	1.518	58.0%	1.713	64.9%	2.140	81.8%
Rural Areas	0.301	25.9%	0.389	33.3%	0.536	45.0%	0.675	60.8%
Urban Areas	1.094	75.7%	1.129	77.9%	1.177	81.3%	1.465	97.3%
100/20 Mbps- Excluding Fixed Wireless								
Tribal Land	1.949	48.3%	2.133	52.6%	2.355	57.7%	2.906	71.7%
Rural Areas	0.521	24.8%	0.647	30.6%	0.807	37.6%	1.009	50.4%
Urban Areas	1.427	73.8%	1.486	76.7%	1.549	80.0%	1.897	92.6%
Alaskan Villages	0.128	47.9%	0.133	49.6%	0.137	50.9%	0.153	56.4%
Rural Areas	0.049	28.7%	0.054	31.3%	0.058	33.3%	0.058	35.0%
Urban Areas	0.078	82.7%	0.079	83.1%	0.079	83.1%	0.095	90.1%
Hawaiian Home Lands	0.030	88.7%	0.032	92.8%	0.032	93.2%	0.034	98.9%
Rural Areas	0.003	46.1%	0.004	63.2%	0.004	65.8%	0.006	94.7%
Urban Areas	0.027	98.1%	0.028	99.5%	0.028	99.5%	0.028	99.9%
Lower 48 States	0.411	36.4%	0.463	40.8%	0.505	44.3%	0.595	52.7%
Rural Areas	0.181	23.8%	0.211	27.5%	0.238	30.7%	0.286	39.8%
Urban Areas	0.229	62.6%	0.251	68.6%	0.267	73.1%	0.309	75.3%
Tribal Statistical Areas	1.381	52.9%	1.506	57.6%	1.681	63.7%	2.123	81.2%
Rural Areas	0.288	24.7%	0.377	32.3%	0.506	42.5%	0.658	59.3%
Urban Areas	1.093	75.6%	1.129	77.9%	1.175	81.2%	1.465	97.3%
940/500 Mbps								
Tribal Land	0.453	11.2%	0.587	14.5%	0.820	20.1%	1.096	27.1%
Rural Areas	0.179	8.5%	0.249	11.8%	0.399	18.6%	0.490	24.5%
Urban Areas	0.274	14.2%	0.337	17.4%	0.421	21.7%	0.606	29.6%
Alaskan Villages	0.000	0.0%	0.000	0.0%	0.000	0.2%	0.014	5.2%
Rural Areas	0.000	0.0%	0.000	0.0%	0.000	0.3%	0.002	1.3%

Area	2018		2019		2020		2021	
	Pop.	%	Pop.	%	Pop.	%	Pop.	%
Urban Areas	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.012	11.4%
Hawaiian Home Lands	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.007	20.2%
Rural Areas	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.001	9.6%
Urban Areas	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.006	22.6%
Lower 48 States	0.084	7.5%	0.099	8.7%	0.131	11.5%	0.163	14.4%
Rural Areas	0.067	8.7%	0.073	9.5%	0.089	11.4%	0.114	15.8%
Urban Areas	0.018	4.8%	0.026	7.1%	0.042	11.6%	0.049	11.9%
Tribal Statistical Areas	0.369	14.1%	0.487	18.6%	0.689	26.1%	0.912	34.9%
Rural Areas	0.112	9.6%	0.176	15.1%	0.310	26.0%	0.373	33.6%
Urban Areas	0.256	17.7%	0.311	21.5%	0.378	26.1%	0.539	35.8%
940/500 Mbps - Excluding Fixed Wireless.								
Tribal Land	0.453	11.2%	0.586	14.5%	0.817	20.0%	1.096	27.0%
Rural Areas	0.179	8.5%	0.249	11.8%	0.398	18.5%	0.490	24.5%
Urban Areas	0.274	14.2%	0.337	17.4%	0.419	21.7%	0.606	29.6%
Alaskan Villages	0.000	0.0%	0.000	0.0%	0.000	0.2%	0.014	5.2%
Rural Areas	0.000	0.0%	0.000	0.0%	0.000	0.3%	0.002	1.3%
Urban Areas	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.012	11.4%
Hawaiian Home Lands	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.007	20.2%
Rural Areas	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.001	9.6%
Urban Areas	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.006	22.6%
Lower 48 States	0.084	7.5%	0.099	8.7%	0.128	11.2%	0.162	14.3%
Rural Areas	0.067	8.7%	0.073	9.5%	0.087	11.2%	0.113	15.8%
Urban Areas	0.018	4.8%	0.026	7.0%	0.041	11.2%	0.048	11.8%
Tribal Statistical Areas	0.369	14.1%	0.487	18.6%	0.689	26.1%	0.912	34.9%
Rural Areas	0.112	9.6%	0.176	15.1%	0.310	26.0%	0.373	33.6%
Urban Areas	0.256	17.7%	0.311	21.5%	0.378	26.1%	0.539	35.8%
Pop. Evaluated	4.039	100.0%	4.052	100.0%	4.083	100.0%	4.051	100.0%

Source: FCC Form 477 data; Staff Block Estimates.

b. Deployment of Mobile Broadband

343. Figure III.A.2a reports coverage for 4G LTE with a minimum advertised speed of at least 5/1 Mbps.[989] Figure III.A.2.b reports coverage for 5G services at 7/1 Mbps and 35/3 Mbps. As explained

[989] The analysis presented in Figs. III.A.2a and III.A.3a includes the states, District of Columbia, and Puerto Rico. The analysis presented in these figures in the *2020 Communications Marketplace Report* did not include Puerto Rico; hence, the figures for 2018 and 2019 in this *Report* will differ from those reported in the earlier *Report*. *See 2020 Communications Marketplace Report*, 36 FCC Rcd at 3105-06, Figs. III.A.2a and III.A.3a. We do not present figures for the U.S. territories in total or separately because we do not have population estimates for American Samoa, Guam, the Northern Mariana Islands, and the U.S. Virgin Islands. *See infra* Appx. F-1a (reporting deployment of fixed terrestrial services (25/3 Mbps, 100/20 Mbps, and 940/500 Mbps) and 4G LTE 5/1 Mbps by

(continued….)

above, because of the change in census geographies during our data collection period, we must be cautious of how we interpret the change in deployment between 2020 and 2021 for urban and rural areas.[990]

Fig. III.A.2a
Percentage of Population Living in Census Blocks with Deployment (millions) of 4G LTE with a Minimum Advertised Speed of 5/1 Mbps (2018-2021)

Area	2018		2019		2020		2021	
	Pop.	%	Pop.	%	Pop.	%	Pop.	%
United States	329.920	99.9%	331.009	99.9%	332.316	99.9%	333.911	99.6%
Rural Areas	64.303	99.4%	64.929	99.4%	65.706	99.5%	61.357	98.1%
Urban Areas	265.617	100.0%	266.080	100.0%	266.609	100.0%	272.555	100.0%
Tribal Lands	3.937	97.5%	3.959	97.7%	4.009	98.2%	3.952	97.5%
Pop. Evaluated	330.362	100.0%	331.403	100.0%	332.650	100.0%	335.157	100.0%

Source: FCC Form 477 data; Staff Block Estimates.

(Continued from previous page)
state, District of Columbia, and Puerto Rico); Appx. F-1c (reporting deployment of fixed terrestrial services excluding fixed wireless (25/3 Mbps, 100/20 Mbps, and 940/500 Mbps) and 4G LTE 5/1 Mbps by state, District of Columbia, and Puerto Rico); Appx. F-2 (reporting deployment of 4G LTE 5/1 Mbps on Tribal Lands); Appx. F-9a (reporting deployment of fixed terrestrial services and 4G LTE 5/1 Mbps and 5G 7/1 Mbps services by state, county, and county equivalent); and Appx. F-9b (reporting deployment of fixed terrestrial services and 4G LTE 5/1 Mbps by state, county, and county equivalent, segmented by urban and rural areas).

[990] *See infra* Appx. F-1b (reporting deployment of fixed terrestrial services (25/3 Mbps, 100/20 Mbps, and 940/500 Mbps) and 5G 7/1 Mbps by state, District of Columbia, and Puerto Rico); Appx. F-1d (reporting deployment of fixed terrestrial services excluding fixed wireless (25/3 Mbps, 100/20 Mbps, and 940/500 Mbps) and 5G 7/1 Mbps by state, District of Columbia, and Puerto Rico); Appx. F-3 (reporting deployment of 5G services on Tribal Lands); Appx. F-9a (reporting deployment of fixed terrestrial services and 4G LTE 5/1 Mbps and 5G 7/1 Mbps services by state, county, and county equivalent); Appx. F-6 (reporting deployment fixed terrestrial services and of 5G services on Tribal Lands); Appx. F-9a (reporting deployment of fixed terrestrial services and 5G 7/1 Mbps by state, county, and county equivalent); and Appx. F-9c (reporting deployment of fixed terrestrial services and 5G 7/1 Mbps by state, county, and county equivalent, segmented by urban and rural areas).

Fig. III.A.2b
Percentage of Population Living in Census Blocks with Deployment (millions) of 5G with a Minimum Advertised Speed of 7/1 Mbps; 5G with a Minimum Advertised Speed of 35/3 Mbps (2020-2021)

Area	2020		2021	
	Pop	%	Pop	%
5G with a Minimum Advertised Speed of 7/1 Mbps.				
United States	310.642	93.4%	327.422	97.7%
Rural Areas	52.188	79.1%	55.868	89.3%
Urban Areas	258.455	96.9%	271.555	99.6%
Tribal Lands	3.358	82.3%	3.648	90.0%
Pop. Evaluated	332.650	100.0%	335.157	100.0%
5G with a Minimum Advertised Speed of 35/3 Mbps				
United States	237.475	71.4%	325.038	97.0%
Rural Areas	28.467	43.1%	54.622	87.3%
Urban Areas	209.008	78.4%	270.416	99.2%
Tribal Lands	2.308	56.5%	3.603	88.9%
Pop. Evaluated	332.650	100.0%	335.157	100.0%

Source: Form 477 data; Staff Block Estimates.

344. As explained above, we evaluate mobile broadband deployment and availability using FCC Form 477 data with a minimum advertised speed of 5/1 Mbps, supplemented with Ookla's Speedtest data.[991] Figure III.A.2c reports coverage for mobile broadband services (4G LTE and 5G).[992]

[991] The analyses in Figs. III.A.2a, III.A.2b, III.A.3a, and III.A.3b are based on FCC Form 477 data. In contrast, the analyses in Figs. III.A.2c, and III.A.3c are based on Ookla data and exclude any county (and its associated census blocks) for which there are insufficient Ookla data. In addition, we do not report results for Tribal lands in Figs. III.A.2c and III.A.3c because we have concerns with the reliability of the Ookla data for these areas. Tribal areas not only typically have fewer speed tests, but there are also fewer of these areas relative to urban and rural areas. Thus, deployment estimates for tribal areas are more sensitive to sample variance. The population figure reported in the bottom row of Figs. III.A.2c and III.A.3c is the population evaluated for the reported time period and the percentage is the percentage of the U.S. population evaluated. Figures that include the availability of broadband with a median speed of 10/3 Mbps show less than 100% of the population was evaluated due to the unavailability of Ookla data. Thus, for example, the 326.002 million population evaluated figure for 2021 in Fig. III.A.2c represents approximately 98% of the overall population in the 50 states and the District of Columbia (326.002/331.893=0.982). Regardless of our deployment estimates for mobile broadband with a median speed of 10/3 Mbps, the FCC Form 477 data can be used to determine whether Americans residing in the counties without sufficient Ookla data to create a statistically significant county sample to be included in Figs. III.A.2c and III.A.3c receive minimum advertised speeds of 5/1 Mbps, and likely receive mobile services with speeds higher than 5/1 Mbps.

[992] *See infra* Appx. F-4 (reporting deployment of fixed terrestrial services and mobile broadband with a median speed of 10/3 Mbps by State and District of Columbia).

Fig. III.A.2c
Percentage of Population Living in Census Blocks with Deployment (millions) of Mobile Broadband with a Median Speed of 10/3 Mbps (2018-2021)

	2018		2019		2020		2021	
	Pop.	%	Pop.	%	Pop.	%	Pop.	%
United States	298.401	93.8%	310.923	97.4%	310.203	95.9%	311.625	95.6%
Rural Areas	45.904	79.7%	53.156	90.8%	51.541	84.3%	47.826	82.4%
Urban Areas	252.497	96.9%	257.767	98.8%	258.662	98.6%	263.800	98.4%
Pop. Evaluated	318.269	97.3%	319.341	97.3%	323.466	98.2%	326.002	98.2%

Source: FCC Form 477 data; Staff Block Estimates

c. Deployment of Fixed Services and Mobile Broadband

345. Figures III.A.3a shows deployment across all geographic areas for fixed terrestrial services with speeds of at least 25/3 Mbps, 100/20 Mbps and 940/500 Mbps *and* 4G LTE broadband with a minimum advertised speed of 5/1 Mbps.[993] Figure III.A.3b shows deployment for both fixed terrestrial services *and* 5G services at 7/1 Mbps and 35/3 Mbps.[994]

[993] We present additional deployment data for 25/3 Mbps, 100/20 Mbps, and 940/500 Mbps fixed terrestrial and/or mobile broadband services in the appendices. *See infra* Appx. F-1a (reporting deployment of fixed terrestrial services (25/3 Mbps, 100/20 Mbps, and 940/500 Mbps) and 4G LTE with minimum advertised speed of 5/1 Mbps by state, District of Columbia, and Puerto Rico); Appx. F-1c (reporting deployment for fixed terrestrial services (excluding fixed wireless services) and 4G LTE by state, District of Columbia and Puerto Rico); Appx. F-4 (reporting percentage of population with fixed terrestrial services and mobile broadband with a median speed of 10/3 Mbps by state and District of Columbia); Appx F-5 (reporting deployment of fixed terrestrial services and 4G LTE 5/1 Mbps on Tribal lands); Appx. F-9a (reporting deployment of fixed terrestrial services and 4G LTE 5/1 Mbps and 5G 7/1 Mbps services by state, county, and county equivalent); and Appx. F-9b (reporting deployment of fixed terrestrial services and 4G LTE 5/1 Mbps by state, county, and county equivalent, by urban and rural areas).

[994] *See infra* Appx. F-1b (reporting percentage of population with fixed terrestrial services and 5G with a minimum advertised speed of 7/1 Mbps by state, District of Columbia, and Puerto Rico); Appx. F-1d (reporting deployment of fixed terrestrial services (excluding fixed wireless) and 5G at 7/1 Mbps by state, District of Columbia, and Puerto Rico); Appx. F-6 (reporting deployment on Tribal lands for fixed terrestrial services and 5G); Appx. F-9a (reporting deployment of fixed terrestrial services and 4G LTE 5/1 Mbps and 5G 7/1 Mbps services by state, county, and county equivalent); and Appx. F-9c (reporting deployment of fixed terrestrial services and 5G 7/1 Mbps by state, county, and county equivalent, segmented by urban and rural areas)

Fig. III.A.3a
Percentage of Population Living in Census Blocks with Deployment (millions) of Fixed Terrestrial Services *and* 4G LTE with a Minimum Advertised Speed of 5/1 Mbps (2018-2021)

	2018		2019		2020		2021	
	Pop.	%	Pop.	%	Pop	%	Pop	%
25/3 Mbps and LTE 5/1 Mbps								
United States	311.926	94.4%	316.769	95.6%	324.601	97.6%	328.168	97.9%
Rural Areas	50.158	77.5%	53.891	82.5%	59.885	90.7%	56.896	91.0%
Urban Areas	261.768	98.5%	262.878	98.8%	264.716	99.3%	271.273	99.5%
Tribal Lands	2.914	72.1%	3.196	78.9%	3.539	86.7%	3.654	90.2%
25/3 Mbps (Excluding Fixed Wireless) and LTE 5/1 Mbps								
United States	304.621	92.2%	307.135	92.7%	311.909	93.8%	317.147	94.6%
Rural Areas	44.492	68.8%	46.382	71.0%	49.659	75.2%	48.564	77.6%
Urban Areas	260.129	97.9%	260.753	98.0%	262.250	98.4%	268.584	98.5%
Tribal Lands	2.678	66.3%	2.840	70.1%	3.043	74.5%	3.227	79.7%
100/20 Mbps and LTE 5/1 Mbps								
United States	291.706	88.3%	296.964	89.6%	304.650	91.6%	315.086	94.0%
Rural Areas	37.509	58.0%	40.401	61.9%	44.777	67.8%	47.069	75.2%
Urban Areas	254.196	95.7%	256.564	96.4%	259.874	97.5%	268.018	98.3%
Tribal Lands	1.995	49.4%	2.218	54.7%	2.484	60.8%	2.988	73.8%
100/20 Mbps (Excluding Fixed Wireless) and LTE 5/1 Mbps								
United States	287.780	87.1%	294.002	88.7%	300.331	90.3%	310.028	92.5%
Rural Areas	36.222	56.0%	38.746	59.3%	42.084	63.7%	43.586	69.7%
Urban Areas	251.558	94.7%	255.256	95.9%	258.247	96.9%	266.442	97.7%
Tribal Lands	1.946	48.2%	2.130	52.6%	2.353	57.6%	2.896	71.5%
940/500 Mbps and LTE 5/1 Mbps								
United States	91.433	27.7%	106.203	32.0%	119.436	35.9%	149.427	44.6%
Rural Areas	6.797	10.5%	9.017	13.8%	11.948	18.1%	16.459	26.3%
Urban Areas	84.636	31.9%	97.186	36.5%	107.488	40.3%	132.968	48.8%
Tribal Lands	0.452	11.2%	0.586	14.5%	0.820	20.1%	1.091	26.9%
940/500 Mbps (Excluding Fixed Wireless) and LTE 5/1 Mbps								
United States	88.936	26.9%	103.445	31.2%	115.490	34.7%	146.719	43.8%
Rural Areas	6.649	10.3%	8.887	13.6%	11.469	17.4%	16.223	25.9%
Urban Areas	82.287	31.0%	94.558	35.5%	104.021	39.0%	130.496	47.9%
Tribal Lands	0.452	11.2%	0.585	14.4%	0.817	20.0%	1.090	26.9%

Source: FCC Form 477 data; Staff Block Estimates.

Fig. III. A.3b
Percentage of Population Living in Census Blocks with Deployment (millions) of Fixed Terrestrial Services and 5G Services (2020-2021)

	Fixed Terrestrial Services and 5G with a Minimum Advertised Speed of 7/1 Mbps				Fixed Terrestrial Services and 5G with a Minimum Advertised Speed of 35/3 Mbps			
	2020		2021		2020		2021	
	Pop.	%	Pop	%	Pop.	%	Pop	%
25/3 Mbps and 5G Services								
United States	305.158	91.7%	322.525	96.2%	234.319	70.4%	320.238	95.5%
Rural Areas	48.490	73.5%	52.225	83.5%	26.780	40.6%	51.068	81.6%
Urban Areas	256.668	96.3%	270.299	99.2%	207.538	77.8%	269.171	98.7%
Tribal Lands	3.105	76.0%	3.436	84.8%	2.177	53.3%	3.402	84.0%
25/3 Mbps and 5G Services (Excluding Fixed Wireless).								
United States	294.329	88.5%	312.261	93.2%	227.802	68.5%	310.136	92.5%
Rural Areas	40.017	60.6%	44.626	71.3%	21.773	33.0%	43.615	69.7%
Urban Areas	254.312	95.4%	267.635	98.2%	206.029	77.3%	266.521	97.8%
Tribal Lands	2.685	65.8%	3.050	75.3%	1.951	47.8%	3.019	74.5%
100/20 Mbps and 5G Services								
United States	288.663	86.8%	310.632	92.7%	224.640	67.5%	308.569	92.1%
Rural Areas	36.501	55.3%	43.520	69.6%	20.181	30.6%	42.569	68.1%
Urban Areas	252.162	94.6%	267.111	98.0%	204.460	76.7%	266.000	97.6%
Tribal Lands	2.227	54.5%	2.864	70.7%	1.685	41.3%	2.842	70.1%
100/20 Mbps and 5G Services (Excluding Fixed Wireless).								
United States	284.923	85.7%	305.890	91.3%	222.645	66.9%	303.914	90.7%
Rural Areas	34.303	52.0%	40.337	64.5%	18.883	28.6%	39.452	63.1%
Urban Areas	250.620	94.0%	265.553	97.4%	203.762	76.4%	264.462	97.0%
Tribal Lands	2.128	52.1%	2.789	68.8%	1.618	39.6%	2.767	68.3%
940/500 Mbps and 5G Services								
United States	114.770	34.5%	147.753	44.1%	93.754	28.2%	146.994	43.9%
Rural Areas	9.776	14.8%	15.114	24.2%	5.319	8.1%	14.812	23.7%
Urban Areas	104.994	39.4%	132.639	48.7%	88.435	33.2%	132.182	48.5%
Tribal Lands	0.769	18.8%	1.050	25.9%	0.562	13.8%	1.043	25.8%
940/500 Mbps and 5G Services (Excluding Fixed Wireless).								
United States	110.917	33.3%	145.066	43.3%	90.829	27.3%	144.310	43.1%
Rural Areas	9.350	14.2%	14.894	23.8%	5.007	7.6%	14.593	23.3%
Urban Areas	101.566	38.1%	130.172	47.8%	85.822	32.2%	129.717	47.6%
Tribal Lands	0.766	18.8%	1.050	25.9%	0.561	13.7%	1.043	25.7%

Source: FCC Form 477 data; Staff Block Estimates.

346. Figure III.A.3c shows deployment across all geographic areas for fixed terrestrial services of at least 25/3 Mbps, 100/20 Mbps and 940/500 Mbps and mobile broadband with a median speed of 10/3 Mbps.[995]

Fig. III.A.3c
Percentage of Population Living in Census Blocks with Deployment (millions) of Fixed Terrestrial Services *and* Mobile Broadband with a Median Speed of 10/3 Mbps (2018-2021)

	2018		2019		2020		2021	
	Pop.	%	Pop.	%	Pop.	%	Pop.	%
25/3 Mbps and Mobile Broadband with a Median Speed of 10/3 Mbps								
United States	287.046	90.2%	300.156	94.0%	304.744	94.2%	307.824	94.4%
Rural Areas	37.780	65.6%	45.346	77.4%	47.859	78.3%	45.173	77.9%
Urban Areas	249.266	95.6%	254.810	97.7%	256.885	97.9%	262.651	98.0%
25/3 Mbps (Excluding Fixed Wireless) and Mobile Broadband with a Median Speed of 10/3 Mbps								
United States	281.890	88.6%	292.178	91.5%	294.761	91.1%	299.304	91.8%
Rural Areas	33.823	58.7%	39.172	66.9%	39.920	65.3%	38.887	67.0%
Urban Areas	248.067	95.2%	253.006	97.0%	254.840	97.1%	260.417	97.2%
100/20 Mbps and Mobile Broadband with a Median Speed of 10/3 Mbps								
United States	274.484	86.2%	284.332	89.0%	289.341	89.4%	298.023	91.4%
Rural Areas	29.873	51.9%	34.837	59.5%	36.667	60.0%	38.212	65.9%
Urban Areas	244.611	93.8%	249.495	95.7%	252.673	96.3%	259.811	97.0%
100/20 Mbps (Excluding Fixed Wireless) and Mobile Broadband with a Median Speed of 10/3 Mbps								
United States	272.912	85.7%	282.008	88.3%	286.149	88.5%	294.186	90.2%
Rural Areas	28.970	50.3%	33.533	57.3%	34.622	56.6%	35.501	61.2%
Urban Areas	243.942	93.6%	248.475	95.3%	251.527	95.9%	258.685	96.5%
940/500 Mbps and Mobile Broadband with a Median Speed of 10/3 Mbps								
United States	88.433	27.8%	103.598	32.4%	115.921	35.8%	143.146	43.9%
Rural Areas	5.053	8.8%	7.381	12.6%	9.711	15.9%	13.213	22.8%
Urban Areas	83.380	32.0%	96.217	36.9%	106.210	40.5%	129.933	48.5%
940/500 Mbps (Excluding Fixed Wireless) and Mobile Broadband with a Median Speed of 10/3 Mbps								
United States	85.968	27.0%	100.869	31.6%	112.038	34.6%	140.477	43.1%
Rural Areas	4.924	8.5%	7.259	12.4%	9.282	15.2%	12.988	22.4%
Urban Areas	81.044	31.1%	93.610	35.9%	102.756	39.2%	127.488	47.6%
Pop. Evaluated	318.269	97.3%	319.341	97.3%	323.466	98.2%	326.002	98.2%

Source: FCC Form 477 data; Ookla Speedtest Data; Staff Block Estimates.

[995] *See infra* Appx. F-4 (reporting deployment of mobile broadband with a median speed of 10/3 Mbps with fixed speeds of 25/3 Mbps, 100/20 Mbps, and 940/500 Mbps by state).

d. Additional Deployment Estimates

347. Some of the criticisms raised about the FCC Form 447 data can be mitigated by employing a range of analytical approaches (scenarios) to the FCC Form 477 data and reporting multiple estimates of broadband availability.[996] Below we provide alternative estimates based on criteria that attempt to lessen the effect of factors that could result in either understating deployment in areas where satellite services are purchased by households or overstating deployment in the FCC Form 477 data. In Figure III.A.4, we present alternative estimates of coverage for 25/3 Mbps, 100/20 Mbps, and 940/500 Mbps based on three scenarios that include *all* fixed technologies.[997] These alternative estimates include satellite service to the extent that the service meets the speed threshold and the scenario criteria. For comparison purposes, Scenario I presents fixed broadband coverage for all reported technologies, and takes the filer's data as released by the Commission. The two remaining scenarios include the filer's block-level data only if the filer's residential connections data meets the minimum penetration rate for the scenario.[998] We note that our assessment of deployment requires at least one filer to satisfy the scenario criteria. Scenario II compares each filer's FCC Form 477 deployment data to its residential connections data and excludes the filer's deployment data from the block if the filer does not to attain a 1% penetration rate (the filer's total number of residential connections in the tract/the filer's number of deployed households meeting the speed threshold in the census tract). Scenario III increases the penetration rate in Scenario II from 1% to 5%. Scenarios II and III analyze penetration without regard to subscription speed to account for consumers opting to subscribe to slower speed services than the maximum advertised speed offered by a provider.[999]

348. Figure III.A.4 presents alternative deployment estimates for three scenarios for the entire United States and also by urban, rural, and Tribal lands.[1000] The first column of Figure III.A.4 reports the results from the *last column* of Figure III.A.1a (deployment of fixed terrestrial services for 2021). Comparing the results of the first column of Figure III.A.4 to Scenario I shows the impact of including satellite services in the deployment data, i.e., including all fixed services in the deployment estimates. Including satellite services increases deployment for 25/3 Mbps service in all areas, but the inclusion of satellite services does not significantly affect deployment for the reported higher speed services because satellite providers tend not to offer service at such speeds.

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[996] A census block is classified as served if the FCC Form 477 data indicate that service is available in a census block, even if not to every location. It is not necessarily the case that every household will have coverage from a given provider in census block that the analysis indicates is served. The Commission has found that this type of analysis could overstate the coverage experienced by some consumers, especially in large or irregularly shaped census blocks. *See, e.g.*, *2020 Broadband Deployment Report,* 35 FCC Rcd at 8998, para. 26; *2019 Broadband Deployment Report*, 34 FCC Rcd at 3869, para. 25 & n.92.

[997] These estimates include fixed satellite services. The estimates for Scenarios II and III rely on confidential residential connections (subscriber) data.

[998] Because there are fewer technology codes reported for the subscriber data than for the deployment data for copper and cable technologies, we recode the deployment data for copper-based technology codes 10, 11, 12, 20 and 30 to technology code 10, and we recode the Cable modem technology codes 40, 41, 42, and 43 to technology code 40.

[999] As noted above, in Scenarios II and III, our decision to exclude a filer's FCC Form 477 deployment data does not mean that such service is not available in particular census block, only that the filer failed to attain the relevant penetration rate for purposes of these alternate estimates. In addition, these alternate scenarios have not been included in previous versions of this report; therefore, we are unable to provide any historical context regarding the extent to which individual results may have varied across time. *See supra* paras. 60, 61.

[1000] We also present figures showing the impact of these scenarios on the number of provider options. *See supra* Fig. II.A.33 (reporting figures for All Areas, Rural Areas, and Urban Areas). The results in Fig. II.A.33 are measured in percentage of households, while the results in Fig. III.A.4 are measured in percentage of the population.

349. In contrast, comparing the results of for Scenario I to Scenario II and Scenario III show the impact on the deployment estimates when the analysis excludes a filer's deployment data if the filer's connections data does not meet the penetration rate criteria for the scenario. The criteria for inclusion of a filer's deployment data becomes more stringent in Scenario III compared to Scenario II. The impact of the inclusion of the filer's data on the deployed population is somewhat modest for the nation and urban areas for 25/3 Mbps, but the impact of the criteria increases on the deployment estimates as the speed threshold increases. For example, comparing the results for Scenario II to Scenario I suggests that our deployment estimates for 100/20 Mbps would fall from 98.3% to 97% in urban areas, from 76.9% to 73.7% in rural areas, and from 75.6% to 72.4% on Tribal lands. Imposing a 5% penetration rate test results in more significant effects on our deployment estimates. Comparing the results for Scenario III to Scenario I suggests that our deployment estimates for 100/20 Mbps would fall from 98.3% to 96.7% in urban areas, from 76.9% to 71.7% in rural areas, and from 75.6% to 69.8% on Tribal lands. Hence, the impact of these criteria on our deployment estimates is greater in rural areas and on Tribal lands than in urban areas. Urban areas are more likely to have more providers and to have higher adoption of services; and thus, are more likely to have providers that satisfy these penetration rate criteria.

Fig. III.A.4
Percentage of Population Living in Census Blocks with Deployment (millions) by Scenario for Fixed Services Meeting 25/3 Mbps, 100/20 Mbps, and 940/500 Mbps (Dec. 31, 2021)

	Fig. III.A.1a (last column)		Scenario I: All Technologies		Scenario II: 1% Penetration Rate		Scenario III: 5% Penetration Rate	
	Pop.	%	Pop.	%	Pop.	%	Pop.	%
25/3 Mbps								
United States	329.079	98.2%	335.157	100.0%	330.827	98.7%	325.116	97.0%
Rural Areas	57.755	92.3%	62.550	100.0%	61.907	99.0%	58.064	92.8%
Urban Areas	271.324	99.5%	272.607	100.0%	268.919	98.6%	267.052	98.0%
Tribal Lands	3.682	90.9%	4.051	100.0%	3.993	98.6%	3.777	93.2%
100/20 Mbps								
United States	315.736	94.2%	316.198	94.3%	310.556	92.7%	308.347	92.0%
Rural Areas	47.675	76.2%	48.093	76.9%	46.125	73.7%	44.828	71.7%
Urban Areas	268.061	98.3%	268.105	98.3%	264.431	97.0%	263.519	96.7%
Tribal Lands	2.998	74.0%	3.063	75.6%	2.932	72.4%	2.827	69.8%
940/500 Mbps								
United States	149.649	44.7%	149.649	44.7%	136.255	40.7%	130.868	39.0%
Rural Areas	16.666	26.6%	16.666	26.6%	15.276	24.4%	14.551	23.3%
Urban Areas	132.983	48.8%	132.983	48.8%	120.979	44.4%	116.317	42.7%
Tribal Lands	1.096	27.1%	1.096	27.1%	0.939	23.2%	0.884	21.8%

Source: FCC Form 477 deployment and confidential subscriber data; Staff Block Estimates.

e. Demographics and Deployment

350. In Figures III.A.5a, III.A.5b, and III.A.6, we present demographic data with our deployment analysis.[1001] Figure III.A.5a compares the available demographic data for Americans with and without coverage by *both* fixed terrestrial services at speeds of 25/3 Mbps, 100/20 Mbps and 940/500 Mbps and 5G service with a minimum advertised speed of 7/1 Mbps. Figure III.A.5b presents the same demographic analysis for these service combinations on Tribal lands. These data show that, generally, Americans living in areas where these services are deployed typically live in census block groups with lower poverty rates and with higher average populations, population densities, per capita income, and median household incomes than Americans living in areas without coverage by these services. Figure III.A.6 depicts how the average proportion of the population with coverage by fixed terrestrial services by speed tier varies with median household income, population density, and household poverty rate at the census block group level. On average, deployment is highest in census blocks with the highest median household incomes, the highest population densities, and the lowest household poverty rates.

[1001] To present demographic data and compare the demographic data between areas where services are and are not deployed, we aggregate the census block data up to the census-block group level, the lowest aggregation level for which demographic information is available. This unavoidable aggregation leads to census blocks with differing characteristics being grouped together. In the case of differing levels of deployment, we designate a census-block group as without deployment if more than 5% of the population in the census-block group is without services, regardless of the level of deployment in any particular census block in the group. Further, some census-block groups are a mix of census blocks that are designated as rural and urban. In such instances, we designate a census-block group as rural if more than 50% of the population in the census-block group resides in census blocks designated as rural. Finally, we designate a census-block group as Tribal lands if more than 50% of the land area in the census-block group is designated as Tribal lands. We use the most recently available U.S. Census Bureau's ACS Five-Year Estimates 2016-2020 for income and poverty measures for the states, District of Columbia, and Puerto Rico; income measures are not available for the other U.S. territories. Per capita income and median household income for 2020 are measured in 2020 Inflation-Adjusted Dollars. The household poverty rate is the proportion of households living below the poverty level. Population Density is the total population residing in the census-block group as of 2020 divided by the square miles of land area in the census-block group, based on the 2020 Census. *See* Appx. F-7 (reporting percentage of the population covered, population density, and per capita income by state, county, and county equivalent, for deployment of 25/3 Mbps, 100/20 Mbps, 940/500 Mbps).

Fig. III.A.5a
Demographic Analysis of Areas With and Without Deployment of *Both* Fixed Terrestrial Services and 5G With a Minimum Advertised Speed of 7/1 Mbps (Dec. 31, 2021)

Area	Average Population	Average Population Density	Average Per Capita Income ($2020)	Average Median Household Income ($2020)	Average Poverty Rate
Fixed 25/3 Mbps and 5G With a Minimum Advertised Speed of 7/1 Mbps					
United States (All Areas)					
With Access	1,408.1***	7,239.2***	$36,074.80***	$74,779.07***	13.5%***
Without Access	1,192.5	527.4	$30,249.81	$59,823.02	13.9%
Rural Areas					
With Access	1,318.5***	242.8***	$34,094.36***	$71,823.99***	10.5%***
Without Access	1,132.4	69.9	$29,757.51	$58,525.06	13.5%
Urban Areas					
With Access	1,419.5	8,113.2***	$36,322.17***	$75,153.66***	13.9%***
Without Access	1,424.4	2,293.0	$32,188.26	$65,180.71	15.6%
Fixed 100/20 Mbps and 5G With a Minimum Advertised Speed of 7/1 Mbps					
United States (All Areas)					
With Access	1,408.1***	7,738.1***	$36,365.76***	$75,366.02***	13.6%***
Without Access	1,268.8	808.8	$31,092.07	$62,669.17	13.4%
Rural Areas					
With Access	1,327.5***	303.0***	$35,071.16***	$74,054.40***	10.2%***
Without Access	1,174.9	84.6	$30,383.94	$60,819.70	12.9%
Urban Areas					
With Access	1,415.2***	8,376.0***	$36,476.64***	$75,479.99***	13.9%***
Without Access	1,474.9	2,398.5	$32,662.65	$66,897.99	14.5%
Fixed 940/500 Mbps and 5G With a Minimum Advertised Speed of 7/1 Mbps					
United States (All Areas)					
With Access	1,358.6***	12,016.5***	$40,493.47***	$85,233.52***	12.1%***
Without Access	1,389.0	4,521.9	$33,642.86	$68,838.86	14.0%
Rural Areas					
With Access	1,173.0***	422.6***	$35,605.38***	$76,963.76***	10.2%***
Without Access	1,229.4	138.3	$31,669.80	$64,368.78	12.1%
Urban Areas					
With Access	1,369.3***	12,595.6***	$40,733.55***	$85,645.89***	12.2%***
Without Access	1,441.0	5,952.0	$34,287.04	$70,319.06	14.7%

We test for a statistical difference in the reported means between areas with and without deployment. The level of statistical significance is indicated by the number of stars. The absence of a star indicates no statistical difference between the reported figures. * signifies statistical significance at a 90% level of confidence, ** signifies statistical significance at a 95% level of confidence, and *** signifies statistical significance at a 99% level of confidence.

Source: FCC Form 477 Data; Staff Block Estimates; 2020 Census land area estimate; American Community Survey Five-Year Data Estimates (2016-2020).

Fig. III.A.5b
Demographic Analysis of Areas With and Without Deployment of *Both* Fixed Terrestrial Services and 5G With a Minimum Advertised Speed of 7/1 Mbps on Tribal Lands (Dec. 31, 2021)

Area	Average Population	Average Population Density	Average Per Capita Income ($2020)	Average Median Household Income($2020)	Average Poverty Rate
Fixed 25/3 Mbps and 5G With a Minimum Advertised Speed of 7/1 Mbps					
Tribal Lands					
With Access	1,245.7***	1,673.1***	$29,223.18***	$57,711.97***	15.6%***
Without Access	1,161.0	138.5	$24,194.34	$48,828.40	20.7%
Rural Areas					
With Access	1,209.5**	162.2***	$28,676.02***	$59,823.86***	14.0%***
Without Access	1,142.3	61.0	$24,200.46	$48,265.93	20.5%
Urban Areas					
With Access	1,261.8	2,342.4***	$29,461.61**	$56,792.09	16.3%***
Without Access	1,300.7	716.6	$24,148.52	$53,156.33	22.5%
Fixed 100/20 Mbps and 5G With a Minimum Advertised Speed of 7/1 Mbps					
Tribal Lands					
With Access	1,240.1**	2,060.9***	$29,836.30***	$58,091.36***	15.6%***
Without Access	1,197.1	244.0	$25,282.02	$51,528.60	18.9%
Rural Areas					
With Access	1,187.7	219.6***	$29,274.62***	$61,860.48***	13.6%***
Without Access	1,167.8	74.5	$25,332.76	$51,065.92	18.7%
Urban Areas					
With Access	1,253.1	2,512.3***	$29,970.25***	$57,201.98**	16.1%***
Without Access	1,316.7	934.3	$25,075.92	$53,460.31	19.7%
Fixed 940/500 Mbps and 5G With a Minimum Advertised Speed of 7/1 Mbps					
Tribal Lands					
With Access	1,049.7***	1,805.5***	$30,442.15***	$60,058.12***	15.3%***
Without Access	1,240.0	1,135.2	$27,376.89	$54,433.57	17.4%
Rural Areas					
With Access	1,075.9**	201.1***	$29,896.43***	$64,148.83***	13.0%***
Without Access	1,182.3	95.8	$25,798.64	$52,284.04	18.1%
Urban Areas					
With Access	1,029.2***	3,049.5***	$30,841.95	$57,080.98	17.0%
Without Access	1,294.8	2,123.8	$28,870.36	$56,478.51	16.7%

We test for a statistical difference in the reported means between areas with and without deployment. The level of statistical significance is indicated by the number of stars. The absence of a star indicates no statistical difference between the reported figures. * signifies statistical significance at a 90% level of confidence, ** signifies statistical significance at a 95% level of confidence, and *** signifies statistical significance at a 99% level of confidence.

Source: FCC Form 477 Data; Staff Block Estimates; 2020 Census land area estimate; American Community Survey Five-Year Data Estimates (2016-2020).

Fig. III.A.6
Average Percentage of Population With Fixed Terrestrial Services by Census Block Group Level Demographic Variables (Dec. 31, 2021)

	25/3 Mbps	100/20 Mbps	940/500 Mbps
Median Household Income ($2020)			
First Quartile (Lowest Median Household Income))	96.9%	91.8%	35.9%
Second Quartile	97.1%	90.8%	38.5%
Third Quartile	98.3%	93.5%	43.1%
Fourth Quartile (Highest Median Household Income)	99.5%	97.6%	54.8%
Population Density			
First Quartile (Lowest Pop. Density)	92.5%	77.4%	24.1%
Second Quartile	99.3%	97.3%	41.2%
Third Quartile	99.7%	98.9%	49.1%
Fourth Quartile (Highest Pop. Density)	99.8%	99.5%	57.2%
Household Poverty Rate			
First Quartile (Lowest Household Poverty Rate)	98.9%	95.8%	48.8%
Second Quartile	98.2%	93.3%	43.7%
Third Quartile	97.3%	91.5%	40.7%
Fourth Quartile (Highest Household Poverty Rate)	97.3%	92.9%	38.8%

Source: FCC Form 477 Data; Staff Block Estimates; 2020 Census land area estimate; American Community Survey Five-Year Data Estimates (2016-2020).

B. International Broadband Data Report

351. As part of its statutory requirement for the *Communications Marketplace Report*, the Commission must include "information comparing the extent of broadband service capability (including data transmission speeds and price for broadband service capability) in a total of 75 communities in at least 25 countries abroad for each of the data rate benchmarks for broadband service used by the Commission to reflect different speed tiers."[1002] The Commission must choose international communities comparable to various communities in the United States with respect to population size, population density, topography, and demographic profile.[1003] The Commission is required to include "a geographically diverse selection of countries" and "communities including the capital cities of such countries."[1004] The Commission must "identify relevant similarities and differences in each community, including their market structures, the number of competitors, the number of facilities-based providers, the types of technologies deployed by such providers, the applications and services those technologies enable, the regulatory model under which broadband service capability is provided, the types of applications and services used, business and residential use of such services, and other media available to consumers."[1005]

352. *Selection of Comparison Countries.* We reviewed 37 Organisation for Economic Co-operation and Development (OECD) countries that meet the statutory directive of developing a geographically diverse set of countries for comparison with the United States concerning international broadband services capability. These 37 OECD countries in alphabetical order are: Australia, Austria, Belgium, Canada, Chile, Colombia, Costa Rica, Czech Republic, Denmark, Estonia, Finland, France,

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[1002] 47 U.S.C. § 1303(b)(1).

[1003] *Id.* § 1303(b)(2). Fig. III.A.6 depicts how the average proportion of the U.S. population with coverage by fixed terrestrial services at different speed tiers varies with median household income, population density, and the household poverty rate at the census-block group level. On average, deployment is highest in census blocks with the highest median household incomes, the highest population densities, and the lowest household poverty rates. *See supra* Fig. III.A.6.

[1004] *Id.* § 1303(b)(2)(A), (B).

[1005] *Id.* § 1303(b)(3).

Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Latvia, Lithuania, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Slovenia, South Korea, Spain, Sweden, Switzerland, Turkey, and the United Kingdom.[1006] For the fixed and mobile deployment comparison, we report on the 26 European comparison countries.[1007] For the fixed and mobile broadband speed and performance comparison, we present data for 35 comparison countries. For the fixed and mobile broadband pricing comparisons, we report on a smaller subset of 25 comparison countries.[1008] A complete list of comparison countries is presented in section I of Appendix G.

1. Broadband Deployment Comparison

353. In section II of Appendix G, we compare fixed high-speed broadband deployment and mobile broadband deployment in the United States and 26 European comparison countries. We relied on the European Commission (EC) deployment data published in the Broadband Coverage in Europe 2021 Report and FCC Form 477 data for the United States.[1009]

354. *Fixed Broadband Results—Speed-Tier Results*. The United States ranked 9th, 7th, and 5th out of 27 countries in the percentage of total households with access to fixed broadband with a download speed greater than 30 Mbps, 100 Mbps, and 1 Gbps, respectively.[1010]

355. *Fixed Broadband Results—Technology-Specific Results.* Between 2017 and 2021, the percentage of total households in the United States with access to FTTP increased from 29.3% to 44.7%, and the percentage of rural households with access to FTTP increased from 16.0% to 28.0%. The United States ranked 18th and 16th out of 27 countries in the percentage of total households and rural households, respectively, with access to FTTP. The United States ranked 5th and 4th out of 27 countries in the percentage of total households and rural households, respectively, with access to fixed broadband through either DOCSIS 3.0 or 3.1 technology.

356. *Mobile Broadband Results*. The United States ranked 5th and 2nd out of 27 countries in the percentage of total households and rural households, respectively, with access to 5G networks in 2021, with 99.3% of total households and 86.0% of rural households having access to 5G networks.

1006 OECD, *Our global reach*, https://www.oecd.org/about/document/list-oecd-member-countries.htm (last visited Oct. 6, 2022) (navigate to the "Member countries" subsection in order to obtain the list of member countries).

1007 In addition to the primary broadband deployment analysis comparing European OECD countries and the United States, we report, for the first time, high-level broadband deployment statistics for eight non-European OECD countries.

1008 The countries excluded from the pricing analysis are Chile, Colombia, Costa Rica, Hungary, Israel, Japan, Lithuania, Poland, Slovakia, Slovenia, South Korea, and Turkey. Due to the time-intensive nature of collecting both fixed broadband and mobile broadband pricing data from multiple providers in each country, we limited the pricing analysis to the same countries analyzed in the pricing analysis of the *2020 International Broadband Data Report. See 2020 Communications Marketplace Report*, 36 FCC Rcd at 3750, Appx. G-1: International Broadband Data Report, para. 2.

1009 *See* European Commission, Broadband Coverage in Europe 2021 (2022), https://digital-strategy.ec.europa.eu/en/library/broadband-coverage-europe-2021 (Broadband Coverage in Europe 2021 Report) (the report can be accessed by clicking on the appropriate item listed under the "Downloads" sub header). A provider that reports offering service in a particular census block may not offer service, or service at that speed, to all locations in the census block. Accordingly, the number of providers presented in this *Report* does not necessarily reflect the number of choices available to a particular household and does not purport to measure competition.

1010 To keep the speed tiers consistent across countries, we use 1 Gbps as the threshold for the highest download speed tier for fixed broadband services. If a provider's plan has a download speed of 940 Mbps, it is not included in the 1 Gbps tier for the international comparisons.

2. Broadband Speed and Performance Comparison

357. In section III of Appendix G, based on Ookla Speedtest datasets, we present a comparison of fixed broadband and mobile broadband performance metrics in terms of data transmission speeds (download and upload speeds) and latency for the United States and the 35 comparison countries. For fixed broadband, we examine all technologies accounted for by Ookla,[1011] and for mobile broadband, we examine 4G LTE and 5G.[1012] Our analysis covers a five-year time horizon for fixed broadband and for 4G LTE, but we only consider one year of data for 5G.[1013] We rank speeds from the fastest (1st) to the slowest (36th) and latency from the lowest (1st) to the highest (36th).

358. *Fixed Broadband Results.* The mean download speed in the United States in 2021 was 195.5 Mbps, ranking 9th out of 36 countries—a decline from a ranking of 5th out of 36 countries in 2020 when the mean download speed was 150.5 Mbps. The mean upload speed in the United States in 2021 was 72.9 Mbps, ranking 18th of 36 countries—a slight decline from a ranking of 17th out of 36 countries in 2020. For mean latency, although the United States slipped from a ranking of 25th out of 36 countries in 2017 to a ranking of 29th out of 36 countries in 2021, the mean latency in the United States improved from 29.6 ms in 2017 to 21.3 ms in 2021.

359. *Mobile Broadband—4G LTE Results.* For mean download speeds, the United States ranked 23rd out of 36 countries in 2021, with a mean download speed of 44.8 Mbps, an improvement from a ranking of 34th out of 36 countries in 2017. For mean upload speeds, the United States had the slowest mean upload speed out of 36 countries in 2021. The mean upload speed in the United States in 2021 was 9.9 Mbps, a decrease from 11.1 Mbps in 2019. For mean latency, the United States ranked 34th in 2021, with the mean latency of 41.5 ms, an improvement from the mean latency of 50.4 ms in 2017.

360. *Mobile Broadband—5G Results*. The mean download speed in the United States in 2021 was 187.7 Mbps, ranking 27th out of 36 countries. The mean upload speed in the United States in 2021 was 23.5 Mbps, ranking 31st out of 36 countries. For mean latency, the United States ranked 33rd out of 36 countries, with the mean latency of 33.0 ms.

3. Broadband Pricing Comparison

361. In section IV of Appendix G, we present analyses of fixed broadband and mobile broadband prices for the United States and 25 comparison countries. We collected fixed broadband and mobile broadband prices from the websites of the largest providers in each country between February and July of 2022.[1014] We compare broadband prices using two methods: (1) a broadband price index; and (2) a hedonic broadband price index. The broadband price index ranks countries by their weighted average price, while the hedonic price index accounts for quality differences as well as country-level cost and demographic differences, such as population density, income, topography, and education levels, which are likely to affect pricing across countries. These analyses seek to provide meaningful broadband pricing comparison across countries. We rank the countries from the least expensive (1st) to the most expensive (26th) based on the two price indexes.

[1011] Ookla does not specify which technologies are included in their fixed results because Ookla is unable to distinguish the technology that the test taker is using. Data based on Wi-Fi-using devices are included in these results.

[1012] In the *2020 International Broadband Data Report*, we considered only 4G LTE because 5G networks had been deployed in a very limited number of countries. *See 2020 Communications Marketplace Report*, 36 FCC Rcd at 3749, Appx. G: International Broadband Data Report.

[1013] We present one year of data on mobile broadband—5G, for the year 2021, because these networks had limited deployment in most countries prior to 2021.

[1014] We collected fixed residential broadband plan prices and terms from 84 providers in 26 countries, including the United States, between April and July of 2022. We also collected mobile broadband plan prices and terms from 84 providers from 26 countries, including the United States, between February and April of 2022.

362. *Fixed Broadband Results.* Based on the broadband price index approach, without adjusting for cost, quality, and demand factor differences across countries, the United States ranked 24th among the 26 comparison countries across various measures for fixed broadband services, including fixed broadband service purchased on a standalone basis, fixed broadband service purchased in a bundle with video service, and the weighted combination of the standalone and bundle plans of fixed broadband service. However, using the hedonic price index approach, which adjusted for cost, demographics, and broadband plan characteristics, the United States ranked 13th among the 26 countries. The U.S. ranking remained unchanged after adding additional controls for fixed broadband network quality to the hedonic model. Further, after controlling for potential measures of broadband content quality, primarily based on the number and popularity of websites and domains in the official language of the country, in addition to the aforementioned adjustments for cost, demographics, broadband plan characteristics, and broadband network quality differences across countries, the United States ranked 5th among the 26 countries.

363. *Mobile Broadband Results.* Based on the broadband price index approach, without adjusting for cost, quality, and demand factor differences across countries, the United States ranked 24th among the 26 comparison countries in single-line plan pricing, multi-line pricing, as well as the overall pricing across single-line and multi-line plans of mobile broadband services. However, using the hedonic price index approach which adjusted for cost, demographics, and mobile broadband plan characteristics, the United States ranked 13th among the 26 countries. The ranking of the United States improved slightly to 12th out of the 26 countries after adding additional controls for mobile network quality to the hedonic model. Further, after controlling for potential measures of broadband content quality, primarily based on the number and popularity of websites and domains in the official language of the country, in addition to the aforementioned adjustments for cost, demographics, broadband plan characteristics, and mobile network quality differences across countries, the United States ranked 8th among the 26 countries.

4. International Regulatory Developments

364. We discuss several new market and regulatory developments, including national broadband, satellite, and 5G and 6G developments.[1015] We limit our discussion to developments that have occurred since the last *Report*, and identify the relevant similarities and differences between the United States, the comparison countries, and others, based on multiple criteria.[1016]

365. *Market Developments*. Providers in a number of countries have continued to launch new broadband services and increase broadband speeds over the past two years.[1017] For example, New Zealand fixed line broadband provider Chorus is pursuing Gigabit Passive Optical Network (GPON) technologies, marketed as "Hyperfibre," for future infrastructure upgrades.[1018] Similarly, Canadian broadband providers Bell and Rogers announced in August they would begin delivering internet services

[1015] 47 U.S.C. § 1303(b)(3) ("The Commission shall identify relevant similarities and differences in each community, including their market structures, the number of competitors, the number of facilities-based providers, the types of technologies deployed by such providers, the applications and services those technologies enable, the regulatory model under which broadband service capability is provided, the types of applications and services used, business and residential use of such services, and other media available to consumers.").

[1016] *See 2020 Communications Marketplace Report*, 36 FCC Rcd at 3119-27, paras. 306-18; *2018 Communications Marketplace Report*, 33 FCC Rcd at 12707-13, paras. 280-89.

[1017] *See* TeleGeography, *TeleGeography GlobalComms Database*, http://www.telegeography.com (last accessed Sept. 26, 2022).

[1018] TeleGeography CommsUpdate, *Chorus, Nokia Demo 25G PON Broadband* (May 27, 2022), https://www.commsupdate.com/articles/2022/05/27/chorus-nokia-demo-25g-pon-broadband/; *see generally* Bernd Hesse, *The Emerging PON Technologies Accelerating Worldwide Gigabit Deployment*, Broadband Forum, https://www.broadband-forum.org/the-emerging-pon-technologies-accelerating-worldwide-gigabit-deployment (last visited Oct. 6, 2022).

at 8 Gbps to select areas in Canada as of September 2022.[1019] Operators in many countries are also beginning to retire older services such as copper networks, and 2G and 3G mobile wireless networks.[1020]

366. Providers in several countries are in the process of increasing fiber deployment. For example, as part of its pivot from copper to fiber, NBN Co, which manages Australia's National Broadband Network (NBN), continues to upgrade its FTTP technology to provide "Home Ultrafast" 1 Gbps service to eight million premises by the end of 2023.[1021] In February 2022, Chilean wholesale fiber-optic company On Net Fiber announced that it had rolled out some 21,000 miles of fiber cables to reach almost half of the homes in Chile, along with plans to increase its FTTP footprint by up to 22,369 miles across 15 regions by the end of 2022.[1022] Israel has also sought to increase its fiber deployment.[1023] In March 2022, Israel's Ministry of Communications concluded a tender for fiber deployment in unserved parts of the country, aiming to connect 287,000 premises across 330 settlements within 15 months.[1024] In Europe, over 198 million, or 57%, of all homes had access to fiber as of September 2021, compared to 176 million a year earlier.[1025]

367. The use of Internet services such as online news, VOD, voice and video calling, social networks, online shopping, and online banking has also continued to grow in many countries, and governments have become more active on these matters over the past two years. For example, in July 2022, the European Union adopted two new pieces of legislation to regulate online services, the Digital Services Act and the Digital Markets Act.[1026] The Digital Services Act established tiered rules for online intermediary services with regard to transparency and content moderation, while the Digital Markets Act established rules for digital "gatekeepers."[1027] Further, as online video begins to capture a larger share of

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[1019] Tom Li, It World Canada, *Bell to Roll Out 8 Gbps Internet Service* (Aug. 4, 2022), https://www.itworldcanada.com/article/bell-to-roll-out-8-gbps-internet-service/496224.

[1020] *See* Telecompaper, *Majority of European Telcos Have Started Copper Network Shutdown – Berec* (Dec. 14, 2021), https://www.telecompaper.com/news/majority-of-european-telcos-have-started-copper-network-shutdown-berec--1407720; Telecompaper, *Orange Announces European Roadmap for 2G/3G Network Shutdown* (Mar. 1, 2022), https://www.telecompaper.com/news/orange-announces-european-roadmap-for-2g3g-network-shutdown--1415953.

[1021] TeleGeography CommsUpdate, *NBN Co Makes FTTP Upgrades Available to 50,000 More FTTN Premises* (Mar. 23, 2022), https://www.commsupdate.com/articles/2022/03/23/nbn-co-makes-fttp-upgrades-available-to-50000-more-fttn-premises/; *see also* Robert Clark, Light Reading, *After Seven Years of Copper, Australian NBN Pivots to Fiber* (Sept. 24, 2020), https://www.lightreading.com/opticalip/fttx/after-seven-years-of-copper-australian-nbn-pivots-to-fiber/d/d-id/764170 (analyzing NBN Co's fiber upgrade plans, initially announced in Sept. 2020).

[1022] Telecompaper, *Chile's On Net Fibra Hits 3mln FTTH Premises, Targets 4mln* (Feb. 7, 2022), https://www.telecompaper.com/news/chiles-on-net-fibra-hits-3-mln-ftth-premises-targets-4-mln--1413138.

[1023] TeleGeography CommsUpdate, *MoC Announces Results of Tender Related to Fibre Rollouts in Economically Unprofitable Areas* (Mar. 9, 2022), https://www.commsupdate.com/articles/2022/03/09/moc-announces-results-of-tender-related-to-fibre-rollouts-in-economically-unprofitable-areas/.

[1024] *Id.*

[1025] Telecompaper, *European Fibre Roll-Out Accelerates, 57% of Homes Can Access FTTH/B* (May 24, 2022), https://www.telecompaper.com/news/european-fibre-roll-out-accelerates-57-of-homes-can-access-ftthb--1425414.

[1026] Telecompaper, *European Parliament Gives Final Approval to Landmark Tech Sector Regulations* (Jul. 5, 2022), https://www.telecompaper.com/news/european-parliament-gives-final-approval-to-landmark-tech-sector-regulations--1430076.

[1027] European Commission, *The Digital Services Act: Ensuring a Safe and Accountable Online Environment*, https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/digital-services-act-ensuring-safe-and-accountable-online-environment_en (last visited Oct. 6, 2022); European Commission, *The Digital Markets Act: Ensuring Fair and Open Digital Markets*, https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/digital-markets-act-ensuring-fair-and-open-digital-markets_en (last visited Oct. 6, 2022).

revenue in key media markets,[1028] some countries are beginning to look more closely at how online video providers contribute to local content markets.[1029]

368. *National Broadband Developments*.[1030] Many countries continue to progress comprehensive broadband agendas, increasingly with a view towards new and innovative applications and services such as 5G, IoT, and artificial intelligence.[1031] For example, the UK government announced a plan for the country called "Levelling Up" that includes the goal of providing "nationwide gigabit-capable broadband and 4G coverage, with 5G coverage for the majority of the population" by 2030.[1032] In addition, the European Union set targets for Europe's digital transformation by 2030, including development of digital skills, digital transformation of businesses, securing sustainable digital infrastructures, and digitalization of public services.[1033] To help achieve its goals on broadband connectivity, the European Union established a Connecting Europe Facility, which is a key funding instrument that will provide over 2 billion euros (EUR) from 2021-2027 for secure and high-performance broadband, with 1 billion Euro available during 2021-2023 across several rounds of funding.[1034]

369. Over the past several years, as part of modernizing its universal service programs, the Commission has instituted a number of reforms to target support for broadband expansion and adoption in the United States.[1035] Other regulators are likewise increasingly including broadband in their universal service obligations. For example, the Japanese government is considering amendments to its

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[1028] *See* Telecompaper, *OTT Platforms to Account for one-fifth of European Sports Right Spend* (Mar. 23, 2022), https://www.telecompaper.com/news/ott-platforms-to-account-for-one-fifth-of-european-sports-right-spend--1418671.

[1029] *See, e.g.*, Telecompaper, *Dutch Govt Plans Law to Require Local Content Investment by SVOD Services* (July 11, 2022), https://www.telecompaper.com/news/dutch-govt-plans-law-to-require-local-content-investment-by-svod-services--1430636.

[1030] According to the International Telecommunications Union (ITU), at the end of 2020, 165 countries had national broadband plans of some sort. Countries are focusing less on developing targeted new plans, however, and are instead upgrading universal service programs, or developing broader digital transformation strategies that include but are not limited to connectivity. *See* Broadband Commission for Sustainable Development, The State of Broadband: People-Centered Approaches for Universal Broadband at 37 (2021), https://www.itu.int/dms_pub/itu-s/opb/pol/S-POL-BROADBAND.23-2021-PDF-E.pdf (State of Broadband Report 2021). The United Nations' Broadband Commission for Sustainable Development has set seven global broadband targets, including a target for all countries to have a funded national broadband plan or strategy, or to include broadband in their universal access and services definition, by 2025. *See generally* State of Broadband Report 2021, Chapter 3 (discussing overall progress towards the targets).

[1031] State of Broadband Report 2021 at 37. *See, e.g.*, South Korea Ministry of Science & ICT, National Strategy for Artificial Intelligence (2019), https://www.msit.go kr/eng/bbs/view.do?sCode=eng&mId=10&mPid=9&pageIndex=&bbsSeqNo=46&nttSeqNo=9&searchOpt=ALL&searchTxt=.

[1032] Vicki Deblasi, *UK Government announces changes to permitted development rights for electronic communications infrastructure* (Mar. 7, 2022), https://uk5g.org/updates/read-articles/dcms-announces-changes-to-permitted-development-rights-for-electronic-communications-infrastructure/.

[1033] European Commission, *Europe's Digital Decade: Digital Targets for 2030*, https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/europes-digital-decade-digital-targets-2030_en (last visited Oct. 6, 2022).

[1034] *See* Telecompaper, *EU to Allocate First EUR 1 bln CEF Funding to Gigabit and 5G Networks* (Dec. 17, 2021), https://www.telecompaper.com/news/eu-to-allocate-first-eur-1-bln-cef-funding-to-gigabit-and-5g-networks--1408233; Telecompaper, *EU Opens CEF Call for Funding 5G, Gigabit Network Projects* (Jan. 12, 2022), https://www.telecompaper.com/news/eu-opens-cef-call-for-funding-5g-gigabit-network-projects--1410354.

[1035] For a more detailed description of the Commission's recent universal service reforms, *see* FCC, *Universal Service*, https://www.fcc.gov/general/universal-service (last visited Oct. 6, 2022).

Telecommunications Business Act that would allow the Japanese Ministry of Internal Affairs and Communications (MIC) to include fixed broadband in its universal service regime for the first time.[1036] Countries are also considering how to fund further broadband investments, with the European Union considering a new Connectivity Infrastructure Act,[1037] and Member States[1038] and European telecom operators[1039] seeking to have large technology companies contribute to funding broadband deployment.

370. *Satellite Developments.* Many countries are also increasingly recognizing the possible impact of innovative satellite technologies. In February 2021, the Government of Quebec entered into a memorandum of understanding with Canadian satellite communications company Telesat to invest $400 million Canadian dollars (CAD) in the company's LEO satellite network, Telesat Lightspeed. In exchange, Telesat committed to invest $1.6 billion CAD in Quebec by moving a "significant portion" of Lightspeed manufacturing and operations to the Canadian province.[1040] In February 2022, the European Union announced that it planned to help fund the development of "a new secure satellite system to support government communications and wider broadband access" that would begin deployment in 2023 and start offering service in 2025.[1041] Similarly, in October 2021, Egypt's National Company for Telecommunications Services contracted a U.S. company to deploy the ground segment for its Ka-band TIBA-1 satellite, which will be used to provide broadband connectivity to rural and remote areas in the country.[1042] And in June 2022, the Rwanda Space Agency signed an MoU with the Global Satellite Operators Association to ensure access to spectrum and deploy satellite communication services to improve rural connectivity.[1043]

371. Regulators in other countries are examining how best to deploy this new generation of satellite technologies, both independently and collectively. The governments of the United States, United Kingdom, Japan, Canada, Italy, Belgium, and Austria, along with various commercial entities, are partnering to develop and fund a satellite-based quantum technology encryption network, which is expected to cost more than $70 million USD.[1044] With the launch of the European Space Agency and the

[1036] Benjamin C. Han, Hiroki Kobayashi, and Stuart Beraha, Lexology, *Spotlight: Telecoms and Internet Access in Japan* (Jan. 11, 2022), https://www.lexology.com/library/detail.aspx?g=3d651375-4522-4659-8c2c-5e40e3c0c209.

[1037] Telecompaper, *European Commission plans Connectivity Infrastructure Act for Autumn* (June 27, 2022), https://www.telecompaper.com/news/european-commission-plans-connectivity-infrastructure-act-for-autumn--1429109.

[1038] Telecompaper, *Italy, Spain and France Call on Tech Giants to Fund Network Costs* (Aug. 2, 2022), https://www.telecompaper.com/news/italy-spain-and-france-call-on-tech-giants-to-fund-network-costs--1432970.

[1039] *See* European Telecommunications Network Operators' Association (ETNO), *Joint EU and National Telecom Sector Statement on "Fair Contribution"* (July. 18, 2022), https://etno.eu/news/all-news/8-news/747-joint-eu-and-national-telecom-sector-statement-on-fair-contribution html; *see also* ETNO, *8 Common Questions on the "Fair Contribution" Debate* (June 8, 2022), https://etno.eu/news/all-news/742:8-questions-fair-contribution html.

[1040] Telesat, *Telesat Lightspeed to Receive $400 Million Investments from the Government of Quebec* (Feb. 18, 2021), https://www.telesat.com/press/press-releases/telesat-lightspeed-to-receive-400-million-investment-from-the-government-of-quebec/.

[1041] Telecompaper, *EU Plans New Secure Satellite Communications System* (Feb. 16, 2022), https://www.telecompaper.com/news/eu-plans-new-secure-satellite-communications-system--1414332.

[1042] Mustapha Iderawumi, Africa News, *NCTS Selects Hughes JUPITER System to Deliver Satellite Broadband in Egypt* (Nov. 1, 2021), https://africanews.space/ncts-selects-hughes-jupiter-system-to-deliver-satellite-broadband-in-egypt/.

[1043] TeleGeography CommsUpdate, *Rwanda and GSOA sign MoU covering satellite communications* (June 10, 2022), https://www.commsupdate.com/articles/2022/06/10/rwanda-and-gsoa-sign-mou-covering-satellite-communications/.

[1044] Jason Rainbow, Space News, *Governments Ally for Federal Quantum Encryption Satellite Network* (June 11, 2021), https://spacenews.com/governments-ally-for-federated-quantum-encryption-satellite-network/.

European Union's new space program, the European Union will allocate 9 billion Euro for the 2021-2027 period, which will include investment towards satellite navigation and secure communications.[1045] As part of its Five-Year Spectrum Outlook 2021-2026, the Australian Communications and Media Authority is considering how best to address spectrum management challenges arising from rapid innovations in satellite technologies and services.[1046]

372. *5G Developments.* Many countries have been approaching broadband development and deployment with a particular focus on 5G infrastructure. Although commercial 5G services are now available in every region of the world, approaches to 5G development and the status of deployment efforts continue to vary across countries. As of August 2022, 208 operators had launched more than 112,700 5G deployments worldwide.[1047]

373. The Commission has focused on five key principles for delivering 5G that is fast, secure, resilient, and available everywhere in the United States: (1) making additional and appropriate spectrum available for 5G services; (2) expanding the reach of fiber facilities; (3) diversifying network equipment; (4) building secure and resilient supply chains; and (5) setting the technology standards of the future.[1048] Some countries and regions have developed or are developing 5G plans that cover a range of policy initiatives, such as the European Union's Digital Decade from 2021-2030, and Colombia's December 2019 Action Plan for 5G Adoption.[1049]

374. Regulators around the world, including in the United States, have continued to allocate, auction, and/or license additional spectrum across various bands to support 5G services, with more than U.S. 130 billion spent on 5G assignments in 2021, and 50 countries planning further 5G assignments through the end of 2023.[1050] For example, in December 2021, Australia concluded an auction of reallocated spectrum in the 850/900 MHz band for 5G services.[1051] Australia also intends to auction spectrum in the 3.4-3.8 GHz range in early to mid-2023.[1052]

[1045] Alexandra Brzozowski, Euractiv, *EU Reaches for the Stars as New Space Programme Lifts Off* (June 23, 2021), https://www.euractiv.com/section/outer-space/news/eu-reaches-for-the-stars-as-new-space-programme-lifts-off/.

[1046] Australian Communications & Media Authority (ACMA), *Five-Year Spectrum Outlook 2021-26 Work Program* (Sept. 2021), https://www.acma.gov.au/publications/2021-09/plan/five-year-spectrum-outlook-2021-26.

[1047] Ookla, *Ookla 5G Map*, https://www.speedtest.net/ookla-5g-map (last visited Oct. 6, 2022). As of November 30, 2021, there were 5G deployments in 112 countries, up from 99 countries on the same date the previous year. Isla McKetta, Ookla, *Growing and Slowing: The State of 5G Worldwide in 2021* (Dec. 20, 2021), https://www.ookla.com/articles/state-of-worldwide-5g-2021.

[1048] *See, e.g.*, Remarks of Acting Chairwoman Jessica Rosenworcel to the 10th Americas Spectrum Management Conference (Oct. 12, 2021), https://www.fcc.gov/document/acting-chair-rosenworcel-americas-spectrum-management-conference.

[1049] *See* European Commission, *Europe's Digital Decade: Digital Targets for 2030*, https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/europes-digital-decade-digital-targets-2030_en (last visited Oct. 6, 2022); Government of Colombia, *Plan 5G Colombia* (Dec. 2019), https://mintic.gov.co/micrositios/plan_5g//764/articles-162230_recurso_1.pdf.

[1050] Global Mobile Suppliers Association, *5G—5G Infographic June 2022* (July 1, 2022), https://gsacom.com/paper/5g-infographic-june-2022/; *see also* S&P Global, Upcoming Global Spectrum Auctions, 2021 Onwards (Apr. 2, 2021), https://www.spglobal.com/marketintelligence/en/news-insights/blog/upcoming-global-spectrum-auctions-2021-onward.

[1051] ACMA, *Spectrum Allocation and Auction Summary—850/900 MHz band (2021)*, https://www.acma.gov.au/spectrum-allocation-and-auction-summary-850900-mhz-band-2021 (last visited Oct. 6, 2022). ACMA also previously auctioned 5G spectrum in the 26 GHz band in April 2021. ACMA, *Auction summary—26 GHz band (2021)*, https://www.acma.gov.au/auction-summary-26-ghz-band-2021 (last visited Oct. 6, 2022).

[1052] ACMA, *Five-Year Spectrum Outlook 2021-26 Work Program* (Sept. 2021), https://www.acma.gov.au/publications/2021-09/plan/five-year-spectrum-outlook-2021-26.

375. In the European Union, up to 64% of households had access to at least one 5G network, as of the end of 2021.[1053] In line with the European Union's Digital Decade targets and its earlier 2016 5G Action Plan,[1054] European Union member states are focusing on several "pioneer band[s]" to harmonize the initial launch of 5G services across Europe,[1055] with an initial emphasis on the 700 MHz, 3.4-3.8 GHz, and 26 GHz bands.[1056] As of May 2022, 19 of the 27 European Union member states had assigned spectrum in the 700 MHz band, 21 had assigned spectrum in the 3.6 GHz band (3.4-3.8 GHz), and six had assigned spectrum in the 26 GHz band.[1057] European operators are also repurposing spectrum in the 800, 1500, 1800, 2100, and 2600 MHz bands for 5G.[1058] In February 2022, the European Commission enabled the use of existing spectrum in the 900 MHz and 1800 MHz bands for 5G by adopting updated technical criteria.[1059]

376. In February 2021, Chile became the first country in Latin America to auction spectrum suitable for 5G technologies, with four operators winning spectrum in the 700 MHz, 1700/2100 MHz, 3.5 GHz, and 26 GHz bands.[1060] 5G became commercially available in Chile in December 2021.[1061] Canada and Mexico have also launched 5G services. Canada concluded the country's 3.5 GHz band auction in July 2021 for 5G services. Canada's top providers, Rogers Communication and Bell Canada, have announced they will offer commercial 5G standalone network services by 2023.[1062] Similarly, Mexico has taken significant steps to facilitate 5G service deployment. In February 2022, for example, the Federal Institute of Telecommunications (IFT) authorized the largest Mexican incumbent, Telcel, to offer 5G services in Mexico in the 3.5 GHz band.[1063] Mexico also completed a public auction in October 2021 that assigned regional blocks of spectrum in the 800 MHz and 2.5 GHz bands to AT&T and Telcel, and in September

[1053] Telecompaper, *EU 5G Coverage Up to 64% of Population, 31 mln Users—Study* (May 12, 2022), https://www.telecompaper.com/news/eu-5g-coverage-up-to-64-of-population-31-mln-users-study--1424148.

[1054] *See* European Commission, *5G for Europe: An Action Plan* (Sept. 14, 2016), https://digital-strategy.ec.europa.eu/en/library/communication-5g-europe-action-plan-and-accompanying-staff-working-document.

[1055] Radio Spectrum Policy Group, *Strategic Roadmap Towards 5G for Europe: Opinion on Spectrum-Related Aspects for Next-Generation Wireless Systems (5G)* (2016), https://rspg-spectrum.eu/wp-content/uploads/2013/05/RPSG16-032-Opinion_5G.pdf (identifying the following "pioneer band[s]": 3400-3800 MHz; below 1 GHz, particularly the 700 MHz band; 24.25-27.5 GHz; and upper bands, including 31.8-33.4 GHz and 40.5-43.5 GHz).

[1056] Radio Spectrum Policy Group, *Strategic Spectrum Roadmap Towards 5G for Europe: RSPG Second Opinion on 5G Networks* (2018), https://circabc.europa.eu/sd/a/fe1a3338-b751-43e3-9ed8-a5632f051d1f/RSPG18- 005final-2nd_opinion_on_5G (identifying the 3.4-3.8 GHz band as the "key for success of 5G in Europe").

[1057] European Commission, *5G Observatory Quarterly Report 15—Status in March 2022* at 14-15 (2022), https://5gobservatory.eu/wp-content/uploads/2022/05/5G-Observatory-Quarterly-Report-15-May-2022.pdf.

[1058] *Id.* at 15.

[1059] Telecompaper, *EU Updates Spectrum Rules for 5G in 900, 1,800 MHz Bands* (Feb. 10, 2022), https://www.telecompaper.com/news/eu-updates-spectrum-rules-for-5g-in-900-1800-mhz-bands--1413697.

[1060] TeleGeography CommsUpdate, *Movistar, Entel, WOM Win 3500MHz 5G Auction* (Feb. 17, 2021), https://www.commsupdate.com/articles/2021/02/17/movistar-entel-wom-win-3500mhz-5g-auction/.

[1061] Juan Pedro Tomás, RCR Wireless News, *Chile Kicks Off 5G Era with Initial Deployments* (Dec. 20, 2021), https://www.rcrwireless.com/20211220/5g/chile-kicks-off-5g-era-initial-deployments.

[1062] TeleGeography CommsUpdate, *Bell Launches '5G+ 3500MHz Service in Ontario; Prepares to Deploy 5G SA core network* (July 29, 2022), https://www.commsupdate.com/articles/2022/07/29/bell-launches-5g-3500mhz-service-in-ontario-prepares-to-deploy-5g-sa-core-network/.

[1063] TeleGeography CommsUpdate, *IFT Authorises Telcel to Offer 5G Services; Promises Largest 5G Network in LatAm* (Feb. 11, 2022), https://www.commsupdate.com/articles/2022/02/11/ift-authorises-telcel-to-offer-5g-services-promises-largest-5g-network-in-latam.

2022, Mexico plans to auction spectrum in the 600 MHz, 3.3 GHz, 3.5 GHz and 1500 MHz bands for 5G commercial use.[1064]

377. In Sub-Saharan Africa, 5G services are available in five countries[1065] with several others implementing steps to facilitate 5G deployment. In March 2022, the Independent Communications Authority South Africa concluded the country's multi-band auction of mobile spectrum in the 700 MHz, 800 MHz, 2.6 GHz, and 3.5 GHz bands.[1066] 5G services were first launched in South Africa in September 2019 when Rain announced the country's first commercial-ready 5G network in Cape Town. Zambia and Nigeria also auctioned spectrum in 2022 to facilitate the deployment of 5G services. In April 2022, the Zambia Information and Communication Technology Authority issued licenses to Airtel Zambia and MTN Zambia for spectrum in the 800 MHz and 2.6 GHz bands.[1067] And in May 2022, the Nigerian Communications Commission issued licenses to MTN and Mafab Communications for spectrum in the 3.5 GHz band.[1068] While 5G development is still in its early stages in the region, countries like Kenya,[1069] Ethiopia,[1070] Uganda, and Angola continue to take steps to facilitate its deployment by issuing licenses, reallocating spectrum suitable for 5G, and conducting 5G trials.[1071]

378. In the Middle East and North Africa region, 5G uptake varies among countries. Some countries, particularly those in the Persian Gulf and Israel, have rapidly advanced 5G expansion through focused regulatory measures.[1072] For example, in September 2020, the United Arab Emirates (UAE's) Telecoms and Digital Government Regulatory Authority allocated the spectrum in the 26 GHz band for 5G wireless services, becoming the first country in the Middle East to enable the use of high-frequency spectrum for 5G.[1073] In July 2021, Israel's Ministry of Communications established a deactivation strategy and timeline for 2G and 3G networks, targeting December 2025, in order to foster the growth of

[1064] TeleGeography CommsUpdate, *IFT to Stage 5G Auction this Year; 600MHz, 1500MHz, 3.3GHz, 3.5GHz Up for Grabs* (Feb. 4, 2022), https://www.commsupdate.com/articles/2022/02/04/ift-to-stage-5g-auction-this-year-600mhz-1500mhz-3-3ghz-3-5ghz-up-for-grabs/.

[1065] GSMA, *The Mobile Economy: Sub-Saharan Africa 2021* at 2 (2021), https://www.gsma.com/mobileeconomy/wp-content/uploads/2021/09/GSMA_ME_SSA_2021_English_Web_Singles.pdf. (*Sub-Saharan Africa 2021*).

[1066] Independent Communications Authority of South Africa, Press Release, ICASA Concludes Successful Spectrum Auction And Collects More Than R14.4 Billion Proceeds (Mar. 17, 2022), https://www.icasa.org.za/news/2022/icasa-concludes-successful-spectrum-auction-and-collects-more-than-r14-4-billion-proceeds.

[1067] TeleGeography CommsUpdate, *ZICTA Confirms New 800MHz and 2600MHz Spectrum Awards* (July 22, 2022), https://www.commsupdate.com/articles/2022/07/22/zicta-confirms-new-800mhz-and-2600mhz-spectrum-awards/ .

[1068] Nigerian Communications Commission, Press Release, NCC Issues Final Letters of Licence Awards to 5G Spectrum Winners (May 4, 2022), https://www.ncc.gov.ng/media-centre/news-headlines/1207-press-statement-ncc-issues-final-letters-of-licence-awards-to-5g-spectrum-winners.

[1069] TeleGeography CommsUpdate, *Kenyan regulator to enable 5G pilot networks this year* (Feb. 25, 2022), https://www.commsupdate.com/articles/2022/02/25/kenyan-regulator-to-enable-5g-pilot-networks-this-year/.

[1070] TeleGeography CommsUpdate, *Ethio Telecom announces pre-commercial 5G launch* (May 11, 2022), https://www.commsupdate.com/articles/2022/05/11/ethio-telecom-announces-pre-commercial-5g-launch/.

[1071] *See Sub-Saharan Africa 2021* at 21.

[1072] *See* GSMA, *Roadmaps for Awarding 5G Spectrum in the MENA Region* at 7 (January 2022), https://www.gsma.com/spectrum/wp-content/uploads/2022/01/spec_mena_5g_report_01_22-1.pdf (*GSMA Roadmaps for Awarding 5G Spectrum*).

[1073] TeleGeography CommsUpdate, *UAE Allocates 26GHz Frequencies as Etisalat Uses 5G for Home Broadband* (Sept. 16, 2021), https://www.commsupdate.com/articles/2020/09/16/uae-allocates-26ghz-frequencies-as-etisalat-uses-5g-for-home-broadband/.

next generation technologies, given the scarcity of spectrum.[1074] On the other hand, other countries are still in the early stages of considering how to facilitate future 5G deployment.[1075] For example, in August 2022, Jordan's Telecommunications Regulatory Commission (TRC) entered into an agreement with the country's leasing telecommunications operators to undergo preparations for the introduction of 5G services in the upcoming years.[1076]

379. Operators around the world are increasingly considering using Open RAN to upgrade their networks to 5G.[1077] Recognizing that Open RAN networks offer an alternative to traditional cellular network architecture and could enable diversity in suppliers, better network security, and lower costs, in March 2021, the Commission launched a Notice of Inquiry on the topic.[1078] Moreover, in July 2021, the Commission convened an Open RAN Solutions Showcase to give fixed and mobile network operators an opportunity to hear directly from vendors of interoperable, open interface, standards-based 5G network equipment and services. These actions reflect the Commission's continued efforts to ensure the United States leads the way in researching and developing innovative approaches to mobile network deployment. In Europe, operators have called on governments to provide more support for the Open RAN ecosystem,[1079] with one operator announcing a target of deploying Open RAN in 30% of its towers by 2030.[1080] The European Union is also examining the security of Open RAN.[1081]

380. *6G Developments.* Even as it continues to build towards a 5G future, the Commission has recognized the need to start planning for 6G, the "next-next-generation" of wireless technology.[1082] Likewise, regulators around the world are exploring the possibilities of 6G technology to further facilitate next-generation broadband connectivity. In June 2020, for example, Japan's MIC introduced its "Beyond 5G Promotion Strategy – Roadmap towards 6G," focused on the early development and deployment of "beyond 5G" advanced technologies.[1083] Similarly, in July 2021, the Republic of Korea's Ministry of

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[1074] TeleGeography CommsUpdate, *Ministry Orders Shutdown of Israeli 2G, 3G Networks by 2025* (July 2, 2021), https://www.commsupdate.com/articles/2021/07/02/ministry-orders-shutdown-of-israeli-2g-3g-networks-by-2025/.

[1075] *GSMA Roadmaps for Awarding 5G Spectrum* at 18-28.

[1076] Jordan News, *TRC Signs Agreement to Roll Out 5G Services*, (Aug. 12, 2022), https://www.jordannews.jo/Section-109/News/TRC-signs-agreement-to-roll-out-5G-services-20410.

[1077] *See, e.g.*, Open RAN Policy Coalition, *Compilation of Open RAN Announcements and Demonstrations* (2021), https://www.openranpolicy.org/wp-content/uploads/2021/10/ORPC-Compilation-of-Announcements-and-Demos-9.30.21.pdf; RCR Wireless News, *Open RAN 101–Open RAN Adoption in in different regions: Why, What, When, How?* (*Reader Forum*) (Aug. 6, 2020), https://www rcrwireless.com/20200806/opinion/readerforum/open-ran-101-open-ran-adoption-in-different-regions-why-what-when-how-reader-forum

[1078] *See Open RAN Notice of Inquiry*.

[1079] Telecompaper, *European Telcos Call for More EU Support for Developing Open RAN Ecosystem* (Nov. 18, 2021), https://www.telecompaper.com/news/european-telcos-call-for-more-eu-support-for-developing-open-ran-ecosystem--1404709.

[1080] Telecompaper, *Vodafone Targets OpenRAN in 30 Percent of European Masts by 2030* (Mar. 1, 2022), https://www.telecompaper.com/news/vodafone-targets-openran-in-30-percent-of-european-masts-by-2030--1415967.

[1081] Telecompaper, *Open RAN Creates New Opportunities, but also Security Risks—EU Report* (May 11, 2022), https://www.telecompaper.com/news/open-ran-creates-new-opportunities-but-also-security-risks-eu-report--1424010.

[1082] Remarks of Chairwoman Jessica Rosenworcel, Mobile World Congress, "New Frontiers of Partnerships," Barcelona, Spain (Mar. 1, 2022), https://www fcc.gov/document/chairwoman-rosenworcel-remarks-mobile-world-congress-2022. In July 2021, for example, the Commission reestablished the Technological Advisory Council (TAC) with a new focus on looking beyond 5G and conceptualizing 6G. *Id*.

[1083] Ministry of Internal Affairs and Communications (MIC), Press Release, Release of "Beyond 5G Promotion Strategy—Roadmap towards 6G" (June 30, 2020),

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Science and ICT (MSIT) introduced its "6G R&D Implementation Plan," which includes an investment of $194 million USD by 2025 and outlines three pillars for the Republic of Korea's global leadership in 6G technology.[1084] In Saudi Arabia, the Communications and Information Technology Commission (CITC) designated the entire 6 GHz band for unlicensed use to promote the development and deployment of 6G technology.[1085] And in Europe, the European Commission outlined its vision for 6G as of February 2022,[1086] and some countries such as Finland have already announced several 6G initiatives.[1087]

381. Most countries in Sub-Sahara Africa are in the early stages of considering whether to make the 6 GHz band available for unlicensed use, with most of the discussions taking place in regional forums such as the African Telecommunications Union (ATU). In July 2021, the ATU published its fifth ATU-R Recommendations on spectrum management, encouraging African Administrations to consider designating the lower part of the 6 GHz band for license-exempt use.[1088] And in June 2022, Kenya followed the ATU's recommendations by updating its spectrum guidelines to allow for the use of short-range devices in the lower 6 GHz band.

382. *COVID-19 Pandemic*. In response to the COVID-19 pandemic, the Commission has undertaken a variety of initiatives to keep Americans connected,[1089] and the importance of connectivity during the pandemic has been recognized internationally as well. In Canada, through the Universal Broadband Fund's (UBF) Rapid Response Stream, over $2 billion USD have been allocated to bring high-speed Internet into households in rural and remote communities across Canada by 2030.[1090] As of

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https://www.soumu.go.jp/main_sosiki/joho_tsusin/eng/pressrelease/2020/6/30_7.html; MIC, *Beyond 5G Promotion Strategy* (June 2020), https://www.soumu.go.jp/main_sosiki/joho_tsusin/eng/presentation/pdf/Beyond_5G_Promotion_Strategy.pdf; *see also* Beyond 5G Promotion Consortium, *What is Beyond 5G?*, https://b5g.jp/en/about.html (last visited Oct. 6, 2022) (describing a complementary multistakeholder initiative established in Dec. 2020 to achieve "the early and smooth introduction of Beyond 5G").

1084 Ministry of Science and ICT (MSIT), Press Release, 6G, Korea Takes the Lead Once Again: "6G R&D Implementation Plan" Established (July 2021), https://www.msit.go.kr/eng/bbs/view.do?sCode=eng&mId=4&mPid=2&pageIndex=&bbsSeqNo=42&nttSeqNo=517&searchOpt=ALL&searchTxt= (describing the three pillars of the strategy: securing next-generation key original technologies, gaining dominance in international standards and patents, and laying the foundation for 6G research and industry).

1085 Catherine Sbeglia Nin, RCR Wireless, *Saudi Arabia Designates Entire 6 GHz Band for Unlicensed Use, Paving Way for Wi-Fi 6E* (Mar. 31, 2021), https://www.rcrwireless.com/20210331/network-infrastructure/saudi-arabia-designates-entire-6-ghz-band-for-unlicensed-use-paving-way-for-wi-fi-6e.

1086 European Commission, *Europe Sets Out 6G Vision at Mobile World Congress Barcelona* (Mar. 1, 2022), https://digital-strategy.ec.europa.eu/en/news/europe-sets-out-6g-vision-mobile-world-congress-barcelona.

1087 Juan Pedro Tomás, RCR Wireless News, *Finnish Government Unveils New 6G Initiative* (May 13, 2022), https://www.rcrwireless.com/20220513/5g/finnish-government-unveils-new-6g-initiative; *see generally* 6G Finland, *About Us*, https://www.6gfinland.fi/about/ (last visited Oct. 6, 2022); 6G Flagship, *Welcome Aboard We Are 6G Flagship*, https://www.6gflagship.com/ (last visited Oct. 6, 2022).

1088 African Telecommunications Union, ATU-R-Recommendation-005, The Implementation of Emerging Radiocommunication Technologies Namely: 5G/IMT2020; HAPS; FSS ESIM; MSS Applications; FSS VSAT and Other Applications; Wi-Fi in 6 GHz; WiGig in 60 GHz and 5G NR-U (2021), https://www.atuuat.africa/wp-content/uploads/2021/08/En_ATU-R-Recommendation-005-0.pdf.

1089 *See infra* section V.; *see also* FCC, *Keep Americans Connected*, https://www.fcc.gov/keep-americans-connected (last visited Oct. 6, 2022).

1090 Ministry of Innovation, Science and Economic Development Canada, News Release, Government of Canada Invests Over $5.3 Million to Bring High-Speed Internet Access to 1,662 Households in Ontario (May 3, 2022),
(continued….)

May 2022, 180 projects supported through the UBF's Rapid Response Stream have been announced in Canada.[1091] Similarly, in the European Union, the pandemic has given greater urgency to connecting rural communities in countries like Germany,[1092] and countries such as Italy are using their COVID-19 recovery funds to support broadband buildout.[1093]

383. Switzerland, for example, is considering increasing the minimum broadband speed offered via universal service from 10/1 Mbps to 80/8 Mbps in 2024, highlighting in its reasoning the increasing demand for broadband for work from home and virtual schooling during the pandemic.[1094] In the Middle East and North Africa region, several countries, such as Algeria, Oman, Saudi Arabia, and Jordan, increased access to spectrum to enable operators to meet greater demand for broadband services during the pandemic period.[1095] In the wake of the pandemic, countries in the region have shifted their focuses to economic recovery, particularly through initiatives aimed at boosting the digital sector. For example, Saudi Arabia's Minister of Communication and Information Technology announced the government would provide $6.4 billion USD in investments to support the development of emerging technologies in the country.[1096]

384. Likewise, in order to accelerate post-pandemic economic recovery, the Republic of Korea launched its "Digital New Deal 2.0" in July 2021, which aims to create nearly one million new jobs by 2025 through government investment in key sectors.[1097] In Africa, the ATU published its sixth set of

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https://www.canada.ca/en/innovation-science-economic-development/news/2022/05/government-of-canada-invests-over-53-million-to-bring-high-speed-internet-access-to-1662-households-in-ontario-rural-communities-to-benefit-from-in html.

[1091] Ministry of Innovation, Science and Economic Development Canada, News Release, Government of Canada Invests Over $5.3 Million to Bring High-Speed Internet Access to 1,662 Households in Ontario (May 3, 2022), https://www.canada.ca/en/innovation-science-economic-development/news/2022/05/government-of-canada-invests-over-53-million-to-bring-high-speed-internet-access-to-1662-households-in-ontario-rural-communities-to-benefit-from-in html.

[1092] Janosch Delcker, Deutsche Welle, *German Village's Painfully Slow Internet Quickly Becomes a Major Problem* (Aug. 29, 2021), https://www.dw.com/en/german-villages-painfully-slow-internet-quickly-becomes-a-major-problem/a-58267474.

[1093] Elvira Pollina and Giuseppe Fonte, Reuters, *Italy to Spend 60% More of EU Funds on Better Broadband, Sources Say* (Apr. 13, 2021), https://www reuters.com/business/media-telecom/exclusive-italy-spend-60-more-eu-funds-better-broadband-sources-say-2021-04-13/.

[1094] Federal Council of Switzerland, *Höhere Internet-Geschwindigkeit in der Grundversorgung (Higher Internet Speed in the Basic Service)* (Dec. 10, 2021), https://www.admin.ch/gov/de/start/dokumentation/medienmitteilungen.msg-id-86370.html; Communications Commission of Switzerland, *ComCom Extends Universal Service Licence for One Year* (May 19, 2022), https://www.admin.ch/gov/en/start/documentation/media-releases.msg-id-88887 html (indicating that the current universal service license at 10/1 Mbps, which was set to expire in 2022, has been extended to 2023, pending a decision on whether to increase the required speed to 80/8 Mbps).

[1095] World Bank, *Global Digital Development Policy Response Database* (Mar. 1, 2021), https://dataviz.worldbank.org/views/DD-COVID19/Overview?%3Aembed=y&%3AisGuestRedirectFromVizportal=y&%3Adisplay_count=n&%3AshowAppBanner=false&%3Aorigin=viz_share_link&%3AshowVizHome=n.

[1096] Aziz El Yaakoubi, Reuters, *Saudi Arabia Announces $6.4 Billion Investments in Future Tech* (Feb. 1, 2022), https://www.reuters.com/markets/funds/saudi-arabia-announces-64-billion-investments-future-tech-2022-02-01/; *see also* GSMA, *The Mobile Economy Middle East & North Africa 2022* (2022), https://www.gsma.com/mobileeconomy/wp-content/uploads/2022/05/GSMA_MENA_ME2022_R_WebSingles.pdf.

[1097] MSIT, Press Release, The Digital New Deal is to Lead Digital Transformation in the World After COVID-19 (July 15, 2021), https://www.msit.go kr/eng/bbs/view.do?sCode=eng&mId=4&mPid=2&pageIndex=&bbsSeqNo=42&nttSeqNo=44

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spectrum recommendations on options for mitigating the effects of the pandemic.[1098] The recommendations highlighted the importance of implementing additional efforts along with the release of temporary spectrum in order to maximum its use and accelerate broadband deployment. Some of the more widely used options include releasing spectrum to existing network operators at no additional cost and expediting license approvals. South Africa, Ghana, and Zambia all allotted temporary spectrum to mobile operators at no additional cost. Kenya and Mozambique implemented steps to fast-track regulatory approvals for new and conventional technologies for broadband deployment. At a global level, the International Telecommunications Union (ITU)—the United Nations specialized agency for telecommunications and information and communication technologies—has collected best practices from around the world on supporting access to and use of communications technologies throughout the pandemic.[1099]

IV. ENTRY AND EXPANSION CONDITIONS IN THE COMMUNICATIONS MARKETPLACE

385. New entry and incumbent expansion occurs in the context of underlying regulatory and market conditions that directly influence the total number of firms that can successfully compete and grow. To evaluate the competitiveness of any market, one must consider multiple factors, including, as discussed in section II, prices and trends in prices, non-price competition, investment, innovation, as well as any barriers to entry or expansion by incumbents.[1100] While there is no single definition in the economics literature of what constitutes a barrier to entry,[1101] it is nonetheless the case that high barriers to entry reduce the threat to incumbents of new entry.[1102] In addition, barriers to expansion reduce the ability of existing competitors to successfully enter new geographic areas.

A. The Fixed Communications Marketplace

386. In the fixed marketplace, as in the mobile wireless marketplace, there are both regulatory and non-regulatory barriers to entry. Regulatory barriers include provider difficulties in obtaining the legal right to deploy facilities (such as on poles, in rights-of-way, and in multi-tenant environments

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3&searchOpt=&searchTxt=. The four sectors are identified as the following: (1) Improve the Ecosystem of Data, Network, and AI ("DNA"); (2) Digitalize the Education Infrastructure; (3) Nurture Contactless Industries (e.g., smart healthcare); and (4) Digitalize Social Overhead Capital (e.g., smart logistics).

[1098] African Telecommunications Union, *ATU-R-Recommendation-006-0, Options and Factors for Consideration on Special Spectrum Release or System Authorization in Fight of Covid-19 and its Impact Mitigation* (2020), https://www.atuuat.africa/wp-content/uploads/2022/06/ATU-R-Recommendation-006-0.pdf

[1099] *See* ITU, *COVID-19 Response and Recovery*, https://www.itu.int/en/Pages/covid-19.aspx (last visited Oct. 6, 2022).

[1100] *Applications of AT&T Inc. and DIRECTV For Consent to Assign or Transfer Control of Licenses and Authorizations*, Memorandum Opinion and Order, 30 FCC Rcd 9131, 9140, paras. 19-20 (2015); *Applications of AT&T Wireless Services, Inc. and Cingular Wireless Corporation*, Memorandum Opinion and Order, 19 FCC Rcd 21522, 21544-45, paras. 41-42 (2004).

[1101] *See, e.g.*, Joe S. Bain, Barriers to New Competition (1950); George J. Stigler, The Organization of Industry (1968); Carl Christian von Weizsacker, *A Welfare Analysis of Barriers to Entry*, 11 Bell Journal of Economics 399 (1980); Richard Gilbert, *Mobility Barriers and the Value of Incumbency*, Handbook of Industrial Organization 475 (Richard Schmalensee and Robert Willig eds. 1989); R. Preston McAfee, Hugo M. Mialon & Michael A. Williams, *What is a Barrier to Entry?*, 94 AEA Papers and Proceedings, 461 (2004).

[1102] High economic profits encourage entry into the market, low economic profits discourage entry, and prolonged negative economic profits induce exit from the market. *See, e.g.*, Hal R. Varian, Intermediate Microeconomics: A Modern Approach, 433-34 (9th ed. 2014); Dennis W. Carlton and Jeffrey M. Perloff, Modern Industrial Organization, 61, 76 (4th ed. 2005); *see also* George S. Ford, et al., *Competition After Unbundling: Entry, Industry Structure, and Convergence*, 59 Fed. Com. L.J. 344 (2007).

(MTEs)). Geography, the general cost of deploying wireline networks, and access to spectrum (for terrestrial fixed wireless providers) are examples of non-regulatory barriers.

387. Commenters identify a wide variety of potential barriers to entry and expansion in the fixed marketplace. Some of these barriers are more general in scope and could potentially affect both incumbent and non-incumbent providers, such as the high cost of deploying networks in rural areas and supply chain issues. Others may disproportionately affect a particular group of providers, such as difficulties in accessing poles, rights of way, and multi-unit dwellings and MTEs.

388. Congress and the Commission have repeatedly recognized that the business case for delivering high-quality broadband service to sparsely populated rural and insular areas at affordable rates often requires financial subsidies, such as through the Universal Service Fund (USF) or separate programs, such as the Broadband Equity, Access, and Deployment Program (BEAD Program) authorized by the 2021 Infrastructure Act and managed by the National Telecommunications and Information Administration (NTIA).[1103] Commenters acknowledge these costs,[1104] as well as the importance of efficient management of such programs.[1105] Commenters offer suggestions for how such programs can be best coordinated and implemented—some suggesting more stringent or flexible eligibility requirements,[1106] and USTelecom suggesting means of ensuring the stability of such programs.[1107] Apart from the need for funding, NCTA and WISPA, for example, raise the continuing importance of access to licensed and unlicensed spectrum in deploying networks.[1108]

389. The record also reflects potential barriers to entry and expansion based on current general economic conditions. Most significantly, NTCA observes that lengthy delays in the availability of telecommunications and broadband supplies, combined with significant increases in the cost of such equipment, are causing significant concern about the ability to meet deployment obligations under various government programs.[1109]

[1103] *See Report on the Future of the Universal Service Fund*, WC Docket No. 21-476, Report, FCC 22-67, at 4-5, paras. 6-8 (Aug. 15, 2022), (*Future of the USF Report*); Infrastructure Investment and Jobs Act, Pub. L. No. 117-58, div. F, tit. I, § 60102, 135 Stat. 429, 1182-1205 (2021) (Infrastructure Act).

[1104] ACA Comments at 6; NCTA Comments at 12; USTelecom Comments at 24.

[1105] USTelecom Comments at 24-25 (coordination of various federal programs); WISPA Comments at 38-43 (funding of overbuilders).

[1106] USTelecom Comments at 24-25 (coordination of various federal programs); NCTA Comments at 13-14 (reevaluate USF programs based on recent new federal funding programs, focus on competitive bidding); NTCA Comments at 11-12 (support high costs following deployment, strong vetting of potential USF recipients, high service standards for USF recipients; EchoStar Comments at 6-7 (access to USF and other federal funding for satellite services); WISPA Comments at 29-38 (various concerns regarding the NTIA's definition of "Reliable Broadband Service" for BEAD Program purposes).

[1107] USTelecom Comments 23-24 (expand USF contribution base to include services and entities that benefit from broadband access). In addition to comments regarding high-cost funding programs' effect on broadband investment, some commenters argue that the Commission's current classification of broadband promotes broadband innovation and investment. ACA Comments at 6-7; USTelecom Comments at 22.

[1108] NCTA Comments at 14-19; WISPA Comments at 20-24.

[1109] NTCA Comments at 7-8. An NTCA member survey showed that more than half of respondents named fiber order fulfillment delays as a significant barrier to deployment—twice as many as the previous year—while approximately 80% of responding companies reported they are experiencing an inability or delay in procuring supplies needed for network deployment. NTCA Comments at 7. The same survey revealed the effect of these delays, or the inability to procure supplies at any price, which is delayed installation of service at customer premises for 66.7% of responding companies and delayed network construction for 64% of responding companies. NTCA Comments at 7.

390. Commenters argue that difficulty in accessing poles and government rights of way remains a roadblock to network deployment. The record contains allegations that pole owners process requests for access too slowly and shift too many costs, such as the costs of pole replacement, onto attachers.[1110] Regarding access to rights of way, commenters claim that they experience permitting delays and fees that exceed reasonable costs.[1111]

391. Commenters also identify difficulty in accessing MTEs as a roadblock to deployment. They specifically reference commercial agreements that they argue serve to maintain monopolies in MTEs, such as exclusive wiring arrangements, bulk billing arrangements, and exclusivity agreements regarding access to rooftop antenna and distributed antenna system facilities.[1112] According to some commenters, competitive disparities between providers are sometimes exacerbated by certain barriers to entry or expansion. For example, in addition to MTE-related practices favoring providers already serving such locations,[1113] commenters identify policies that they argue disfavor smaller providers[1114] and incumbent local exchange carriers.[1115] The Commission took action earlier this year to address many of these issues, thereby helping to ensure competitive choice of communications services for those living and working in MTEs.[1116]

B. The Mobile Wireless Communications Marketplace

392. In the mobile wireless marketplace, there are both regulatory and non-regulatory factors that can affect entry or expansion. Regulatory barriers to entry arise from government regulations, rules, and restrictions that may have the effect of discouraging entry or expansion. For the most part, they are related to the inputs necessary to offer mobile wireless services. Spectrum policy, which affects the spectrum capacity available for mobile wireless services and infrastructure regulations that govern tower and antenna siting, may constitute barriers to entry or expansion. Non-regulatory or market conditions that may determine the number of providers that can operate in the market, or may deter entry or expansion, include efficiencies of size and scale, permanent asymmetries across service providers' costs, and capital cost requirements, such as those costs incurred in acquiring spectrum or deploying a nationwide network.[1117]

[1110] NTCA Comments at 5-6; INCOMPAS Comments at 28-30. INCOMPAS also argues that the current classification of Internet access service as a non-telecommunications service places attachers seeking to offer such service at a disadvantage. INCOMPAS Comments at 25 & n.61.

[1111] INCOMPAS Comments at 26-28; NTCA Comments at 5-6; USTelecom Comments at 23; USTelecom Reply at 11; FSF Reply at 2.

[1112] INCOMPAS Comments at 31-32; WISPA Comments at 44-45. In addition, WISPA arguments that state mandatory access laws favoring cable and telecommunications providers over fixed wireless providers are discriminatory and harmful to consumers. WISPA Comments at 45-46.

[1113] *See* INCOMPAS Comments at 30-32.

[1114] *See, e.g.*, NTCA Comments at 10-11 (small provider needs for IP interconnection); WISPA Comments at 43-44 (information burdens on small providers with regard to broadband labels).

[1115] USTelecom Comments at 20-21; FSF Reply at 2-3, 7-8.

[1116] *Improving Competitive Broadband Access to Multiple Tenant Environments*, GN Docket 17-142, Report and Order and Declaratory Ruling, FCC 22-12, (Feb. 22, 2022), https://docs.fcc.gov/public/attachments/FCC-22-12A1.pdf.

[1117] Relatively high fixed costs in relation to the number of customers may limit the number of firms that can enter and survive in a market. *See, e.g.*, John Sutton, *Sunk Costs and Market Structure* (1991); Luis Cabral, *Introduction to Industrial Organization* (2000); Dennis W. Carlton and Jeffrey M. Perloff, *Modern Industrial Organization* 41 (4th ed. 2005); George S. Ford, et al., *Competition After Unbundling: Entry, Industry Structure, and Convergence*, 59 Fed. Com. L.J. 59:2, 332, 337 (2007).

393. *Spectrum*. The Commission has made significant efforts to make more spectrum available and to reduce the cost of infrastructure deployment. Increasing the total supply of spectrum bandwidth that the Commission allocates and licenses is important, and since the release of the *2020 Communications Marketplace Report*, the Commission has continued its efforts to expand access to spectrum to support 5G and other advanced wireless services. The Commission has pursued a comprehensive strategy that emphasizes the need to free up spectrum in the low-, mid-, and high-frequency bands. The demand for mid-band spectrum for 5G networks has especially increased in recent years. Building on the mid-band efforts detailed in the *2020 Communications Marketplace Report*, the Commission's mid-band spectrum strategy over the last two years will further the deployment of 5G, IoT, and other advanced spectrum-based services.[1118]

394. In February 2021, for example, the Commission concluded Auction 107, which is thus far the largest auction of mid-band spectrum and the highest-grossing spectrum auction overall ever held in the United States.[1119] This auction, which commenced on December 8, 2020, made available 280 megahertz of new flexible-use overlay licenses in the 3.7-3.98 GHz band (C-band).[1120] In March 2021, the Commission released an order[1121] that was the next step towards an auction to grant new initial licenses subject to flexible use in the 3450-3550 MHz (3.45 GHz) band by the end of 2021.[1122] In January 2022, bidding in the 3.45 GHz auction (Auction 110) concluded following the close of bidding in the assignment phase.[1123] In July 2022, the Commission began the bidding in the auction of mid-band 2.5 GHz band licenses (Auction 108).[1124] Auction 108 offered county-sized overlay licenses in the single largest contiguous portion of available mid-band spectrum below 3 GHz, which had been underutilized, particularly in rural areas, for years.[1125] Bidding in the auction concluded on August 29, 2022, and of the

[1118] *2020 Communications Marketplace Report*, 36 FCC Rcd 3128-29, para. 324 (detailing actions in the 2.5 GHz, 3.55-3.65 GHz, 3.45-3.55 GHz, and 3.7-4.2 GHz bands).

[1119] *Auction 107 Closing Public Notice*, 36 FCC Rcd at 4318; FCC, Press Release, First Phase of Record-Breaking 5G Spectrum Auction Concludes (Jan. 15, 2021), https://docs.fcc.gov/public/attachments/DOC-369265A1.pdf.

[1120] *Auction 107 Closing Public Notice*, 36 FCC Rcd at 4318, para. 1; *Expanding Flexible Use of the 3.7 to 4.2 GHz*, GN Docket No. 18-122, Report and Order and Order of Proposed Modification, 35 FCC Rcd 2343, 2345, para. 4 (2020) (*3.7 GHz Report and Order*), *upheld sub nom. PSSI Global Services, L.L.C. v. FCC,* 983 F.3d 1 (D.C. Cir. 2020).

[1121] *Facilitating Shared Use in the 3100-3550 MHz Band*, WT Docket 19-348, Second Report and Order, Order on Reconsideration, and Order of Proposed Modification, 36 FCC Rcd 5987 (2021) (*3.45 GHz Second Report and Order*).

[1122] *3.45 GHz Second Report and Order*, 36 FCC Rcd at 5988, para. 1. In CTIA's comments, it states that mid-band spectrum is a key factor for 5G because it provides high speeds over a broad coverage area and asserts that the lower 3 GHz band (3.1-3.45 GHz) is a top priority for U.S. wireless interests. CTIA notes that these frequencies are internationally harmonized and sit next to other full-power 5G spectrum, making this swath an ideal fit to provide large channels and the flexibility to be aggregated with other bands. CTIA Comments at 61.

[1123] *Auction of Flexible-Use Service Licenses in the 3.45-3.55 GHz Band Closes; Winning Bidders Announced for Auction 110*, Public Notice, DA 22-39 (WTB/OEA Jan. 14, 2022) (*Auction 110 Closing Public Notice*).

[1124] FCC, Press Release, FCC Starts 5G Mid-Band Spectrum Auction (July 29, 2022), https://docs.fcc.gov/public/attachments/DOC-385771A1.pdf.

[1125] *Auction of Flexible-Use Licenses in the 2.5 GHz Band for Next-Generation Wireless Services, Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments, and Other Procedures for Auction 108, Bidding Scheduled to Begin July 29, 2022*, AU Docket No. 20-429, Public Notice, FCC 22-24, at 5-6, para. 7 (Mar. 21, 2022) (*Auction 108 Procedures Public Notice*); *see also* FCC, Press Release, FCC Transforms 2.5 GHz Band For 5G Services (July 10, 2019), https://docs fcc.gov/public/attachments/DOC-358396A1.pdf.

63 bidders winning a total of 7,872 licenses for total net winning bids exceeding $419 million, 77% of them qualified as small businesses or as entities serving rural communities.[1126]

395. Spectrum policies are also an important component to providing broadband access to underserved communities. For example, in October 2021, WTB released a public notice seeking to supplement the record in the rulemaking on *Modernizing and Expanding Access to the 70/80/90 GHz Bands* to address the potential for use of the 71-76 GHz, 81-86 GHz, 92-94 GHz, and 94.1-95 GHz bands to provide broadband Internet access to consumers and communities that may otherwise lack robust, consistent connectivity.[1127] The Commission also took steps towards the more efficient use of available spectrum. In July 2022, the Commission adopted a Report and Order creating the Enhanced Competition Incentive Program (ECIP) to establish incentives for wireless licensees to make underutilized spectrum available to small carriers, Tribal Nations, and entities serving rural areas.[1128]

396. Public Knowledge et al. state that it is of vital importance that the Commission continue the type of balanced spectrum policy it has pioneered in recent years by making new large contiguous blocks of spectrum available for the widest possible range of users on an unlicensed, licensed, and license by rule basis.[1129] In CTIA's comments, it states that, since the last *Communications Marketplace Report*, the Commission has made meaningful progress in freeing up critical mid-band spectrum for exclusive, licensed use, leading to the first and third highest grossing spectrum auctions to date.[1130] CTIA asserts that a myriad of industries and communities have already realized the benefits of 5G, and it urges the Commission to continue to promote spectrum policies that encourage the rapid deployment of these advanced offerings.[1131]

397. *Infrastructure*. Wireless infrastructure constitutes another major input in the provision of mobile wireless services. Section 706 of the Telecommunications Act of 1996 directs the Commission to encourage deployment of advanced telecommunications capability by, among other things, "remov[ing] barriers to infrastructure investment."[1132] Encouraging investment in broadband deployment is essential to closing the connectivity gap and combatting digital discrimination, and the Commission has continued its efforts to facilitate the deployment of infrastructure necessary to support modern wireless networks. For example, in January 2021, the Commission released a Report and Order that expanded the Commission's over-the-air reception devices (OTARD) rule[1133] to include hub and relay antennas that are used for the distribution of broadband-only fixed wireless services to multiple customer locations,

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[1126] *Auction of Flexible-Use Licenses in the 2.5 GHz Band Closes; Winning Bidders Announced for Auction 108*, AU Docket No. 20-429, Public Notice, DA 22-910, at 1, para. 1 (WTB/OEA Sept. 1, 2022) (*Auction 108 Closing Public Notice*); *see also* FCC, Press Release, FCC Concludes 2.5 GHz Spectrum Auction: A Boost Of Mid-Band Spectrum For Rural America (Sept. 1, 2022), https://docs fcc.gov/public/attachments/DOC-386826A1.pdf.

[1127] *Wireless Telecommunications Bureau Seeks to Supplement the Record on 70/80/90 GHz Bands Notice of Proposed Rulemaking*, WT Docket No. 20-133, Public Notice, DA 21-1263 (WTB Oct. 8, 2021) (*70/80/90 GHz Record Public Notice*); *see also Modernizing and Expanding Access to the 70/80/90 GHz Bands, et al*., WT Docket No. 20-133, et al., Notice of Proposed Rulemaking and Order, 35 FCC Rcd 6039 (2020).

[1128] *ECIP Report and Order* at 2, paras. 1-2; *see also* FCC, Press Release, FCC Establishes Enhanced Competition Incentive Program For Wireless Radio Services (July 14, 2022), https://www fcc.gov/document/fcc-establishes-enhanced-competition-incentive-program (*ECIP Press Release*).

[1129] Public Knowledge, OTI, and Consumer Reports Reply at 8.

[1130] CTIA Comments at viii.

[1131] CTIA Comments at viii.

[1132] 47 U.S.C. § 1302(a).

[1133] *Updating the Commission's Rule for Over-the-Air Reception Devices*, WT Docket No. 19-71, Report and Order, 36 FCC Rcd 537, 537-38, para. 2 (2021) (*OTARD Report and Order*).

regardless of whether they are primarily used for this purpose, provided the antennas satisfy other conditions of the rule.[1134]

398. CTIA states that the deployments enabled by the Commission's siting reforms are crucial to meeting consumers' growing need for wireless data and the development of innovative technology, such as telehealth.[1135] CCA states that it agrees with the Commission that supporting the deployment of 5G and other next-generation wireless services through smart infrastructure policy is critical, and CCA emphasizes that the Commission should continue identifying and addressing impediments to infrastructure deployment at the federal, state, and local level.[1136]

C. The Satellite Marketplace

399. *Satellite Services*. In recent years, there has been an expanded interest in NGSO orbits, ESIMs, commercial use of small, short-duration satellites for the provision of broadband services to remote locations, Earth observation, and IoT. Some operators are planning to provide services to other satellite service providers to provide data backhaul or satellite mission extension capability. As discussed in section VI, the Commission has acted to remove regulatory barriers in order to enable market-based efficient use of spectrum and facilitate the deployment of these systems.

400. *Satellite Fleet Expansion*. Recent trends in the satellite industry include investments in GSO and NGSO satellites[1137] with the potential to provide download speeds of up to a gigabit per second and simultaneously process a terabit of data per second.[1138] For example, Inmarsat's Global Xpress system delivers high-speed broadband with a GSO constellation made up of Ka-band high speed mobile broadband satellites.[1139] The first Inmarsat-6 satellite, with both Ka-band and L-band payloads, was launched in 2021 and reached geostationary orbit in July 2022, and the second Inmarsat-6 satellite is due to be launched in the first quarter of 2023, with both Inmarsat-6 satellites planned to enter service in 2023.[1140] Inmarsat plans to launch the next generation of its Global Xpress satellites in 2023 and 2024, to consist of three geostationary (GSO) satellites and two satellites in highly elliptical orbits (HEO) for coverage to arctic regions.[1141] Telesat's Telestar 19 VANTAGE satellite launched in July of 2018 is part of a new generation of Telesat GSO satellites that combine broad regional beams and high throughput satellite (HTS) spot beams in a design optimized for high bandwidth applications.[1142] In November 2021,

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[1134] *Id.* at 537, para. 1.

[1135] CTIA Comments at 63.

[1136] CCA Comments at 8.

[1137] Some satellite companies have reported that COVID-19-related supply chain issues have resulted in reductions in the size of planned constellations or delays in the manufacture and deployment of their planned satellites. *See, e.g.*, Telesat Canada, SEC 2021 Form 20-F, at 24-25 (filed Mar. 3, 2022) (Telesat Canada 2021 SEC Form 20-F); EchoStar, Annual Report Year Ended Dec. 31, 2021, at 12 (Mar. 17, 2022), https://ir.echostar.com/static-files/673c54c0-e7ff-4f55-b5ff-05ea33a6ede2; *see also* Jason Rainbow, Space News, *Seeking Regulatory Mercy: The case for extending constellation deployment deadlines* (Aug. 17, 2022), https://spacenews.com/seeking-regulatory-mercy-the-case-for-extending-constellation-deployment-deadlines/.

[1138] SIA Comments at 11.

[1139] *Id.* at 11-12.

[1140] Inmarsat, Press Release, Most Sophisticated Commercial Communications Satellite Ever Reaches Geostationary Orbit, Begins On-orbit Testing (July 25, 2022), https://www.inmarsat.com/en/news/latest-news/corporate/2022/most-sophisticated-commercial-communications-satellite-geostationary-orbit html.

[1141] Inmarsat, *Satellites*, https://www.inmarsat.com/en/about/technology/satellites.html (last visited Oct. 20, 2022).

[1142] SIA Comments at 12; Telesat Canada, SEC 2021 Form 20-F, at 20, 63 (filed Mar. 3, 2022) (Telesat Canada 2021 SEC Form 20-F); Telstar, *Telstar 19 VANTAGE Coverage Map*, https://www.telesat.com/wp-content/uploads/2022/11/Telstar-19-VANTAGE.pdf (last visited Oct. 20, 2022).

SES launched its SES-17, a high through-put GSO satellite which is expected to begin delivering broadband connectivity in the second half of 2022.[1143] Hughes is currently in the process of constructing its next generation Ultra-High Density GSO Satellite, EchoStar XXIV (also known as Jupiter 3), which it expects to launch in the fourth quarter of 2022.[1144]

401. As discussed in section II.D, several providers have launched new NGSO satellites to provide low-latency, high-speed broadband, with more planned over the next decade.[1145] In 2019, SES completed its 20-satellite O3B medium earth orbit (MEO) constellation. In 2022, SES plans to launch its first batch of O3B mPOWER MEO satellites, as part of an initial constellation of 11 high-throughput, low-latency satellites.[1146] OneWeb has a constellation of 428 NGSO low earth orbit (LEO) satellites to provide high speed, low latency connectivity,[1147] and began providing service to Alaska in late 2021.[1148] SpaceX has launched over 2,600 Starlink NGSO LEO satellites.[1149] Kepler has a constellation of 19 satellites in its LEO constellation.[1150] Telesat has launched a demonstration satellite for its global LEO constellation,[1151] and had plans for 198 LEO satellites, including 10 in-orbit spares, employing polar-orbits and inclined-orbits to provide global coverage and concentrated capacity over areas with high demand.[1152] On July 30, 2020, the Commission granted authority to Kuiper Systems LLC (Amazon) to

[1143] SES, Annual Report 2021, at 10, 16, 18, https://www.ses.com/sites/default/files/2022-03/20220301_SES_AR2021_final.pdf (last visited Sept. 2, 2022).

[1144] SIA Comments at 12; Echostar Comments at 2; EchoStar Annual Report Year Ended Dec. 31, 2021, at 4 (Mar. 17, 2022), https://ir.echostar.com/static-files/673c54c0-e7ff-4f55-b5ff-05ea33a6ede2.

[1145] SIA Comments at 12-13.

[1146] *Id.* at 13; SES, *O3b mPOWER*, https://www.ses.com/newsroom/o3b-mpower (last visited Aug. 30, 2022); SES, *Our Medium Earth Orbit (MEO) Journey*, https://www.ses.com/sites/default/files/2022-06/SES_O3bmPower_PR_timeline_Landscape_2022_Final.pdf (last visited Aug. 30, 2022).

[1147] OneWeb, Press Release, OneWeb Confirms Successful Launch of 34 Satellites, Delivering Ongoing Momentum at the Start of 2022 (Feb. 10, 2022), https://oneweb net/resources/oneweb-confirms-successful-launch-34-satellites-delivering-ongoing-momentum-start-2022; OneWeb, Press Release, OneWeb to resume satellite launches through agreement with SpaceX (Mar. 21, 2022), https://oneweb.net/resources/oneweb-resume-satellite-launches-through-agreement-spacex.

[1148] SIA Comments at 13; Capacity, *Alaska community first to get broadband via OneWeb satellite* (Oct. 22, 2021), https://www.capacitymedia.com/article/29otdn0ylukn01phmg3k0/news/alaska-community-first-to-get-broadband-via-oneweb-satellite.

[1149] SIA Comments at 13; *SpaceX ESIM and Kepler ESV Order* at 1, para. 1. SpaceX has launched more than 3,000 Starlink satellites, of which more than 2,600 are in orbit and functioning. Stephen Clark, *Falcon 9 rocket deploys SpaceX's 3,000th Starlink internet satellite* (Aug. 10, 2022), https://spaceflightnow.com/2022/08/10/falcon-9-rocket-deploys-spacexs-3000th-starlink-internet-satellite/.

[1150] SIA Comments at 13; Kepler, Press Release, Kepler announces successful launch of 4 new Gen1 satellites including test bed for Aether™ Service (Jan. 13, 2022), https://www.globenewswire.com/en/news-release/2022/01/13/2366739/0/en/Kepler-Communications-Announces-Successful-Launch-of-4-New-GEN1-Satellites-Including-Test-Bed-for-%C3%86THER-Service.html.

[1151] Telesat Canada, SEC 2021 Form 20-F, at 70 (filed Mar. 3, 2022) (Telesat Canada 2021 SEC Form 20-F).

[1152] SIA Comments at 12; Telesat, Press Release, Telesat to Redefine Global Broadband Connectivity with Telesat Lightspeed, the World's Most Advanced Low Earth Orbit (LEO) Satellite Network (Feb. 9, 2021), https://www.telesat.com/press/press-releases/manufacturer-announcement/; Telesat Canada, SEC 2021 Form 20-F, at 65-74 (filed Mar. 3, 2022) (Telesat Canada 2021 SEC Form 20-F). A larger Lightspeed constellation was originally planned, but the order was reduced. *See* Jason Rainbow, Space News, *Telesat to order 100 fewer satellites for LEO constellation* (May 6, 2022), https://spacenews.com/telesat-to-order-90-fewer-satellites-for-leo-constellation/; Telesat LEO Inc. Response to Comments, SAT-MPL-20200526-00053, SAT-APL-20210104-00002, SAT-APL-20220616-00059 (rec. Aug. 30, 2022) (where Telesat claims that it is no longer requesting that its first-

(continued….)

deploy a LEO constellation of 3,236 satellites designed to increase the availability of high-speed broadband services to consumers, government, and businesses.[1153] In April 2022, Amazon signed contracts for up to 83 launches for the bulk of the planned 3,236 "Project Kuiper" satellites.[1154] In November 2021, Kinéis, a French satellite company, was granted U.S. market access for its proposed constellation of 25 small LEO satellites to offer connectivity for IoT and maritime domain awareness.[1155]

402. *Technological Innovation*. Technological developments in the satellite industry include new satellite launch technologies, and next generation high throughput satellite systems.[1156] Advances in launch technology include the development of reusable hardware and vehicles designed to launch smaller satellites.[1157] As noted above, several high throughput systems are under construction or have been recently launched.

403. The current period of innovation in the space industry has resulted and will likely continue to result in a significant increase in the number of satellites and types of operations in orbit. The development of less expensive delivery systems, along with the production of small imaging satellites such as CubeSats, has lowered the cost of entry into the satellite imaging business.[1158] The Commission has implemented amateur and experimental satellite rules to facilitate use of satellites for scientific and research missions and experimental testing.[1159] The Commission recently made available a new, optional licensing process for commercial deployment of small satellites, which allowed small satellite applicants

(Continued from previous page)
round grant be expanded by the 117 satellites authorized in the grant, but that its "Final Constellation" will be 1,671 satellites).

[1153] *Kuiper Systems, LLC Application for authority to Deploy and Operate a Ka-band Non-Geostationary Satellite Orbit System*, IBFS File No. SAT-LOA-20190704-00057, Order and Authorization, 35 FCC Rcd 8324 (2020).

[1154] Amazon, Press Release, Amazon Secures Up to 83 Launches from Arianespace, Blue Origin, and United Launch Alliance for Project Kuiper (Apr. 5, 2022), https://press.aboutamazon.com/news-releases/news-release-details/amazon-secures-83-launches-arianespace-blue-origin-and-united. Amazon contracted for 18 launches on Arianespace's Ariane 6 rocket, 38 launches with United Launch Alliance's Vulcan Centaur and 12 launches, with an option for 25 more, with Blue Origin. *Id.*

[1155] *Kinéis Petition for Declaratory Ruling to Access the U.S. Market Using a Low-Earth Orbit Satellite System*, Order, IBFS File No. SAT-PDR-20191011-00113 Call Sign S3054, Order and Declaratory Ruling, FCC-21-118 (Nov. 19, 2021). The constellation is planned to be placed in orbit in 2023. Kinéis, *Une technologie*, https://www.kineis.com/une-technologie-de-pointe/ (last visited Aug 30, 2022).

[1156] Telesat Canada, 2021 SEC Form 20-F, at 20 (filed Mar. 3, 2022) (Telesat Canada 2021 SEC Form 20-F); Organisation of Economic Cooperation and Development (OECD), The Space Economy in Figures: How Space Contributes to the Global Economy at 108 (2019), https://doi.org/10.1787/c5996201-en.

[1157] Organisation of Economic Cooperation and Development (OECD), *Broadband Policy and Technology Developments* at 43 (2021), https://www.oecd-ilibrary.org/docserver/e273ff77-en.pdf; Organisation of Economic Cooperation and Development (OECD), *The Evolving Role of Satellite Networks in Rural and Remote Broadband Access* at 21-22 (2017), https://www.oecd-ilibrary.org/science-and-technology/the-evolving-role-of-satellite-networks-in-rural-and-remote-broadband-access_7610090d-en.

[1158] *Streamlining Licensing Procedures for Small Satellites*, IB Docket 18-86, Report and Order, 34 FCC Rcd 13077, 13078, para. 1 (2019) (*Small Satellites Report and Order*).

[1159] The Commission's rules set forth three different procedures for licensing satellites. Part 25 of the Commission's rules govern licensing and operation of space stations and earth stations for the provision of satellite communication services, including commercial communication and remote sensing satellites. 47 CFR §§ 25.101-25.702. Part 5 of the Commission's rules govern experimental operations. 47 CFR §§ 5.1-5.602. Part 97 of the Commission's rules govern amateur radio service satellite operations. 47 CFR §§ 97.111-97.117, 97.207; *see also Guidance On Obtaining Licenses For Small Satellites*, Public Notice, 28 FCC Rcd 2555 (2013).

to choose a streamlined part 25 licensing procedure and thereby take advantage of an easier application process, a lower application fee, and a shorter timeline for review.[1160]

404. In-space servicing, assembly, and manufacturing (ISAM) is a developing area that could augment the capabilities of existing spacecraft and give rise to new market segments.[1161] For example, in 2020, Space Logistics, LLC's Mission Extension Vehicle-1 (MEV-1) brought a deorbited Intelsat satellite back into service,[1162] and in 2021, MEV-2 docked with another Intelsat satellite, which was running low on fuel, and extended its life for five years.[1163] In October 2020, SpaceIce was granted an experimental license for a satellite designed to investigate freeze-casting in the microgravity environment. In November 2021, Astroscale Ltd. obtained U.S. earth station authorizations to support its ELSA-d testing of spacecraft capabilities for orbital debris removal, and NanoRacks LLC was granted an experimental license to demonstrate metal-cutting in space.[1164] Proposed deployments of large satellite constellations in the intensely used LEO region, along with other satellites deployed in the LEO region, will have the potential to increase the risk of debris-generating events.[1165] In April 2020, the Commission updated the Commission's existing rules regarding orbital debris mitigation, which were adopted in 2004, to provide a clear regulatory framework for applicants for non-Federal satellite communications.[1166] On September 30, 2022, the Commission released a Second Report and Order, which adopted new rules requiring satellite operators in low-Earth orbit to dispose of their satellites within five years of completing their missions. The new rules shorten the decades-old 25-year guideline for deorbiting satellites post-mission, taking an important step in a new era for space safety and orbital debris policy.[1167]

D. The Video and Audio Communications Marketplace

405. *Regulatory Barriers*. Many video and audio marketplace participants need authorization to operate from either the federal government or a local municipality. In addition, they often are subject to a range of regulations, including technical and interference standards, as well as programming and public interest obligations. As a result, some market participants face barriers to entry or compliance costs that are greater than or different from those of other participants. Many regulated entities, however,

[1160] *Streamlining Licensing Procedures for Small Satellites*, IB Docket 18-86, Report and Order, 34 FCC Rcd 13077, 10378, para. 2 (2019) (*Small Satellites Report and Order*). The streamlined licensing process is available to commercially deployed small satellite systems as well as other small satellite systems that that also have the option of applying under the amateur or experimental rules. *Small Satellites Report and Order*, 34 FCC Rcd at 13080-81, para. 12. *See also, e.g.*, *Satellite Policy Branch Information Actions Taken*, Public Notice, DA 20-1226 (IB Oct 16, 2020); *Satellite Policy Branch Information Actions Taken*, Public Notice, DA 21-630 (IB May 28, 2021) (granting authority for earth exploration satellite service to Loft Orbital Solutions, Inc.); *Satellite Policy Branch Information Actions Taken*, Public Notice, DA 20-1502 (IB Dec. 18, 2020) (granting authority for earth exploration satellite service to R2 Space, Inc. and Capella Space Corp. under the streamlined small satellite procedures).

[1161] ISAM missions include satellite refueling, inspecting and repairing in-orbit spacecraft, capturing and removing debris, and transforming materials through manufacturing while in space.

[1162] *See* Northrop Grumman, *Space Logistics*, https://www.northropgrumman.com/space/space-logistics-services/ (last visited Aug. 16, 2022).

[1163] *See* Jason Rainbow, Space News, *MEV-2 servicer successfully docks to live Intelsat satellite* (Apr. 12, 2021), https://spacenews.com/mev-2-servicer-successfully-docks-to-live-intelsat-satellite/.

[1164] *Space Innovation Notice of Inquiry* at 2-3, para. 5.

[1165] *Orbital Debris Report and Order and Further* Notice, 35 FCC Rcd at 4156, 4158-59, paras. 3-4. Orbital debris, also known as "space debris," consists of artificial objects orbiting the Earth that are not functional spacecraft. *Orbital Debris NPRM*, 33 FCC Rcd at 11353-54, para. 2.

[1166] *Orbital Debris Report and Order and Further Notice*, 35 FCC Rcd at 4157, para. 2.

[1167] *Orbital Debris Second Report and Order* at 2, para. 4.

hold exclusive spectrum licenses and/or often enjoy a strong position as the legacy service provider in the marketplace. We discuss below a few of the basic regulatory issues that industry participants confront.

406. Broadcast television and radio stations operate pursuant to a license from the Commission and must receive authorization before they may construct and operate in the United States.[1168] Further, broadcast stations are subject to the Communications Act of 1934, as amended, and regulations promulgated by the Commission thereunder. In allocating and authorizing broadcast stations, the Commission is charged with ensuring that such stations are distributed across the country and licensed to communities in a manner that serves the public interest.[1169] In addition, licensees of broadcast stations must comply with certain obligations and rules to ensure that the licensed spectrum is used to serve the public interest.[1170] These include structural limits governing ownership of broadcast television and radio stations.[1171] Broadcast licenses are awarded for an eight-year term that can be renewed upon application and Commission approval.[1172]

407. Licenses for new commercial broadcast television and radio stations are awarded by auction. In June 2022, the Commission auctioned construction permits for 27 full power television stations.[1173] This was the first full power television auction opportunity since 2011. While authorizations for new radio stations are available from the Commission periodically, in 2021, the Commission auctioned new construction permits for 135 commercial FM and four AM radio stations [1174]—frequencies for radio stations are typically in high demand.[1175] In fact, in many areas of the country no frequencies are available on which a new station could commence operation without causing impermissible interference to existing stations.[1176] As a result, the Commission does not allocate many new broadcast radio stations, and stations that are allocated tend to be outside the top markets and for lower power. Given the limited number of new broadcast licenses, particularly in the television service or in large metropolitan areas, new entrants typically enter the broadcast television or radio business by purchasing a construction permit, a station, or a group of stations on the secondary market (i.e., by purchasing from an existing permittee or station owner).

408. MVPDs must obtain appropriate regulatory authority before providing video services and are subject to several Commission rules implicating the operation of their services, which vary depending on whether the entity is a cable MVPD or a non-cable MVPD.[1177] These rules include regulations that govern an MVPD's franchising and licensing, effective competition, program carriage, program access, must-carry and retransmission consent, protection of exclusive broadcast distribution rights, public interest programming, access to multiple dwelling units, and over-the-air reception devices.[1178]

[1168] 47 U.S.C. § 301. The Commission licenses broadcast spectrum to respective applicants and approves any assignment or transfer of control of broadcast licenses. *Id.* §§ 303(c), 308(a), 309(a), 310(d).

[1169] *Id.* §§ 303, 307.

[1170] *Id.* §§ 301, 303(c), 308(a), 309(a), 310(d).

[1171] 47 CFR § 73.3555.

[1172] *Id.* § 73.1020.

[1173] *See infra* section VI.D.

[1174] *Id*.

[1175] In addition, in 2021, the Commission opened a filing window for parties seeking construction permits for new Noncommercial Educational (NCE) FM stations. *See id*.

[1176] *See, e.g.*, FCC, *How to Apply for a Radio or Television Broadcast Station*, https://www.fcc.gov/media/radio/how-to-apply (last visited Oct. 6, 2022).

[1177] *See, e.g.*, *18th Video Competition Report*, 32 FCC Rcd at 578-79, para. 25.

[1178] *Id*.

409. In addition to broadcast radio stations, the Commission has authorized satellite digital audio radio service (SDARS). Because there are no additional SDARS licenses available, any new entity wishing to provide SDARS service would be required to purchase licenses from SiriusXM, the only incumbent provider in the marketplace. In addition, because the service is delivered via satellite, SDARS requires a significant capital investment for operation.[1179]

410. Online audio and video providers generally are not subject to Commission regulation.[1180] Nonetheless, statutes and regulations that are outside of the Commission's purview can also have a competitive impact on non-broadcast service providers. For example, under federal copyright law, AM and FM radio stations, unlike other audio platforms, do not pay performance rights fees for sound recordings they transmit via over-the-air (OTA) broadcasts.[1181] musicFIRST Coalition and Future of Music Coalition (musicFIRST/FMC) argue that this gives broadcast radio stations a significant competitive advantage over other audio delivery services.[1182] The National Association of Broadcasters (NAB) responds that radio broadcasters pay royalties to the composers of the music they air OTA and stream online, and that broadcasters that webcast also pay performance rights fees to record labels and performers when they stream copyrighted sound recordings online.[1183] Moreover, NAB disagrees that this differential treatment under copyright law confers any significant competitive advantage to terrestrial radio broadcasters, because terrestrial radio broadcasters must provide their OTA product for free and have many costs and burdens that do not apply to satellite and online marketplace competitors.[1184]

411. *Marketplace Barriers.* ACA Connects argues that programming and retransmission consent fees continue to rise, along with requirements that MVPDs carry lower-rated programming and multicast signals to receive the higher-rated channels and stations their customers want.[1185] ACA Connects maintains that these challenges disproportionately affect smaller MVPDs (and ultimately their customers) as compared to larger MVPDs due to greater imbalances in bargaining power against cable programmers and broadcasters.[1186] ACA Connects contends that the problems are particularly dire when it comes to retransmission consent as broadcasters have further consolidated and used their market power to extract escalating fees from MVPDs.[1187] Most recently, according to ACA Connects, broadcasters have increased demands to pay for multicast channels as part of retransmission consent renewal agreements.[1188] Further, although small and medium-sized MVPDs have sought to diminish retransmission consent fees by negotiating with broadcasters through buying groups, the buying groups did not meaningfully narrow the gap between what large and small MVPDs pay for retransmission consent.[1189] According to DIRECTV, retransmission consent fees represent the fastest growing segment of programming costs.[1190]

[1179] *See SDARS Second Further Notice*, 22 FCC Rcd at 22150, Appx. B.

[1180] There are some exceptions. For example, the Commission's closed captioning rules, 47 CFR § 79.4, require programming distributed via IP to be captioned if the programming was previously shown on television with captions.

[1181] musicFIRST/FMC Comments at iv, 18; musicFIRST/FMC Reply at 3; NAB Reply at 19-20.

[1182] musicFIRST/FMC Comments at iv, 18-22; musicFIRST/FMC Reply at 3-4.

[1183] NAB Reply at 20.

[1184] *Id.* at 21-25.

[1185] ACA Connects Comments at 12.

[1186] *Id*.

[1187] *Id*. at 13.

[1188] *Id*. at 15.

[1189] *Id*. at 18-19.

[1190] DIRECTV Comments at 2.

DIRECTV blames the higher fees on the increased local and national consolidation of broadcasters, which gives broadcasters greater leverage in negotiating with MVPDs.[1191]

412. INCOMPAS explains that consumers are actively seeking alternatives to traditional MVPDs because of general dissatisfaction with increasing prices and an increase in program carriage disputes between MVPDs and broadcasters and cable networks.[1192] INCOMPAS maintains, however, that these services face a highly concentrated marketplace for broadband internet access with almost 80% of the residential last mile broadband being served by only four companies: Comcast, Charter, AT&T, and Verizon.[1193] INCOMPAS suggests that vertically integrated broadband providers and vertically integrated MVPDs may have incentives to engage in discriminatory practices.[1194]

413. NTCA argues that substantial and ongoing increases in retransmission consent fees have resulted in several MVPDs being forced to discontinue offering video service.[1195] And a survey of NTCA's members found that nearly all respondents that are considering or have definite plans to discontinue their video service cite increased programming costs and the difficulty of negotiating retransmission consent agreements as causes for the decision.[1196]

414. According to musicFIRST/FMC, consolidation of AM/FM radio stations has limited competition by allowing a small number of entities to acquire the majority of AM/FM stations.[1197] They argue that consolidation resulted in large scale layoffs of local on-air and programming workforce and fewer airplay decisions being made in the local communities that stations serve.[1198] MusicFIRST/FMC contend that independent commercial radio stations have been harmed by the consolidation of radio by virtue of having to compete against large radio clusters that wield outsized market share.[1199] With their focus on intramodal competition, musicFIRST/FMC maintain that further consolidation of FM stations will harm "the relatively few remaining owners of commercial FM stations in local markets that are either stand-alone FM stations or are part of smaller local commercial clusters."[1200]

415. Redrock Broadcasting argues consolidation should be limited so that no entity can hold more than 30% of the available radio or television station licenses in any market.[1201] According to Redrock Broadcasting, this limit "will ensure competition, better local service to each community, freedom from predatory pricing practices that can injure local merchants, and provide an opportunity for single small operators, minorities, women and community groups to own stations to have a voice in their hometown."[1202]

416. Rural Media Group (RMG) argues that the vertical integration of MVPDs has restricted access to independent cable networks and left rural viewers with fewer programming options.[1203] RMG

[1191] *Id*. at 3-4.

[1192] INCOMPAS Comments at 36.

[1193] *Id*. at 38.

[1194] *Id*. at 38-39.

[1195] NTCA Comments at 14.

[1196] *Id*. at 14-15.

[1197] musicFIRST/FMC Comments at 5.

[1198] *Id*. at 5-6.

[1199] *Id*. at 7; musicFIRST/FMC Reply at 2-3.

[1200] musicFIRST/FMC Reply at 5.

[1201] Redrock Broadcasting Comments at 2.

[1202] *Id*.

[1203] RMG Comments at 13-16.

maintains that its programming on RFD-TV and the Cowboy Channel, which includes coverage of commodities and food supply chain issues, horses and ranching, rodeo, regional music, and rural lifestyle is not replicated by other cable networks.[1204] According to RMG, many of the largest MVPDs refuse to carry RFD-TV and the Cowboy Channel, channels that serve rural communities.[1205] When reviewing transactions, RMG encourages the Commission and policymakers to ensure that independent rural programming like RFD-TV can continue to obtain carriage on rapidly consolidating MVPD systems.[1206] RMG reports that since filing its initial comments, a bipartisan Senate coalition introduced a resolution titled "Recognizing the need for greater access to rural and agricultural media programming," that highlights many of the same concerns that RMG raised in its comments.[1207]

417. The Affiliates Associations maintain that "despite the proliferation of new content sources, there has been no significant new entrant into the local news space."[1208] According to Affiliates Associations, this makes the service provided by local broadcasters to their communities even more important.[1209] The Affiliates Associations explain that vMVPDs, which are not subject to retransmission consent regulations, negotiate with broadcast networks rather than with local broadcasters.[1210] They argue that direct negotiations between broadcast stations and vMVPDs would enable broadcasters to receive fair compensation and increased carriage of multicast channels.[1211] Affiliates Associations want the Commission to classify vMVPDs as MVPDs for purposes of the retransmission consent rules.[1212] Affiliates Associations also argue that the giant tech platforms use broadcasters' own local news and public affairs programming without paying fair compensation.[1213]

418. NAB asserts that giant technology platforms "control the technologies that power both content discovery (search) and digital advertising, permitting them to make unilateral decisions and impose policies that impede broadcasters' ability to connect with their audiences and to monetize their own content online."[1214] NAB argues that broadcasters compete against much larger competitors and need to achieve increased scale economies to remain economically viable.[1215] NAB maintains that the Commission should reject requests to focus on intramodal competition and recognize that radio's toughest competition "comes not from other terrestrial radio stations but from internet companies often owned by vastly larger entities, including the biggest tech platforms."[1216] According to NAB, TV broadcasters are hopeful that the multicasting capabilities of ATSC 3.0 will help them grow audiences and attract advertisers.[1217]

[1204] *Id*. at 10.

[1205] *Id*. at 16-19.

[1206] *Id*. at 14.

[1207] RMG Reply at 1-5.

[1208] Four Network Affiliates Associations Reply at 5.

[1209] *Id*. at 5-7.

[1210] *Id*. at 11.

[1211] *Id*. at 11-13.

[1212] *Id*. at 14.

[1213] *Id*. at 16-17.

[1214] NAB Comments at 3-4; NAB Reply at 3-4.

[1215] NAB Comments at 29, 35-36.

[1216] NAB Reply at 11-18.

[1217] NAB Comments at 45.

V. CONNECTIVITY AND COVID-19

419. The COVID-19 pandemic resulted in unprecedented disruptions to life in America, as it did around the world. The temporary closures of in-person schools, businesses, and workplaces transformed the way that Americans learn, work, and engage in social and economic activities, with significant shifts from physical spaces to virtual settings. According to a Pew survey of U.S. adults in April 2021, 90% of adults say the Internet has been essential or important to them personally, 93% of parents with K-12 children at home say their children had some online instruction, and 81% of adults talked with others via video calls at some point since the onset of the pandemic.[1218] Many Americans have had to adapt to their new digital reliance. The COVID-19 pandemic has also highlighted the role innovative technologies play in improving public safety and preventing the spread of infection.[1219] For example, about 40% of Americans reported that they use technology or the Internet in ways that were new or different to them, and approximately 29% of U.S. broadband users took actions to increase the speed, reliability, or quality of their Internet connection after the onset of the COVID-19 pandemic.[1220]

420. Among the most pronounced changes in Americans' activities in response to the pandemic was the shift to telework. Telework accounted for an average of 48.6% of paid working days between May 2020 and March 2021, nearly ten times the pre-pandemic level.[1221] As state and local governments started to loosen their COVID-19 restrictions, firms continued to report flexibility in work arrangements. The Federal Reserve Bank of Atlanta estimated that as of January 2021, 34.3% of full-time employees in the private sector were teleworking at least one day a week.[1222] A Bureau of Labor Statistics 2021 Business Response Survey conducted between July and September 2021 indicated that 22% of jobs continued to involve teleworking at least some of the time.[1223] Taking advantage of the ability to work from anywhere, many employees moved from dense metropolitan cities to smaller towns or rural and suburban areas.[1224] Although increasing numbers of workers are returning to their office, telework is expected to remain a significant aspect of the labor market post-pandemic.[1225]

421. *Fixed Broadband*. When millions of Americans were ordered to stay home and many activities shifted online, ISPs experienced tremendous increases in network demand. Fixed residential connections increased by 6.6% from 2019 to 2020, doubling the growth rate of 3.3% from 2018 to 2019.

[1218] Pew Research Center, The Internet and the Pandemic at 1-2, 8 (2021), https://www.pewresearch.org/internet/wp-content/uploads/sites/9/2021/09/PI_2021.09.01_COVID-19-and-Tech_FINAL.pdf (Pew Pandemic Research Report).

[1219] CTA Comments at 2-3.

[1220] Pew Pandemic Research Report at 2.

[1221] Jose Maria Barrero, Nickolas Bloom & Steven J. Davis, *Why Working from Home Will Stick*, NBER Working Paper 28731, at 9 (2021), https://www.nber.org/system/files/working_papers/w28731/w28731.pdf.

[1222] Federal Reserve Bank of Atlanta, *WFH is Onstage and Here to Stay*, Chart 1 (Feb. 24, 2021), https://www.atlantafed.org/blogs/macroblog/2021/02/24/wfh-onstage-and-here-to-stay.

[1223] U.S. Bureau of Statistics, *Telework during the COVID-19 pandemic: estimates using the 2021 Business Response Survey* (Mar. 2022), https://www.bls.gov/opub/mlr/2022/article/telework-during-the-covid-19-pandemic.htm#:~:text=Loewenstein%20found%20that%2C%20between%20October,teleworking%20because%20of%20the%20pandemic.&text=The%20Federal%20Reserve%20Bank%20of,least%201%20day%20per%20week.

[1224] WISPA Comments at 16 (employees moving out of the densest parts of big cities "with more than 10,000 people per square mile, jumped 17% to about 2.9 million during the first year of the pandemic, from March 2020 to February 2021").

[1225] OECD ECOSCOPE, *Telework after COVID-19: survey evidence from managers and workers on implications for productivity and well-being* (July 28, 2021), https://oecdecoscope.blog/2021/07/28/telework-after-covid-19-survey-evidence-from-managers-and-workers-on-implications-for-productivity-and-well-being/; *see also* WISPA Comments at 16-17.

Connections continued to grow at a rate of 3.6% from 2020 to 2021.[1226] Multiple sources reported how the COVID-19 pandemic impacted traffic on networks in the United States, with the increased traffic estimates ranging between 20% and 40% during the early stages of the pandemic.[1227]

422. *Mobile Wireless*. During the COVID-19 pandemic lockdown, the surging demand for connectivity also affected mobile wireless service. CTIA reports the shift in demand based on data from AT&T, T-Mobile, UScellular, and Verizon Wireless on a weekly basis for each Monday between March 23, 2020 and July 27, 2020 compared to each provider's average of pre-pandemic Mondays between February 24 and March 13, 2020.[1228] During this period, these major wireless providers saw a 25% increase in texting.[1229] Voice minutes increased by up to 24.3% on the first Monday (March 23, 2020) during the tracking period, compared to the pre-pandemic baseline.[1230] Although demand for voice remained higher than the pre-pandemic levels, the voice minutes used gradually trended down compared to the peak at the beginning of the COVID-19 pandemic. On July 27, 2020, the highest voice minutes reported by the four providers was only 12.2% higher than its pre-pandemic levels.[1231] In contrast, although data usage increased by up to 9.2% on March 23, 2020 compared to the pre-pandemic baseline, the demand for mobile data contracted between mid-April and mid-May as consumer mobility was

[1226] *See supra* Fig. II.A.10 (staff calculations based on the total fixed terrestrial residential connections for any reported speeds—101.277 million connections in 2018, 104.629 million connections in 2019, 111.528 million connections in 2020, and 115.541 million connections in 2021).

[1227] *2020 Communications Marketplace Report*, 36 FCC Rcd at 3164, para. 420; *see also* Broadband Internet Technical Advisory Group (BITAG), 2020 Pandemic Network Performance at 4 (2021), https://www.bitag.org/documents/bitag_report.pdf ("Large cable operators reported downstream traffic growing 20% and upstream traffic growing 35%, while smaller cable operators reported downstream growing 27% and upstream growing 36% during the shelter-in-place orders") (BITAG Report); NTCA, Tele-Everything and Its Impact to The Network at 4 (2020), https://www.nctatechnicalpapers.com/Paper/2020/2020-tele-everything-and-its-impact-to-the-network/download ("Peak upstream utilization occurred the week ending April 18, 2020, with a 35% increase over the pre-shutdown levels. For downstream traffic, the largest change in peak utilization occurred for the week ending March 28, 2020, at 20%."); Recon Analytics, U.S. Broadband Network Performance During COVID-19 and Beyond at 2 (2021), http://reconanalytics.com/2021/11/us-broadband-network-performance-during-covid-19-and-beyond/ ("Internet traffic increased significantly: fiber/copper traffic peaked at 27.3% above pre-pandemic levels; mobile internet traffic hit the highest point at 22.6% above pre-pandemic levels; and cable internet peak utilization crested at 22.1% above pre-pandemic levels.").

See also NCTA Comments at 5 (NCTA tracked the performance of cable broadband networks between March 2020 and July 2021 and shows in the figure that both upstream and downstream peak traffic growth accelerated throughout 2020 and remained at the relatively high levels in 2021.); INCOMPAS Comments at 10; USTelecom Comments at 12 ("In 2020 alone, broadband usage increased by 40 percent over the prior year."); WISPA Comments at 17 ("In 2020, WISPA reported the results of a member survey showing that consumer demand for broadband increased more than 35 percent during the early stages of the pandemic. Since January 2021, individual WISPA members have reported steady 12 percent year-over-year growth (including churn) for the number of installation for residential customers . . . Per customer usage of bandwidth also has increased. As one WISPA member reported, "[b]efore Covid the average usage was 7-10 mbps, now it's 11 mbps to 50 mbps.").

[1228] CTIA, *The Wireless Industry Responds to COVID-19*, https://www.ctia.org/covid-19 (last visited Oct. 6, 2022) (CTIA COVID-19 Website).

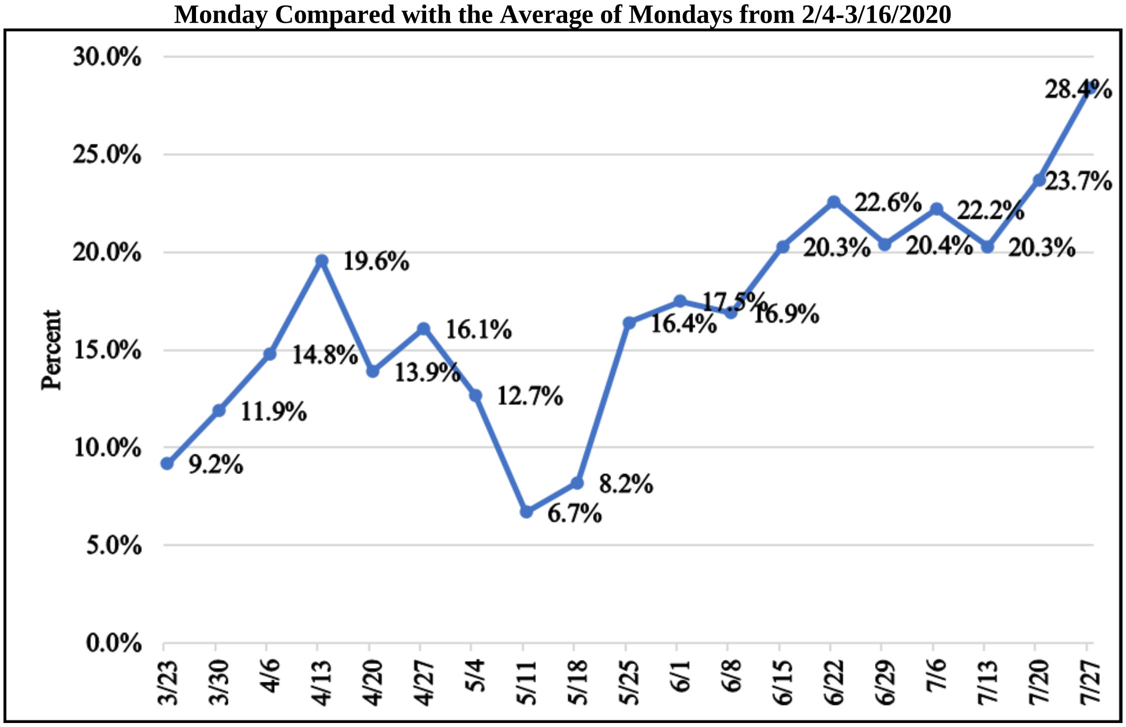
[1229] CTIA, *How Wireless Kept Americans Connected During COVID-19* (June 23, 2020), https://www.ctia.org/news/report-how-wireless-kept-americans-connected-during-covid-19.

[1230] *Id.*; *see also* CTIA Comments at 5 ("The wireless industry routed 2.9 trillion minutes of voice traffic in 2020, an average of 8,900 minutes per person. At the beginning of the pandemic, voice traffic increased 20-40 percent on wireless networks. This is all the more significant because nearly 80 percent of voice connections in the United States are wireless.").

[1231] *Id*.

severely restricted by the stay-at-home orders.[1232] As the stay-at-home orders were gradually lifted, individual movements were on the rise, and demand increased again.[1233] By July 27, 2020, the highest increase in demand for wireless data reported by the four providers was 28.4% higher than its pre-pandemic levels as shown in Figure V.1.[1234] Overall mobile wireless data traffic reached a record 42 trillion megabytes in 2020. This growth represents a 207% increase in traffic since 2016 and a 108-fold increase in mobile traffic since 2010.[1235] The change in mobile wireless data usage patterns is documented in detail in section II.B.1.d.

Fig. V.1
Upper Range of Increase in Mobile Data Use Reported Weekly by the Top 4 Providers for each Monday Compared with the Average of Mondays from 2/4-3/16/2020



Source: CTIA COVID-19 Website.

423. The surge in demand for wireless broadband service induced by the COVID-19 pandemic lockdown resulted in a slight decrease in average download speeds on mobile networks during the first few weeks since network capacity was initially constrained in the near-term. The weighted average mobile broadband download speed in the United States went from 44 Mbps on March 13, 2020 to 41 Mbps on March 29, 2020, according to the Ookla Speedtest data.[1236] The slowdown of mobile broadband

[1232] CTIA COVID-19 Website; *see also* Francesco Rizzato, Opensignal, *Analyzing mobile data consumption and experience during the COVID-19 pandemic* (Oct. 5, 2020), https://www.opensignal.com/2020/10/05/analyzing-mobile-data-consumption-and-experience-during-the-covid-19-pandemic (Opensignal COVID-19 Mobile Data Report).

[1233] CTIA COVID-19 Website.

[1234] *Id*.

[1235] CTIA Comments at 2; *see also* CTIA, 2021 Annual Survey Highlights at 8 (July 27, 2021), https://www.ctia.org/news/2021-annual-survey-highlights (2021 CTIA Annual Survey Highlights).

[1236] Anna-Maria Kovacs, U.S. broadband networks rise to the challenge of surging traffic during the pandemic, at 5, Fig. 3 (2020), https://www.ustelecom.org/wp-content/uploads/2020/06/PP-2020-06-Kovacs-internet-performance.pdf.

speed was short-lived, however, and on April 26, 2020, the average download speed had increased to 45 Mbps.[1237]

424. *Video*. As noted above, traditional MVPD subscriptions have been falling since 2013. Figure II.A.2 above shows that the greatest decline in traditional MVPD subscribers took place in 2020 (a loss of 7.3 million subscribers from 2019). The COVID-19 pandemic likely contributed to this decline, although large declines were seen in 2019 and 2021 as well.[1238] The COVID-19 pandemic may have also fueled growth for SVOD services.[1239] From 2019 to 2020, Figure II.E.9 shows that SVOD subscriptions increased by 68.9 million, an increase of approximately 31%.

425. Figure II.E.17 above shows that broadcast TV station advertising revenue decreased between 2019 and 2020. Both local and national advertising revenue earned by broadcast TV stations declined by more than 15%, but we note that because 2020 was an election year, political advertising revenue was up significantly from 2019. Therefore, total advertising revenue for broadcast TV stations, which includes national advertising, local advertising, political advertising, and online advertising, fell by only about 4%, and total station revenue was up by less than 1% due to an increase in retransmission consent revenue. In 2021, local and national advertising revenues increased but they did not return to pre-pandemic levels.

426. There is some evidence that people watched more video programming during the first year of the COVID-19 pandemic. Figure V.2 shows time spent watching TV per day from the Bureau of Labor Statistics' American Time Use Survey.[1240] The figure shows that time spent watching TV in the third and fourth quarters of 2020 was higher than in the same quarters in 2019. The survey shows that average minutes spent watching TV per day increased 16.8 minutes from 155.4 to 172.2 minutes from third quarter 2019 to third quarter 2020. From fourth quarter 2019 to fourth quarter 2020, time spent watching TV increased 18.5 minutes from 171.7 to 190.2 minutes. Although there is evidence that time spent watching video increased during the first year of the COVID-19 pandemic, it is unclear whether video viewing habits have shifted permanently. By the second quarter of 2021, time spent watching TV was similar to its 2019 level.

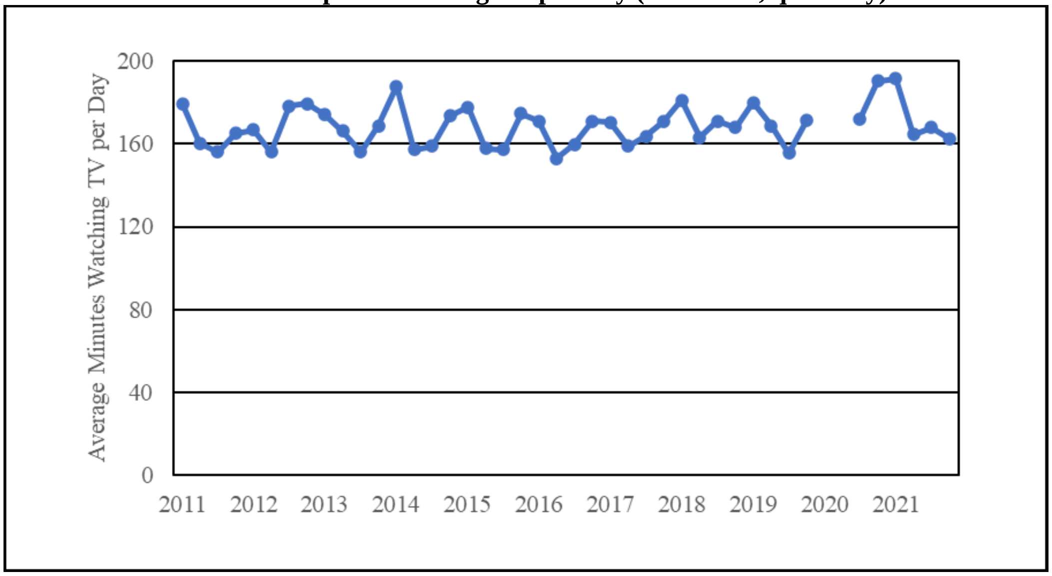
[1237] CTIA Comments at 5.

[1238] From 2018 to 2019, MVPD subscriptions fell by 6.5 million and from 2020 to 2021, MVPD subscriptions fell by 6.7 million.

[1239] *See* NAB Comments at 3, 14; MPA Reply at 2.

[1240] The American Time Use Survey defines time watching television as any time people report their main activity involved watching television, videos, or movies. This includes time spent watching live programming, DVDs, or streaming services on television sets, computers, and portable devices. Rachel Krantz-Kent, U.S. Bureau of Labor Statistics, *Television, capturing America's attention at prime time and beyond* at 2 (Sept. 2018), https://www.bls.gov/opub/btn/volume-7/pdf/television-capturing-americas-attention.pdf.

Fig. V.2
Time Spent Watching TV per Day (2011-2021, quarterly)



Source: Bureau of Labor Statistics, *American Time Use Survey, Average Time per Day – Watching TV, all persons 15+, Series ID: TUU10101QA01014236*, https://data.bls.gov/PDQWeb/tu (last visited Oct. 6, 2022). Note: Data collection issues prevent the publication of 2020 Q1 and Q2 estimates.

427. *Audio*. The COVID-19 pandemic had a significant impact on the advertising revenue of terrestrial broadcast radio stations. Total broadcast radio revenue declined 24.2% from 2019 to 2020.[1241] This decline was likely due to reduced radio listening in cars while commuting because of increased teleworking as well as a decline in demand for advertising by businesses.[1242] In 2021, radio station revenue was still 17.1% lower than its 2019 level.[1243]

428. *FCC Actions in Response to the COVID-19 Pandemic*. The Commission undertook several initiatives to provide temporary regulatory flexibility to ensure Americans stayed connected. For instance, the Commission waived the strict geographic requirement to allow affiliated competitive eligible telecommunications carriers (ETCs) to spend their universal service support in any affiliated ETC's designated service area so they can respond to the COVID-19 pandemic by spending funds where they were needed most.[1244] The Commission also issued several waivers and extensions for the Rural Health Care, E-Rate, and Lifeline program rules and deadlines to ensure connectivity for various needs.[1245] To help wireless service providers meet increased consumer demand for broadband during the COVID-19 pandemic, the Commission issued more than 200 grants of Special Temporary Authority (STA) to use additional spectrum to wireless service providers.[1246] For instance, the Commission granted requests for

[1241] Justin Nielson, S&P Global, *US TV and radio station ad projections 2022-32: Political offsets dwindling core* (July 15, 2022).

[1242] *See* NAB Comments at 23–27; musicFIRST/FMC Comments at 11; Justin Nielson, S&P Global, *US TV and radio station ad projections: Post-pandemic bump* (June 17, 2021).

[1243] Justin Nielson, S&P Global, *US TV and radio station ad projections 2022-32: Political offsets dwindling core* (July 15, 2022).

[1244] *2020 Communications Marketplace Report*, 36 FCC Rcd at 3166, para. 427; *Connect America Fund*, WC Docket No. 10-9-, Order, 35 FCC Rcd 2964.

[1245] *Id.* at 3167-68, paras. 428-30.

STAs to more than 100 Wireless ISPs for temporary access to the lower 45 megahertz of the 5.9 GHz band to expand and improve broadband service provided largely in rural and suburban communities.[1247]

429. *COVID-19 Telehealth Program.* One critical component of the Commission's pandemic response has been the COVID-19 Telehealth Program. The Commission established the COVID-19 Telehealth Program in 2020 pursuant to the Coronavirus Aid, Relief, and Economic Security (CARES) Act, which was signed into law on March 27, 2020.[1248] The COVID-19 Telehealth Program distributes funding appropriated by Congress to help health care providers furnish telehealth services to patients at their homes or mobile locations in response to the COVID-19 pandemic.[1249] Between April 16, 2020 and July 8, 2020, the Commission approved 539 funding applications in 47 states plus the District of Columbia and Guam for a total of $200 million in funding.[1250]

430. In December 2020, Congress appropriated another $249.95 million for a second round of funding to be distributed by the Commission.[1251] On March 29, 2021, the Commission adopted a new order to establish a second round of the COVID-19 Telehealth Program to fund telehealth and connected care services as required by Congress in the Consolidated Appropriations Act, 2021 (Consolidated Appropriations Act).[1252] During this second round of the program, the Commission approved applications by 446 health care providers and awarded more than $256 million in funding.[1253] Over the course of the two funding rounds, the COVID-19 Telehealth Program has approved 985 awards to health care providers in each state, territory, and the District of Columbia.[1254]

431. *Emergency Broadband Benefit (EBB) and the Affordable Connectivity Program (ACP).* At Congress's direction, the Commission has established a series of programs designed to offer discounted broadband service and connected devices to help low-income households get connected and stay connected to work, school, family, and social services. The EBB Program was established as a response to the COVID-19 pandemic, which accentuated concern about broadband affordability problems that disproportionately affected low-income households.[1255] On May 12, 2021, the Commission launched the EBB Program,[1256] with a $3.2 billion appropriation through the Consolidated Appropriations Act of

(Continued from previous page)

[1246] *Id.* at 3165, para. 424; *see also* CTIA Comments at 7.

[1247] *Id.* at 3165, para. 424; *see also* WISPA Comments at 23 ("More than 200 WISPs have obtained STAs in this band.").

[1248] *COVID-19 Telehealth Program, Promoting Telehealth for Low-Income Consumers*, WC Docket No. 20-89, Report and Order, 35 FCC Rcd 3366 (2020).

[1249] *Wireline Competition Bureau Announces Covid-19 Telehealth Program Application Portal Will Open Monday*, WC Docket No. 20-89, Public Notice, 35 FCC Rcd 3076 (WCB 2020).

[1250] *2020 Communications Marketplace Report*, 36 FCC Rcd at 3166, para. 426.

[1251] *COVID-19 Telehealth Program, Promoting Telehealth for Low Income Consumers*, WC Docket No. 20-89, Report and Order and Order on Reconsideration, 36 FCC Rcd 7141, 7142-43, paras. 2-3 (2021) (*COVID-19 Telehealth Round Two Order*).

[1252] *COVID-19 Telehealth Round Two Order*, 36 FCC Rcd at 7141-42, para. 1.

[1253] *See* FCC, *COVID-19 Telehealth Program (Invoices & Reimbursements)*, Final List of COVID-19 Telehealth Program Round 2 Awardees (June 30, 2022), https://www fcc.gov/covid-19-telehealth-program-invoices-reimbursements.

[1254] *Id*.

[1255] *Emergency Broadband Benefit Program*, WC Docket No. 20-445, Report and Order, 36 FCC Rcd 4612, 4613, para. 1 (2021) (*EBB Program Report and Order*); *see also* Pew Pandemic Research Report at 5-6.

[1256] *Wireline Competition Bureau Announces Emergency Broadband Benefit Program Launch Date*, WC Docket. No. 20-445, Public Notice, 36 FCC Rcd 7614 (WCB 2021) (*EBB Launch Date Public Notice*). The Commission established the EBB Program rules in the *EBB Program Report and Order*.

2021.[1257] The EBB Program provided eligible low-income households with a monthly discount off the cost of broadband service and certain connected devices during an emergency period relating to the COVID-19 pandemic, and participating providers could receive a reimbursement for such discounts.[1258]

432. Through the EBB Program, participating broadband providers offered eligible households a monthly discount of up to $50 off the standard rate of broadband service, or up to $75 on Tribal lands.[1259] Participating providers could also offer an eligible household a connected device, such as a laptop, desktop computer, or tablet, at a discounted price and receive a reimbursement of up to $100, provided that the eligible household is charged a co-payment of more than $10 but less than $50 toward the purchase of the device.[1260] A household qualified for the EBB Program if at least one member of the household: (1) met the qualifications for participation in the Lifeline program; (2) had applied for and been approved to receive benefits under the free and reduced price lunch program or the school breakfast program; (3) had experienced a substantial loss of income since February 29, 2020; (4) had received a Federal Pell Grant in the current award year; or (5) met the eligibility criteria for a participating provider's existing low-income or COVID-19 program.[1261] The EBB Program ended on December 31, 2021 and was immediately replaced by the ACP.[1262]

433. Congress created the ACP as part of its investment in broadband affordability, deployment, and access in the November 2021 Infrastructure Investment and Jobs Act (Infrastructure Act).[1263] In establishing the ACP, Congress made several changes to the EBB Program to transform it from an emergency program designed to respond to a public health crisis to a longer-term broadband affordability program, and appropriated to the Commission an additional $14.2 billion for the program.[1264] Under the ACP, eligible households can receive a discount of up to $30 per month, with an enhanced benefit of up to a $75 monthly discount available for eligible consumers on qualifying Tribal lands, off the price of broadband service. Like the EBB Program, the ACP provides a one-time discount of up to $100 for a laptop, desktop, or tablet per household, provided that the household contributes more than $10 but less than $50 toward the cost of the device.[1265] As with the EBB Program, a household qualifies for the ACP if a member of the household (1) qualifies for Lifeline; (2) had applied for and been approved to receive benefits under the free and reduced price lunch program or the school breakfast program; (3) had received a Federal Pell Grant in the current award year; or (4) meets the eligibility criteria for a participating provider's existing low-income program, subject to approval by the Commission.[1266] The Infrastructure Act expanded eligibility to those households with a member that receives assistance through the Special Supplemental Nutritional Program for Woman, Infants, and Children (WIC) and

[1257] Consolidated Appropriations Act, 2021, Pub. L. No. 116-260, 134 Stat. 1182 (2020), https://www.congress.gov/bill/116th-congress/house-bill/133/text (Consolidated Appropriations Act).

[1258] Consolidated Appropriations Act, 2021, Pub. L. No. 116-260, 134 Stat. 1182, 2130, 2135, div. N, tit. IX, div. N, tit. V, § 904(i) (2020).

[1259] *EBB Program Report and Order*, 36 FCC Rcd at 4614, para. 4.

[1260] *Id.* at 4614, para. 5.

[1261] *Id.* at 4631, para. 43.

[1262] *Affordable Connectivity Program; Emergency Broadband Benefit Program*, WC Docket Nos. 21-450, 20-445, Report and Order and Further Notice of Proposed Rulemaking, FCC 22-2, at 3, para. 2 (Jan. 21, 2022) (*ACP Report and Order and Further Notice*).

[1263] Infrastructure Investment and Jobs Act, Pub. L. No. 117-58, 135 Stat. 429 (2021), https://www.congress.gov/117/plaws/publ58/PLAW-117publ58.pdf (Infrastructure Act).

[1264] *ACP Report and Order and Further Notice* at 2, para. 1.

[1265] 47 U.S.C. § 1752(b)(5); *ACP Report and Order and Further Notice* at 65, para. 136.

[1266] *Id.* at 26, para. 49.

those households with an income below 200% of the Federal Poverty Guidelines.[1267] Congress eliminated as a qualifying criteria substantial loss of income since February 29, 2020 and participation in a provider's COVID-19 program.[1268]

434. As directed by Congress, the EBB Program ended on December 31, 2021.[1269] At the end of the EBB Program, the more than 9 million households enrolled in the EBB Program transitioned to the ACP.[1270] As of December 31, 2021, nearly half of the enrolled households were automatically qualified for the EBB Program through their enrollment for the Lifeline program,[1271] the Commission's universal service program to make communications services affordable for low-income consumers.[1272] Under the EBB Program and the ACP, providers offering fixed or mobile broadband service, including cable providers, wireless Internet service providers, electric cooperatives, or municipal governments, could participate and offer qualifying supported broadband service to enrolled households. Qualifying Internet service offerings had to include a broadband connection—fixed or mobile—that permitted households to rely on these connections for purposes essential to participating in society during the pandemic, such as telework, remote learning, and telehealth.[1273] As shown in Figure V.3 below, about 32.7% of enrollees participating in the EBB Program received the subsidies for fixed broadband service, including broadband connections via cable, DSL, and fiber.[1274] Among the 9 million households that were enrolled in the EBB Program at the program's end, 66.8% received discounted mobile broadband services.[1275]

[1267] *Id.*

[1268] *Id.*.

[1269] *Id.* at 3, para. 2.

[1270] *Id.*; USAC, *Emergency Broadband Benefit Program Enrollments and Claims Tracker—Total Enrolled Households-Weekly*, https://www.usac.org/about/emergency-broadband-benefit-program/emergency-broadband-benefit-program-enrollments-and-claims-tracker/#total-enrolled (last visited Oct. 6, 2022). Importantly, the ACP website is updated on a regular basis and all previous information and data are replaced by new information and data at that time.

[1271] USAC, *Additional EBB Program Data—Total Enrolled EBB Program Subscribers by Method of Verification*, https://www.usac.org/about/emergency-broadband-benefit-program/emergency-broadband-benefit-program-enrollments-and-claims-tracker/additional-ebb-program-data/ (last visited Oct. 6, 2022).

[1272] Lifeline provides up to a $9.25 monthly discount on service for low-income subscribers and up to $34.25 per month for those on Tribal lands. To qualify for the program, consumers must have an income that is at or below 135% of the Federal Poverty Guidelines or participate in certain federal assistance programs, such as the Supplemental Nutrition Assistance Program (SNAP), Medicaid, Federal Housing Assistance, Supplemental Security Income, the Veterans and Survivors Pension Benefit, or certain Tribal programs. FCC, *Lifeline Support for Affordable Communications*, https://www.fcc.gov/lifeline-consumers (last visited Oct. 6, 2022).

[1273] *EBB Program Report and Order*, 36 FCC Rcd at 4617, para. 13; *ACP Report and Order and Further Notice* at 7, para. 11.

[1274] USAC, *Additional EBB Program Data*, https://www.usac.org/about/emergency-broadband-benefit-program/emergency-broadband-benefit-program-enrollments-and-claims-tracker/additional-ebb-program-data/ (last visited Oct. 6, 2022) (navigate to "Total Enrolled EBB Program Subscribers by Service Type" section).

[1275] *Id*.

Fig. V.3
Total Enrolled Emergency Broadband Benefit Subscribers by Service Type

Service Type	EBB (as of Dec. 31, 2021)		ACP (as of Sept. 1, 2022)	
	Subscribers	Percent	Subscribers	Percent
Mobile Broadband	6,039,916	66.8%	7,617,944	56.3%
Fixed Broadband	2,957,312	32.7%	5,798,425	42.9%
Fixed Wireless or Satellite	51,308	0.6%	98,467	0.8%
Total	9,048,536	100.0%	13,514,836	100.0%

Source: Universal Service Administrative Co. (USAC) additional EBB Program and ACP data.[1276]

435. As of September 1, 2022, the total enrollment, including those households previously enrolled in the EBB Program, had exceeded 13 million households.[1277] The percentage of households enrolled in the ACP that qualified through Lifeline decreased to 35.8% from 48.9% at the end of the EBB Program.[1278] Over the course of the EBB Program and the ACP, the mix of service types on which households received discounted service shifted slightly away from mobile broadband service.[1279] Of the more than 13 million households enrolled in the ACP as of September 1, 2022, 56.3% received subsidies for their mobile broadband service, and 42.9% received discounted fixed broadband services.[1280] According to a study submitted by commenters, awareness of the ACP varies widely among consumers

[1276] Fixed Broadband includes cable, DSL, and fiber. *See* USAC, *Additional EBB Data*, https://www.usac.org/about/emergency-broadband-benefit-program/emergency-broadband-benefit-program-enrollments-and-claims-tracker/additional-ebb-program-data/ (last visited Oct. 6, 2022) (navigate to "Total Enrolled EBB Program Subscribers by Service Type" section); *see also* USAC, *Additional ACP Data*, https://www.usac.org/about/affordable-connectivity-program/acp-enrollment-and-claims-tracker/additional-acp-data/ (last visited Oct. 6, 2022) (navigate to "Total Enrolled ACP Subscribers by Service Type" section).

[1277] USAC, *Additional ACP Data—Total Enrolled ACP Subscribers by Service Type*, https://www.usac.org/about/affordable-connectivity-program/acp-enrollment-and-claims-tracker/additional-acp-data/ (last visited Oct. 6, 2022). Our analysis is based on data reported up to September 1, 2022. ACP enrollments, however, continued to increase and are expected to change over time. As of December 5, 2022, the number of households enrolled in the ACP exceeded 15 million. USAC, *ACP Enrollment and Claims Tracker*, https://www.usac.org/about/affordable-connectivity-program/acp-enrollment-and-claims-tracker/ (last visited Dec. 9, 2022).

[1278] Staff calculations are based on USAC data. *See* USAC, *Additional EBB Data*, https://www.usac.org/about/emergency-broadband-benefit-program/emergency-broadband-benefit-program-enrollments-and-claims-tracker/additional-ebb-program-data/ (last visited Oct. 6, 2022); *see also* USAC, *Additional ACP Data*, https://www.usac.org/about/affordable-connectivity-program/acp-enrollment-and-claims-tracker/additional-acp-data/ (last visited Oct. 6, 2022).

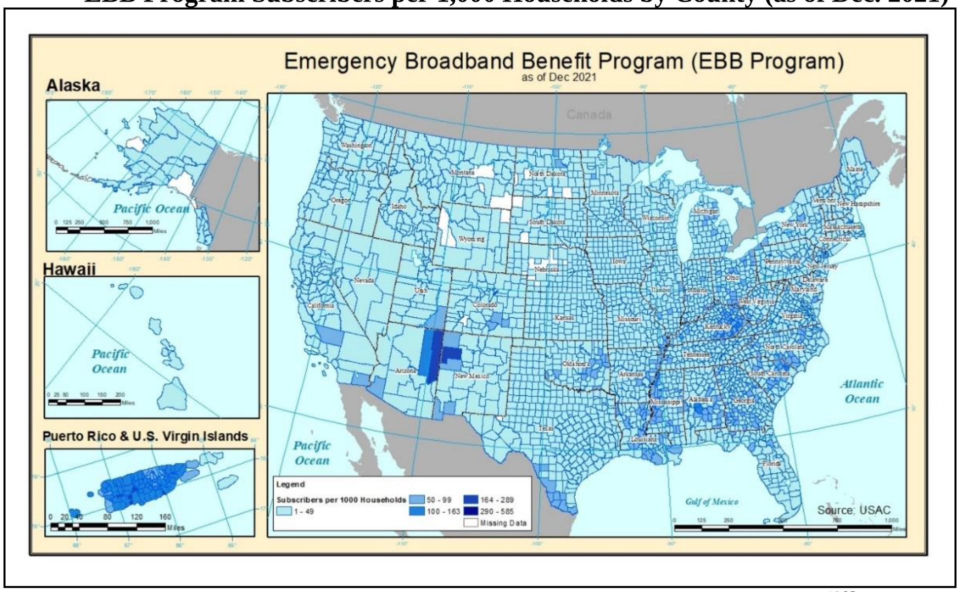
[1279] USAC, *Additional ACP Data—Total Enrolled ACP Subscribers by Service Type*, https://www.usac.org/about/affordable-connectivity-program/acp-enrollment-and-claims-tracker/additional-acp-data/ (last visited Oct. 6, 2022) (*USAC Additional ACP Data*); *see also* USAC, *Additional ACP Data—Total Enrolled ACP Subscribers by Method of Verification*, https://www.usac.org/about/affordable-connectivity-program/acp-enrollment-and-claims-tracker/additional-acp-data/ (last visited Oct. 6, 2022).

[1280] *USAC Additional ACP Data*. The ACP reduced the regular monthly broadband service subsidy cap to $30 but retained the $75 cap on Tribal lands. In addition, it adjusted the income threshold from 135% to 200% of the Federal Guidelines and added the Special Supplemental Nutritional Program for Woman, Infants, and Children as a qualifying program. *ACP Report and Order and Further Notice* at 34, para. 64.

across mobile service providers. Approximately 70% of consumers relying on pre-paid services provided by Metro by T-Mobile, Cricket Wireless, or Boost Mobile are aware of the ACP.[1281] In contrast, fewer than 45% of mobile wireless consumers serviced by AT&T, T-Mobile, or Verizon Wireless are aware of the program.[1282]

436. Figures V.4 and V.5 show enrollments per 1,000 households for the EBB Program and the ACP by county, respectively. Puerto Rico, Apache County (Arizona), and McKinley County (New Mexico) were among the highest-participating areas in the EBB Program. Because the ACP is an extension of the EBB Program, ACP enrollments increased relative to EBB in most counties.

Fig. V.4
EBB Program Subscribers per 1,000 Households by County (as of Dec. 2021)



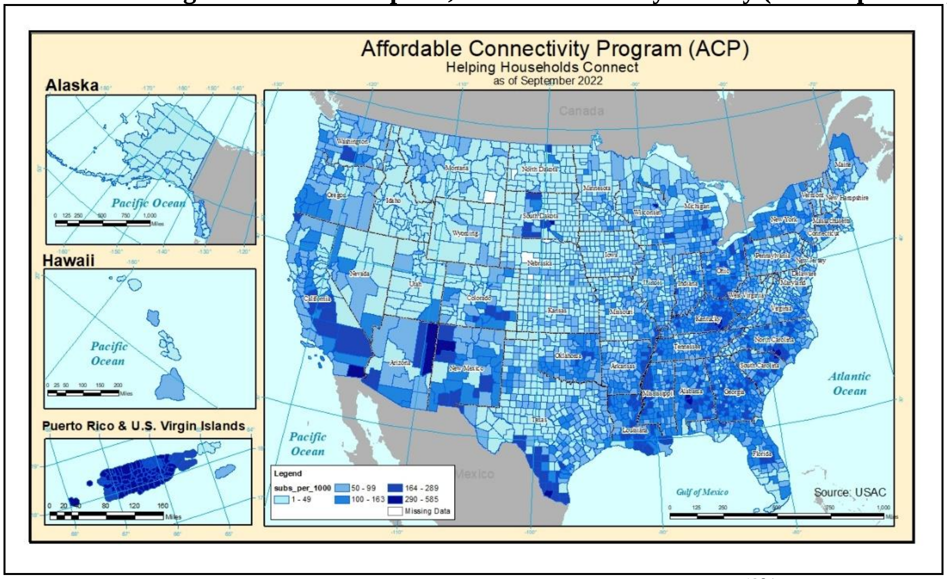
Source: Universal Service Administrative Co. (USAC) additional EBB Program data.[1283]

[1281] *Recon Analytics Ex Parte* at 1 (the awareness of the ACP among pre-paid mobile wireless consumers is: Metro by T-Mobile—68.2%, Cricket Wireless—67.8%, Boost Mobile—70.2%, Google Fi—68.7%, and Tracfone/Straight Talk—58%).

[1282] *Recon Analytics Ex Parte* at 1 (on the top three national providers' networks, the awareness of the ACP among mobile wireless consumers is: AT&T—45.5%, T-Mobile—41.6%, and Verizon Wireless—39%).

[1283] USAC, *EBB Households and Claims by County (May 2021—December 2021)*, https://www.usac.org/wp-content/uploads/about/documents/acp/EBB-Households-and-Claims-by-County-May-2021-Dec-2021.xlsx (last visited Oct. 6, 2022).

Fig. V.5
ACP Program Subscribers per 1,000 Households by County (as of Sept. 2022)



Source: Universal Service Administrative Co. (USAC) additional ACP data.[1284]

437. *Emergency Connectivity Fund*. Before the COVID-19 pandemic, millions of students who lacked home broadband connections and access to computers were caught in the "homework gap."[1285] The COVID-19 pandemic has exacerbated the inequities between students who have a broadband connection and those who do not when temporary in-person school closures forced learning to take place remotely.[1286] Pursuant to the American Rescue Plan Act of 2021, the Commission established the Emergency Connectivity Fund (ECF) program on May 10, 2021 to distribute up to $7.171 billion to eligible schools and libraries for the purchases of Wi-Fi hotspot devices, modems, routers, devices that combine a modem and router, connected devices and broadband connections for use by students, school staff, and library patrons at locations that include locations other than the schools and libraries.[1287]

438. The ECF program reimburses 100% of the reasonable costs associated with the eligible broadband Internet services and equipment, and sets a maximum support cap of $400 for connected devices (i.e., laptop and tablet computers) and a $250 support cap for Wi-Fi hotspots provided to an individual student, school staff, or library patron.[1288] This program allows students, school staff, and

[1284] USAC, *ACP Households and Claims by County (January—August 2022)*, https://www.usac.org/wp-content/uploads/about/documents/acp/ACP-Households-and-Claims-by-County-January-August-2022.xlsx (last visited Oct. 6, 2022).

[1285] *Establishing Emergency Connectivity Fund to Close the Homework Gap*, WC Docket No. 21-93, Report and Order, 36 FCC Rcd 8696, 8697-98, paras. 1, 3 (2021) (*ECF Report and Order*); *see also* Pew Research Center, *As schools close due to the coronavirus, some U.S. students face a digital 'homework gap'* (Mar. 16, 2020), https://www.pewresearch.org/fact-tank/2020/03/16/as-schools-close-due-to-the-coronavirus-some-u-s-students-face-a-digital-homework-gap/ ("15% of U.S. households with school-age children do not have a high-speed internet connection at home, according to a previously published Pew Research Center analysis of 2015 U.S. Census Bureau data.").

[1286] *ECF Report and Order*, 36 FCC Rcd at 8696, 8697-98, paras. 1, 3.

[1287] *Id.* at 8697-98, paras.1, 3-4.

[1288] *Id.* at 8730-31, 8734, paras. 69, 71, 78.

library patrons who do not have an Internet connecting device or service at home to be connected and gain educational resources online. USAC and the Commission have opened and closed three application filing windows, with the requests received totaling more than $9.2 billion.[1289] As requests received during the third application filing window exceeded the amount of available funds, the funding requests will be prioritized, with support going to the schools and libraries with the greatest need and a preference to rural schools and libraries.[1290] It is not expected that there will be any additional application filing windows for the ECF program.[1291] As of November 16, 2022, total funding committed had exceeded $6.3 billion, and applications are continuing to be reviewed.[1292]

439. *Regulatory Flexibility for the E-Rate Program*. On October 7, 2021, the Wireline Competition Bureau (WCB) issued a second extension of its waiver of the gift rule for the E-Rate Program, that allowed service providers to offer, and E-Rate Program participants to solicit and accept, improved broadband connections or equipment for telehealth or remote learning during the COVID-19 pandemic.[1293] This second extension was effective through June 30, 2022.[1294]

440. *Regulatory Flexibility for Lifeline Program.* WCB has also granted multiple waivers relating to the COVID-19 pandemic to ensure that participants in the Lifeline program did not lose access to vital connectivity services during the worst parts of the pandemic. Beginning on March 17, 2020, WCB temporarily waived the Lifeline program's annual recertification and reverification requirements for such participants.[1295] In addition, on March 30, 2020, WCB waived the non-usage rules and general de-enrollment rules to prevent Lifeline subscribers from being involuntary de-enrolled during the pandemic and,[1296] on April 29, 2020, WCB eased documentation requirements for subscribers demonstrating eligibility based on income to facilitate the application process for individuals who lost their employment during the pandemic.[1297] Relatedly, beginning on June 1, 2020, the Bureau streamlined

[1289] *See* FCC, Press Release, FCC Announces Over $5 Billion in Funding Requests Received in the Emergency Connectivity Fund Program (Aug. 25, 2021), https://www.fcc.gov/document/fcc-announces-over-5-billion-emergency-connectivity-fund-requests; FCC, Press Release, FCC Announces Nearly $1.3 Billion in Funding Requests Received in Emergency Connectivity Fund Program Second Application Filing Window (Oct. 25, 2021), https://docs.fcc.gov/public/attachments/DOC-376868A1.pdf; FCC, Press Release, FCC Announces Over $2.8 Billion in Funding Requests for Final Window in Ongoing Work to Close the Homework Gap (May 25, 2022), https://docs.fcc.gov/public/attachments/DOC-383685A1.pdf.

[1290] FCC, Press Release, FCC Announces Over $2.8 Billion in Funding Requests for Final Window in Ongoing Work to Close the Homework Gap (May 25, 2022), https://docs fcc.gov/public/attachments/DOC-383685A1.pdf.

[1291] *Id.* (explaining that applications from all 50 states, the District of Columbia, and Puerto Rico were received in the third and final application filing window for the ECF program).

[1292] FCC, Press Release, FCC Announces Nearly $84 Million in Emergency Connectivity Funding for Schools and Libraries (Nov. 16, 2022), https://docs fcc.gov/public/attachments/DOC-389226A1.pdf..

[1293] *Rural Health Care Universal Service Support Mechanism*; *Schools and Libraries Universal Service Support Mechanism*, WC Docket No. 02-60, CC Docket No. 02-6, Order, 35 FCC Rcd 2741 (WCB 2020); *Schools and Libraries Universal Service Support Mechanism*, WC Docket No. 02-60, CC Docket No. 02-6, Order, 35 FCC Rcd 9416 (WCB 2020); *Rural Health Care Universal Service Support Mechanism*; *Schools and Libraries Universal Service Support Mechanism*, WC Docket No. 02-60, CC Docket No. 02-6, Order, 35 FCC Rcd 14544 (WCB 2020); *Rural Health Care Universal Service Support Mechanism*; *Schools and Libraries Universal Service Support Mechanism*, WC Docket No. 02-60, Order, DA 21-1257 (WCB Oct. 7, 2021) (*Oct. 7, 2021 E-Rate Gift Rule Waiver*).

[1294] *Oct. 7, 2021 E-Rate Gift Rule Waiver* at 1, para. 2.

[1295] *Lifeline and Link Up Reform and Modernization*, WC Docket No. 11-42, Order, 35 FCC Rcd 2729 (WCB 2020).

[1296] *Id.* The waiver of the Lifeline non-usage requirements expired on May 1, 2021. *See Lifeline and Link Up Reform and Modernization*, WC Docket No. 11-42, Order, DA 21-229, at 1, para. 1 (WCB 2021).

[1297] *Lifeline and Link Up Reform and Modernization*, WC Docket No. 11-42, Order, 35 FCC Rcd 4482 (WCB 2020).

the enrollment process for subscribers residing on rural Tribal lands by enabling carriers to begin providing service to those subscribers prior to the submission of all required documentation.[1298] These waivers were extended multiple times to last largely through June 30, 2022.[1299]

441. *Regulatory Flexibility for the Rural Health Care Program*. On February 12, 2021, WCB waived the Commission's rules to extend the close of the funding year 2021 application filing window for the Rural Health Care Program until June 1, 2021.[1300] WCB found that an extension of the application filing window for funding year 2021 was necessary in light of the ongoing disruptions caused by the COVID-19 pandemic to program participants, the emergence of the more contagious new COVID-19 variants, and the overwhelming burden placed on health care providers to administer COVID-19 testing and vaccines.[1301] On April 8, 2021, WCB waived Commission rules regarding service delivery deadlines, invoice deadlines, and deadlines to respond to information requests to give RHC Program participants additional flexibility with additional deadlines in light of the COVID-19 pandemic.[1302] On March 3, 2022, WCB waived the Commission's rules to extend the close of the funding year 2022 application filing window for the Rural Health Care Program until June 1, 2022.[1303] WCB found that an extension of the application filing window for funding year 2022 was necessary in light of the persistent and ongoing disruptions caused by the COVID-19 pandemic to program participants and the shortage and burnout of health care staff aggravated by the surge of the Omicron variant.[1304]

VI. COMMISSION ACTIONS ALREADY TAKEN TO PROMOTE COMPETITION, ENCOURAGE UNIVERSAL DEPLOYMENT OF COMMUNICATIONS SERVICES AND ENSURE INCLUSION

442. RAY BAUM'S Act of 2018 requires the Commission to describe the actions it has taken over the previous two years in addressing the competitive challenges and opportunities in the communications marketplace.

A. The Fixed Communications Marketplace

443. *Measuring Broadband Deployment*. In January 2021, the Commission adopted BDC rules requiring facilities-based fixed service providers to report the availability of BIAS service and to indicate whether the service offered is residential, business, or both.[1305] Fixed providers must report the maximum advertised download and upload speeds offered for each technology to the location or in the area.[1306] In addition, fixed providers must report latency information associated with each maximum

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[1298] *Lifeline and Link Up Reform and Modernization*, WC Docket No. 11-42, Order, 35 FCC Rcd 5510 (WCB 2020).

[1299] *Lifeline and Link Up Reform and Modernization*, WC Docket No. 11-42, Order, DA 22-323 (WCB Mar. 25, 2022). WCB concluded that the primary motivating factor for the waivers, the effect of the COVID-19 pandemic, diminished and there are genuine program integrity concerns associated with a general extension beyond June 30, 2022. However, the Bureau granted an extension of the waiver of the Lifeline recertification and reverification requirements for Lifeline consumers residing on Tribal lands. *See Lifeline and Link Up Reform and Modernization*, Order, WC Docket No. 11-42, Order, DA 22-691, at 3-4, paras. 1, 6-7 (WCB June 30, 2022).

[1300] *Rural Health Care Support Mechanism*, WC Docket No. 02-60, Order, 36 FCC Rcd 1604 (WCB 2021) (*Rural Health Care Support Mechanism Order*).

[1301] *Rural Health Care Support Mechanism Order*, 36 FCC Rcd at 1606, para. 5.

[1302] *Promoting Telehealth in Rural America*, WC Docket No. 17-310, Order, 36 FCC Rcd 7051 (WCB 2021) (*Promoting Telehealth in Rural America Order*).

[1303] *Rural Health Care Support Mechanism*, WC Docket No. 02-60, Order, DA 22-221 (WCB Mar. 3, 2022).

[1304] *Id.* at 1, para. 1.

[1305] *BDC Third Report and Order*, 36 FCC Rcd at 1130-31, paras. 9-10.

[1306] For services offered below 25/3 Mbps, providers must report the speed associated with the service using two speed tiers: (1) greater than 200 kbps in at least one direction and less than 10/1 Mbps and (2) greater or equal to

(continued….)

speed and technology combination for a particular geographic area.[1307] Fixed providers may report broadband availability data using either coverage polygons or a list of locations. Regardless of how the data are reported, the Commission overlays the availability data onto the Fabric locations, and fixed availability challenges must be made on a location basis.

444. Consumers may challenge the accuracy of the coverage maps at a particular location where they own property, reside, or are authorized to request service.[1308] Similarly, governmental and other entities may challenge fixed availability data at various locations by submitting in individual or bulk form, the required information about the challenge, as well as evidence to support it.[1309] Consumers and governmental and other entities may also challenge the Fabric data on the basis of: (1) wrong placement of a location on the map; (2) a location not being broadband serviceable; (3) a serviceable location not being reflected in the Fabric; or (4) information about a location being incorrect in the Fabric.[1310] Challenges to the fixed availability data and Fabric are intended to improve the accuracy of the broadband availability data, as well as the Fabric data over time.

445. *Rural Digital Opportunity Fund*. The Rural Digital Opportunity Fund auction, a program aimed at expanding broadband in unserved rural areas, concluded on November 25, 2020.[1311] The Commission started the process of authorizing funding for winning bidders which had received approval for the long-form applications on September 15, 2021 and, as of December 15, 2022, has authorized $5.76 billion to provide service to over 3.24 million locations.[1312] Winners are committed to providing 1 Gbps/500 Mbps to over 97% of locations being funded.[1313]

446. *Bringing Puerto Rico Together and Connect USVI Funds*. In June 2021, the Commission authorized funding for the winning proposals from the Stage 2 Bringing Puerto Rico Together Fund and Connect USVI Fund competitive bidding processes—$127.1 million and $84.5 million, respectively.[1314] This funding will provide support over a 10-year period for deployment of fixed voice and broadband

(Continued from previous page)
10/1 Mbps and less than 25/3 Mbps. For speeds greater than or equal to 25/3 Mbps, the provider must report the maximum advertised download and upload speeds associated with the service. *BDC Third Report and Order*, 36 FCC Rcd at 1136, para. 22.

[1307] *Id.* at 1138, para. 27.

[1308] Consumers must choose a dispute category from pre-approved options in the online BDC portal (e.g., no service at the location, provider failed to install service within ten business days, provider denied request for service, or reported speed not offered). *BDC Third Report and Order*, 36 FCC Rcd at 1155-56, para. 72.

[1309] *Id.* at 1162, para. 90.

[1310] *Id.* at 1161-62, 1163-64, paras. 89, 95.

[1311] *Rural Digital Opportunity Fund Phase I Auction (Auction 904) Closes*, AU Docket No. 20-34, WC Docket Nos. 19-126 and 10-90, Public Notice, 35 FCC Rcd 13888, 13888, para. 1 (OEA/WCB 2020) (*Auction 904 Closing Public Notice*).

[1312] *Rural Digital Opportunity Fund Support Authorized for 466 Winning Bids*, AU Docket No. 20-34, WC Docket Nos. 19-126 and 10-90, Public Notice, DA 21-1158 (OEA/WCB Sept. 15, 2021); FCC, *Auction 904: Rural Digital Opportunity Fund*, https://www fcc.gov/auction/904/round-results (navigate to the "Authorized Auction 904 Long-Form Applicants (updated 12/15/2022)" subheading and click on the link to the spreadsheet) (last visited Dec. 22, 2022).

[1313] *See* FCC, *Auction 904: Rural Digital Opportunity Fund*, https://www.fcc.gov/auction/904/round-results (last visited July 6, 2022). The 97% referenced above is calculated using the spreadsheet found at this link,

[1314] *Wireline Competition Bureau Authorizes Stage 2 Support for Puerto Rico Telephone Company and Liberty Communications of Puerto Rico*, WC Docket Nos. 18-143 and 10-90, Public Notice, 36 FCC Rcd 9914 (WCB, 2021) (*Bringing Together Puerto Rico Winning Applicant Announcement*); *Connect USVI Fund Stage 2 Support Authorized for Broadband VI*, WC Docket Nos. 18-143 and 10-90, Public Notice, 36 FCC Rcd 9405 (WCB 2021) (*USVI Fund Winning Applicant Announcement*).

services. Bringing Puerto Rico Together Stage 2 funding will support deployment of service at a minimum speed of 100/20 Mbps, with service obligations at some funded locations as high as 1 Gbps/500 Mbps.[1315] In the U.S. Virgin Islands, the Connect USVI Stage 2 support will result in the deployment of 1 Gbps/500 Mbps service to all funded locations.[1316]

447. *Rural Broadband Accountability Plan*. The Rural Broadband Accountability Plan (RBAP) is a new effort to monitor and ensure compliance for universal service high-cost programs, including the Rural Digital Opportunity Fund and Connect America Fund Phase II Auction.[1317] The RBAP makes a number of changes and enhancements to existing audit and verification procedures. Under the RBAP, the number of audits and verifications will double in 2022 as compared to 2021, and inspectors will conduct on-site audits as well as audits and verifications based on random selection.[1318] The largest dollar recipients will be subject to an on-site audit in at least one state, and higher-risk recipients will be subject to additional audits and verifications.[1319] In addition, for the first time, results of

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[1315] *See Bringing Together Puerto Rico Winning Applicant Announcement*, 36 FCC Rcd at 9914, para. 1 (identifying Puerto Rico Telephone Co., Inc. (PRTC) and Liberty Communications of Puerto Rico (Liberty) as the winning applicants); PRTC Uniendo a Puerto Rico Fund Stage 2 Fixed Support Application Form, WC Docket Nos. 18-143 and 10-90, Initial Overview at 1 (filed June 22, 2021) (*PRTC Network Description*); Liberty Uniendo a Puerto Rico Fund Stage 2 Fixed Support Application Form, WC Docket Nos. 18-143 and 10-90, Initial Overview at 4 (filed June 22, 2021) (*Liberty Network Description*). We refer to the *Bringing Together Puerto Rico Winning Applicant Announcement*, *PRTC Network Description*, and *Liberty Network Description* together as the *Bringing Together Puerto Rico Broadband Speed Requirements*.

[1316] *See USVI Fund Winning Applicant Announcement*, 36 FCC Rcd at 9405, para. 1 (identifying Broadband VI as the winning applicant); Broadband VI Uniendo a Puerto Rico Fund Connect USVI Fund Stage 2 Fixed Support Application Form, WC Dockets Nos. 18-143 and WC 10-90, Initial Overview at 1 (filed June 11, 2021) (together with the *USVI Fund Winning Applicant Announcement*, the *USVI Fund Broadband Speed Requirements*). In June 2020, the Commission similarly authorized a total of $258.8 million in funding to wireless carriers participating in Stage 2 of the Bringing Puerto Rico Together Fund and the Connect USVI Fund to facilitate the restoration, hardening, and expansion of mobile networks capable of providing 4G LTE and 5G-NR services over a three-year term. *Wireline Competition Bureau Authorizes Stage 2 Mobile Support for Certain Providers Participating in the Uniendo a Puerto Rico Fund and the Connect USVI Fund*, WC Docket Nos. 18-143 and 10-90, Public Notice, 35 FCC Rcd 6321, 6324, Attach. A (WCB 2020) (authorizing support for AT&T Mobility, PRTC, and T-Mobile in Puerto Rico, and AT&T Mobility in the U.S. Virgin Islands); *Wireline Competition Bureau Authorizes Stage 2 Mobile Support for T-Mobile in Puerto Rico*, WC Docket Nos. 18-143 and 10-90, Public Notice, 35 FCC Rcd 10303, 10305, Attach. A (WCB 2020) (authorizing additional mobile support in September 2020 for T-Mobile based on its acquisition of PR Wireless, LLC); *Wireline Competition Bureau Authorizes Stage 2 Mobile Support for Viya in the U.S. Virgin Islands*, WC Docket Nos. 18-143 and 10-90, Public Notice, 35 FCC Rcd 11555, 11557, Attach. A (WCB 2020) (authorizing support to Virgin Islands Telephone Corp. d/b/a Viya). Carriers must restore network coverage in the territories to at least pre-hurricane levels by the conclusion of the support period, providing outdoor transmission rates of at least 10 Mbps download and 1 Mbps upload speeds for 4G LTE and 35/3 Mbps for 5G-NR service. 47 CFR §§ 54.1509(c), 54.1514(b)(1). On October 28, 2022, in light of damage caused by hurricanes in the fall of 2022, the Commission released a Further Notice of Proposed Rulemaking proposing to extend by 24 months (until December 2025) the phase-down of frozen support for incumbent fixed providers in Puerto Rico and the U.S. Virgin Islands for the areas in which they were not awarded long-term support for broadband services, as well as the end of mobile support in Puerto Rico and the U.S. Virgin Islands. *The Uniendo a Puerto Rico Fund and the Connect USVI Fund; Connect America Fund*, WC Docket Nos. 18-143 and 10-90, Further Notice of Proposed Rulemaking, FCC 22-79 (Oct. 28, 2022), https://docs.fcc.gov/public/attachments/FCC-22-79A1.pdf.

[1317] FCC, *Rural Broadband Accountability Plan*, https://www.fcc.gov/rbap (last visited Oct. 21, 2022).

[1318] FCC, *FACT SHEET: Rural Broadband Accountability Plan*, https://docs fcc.gov/public/attachments/DOC-379729A1.pdf (last visited Oct. 21, 2022).

[1319] *Id*.

verifications, audits, and speed and latency performance testing will be made publicly available.[1320] The Commission established the RBAP as part of an ongoing effort to increase accountability and to build upon existing audit and verification processes performed by the Universal Service Administrative Company (USAC).[1321]

448. *Enhanced Alternative Connect America Model Support*. On May 21, 2022, the Commission sought comment on a proposal to achieve widespread deployment of 100/20 Mbps broadband service throughout the rural areas served by carriers currently receiving Alternative Connect America Model (A-CAM) support.[1322] The Commission sought comment on whether such enhancements to the A-CAM program would be an efficient means of funding deployment in a manner complementary to other federal and state efforts such as through the Infrastructure Investment and Jobs Act.[1323]

449. *Precision Agriculture Connectivity Task Force*. The Task Force for Reviewing the Connectivity and Technology Needs of Precision Agriculture in the United States (Precision Agriculture Connectivity Task Force or Task Force) continued its work in 2021 and 2022 by providing advice and recommendations to the Commission and the U.S. Department of Agriculture (USDA) on how to assess and advance deployment of broadband access service on unserved and underserved agricultural lands and to promote precision agriculture for both cropping and husbandry.[1324] The Task Force met six times in 2021.[1325] In November 2021, the Precision Agriculture Connectivity Task Force submitted a report to the Commission including recommendations that the Commission and USDA: (1) improve federal broadband maps and consistently validate user experiences through crowd sourcing, on-the-ground

[1320] *Id*.

[1321] *Id*.

[1322] *Connect America Fund: A National Broadband Plan for Our Future High-Cost Universal Service Support et al.*, WC Docket No. 10-90, Notice of Proposed Rulemaking, FCC 22-35 (May 20, 2022), https://docs.fcc.gov/public/attachments/FCC-22-35A1.pdf.

[1323] *Id.* at 22-40, paras. 59-111.

[1324] *See FCC Announces the Establishment of the Task Force for Reviewing Connectivity and Technology Needs of Precision Agriculture in the United States and Seeks Nominations for Membership*, Public Notice, 34 FCC Rcd 5057 (WCB 2019) (announcing the 2019-20 charter); *FCC Announces the Membership and First Meeting of the Re-chartered Task Force for Reviewing the Connectivity and Technology Needs of Precision Agriculture in the United States*, GN Docket No. 19-329, Public Notice, DA 21-1542 (WCB Dec. 9, 2021), https://docs.fcc.gov/public/attachments/DA-21-1532A1.pdf (*2021-22 Precision Agriculture Connectivity Task Force Re-Charter Public Notice*); *see also* Agriculture Improvement Act of 2018, Pub. L. No. 115-334, 132 Stat. 4490, § 12511(b)(2) (2018 Farm Bill) (establishing the Task Force and setting forth its duties and obligations). The Precision Agriculture Connectivity Task Force will perform duties and submit reports consistent with section 12511 of the 2018 Farm Bill and in consultation with the Department of Agriculture in successive terms until the Task Force ends on January 1, 2025. *Id.* § 12511(b)(3), (6).

[1325] *See FCC Announces Next Meeting of the Task Force for Reviewing the Connectivity and Technology Needs of Precision Agriculture in the United States on March 21, 2021*, GN Docket No. 19-329, Public Notice, 36 FCC Rcd 4165 (WCB 2021); *FCC Announces Next Meeting of the Task Force for Reviewing the Connectivity and Technology Needs of Precision Agriculture in the United States on July 8, 2021,* GN Docket No. 19-329, Public Notice, 36 FCC Rcd 9440 (WCB 2021); *FCC Announces Next Meeting of the Task Force for Reviewing the Connectivity and Technology Needs of Precision Agriculture in the United States on August 19, 2021,* GN Docket No. 19-329, Public Notice, 36 FCC Rcd 11399 (WCB 2021); *FCC Announces Next Meeting of the Task Force for Reviewing the Connectivity and Technology Needs of Precision Agriculture in the United States on September 14, 2021,* GN Docket No. 19-329, Public Notice, 36 FCC Rcd 12777 (WCB 2021); *FCC Announces Next Meeting of the Task Force for Reviewing the Connectivity and Technology Needs of Precision Agriculture in the United States on October 14, 2021,* GN Docket No. 19-329, Public Notice, 36 FCC Rcd 13875 (WCB 2021); *FCC Announces Next Meeting of the Task Force for Reviewing the Connectivity and Technology Needs of Precision Agriculture in the United States on November 10, 2021,* GN Docket No. 19-329, Public Notice, DA 21-1045 (WCB Oct. 20, 2021), https://docs.fcc.gov/public/attachments/DA-21-1314A1.pdf.

testing, and independent data verification; (2) increase incentives and subsidies through federal broadband programs to increase adoption of precision agriculture and build out a robust infrastructure that will support precision agriculture networks and operations; (3) enhance high-speed standards to meet technology needs in agriculture; (4) improve collaboration between federal agencies and remove regulatory impediments; and (5) increase digital access to education and training for individuals engaged in farming.[1326] In December 2021, the Commission re-chartered the Task Force for a new two-year term.[1327] The Task Force met five times in 2022[1328] and adopted interim reports submitted by each of its four working groups in December 2022.[1329]

450. *Supporting Survivors of Domestic Violence*. The Commission opened an inquiry in July 2022 to evaluate how the FCC's low-income programs might help survivors of domestic violence and other harmful abuse get access to connectivity services.[1330] The Notice of Inquiry seeks comment on whether the Lifeline and Affordable Connectivity Programs can be modified to support the connectivity needs of survivors.[1331] Specifically, the inquiry seeks comment on whether survivors are currently able to fully utilize these programs and to gain a better understanding of whether and how these programs might be modified to support survivors, while continuing to protect the programs against waste, fraud, and abuse.[1332]

451. *E-Rate*. For over two decades, schools and libraries have relied on the Commission's E-Rate program to secure affordable telecommunications and broadband services to provide connectivity

[1326] Task Force for Reviewing the Connectivity and Technology Needs of Precision Agriculture in the United States, Report adopted as of November 10, 2021 at 4 (2021), https://www.fcc.gov/sites/default/files/precision-ag-report-11102021.pdf.

[1327] Task Force for Reviewing the Connectivity and Technology Needs of Precision Agriculture in the United States Charter (filed Dec. 2, 2021), https://www.fcc.gov/sites/default/files/precision-ag-task-force-charter-12022021.pdf; *see also 2021-22 Precision Agriculture Connectivity Task Force Re-Charter Public Notice*.

[1328] *2021-22 Precision Agriculture Connectivity Task Force Re-Charter Public Notice* (setting Jan. 13, 2022 as the date of the second term's first meeting); *FCC Announces Next Meeting of the Task Force for Reviewing the Connectivity and Technology Needs of Precision Agriculture in the United States on March 21, 2022*, GN Docket No. 19-329, Public Notice, DA 22-219 (WCB Mar. 3, 2022), https://docs fcc.gov/public/attachments/DA-22-219A1.pdf; *FCC Announces Next Meeting of the Task Force for Reviewing the Connectivity and Technology Needs of Precision Agriculture in the United States on July 21, 2022*, GN Docket No. 19-329, Public Notice, DA 22-666 (WCB June 23, 2022), https://docs fcc.gov/public/attachments/DA-22-666A1.pdf; *FCC Announces Next Meeting of the Task Force for Reviewing the Connectivity and Technology Needs of Precision Agriculture in the United States on October 5, 2022*, GN Docket No. 19-329, Public Notice, DA 22-966 (WCB Sept. 16, 2022), https://docs.fcc.gov/public/attachments/DA-22-966A1.pdf; *FCC Announces Next Meeting of the Task Force for Reviewing the Connectivity and Technology Needs of Precision Agriculture in the United States on December 2, 2022*, GN Docket No. 19-329, Public Notice, DA 22-1164 (WCB Nov. 8, 2022), https://docs.fcc.gov/public/attachments/DA-22-1164A1.pdf.

[1329] *See* FCC, *Precision Ag Connectivity Task Force Meeting – December 2022*, https://www fcc.gov/news-events/events/2022/12/precision-ag-connectivity-task-force-meeting-december-2022 (last visited Dec. 6, 2022). As in the 2019-20 term, four working groups are assisting the Task Force in carrying out its work: (1) Mapping and Analyzing Connectivity on Agricultural Lands; (2) Examining Current and Future Connectivity Demand for Precision Agriculture; (3) Encouraging Adoption of Precision Agriculture and Availability of High-Quality Jobs on Connected Farms; and (4) Accelerating Broadband Deployment on Unserved Agricultural Lands.

[1330] *Lifeline and Link Up Reform and Modernization et al.*, WC Docket No. 11-42, Notice of Inquiry, FCC 22-56 (July 18, 2022), https://docs fcc.gov/public/attachments/FCC-22-56A1.pdf.

[1331] *Id.* at 8-16, 19, paras. 19-47, 63-65.

[1332] In addition to seeking comment relating to the Lifeline and Affordable Connectivity Programs, the Commission in the Notice of Inquiry also explores ways to keep calls to hotlines and shelters from appearing on call logs, due to the potential for abusers to exploit this information. *Id.* at 16-19, 20, paras. 48-62, 66-67.

for schools and libraries.[1333] At the same time, the Commission has been mindful of the need to protect limited E-Rate funds by requiring them to be used for eligible services and equipment provided to eligible entities, for eligible purposes, and in accordance with program rules.[1334] On December 16, 2021, the Commission proposed a change to the E-Rate program targeted at several goals: streamlining program requirements for applicants and service providers, strengthening program integrity, preventing improper payments, and decreasing the risk of fraud, waste, and abuse.[1335] Specifically, the Commission sought comment on a proposal to implement a central document repository (the bidding portal) through which service providers would be required to submit bids to the E-Rate program administrator, the Universal Service Administrative Company (USAC), instead of directly to applicants.[1336]

452. For far too long, Tribal libraries have been unable to participate fully in the E- Rate program.[1337] This situation has exacerbated enduring inequities, as Tribal libraries often serve as a critical source of Internet access in underserved areas across the nation.[1338] In 2018, Congress acted to address this gap through passage of the Museum and Library Services Act of 2018, which amended the Library Services and Construction Act to explicitly include Tribal libraries in the definition of libraries.[1339] Consistent with this legislation, on January 28, 2022, the Commission modified the definition of "library" in its E-Rate program rules to include Tribal libraries and clarify Tribal libraries are eligible to participate in the E-Rate program.[1340] The Commission also waived the E-Rate FCC Form 471 application filing deadline for new Tribal libraries applying for E-Rate support in funding year 2022 recognizing that special circumstances warranted additional flexibility for these applicants to complete their competitive bid processes and submit their applications.[1341] In furtherance of the E-Rate program and other broadband affordability initiatives, on June 24, 2022, the Commission also executed a Memorandum of Understanding (MOU) with the Institute of Museum and Library Services to jointly promote public awareness and facilitate the availability of federal funding opportunities for broadband.[1342] The partnership will work to generate efforts to promote the availability of affordable broadband programs, in recognition of the significant role that libraries and other community anchor institutions play in promoting digital access and inclusion.[1343] The Commission's and Institute of Museum and Library

[1333] *Promoting Fair and Open Competitive Bidding in the E-Rate Program*, WC Docket No. 21-455, Notice of Proposed Rulemaking, FCC 21-124, at 1, para. 1 (Dec. 16, 2021), https://docs fcc.gov/public/attachments/FCC-21-124A1.pdf.

[1334] *Id.* at 1-2, para. 2.

[1335] *Id.* at 2, para. 3.

[1336] *Id.* at 6-14, paras. 11-36.

[1337] *Schools and Libraries Universal Service Support Mechanism*, CC Docket No. 02-6, Report and Order, FCC 22-8, at 1, para. 1 (2022), https://docs.fcc.gov/public/attachments/FCC-22-8A1.pdf.

[1338] *Id.* at 1, para. 1.

[1339] *Id.* at 2-3, para. 5.

[1340] *Id.* at 3-6, paras. 7-13.

[1341] *See Request for Waiver by Alaska Federation of Natives*, CC Docket No. 02-6, Order, DA 22-231, at 3-4, para. 8 (WCB Mar. 22, 2022), https://docs fcc.gov/public/attachments/DA-22-231A1.pdf (directing USAC to treat as timely filed all applications with a new Tribal library as a recipient of service that are filed within 65 days of the application filing window deadline, or by May 26, 2022).

[1342] FCC, Press Release, FCC and Institute of Museum and Library Services Sign Agreement to Promote Broadband Access (June 24, 2022), https://docs fcc.gov/public/attachments/DOC-384621A1.pdf.

[1343] *Id.*; Infrastructure Act, § 60104(c).

Services' coordination will also focus on communities where broadband access has been especially challenging such as rural and Tribal areas.[1344]

453. *Rural Health Care Program.* On February 22, 2022, the Commission proposed and sought comment on several revisions to the Commission's Rural Health Care (RHC) Program rules designed to ensure that rural healthcare providers receive funding necessary for broadband and telecommunications services to provide vital healthcare services, while limiting costly inefficiencies and the potential for waste, fraud, and abuse.[1345] The RHC Program provides vital support to assist rural health care providers with the costs of broadband and other communications services.[1346] The Commission took this action in an effort to improve the accuracy and fairness of RHC Program support and increase the efficiency of program administration.[1347] In addition, WCB waived the mechanism for funding that was planned to go into effect out of concerns that the mechanism provided insufficient support.[1348]

454. *Connected Care Pilot Program*. The Connected Care Pilot Program was established to provide up to $100 million in USF support to help eligible health care providers defray the costs of providing connected care services to their patients and study how the USF can help support the continuing trend toward connected care services, with an emphasis on providing connected care services to low-income and veteran patients.[1349] On June 21, 2021, the Commission released an Order providing further guidance on the administration of the Pilot Program, including guidance on eligible services, competitive bidding, invoicing, and data reporting for selected participants.[1350] From January 2021 to March 2022, the Commission selected 107 projects to receive funding through the program.[1351] The projects selected by the Commission represent a broad array of geographic areas and a diversity of provider types, involve patients in underserved communities, and will address a range of health conditions.[1352]

455. *Interagency Information Sharing and Coordination*. The Commission and the U.S. Department of Agriculture's (USDA) Rural Utilities Service (RUS) began coordinating on broadband funding as early as 2014, when the agencies entered into a Memorandum of Understanding that governs sharing information on their respective funding programs. Pursuant to the 2014 Memorandum of Understanding, the Commission and RUS have maintained an ongoing dialogue at the staff- and leadership levels to avoid duplication and coordinate their broadband funding efforts. In early 2021, the Commission, the National Telecommunications and Information Administration (NTIA) and USDA/RUS

[1344] FCC, Press Release, FCC and Institute of Museum and Library Services Sign Agreement to Promote Broadband Access (June 24, 2022), https://docs fcc.gov/public/attachments/DOC-384621A1.pdf; Infrastructure Act, § 60104(c).

[1345] *Promoting Telehealth in Rural America*, WC Docket No. 17-310, Further Notice of Proposed Rulemaking, FCC 22-15 (Feb. 22, 2022), https://docs fcc.gov/public/attachments/FCC-22-15A1.pdf.

[1346] *Id.* at 1, para. 1.

[1347] *Id*. at 2, para. 1.

[1348] *Promoting Telehealth in Rural America Order*, 36 FCC Rcd 7051; *Promoting Telehealth in Rural America*, WC Docket No. 17-310, Order, 36 FCC Rcd 791 (WCB 2021); *Promoting Telehealth in Rural America*, WC Docket No. 17-310, Order, DA 22-401 (WCB Apr. 12, 2022); *Promoting Telehealth in Rural America*, WC Docket No. 17-310, Order, DA 22-580 (WCB May 25, 2022).

[1349] *Federal Communications Commission Announces Final Set of Projects Selected for the Connected Care Program*, WC Docket No. 18-213, Public Notice, DA 22-23, at 1, para. 1 (WCB Mar. 17, 2022) (*Final Set of Projects for Connected Care Program Public Notice*).

[1350] *Promoting Telehealth for Low Income Consumers*, WC Docket No. 18-213, Second Report and Order, 36 FCC Rcd 10642, 10643, para. 1 (2021).

[1351] FCC, Press Release, FCC Announces Final Group of Approved Projects for Connected Care Pilot Program (Mar. 16, 2022), https://www fcc.gov/document/fcc-announces-final-group-connected-care-pilot-program-projects.

[1352] *Final Set of Projects for Connected Care Program Public Notice* at 1, para. 2.

began regular meetings to facilitate coordination as they implemented the existing broadband funding programs, as well as new funding programs established by Congress in the Consolidated Appropriation Act, 2021.[1353] The Consolidated Appropriations Act, 2021 included the Broadband Interagency Coordination Act of 2020, which required the Commission, USDA and NTIA to enter into an interagency agreement to coordinate for the distribution of funds for broadband deployment and to share information about existing or planned projects receiving funding in their respective programs.[1354] In June 2021, the Commission entered into the required agreement with USDA and NTIA to share information about and coordinate the distribution of federal broadband deployment funds.[1355] Specifically, under the agreement, the agencies will consult with one another and share information about the distribution of new funds from the Commission's high-cost programs that support broadband buildout in rural areas, the RUS grant and loan programs, and programs administered or coordinated by NTIA. Recognizing the importance of a comprehensive approach to federal broadband funding, in May 2022, the Commission, USDA and NTIA entered into an agreement with the U.S. Department of Treasury (Treasury) to share information about and collaborate regarding the collections and reporting of certain data and metrics relating to broadband deployment, including deployment funded by Treasury-administered programs.[1356] This agreement provides that the agencies will consult with one another and share information on data collected from programs administered by the Commission and the USDA's Rural Utilities Service, programs administered or coordinated by NTIA, and Treasury's Coronavirus Capital Projects Fund and the Coronavirus State and Local Fiscal Recovery Funds.

456. *Future of the USF Report*. As directed by Congress in Section 60104(c) of the Infrastructure Act, the Commission released a report on August 15, 2022 evaluating the implications of federal investments in broadband in the Infrastructure Act and other recent legislation on how the Commission should achieve its universal service goals for broadband.[1357] In the *Future of the USF Report*, the Commission established as goals universal deployment, affordability, adoption, availability, and equitable access to broadband throughout the United States.[1358] The Commission also made recommendations for further actions by the Commission and Congress to improve the ability of the Commission to achieve its goals[1359] and addressed arguments concerning the lawfulness of the USF.[1360]

457. *Multiple Tenant Environments*. Millions of people work and live in multiple tenant environments (MTEs), with a third of Americans residing in apartments, condominiums, or other

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[1353] *See, e.g.*, Consolidated Appropriations Act, 2021, Pub. L. No. 116-260, 134 Stat. 1182, 2138, 2139, div. N, tit. IX, § 905(c) (establishing the Tribal Broadband Connectivity Program) and § 905(d) (establishing the Broadband Infrastructure Program) (2020)).

[1354] *Id.*, 134 Stat. at 3214, div. FF, tit. IX, § 904.

[1355] Interagency Agreement Between the Federal Communications Commission, U.S. Department of Agriculture, and the National Telecommunications and Information Administration of the U.S. Department of Congress (June 25, 2021), https://www fcc.gov/document/fcc-ntia-usda-sign-interagency-pact-broadband-funding-deployment.

[1356] Memorandum of Understanding Regarding Information Sharing, dated as of May 9, 2022, between the Federal Communications Commission, U.S. Department of Agriculture, the National Telecommunications and Information Administration of the U.S. Department of Commerce, and the U.S. Department of the Treasury (May 11, 2022), https://docs.fcc.gov/public/attachments/DOC-383278A1.pdf.

[1357] *Future of the USF Report*.

[1358] *Id.* at 6-8, paras. 11-16.

[1359] *Id.* at 12-54, paras. 27-111. Specifically in regard to its goal of affordability, the Commission made recommendations for further actions by the Commission and Congress related to the Lifeline program and the Affordable Connectivity Program. *Id.* at 29-40, paras. 55-74.

[1360] *Id.* at 54-58, paras. 112-19.

multiunit buildings.[1361] To ensure competitive choice of communications services for those living and working in MTEs, and to address practices that undermine longstanding rules promoting competition in MTEs, on February 15, 2022, the Commission took three specific actions.[1362] First, the Commission adopted new rules prohibiting providers from entering into certain types of revenue sharing agreements that are used to evade the Commission's existing rules.[1363] Second, the Commission adopted new rules requiring providers to disclose the existence of exclusive marketing arrangements in simple, easy-to-understand language.[1364] Third, the Commission clarified that existing Commission rules regarding cable inside wiring prohibit so-called "sale-and-leaseback" arrangements, which effectively deny access to alternative providers.[1365] In taking these actions, the Commission sought to promote tenant choice and competition in the provision of communications services to the benefit of those who live and work in MTEs.[1366]

458. *Combating Digital Discrimination*. One of the Commission's foremost goals is to ensure that every person in the United States has equal access to high-quality, affordable broadband internet access service.[1367] Among many steps towards achieving that goal, in February 2022 Chairwoman Rosenworcel established the cross-agency Task Force to Prevent Digital Discrimination.[1368] On March 17, 2022, the Commission commenced a proceeding "to ensure that all people of the United States benefit from equal access to broadband internet access service," with the intention of preventing and identifying steps the Commission should take to eliminate "digital discrimination of access based on income level, race, ethnicity, color, religion, or national origin," consistent with Congress's directive in section 60506 of the Infrastructure Investment and Jobs Act (Infrastructure Act).[1369] In a Notice of Inquiry focusing on the requirements encompassed in section 60506, the Commission sought comment on the meaning of the terms and concepts included in the relevant provisions and how they should be applied in the context of facilitating equal access to broadband, preventing digital discrimination, and identifying steps the Commission should take to eliminate digital discrimination.[1370] The Commission also sought comment on the framework of the rules it should adopt to achieve the goal of ensuring all people in the United States have equal access to broadband regardless of "income level, race, ethnicity, color, religion, or national origin."[1371] On December 21, 2022, the Commission adopted a Notice of Proposed Rulemaking proposing and seeking comment on possible definitions of "digital discrimination of access" as used in the Infrastructure Act and seeking comment on the rule or rules we should adopt to prevent digital

[1361] *Improving Competitive Broadband Access to Multiple Tenant Environments*, GN Docket 17-142, Report and Order and Declaratory Ruling, FCC 22-12, at 2, para. 1 (Feb. 15, 2022), https://docs.fcc.gov/public/attachments/FCC-22-12A1.pdf.

[1362] *Id.* at 2, para. 2.

[1363] *Id.* at 9-14, paras. 16-26.

[1364] *Id.* at 17-22, paras. 33-42.

[1365] *Id.* at 24-29, paras. 47-60.

[1366] *Id.* at 3, para. 2.

[1367] *Implementing the Infrastructure Investment and Jobs Act: Prevention and Elimination of Digital Discrimination*, GN Docket No. 22-69, Notice of Inquiry, FCC 22-21, at 1, para. 1 (Mar. 17, 2022) (*Digital Discrimination NOI*), https://docs.fcc.gov/public/attachments/FCC-22-21A1.pdf.

[1368] FCC, Press Release, Chairwoman Rosenworcel Announces Cross-Agency Task Force to Prevent Digital Discrimination (Feb. 8, 2022), https://docs.fcc.gov/public/attachments/DOC-380060A1.pdf.

[1369] *Digital Discrimination NOI* at 1-2, para. 2 (quoting the Infrastructure Investment and Jobs Act, Pub. L. No. 117-58, 135 Stat. 429 (2021)). Section 60506 of the Infrastructure Act is codified at 47 U.S.C. § 1754, Digital Discrimination.

[1370] *Id.* at 5-12, paras. 10-28.

[1371] *Id.* at 13-14, paras. 29-33.

discrimination of access, as required by Congress.[1372] Further, as directed by the Infrastructure Act, the Commission proposed to revise our informal consumer complaint process to accept complaints of digital discrimination, and proposed to adopt model policies and best practices for states and localities combating digital discrimination (the Commission sought a recommendation from the Communications Equity and Diversity Council, a Federal Advisory Committee, to assist in this process).[1373]

459. *Pole Attachments*. In January 2021, WCB issued the *Pole Replacement Declaratory Ruling*, clarifying that it is unreasonable and inconsistent with section 224 of the Communications Act, the Commission's rules, and past Commission precedent, for utilities to impose the entire cost of a pole replacement on a requesting attacher when the attacher is not the sole cause of a pole replacement.[1374] Following this decision, on March 18, 2022, the Commission released a Further Notice of Proposed Rulemaking that sought comment on whether additional reforms to the Commission's pole attachment rules are necessary to facilitate broadband deployment, with a particular focus on the role of pole replacements in new broadband deployments.[1375] The Commission also sought comment on whether it should require utilities to share information with potential attachers concerning the condition and replacement status of their poles and other measures that may help avoid or expedite the resolution of disputes between the parties.[1376]

460. *Access Stimulation*. The Commission also proposed to adopt rules that would modify the intercarrier compensation regime to address ongoing harmful arbitrage practices that raise costs for long-distance carriers and their customers and, as the Commission has recognized in the past, divert funds away from network investment.[1377] In July 2022, the Commission adopted a Further Notice of Proposed Rulemaking seeking comment on proposed changes to its access stimulation rules to ensure that they apply to traffic that terminates through providers of IP-enabled services.[1378] The Commission proposed to require these providers to count and report their terminating-to-originating call traffic ratios to the Commission to determine compliance with the access stimulation rules.[1379]

461. *Calling Services for Incarcerated People*. Access to affordable communications services is critical for everyone in the United States, especially for incarcerated people whose primary or only communications option is to purchase telephone service from providers that typically operate on a monopoly basis. In May 2021, the Commission lowered the interim rate caps on interstate inmate calling services, established caps on international calling services rates for the first time, reformed the ancillary charge rules for third-party financial transaction fees, and adopted a new mandatory data collection to

[1372] *Implementing the Infrastructure Investment and Jobs Act: Prevention and Elimination of Digital Discrimination*, GN Docket No. 22-69, Notice of Proposed Rulemaking, FCC 22-98, at 5-31, 34-50, paras. 12-51, 58-92 (Dec. 22, 2022), https://docs fcc.gov/public/attachments/FCC-22-98A1.pdf.

[1373] *Id.* at 31-34, 50-52, paras. 52-57, 93-96.

[1374] *Accelerating Wireline Broadband Deployment by Removing Barriers to Infrastructure Investment*, WC Docket No. 17-84, Declaratory Ruling, 36 FCC Rcd 776 (WCB 2021).

[1375] *Accelerating Wireline Broadband Deployment by Removing Barriers to Infrastructure Investment*, WC Docket No. 17-84, Second Further Notice of Proposed Rulemaking, FCC 22-20, at 15-22, paras. 27-34 (Mar. 18, 2022), https://docs.fcc.gov/public/attachments/FCC-22-20A1.pdf.

[1376] *Id.* at 11-15, paras. 19-26.

[1377] *See USF/ICC Transformation Report and Order and Further Notice*, 26 FCC Rcd at 17875, para. 663, *aff'd*, *In re* FCC 11-161, 753 F.3d 1015 (10th Cir. 2014) ("Access stimulation imposes undue costs on consumers, inefficiently diverting capital away from more productive uses such as broadband deployment.").

[1378] *Updating the Intercarrier Compensation Regime to Eliminate Access Arbitrage*, WC Docket No. 18-55, Further Notice of Proposed Rulemaking, FCC 22-54 (July 15, 2022).

[1379] *Id.* at 6-22, paras. 10-56.

gather data to set permanent interstate and international rates caps.[1380] In September 2022, the Commission improved communications access for incarcerated people with communications disabilities by requiring calling services providers to provide access to all relay services eligible for Telecommunications Relay Services fund support in any correctional facility that is located where broadband is available and is part of a correctional system that houses 50 or more incarcerated people. The Commission also restricted provider charges for relay services and point-to-point video calls, and adopted rules requiring the refund of unused consumer balances, among other reforms.[1381] Also in September 2022, the Commission adopted a Further Notice of Proposed Rulemaking seeking comment on additional actions to make telephone service for all incarcerated individuals more equitable and affordable.[1382]

B. The Mobile Wireless Marketplace

462. *Broadband Deployment and Universal Access*. The Commission has continued its work to ensure universal access to mobile services and evaluate the status of broadband deployment since the release of the *2020 Communications Marketplace Report*. In January 2021, as noted above, the Commission adopted a Third Report and Order that took key additional steps to ensure that both the new data collection itself, and the measures for verifying the accuracy of the data collected, will yield a robust and reliable data resource for the Commission, Congress, federal and state policymakers, and consumers to evaluate the status of broadband deployment throughout the United States.[1383] For mobile services, the Commission required additional information regarding provider networks and propagation, which will allow the Commission to verify provider data more effectively.[1384] The order also established the requirements for challenges to mobile service coverage reporting and for challenges to the Fabric data.[1385]

463. In July 2021, the Chiefs of WTB, OEA, and OET released the *BDC Mobile Technical Requirements Public Notice* seeking comment on proposed technical requirements for the mobile challenge, verification, and crowdsourcing processes required under the Broadband DATA Act.[1386] In March 2022, the proposed processes and methodology set forth in the public notice for collecting challenge process data and for determining when the threshold to create a cognizable challenge has been met were adopted.[1387] In addition, the Bureaus and Offices adopted detailed processes for mobile providers to respond to challenges, for the Commission to initiate a verification request to a mobile service provider, and for mobile providers to respond to verification requests to confirm broadband coverage in areas they claim have service.[1388] Further, the order provided a technical appendix that set forth the parameters and metrics that must be collected both for on-the-ground test data to support

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[1380] *Rates for Interstate Inmate Calling Services*, WC Docket No. 12-375, Third Report and Order, Order on Reconsideration, and Fifth Further Notice of Proposed Rulemaking, 36 FCC Rcd 9519 (2021).

[1381] *Rates for Interstate Inmate Calling Services*, WC Docket No. 12-375, Fourth Report and Order and Sixth Further Notice of Proposed Rulemaking, FCC 22-76, at 8-43, paras. 19-92 (Sept. 30, 2022) (*Rates for Interstate Inmate Calling Services Fourth Report and Order*).

[1382] *Id.* at 43-65, paras. 93-162.

[1383] *BDC Third Report and Order*, 36 FCC Rcd at 1127, para. 2.

[1384] *See Id.* at 1130, para. 9.

[1385] *Id.* at 1130, para. 9.

[1386] *Comment Sought on Technical Requirements for the Mobile Challenge, Verification, and Crowdsource Processes Required Under the Broadband Data Act*, WC Docket No. 19-195, Public Notice, 36 FCC Rcd 11196 (WTB/OEA/OET 2021) (*BDC Mobile Technical Requirements Public Notice*).

[1387] *BDC Mobile Technical Requirements Order* at 2, para. 2.

[1388] *Id*.

challenge submissions, rebuttals to cognizable challenges, and responses to verification requests, and for infrastructure information to support challenge rebuttals and responses to verification requests.[1389]

464. In May 2022, the Task Force, WTB, WCB, OEA, and OET sought comment on a petition filed by the Competitive Carriers Association (CCA) seeking clarification or waiver of the engineering certification requirements for BDC filings.[1390] On July 8, 2022, the Task Force and Bureaus and Offices, responding to CCA's petition, issued a Declaratory Ruling and Limited Waiver regarding the requirement that a corporate engineering officer or certified professional engineer certify providers' BDC filings.[1391] The Declaratory Ruling clarified that a corporate engineering officer means a corporate officer that has at least a Bachelor of Science in engineering (BSE) degree and has direct knowledge of, and responsibility for, the carrier's network design and construction.[1392] The Limited Waiver allows, for the first three BDC bi-annual filing cycles, BDC submissions to be certified by an "otherwise qualified engineer," which means an engineer with either "(i) a bachelor's or postgraduate degree in electrical engineering, electronic technology, or another similar discipline, and at least seven years of relevant experience in broadband network design and/or performance; or (ii) specialized training relevant to broadband network engineering and design, deployment, and/or performance, and at least ten years of relevant experience in broadband network engineering, design, and/or performance."[1393]

465. On September 15, 2022, the Task Force, together with the WTB, OET, and OEA, released a public notice establishing procedures for mobile wireless broadband service providers, governmental entities, and other third parties that use their own hardware and software to submit on-the-ground speed test data in connection with as part of the mobile challenge and verification processes as part of the BDC.[1394] The public notice announces that if a mobile provider uses hardware and software other than the FCC Speed Test app or a third-party speed test app approved by OET for use in the mobile challenge process, it must incorporate the test methodology and collect the metrics that OET-approved apps must gather for consumer mobile challenges and that governmental and third-party challenger speed test data must contain.[1395] The public notice also establishes a procedure by which entities submitting mobile challenges and mobile providers responding to mobile challenges will disclose their methodology for collecting on-the-ground data.[1396]

466. The Commission has also continued its work to ensure that mobile providers meet their commitments to serve remote Alaska in exchange for receiving high-cost support under the Alaska Plan.

[1389] *Id*.

[1390] *Broadband Data Task Force, Wireless Telecommunications Bureau, Wireline Competition Bureau, and Office of Economics and Analytics Seek Comment on Competitive Carriers Association Petition for Declaratory Ruling or Limited Waiver Regarding the Requirement for a Certified Professional Engineer to Certify Broadband Data Collection Maps*, WC Docket No. 19-195, Public Notice, DA 22-543 (May 17, 2022); Petition of Competitive Carriers Association (CCA) for Declaratory Ruling or Limited Waiver, WC Docket No. 19-195 (filed May 13, 2022), https://www fcc.gov/ecfs/search/search-filings/filing/1051393345823.

[1391] *Establishing the Digital Opportunity Data Collection; Competitive Carriers Association Petition for Declaratory Ruling or Limited Waiver Regarding the Requirement for a Certified Professional Engineer to Certify Broadband Data Collection Maps*, WC Docket No. 19-195, Declaratory Ruling and Limited Waiver, DA 22-733 (July 8, 2022) (*BDC Declaratory Ruling and Limited Waiver*).

[1392] *BDC Declaratory Ruling and Limited Waiver* at 3-4, para. 6.

[1393] *Id.*

[1394] *Broadband Data Task Force Establishes Process for Entities to Use Their Own Software and Hardware to Collect On-The-Ground Mobile Speed Test Data as Part of the Broadband Data Collection*, WC Docket No. 19-195, Public Notice, DA 22-962 (Sept. 15, 2022) (*BDC Software and Hardware Process Public Notice*).

[1395] *BDC Software and Hardware Process Public Notice* at 2, para. 5.

[1396] *Id.* at 3, para. 6.

Due to the unique challenges of providing communications services in remote Alaska, the Commission adopted the *Alaska Plan Report and Order* in 2016, as a ten-year plan to ensure eligible remote areas were able to receive advanced communications services.[1397] This order required mobile service provider participants to submit performance plans committing to cover a specific number of Alaskans by specified last-mile mobile technology subject to middle-mile technology available.[1398] The *Alaska Plan Report and Order* also required each mobile service provider participant to certify that it met the obligations contained in its performance plan by the end of year five (ending December 31, 2021) and the end of year ten (ending December 31, 2026).[1399]

467. The *Alaska Plan Report and Order* required mobile provider participants receiving more than $5 million annually in Alaska Plan high-cost funding to support their certifications with drive test data.[1400] After seeking comment on a drive test model,[1401] in May of this year, WTB released an Order and Request for Comment adopting drive-test parameters and a model for the drive tests that are required under the Alaska Plan.[1402] WTB will use the data derived from these drive tests, combined with FCC Form 477 coverage data and complementary middle-mile data, to verify that those mobile providers receiving more than $5 million annually have met their commitments.[1403] WTB also sought comment on a proposal to require mobile provider participants subject to the drive-test requirement to submit new drive-test data consistent with the drive-test model and parameters if they fail to meet a buildout milestone and later seek to cure a compliance gap.[1404]

468. While the drive-test data were initially due in March 2022, WTB adopted an order in November 2021 that extended the deadline for the providers to submit drive test data to September 30, 2022.[1405] In July of this year, to address concerns of testing burdens, WTB adopted a waiver order to allow the mobile providers subject to the Alaska Plan's drive-test requirement to test certain specified roadless grid cells, which was determined based on the criteria set forth in the order, using nearby proxy grid cells chosen by WTB with the specifications outlined in the order.[1406]

469. After Hurricanes Irma and Maria caused extensive damage to Puerto Rico and the U.S. Virgin Islands in September 2017, the Commission created a multi-stage fund for the repair, hardening, and upgrading of the communications networks on those islands,[1407] and Stage 2 of the fund allocated

[1397] *Connect America Fund et al.*, WC Docket No. 16-271, Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd 10139, 10140, para. 1 (2016) (*Alaska Plan Report and Order and Further Notice*).

[1398] *Alaska Plan Report and Order and Further Notice*, 31 FCC Rcd at 10166, 10172-73, paras. 85, 102.

[1399] *Id.* at 10166-67, 10173, paras. 85, 103; *see also* 47 CFR § 54.321; *Connect America Fund—Alaska Plan*, WC Docket No. 16-271, Order and Request for Comment, DA 22-484, at 3, 6, paras. 4, 9 (WTB May 5, 2022) (*Alaska Drive Test Order*).

[1400] *Alaska Plan Report and Order and Further Notice*, 31 FCC Rcd at 10173, para. 103.

[1401] *Wireless Telecommunications Bureau Seeks Comment on Drive Test Parameters and Model for Alaska Plan Participants*, WC Docket No. 16-271, Public Notice, 36 FCC Rcd 11279 (WTB 2021).

[1402] *Alaska Drive Test Order* at 2, para. 1.

[1403] *Alaska Drive Test Order* at 3, 6, paras. 4, 9; *see also* 47 CFR § 54.321; *Alaska Plan Report and Order and Further Notice*, 31 FCC Rcd at 10166-67, 10173, paras. 85, 103.

[1404] *Id.* at 2, para. 1.

[1405] *Connect America Fund—Alaska Plan*, WC Docket No. 16-271, Order, DA 21-1394 (WTB Nov. 8, 2021).

[1406] *Connect America Fund—Alaska Plan*, WC Docket No. 16-271, Order, DA 22-755 (WTB July 13, 2022).

[1407] *See Uniendo a Puerto Rico Fund and the Connect USVI Fund; Connect America Fund; ETC Annual Reports and Certifications*, WC Docket Nos. 18-143, 10-90, 14-58, Report and Order and Order on Reconsideration, 34 FCC Rcd 9109, 9110, paras. 1-3 (2019) (*PR-USVI Stage 2 Report and Order*).

more than $250 million over three years for mobile services.[1408] In April 2022, T-Mobile, one of the recipients of the Stage 2 mobile-service funds, petitioned the Commission to declare that Stage 2 funds could be used for DAS, which would provide mobile services solely within buildings, such as hospitals.[1409] In July 2022, WCB, in consultation with WTB, acting under its delegated authority, adopted a Declaratory Ruling clarifying that Stage 2 funds are presumptively appropriate for deploying DAS to public or publicly accessible facilities that aid disaster response where the market would otherwise not support DAS deployment.[1410] The Ruling also clarified that "[f]or an indoor DAS deployment to be constructed consistent with the *PR-USVI Stage 2 Report and Order*, it must be capable of remaining operational independent of the communications network outside the building; otherwise, the DAS network would not be adding any hardening benefit to what the surrounding mobile service would provide during a disaster."[1411] Providers must also certify that the DAS deployments constructed with Stage 2 funds meet the Commission's minimum performance requirements for 4G LTE or 5G service.[1412]

470. *Spectrum Policies*. Congress requires that the Commission implement spectrum policies that promote competition, innovation, and the efficient use of spectrum to serve the public interest, convenience, and necessity.[1413] Therefore, the Commission has established policies to make spectrum available to mobile providers and new entrants through initial licensing, primarily by competitive bidding,[1414] and through secondary market transactions.[1415] The Commission has worked vigorously to make spectrum available in the low-, mid-, and high-frequency bands for mobile providers to develop and deploy new technologies like 5G[1416] and support existing 4G LTE networks.[1417]

[1408] *PR-USVI Stage 2 Report and Order*, 34 FCC Rcd at 9110, para. 3.

[1409] Petition of T-Mobile USA, Inc. for Declaratory Ruling, WC Docket No. 18-143, at 1, 7 (filed Apr. 7, 2022); *Uniendo a Puerto Rico Fund and the Connect USVI Fund; Connect America Fund*, WC Docket Nos. 18-143 and 10-90, Declaratory Ruling, DA 22-719, at 2 & n.12 (WCB July 6, 2022) (*PR/USVI DAS Declaratory Ruling*).

[1410] *PR/USVI DAS Declaratory Ruling* at 4-5, paras. 9-10.

[1411] *Id.* at 5-6, para. 12.

[1412] *Id.* at 6-7, para. 15.

[1413] 47 U.S.C. § 309(j)(3)(B).

[1414] The Commission generally provides a bidding credit—or discount—to promote participation by small businesses and rural service providers, including businesses owned by members of minority groups and women. 47 U.S.C. § 309(j)(3)(B), (j)(4)(D); *see also* 47 CFR § 1.2110; *Updating Part 1 Competitive Bidding Rules et al.*, WT Docket No. 14-170 et al., Report and Order, Order on Reconsideration of the First Report and Order, Third Order on Reconsideration of the Second Report and Order, and Third Report and Order, 30 FCC Rcd 7493 (2015) (modified by *erratum*, Aug. 25, 2015).

[1415] *Mobile Spectrum Holdings Report and Order*, 29 FCC Rcd at 6143-44, 6167-68, 6190, 6193, 6221-22, 6223-24, paras. 17, 67-69, 135, 144, 225-27, 231-32. The Commission generally has adopted "flexible use" policies, thereby allowing licensees to decide which services to offer and what technologies to deploy on spectrum used for the provision of mobile wireless services.

[1416] CTIA states that since wireless operators first launched 5G service in 2019, three nationwide networks—and regional provider networks across the United States—already cover more than 300 million Americans, up from 200 million last year. CTIA Comments at iii, 10-11. CTIA asserts that 5G has the potential to impact nearly every industry vertical, such as transportation, manufacturing, agriculture, education, retail, healthcare, energy, home and consumer goods, and information services. CTIA Comments at 29-36; *see also* CTA Comments at 5-10 (stating that competition and innovation continue to thrive in other consumer technology verticals, such as telemedicine and health, smart homes, transportation, and robotics).

[1417] According to CTIA, in 2020, 99% of Americans had a choice of obtaining 4G LTE service from three or more wireless providers from among national operators and more than 100 regional operators, including resellers and MVNOs. *See* CTIA Comments at iv, 10-11.

471. In particular, over the past two years, the Commission has pursued a comprehensive strategy to make available more mid-band spectrum,[1418] which is uniquely suited for 5G deployment because of its favorable technical characteristics. In February 2021, the Commission concluded Auction 107, which is thus far the largest auction of mid-band spectrum and the highest-grossing spectrum auction overall ever held in the United States.[1419] This auction, which commenced on December 8, 2020, made available new flexible-use overlay licenses in the 3.7-3.98 GHz band (C-band) for 280 megahertz of spectrum or more than half of the C-band.[1420] By repacking existing satellite operations into the upper 200 megahertz of the C-band, the Commission is making a significant amount of spectrum available for flexible terrestrial use throughout the contiguous United States in a manner that ensures the continuous and uninterrupted delivery of services currently offered in the band.[1421] This auction's net winning bids exceeded $81.1 billion, with 21 bidders winning all of the available 5,684 licenses.[1422]

472. In March 2021, the Commission released an order that also took steps to advance the Commission's objectives to make more mid-band spectrum available for 5G.[1423] The order continued the implementation of the Beat China by Harnessing Important, National Airwaves for 5G Act of 2020, which required the Commission to start an auction to grant new initial licenses subject to flexible use in the 3450-3550 MHz (3.45 GHz) band by the end of 2021.[1424] The order adopted a framework that will enable full-power commercial use[1425] of this band and require that future licensees deploy their networks quickly.[1426] In January 2022, bidding in that auction (Auction 110) concluded following the close of bidding in the assignment phase.[1427] The net proceeds of Auction 110 exceeded $22.4 billion with 23 bidders winning a total of 4,041 licenses.[1428] Collectively, the 3.45 GHz band and the neighboring 3.5 GHz and 3.7 GHz bands will offer 530 megahertz of contiguous mid-band spectrum for 5G services.[1429]

[1418] *See, e.g.*, CCA Comments at 11 (asserting that the Commission has made important progress recently in developing mid-band spectrum, such as the 3.45 GHz band and the 3.7 GHz band).

[1419] *Auction 107 Closing Public Notice*, 36 FCC Rcd at 4318; FCC, Press Release, First Phase of Record-Breaking 5G Spectrum Auction Concludes (Jan. 15, 2021), https://docs.fcc.gov/public/attachments/DOC-369265A1.pdf.

[1420] *Auction 107 Closing Public Notice*, 36 FCC Rcd at 4318, para. 1; *3.7 GHz Report and Order*, 35 FCC Rcd at 2345, para. 4.

[1421] *3.7 GHz Report and Order*, 35 FCC Rcd at 2345, para. 4.

[1422] *Auction 107 Closing Public Notice*, 36 FCC Rcd at 4318, para. 1. CTIA states that in the last three years alone, the wireless industry invested more than $108 billion in Commission-led spectrum auctions, pointing to this C-band auction as representing the largest investment in a spectrum auction to date. CTIA further states that, in total, the industry has made more than $230 billion in payments to the government for the spectrum needed to power wireless networks and carry the increasing volumes of consumer services across the country. CTIA Comments at 9-10; *see also* CCA Comments at 11-12.

[1423] *3.45 GHz Second Report and Order*, 36 FCC Rcd at 5987.

[1424] *Id.* at 5988, para. 1. In CTIA's comments, it states that mid-band spectrum is a key factor for 5G because it provides high speeds over a broad coverage area and asserts that the lower 3 GHz band (3.1-3.45 GHz) is a top priority for U.S. wireless interests. CTIA notes that these frequencies are internationally harmonized and sit next to other full-power 5G spectrum, making this swath an ideal fit to provide large channels and the flexibility to be aggregated with other bands. CTIA Comments at 61.

[1425] Commercial use as it is used here refers to non-federal, primary, flexible use of the 3.45 GHz band and do not preclude use of the band for private mobile radio services. *3.45 GHz Second Report and Order*, 36 FCC Rcd at 5988, para. 1 & n.1; *see also* 47 U.S.C. § 332(d)(3); 47 CFR § 20.3.

[1426] *3.45 GHz Second Report and Order*, 36 FCC Rcd at 5988, para. 1.

[1427] *Auction 110 Closing Public Notice* at 1, para. 1.

[1428] *Id.* at 1, para. 1.

[1429] *3.45 GHz Second Report and Order*, 36 FCC Rcd at 5988, para. 1.

Within the last two years, WTB granted licenses in all three of these bands, and the 3.5 GHz band is also available for opportunistic use.[1430] All three of these bands are available for fixed and mobile use.[1431]

473. In July 2022, the Commission began the bidding in the auction of mid-band 2.5 GHz band licenses (Auction 108).[1432] Auction 108 offered the single largest contiguous portion of available mid-band spectrum below 3 GHz, and the licenses made available in this auction will help extend 5G service beyond the most populated areas.[1433] This auction made available approximately 8,000 new flexible-use geographic overlay licenses in the 2.5 GHz band, mostly in rural areas.[1434] Bidding in the auction concluded on August 29, 2022, with 63 bidders winning a total of 7,872 licenses and total net winning bids exceeding $419 million.[1435]

474. The Commission conducted Auction 108 in accordance with the July 2019 *2.5 GHz Report and Order*, which transformed the regulatory framework governing the 2.5 GHz band.[1436] The *2.5 GHz Report and Order* included a pre-auction priority window for Tribal Nations to apply to obtain the unassigned spectrum on rural Tribal lands to address the needs of their communities.[1437] To further the goal of ensuring that this fallow spectrum be used to provide high-speed broadband service, particularly in rural areas, the auction offered county-sized licenses for the remaining spectrum in this band to entities that will use it, therefore making this valuable mid-band spectrum more available for advanced wireless services, including 5G.[1438]

475. The Commission has continued taking steps to sustain and spur growth of the white space ecosystem promoting innovative and efficient uses of spectrum. In January 2022, the Commission adopted two orders resolving pending issues associated with white space devices and the white spaces databases.[1439] These actions will provide additional certainty to white space device users, manufacturers,

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1430 *See, e.g.*, *Wireless Telecommunications Bureau Grants Auction 110 Licenses*, Public Notice, DA 22-462 (WTB May 4, 2022); *Wireless Telecommunications Bureau Grants Auction 107 Licenses*, Public Notice, DA 21-839 (WTB July 23, 2021); *Wireless Telecommunications Bureau Grants Auction 103 Priority Access Licenses*, Public Notice, DA 21-300 (WTB Mar. 12, 2021); *see also Promoting Investment in the 3550-3700 MHz Band*, GN Docket No. 17-258, Report and Order, 33 FCC Rcd 10598, 10628, para. 53 (2018) (*3.5 GHz Report and Order*); 47 CFR § 96.33, 96.35.

1431 *See, e.g.*, *3.45 GHz Second Report and Order*, 36 FCC Rcd at 5988, para. 1; *3.7 GHz Report and Order*, 35 FCC Rcd at 2353, para. 22; *3.5 GHz Report and Order*, 33 FCC Rcd at 10598-99, paras. 1-2.

1432 FCC, Press Release, FCC Starts 5G Mid-Band Spectrum Auction (July 29, 2022), https://docs.fcc.gov/public/attachments/DOC-385771A1.pdf.

1433 *Auction 108 Procedures Public Notice* at 3, para. 1.

1434 *Id*.

1435 *Auction 108 Closing Public Notice* at 1, para. 1.

1436 *2.5 GHz Report and Order*, 34 FCC Rcd at 5447, para. 3.

1437 *Id.* at 5463-69, paras. 47-65.

1438 *Id.* at 5450, para. 13.

1439 *Amendment of Part 15 of the Commission's Rules for Unlicensed Operations in the Television Bands, Repurposed 600 MHz Band, 600 MHz Guard Bands and Duplex Gap, and Channel 37, et al*., ET Docket No. 14-165, et al., Second Order of Reconsideration, Further Notice of Proposed Rulemaking, and Order, FCC 22-6, at 2, para. 1 (Jan. 26, 2022) (*White Space Devices Order*); *see also Unlicensed White Space Device Operations in the Television Bands*, ET Docket No. 20-36, Report and Order, 35 FCC Rcd 12603 (2020) (revising rules to facilitate the development of new and innovative narrowband Internet of Things devices in TV white spaces and expand the ability of unlicensed white space devices to deliver wireless broadband services in rural areas and areas where fewer broadcast stations are on the air).

and database administrators to enable unlicensed white space devices to operate efficiently and protect other spectrum users.[1440]

476. In the *6 GHz Order and Further Notice*, the Commission opened up the entire 6 GHz band (5.925-7.125 GHz) for unlicensed indoor lower power access points.[1441] In this April 2020 order, the Commission found that these access points will be ideal for connecting devices, in homes and businesses, such as smartphones, tablet devices, laptops, and Internet-of-Things devices, to the Internet.[1442] Shortly thereafter, a petition was filed with the D.C. Circuit Court of Appeals seeking judicial review of this order.[1443] The petitioners represented licensed commercial wireless service providers, electric utilities, public safety entities, and broadcasters operating in the 6 GHz band;[1444] these petitioners asserted that the *6 GHz Report and Order* contravenes the Communications Act of 1934, as amended, and the Administrative Procedure Act.[1445] On December 28, 2021, the D.C. Circuit largely rejected these challenges.[1446] It held that "the petitioners have failed to provide a basis for questioning the Commission's conclusion that the [*6 GHz Report and Order*] will protect against a significant risk of harmful interference," and "den[ied] the petitions for review in all respects save one."[1447] The single remand was based on complaints by the NAB concerning interference in the 2.4 GHz band.[1448]

477. In March of this year, OET released a public notice that sought comment on NAB's arguments in the Commission's proceeding regarding broadcasters' experience in the 2.4 GHz band, how that experience relates to the kinds of contention-based protocol operations prescribed for indoor use in the 6 GHz rules, and whether the 2.4 GHz experience warrants reservation of a portion of the 6 GHz band for mobile indoor operations or any other modifications to the Commission's 6 GHz rules.[1449]

478. WTB and PSHSB released a public notice in August 2021 that provided guidance regarding the adoption of new rules for the 5.850-5.925 GHz (5.9 GHz) band.[1450] In particular, WTB and PSHSB provided guidance to intelligent transportation system (ITS) licensees seeking waivers of the Commission's rules to operate roadside units with cellular vehicle to everything (C-V2X)-based

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[1440] *White Space Devices Order* at 2, para. 1.

[1441] *6 GHz Order and Further Notice*, 35 FCC Rcd at 3860, para. 18, *aff'd in part and remanded in part*, *AT&T Services, Inc. v. FCC*, 21 F.4th 841, 853-54 (D.C. Cir. 2021).

[1442] *6 GHz Order and Further Notice*, 35 FCC Rcd at 3854, para. 3. NCTA points out that the Commission's 6 GHz decision authorized 1200 megahertz of mid-band spectrum for shared unlicensed use, allowing broadband providers and equipment manufacturers to access the 160-megahertz channels enabled by the current Wi-Fi 6/6E standard and provide significant improvements in speed and spectrum efficiency. NCTA states that the FCC is poised to expand on these improvements and unleash additional consumer benefits as it considers as part of its 6 GHz Further Notice proceeding, which would allow increased Wi-Fi power levels for low-power indoor Wi-Fi. NCTA Comments at 15-16; *see also* Public Knowledge, OTI, and Consumer Reports Reply at 9.

[1443] *AT&T Services, Inc. v. FCC*, 21 F.4th 841, 842, 845 (D.C. Cir. 2021).

[1444] *AT&T*, 21 F.4th at 842-43, 845.

[1445] *Id.* at 843, 845 (citing 47 U.S.C. § 151, *et seq*., 5 U.S.C. § 706(2)(A)).

[1446] *Id.* at 843, 854.

[1447] *Id.* at 843.

[1448] *Id.* at 853-55; *6 GHz Order and Further Notice*, 35 FCC Rcd at 3915, para. 168.

[1449] *Office of Engineering and Technology Seeks Comment Following Court Remand of 6 GHz Band Order*, ET Docket No. 18-295, GN Docket No. 17-183, Public Notice, DA 22-253 (OET Mar. 10, 2022).

[1450] *Wireless Telecommunications Bureau and Public Safety and Homeland Security Bureau Provide Guidance for Waiver Process to Permit Intelligent Transportation System Licensees to Use C-V2X Technology in the 5.895-5.925 GHz Band*, ET Docket No. 19-138, Public Notice, 36 FCC Rcd 12406 (WTB/PSHSB 2021) (*5.9 GHz Waiver Public Notice*).

technology in the upper 30 megahertz (5.895-5.925) portion of the 5.9 GHz band, prior to adoption of final rules providing for such use, as well as guidance for waivers associated with equipment certifications and on-board units.[1451] Similarly, in June 2022, WTB and PSHSB sought comment in a public notice on a joint filing by certain automakers, state departments of transportation, and equipment manufacturers requesting a waiver of the Commission's rules applicable to ITS operations in the upper 30 megahertz portion of the 5.9 GHz band.[1452] When combined with existing Wi-Fi spectrum in the adjacent 5 GHz band, the Commission's actions over the last several years will allow for near-term deployment of a high-throughput, 160-megahertz channel that will enable gigabit connectivity for schools, hospitals, small businesses, and other consumers.

479. In October 2021, WTB released a public notice seeking to supplement the record in the rulemaking on *Modernizing and Expanding Access to the 70/80/90 GHz Bands* to address the potential for use of the 71-76 GHz, 81-86 GHz, 92-94 GHz, and 94.1-95 GHz bands to provide broadband Internet access to consumers and communities that may otherwise lack robust, consistent connectivity.[1453] In this public notice, WTB sought comment on whether High Altitude Platform Stations or other stratospheric-based platform services could be deployed for this purpose in the 70/80/90 GHz bands.[1454] The 70/80/90 GHz bands are allocated on a co-primary basis for Federal and non-Federal use, variously for terrestrial, satellite, radio astronomy, and radiolocation uses.[1455] WTB also sought additional information regarding the potential use of these bands to provide broadband Internet access to customers on airplanes and aboard ships.[1456]

480. The Commission also took steps towards the more efficient use of available spectrum. In July 2022, the Commission adopted a Report and Order creating the Enhanced Competition Incentive Program (ECIP) to establish incentives for wireless licensees to make underutilized spectrum available to small carriers, Tribal Nations, and entities serving rural areas.[1457] The Report and Order built on the Congressional goals of the Making Opportunities for Broadband Investment and Limiting Excessive and Needless Obstacles to Wireless Act (MOBILE NOW Act), by considering steps to "increase the diversity of spectrum access" and the "availability of advanced telecommunications services in rural areas" and to facilitate transactions that will benefit the public interest.[1458] Under ECIP, any covered geographic licensee may offer spectrum to an unaffiliated eligible entity through a partition and/or disaggregation, and any covered geographic licensee eligible to lease in an included service may offer spectrum to an unaffiliated eligible entity through a long-term leasing arrangement.[1459] As a result, ECIP encourages licensees to partition, disaggregate, or lease spectrum to better match available spectrum resources with

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[1451] *5.9 GHz Waiver Public Notice*, 36 FCC Rcd at 12406.

[1452] *Wireless Telecommunications Bureau and Public Safety and Homeland Security Bureau Seek Comment on a Request for Nationwide Waiver of Intelligent Transportation System Rules to Use C-V2X Technology in the 5.895-5.925 GHz Band*, ET Docket No. 19-138, Public Notice, DA 22-611 (WTB/PSHSB June 7, 2022); *see also Public Safety and Homeland Security Bureau Seeks Comment on Waiver Requests from Intelligent Transportation System Licensees to Use C-V2X Technology in the 5.895-5.925 GHz Band*, ET Docket No. 19-138, Public Notice, DA 22-617 (PSHSB June 7, 2022).

[1453] *70/80/90 GHz Record Public Notice* at 1, para. 1; *see also Modernizing and Expanding Access to the 70/80/90 GHz Bands, et al.*, WT Docket No. 20-133, et al., Notice of Proposed Rulemaking and Order, 35 FCC Rcd 6039 (2020).

[1454] *70/80/90 GHz Record Public Notice* at 1, para. 1.

[1455] *Id.* at 1, para. 2.

[1456] *Id.* at 1, para. 1.

[1457] *ECIP Report and Order* at 2, para. 1; *see also ECIP Press Release*.

[1458] *ECIP Report and Order* at 2, para. 1.

[1459] *Id.* at 6-7, 18-19, paras. 2, 18; *ECIP Press Release* at 1.

entities that seek to provide needed services to underserved communities.[1460] In the same Report and Order, the Commission also provided for reaggregation of previously partitioned and disaggregated licenses up to the original license size, while adopting appropriate safeguards.[1461] The Second Further Notice sought comment on whether to expand program eligibility to allow non-common carriers serving non-rural areas to be eligible to participate in the program, and whether to adopt alternative construction requirements for wireless radio licensees generally, including a safe harbor.[1462]

481. As mobile networks transition to 5G, the Commission is continuing to explore ways to leverage certain technologies to ensure network security and 5G leadership. For example, in March 2021, the Commission released its first inquiry exploring how the Commission can accelerate the development and deployment of Open RAN.[1463] This notice of inquiry will help the Commission develop information that can inform providers' decision making as they examine which equipment and services to deploy in their next generation networks.[1464] In particular, the Commission sought comment on the status of Open RAN: where the technology is today, and what steps are required to deploy Open RAN networks broadly and at scale.[1465] The Commission sought input on whether, and if so how, deployment of Open RAN-compliant networks could further the Commission's policy goals and statutory obligations, advance legislative priorities, and benefit American consumers by making state-of-the-art wireless broadband available faster and to more people in additional parts of the country.[1466] Commission staff are continuing to analyze the comments, replies, and *ex partes*[1467] that have been filed in this docket. The Commission hosted an Open RAN showcase in July 2021, in which more than 30 vendors participated and shared the latest development of their Open RAN solutions with wireless service providers.[1468] In addition, collaborating with the National Science Foundation (NSF) and Platforms for Advanced Wireless Research (PAWR), the Commission launched two new innovation zones in Boston and Raleigh to test

[1460] *ECIP Report and Order* at 2, para. 2; *ECIP Press Release* at 1.

[1461] *ECIP Report and Order* at 2, para. 3.

[1462] *Id*.

[1463] *See Open RAN Notice of* Inquiry, 36 FCC Rcd at 5947.

[1464] *Id.* at 5948-49, para. 3. In CTIA's comments, it asserts that Open RAN has the potential to advance competition and innovation over the next decade. CTIA states that industry development of Open RAN is part of a larger evolution and paradigm shift in telecommunications networks. *See* CTIA Comments at 19.

[1465] *Open RAN Notice of Inquiry*, 36 FCC Rcd at 5948-49, para. 3.

[1466] *Id.*

[1467] *See, e.g.*, Letter from Kristian Toivo, Executive Director, Telecom Infra Project, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 21-63 (filed Sept. 26, 2022); Letter from Adriana Rios Welton, U.S. Cellular Corporation, to Marlene H. Dortch, FCC, GN Docket No. 21-63 (filed Aug. 31, 2022); Letter from Jeffrey H. Blum, Executive Vice President, DISH Network, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 21-63 (filed Mar. 16, 2022); Letter from Jared M. Carlson, Vice President, Ericsson, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 21-63 (filed Feb. 25, 2022); Letter from Caressa D. Bennet and E. Alex Espinoza, Womble Bond Dickinson LLP, Counsel, Mavenir Systems, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 21-63 (filed Jan. 10, 2022); Letter from Colleen Thompson, Director, AT&T, to Ms. Marlene H. Dortch, Secretary, FCC, GN Docket No. 21-63 (filed Dec. 2, 2021); Letter from John Hunter, Senior Director, T-Mobile, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 21-63 (filed Dec. 2, 2021); Letter from Alexi Maltas, General Counsel, CCA, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 21-63 (filed Nov. 16, 2021); Letter from Carri Bennet, General Counsel, and E. Alex Espinoza, Regulatory Counsel, RWA, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 21-63 (filed Oct. 22, 2021).

[1468] *FCC Announces Open RAN Solutions Showcase Agenda*, Public Notice (July 12, 2021), https://www.fcc.gov/document/fcc-announces-open-ran-solutions-showcase-agenda.

new advanced technologies and prototype networks, including Open RAN.[1469] Further, the Commission allows wireless service providers to replace covered equipment that pose threats to national security with alternative closed or Open RAN equipment through the Secure and Trusted Communication Networks Reimbursement Program.[1470]

482. *Wireless Infrastructure Siting.* Wireless providers will need to deploy a vast amount of new equipment and will need to modify older equipment to upgrade networks within a relatively short amount of time in order to match the demand for advanced wireless technologies. The Commission's over-the-air reception devices (OTARD) rule prohibits laws, regulations, or restrictions imposed by State or local governments or private entities that impair the ability of antenna users to install, maintain, or use over-the-air reception devices.[1471] In January 2021, the Commission released a Report and Order that expanded the rule's coverage to include hub and relay antennas that are used for the distribution of broadband-only fixed wireless services to multiple customer locations, regardless of whether they are primarily used for this purpose, provided the antennas satisfy other conditions of the rule.[1472] This rule adjustment should allow fixed wireless service providers to bring faster Internet speeds, lower latency, and advanced applications, such as the Internet of Things, telehealth, and remote learning, to all areas of the country, and to rural and underserved communities in particular.[1473]

483. On September 13, 2022, WTB held a workshop on environmental and historic preservation review processes that are required prior to the construction of communications facilities supporting Commission licensed services.[1474] The workshop included information relevant to the construction of new communications towers and the collocation of communications equipment on existing towers and other structures, including requirements for Antenna Structure Registration.[1475]

C. The Satellite Marketplace

484. On May 13, 2020, the Commission adopted rules expanding the scope of operations available with ESIMs.[1476] The Commission extended licensing rules for ESIMs that operate with GSO FSS space stations to additional frequency bands available for blanket licensing of earth stations at fixed

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[1469] FCC, Press Release, FCC Designates New Innovation Zones for Advanced Wireless Technology Research and Innovation (Aug. 5, 2021), https://docs fcc.gov/public/attachments/DOC-374691A1.pdf.

[1470] *Wireline Competition Bureau Finalizes Application Filings, Procedures, Cost Catalog, and Replacement List for the Secure and Trusted Communications Networks Reimbursement Program*, WC Docket No. 18-89, Public Notice, 36 FCC Rcd 12190 (WCB 2021).

[1471] *OTARD Report and Order*, 36 FCC Rcd at 537-38, para. 2.

[1472] *Id.* at 537, para. 1.

[1473] *Id.* at 537, para. 1. In February 2021, the Children's Health Defense and four individual petitioners filed a petition for review in the Court of Appeals in the D.C. Circuit asserting that this order violated their rights under the Americans with Disabilities Act, the Fair Housing Act, and the Constitution. However, in February 2022, the D.C. Circuit Court of Appeals denied the petition. *Children's Health Defense, et al. v. FCC*, 25 F.4th 1045 (D.C. Cir. 2022).

[1474] *Wireless Telecommunications Bureau Announces September 13, 2022 Workshop on Environmental Compliance and Historic Preservation Review Procedures*, Public Notice, DA 22-754 (WTB July 13, 2022) (*WTB NEPA and NHPA Workshop*).

[1475] *WTB NEPA and NHPA Workshop* at 1, para. 1.

[1476] *Amendment of Parts 2 and 25 of the Commission's Rules to Facilitate the Use of Earth Stations in Motion Communicating with Geostationary Orbit Space Stations in Frequency Bands Allocated to the Fixed Satellite Service; Facilitating the Communications of Earth Stations in Motion with Non-Geostationary Orbit Space Stations*, IB Docket Nos. 17-95 and 18-315, Second Report and Order, Report and Order, and Further Notice of Proposed Rulemaking, 35 FCC Rcd 5137 (2020) (*ESIMs Second Report and Order and Further Notice*).

locations.[1477] The Commission also adopted rules enabling the licensing of ESIMs with NGSO FSS space stations based on the regulatory framework adopted for ESIM communications with GSO FSS networks.[1478]

485. On November 18, 2020, the Commission further streamlined its rules governing satellite services by more closely aligning the licensing processes for space stations and earth stations.[1479] The Commission created an optional, unified license framework to authorize the blanket-licensed earth stations and space stations in a satellite system under a single license.[1480] The Commission also harmonized the build-out requirements for earth stations and space stations and eliminated unnecessary reporting rules to reduce regulatory burdens and provide additional operational flexibility.[1481]

486. On August 3, 2022, the Commission permitted use of the 17.3-17.7 GHz band for GSO FSS downlinks on a co-primary basis with incumbent services and use of the 17.7-17.8 GHz band for GSO FSS downlinks on a unprotected basis with respect to fixed service operations, thereby creating a contiguous band for fixed-satellite downlink operations, and enabling greater flexibility and efficiency.[1482] The Commission also defined an extended Ka-band, streamlining licensing of FSS earth stations in a harmonized regulatory framework for similar FSS transmissions in the conventional and extended Ka-bands.[1483] In addition, the Commission sought comment on whether to allow operations of non-geostationary satellite orbit (NGSO) in the FSS (space-to-Earth) in the 17.3-17.8 GHz band and the appropriate technical rules and standards.[1484]

487. Growth in space activity has heightened concerns about the risks of orbital debris, and post-mission disposal of spacecraft is a necessary part in the mitigation of orbital debris, with orbital lifetime a crucial element affecting both collision risk. On April 24, 2020, the Commission comprehensively updated the Commission's rules regarding orbital debris mitigation.[1485] The updated regulations were designed to ensure that the Commission's actions concerning radio communications, including licensing U.S. spacecraft and granting access to the U.S. market for non-U.S. spacecraft, mitigate the growth of orbital debris, while at the same time not creating undue regulatory obstacles to new satellite ventures.[1486] Post-mission disposal and orbital lifetime are crucial factors in the mitigation of orbital debris, as they not only affect the collision risk of a space station or system, but also affect spacecraft that are unable to complete post-mission disposal, particularly when left at higher altitudes where they may persist indefinitely, will contribute to the growing congestion in the space environment over the long-term, and increase risks to space operations.[1487] On September 30, 2022, the Commission shortened the 25-year benchmark for post-mission disposal of NGSO space stations to five years for space stations in LEO.[1488]

[1477] *ESIMs Second Report and Order and Further Notice*, 35 FCC Rcd at 5139-44, paras. 5-20.

[1478] *Id.* at 5139, 5146-58, paras. 5, 26-61.

[1479] *Further Streamlining Part 25 Rules Governing Satellite Services*, IB Docket No. 18-314, Report and Order, 35 FCC Rcd 13285 (2020).

[1480] *Id*. at 13290-97, paras. 15-36.

[1481] *Id*. at 13297-307, paras. 37-65.

[1482] *17 GHz Report and Order* at 2, para. 1.

[1483] *Id.* at 2, para. 2.

[1484] *Id.* at 2, para. 3.

[1485] *Orbital Debris Report and Order and Further Notice*, 35 FCC Rcd at 4157, para. 1.

[1486] *Id.* at 4157, para. 2.

[1487] *Orbital Debris Second Report and Order* at 2, para. 4.

[1488] *Id.* at 2, para. 4.

D. The Video and Audio Communications Marketplace

488. *Next Generation Television Standard.* The Commission's work to enable the deployment of the ATSC 3.0 broadcast transmission standard is proceeding.[1489] As reported in the *2020 Communications Marketplace Report*, the Commission has previously taken a number of actions to allow broadcasters, manufacturers, and consumers to explore this new technology by: authorizing television stations to use the ATSC 3.0 broadcast transmission standard; setting forth applicable operational requirements, MVPD carriage rights, public interest obligations, and technical standards; and providing guidance for ATSC 3.0 television broadcasters.[1490]

489. In January 2021, the Commission adopted a technical modification to the Commission's rules governing the use of a DTS, or single frequency network, by a broadcast television station.[1491] The Commission provided greater flexibility and additional clarity in the Commission's rules to foster the potential use of DTS as stations seek to operate in ATSC 3.0.[1492] Specifically, the rule changes were designed to give stations greater flexibility in the placement of transmitters, thereby allowing broadcasters to enhance signal capabilities and coverage, improve indoor and mobile reception, and increase spectrum efficiency by reducing the need for additional television translator stations operating on separate channels.[1493]

490. *New Broadcast Stations.* Over the last two years, the Commission has taken steps to allow new entities to enter the broadcast marketplace and for existing licensees to expand or improve their service. In October 2021, the Commission updated the TV Table of Allotments (TV Table) to codify Commission actions taken over the past several years that modified the channel allotments reflected in the TV Table, including primarily actions related to the incentive auction and repacking process authorized by The Middle Class Tax Relief and Job Creation Act of 2012.[1494] After this update,

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[1489] For example, as of November 16, 2022, the Commission has licensed at least one station to commence ATSC 3.0 operations in a total of 78 DMAs. Moreover, the Commission is aware of approximately 120 models of television sets with ATSC 3.0 tuners currently available in the United States from four manufacturers. *See, e.g.*, NAB Comments, GN Docket No. 16-142, at 4-5 (rec. Aug. 8, 2022) ("Hisense is expected to make its 3.0 compatible sets available later this month, at which point we expect there will be approximately 120 models of television sets with 3.0 receivers available at a variety of price points from four manufacturers"); Pearl TV Comments, GN Docket No. 16-142, at 14 (rec. Aug. 8, 2022) ("consumers will soon have over 120 models of TV sets from four different manufacturers to choose from, with more on the way").

[1490] *2020 Communications Marketplace Report*, 36 FCC Rcd at 3161, para. 413; *see also Authorizing Permissive Use of the "Next Generation" Broadcast Television Standard*, GN Docket No. 16-142, Report and Order and Further Notice of Proposed Rulemaking, 32 FCC Rcd 9930 (2017); *Authorizing Permissive Use of the "Next Generation" Broadcast Television Standard*, GN Docket No. 16-142, Second Report and Order and Order on Reconsideration, 35 FCC Rcd 6793, 6794, 6797-6807, 6810-11, paras. 1, 9-28, 34-37 (2020).

[1491] *Rules Governing the Use of Distributed Transmission System Technologies*, MB Docket No. 20-74, Report and Order, 36 FCC Rcd 1227 (2021) (*DTS Order*). Microsoft Corporation filed a Petition for Reconsideration of the *DTS Order* on May 21, 2021. *Petition for Reconsideration of Action in Proceeding*, Public Notice, MB Docket Nos. 20-74, 16-142 (June 32, 2020). The petition remains pending.

[1492] *DTS Order*, 36 FCC Rcd at 1227, para. 1.

[1493] *Id*.

[1494] *See Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auction*, GN Docket No. 12-268, Order, 36 FCC Rcd 15891 (2021); The Middle Class Tax Relief and Job Creation Act of 2012, Pub. L. No. 112-96, §§ 6402 (codified at 47 U.S.C. § 309(j)(8)(G)), 6403 (codified at 47 U.S.C. § 1452), 126 Stat. 156 (2012); *Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*, GN Docket No. 12-268, Report and Order, 29 FCC Rcd 6567, 6568-70, para. 1 (2014), *aff'd*, *National Ass'n of Broadcasters v. FCC*, 789 F.3d 165 (D.C. Cir. 2015) (subsequent citations omitted); *Incentive Auction Closing and Channel Reassignment Public Notice: The Broadcast Television Incentive Auction Closes; Reverse Auction and Forward Auction Results Announced; Final Television Band Channel Assignments Announced; Post-Auction*

(continued….)

27 allotments in the TV Table were available for licensing.[1495] Auction 112 made full power television construction permits on these allotted-but-unlicensed channels available.[1496] The auction, which took place between June 7 and June 15, 2022, raised a total of $33,043,250 in net bids, with seven bidders winning a total of 18 construction permits.[1497] Winning bidders have made all required payments, and Commission staff has processed all long form applications, thereby granting the new construction permits.

491. In addition, between July 27, 2021 and August 5, 2021, the Commission held broadcast Auction 109,[1498] auctioning new construction permits for 135 commercial FM and four AM radio stations.[1499] While none of the AM permits received bids, 67 bidders placed winning bids on 97 new FM construction permits for a total of $12,344,110.[1500] Winning bidders have made all required payments and filed their long-form applications.

492. Finally, in November 2021, the Media Bureau opened a filing window for parties seeking construction permits for new Noncommercial Educational (NCE) FM stations.[1501] This filing window provided the first new licensing opportunity for noncommercial stations in more than 10 years. The Bureau received 1,282 applications for new NCE FM stations during the window, indicative of the pent-up demand for such stations.[1502] The Bureau has granted more than 600 applications, and the

(Continued from previous page)
Deadlines Announced, GN Docket No. 12-268, Public Notice, 32 FCC Rcd 2786 (2017) (*Broadcast Incentive Auction Closing and Channel Reassignment Public Notice*).

[1495] *Auction of Construction Permits for Full Power Television Stations; Comment Sought on Competitive Bidding Procedures for Auction 112*, AU Docket No. 21-449, Public Notice, DA 21-1444, at 2, paras. 2-3 (Nov. 19, 2021).

[1496] *Id*.

[1497] *Auction of Construction Permits for Full Power Television Stations; Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments, and Other Procedures for Auction 112; Bidding Scheduled io Begin June 7, 2022*, AU Docket No. 21-449, Public Notice, DA 22-125, at 3, para. 1 (Feb. 10, 2022); *Auction of Construction Permits for Full Power Television Stations Closes; Winning Bidders Announced for Auction 112*, AU Docket No. 21-449, Public Notice, DA 22-659, at 1, para. 1 (June 23, 2022).

[1498] Auction 109 replaced canceled FM Auction 106, which was to have taken place beginning April 28, 2020, but was postponed due to the COVID-19 pandemic. *Auction 106 Postponed*, AU Docket No. 19-290, Public Notice, 35 FCC Rcd 2886 (2020).

[1499] *Auction of AM and FM Broadcast Construction Permits; 114 Bidders Qualified to Participate in Auction 109; One FM Broadcast Construction Permit Removed From Auction 109*, AU Docket No. 21-39, Public Notice, DA 21-780, at 1, para 1. (July 1, 2021); *Auction of AM and FM Broadcast Construction Permits Closes; Winning Bidders Announced for Auction 109*, AU Docket No. 21-39, Public Notice, DA 21-983, at 1, para. 1 (Aug. 12, 2021).

[1500] *Id.* at 1, para. 1, Attach. A.

[1501] *Media Bureau Announces NCE FM New Station Application Filing Window; Window Open from November 2, 2021 to November 9, 2021*, MB Docket No. 20-343, Public Notice, 36 FCC Rcd 7449 (2021).

[1502] *Media Bureau Dismisses Defective Singleton Applications Submitted in the November 2021, Filing Window For New Noncommercial Education FM Stations*, MB Docket No. 20-343, Public Notice, 36 FCC Rcd 16718 (2021). Many of these applications were not mutually exclusive with any other application filed in the window and therefore acceptable for filing. *Id.* 75 of the applications filed in the window were dismissed for failure to comply with filing requirements. *Id.* at 16719. The Bureau also identified 231 groups of mutually exclusive (MX) applications, comprised of 833 total applications, and provided a 60-day settlement period, ending January 28, 2022, for MX applicants to enter into and file settlement agreements and/or submit technical amendments to resolve conflicts to allow for the grant of some of these applications. *Id.* at 16718-16719; *Media Bureau Identifies Groups of Mutually Exclusive Applications Submitted in the November 2021, Filing Window for New Noncommercial Educational FM Stations; Opens Window to Accept Settlements and Technical Amendments*, MB Docket No. 20-343, Public Notice, DA 21-1476 (Nov. 29, 2021).

Commission continues to identify tentative selectees in groups of mutually exclusive applicants and grant construction permits to enable the introduction of new noncommercial radio service.[1503]

493. *LPTV/TV Translator Digital Transition.* Following the conclusion of the broadcast incentive auction, which saw significant changes to the television spectrum band, the Commission sought to fully transition all television operations to digital transmissions. Accordingly, the Commission set a deadline of July 13, 2021 for all LPTV and TV translator stations to convert to digital operations.[1504] To date, all LPTV and TV translator facilities have ceased analog operations and, with limited exceptions, all have completed their conversion to digital. The limited number of stations that have not yet completed converting their facilities to digital operations are expected do so by early 2023.

VII. COMMISSION AGENDA TO FURTHER PROMOTE COMPETITION, ENCOURAGE UNIVERSAL DEPLOYMENT OF COMMUNICATIONS SERVICES, AND ENSURE INCLUSION

494. RAY BAUM'S Act of 2018 also requires the Commission to describe the agenda of the Commission for the next two-year period for addressing competitive challenges and opportunities in the communications marketplace.

A. The Fixed Communications Marketplace

495. Over the next two years, we expect the Commission to continue its efforts to connect every American to an affordable, high-speed broadband connection. As has historically been the case, a key component of that effort will be through use of the Commission's USF Programs. The Commission expects to complete a targeted inquiry commenced in May 2022 into the management and administration of the high-cost program to improve its efficiency and efficacy[1505] and begin considering appropriate next steps. Further, we expect to consider the services funded by the Lifeline Program and also work to better align the Lifeline and Affordable Connectivity Programs. We would evaluate whether voice services should remain a part of the Lifeline program and how the Lifeline Program can best operate with the ACP. We expect to leverage lessons learned from implementation of the EBB Program and the ACP that may be able to be applied to the Lifeline Program. We also expect to continue our reform of the Rural Health Care Program to protect program integrity and ensure program participants receive adequate levels of support.[1506] We also expect to continue to evaluate developments concerning the burden of Universal Service contributions on households and businesses, the USF contribution factor, and contribution base, as well as the scope of the Commission's authority under section 254(d), and consider further actions if necessary, to the existing contributions methodology.[1507]

[1503] *See, e.g., Comparative Consideration of 27 Groups of Mutually Exclusive Applications for Permits to Construct New Noncommercial Educational FM Stations*, NCE FM 2021 Window, Memorandum Opinion and Order, FCC 22-61 (Aug. 2, 2022).

[1504] *See Amendment of Parts 73 and 74 of the Commission's Rules to Establish Rules for Digital Low Power Television and Television Translator Stations*, MB Docket No. 03-185, Third Report and Order and Fourth Notice of Proposed Rulemaking, 30 FCC Rcd 14927, 14932-33, paras. 8-9 (2015); *see also Broadcast Incentive Auction Closing and Channel Reassignment Public Notice*. Given the April 13, 2017 release date of the *Broadcast Incentive Auction Closing and Channel Reassignment Public Notice*, the LPTV/translator digital transition date was July 13, 2021. The Commission also required all LPTV and TV translator stations to terminate analog operations on that date, regardless of whether their digital facilities were operational. 47 CFR § 74.731(m). In accordance with our rules, all licenses for analog operations automatically cancelled after 11:59 pm on July 13, 2021, without any affirmative action by the Commission.

[1505] *Connect America Fund: A National Broadband Plan for Our Future High-Cost Universal Service Support et al.*, WC Docket No. 10-90, Notice of Proposed Rulemaking, FCC 22-35, at 22-40, paras. 59-111 (May 20, 2022).

[1506] *See Promoting Telehealth in Rural America*, WC Docket No. 17-310, Further Notice of Proposed Rulemaking, FCC 22-15 (Feb. 22, 2022).

[1507] *Future of the USF Report* at paras. 88-106.

496. Going forward, our broadband deployment policymaking and future reports will be heavily informed by the BDC. This includes not only most effectively targeting USF support, but also in evaluating the success of other policies affecting fixed communications marketplace entry and expansion, such as what we expect to be our continuing work regarding access to rights of way, poles, and MTEs, our work combatting digital discrimination,[1508] and consideration of recommendations from the Precision Agriculture Connectivity Task Force.

497. Given the recent unprecedented levels of federal funding made available for broadband buildout through Congressional action, including the $42.45 billion for the Broadband, Equity, Access, and Deployment Program (BEAD) being administered by the National Telecommunications and Information Administration (NTIA), we anticipate that in addition to continuing our close coordination with other federal agencies (including NTIA, U.S. Department of the Treasury, and the Department of Agriculture) to ensure the most efficient use of federal funding, it will be necessary to evaluate the funding needs of existing and future providers that have already deployed high-speed broadband networks and to consider the creation of new support processes.

498. We also expect to evaluate our rules pertaining to communications services for incarcerated people, such as the methodology to be used in setting permanent interstate and international rate caps, additional reforms to our ancillary service charge rules, and expanding access to all eligible relay services for incarcerated people with communication disabilities.[1509]

B. The Mobile Wireless Communications Marketplace

499. *Spectrum*. Incumbent service providers need additional spectrum to increase their coverage or capacity, while new entrants need access to spectrum to enter a geographic area. In addition, average data usage per connection has been substantially increasing in recent years, and this growth is expected to continue, in turn increasing service providers' need for additional spectrum. Forward thinking spectrum policy is critical for next generation wireless networks. To spur greater investment in the mobile wireless industry, the Commission will continue to make available a significant amount of additional spectrum across a range of low-, mid-, and high-band frequencies to ensure a competitive mobile wireless services marketplace.

500. Congress is considering legislation that will affect the Commission's authority to grant licenses or permits through systems of competitive bidding.[1510] Pending future provision of authority, the Commission intends to examine for potential re-auction its inventory of licenses in services well-suited for 5G that were previously offered at auction.[1511] The Commission has authority to conduct competitive bidding for licenses to use spectrum to be identified between 3.1 and 3.45 GHz only after November 30, 2024.[1512] Current law further provides the Commission with authority to conduct competitive bidding for licenses to use 30 megahertz of spectrum yet to be identified.[1513] In the interim, the FCC has several active proceedings in which it is considering whether and how to enable sharing or repurpose bands, potentially creating opportunities for spectrum auctions beyond FY2023. For example, the FCC recently

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[1508] Infrastructure Act, § 60506, codified at 47 U.S.C. § 1754.

[1509] *See Rates for Interstate Inmate Calling Services Fourth Report and Order* at 43-65, paras. 93-162.

[1510] Congress recently extended that authority from a prior deadline through Dec. 16, 2022. Continuing Appropriations and Ukraine Supplemental Appropriations Act, 2023, Pub. L. No. 117-180, Div. C, sec. 101 (Sept. 30, 2022).

[1511] *See Estimate of Systems of Competitive Bidding for Fiscal Year 2023*, Public Notice, DA 22-1030 (OEA Sept. 30, 2022).

[1512] Infrastructure Investment and Jobs Act, Pub. L. No. 117-58, § 90008(b)(3) (2021) (codified at 47 U.S.C. § 921 note).

[1513] Spectrum Pipeline Act of 2015, Pub. L. No. 114-74, § 1004(a) (2015) (codified at 47 U.S.C. § 921 note).

put a freeze on new and modified applications in the 12.7 GHz band to preserve the current landscape as the Commission considers actions that might encourage more efficient use of that band.[1514]

501. OET released a public notice seeking comments in connection with the remand by the D.C. Circuit Court of Appeals regarding the Commission's *6 GHz Report and Order*.[1515] The court largely rejected the challenges to this order; the one issue on remand was limited in scope to NAB's arguments regarding interference in the 2.4 GHz band.[1516] To address the issues raised by NAB, OET invited comment in the *6 GHz Remand Public Notice* regarding this and other surrounding issues.[1517] The comment period for this public notice ended in early June of this year. OET is currently evaluating the comments, replies, and *ex partes* that have been filed in the relevant dockets.

502. *Infrastructure*. To meet rapidly increasing demand for wireless services and prepare our national infrastructure for 5G, the Commission will continue to evaluate ways to help facilitate wireless infrastructure investment and deployment. Supporting the deployment of 5G and other next-generation wireless services through smart infrastructure policy is critical. The wireless infrastructure landscape has shifted toward the development of 5G networks and technologies that require dense deployment of smaller antennas across provider networks in locations closer to customers.[1518]

503. In October 2021, the Commission began collaborating with NTIA on a project to help NTIA meet its Section 106 Tribal outreach obligations for NTIA's Broadband Infrastructure Programs (including the Tribal Broadband Connectivity Program) that provide federal assistance for broadband construction and other projects by allowing NTIA to use the Commission's Tower Construction Notification System (TCNS).[1519] TCNS notifies all 547 federally recognized Tribal Nations of infrastructure deployment proposed on Tribal or ancestral lands and provides Tribal representatives with the opportunity to participate in the Section 106 review of projects that may impact historic properties of religious or cultural Tribal significance.[1520]

C. The Satellite Marketplace

504. On December 15, 2021, the Commission proposed revisions to the spectrum sharing requirements among NGSO FSS systems to facilitate the deployment of NGSO FSS systems capable of providing broadband services with higher speeds and lower latency than previous satellite offerings. The Commission proposed, *inter alia*, to adopt a rule that NGSO FSS licensees and market access recipients are entitled to protection from NGSO FSS systems authorized through later processing rounds. The

[1514] *180-Day Freeze on Applications for New or Modified Authorizations for the 12.7-13.25 GHz Band*, Public Notice, DA 22-974 (WTB Sept. 19, 2022).

[1515] *Office of Engineering and Technology Seeks Comment Following Court Remand of 6 GHz Band Order*, ET Docket No. 18-295, GN Docket No. 17-183, Public Notice, DA 22-253 (OET Mar. 10, 2022) (*6 GHz Remand Public Notice*).

[1516] *AT&T*, 21 F.4th at 843, 845, 854.

[1517] *6 GHz Remand Public Notice* at 2-3.

[1518] *Updating the Commission's Rule for Over-the-Air Reception Devices*, WT Docket No. 19-71, Notice of Proposed Rulemaking, 34 FCC Rcd 2695, 2697, para. 7 (2019).

[1519] Letter to Tribal Leader from Joel Taubenblatt, Acting Bureau Chief, Wireless Telecommunications Bureau, FCC, and Douglas Kinkoph, Associate Administrator, Office of Internet Connectivity and Growth, NTIA (Oct. 22, 2021), https://www fcc.gov/sites/default/files/ntia_tcns_tribal_leader_letter_10.22.21.pdf.

[1520] *See* FCC, *Tower Construction Notification System*, https://www.fcc.gov/sites/default/files/wireless/outreach/notification/TCNS_industry.pdf (last visited Aug. 15, 2022).

proposed revisions would also promote competition and make it easier for new competitors to enter the market.[1521]

505. The Commission plans further revisions to its orbital debris mitigation requirements. The Commission plans to address maneuverability, accidental explosion risk and collision risks associated with larger constellations. On September 30, 2022, the Commission, given the risks associated with the increasing congestion in the orbital environment, adopted a rule reducing the post-mission disposal time frame.[1522] The Commission continues to assess potential maneuverability requirements as well as other topics from the earlier Further Notice,[1523] such as maneuverability, accidental explosion risk, and collision risks associated with larger constellations.[1524]

506. On Aug 8, 2022, the Commission adopted a Notice of Inquiry to examine the opportunities and challenges of in-space servicing, assembly, and manufacturing (ISAM) that can support sustained economic activity in space, and to facilitate capabilities for ISAM.[1525] Missions can include satellite refueling, inspecting and repairing in-orbit spacecraft, capturing and removing debris, and transforming materials through manufacturing while in space.[1526] In this proceeding, the Commission seeks to develop a record on where these capabilities are today and the steps needed to promote their development. As part of the proceeding, we seek to develop a record on the efforts to minimize the creation of new debris in connection with ISAM, as well as on the opportunities to leverage these capabilities to clean up existing debris, i.e., both orbital debris mitigation and orbital debris remediation.[1527] The information developed in this Notice of Inquiry can help position the United States to realize the critical benefits of ISAM while ensuring space safety and sustainability.[1528] With this proceeding, the Commission advances the National Science and Technology Council's ISAM National Strategy to support and stimulate government, academic, and commercial development of ISAM capabilities.[1529]

507. On November 3, 2022, Commission Chairwoman Rosenworcel announced a plan to reorganize the agency to better support the needs of the growing satellite industry, promote long-term technical capacity at the Commission, and navigate 21st century communications policy.[1530] This plan would reorganize the Commission's International Bureau into a new Space Bureau and a standalone Office of International Affairs. These changes will help ensure that the Commission's resources are better aligned so that the agency can continue to fulfill its statutory obligations and keep pace with the rapidly changing realities of the satellite industry and global communications policy.

[1521] *Non-GSO Spectrum Sharing Order and NPRM* at 1-2, 6, 18, paras. 1-2, 14-16.

[1522] *Orbital Debris Second Report and Order* at 2, para. 4.

[1523] *Orbital Debris Report and Order and Further Notice*.

[1524] *Orbital Debris Second Report and Order* at 3-4, para. 8.

[1525] *Space Innovation Notice of Inquiry*.

[1526] *Id.* at 1, para. 2.

[1527] *Id*. at 1-2, para. 3.

[1528] *Id*.

[1529] *See* National Science and Technology Council, In-Space Servicing, Assembly, and Manufacturing Interagency Working Group, In-Space Servicing, Manufacturing, and Assembly National Strategy (2022), https://www.whitehouse.gov/wp-content/uploads/2022/04/04-2022-ISAM-National-Strategy-Final.pdf (ISAM National Strategy).

[1530] FCC, Press Release, Chairwoman Rosenworcel Announces Plan To Modernize The FCC By Establishing A Space Bureau And Office Of International Affairs (Nov. 3, 2022), https://www fcc.gov/document/chairwoman-rosenworcel-proposes-space-bureau.

D. The Video and Audio Communications Marketplace

508. *Next Generation Television Standard.* Over the next two years, the Commission will continue to monitor technological and marketplace developments, remaining alert for potential regulatory actions to help foster innovative, and competitive, service by television broadcasters while also protecting consumers. In this regard, the Commission adopted a Third Further Notice of Proposed Rulemaking (*Third ATSC 3.0 Further Notice*) in June 2022 seeking comment on the progress of broadcasters' deployment of Next Gen TV and the current status of the ATSC 3.0 marketplace.[1531] The item also seeks comment on the scheduled 2023 sunset of two requirements related to broadcasters' provision of ATSC 3.0 service.[1532] The first is the requirement that a Next Gen TV station's ATSC 1.0 simulcast primary video programming stream be "substantially similar" to its 3.0 primary programming stream, which the Commission enacted to protect viewers' access to the broadcast programming they receive today, while providing broadcasters with flexibility to innovate and experiment with new, innovative Next Gen TV programming features using Next Gen TV technology.[1533] The second is a requirement that Next Gen TV stations comply with the ATSC A/322 standard, which creates certainty about the ability of 3.0-equipped consumer equipment to receive primary broadcast signals.[1534] In addition, the *Third ATSC 3.0 Further Notice* asks whether holders of essential patents for the ATSC 3.0 standards are licensing those patents on reasonable and non-discriminatory terms.[1535] Furthermore, the *Third ATSC 3.0 Further Notice* seeks comment on the extent to which ATSC 3.0 is being used to deploy enhanced accessibility features.[1536] The Commission hopes to issue an Order addressing the issues raised in the *Third ATSC 3.0 Further Notice* in the near term.

509. *Structural Ownership Rules*. The Commission also continues to examine its broadcast ownership regulations, particularly through the statutorily required quadrennial review of the media ownership rules. Section 202(h) of the Telecommunications Act of 1996 requires the Commission to review its media ownership rules every four years to determine whether they remain "necessary in the public interest as the result of competition."[1537] Pursuant to that mandate, the Media Bureau recently released a Public Notice stating that it has initiated the 2022 Quadrennial Review of its media ownership rules.[1538] The Commission's review will consider whether the key structural ownership rules remain in the public interest in light of the current media marketplace or whether, alternatively, the public interest would benefit from modification or elimination of these rules. Retention, modification, or elimination of these structural ownership rules may impact competition in the video and/or audio marketplace.

510. *LPTV FM Operation on Channel 6.* Historically, a number of analog LPTV stations licensed on television channel 6 programmed an audio signal that could be received by FM radio listeners at 87.75 MHz, which is adjacent to the noncommercial educational portion of the FM radio dial

[1531] *Authorizing Permissive Use of the "Next Generation" Broadcast Television Standard*, GN Docket No. 16-142, Third Further Notice of Proposed Rulemaking, FCC 22-47 (June 22, 2022).

[1532] *Id.* at 1, 3-5, 13-16, paras. 1, 6-7, 24-32.

[1533] *Id.* at 1, 3-4, 13-15, paras. 1, 6, 24-29.

[1534] *Id.* at 1, 4-5, 15-16, paras. 1, 7, 30-32.

[1535] *Id.* at 1, 5-6, 13, paras. 1, 8, 23.

[1536] *Id.* at 9, para. 17.

[1537] Telecommunications Act of 1996, Pub. L. No. 104-104, § 202(h), 110 Stat. 56, 111-12 (1996) (1996 Act); Consolidated Appropriations Act, 2004, Pub. L. No. 108-199, § 629, 118 Stat. 3, 99-100 (2004) (Appropriations Act) (amending Sections 202(c) and 202(h) of the 1996 Act). In 2004, Congress revised the then-biennial review requirement to require such reviews quadrennially. *See* Appropriations Act § 629, 118 Stat. at 100.

[1538] *Media Bureau Opens Docket and Seeks Comment for 2022 Quadrennial Review of Media Ownership Rules,* MB Docket No. 22-459, Public Notice, DA 22-1364 (MB Dec 22, 2022).

(specifically, channel 201 at 88.1 MHz).[1539] When LPTV stations converted to the use of a digital transmission standard, however, stations offering an audio signal on the FM band were unable to continue providing this service, because the digital audio portion of their signal could no longer be received by standard FM receivers.[1540] Responding to applications from such operators, the Commission has granted special temporary authority to 13 channel 6 LPTV stations to continue providing such service. And in June 2022, the Commission adopted a Notice of Proposed Rulemaking exploring whether to allow continued analog FM radio operations by existing digital channel 6 LPTV stations and seeking comment on related technical issues.[1541] FM broadcasting by these LPTV stations may help bring diverse, niche, local programming to communities, including weather, news, sports, and community events.

511. *Communications Equity and Diversity Council.* On June 29, 2021, Chairwoman Rosenworcel re-chartered the former Advisory Committee on Diversity and Digital Empowerment as the Communications Equity and Diversity Council (CEDC) for a two-year charter into 2023.[1542] The CEDC is tasked with making recommendations to the Commission on diversity and equity issues across the media, communications, and tech sectors, including how to help small and diverse businesses enter and compete in the communications, media, digital news and information, and audio and video programming industries.[1543] The mission of the CEDC is to present recommendations to the Commission on "advancing equity in the provision of and access to digital communication services and products for all people of the United States, without discrimination on the basis of race, color, religion, national origin, sex, or disability."[1544] The council is intended to allow stakeholders to exchange ideas and develop recommendations to the Commission on various issues including mentoring for small business; access to capital; developing skills necessary for employment in the media and technology industries; diversity in media ownership; and procurement opportunities. In this way, the CEDC's efforts will result in potential recommendations to foster new, small, and diverse participants in the audio and video marketplaces.

VIII. PROCEDURAL MATTERS

512. This Communications Marketplace Report is issued pursuant to section 401 of the Repack Airwaves Yielding Better Access for Users of Modern Services Act of 2018 (codified at 47 U.S.C. § 163), section 103(b) of the Broadband Data Improvement Act (codified at 47 U.S.C. § 1303(b)), and section 623(k) of the Communications Act of 1934, as amended (codified at 47 U.S.C. § 543(k)).

513. **IT IS ORDERED** that this Communications Marketplace Report shall be published on the website of the Federal Communications Commission and that the Office of Legislative Affairs shall submit copies of this Communications Marketplace Report to the Committee on Energy and Commerce of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate.

[1539] *Amendment of Parts 73 and 74 of the Commission's Rules to Establish Rules for Digital Low Power Television and Television Translator Stations*, MB Docket No. 03-185, Third Notice of Proposed Rulemaking, 29 FCC Rcd 12536, 12554, para. 47 (2014).

[1540] *Id.*

[1541] *Amendment of Parts 73 and 74 of the Commission's Rules to Establish Rules for Digital Low Power Television and Television Translator Stations*, MB Docket No. 03-185, Fifth Notice of Proposed Rulemaking, FCC 22-40 (June 7, 2022).

[1542] FCC, Press Release, FCC Acting Chairwoman Announces Expanded Focus of Advisory Committee on Diversity and Digital Empowerment to Take on Broader Tech Sector Issues (June 24, 2021), https://docs.fcc.gov/public/attachments/DOC-373555A1.pdf.

[1543] *Id.*

[1544] *FCC Seeks Nominations for Membership on Communications Equity and Diversity Council*, Public Notice, DA 21-795, at 1 (MB July 6, 2021).

514. **IT IS FURTHER ORDERED** that the proceeding in GN Docket No. 22-203 is **TERMINATED**.

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch
Secretary

APPENDIX A

LIST OF COMMENTERS

Comments

ACA Connects—America's Communications Association (ACA Connects) Comments (filed Jul. 1, 2022) (ACA Connects Comments)
Competitive Carriers Association (CCA) Comments (filed Jul. 1, 2022) (CCA Comments)
Consumer Technology Association (CTA) Comments (filed Jul. 1, 2022) (CTA Comments)
CTIA Comments (filed Jul. 1, 2022) (CTIA Comments)
DIRECTV, LLC Comments (filed Jul. 1, 2022) (DIRECTV Comments)
EchoStar Satellite Services, LLC and Hughes Network Systems, LLC (Echostar) Comments (filed Jul. 1, 2022) (Echostar Comments)
INCOMPAS Comments (filed Jul. 1, 2022) (INCOMPAS Comments)
musicFIRST Coalition; Future of Music Coalition (FMC) Comments (filed Jul. 1, 2022) (musicFIRST/FMC Comments)
National Association of Broadcasters (NAB) Comments (filed Jul. 4, 2022) (NAB Comments)
NCTA—The Internet & Television Association Comments (filed Jul. 1, 2022) (NCTA Comments)
NTCA—The Rural Broadband Association Comments (filed Jul. 1, 2022) (NTCA Comments)
Prison Policy Initiative (PPI) Comments (filed Jul. 1, 2022) (PPI Comments)
Redrock Broadcasting Comments (filed June 23, 2022) (Redrock Broadcasting Comments)
Rural Media Group (RMG) Comments (filed Jul. 1, 2022) (RMG Comments)
Satellite Industry Association (SIA) Comments (filed Jul. 1, 2022) (SIA Comments)
The Free State Foundation (FSF) Comments (filed Jul. 1, 2022) (FSF Comments)
USTelecom Comments (filed Jul. 1, 2022) (USTelecom Comments)
Wireless Internet Service Providers Association (WISPA) Comments (filed Jul. 1, 2022) (WISPA Comments)

Reply Comments

ABC Television Affiliates Association, CBS Television Network Affiliates Association, FBC Television Affiliates Association, NBC Television Affiliates (Four Network Affiliates Associations) Reply Comments (filed Aug. 1, 2022) (Four Network Affiliates Associations Reply)
Motion Picture Association (MPA) Reply Comments (filed Aug. 1, 2022) (MPA Reply)
musicFIRST Coalition; Future of Music Coalition (FMC) Reply Comments (filed Aug. 1, 2022) (musicFIRST /FMC Reply)
National Association of Broadcasters (NAB) Reply Comments (filed Aug. 1, 2022) (NAB Reply)
NCTA—The Internet & Television Association Reply Comments (filed Aug. 1, 2022) (NCTA Reply)
Public Knowledge, Open Technology Institute (OTI), and Consumer Reports Reply Comments (filed Aug. 1, 2022) (Public Knowledge, OTI, and Consumer Reports Reply)
Rural Media Group (RMG) Reply Comments (filed Aug. 1, 2022) (RMG Reply)
SES Americom, Inc.; O3b Limited (SES) Reply Comments (filed Aug. 1, 2022) (SES and O3b Reply)
The Free State Foundation (FSF) Reply Comments (filed Aug. 1, 2022) (FSF Reply)
USTelecom Reply Comments (filed Aug. 1, 2022) (USTelecom Reply)

Ex Partes

CTIA *Ex Parte* (filed Sept. 22, 2022) (CTIA *Ex Parte*)
INCOMPAS *Ex Parte* (filed Nov. 3, 2022) (INCOMPAS Nov. 3 *Ex Parte*)
INCOMPAS *Ex Parte* (filed Nov. 4, 2022) (INCOMPAS Nov. 4 *Ex Parte*)
Public Knowledge *Ex Parte* (filed Sept. 16, 2022) (Public Knowledge *Ex Parte*)
Recon Analytics *Ex Parte* (filed Aug. 26, 2022) (Recon Analytics *Ex Parte*)
Satellite Industry Association (SIA) *Ex Parte* (filed Sept. 6, 2022) (SIA *Ex Parte*)

APPENDIX B

FIXED BROADBAND SERVICES

APPENDIX B-1: Adoption Rate for Fixed Terrestrial Services in the United States (Dec. 31, 2021)

APPENDIX B-2: Percentage of Households Living in Census Blocks with Zero, One, Two, or At Least Three Provider Options for 25/3 Mbps Fixed Terrestrial Services (Dec. 31, 2021)

APPENDIX B-3: Percentage of Households Living in Census Blocks with Zero, One, Two, or At Least Three Provider Options for 100/20 Mbps Fixed Terrestrial Services (Dec. 31, 2021)

APPENDIX B-4: Percentage of Households Living in Census Blocks with Zero, One, Two, or At Least Three Provider Options for 940/500 Mbps Fixed Terrestrial Services (Dec. 31, 2021)

APPX. B-1
Adoption Rate for Fixed Terrestrial Services in the United States (Dec. 31, 2021)[1]

	25/3 Mbps	100/20 Mbps	940/500 Mbps
United States	79.4%	32.7%	15.9%
Alabama	68.0%	29.2%	18.7%
Alaska	66.1%	*	*
Arizona	81.5%	20.6%	*
Arkansas	60.8%	31.3%	13.7%
California	83.6%	28.0%	11.1%
Colorado	83.8%	24.4%	17.0%
Connecticut	82.4%	29.6%	3.4%
Delaware	98.8%	37.5%	*
District of Columbia	85.4%	36.8%	*
Florida	90.1%	37.7%	11.4%
Georgia	79.7%	40.3%	19.0%
Hawaii	*	*	*
Idaho	63.1%	36.1%	16.6%
Illinois	75.4%	32.6%	11.5%
Indiana	71.5%	32.4%	12.7%
Iowa	66.1%	29.0%	7.6%
Kansas	72.9%	31.3%	22.2%
Kentucky	71.0%	29.9%	9.2%
Louisiana	67.6%	26.1%	14.6%
Maine	78.5%	12.5%	1.6%
Maryland	89.9%	40.8%	*
Massachusetts	91.1%	29.1%	*
Michigan	77.8%	26.4%	8.4%
Minnesota	75.5%	20.7%	4.0%
Mississippi	56.6%	31.1%	22.0%
Missouri	67.7%	34.2%	20.1%
Montana	68.1%	16.0%	10.5%
Nebraska	73.2%	26.9%	11.2%

[1] * Data not reported to maintain confidentiality.

	25/3 Mbps	100/20 Mbps	940/500 Mbps
Nevada	82.8%	21.9%	12.3%
New Hampshire	91.9%	24.8%	1.6%
New Jersey	92.8%	57.1%	*
New Mexico	66.3%	14.8%	6.3%
New York	85.2%	50.6%	*
North Carolina	81.4%	33.2%	17.0%
North Dakota	81.6%	46.7%	3.1%
Ohio	76.8%	22.2%	6.0%
Oklahoma	65.7%	27.4%	16.4%
Oregon	78.5%	21.8%	8.9%
Pennsylvania	82.4%	29.0%	*
Puerto Rico	27.6%	9.4%	*
Rhode Island	90.2%	46.6%	*
South Carolina	81.0%	35.7%	11.4%
South Dakota	80.6%	34.2%	1.4%
Tennessee	77.5%	39.7%	19.9%
Texas	79.0%	40.0%	20.8%
Utah	81.2%	29.7%	15.5%
Vermont	73.2%	17.2%	10.1%
Virginia	81.6%	35.7%	*
Washington	79.7%	23.2%	14.1%
West Virginia	58.7%	23.3%	8.2%
Wisconsin	72.9%	20.2%	8.5%
Wyoming	74.9%	17.8%	2.6%

Source: FCC Form 477 Deployment and confidential Residential Connections Data; Staff Block Estimates.

APPX. B-2
Percentage of Households Living in Census Blocks with Zero, One, Two, or At Least Three Provider Options for 25/3 Mbps Fixed Terrestrial Services (Dec. 31, 2021)

	Households (millions)	Zero	One	Two	At least Three
United States	129.659	1.6%	8.5%	20.6%	69.3%
Alabama	2.035	5.3%	14.2%	24.2%	56.3%
Alaska	0.271	8.5%	21.1%	46.0%	24.4%
Arizona	2.756	2.1%	5.4%	10.7%	81.8%
Arkansas	1.213	6.2%	18.0%	25.3%	50.5%
California	13.588	0.3%	3.1%	12.0%	84.6%
Colorado	2.303	0.6%	2.9%	7.2%	89.3%
Connecticut	1.424	0.2%	7.4%	24.5%	67.9%
Delaware	0.394	1.8%	16.6%	36.9%	44.7%
District of Columbia	0.319	0.3%	0.5%	1.5%	97.7%
Florida	8.695	1.7%	9.2%	27.8%	61.3%
Georgia	4.080	3.2%	10.5%	26.9%	59.4%
Hawaii	0.494	0.5%	17.9%	32.5%	49.1%
Idaho	0.698	2.8%	7.5%	18.5%	71.2%
Illinois	5.012	0.6%	3.8%	12.7%	82.8%
Indiana	2.693	1.0%	5.1%	12.9%	81.1%
Iowa	1.301	0.8%	6.3%	18.4%	74.5%
Kansas	1.159	0.2%	4.5%	11.2%	84.1%
Kentucky	1.811	2.8%	15.5%	22.4%	59.3%
Louisiana	1.850	6.0%	14.6%	28.4%	51.0%
Maine	0.587	0.7%	18.0%	34.0%	47.3%
Maryland	2.336	0.8%	8.3%	28.9%	62.0%
Massachusetts	2.767	0.6%	18.0%	34.2%	47.1%
Michigan	4.060	2.6%	11.6%	24.1%	61.7%
Minnesota	2.283	0.4%	4.8%	9.0%	85.8%
Mississippi	1.169	11.6%	21.3%	27.9%	39.2%
Missouri	2.498	2.1%	7.2%	12.3%	78.4%
Montana	0.454	4.6%	16.0%	30.2%	49.3%
Nebraska	0.783	0.2%	2.4%	9.0%	88.4%
Nevada	1.200	1.1%	7.7%	22.1%	69.1%
New Hampshire	0.561	1.5%	18.0%	37.1%	43.4%

	Households (millions)	Zero	One	Two	At least Three
New Jersey	3.444	0.7%	11.9%	36.0%	51.4%
New Mexico	0.836	4.0%	11.7%	18.5%	65.7%
New York	7.755	0.3%	9.4%	26.8%	63.5%
North Carolina	4.245	1.3%	8.9%	23.3%	66.5%
North Dakota	0.326	0.4%	22.4%	34.3%	42.8%
Ohio	4.834	0.9%	7.3%	20.2%	71.6%
Oklahoma	1.550	3.0%	10.2%	19.5%	67.4%
Oregon	1.693	1.3%	4.5%	9.7%	84.6%
Pennsylvania	5.236	1.4%	13.8%	31.1%	53.7%
Puerto Rico	1.331	0.0%	0.3%	1.7%	98.0%
Rhode Island	0.443	0.1%	5.3%	42.0%	52.6%
South Carolina	2.094	2.4%	12.4%	26.3%	58.9%
South Dakota	0.357	0.7%	14.4%	16.1%	68.9%
Tennessee	2.795	2.3%	10.4%	22.7%	64.6%
Texas	10.750	0.9%	4.0%	11.9%	83.3%
Utah	1.093	0.9%	2.3%	6.6%	90.2%
Vermont	0.274	2.7%	13.7%	32.1%	51.6%
Virginia	3.353	1.9%	10.5%	30.5%	57.1%
Washington	3.026	2.3%	7.9%	16.8%	73.0%
West Virginia	0.746	6.7%	25.9%	32.4%	35.0%
Wisconsin	2.448	2.2%	11.1%	20.0%	66.6%
Wyoming	0.237	1.6%	6.5%	13.2%	78.7%

Source: Form 477 Deployment Data; Staff Block Estimates for 2021 (2020 Census Blocks)

APPX. B-3
Percentage of Households Living in Census Blocks with Zero, One, Two, or At Least Three Provider Options for 100/20 Mbps Fixed Terrestrial Services (Dec. 31, 2021)

	Households (millions)	Zero	One	Two	At least Three
United States	129.659	5.4%	30.5%	42.8%	21.3%
Alabama	2.035	12.4%	35.9%	36.7%	14.9%
Alaska	0.271	14.8%	32.6%	50.4%	2.2%
Arizona	2.756	7.6%	54.8%	31.8%	5.8%
Arkansas	1.213	22.7%	38.0%	29.7%	9.7%
California	13.588	2.0%	16.5%	38.7%	42.7%
Colorado	2.303	5.9%	24.3%	29.3%	40.5%
Connecticut	1.424	0.9%	57.6%	34.6%	6.9%
Delaware	0.394	4.7%	40.0%	54.0%	1.4%
District of Columbia	0.319	0.3%	1.3%	4.9%	93.4%
Florida	8.695	4.5%	29.9%	53.6%	12.0%
Georgia	4.080	7.0%	25.0%	54.0%	14.1%
Hawaii	0.494	0.7%	39.9%	58.5%	0.9%
Idaho	0.698	15.9%	33.8%	35.8%	14.5%
Illinois	5.012	4.3%	29.7%	44.3%	21.7%
Indiana	2.693	6.8%	28.7%	42.0%	22.5%
Iowa	1.301	4.4%	33.9%	40.6%	21.1%
Kansas	1.159	7.4%	33.2%	30.7%	28.6%
Kentucky	1.811	7.7%	34.2%	45.8%	12.4%
Louisiana	1.850	11.0%	33.9%	40.7%	14.3%
Maine	0.587	7.0%	68.8%	20.5%	3.7%
Maryland	2.336	2.2%	27.9%	65.2%	4.7%
Massachusetts	2.767	1.4%	40.8%	34.4%	23.4%
Michigan	4.060	7.7%	36.8%	34.9%	20.6%
Minnesota	2.283	3.0%	17.1%	29.8%	50.2%
Mississippi	1.169	22.1%	42.0%	27.2%	8.7%
Missouri	2.498	11.1%	27.0%	43.1%	18.8%
Montana	0.454	21.3%	62.8%	14.3%	1.7%
Nebraska	0.783	5.6%	33.6%	36.5%	24.3%
Nevada	1.200	2.6%	36.5%	42.0%	18.9%
New Hampshire	0.561	2.8%	40.3%	52.4%	4.5%

	Households (millions)	Zero	One	Two	At least Three
New Jersey	3.444	1.1%	30.5%	62.9%	5.4%
New Mexico	0.836	12.2%	25.1%	29.5%	33.2%
New York	7.755	0.5%	22.5%	43.3%	33.8%
North Carolina	4.245	3.7%	36.6%	43.9%	15.9%
North Dakota	0.326	0.8%	53.4%	25.7%	20.1%
Ohio	4.834	4.2%	37.3%	37.9%	20.6%
Oklahoma	1.550	13.4%	39.1%	41.6%	5.9%
Oregon	1.693	5.9%	22.7%	52.1%	19.3%
Pennsylvania	5.236	2.8%	36.7%	52.4%	8.0%
Puerto Rico	1.331	0.0%	6.1%	20.4%	73.5%
Rhode Island	0.443	0.2%	12.2%	87.2%	0.4%
South Carolina	2.094	6.9%	34.6%	41.9%	16.6%
South Dakota	0.357	6.8%	37.4%	40.2%	15.6%
Tennessee	2.795	6.2%	32.5%	45.9%	15.5%
Texas	10.750	5.6%	25.4%	42.2%	26.9%
Utah	1.093	3.5%	29.3%	28.7%	38.6%
Vermont	0.274	11.0%	43.2%	41.6%	4.2%
Virginia	3.353	5.2%	28.5%	57.3%	9.1%
Washington	3.026	10.8%	39.3%	42.1%	7.8%
West Virginia	0.746	16.7%	64.4%	16.6%	2.2%
Wisconsin	2.448	9.9%	39.4%	44.9%	5.7%
Wyoming	0.237	8.4%	15.8%	41.4%	34.4%

Source: Form 477 Deployment Data; Staff Block Estimates for 2021 (2020 Census Blocks)

APPX. B-4
Percentage of Households Living in Census Blocks with Zero, One, Two, or At Least Three Provider Options for 940/500 Mbps Fixed Terrestrial Services (Dec. 31, 2021)

	Households (millions)	Zero	One	Two	At least Three
United States	129.659	54.9%	41.0%	3.7%	0.4%
Alabama	2.035	59.9%	35.7%	4.3%	0.0%
Alaska	0.271	97.2%	2.8%	0.0%	0.0%
Arizona	2.756	80.0%	17.3%	2.7%	0.0%
Arkansas	1.213	64.7%	30.8%	4.0%	0.5%
California	13.588	57.6%	37.9%	4.3%	0.2%
Colorado	2.303	65.3%	32.7%	2.0%	0.0%
Connecticut	1.424	62.9%	32.7%	4.3%	0.1%
Delaware	0.394	43.3%	56.7%	0.0%	0.0%
District of Columbia	0.319	15.2%	84.5%	0.3%	0.0%
Florida	8.695	52.6%	44.6%	2.4%	0.4%
Georgia	4.080	47.1%	49.4%	3.5%	0.0%
Hawaii	0.494	39.8%	60.2%	0.0%	0.0%
Idaho	0.698	70.6%	26.0%	3.3%	0.1%
Illinois	5.012	73.1%	24.9%	1.8%	0.2%
Indiana	2.693	54.9%	40.8%	4.1%	0.1%
Iowa	1.301	56.1%	39.0%	4.3%	0.6%
Kansas	1.159	50.5%	37.7%	11.0%	0.8%
Kentucky	1.811	47.8%	46.8%	5.3%	0.0%
Louisiana	1.850	64.6%	30.7%	4.3%	0.4%
Maine	0.587	82.7%	16.1%	1.2%	0.0%
Maryland	2.336	33.9%	65.5%	0.5%	0.1%
Massachusetts	2.767	51.8%	48.1%	0.1%	0.0%
Michigan	4.060	77.3%	21.7%	1.0%	0.0%
Minnesota	2.283	25.5%	48.4%	21.3%	4.8%
Mississippi	1.169	59.5%	31.3%	8.5%	0.6%
Missouri	2.498	58.6%	37.7%	3.7%	0.0%
Montana	0.454	83.2%	15.6%	1.2%	0.1%
Nebraska	0.783	58.6%	33.7%	6.9%	0.9%
Nevada	1.200	70.3%	24.9%	4.5%	0.3%
New Hampshire	0.561	39.3%	58.3%	2.5%	0.0%
New Jersey	3.444	32.0%	67.9%	0.1%	0.0%

	Households (millions)	Zero	One	Two	At least Three
New Mexico	0.836	80.1%	18.5%	1.4%	0.0%
New York	7.755	35.0%	60.4%	4.3%	0.3%
North Carolina	4.245	54.4%	38.8%	6.8%	0.0%
North Dakota	0.326	33.0%	50.0%	16.5%	0.5%
Ohio	4.834	65.2%	34.2%	0.6%	0.0%
Oklahoma	1.550	59.2%	34.5%	5.5%	0.8%
Oregon	1.693	48.1%	48.9%	2.9%	0.0%
Pennsylvania	5.236	58.6%	41.0%	0.3%	0.0%
Puerto Rico	1.331	50.1%	43.5%	6.2%	0.2%
Rhode Island	0.443	15.8%	83.9%	0.3%	0.0%
South Carolina	2.094	56.4%	39.8%	3.5%	0.2%
South Dakota	0.357	50.3%	37.4%	11.1%	1.1%
Tennessee	2.795	45.6%	47.3%	6.9%	0.2%
Texas	10.750	48.1%	46.4%	4.9%	0.6%
Utah	1.093	46.6%	22.8%	15.0%	15.6%
Vermont	0.274	52.0%	44.2%	3.6%	0.2%
Virginia	3.353	45.9%	53.1%	1.0%	0.0%
Washington	3.026	60.7%	36.8%	1.1%	1.4%
West Virginia	0.746	93.2%	6.7%	0.2%	0.0%
Wisconsin	2.448	73.6%	25.8%	0.6%	0.0%
Wyoming	0.237	75.4%	23.0%	1.5%	0.0%

Source: Form 477 Deployment Data; Staff Block Estimates for 2021 (2020 Census Blocks)

APPENDIX C

MEASURING BROADBAND AMERICA REPORT

The *Eleventh Measuring Broadband America Report* is published as an Appendix attachment to the *2022 Communications Marketplace Report*. It can be accessed here: https://www.fcc.gov/reports-research/reports/consolidated-communications-marketplace-reports/CMR-2022.

APPENDIX D

MOBILE WIRELESS SERVICES

APPX. D-1
Estimated Total Mobile Wireless Connections: 2003–2021

	NRUF			CTIA
Year	Connections (millions)	Increase from previous year (millions)	Connections Per 100 People	Estimated Connections (millions)
2003	160.6	18.8	54	158.7
2004	184.7	24.1	62	182.1
2005	213.0	28.3	71	207.9
2006	241.8	28.8	80	233.0
2007	263.0	21.2	86	255.4
2008	279.6	16.6	91	270.3
2009	290.7	11.1	94	285.6
2010	301.8	11.1	97	296.3
2011	317.3	15.5	101	316.0
2012	329.2	11.9	105	326.5
2013	339.2	10.0	108	335.7
2014	357.1	17.2	114	355.4
2015	378.2	21.1	121	377.9
2016	398.4	20.2	127	395.9
2017	410.7	12.3	126	400.2
2018	421.7	11.0	128	421.8
2019	430.3	8.6	130	442.5
2020	438.7	8.4	132	468.9
2021	456.9	18.2	138	498.9

Source: NRUF 2003–2021; CTIA Year-End 2021 Wireless Industry Indices Report; Census data.

APPX. D-2
Change in CPI, 1997-2021

Year	CPI		Wireless Telephone Services CPI		Telephone Services CPI		Residential Telephone Services CPI	
	Annual Index Average	Annual Change	Annual Index Average	Annual Change	Annual Index Average	Annual Change	Annual Index Average	Annual Change
1997	100.0		100.0		100.0			
1998	101.6	1.6%	95.1		100.7			
1999	103.8	2.2%	84.9	-10.7%	100.1	-0.6%		
2000	107.3	3.4%	76.0	-10.5%	98.5	-1.6%		
2001	110.3	2.8%	68.1	-10.4%	99.3	0.8%		
2002	112.1	1.6%	67.4	-1.0%	99.7	0.4%		
2003	114.6	2.3%	66.8	-0.9%	98.3	-1.4%		
2004	117.7	2.7%	66.2	-0.9%	95.8	-2.5%		
2005	121.7	3.4%	65.0	-1.8%	94.9	-0.9%		
2006	125.6	3.2%	64.6	-0.6%	95.8	0.9%		
2007	129.2	2.9%	64.4	-0.3%	98.2	2.6%		
2008	134.1	3.8%	64.2	-0.2%	100.5	2.2%		
2009	133.7	-0.4%	64.3	0.0%	102.4	1.9%	100.0	
2010	135.8	1.6%	62.4	-2.9%	102.4	0.0%	101.6	
2011	140.1	3.2%	60.1	-3.6%	101.2	-1.1%	103.3	1.7%
2012	143.0	2.1%	59.7	-0.8%	101.7	0.5%	105.6	2.2%
2013	145.1	1.5%	58.6	-1.8%	101.6	-0.1%	108.1	2.4%
2014	147.5	1.6%	57.4	-2.1%	101.1	-0.4%	111.1	2.7%
2015	147.7	0.1%	55.2	-3.8%	99.3	-1.8%	113.4	2.1%
2016	149.5	1.3%	54.7	-1.0%	98.8	-0.5%	114.5	1.0%
2017	152.7	2.1%	48.8	-10.7%	91.8	-7.2%	116.1	1.4%
2018	156.5	2.4%	47.6	-2.5%	90.4	-1.5%	117.2	1.0%
2019	159.3	1.8%	46.4	-2.5%	89.4	-1.1%	120.8	3.0%
2020	161.3	1.3%	47.3	2.0%	92.2	3.2%	128.9	6.7%
2021	165.9	2.9%	48.2	1.7%	94.4	2.4%	136.2	5.7%
1997 to 2021		**65.9%**		**-51.8%**		**-5.6%**		**36.2%**

Source: Data from Bureau of Labor Statistics. All CPI figures were taken from BLS databases. Bureau of Labor Statistics, https://www.bls.gov/. Beginning of January 2010, the CPIs for local telephone service and long-distance were discontinued and replaced by a new CPI for land-line (now renamed as residential) telephone service.[1] Unadjusted for inflation.

[1] The index used in this analysis, the CPI for All Urban Consumers (CPI-U), represents about 93% of the total U.S. population. Bureau of Labor Statistics, Consumer Price Index: Frequently Asked Questions, https://www.bls.gov/cpi/questions-and-answers.htm. The CPI category "Telephone Services" has two components: wireless telephone services and landline telephone services. Additional information can be found at Bureau of Labor Statistics, Consumer Price Index: How the Consumer Price Index Measures Price Change for Telephone Services, https://www.bls.gov/cpi/factsheets/telephone-services htm.

APPX. D-3
Annualized Average Revenue Per Reported Subscriber Unit (ARPU): 1993–2021

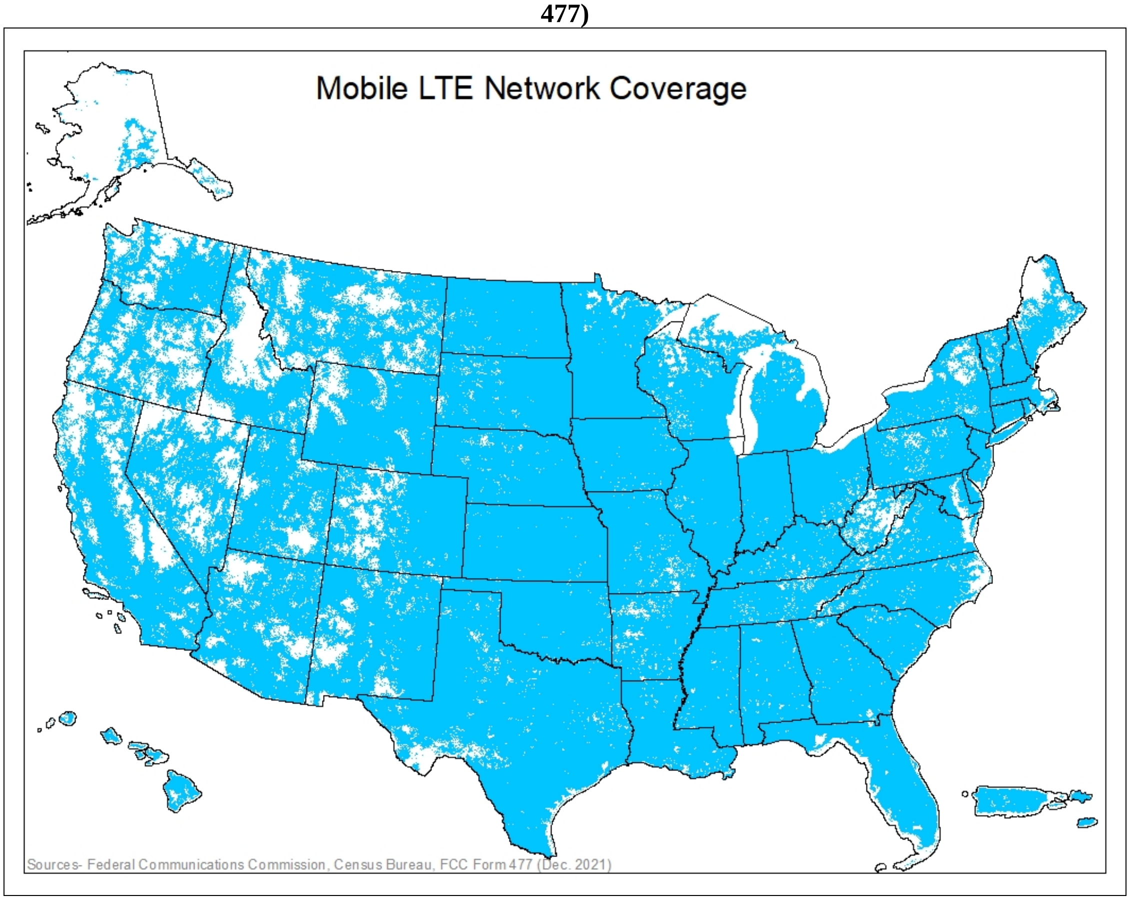
Year	Total Annual Service Revenue (thousands)	Percentage Change	Average Reported Subscribers	Average Monthly Revenue per Active Subscriber Unit
1993	$10,895,175		11,861,362	$76.55
1994	$14,229,922	30.6%	18,299,487	$64.80
1995	$19,081,239	34.1%	26,757,320	$59.43
1996	$23,634,971	23.9%	35,554,818	$55.40
1997	$27,485,633	16.3%	46,375,849	$49.39
1998	$33,133,175	20.6%	58,455,471	$47.23
1999	$40,018,489	20.8%	71,885,076	$46.39
2000	$52,466,020	31.1%	90,048,320	$48.55
2001	$65,316,235	24.5%	109,318,848	$49.79
2002	$76,508,187	17.1%	125,002,023	$51.00
2003	$87,624,093	14.5%	141,658,059	$51.55
2004	$102,121,210	16.5%	161,980,026	$52.54
2005	$113,538,221	11.2%	186,801,940	$50.65
2006	$125,456,825	10.5%	213,077,033	$49.07
2007	$138,869,304	10.7%	234,921,960	$49.26
2008	$148,084,170	6.6%	252,539,475	$48.87
2009	$152,551,854	3.0%	265,038,212	$47.97
2010	$159,929,648	4.9%	280,392,201	$47.53
2011	$169,767,314	6.2%	306,840,648	$46.11
2012	$185,013,936	9.0%	314,685,754	$48.99
2013	$189,192,812	2.3%	323,133,932	$48.79
2014	$187,848,477	(0.7%)	335,606,098	$46.64
2015	$191,949,025	2.2%	358,228,494	$44.65
2016	$188,524,256	(1.8%)	378,554,642	$41.50
2017	$179,091,135	(5.0%)	386,013,771	$38.66
2018	$182,779,484	2.1%	402,376,536	$37.85
2019	$187,361,982	2.5%	423,609,827	$36.86
2020	$189,912,414	1.4%	448,206,414	$35.31
2021	$204,214,004	7.5%	476,179,415	$35.74

Source: CTIA Year-End 2021 Wireless Industry Indices Report.

APPX. D-4
Mobile Wireless Coverage Maps

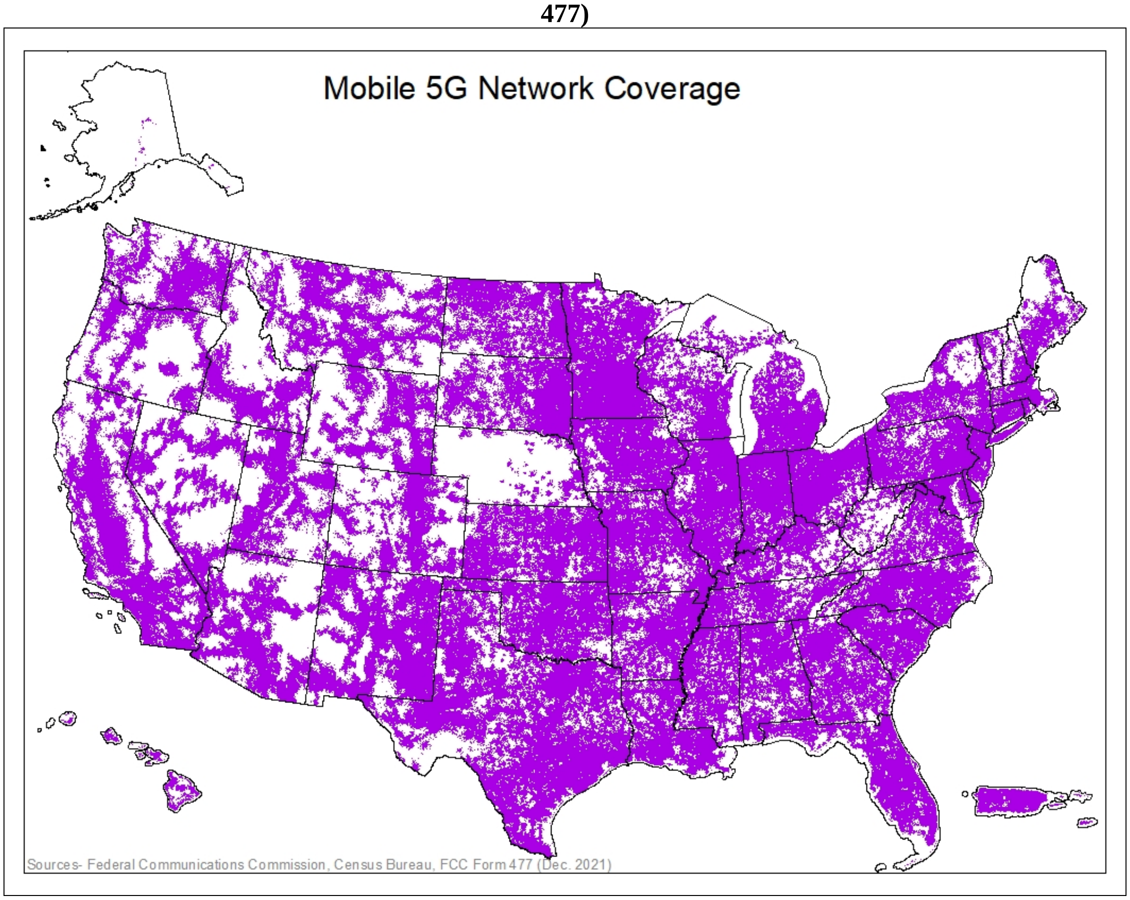
The maps presented below are based on Commission estimates derived from census block analysis of December 2021 FCC Form 477 coverage maps, using the centroid methodology.[2]

Nationwide 4G LTE Coverage, Year-End 2021 (FCC Form 477)



[2] The centroid methodology provides estimates of the percentage of the population located in census blocks with a certain number of service providers and represents network coverage. That a particular service provider has indicated that it has network coverage in a particular census block does not necessarily mean that it offers service to residents in that census block. In addition, the fact that a service provider reports coverage in a particular census block does not mean that it necessarily provides coverage everywhere in the census block. This is likely to be particularly relevant in larger rural census blocks. For both these reasons, the number of service providers in a census block does not necessarily reflect the number of choices available to a particular individual or household.

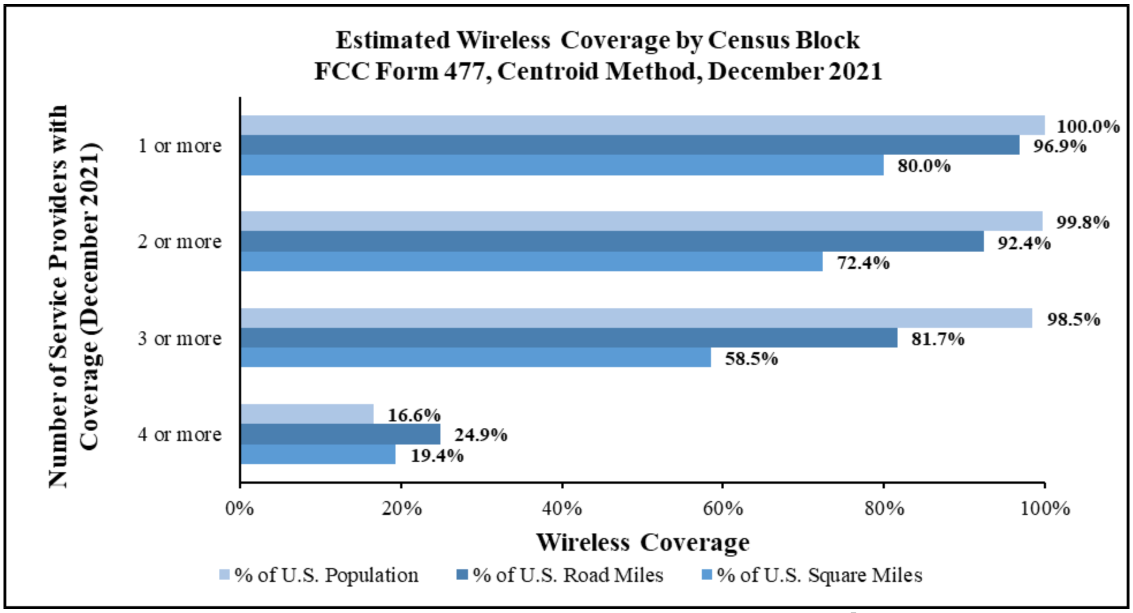
Nationwide 5G Coverage, Year-End 2021 (FCC Form 477)



APPX. D-5
Mobile Wireless Coverage

The figures presented below are based on Commission estimates derived from census block analysis of December 2021 FCC Form 477 coverage maps, using both the centroid[3] and the actual area[4] coverage methodologies.

Appx. D-5.i



Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.[5]

[3] The centroid methodology is applied to U.S. census blocks overlaid on service provider coverage maps. Under this methodology, if the geometric center point, or centroid, of a census block is within the coverage boundary of a coverage map, then we consider that block to be "covered" by that service provider and/or technology. We then aggregate the population, land area, and road miles of the covered census blocks to generate our total coverage estimates. We note that these coverage estimates represent deployment of mobile networks and do not indicate the extent to which service providers affirmatively offer service to residents in the covered areas. While we recognize that this analysis likely overstates the coverage experienced by some consumers, especially in large or irregularly shaped census blocks, we find that it is nonetheless useful because estimated coverage can be compared across network technologies and service providers. For a more detailed discussion of the centroid methodology, *see Twentieth Wireless Competition Report*, 32 FCC Rcd at 9016, para. 71.

[4] For the actual area methodology, since we do not know the distribution of either the population or road miles at the sub-census block level, as noted above, we must approximate the percentage that is covered by each technology. To do this, we assume that both population and road miles are distributed uniformly across each census block. The fraction of the population or road miles covered in a census block is assumed to be proportional to the fraction of the actual area covered. We then sum the estimated covered population (road miles) across blocks to estimate the total covered population (road miles) within the United States. Unlike the centroid methodology where each block is either covered or not, the actual area coverage methodology acknowledges that many blocks are only partially covered. Because it is unclear which census blocks should be considered covered or not, we do not report the number of blocks covered in these results. This applies to all figures using the actual area methodology.

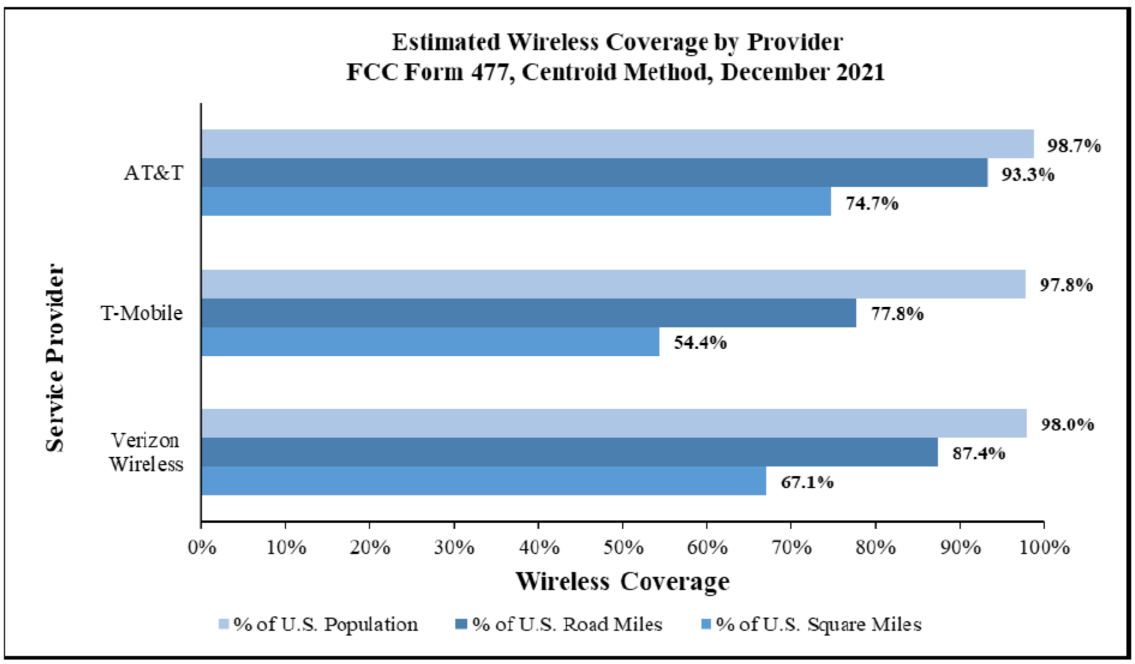
[5] Note that the number of service providers in a census block represents network coverage only. Network coverage does not necessarily reflect the number of service providers that actively offer service to individuals located in a given area. This applies to all figures presented in Appx. D.

Appx. D-5.ii
***Estimated* Overall Wireless Coverage by Census Block**
FCC Form 477, Centroid Method, Dec. 2021

Number of Providers with Coverage in a Block	Number of Blocks	Population Contained in Those Blocks	% of Total U.S. Population	Square Miles Contained in Those Blocks	% of Total U.S. Square Miles	Road Miles Contained in Those Blocks	% of Total U.S. Road Miles
U.S. Total	*7,935,728*	*334,724,982*	*100.0%*	*3,577,898*	*100.0%*	*6,867,154*	*100.0%*
1 or more	7,871,050	334,561,534	100.0%	2,860,882	80.0%	6,652,412	96.9%
2 or more	7,765,320	333,901,413	99.8%	2,590,798	72.4%	6,347,038	92.4%
3 or more	7,399,111	329,697,486	98.5%	2,094,052	58.5%	5,609,021	81.7%
4 or more	1,907,155	55,594,774	16.6%	693,872	19.4%	1,709,517	24.9%

Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.iii



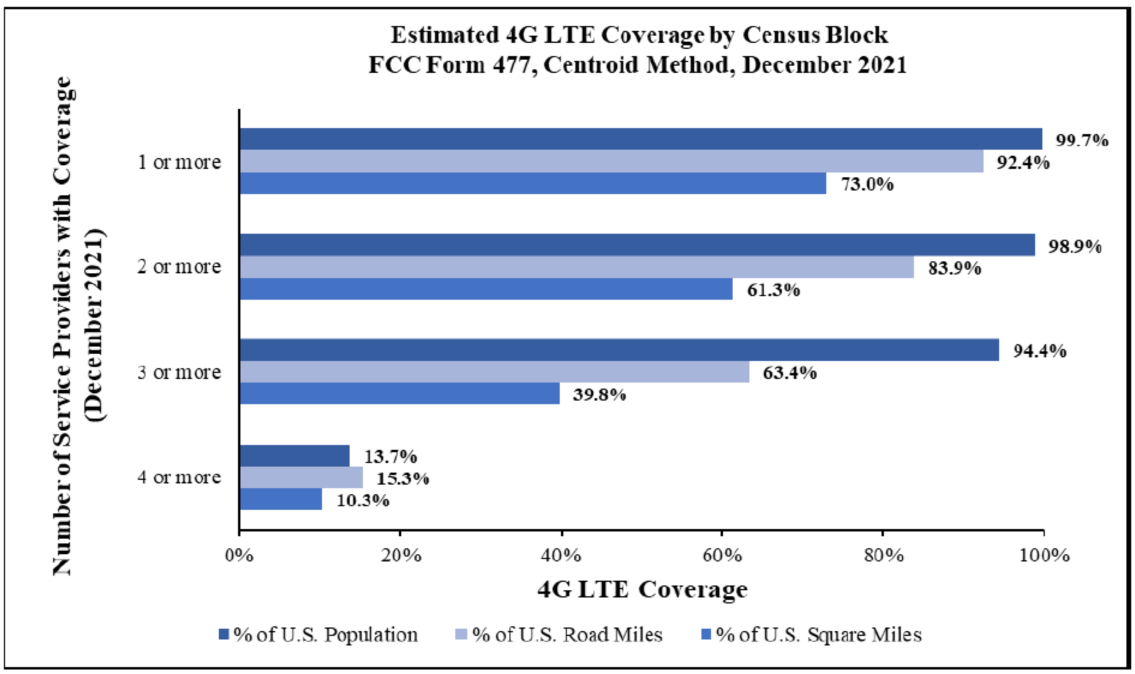
Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.iv
***Estimated* Overall Wireless Coverage in the United States by Provider**
FCC Form 477, Centroid Method, Dec. 2021

Provider	Number of Blocks	Population Contained in Those Blocks	% of Total U.S. Population	Square Miles Contained in Those Blocks	% of Total U.S. Square Miles	Road Miles Contained in Those Blocks	% of Total U.S. Road Miles
U.S. Total	*7,935,728*	*334,724,982*	*100.0%*	*3,577,898*	*100.0%*	*6,867,154*	*100.0%*
AT&T	7,741,641	330,523,156	98.7%	2,673,479	74.7%	6,403,757	93.3%
T-Mobile	7,212,492	327,255,910	97.8%	1,945,984	54.4%	5,339,834	77.8%
Verizon Wireless	7,516,496	327,929,288	98.0%	2,401,215	67.1%	6,005,105	87.4%

Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.v



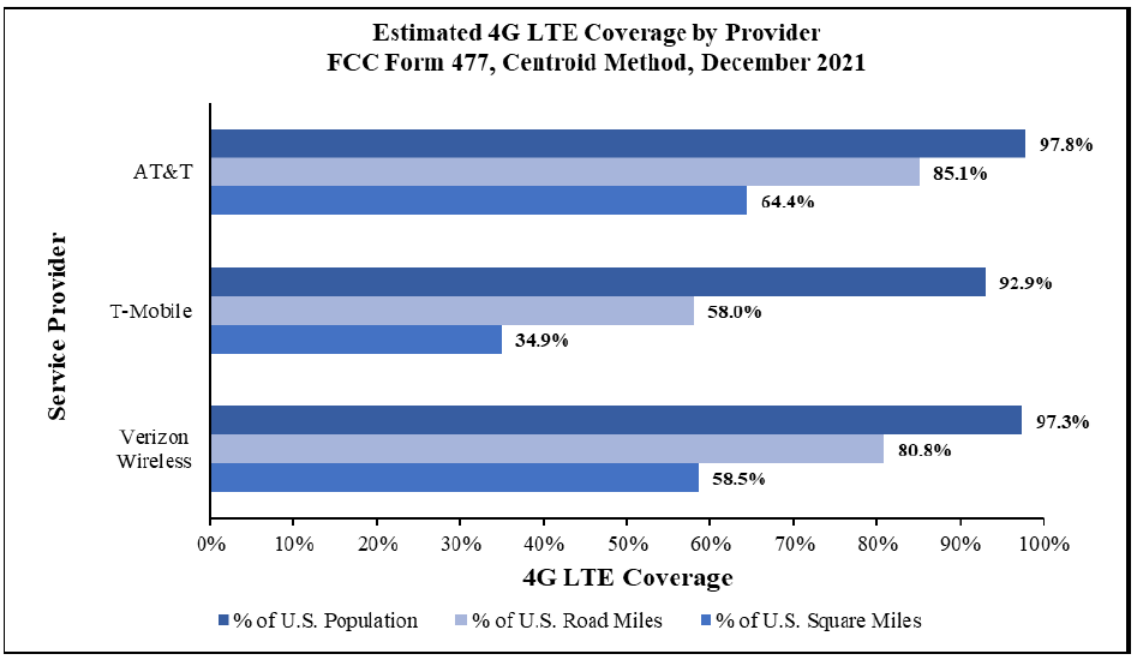
Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.vi
***Estimated* 4G LTE Coverage by Census Block**
FCC Form 477, Centroid Method, Dec.2021

Number of Providers with Coverage in a Block	Number of Blocks	Population Contained in Those Blocks	% of Total U.S. Population	Square Miles Contained in Those Blocks	% of Total U.S. Square Miles	Road Miles Contained in Those Blocks	% of Total U.S. Road Miles
U.S. Total	*7,935,728*	*334,724,982*	*100.0%*	*3,577,898*	*100.0%*	*6,867,154*	*100.0%*
1 or more	7,757,998	333,724,607	99.7%	2,610,855	73.0%	6,345,822	92.4%
2 or more	7,508,874	330,987,667	98.9%	2,192,776	61.3%	5,759,305	83.9%
3 or more	6,627,901	316,056,904	94.4%	1,423,490	39.8%	4,351,974	63.4%
4 or more	1,439,574	46,008,629	13.7%	367,669	10.3%	1,053,948	15.3%

Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.vii



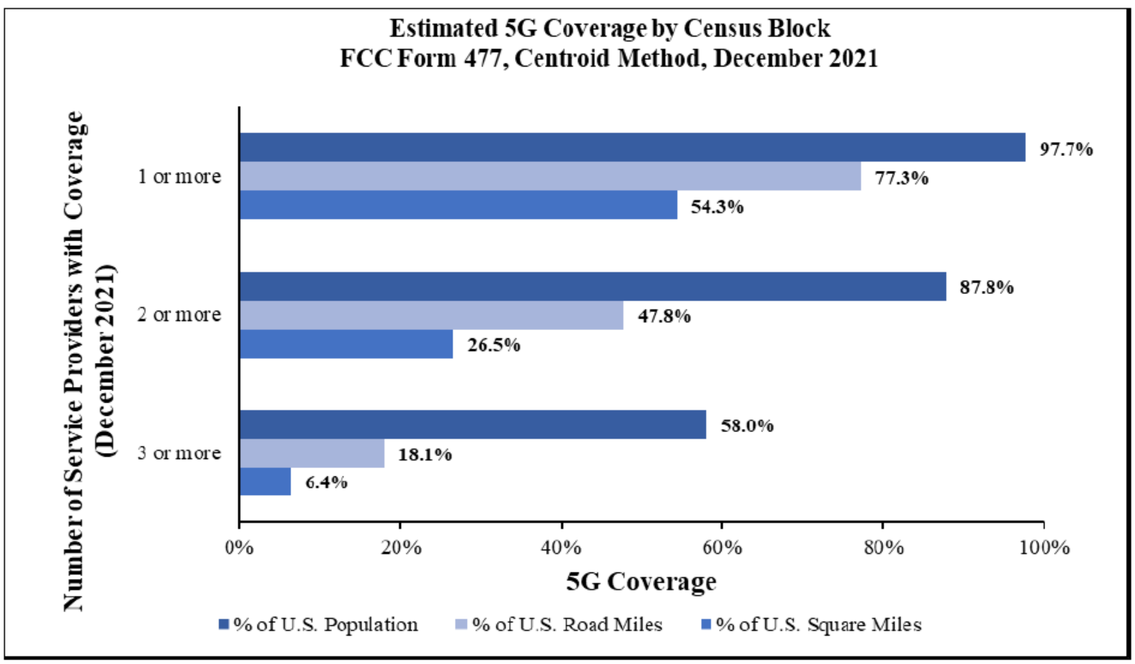
Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.viii
***Estimated* 4G LTE Coverage in the United States by Provider**
FCC Form 477, Centroid Method, Dec. 2021

Provider	Number of Blocks	Population Contained in Those Blocks	% of Total U.S. Population	Square Miles Containe d in Those Blocks	% of Total U.S. Square Miles	Road Miles Contained in Those Blocks	% of Total U.S. Road Miles
U.S. Total	*7,935,728*	*334,724,982*	*100.0%*	*3,577,898*	*100.0%*	*6,867,154*	*100.0%*
AT&T	7,479,356	327,403,101	97.8%	2,303,837	64.4%	5,845,295	85.1%
T-Mobile	6,317,629	310,941,047	92.9%	1,248,390	34.9%	3,980,869	58.0%
Verizon Wireless	7,310,821	325,718,384	97.3%	2,094,826	58.5%	5,548,533	80.8%

Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.ix



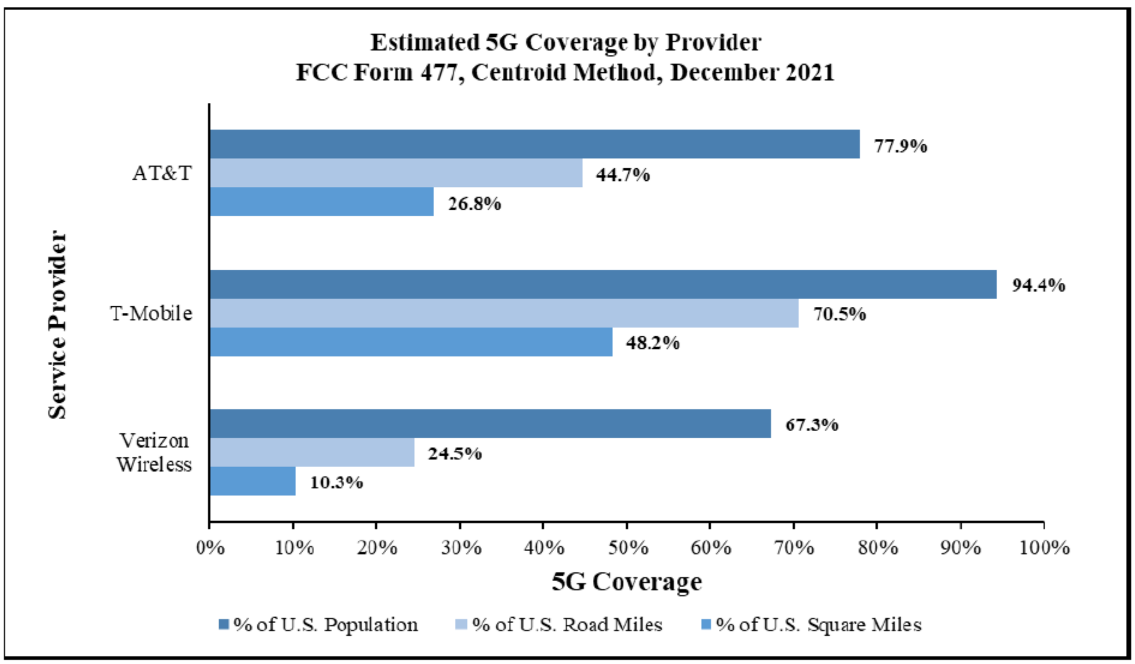
Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.x
***Estimated* 5G Coverage by Census Block**
FCC Form 477, Centroid Method, Dec. 2021

Number of Providers with Coverage in a Block	Number of Blocks	Population Contained in Those Blocks	% of Total U.S. Population	Square Miles Contained in Those Blocks	% of Total U.S. Square Miles	Road Miles Contained in Those Blocks	% of Total U.S. Road Miles
U.S. Total	*7,935,728*	*334,724,982*	*100.0%*	*3,577,898*	*100.0%*	*6,867,154*	*100.0%*
1 or more	7,205,179	327,081,784	97.7%	1,943,406	54.3%	5,305,997	77.3%
2 or more	5,592,678	294,033,829	87.8%	949,428	26.5%	3,282,635	47.8%
3 or more	2,880,359	194,175,083	58.0%	230,465	6.4%	1,241,102	18.1%

Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xi



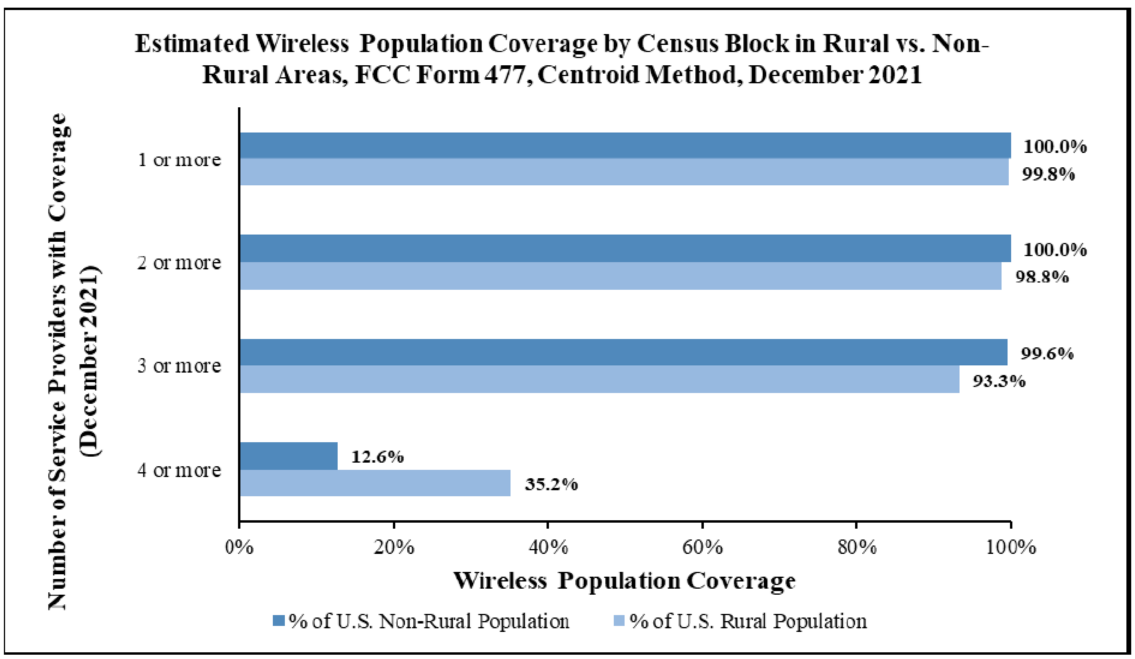
Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xii
***Estimated* 5G Coverage in the United States by Provider**
FCC Form 477, Centroid Method, Dec. 2021

Provider	Number of Blocks	Population Contained in Those Blocks	% of Total U.S. Population	Square Miles Contained in Those Blocks	% of Total U.S. Square Miles	Road Miles Contained in Those Blocks	% of Total U.S. Road Miles
U.S. Total	*7,935,728*	*334,724,982*	*100.0%*	*3,577,898*	*100.0%*	*6,867,154*	*100.0%*
AT&T	4,994,400	260,800,459	77.9%	960,155	26.8%	3,066,658	44.7%
T-Mobile	6,780,958	316,007,565	94.4%	1,725,734	48.2%	4,844,187	70.5%
Verizon Wireless	3,510,954	225,178,007	67.3%	369,222	10.3%	1,683,968	24.5%

Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xiii



Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xiv
***Estimated* Wireless Coverage in Rural Areas by Census Block**
FCC Form 477, Centroid Method, Dec. 2021

Number of Providers with Coverage in a Block	Number of Blocks	Population Contained in Those Blocks	% of Total Rural U.S. Population	Square Miles Contained in Those Blocks	% of Total Rural U.S. Square Miles	Road Miles Contained in Those Blocks	% of Total Rural U.S. Rural Road Miles
U.S. Total	*3,433,590*	*58,782,633*	*100.0%*	*3,023,291*	*100.0%*	*4,572,033*	*100.0%*
1 or more	3,372,995	58,638,630	99.8%	2,317,883	76.7%	4,368,517	95.5%
2 or more	3,277,029	58,092,421	98.8%	2,065,078	68.3%	4,083,648	89.3%
3 or more	2,955,454	54,846,921	93.3%	1,607,301	53.2%	3,410,590	74.6%
4 or more	1,177,167	20,690,931	35.2%	590,291	19.5%	1,288,735	28.2%

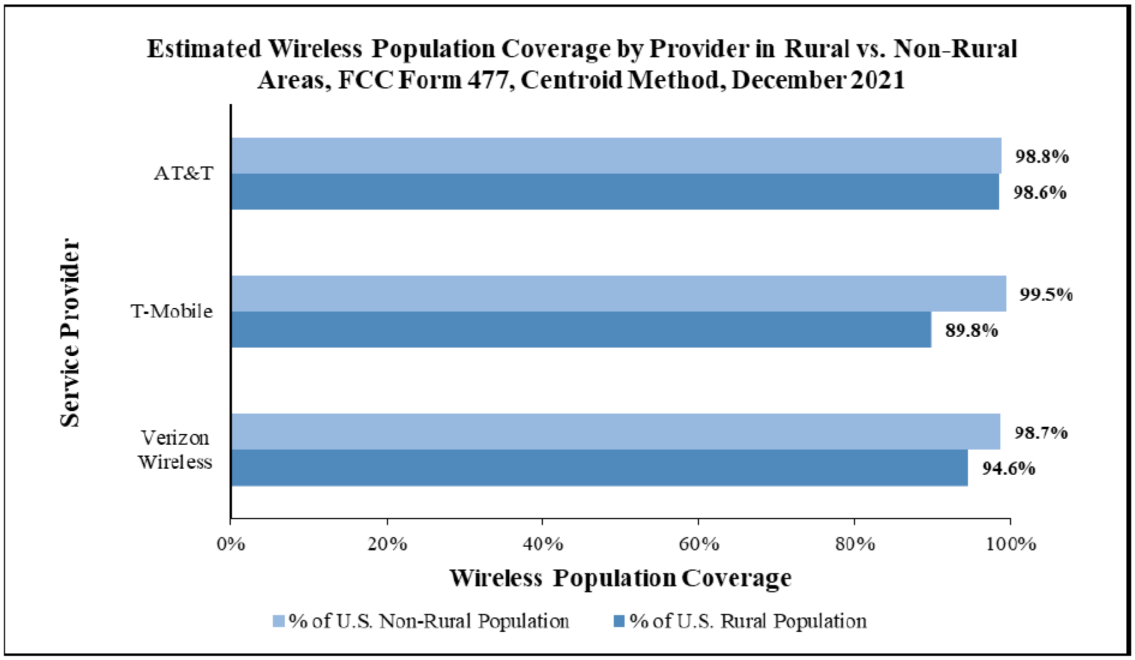
Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xv
***Estimated* Wireless Coverage in Non-Rural Areas by Census Block**
FCC Form 477, Centroid Method, Dec. 2021

Number of Providers with Coverage in a Block	Number of Blocks	Population Contained in Those Blocks	% of Total Non-Rural U.S. Population	Square Miles Contained in Those Blocks	% of Total Non-Rural U.S. Square Miles	Road Miles Contained in Those Blocks	% of Total Non-Rural U.S. Road Miles
U.S. Total	*4,502,138*	*275,942,349*	*100.0%*	*554,607*	*100.0%*	*2,295,121*	*100.0%*
1 or more	4,498,055	275,922,904	100.0%	542,999	97.9%	2,283,895	99.5%
2 or more	4,488,291	275,808,992	100.0%	525,720	94.8%	2,263,391	98.6%
3 or more	4,443,657	274,850,565	99.6%	486,751	87.8%	2,198,431	95.8%
4 or more	729,988	34,903,843	12.6%	103,581	18.7%	420,782	18.3%

Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xvi



Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xvii
Estimated Rural Wireless Coverage in the United States by Provider
FCC Form 477, Centroid Method, Dec. 2021

Provider	Number of Blocks	Population Contained in Those Blocks	% of Total Rural U.S. Population	Road Miles Contained in Those Blocks	% of Total U.S. Rural Road Miles
U.S. Total	*3,433,590*	*58,782,633*	*100.0%*	*4,572,033*	*100.0%*
AT&T	3,288,254	57,930,559	98.6%	4,152,244	90.8%
T-Mobile	2,773,254	52,784,270	89.8%	3,147,003	68.8%
Verizon Wireless	3,079,423	55,599,817	94.6%	3,779,667	82.7%

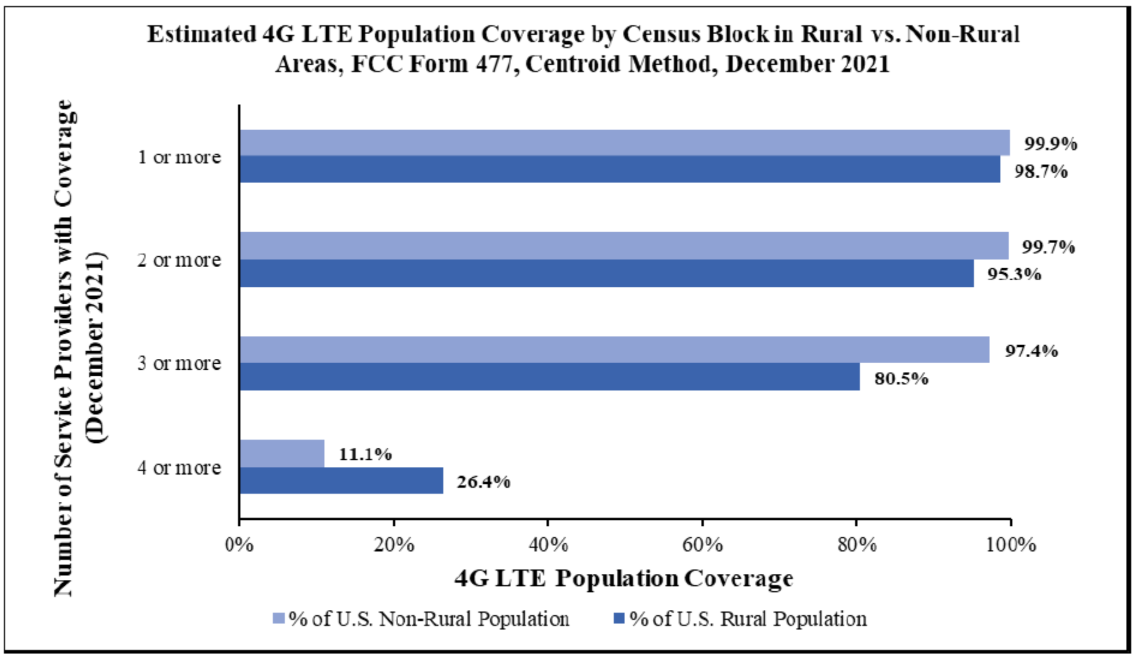
Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xviii
***Estimated* Non-Rural Wireless Coverage in the United States by Provider**
FCC Form 477, Centroid Method, Dec. 2021

Provider	Number of Blocks	Population Contained in Those Blocks	% of Total Non-Rural U.S. Population	Road Miles Contained in Those Blocks	% of Total Non-Rural U.S. Road Miles
U.S. Total	*4,502,138*	*275,942,349*	*100.0%*	*2,295,121*	*100.0%*
AT&T	4,453,387	272,592,597	98.8%	2,251,513	98.1%
T-Mobile	4,439,238	274,471,640	99.5%	2,192,831	95.5%
Verizon Wireless	4,437,073	272,329,471	98.7%	2,225,438	97.0%

Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xix



Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xx
***Estimated* 4G LTE Coverage in *Rural* Areas by Census Block**
FCC Form 477, Centroid Method, Dec. 2021

Number of Providers with Coverage in a Block	Number of Blocks	Population Contained in Those Blocks	% of Total Rural U.S. Population	Square Miles Contained in Those Blocks	% of Total Rural U.S. Square Miles	Road Miles Contained in Those Blocks	% of Total Rural U.S. Road Miles
U.S. Total	*3,433,590*	*58,782,633*	*100.0%*	*3,023,291*	*100.0%*	*4,572,033*	*100.0%*
1 or more	3,273,050	57,995,446	98.7%	2,084,489	68.9%	4,086,696	89.4%
2 or more	3,058,277	56,002,476	95.3%	1,702,792	56.3%	3,559,809	77.9%
3 or more	2,371,296	47,338,437	80.5%	1,037,821	34.3%	2,381,010	52.1%
4 or more	810,697	15,499,734	26.4%	298,539	9.9%	730,965	16.0%

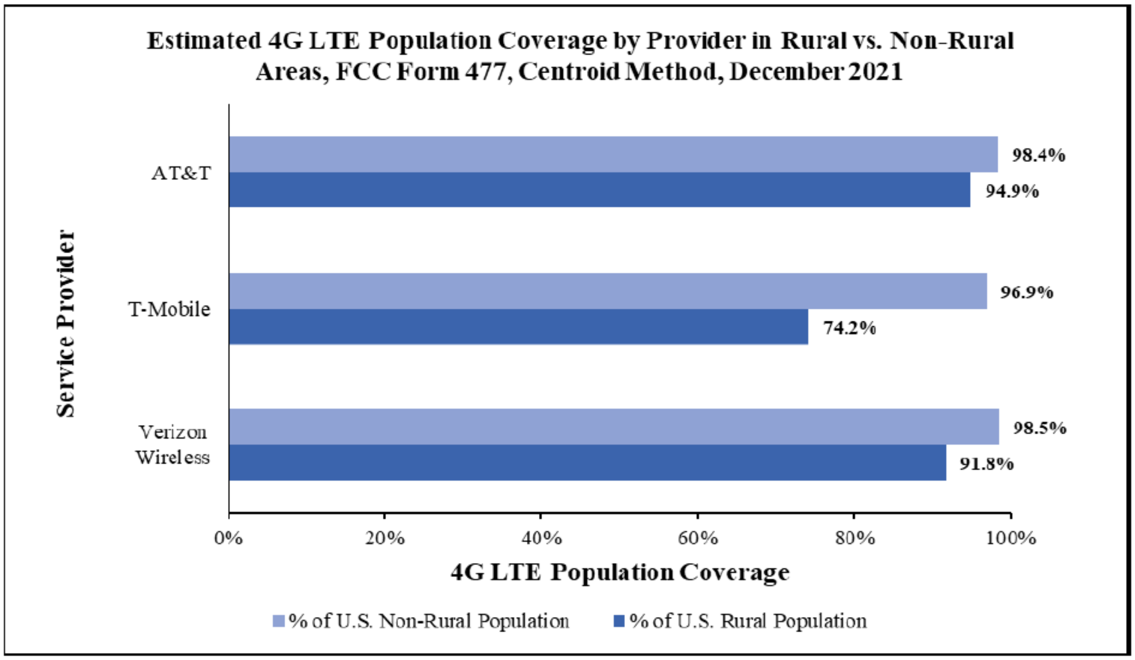
Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xxi
***Estimated* 4G LTE Coverage in *Non-Rural* Areas by Census Block**
FCC Form 477, Centroid Method, Dec. 2021

Number of Providers with Coverage in a Block	Number of Blocks	Population Contained in Those Blocks	% of Total Non-Rural U.S. Population	Square Miles Contained in Those Blocks	% of Total Non-Rural U.S. Square Miles	Road Miles Contained in Those Blocks	% of Total Non-Rural U.S. Road Miles
U.S. Total	*4,502,138*	*275,942,349*	*100.0%*	*554,607*	*100.0%*	*2,295,121*	*100.0%*
1 or more	4,484,948	275,729,161	99.9%	526,366	94.9%	2,259,126	98.4%
2 or more	4,450,597	274,985,191	99.7%	489,984	88.3%	2,199,496	95.8%
3 or more	4,256,605	268,718,467	97.4%	385,669	69.5%	1,970,964	85.9%
4 or more	628,877	30,508,895	11.1%	69,130	12.5%	322,983	14.1%

Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xxii



Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xxiii
***Estimated* Rural 4G LTE Coverage in the United States by Provider**
FCC Form 477, Centroid Method, Dec. 2021

Provider	Number of Blocks	Population Contained in Those Blocks	% of Total Rural U.S. Population	Road Miles Contained in Those Blocks	% of Total U.S. Rural Road Miles
U.S. Total	*3,433,590*	*58,782,633*	*100.0%*	*4,572,033*	*100.0%*
AT&T	3,066,626	55,810,207	94.9%	3,659,726	80.0%
T-Mobile	2,093,650	43,601,040	74.2%	2,037,091	44.6%
Verizon Wireless	2,900,457	53,949,050	91.8%	3,367,120	73.6%

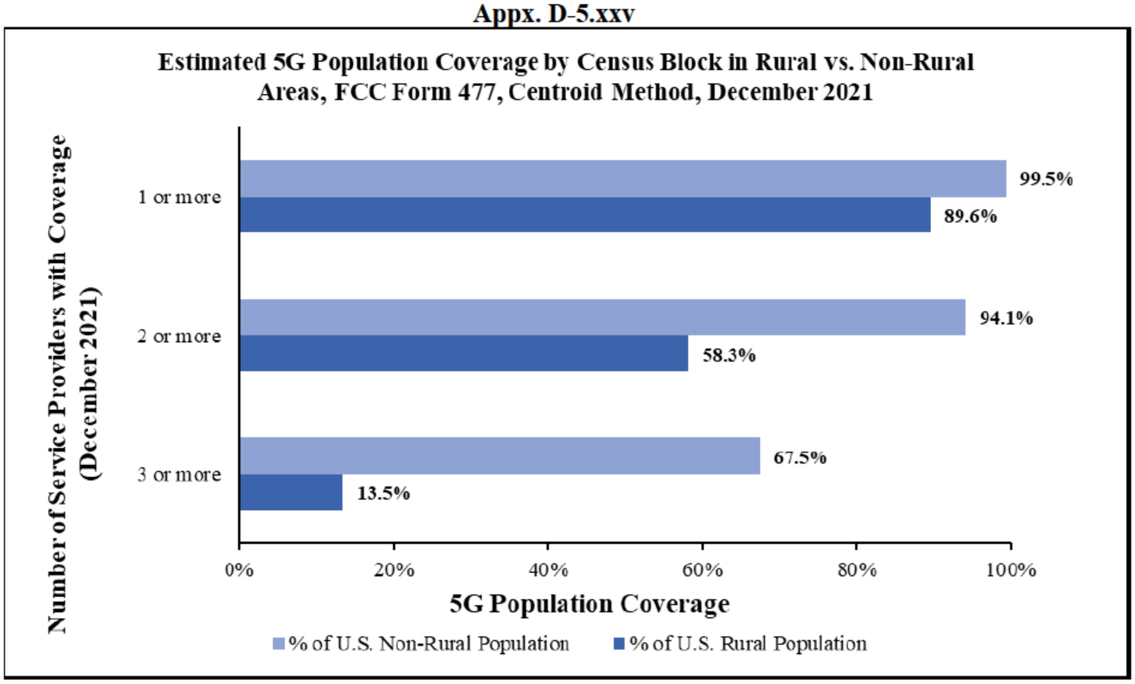
Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xxiv
***Estimated* Non-Rural 4G LTE Coverage in the United States by Provider**
FCC Form 477, Centroid Method, Dec. 2021

Provider	Number of Blocks	Population Contained in Those Blocks	% of Total Non-Rural U.S. Population	Road Miles Contained in Those Blocks	% of Total Non-Rural U.S. Road Miles
U.S. Total	*4,502,138*	*275,942,349*	*100.0%*	*2,295,121*	*100.0%*
AT&T	4,412,730	271,592,894	98.4%	2,185,570	95.2%
T-Mobile	4,223,979	267,340,007	96.9%	1,943,779	84.7%
Verizon Wireless	4,410,364	271,769,334	98.5%	2,181,413	95.0%

Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xxv



Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xxvi
***Estimated* 5G Coverage in *Rural* Areas by Census Block**
FCC Form 477, Centroid Method, Dec. 2021

Number of Providers with Coverage in a Block	Number of Blocks	Population Contained in Those Blocks	% of Total Rural U.S. Population	Square Miles Contained in Those Blocks	% of Total Rural U.S. Square Miles	Road Miles Contained in Those Blocks	% of Total Rural U.S. Road Miles
U.S. Total	*3,433,590*	*58,782,633*	*100.0%*	*3,023,291*	*100.0%*	*4,572,033*	*100.0%*
1 or more	2,771,969	52,644,502	89.6%	1,459,152	48.3%	3,122,180	68.3%
2 or more	1,542,702	34,252,552	58.3%	586,981	19.4%	1,429,736	31.3%
3 or more	262,691	7,917,432	13.5%	65,393	2.2%	192,045	4.2%

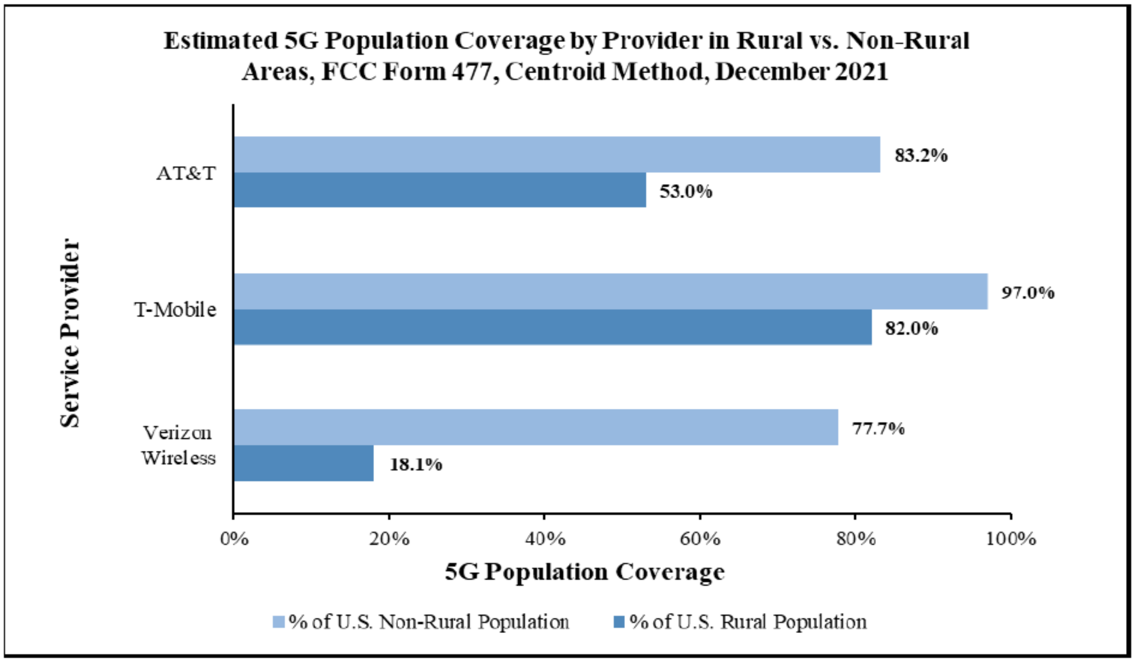
Source: Based on centroid analysis of Dec.2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xxvii
***Estimated* 5G Coverage in *Non-Rural* Areas by Census Block**
FCC Form 477, Centroid Method, Dec. 2021

Number of Providers with Coverage in a Block	Number of Blocks	Population Contained in Those Blocks	% of Total Non-Rural U.S. Population	Square Miles Contained in Those Blocks	% of Total Non-Rural U.S. Square Miles	Road Miles Contained in Those Blocks	% of Total Non-Rural U.S. Road Miles
U.S. Total	*4,502,138*	*275,942,336*	*100.0%*	*554,607*	*100.0%*	*2,295,121*	*100.0%*
1 or more	4,433,210	274,437,280	99.5%	484,254	87.3%	2,183,817	95.2%
2 or more	4,049,976	259,781,280	94.1%	362,447	65.4%	1,852,900	80.7%
3 or more	2,617,668	186,257,648	67.5%	165,072	29.8%	1,049,057	45.7%

Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xxviii



Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xxix
***Estimated* Rural 5G Coverage in the United States by Provider**
FCC Form 477, Centroid Method, Dec. 2021

Provider	Number of Blocks	Population Contained in Those Blocks	% of Total Rural U.S. Population	Road Miles Contained in Those Blocks	% of Total U.S. Rural Road Miles
U.S. Total	*3,433,590*	*58,782,633*	*100.0%*	*4,572,033*	*100.0%*
AT&T	1,488,174	31,164,279	53.0%	1,501,444	32.8%
T-Mobile	2,498,382	48,225,731	82.0%	2,783,529	60.9%
Verizon Wireless	358,803	10,642,062	18.1%	301,717	6.6%

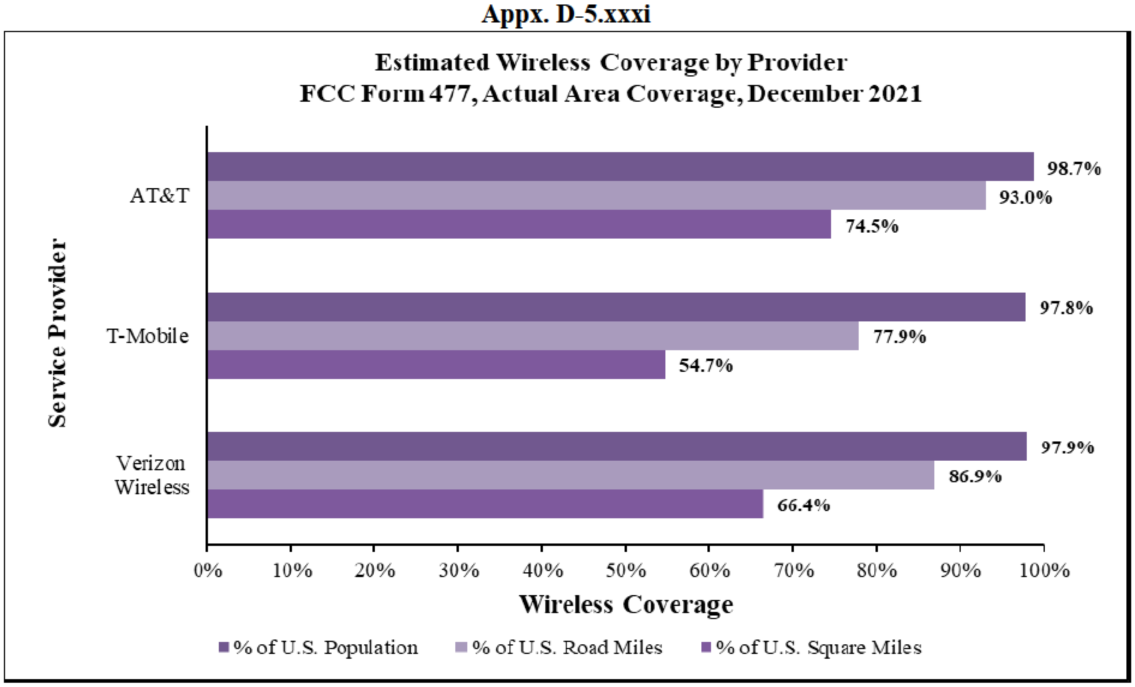
Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xxx
Estimated Non-Rural 5G Coverage in the United States by Provider
FCC Form 477, Centroid Method, Dec. 2021

Provider	Number of Blocks	Population Contained in Those Blocks	% of Total Non-Rural U.S. Population	Road Miles Contained in Those Blocks	% of Total Non-Rural U.S. Road Miles
U.S. Total	*4,502,138*	*275,942,349*	*100.0%*	*2,295,121*	*100.0%*
AT&T	3,506,226	229,636,180	83.2%	1,565,214	68.2%
T-Mobile	4,282,576	267,781,834	97.0%	2,060,658	89.8%
Verizon Wireless	3,152,151	214,535,945	77.7%	1,382,251	60.2%

Source: Based on centroid analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xxxi



Source: Based on actual area coverage analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xxxii
***Estimated* Wireless Coverage in the United States by Provider**
FCC Form 477, Actual Area Method, Dec. 2021

Provider	Covered Population	% of Total U.S. Population	Covered Square Miles	% of Total U.S. Square Miles	Covered Road Miles	% of Total U.S. Road Miles
U.S. Total	*334,724,982*	*100.0%*	*3,577,898*	*100.0%*	*6,867,154*	*100.0%*
AT&T	330,430,493	98.7%	2,667,170	74.5%	6,386,192	93.0%
T-Mobile	327,313,942	97.8%	1,958,678	54.7%	5,346,239	77.9%
Verizon Wireless	327,765,192	97.9%	2,377,276	66.4%	5,970,222	86.9%

Source: Based on actual area analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xxxiii
***Estimated* 4G LTE Coverage by Census Block**
FCC Form 477, Actual Area Coverage Method, Dec. 2021

Number of Providers with Coverage in a Block	Covered Population	% of Total U.S. Population	Covered Square Miles	% of Total U.S. Square Miles	Covered Road Miles	% of Total U.S. Road Miles
U.S. Total	*334,724,982*	*100.0%*	*3,577,898*	*100.0%*	*6,867,154*	*100.0%*
1 or more	333,608,736	99.7%	2,601,811	72.7%	6,321,362	92.1%
2 or more	330,829,571	98.8%	2,183,082	61.0%	5,738,804	83.6%
3 or more	316,211,882	94.5%	1,431,843	40.0%	4,355,412	63.4%
4 or more	45,846,185	13.7%	365,321	10.2%	1,046,957	15.2%

Source: Based on actual area analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xxxiv
***Estimated* 4G LTE Coverage in the United States by Provider**
FCC Form 477, Actual Area Method, Dec. 2021

Provider	Covered Population	% of Total U.S. Population	Covered Square Miles	% of Total U.S. Square Miles	Covered Road Miles	% of Total U.S. Road Miles
U.S. Total	*334,724,982*	*100.0%*	*3,577,898*	*100.0%*	*6,867,154*	*100.0%*
AT&T	327,295,282	97.8%	2,295,559	64.2%	5,825,115	84.8%
T-Mobile	311,386,970	93.0%	1,273,697	35.6%	4,011,466	58.4%
Verizon Wireless	325,508,670	97.2%	2,083,496	58.2%	5,523,772	80.4%

Source: Based on actual area analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xxxv
***Estimated* 5G Coverage by Census Block**
FCC Form 477, Actual Area Coverage Method, Dec. 2021

Number of Providers with Coverage in a Block	Covered Population	% of Total U.S. Population	Covered Square Miles	% of Total U.S. Square Miles	Covered Road Miles	% of Total U.S. Road Miles
U.S. Total	*334,724,982*	*100.0%*	*3,577,898*	*100.0%*	*6,867,154*	*100.0%*
1 or more	327,095,449	97.7%	1,950,408	54.5%	5,311,228	77.3%
2 or more	293,952,538	87.8%	952,868	26.6%	3,283,373	47.8%
3 or more	194,034,354	58.0%	231,663	6.5%	1,240,281	18.1%

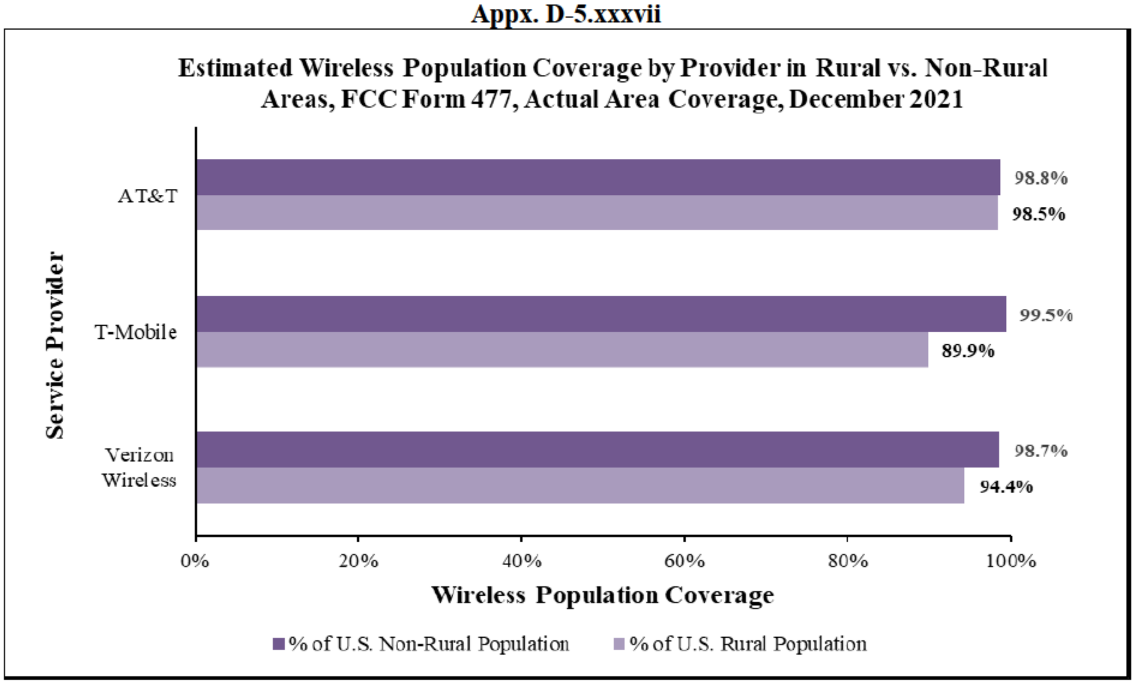
Source: Based on actual area analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xxxvi
***Estimated* 5G Coverage in the United States by Provider**
FCC Form 477, Actual Area Method, Dec. 2021

Provider	Covered Population	% of Total U.S. Population	Covered Square Miles	% of Total U.S. Square Miles	Covered Road Miles	% of Total U.S. Road Miles
U.S. Total	*334,724,982*	*100.0%*	*3,577,898*	*100.0%*	*6,867,154*	*100.0%*
AT&T	260,651,318	77.9%	954,587	26.7%	3,059,631	44.6%
T-Mobile	316,128,682	94.4%	1,740,063	48.6%	4,859,178	70.8%
Verizon Wireless	224,973,346	67.2%	370,362	10.4%	1,679,169	24.5%

Source: Based on actual area analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xxxvii



Source: Based on actual area coverage analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xxxviii
***Estimated* Rural Wireless Coverage in the United States by Provider**
FCC Form 477, Actual Area Coverage, Dec. 2021

Provider	Covered Population	% of Total Rural U.S. Population	Covered Road Miles	% of Total U.S. Rural Road Miles
U.S. Total	*58,782,633*	*100.0%*	*4,572,033*	*100.0%*
AT&T	57,886,832	98.5%	4,136,034	90.5%
T-Mobile	52,832,837	89.9%	3,153,440	69.0%
Verizon Wireless	55,514,087	94.4%	3,747,450	82.0%

Source: Based on actual area analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xxxix
***Estimated* Non-Rural Wireless Coverage in the United States by Provider**
FCC Form 477, Actual Area Coverage, Dec. 2021

Provider	Covered Population	% of Total Non-Rural U.S. Population	Covered Road Miles	% of Total Non-Rural U.S. Road Miles
U.S. Total	*275,942,349*	*100.0%*	*2,295,121*	*100.0%*
AT&T	272,543,661	98.8%	2,250,158	98.0%
T-Mobile	274,481,105	99.5%	2,192,800	95.5%
Verizon Wireless	272,251,105	98.7%	2,222,772	96.8%

Source: Based on actual area analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xl
***Estimated* 4G LTE Coverage in *Rural* Areas by Census Block**
FCC Form 477, Actual Area Coverage Method, Dec. 2021

Number of Providers	Covered Population	% of Total Rural U.S. Population	Covered Road Miles	% of Total Rural U.S. Road Miles
U.S. Total	*58,782,633*	*100.0%*	*4,572,033*	*100.0%*
1 or more	57,933,015	98.6%	4,064,464	88.9%
2 or more	55,922,348	95.1%	3,541,327	77.5%
3 or more	47,423,683	80.7%	2,381,080	52.1%
4 or more	15,292,570	26.0%	723,069	15.8%

Source: Based on actual area analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xli
***Estimated* 4G LTE Coverage in *Non-Rural* Areas by Census Block**
FCC Form 477, Actual Area Coverage Method, Dec. 2021

Number of Providers	Covered Population	% of Total Non-Rural U.S. Population	Covered Road Miles	% of Total Non-Rural U.S. Road Miles
U.S. Total	*275,942,349*	*100.0%*	*2,295,121*	*100.0%*
1 or more	275,675,720	99.9%	2,256,898	98.3%
2 or more	274,907,223	99.6%	2,197,477	95.7%
3 or more	268,788,199	97.4%	1,974,332	86.0%
4 or more	30,553,615	11.1%	323,888	14.1%

Source: Based on actual area analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xlii
***Estimated* Rural 4G LTE Coverage in the United States by Provider**
FCC Form 477, Actual Area Coverage, Dec. 2021

Provider	Covered Population	% of Total Rural U.S. Population	Covered Road Miles	% of Total U.S. Rural Road Miles
U.S. Total	*58,782,633*	*100.0%*	*4,572,033*	*100.0%*
AT&T	55,748,792	94.8%	3,641,122	79.6%
T-Mobile	43,854,187	74.6%	2,060,614	45.1%
Verizon Wireless	53,869,234	91.6%	3,346,784	73.2%

Source: Based on actual area analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xliii
***Estimated* Non-Rural 4G LTE Coverage in the United States by Provider**
FCC Form 477, Actual Area Coverage, Dec. 2021

Provider	Covered Population	% of Total Non-Rural U.S. Population	Covered Road Miles	% of Total Non-Rural U.S. Road Miles
U.S. Total	*275,942,349*	*100.0%*	*2,295,121*	*100.0%*
AT&T	271,546,491	98.4%	2,183,993	95.2%
T-Mobile	267,532,783	97.0%	1,950,852	85.0%
Verizon Wireless	271,639,436	98.4%	2,176,988	94.9%

Source: Based on actual area analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xliv
***Estimated* 5G Coverage in *Rural* Areas by Census Block**
FCC Form 477, Actual Area Coverage Method, Dec. 2021

Number of Providers	Covered Population	% of Total Rural U.S. Population	Covered Road Miles	% of Total Rural U.S. Road Miles
U.S. Total	*58,782,633*	*100.0%*	*4,572,033*	*100.0%*
1 or more	52,711,976	89.7%	3,127,804	68.4%
2 or more	34,308,321	58.4%	1,432,095	31.3%
3 or more	7,926,322.5	13.5%	192936.4	4.2%

Source: Based on actual area analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xlv
***Estimated* 5G Coverage in *Non-Rural* Areas by Census Block**
FCC Form 477, Actual Area Coverage Method, Dec. 2021

Number of Providers	Covered Population	% of Total Non-Rural U.S. Population	Covered Road Miles	% of Total Non-Rural U.S. Road Miles
U.S. Total	*275,942,349*	*100.0%*	*2,298,858*	*100.0%*
1 or more	274,383,474	99.4%	2,183,424	95.1%
2 or more	259,644,217	94.1%	1,851,278	80.7%
3 or more	186,108,032	67.4%	1,047,345	45.6%

Source: Based on actual area analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xlvi
***Estimated* Rural 5G Coverage in the United States by Provider**
FCC Form 477, Actual Area Coverage, Dec. 2021

Provider	Covered Population	% of Total Rural U.S. Population	Covered Road Miles	% of Total U.S. Rural Road Miles
U.S. Total	*58,782,633*	*100.0%*	*4,572,033*	*100.0%*
AT&T	31,185,954	53.1%	1,496,174	32.7%
T-Mobile	48,349,083	82.3%	2,796,923	61.2%
Verizon Wireless	10,617,788	18.1%	300,623	6.6%

Source: Based on actual area analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

Appx. D-5.xlvii
***Estimated* Non-Rural 5G Coverage in the United States by Provider**
FCC Form 477, Actual Area Coverage, Dec. 2021

Provider	Covered Population	% of Total Non-Rural U.S. Population	Covered Road Miles	% of Total Non-Rural U.S. Road Miles
U.S. Total	*275,942,349*	*100.0%*	*2,295,121*	*100.0%*
AT&T	229,465,364	83.2%	1,563,457	68.1%
T-Mobile	267,779,599	97.0%	2,062,255	89.9%
Verizon Wireless	214,355,558	77.7%	1,378,546	60.1%

Source: Based on actual area analysis of Dec. 2021 FCC Form 477 and 2020 Census data.

APPENDIX E

REPORT ON CABLE INDUSTRY PRICES

The *Report on Cable Industry Prices* is published as an Appendix attachment to the *2022 Communications Marketplace Report*. It can be accessed here: https://www.fcc.gov/reports-research/reports/consolidated-communications-marketplace-reports/CMR-2022.

APPENDIX F

DEPLOYMENT AND ADVANCED TELECOMMUNICATIONS CAPABILITY

The information on deployment and advanced telecommunications capability is published as an Appendix attachment to the *2022 Communications Marketplace Report*. It can be accessed here: https://www.fcc.gov/reports-research/reports/consolidated-communications-marketplace-reports/CMR-2022.

APPENDIX G

INTERNATIONAL BROADBAND DATA REPORT

The *International Broadband Data Report* is published as an Appendix attachment to the *2022 Communications Marketplace Report*. It can be accessed here: https://www.fcc.gov/reports-research/reports/consolidated-communications-marketplace-reports/CMR-2022.

STATEMENT OF
COMMISSIONER BRENDAN CARR
APPROVING IN PART AND CONCURRING IN PART

Re: *Communications Marketplace Report*, GN Docket No. 22-203

When we adopted the Commission's prior Communications Marketplace Report in 2020, I voted to approve in part and concur in part because, in my view, we could have gone further in recognizing the converged market for connectivity.[1551] I continue to have that view this go around. So I am again voting to approve in part and concur in part.

[1551] *Communications Marketplace Report et al.*, GN Docket No. 20-60, Report, 36 FCC Rcd 2945 (2020) (Statement of Commissioner Carr) ("I would go even further than the Report does in recognizing the converged market for connectivity that now exists. The Commission's decades-old approach of viewing different technologies—including mobile, fixed, satellite, and broadcast offerings—as competing in distinct and separate markets no longer matches the way that Americans consume these services.").