Before the
National Telecommunications and Information Administration
Washington, D.C. 20230

In the Matter of	)	
	)	
Development of a	)	NTIA-2023-0003-0001
National Spectrum Strategy	)	

COMMENTS OF COMCAST CORPORATION

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COMMENTS OF COMCAST CORPORATION

Comcast Corporation ("Comcast") hereby responds to the National Telecommunications and Information Association's ("NTIA") Request for Comments ("RFC") in the above-captioned proceeding.[1] Comcast applauds NTIA for its commitment to developing and implementing a National Spectrum Strategy ("NSS") and, as part of this effort, seeking broad input from all interested stakeholders. NTIA can best achieve its goal of ensuring the United States stays competitive on a global scale by taking a holistic approach to spectrum policy and adopting an NSS that incorporates unlicensed, shared-licensed, and exclusive-licensed frameworks. As part of this strategy, NTIA and other federal agencies should pursue a spectrum policy that leverages coexistence technologies enabling services by commercial and incumbent users. NTIA and the Federal Communications Commission ("FCC") should act without delay to make the 7.125-8.400 GHz ("7/8 GHz") band available for unlicensed and shared use and make the 3.1-3.45 GHz ("Lower 3 GHz") band available for shared use. Moreover, when identifying additional spectrum that can be repurposed, NTIA should consider the characteristics of each band and the needs of various stakeholders, and it should decline to base such decisions on oversimplified megahertz-to-megahertz comparisons, which limit efficient use of spectrum. At the same time,

[1] *See* Nat'l Telecomms. & Info. Admin., Development of a National Spectrum Strategy, Request for Comment, 88 Fed. Reg. 16,244 (Mar. 16, 2023) ("Request for Comments"). Comcast's comments identify in footnotes the specific Pillars and Questions in the RFC to which each subsection is responding.

NTIA must ensure that the technical rules it adopts optimize, and neither unduly constrain nor overprotect, use of the selected bands.

I. INTRODUCTION AND BACKGROUND

Comcast is a global media and technology company, and a leading provider of broadband, video, voice, wireless and other services to residential and business customers in the United States. In 2017, Comcast launched its wireless service, Xfinity Mobile, and Xfinity Mobile is now one of the fastest growing mobile services in the country.

Comcast relies on exclusive-licensed, shared-licensed, and unlicensed spectrum to optimize and extend the reach of its networks. Comcast recognizes the importance of exclusive-licensed frameworks, and currently holds 600 MHz exclusive-use licenses that it plans to use in combination with its shared-use Citizen Broadband Radio Service ("CBRS") Priority Access Licenses ("PALs") at 3550-3700 MHz to more efficiently deliver new 5G services and support Xfinity Mobile operations as a complement to its mobile virtual network operator partnership.[2] Comcast is also a heavy user of unlicensed spectrum for Wi-Fi for broadband connectivity both in and out of the home. With the 6 GHz band now available for unlicensed use, Comcast is deploying Wi-Fi 6E in order to support multi-gigabit symmetrical broadband speeds and increase bandwidth in the home by 3X to support the massive influx of connected devices.[3] Comcast's Wi-Fi offerings were critical in supporting Americans through the COVID-19 pandemic; when

[2] *See* Tom Nagel, *Comcast's Evolving Wireless Strategy*, Comcast (Sept. 21, 2022), https://corporate.comcast.com/stories/comcasts-evolving-wireless-strategy; Comcast, *Wireless*, https://corporate.comcast.com/company/xfinity/wireless, (last visited Apr. 13, 2023).

[3] *See* Press Release, Comcast, *Comcast Begins Rollout of New WiFi 6E Gateway* (Apr. 5, 2022), https://corporate.comcast.com/press/releases/comcast-begins-rollout-of-new-supersonic-wifi.

Internet traffic surged by more than 20 percent in the early months of the pandemic, Comcast's broadband network withstood the sudden shift and increase in demand.[4]

Comcast fully agrees with NTIA that access to more spectrum and identifying a spectrum pipeline "will help the United States continue to lead the world in advanced technology and enhance our national and economic security."[5] As the Center for Strategic and International Studies has explained, "[t]he United States is in a competition where technological and economic leadership are as important as military strength."[6] Developing a sustainable and comprehensive spectrum pipeline is critical to shaping America's economic future, while continuing to protect its national security needs. In the absence of greenfield spectrum available for federal and commercial users, the NSS must reflect a holistic approach to spectrum policy that incorporates not just exclusive-licensed frameworks but also utilizes nimble coexistence technologies that enable shared-licensed and unlicensed frameworks to meet the long-term needs of both federal and non-federal users and to ensure the United States stays competitive on a global scale. Shared-licensed and unlicensed frameworks unlock more efficient usage of spectrum by facilitating coexistence of a wide variety of uses, while protecting federal and other incumbent users. Such coexistence approaches generate massive economic growth and value for consumers, and can bring spectrum to market quickly.

Indeed, the United States has been at the forefront in embracing a comprehensive spectrum approach, as evidenced by the $995 billion in economic value added to the U.S.

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[4] *See* Roger Entner, *US Broadband Network Performance During COVID-19 and Beyond*, ReCon Analytics (Nov. 16, 2021), https://reconanalytics.com/2021/11/us-broadband-network-performance-during-covid-19-and-beyond/.

[5] Request for Comments, 88 Fed. Reg. at 16,245.

[6] *Accelerating 5G in the United States,* Center for Strategic & International Studies, at 5 (Mar. 1, 2021), https://csis-website-prod.s3.amazonaws.com/s3fs-public/publication/210301_Lewis_Accelerating_5G_0.pdf?VersionId=klP hknBLh2uJBCPMkxs5_wRNzFiMbdO.

economy by unlicensed spectrum in 2021 alone (expected to reach $1.58 trillion by 2025), and by the over 300,000 CBRS base-station devices in operation—many of which are used by schools, healthcare providers, factories, manufacturers, farmers, automotive companies, municipalities, cable companies, and mobile providers—across the country just since 2021. An NSS that embraces all of these frameworks can amplify these successes like never before.

II. NTIA'S NATIONAL SPECTRUM STRATEGY MUST TAKE A HOLISTIC APPROACH TO SPECTRUM POLICY

A. Given the Growing Demand for Spectrum, Identifying a Spectrum Pipeline That Can Ensure U.S. Leadership in Spectrum-Based Technologies Will Require Forward-Thinking Solutions.[7]

The demand for spectrum is growing rapidly due to the rise in connected devices, which rely on such spectrum. Over the past decade, there has been a major surge in household-connected devices.[8] The average American household now has a total of 25 connected devices.[9] In 2023, the United States is expected to have the highest average number of devices and connections per capita globally.[10]

Widespread use of spectrum-intensive devices is expected across all sectors. For example, the Consumer Technology Association anticipates growth in gaming in 2023; the

[7] *See* Pillar 1, Question 1: "What are the projected future spectrum requirements of the services or missions of concern to you in the short (less than 3 years), medium (3-6 years) and long (7-10 years) term?"; Pillar 1, Question 2: "Describe why the amount of spectrum now available will be insufficient to deliver current or future services or capabilities of concern to stakeholders."

[8] *See* Cisco Annual Internet Report (2018-2023) White Paper (Mar. 9, 2020), https://www.cisco.com/c/en/us/solutions/collateral/executive-perspectives/annual-internet-report/white-paper-c11-741490.pdf ("Cisco Annual Internet Report (2018-2023)"); NCTA, Broadband Stats: The Power of Wi-Fi (Mar. 23, 2022), https://www ncta.com/whats-new/broadband-stats-the-power-of-wi-fi.

[9] *See How the Pandemic Has Stress-Tested the Increasingly Crowded Digital Home*, Deloitte Insights (June 9, 2021), https://www.prnewswire.com/news-releases/deloitte-how-the-pandemic-stress-tested-the-increasingly-crowded-digital-home-301308718.html.

[10] *See* Cisco Annual Internet Report (2018-2023); *Wi-Fi Predictions from Cisco's Annual Internet Report*, Wi-Fi Alliance, (Mar. 18, 2020), https://www.wi-fi.org/beacon/the-beacon/wi-fi-predictions-from-cisco-s-annual-internet-report.

average time per week has increased from 16 hours in 2019 to 24 hours per week in 2022.[11] And smart home devices, such as smart lights, smart plugs, connected roller blinds, and smart home cameras, and other Internet of Things ("IoT") technologies, are becoming increasingly widespread. American agriculture has come to depend on wireless devices to improve yields, and the number of wireless IoT devices installed by farmers has risen steadily over the past several years.[12]

The growth of connected devices places a tremendous burden on broadband connections and available spectrum. Data-intensive applications used by both federal and non-federal entities require more bandwidth than ever. According to a 2022 report by Plume IQ, the United States leads globally in terms of data use, with an average of 657 GB per month per household, compared to Europe's average data use of 227 GB per month.[13] America's data usage has also grown faster than other countries, at a growth rate of 14.4 percent.[14]

Amidst this increased reliance on and demand for spectrum, spectrum environments are constrained, and the amount of spectrum now available is insufficient to deliver current or future services to consumers. Connectivity provided by broadband providers such as Comcast supports these services and connected devices, but additional spectrum is needed to meet this increase in demand and to ensure that the additional wireline capacity being delivered by broadband

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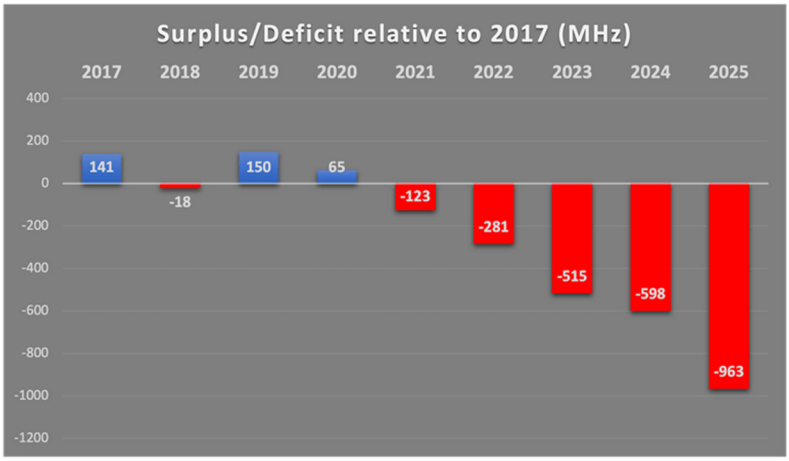
[11] *2023 Tech Trends and the Broadband Networks that Will Fuel Them*, NCTA, (Jan. 20, 2023), https://www.ncta.com/whats-new/2023-tech-trends-and-the-broadband-networks-that-will-fuel-them.

[12] Neil Weste, *The Future of Farming: Testing the Rural Range of Wi-Fi CERTIFIED HaLow*, Wi-Fi Alliance (Nov. 21, 2022), https://www.wi-fi.org/beacon/neil-weste/the-future-of-farming-testing-the-rural-range-of-wi-fi-certified-halow.

[13] *See 1H 2022 Smart Home Market Report*, Plume IQ, https://discover.plume.com/plume-iq-smart-home-1h-2022-smart-home-report html; Claus Hetting, *Plume IQ Smart Home Report for 1H2022: Wi-Fi Devices, Data Consumption Grows 10% YoY,* Wi-Fi Now (Aug. 31, 2022), https://wifinowglobal.com/news-and-blog/plume-iq-smart-home-report-for-1h2022-wi-fi-devices-data-consumption-grows-10-yoy/.

[14] *See supra* note 14.

providers has enough "last mile" spectrum to reach end-user devices. According to a model of spectral demand created by Resonant, "increasing demand for data services threatens to result in a situation where data demand will overwhelm the available spectrum starting in 2021 and continue to worsen through 2025."[15] And this study was based only on 4G and did not even account for increased demand associated with more data-intensive 5G services.



Source: See note 16.

With no greenfield spectrum available, a comprehensive and holistic NSS is needed to address existing and anticipated congestion and future spectrum needs, and will better achieve NTIA's national spectrum goals and objectives to ensure federal agencies "make effective, efficient, and prudent use of the radio spectrum in the best interest of the Nation."[16] NTIA has interpreted this standard as encompassing "the overall benefits the American public derives from radiocommunication services, both Federal and non-federal, as well as the needs of various Federal users and choices among competing users."[17] A holistic approach also promotes

[15] Mike Eddy, *Overcoming a Spectrum Deficit in a 5G World*, Microwaves & RF (Mar. 31, 2021), https://www mwrf.com/technologies/components/article/21159759/resonant-overcoming-a-spectrum-deficit-in-a-5g-world.

[16] *National Spectrum Goals*, NTIA, https://www ntia.doc.gov/book-page/national-spectrum-goals (last visited Apr. 13, 2023).

[17] *Id*.

competition and innovation, which are necessary for the United States to stay competitive on a global scale.

B. Unlicensed and Shared-Licensed Frameworks Optimize Spectrum Use While Advancing NTIA's National Spectrum Goals.

1. Exclusive-Licensed Frameworks Alone Cannot Meet Future Spectrum Needs.[18]

Comcast recognizes the importance of exclusive-licensed frameworks, and currently holds 600 MHz exclusive-use licenses that it plans to use in combination with CBRS spectrum for its Xfinity Mobile service.[19] But in this congested spectrum environment, with no real greenfield spectrum available, exclusive-licensed frameworks alone are not practical for an NSS that must meet long-term spectrum needs and support sustainable spectrum management policies. While exclusive licensing may be appropriate in certain circumstances, this approach can be costly, time-intensive, and highly disruptive to federal and other incumbent users given the current spectrum environment because it requires clearing those users from all or part of the band before new users can deploy.[20] In many cases, the disruption to federal users and other

[18] *See* Pillar 1, Question 2: "[A]re there options available for increasing spectrum access in addition to or instead of repurposing spectrum (i.e., improving the technological capabilities of deployed systems, increasing or improving infrastructure build outs)?"; Pillar 1, Question 4: "What [are the] factors [that] should be considered in identifying spectrum for the pipeline?"; Pillar 1, Question 5: "Are there changes the government should make to its current spectrum management processes to better promote important national goals in the short, medium, and long term without jeopardizing current government missions?"; Pillar 1, Question 7: "What are the use cases, benefits, and hindrances of each of the following spectrum access approaches [exclusive use, predefined sharing, and dynamic sharing]."

[19] *See supra* note 2.

[20] *See* PCAST, *Report to the President: Realizing the Full Potential of Government-Held Spectrum to Spur Economic Growth*, at 4 (July 20, 2012), https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/gorenberg_ppt.pdf (explaining that "[c]learing and [r]eallocation of Federal [s]pectrum is [n]ot [s]ustainable" and that a recent NTIA study found that "[c]learing of just one 95 MHz band will take 10 years, cost $18 billion, and cause significant disruption"); *see also* C. Todd Lopez, *Spectrum Sharing is Way Ahead to Maintain Economic Dominance, Defense Official Says*, U.S. Dep't of Defense (Sept. 21, 2022), https://www.defense.gov/News/News-Stories/Article/Article/3165774/spectrum-sharing-is-way-ahead-to-maintain-economic-dominance-defense-official-s/ (According to John Sherman, DoD Chief Information Officer, "[v]acating the 3100-3450 MHz band would take decades and would cost the DOD billions of dollars"); U.S. Congressional Research Service, *National Security Implications of Fifth Generation (5G) Mobile*

incumbent users could be substantial. Given the advances in coexistence technologies and developments in shared licensed and unlicensed spectrum, exclusive licensing is a spectrum management tool that should be used as one component of a broader multi-pronged approach going forward.

2. Unlicensed Spectrum Fosters Permissionless Innovation and Plays a Critical Role in Connectivity.[21]

Unlicensed spectrum frameworks have emerged as ideal environments for experimentation and the development of innovative-use cases and new technologies.[22] Unlicensed spectrum users are not required to apply for a license or seek permission from government or private entities to use unlicensed spectrum. Because these users are not required to seek a license, anyone using approved equipment can access the unlicensed spectrum. Due to the lower barriers to entry, users are able to channel their investments more directly into developing technology that is able to function in this environment and that will continue to

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Technologies (Mar. 14, 2023), https://crsreports.congress.gov/product/pdf/IF/IF11251/20 ("DoD has argued that moving out of the 3.1-3.45 GHz band alone could cost at least $120 billion and take decades").

[21] *See* Pillar 1, Question 1: "What are the spectrum requirements for next-generation networks and emerging technologies and standards under development (e.g., 5G Advanced, 6G, Wi-Fi 8)?"; Pillar 1, Question 2: "[A]re there options available for increasing spectrum access in addition to or instead of repurposing spectrum (i.e., improving the technological capabilities of deployed systems, increasing or improving infrastructure build outs)?"; Pillar 1, Question 4: "What [are the] factors that should be considered in identifying spectrum for the pipeline?"; Pillar 1, Question 5: "Are there changes the government should make to its current spectrum management processes to better promote important national goals in the short, medium, and long term without jeopardizing current government missions?"; Pillar 1, Question 7: "What are the use cases, benefits, and hindrances of each of the following spectrum access approaches [exclusive use, predefined sharing, and dynamic sharing]"; Pillar 3, Question 1: "What innovations and next-generation capabilities for spectrum management models (including both licensed and unlicensed) are being explored today and are expected in the future to expand and improve spectrum access . . . ?"; Pillar 3, Question 2: "What policies should the National Spectrum Strategy identify to enable development of new and innovative uses of spectrum?"

[22] *See* FCC, *Spectrum Policy Task Force Report*, ET Docket No. 02-135, at 39 (Nov. 2002) ("*Spectrum Policy Task Force Report*"); *see also Spectrum Requirements for the Internet of Things*, Notice of Inquiry, 36 FCC Rcd. 14165 (2021); Philip J. Weiser & Dale N. Hatfield, Policing the Spectrum Commons, 74 Fordham L. Rev. 663, 673 (2005), https://ir.lawnet.fordham.edu/flr/vol74/iss2/12 ("An environment that fosters the development of next generation technologies is what makes America the greatest place in the world to do business, create jobs, and develop state-of-the-art communications tools for consumers. . . . The unlicensed bands were founded on permissionless innovation and sharing.").

function as the environment grows more congested.[23] Among other examples, making the 2.4 GHz band available for unlicensed use led to the development of Bluetooth and Wi-Fi, which have fundamentally transformed the way American consumers and industries use technology.

Today, Wi-Fi serves as the primary on-ramp to the Internet for the majority of broadband connections in the United States. Eighty-five percent of U.S. broadband subscribers have Wi-Fi capability at home,[24] and the United States remains one of the countries with the widest Wi-Fi adoption and use.[25] Demand for Wi-Fi is growing. "Nearly a billion unique devices connected to Wi-Fi in Xfinity households in 2021, reflecting a 12X increase from 2018."[26] And from 2018 to 2023, the number of global public Wi-Fi hotspots is expected to increase fourfold to 628 million.[27] The worldwide share of Internet Protocol access network traffic that is carried over Wi-Fi is also expected to rise from 53 percent in 2019 to 66 percent in 2025.[28]

Wi-Fi networks also carry a large portion of cellular traffic. Globally, "Wi-Fi continues to account for the largest part of wireless network data traffic."[29] Cable operators are seeing that more than 80 percent of their mobile data traffic travel over Wi-Fi, and cable is now the fourth

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[23] *See Spectrum Policy Task Force Report* at 39 ("This [unlicensed] approach . . . promotes technological innovation by providing a spectrum environment in which to develop new technologies. Users do not pay for access to the spectrum, so they will channel their investment exclusively into developing robust technology that can function in this environment and continue to function as the environment grows more congested.").

[24] *Global Economic Value of Wi-Fi 2021-2025*, Wi-Fi Alliance, at 11 (Sept. 2021), https://www.wi-fi.org/download.php?file=/sites/default/files/private/Global_Economic_Value_of_Wi-Fi_2021-2025_202109.pdf.

[25] *Id*.

[26] *See 2021 WiFi Trends Report*, Comcast, at 2 (Feb. 2022), https://update.comcast.com/wp-content/uploads/sites/33/dlm_uploads/2022/02/2021-WiFi-Trends-Report.pdf.

[27] Cisco Annual Internet Report (2018-2023).

[28] *Id*.

[29] Stefano Porto Bonacci & Rupert Wood, *Wireless Network Data Traffic: Worldwide Trends and Forecasts 2021-2026*, Analysys Mason, at 11, https://www.analysysmason.com/contentassets/63ab4d5ecf364c60a558dcca49ee801f/analysys_mason_wireless_traffic_forecast_oct2021_samples_rdnt0.pdf.

largest wireless carrier in the country.[30] Xfinity Mobile now has over 5.3 million customer lines,[31] and Comcast's large number of Wi-Fi hotspots helps seamlessly offload data.[32]

Wi-Fi enables a broad variety of other use cases and supports the innovation needed to keep the United States competitive.[33] Among other examples, Wi-Fi powers the "smart home," which includes devices that "monitor health, manage energy use, stream video, [and] answer questions on command."[34] Wi-Fi supports "smart communities," which use sensors powered by Wi-Fi and unlicensed frequencies to help communities improve building management, enable more efficient traffic flow, and develop new ways to provide essential utilities.[35] And Wi-Fi is strengthening businesses and public spaces through smart stadiums, automated warehouses, and farms with precision agriculture, all of which are fueling the American economy.[36]

The latest advances in Wi-Fi, Wi-Fi 6 and Wi-Fi 7, were driven by the rise in demand for wireless connectivity. Compared to earlier standards, Wi-Fi 6 provides "better security, faster speeds, better energy efficiency, and lower latency."[37] Wi-Fi 7 will utilize wider bandwidths and offers the ability to link bandwidths of different sizes, which will provide better network

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[30] Press Release, Comcast, *Xfinity Rated as the Fastest Internet Provider Inside and Outside of the Home* (Jan. 25, 2023), https://corporate.comcast.com/press/releases/xfinity-ends-2022-rated-fastest-internet-provider#:~:text=Xfinity%20Mobile%20blends%20WiFi%20and mobile%20traffic%20runs%20over%20WiFi; Press Release, NCTA, *Meeting America's Needs Through a Balanced Spectrum Policy* (Mar. 9, 2023), https://www ncta.com/whats-new/meeting-americas-needs-through-a-balanced-spectrum-policy.

[31] *See* Press Release, *Comcast Reports 4th Quarter and Full Year 2022 Results* (Jan. 26, 2023), https://www.cmcsa.com/static-files/564f8423-ccdf-45d7-b2c7-8e31212b04d3.

[32] *The Future of Commercial Spectrum*, NCTA, https://www ncta.com/positions/spectrum-wifi; *How Cable Is Shaking Up the Mobile Marketplace*, NCTA, (Aug. 25, 2022), https://www.ncta.com/whats-new/how-cable-is-shaking-up-the-mobile-marketplace.

[33] Pillar 1, Question 1: "What are the use cases . . . that drive these requirements?"

[34] *The Future of Commercial Spectrum*, NCTA, https://www ncta.com/positions/spectrum-wifi.

[35] *Id*.

[36] *Id*.

[37] *What's Next for Wi-Fi?* (Aug. 16, 2022), NCTA, https://www.ncta.com/whats-new/whats-next-for-wi-fi.

management and performance, enable higher capacity, and deliver speeds up to four times what is currently available.[38] The wider 320-megahertz channels also provide higher throughput and lower latency than those supplied by Wi-Fi 6, which will support augmented and virtual reality, among other bandwidth-intensive applications.[39] Wi-Fi 8 will offer even faster speeds, lower latency, and better performance to meet the requirements of Industry 4.0 and Industrial IoT.[40] Additional unlicensed spectrum is needed to support the next generation of Wi-Fi technology, which enables important multi-gigabit wireline broadband connections.

3. Shared-Licensed Frameworks Promote Competition and Innovation While Protecting Incumbent Users.[41]

Comcast commends NTIA for specifically seeking comment on coexistence through spectrum sharing as part of developing the NSS. As a preliminary matter, NTIA should refine and clarify its definition of spectrum sharing. Sharing means utilization of a band by two or more distinct services or uses, not just two or more *users*. For example, the 3.45 GHz band,

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[38] *Id.*

[39] *Id.*

[40] *What Is Wi-Fi 8?*, Everything RF (Mar. 12, 2023), https://www.everythingrf.com/community/what-is-wi-fi-8.

[41] *See* Pillar 1, Question 1: "What are the projected future spectrum requirements of the services or missions of concern to you in the short (less than 3 years), medium (3-6 years) and long (7-10 years) term?" and "What are the spectrum requirements for next-generation networks and emerging technologies and standards under development (e.g., 5G Advanced, 6G, Wi-Fi 8)?"; Pillar 1, Question 2: "[A]re there options available for increasing spectrum access in addition to or instead of repurposing spectrum (i.e., improving the technological capabilities of deployed systems, increasing or improving infrastructure build outs)?"; Pillar 1, Question 4: "What [are the] factors [that] should be considered in identifying spectrum for the pipeline?"; Pillar 1, Question 5: "Are there changes the government should make to its current spectrum management processes to better promote important national goals in the short, medium, and long term without jeopardizing current government missions?"; Pillar 1, Question 6: Seeking comment on the definition of spectrum sharing; Pillar 1, Question 7: "What are the use cases, benefits, and hindrances of each of the following spectrum access approaches [exclusive use, predefined sharing, and dynamic sharing]"; Pillar 1, Question 8: "What incentives or policies may encourage or facilitate the pursuit of more robust federal and non-federal spectrum sharing arrangements, including in mid-band and other high priority/demand spectrum?"; Pillar 3, Question 1: "What innovations and next-generation capabilities for spectrum management models (including both licensed and unlicensed) are being explored today and are expected in the future to expand and improve spectrum access . . .?"; Pillar 3, Question 2: "What policies should the National Spectrum Strategy identify to enable development of new and innovative uses of spectrum?"; Pillar 3, Question 4: Recommendations for using the IIC or some other mechanism; Pillar 3, Question 5: "What other technologies and methodologies are currently being, or should be, researched and pursued that innovate in real-time dynamic spectrum sharing, particularly technologies that may not rely on databases?"

which involved the auction of exclusive-use licenses, is not a shared-licensed model simply because the exclusive-use licensees are subject to federal operations in the band and require coordination. Nor is it always necessarily the case that incumbent users have to "vacate, compress, or repack" some portion of their systems to "implement the most effective sharing arrangement."[42] To be sure, incumbents' systems could require some modifications in order to facilitate coexistence and/or coordination with, for example, commercial users of spectrum. But a clear-and-reallocate approach, such as the one in C-Band, is not a sharing framework.

Notwithstanding the need to refine the definition of spectrum sharing, the NSS should incorporate shared-licensed frameworks, which promote the efficient use of spectrum by unlocking access to underutilized frequencies, while protecting federal and other incumbent users.[43] Federal users benefit from such frameworks because they can avoid the time-intensive, highly disruptive, and costly clearing and reallocation process often involved in an exclusive-licensed model. Indeed, sharing models most often provide more realistic options for accommodating competing uses than just clearing incumbents out of the band. Moreover, shared-licensed frameworks can ensure DoD and other federal users have sufficient spectrum to maintain operations that are critical to our national security.

In addition to better protecting and accommodating incumbent operations, shared-licensed frameworks advance efficient use of scarce spectrum as well as greater competition and innovation. Shared-licensed models based on proven spectrum management technologies unlock additional capacity in underutilized spectrum bands, resulting in more intensive and efficient use of the spectrum. Further, the additional spectrum made available by

[42] *See* Pillar 1, Question 6.

[43] *See Report to Congress Pursuant to Section 1008 of the Spectrum Pipeline Act of 2015*, Report, 33 FCC Rcd. 11033, ¶ 4 (2018).

shared-licensed frameworks can relieve congestion and support the proliferation of IoT and other connected devices that are used by both federal and non-federal entities.

CBRS is a prime example of a highly successful shared-licensed framework. CBRS utilizes a licensing and access framework that has encouraged new entrants and stimulated innovation while delivering strong protection to incumbent federal systems. Commercial users, including incumbent mobile network operators, are actively utilizing the CBRS band. There are already more than 300,000 CBRS base-station devices, more than 490 different types of client devices, and more than 4,300 certified installers, "illustrating impressive momentum in only two years."[44]

The CBRS band protects incumbents through use of a three-tiered framework enabled by a Spectrum Access System ("SAS"), which accommodates incumbent 3.5 GHz users, CBRS PAL holders, and users in the licensed-by-rule General Authorized Access ("GAA") tier by using an environmental sensing capability ("ESC").[45] Tier 1 incumbent users have constant access to spectrum for critical national security operations, for example, whereas tier 2 PAL holders are permitted to utilize the spectrum when the Department of Defense ("DoD") is not operating. Separate channels are similarly available for tier 3 GAA use when DoD and other incumbent users are not operating. ESCs are strategically deployed to sense activity in the band and inform the SAS when and where DoD or PAL holders are operating. In addition, thousands of certified installers ensure the protection of incumbents in the band, which adds an additional layer of protection to the framework coordinated by the SAS. There have been no publicly

[44] Press Release, OnGo Alliance, *OnGo Alliance Marks Important Milestones for CBRS Networks, Illustrating Substantial Momentum for Private, Fixed and Neutral Networks* (Sept. 28, 2022), https://ongoalliance.org/news/ongo-alliance-marks-important-milestones-for-cbrs-networks-illustrating-substantial-momentum-for-private-fixed-and-neutral-networks/.

[45] *See Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, Order on Reconsideration and Second Report and Order, 31 FCC Rcd. 5011, ¶ 14 (2016).

reported instances of harmful interference to U.S. Navy operations in the CBRS band, and the DoD declared the CBRS framework a spectrum sharing "success" for this and other reasons.[46]

From a competitive standpoint, the CBRS framework has been substantially more successful than exclusive auctions. "CBRS has seen faster, more widespread deployment, by a more diverse range of users, than any other spectrum band in history."[47] Over its entire 40-year history, the incumbent cellular industry has built fewer than 420,000 cell sites, yet over the past two years, more than 300,000 CBRS base-station devices have been deployed nationwide, and there are now more than 900 distinct entities using the CBRS band to provide service.[48] This extraordinary pace of growth has only been possible thanks to the wide diversity of users adopting CBRS spectrum. 228 bidders won PALs in the CBRS auction, almost 10X the number of winning bidders in the exclusive-licensed auction for the 3.45 GHz band.[49] "CBRS-style sharing delivers more economic value, to more businesses and consumers, much more quickly."[50] As a result, U.S. businesses gain more choices in new wireless solutions, services, and partners far more quickly, ultimately creating a more competitive marketplace.

The CBRS band serves as a foundation for innovation for many kinds of new use cases across all industries. The U.S. Marine Corps uses CBRS networks to support warehouse robotics

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[46] *DoD Official Says CBRS Offers 'Promising' Example of Spectrum Sharing*, Communications Daily, (Nov. 16, 2022), https://communicationsdaily.com/article/view?search_id=662545&p=1&id=1420006&BC=bc_642dae39eb221 (reposting portions of a LinkedIn post by Vernita Harris, DoD Director of Spectrum Policy and Programs, stating that CBRS shows "unprecedented coordination between federal users, regulators, and industry" and "[m]ore work lies ahead, but the results of CBRS so far are promising, and those involved in its success so far should be proud").

[47] Jennifer McCarthy, *The CBRS "Innovation Band" Is Already a Historic Success—and the Future Looks Bright*, Federated Wireless (Nov. 22, 2022), https://www federatedwireless.com/blog/cbrs-is-a-success/.

[48] *Id*.

[49] *See Auction of Priority Access Licenses in the 3550-3650 MHz Band Closes*, Public Notice, 35 FCC Rcd. 9287, ¶ 1 (OEA & WTB 2020). Most notable is that these 228 bidders come from a wide-range of backgrounds including national and regional Mobile Network Operators, cable operators, Wireless Internet Services Providers, electric utilities, and more.

[50] *See supra* note 50.

and virtual reality applications,[51] while utilities have deployed CBRS networks to modernize the grid and provide early alerts and warnings for outages, downed power lines, or other safety concerns.[52] In the healthcare industry, CBRS has been deployed to add extra data capacity to support medical IoT networks that are securely walled off from external attacks and to support high-bandwidth technologies like augmented reality and remote diagnostics.[53] CBRS also has supported advances in remote learning by supporting new coverage and capacity and extending school networks to provide Internet access to underserved students' homes.[54] None of these new uses would have been possible without the regulatory flexibility afforded by a shared-licensed spectrum framework.

The U.S. government has recognized the feasibility and importance of spectrum sharing frameworks. A 2018 Presidential Memorandum directed NTIA to evaluate "spectrum-sharing tools and techniques that increase spectrum access, efficiency, and effectiveness[.]"[55] Following this direction, NTIA released a Public Notice seeking to evaluate the Lower 3 GHz and 7/8 GHz bands.[56] In 2021, the Biden administration requested $39 million for 2022 "for advanced communications research at [NTIA], which would support the development and deployment of

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[51] *See* JMA Wireless, *JMA Wireless XRAN Deployed at Marine Corps Warehouse in Albany, Georgia* (Mar. 24, 2021), https://jmawireless.com/jma-brings-semper-fi-5g-to-georgia-marine-corps-facility/.

[52] *See* Crown Castle, *The new spectrum that's expanding wireless connectivity*, https://www.crowncastle.com/innovation-spotlight/cbrs (last visited Apr. 13, 2023).

[53] *See id*.

[54] *See id*.

[55] *Presidential Memorandum on Developing a Sustainable Spectrum Strategy for America's Future*, White House (Oct. 25, 2018), https://trumpwhitehouse.archives.gov/presidential-actions/presidential-memorandum-developing-sustainable-spectrum-strategy-americas-future/.

[56] *See* Memorandum from Diane Rinaldo, Assistant Secretary of Commerce for Communications & Information, U.S. Dep't of Commerce, NTIA to Executive Branch Departments & Agencies, *Review of Current Frequency Assignments and Quantification of Spectrum Usage* (Aug. 1, 2019), https://www ntia.doc.gov/files/ntia/publications/guidance_to_agencies_on_current_spectrum_usage_final_08-01-2019.pdf ("Aug. 1, 2019 Memorandum").

broadband and 5G technologies by identifying innovative approaches to spectrum sharing."[57] The administration's fiscal year 2024 budget also included "$14 million to create an Incumbent Informing Capability (IIC) . . . to improve spectrum sharing."[58] The DoD also has stated that it "remains committed to engaging in a whole-of-nation approach to spectrum sharing to ensure not only our economic prosperity, but also our public safety, national defense, and general welfare."[59]

III. WHILE THE NATIONAL SPECTRUM STRATEGY SHOULD PURSUE NEW BANDS FOR COMMERICAL USE, IT MUST ALSO RAPIDLY MAKE AVAILABLE BANDS THAT HAVE ALREADY BEEN IDENTIFIED

A. NTIA and the FCC Should Act Quickly on the 7/8 GHz Band.[60]

NTIA and the FCC should initiate a proceeding immediately to make the lower portion of the 7/8 GHz band available for unlicensed use and the remaining portion of the 7/8 GHz band available for unlicensed and shared-licensed use.

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[57] Letter from Shalanda D. Young, Acting Director, U.S. Office of Management & Budget to Senator Patrick Leahy, Chairman, Committee on Appropriations, Enclosure 2 at 4 (Apr. 9, 2021).

[58] Press Release, U.S. Dep't of Commerce, *President Biden's Fiscal Year 2024 Budget Would Bolster Key Commerce Department Initiatives* (Mar. 9, 2023), https://www.commerce.gov/news/press-releases/2023/03/president-bidens-fiscal-year-2024-budget-would-bolster-key-commerce.

[59] Mike Dano, *CTIA Report on CBRS Ignites Firestorm of Criticism*, LightReading (Nov. 15, 2022), https://www.lightreading.com/regulatorypolitics/ctia-report-on-cbrs-ignites-firestorm-of-criticism/d/d-id/781787 ("DoD believes the nation that masters spectrum sharing among all users will gain huge technological, economical, and strategic advantage over competitors in the commercial and national security arenas."); *see also* Jason Miller, *For DoD, Solving Spectrum Sharing is a Matter of National, Economic Security*, Federal News Network (Jan. 4, 2022), https://federalnewsnetwork.com/defense-main/2022/01/for-dod-solving-spectrum-sharing-is-a-matter-of-national-economic-security/https://federalnewsnetwork.com/defense-main/2022/01/for-dod-solving-spectrum-sharing-is-a-matter-of-national-economic-security ("We've got to now learn how to share, and for DoD that's going to be extremely important because whoever solves that sharing, how do we share with other technologies, will own on this on the spectrum race."); C. Todd Lopez, *Spectrum Sharing is Way Ahead to Maintain Economic Dominance, Defense Official Says*, U.S. Dep't of Defense (Sept. 21, 2022), https://www.defense.gov/News/News-Stories/Article/Article/3165774/spectrum-sharing-is-way-ahead-to-maintain-economic-dominance-defense-officials/ ("But sharing offers us a way ahead out of this and we've proven we can do this with the other initiatives I've talked about . . . We can make sharing work in collaboration with you all in industry and with our interagency partners.").

[60] *See* Pillar 1, Question 3: "What spectrum bands should be studied for potential repurposing for the services or missions of interest or concern to you over the short, medium, and long term?"

The 7/8 GHz band is optimal for unlicensed use given its adjacency to the 6 GHz band, which already has been authorized for unlicensed use. The 7/8 GHz band would therefore provide a natural extension to and optimize unlicensed use already available in the 6 GHz band. Opening 125 megahertz in the lower portion of this band, when combined with U-NII-8, is the most spectrally efficient way to produce an additional 320 megahertz-wide channel, which is needed to support next-generation Wi-Fi uses. In any other spectral location, a full 320 megahertz would be required. Moreover, the lower portion of the 7/8 GHz band contains federal point-to-point microwave operations with similar characteristics to non-federal point-to-point links in the 6 GHz band, which presents NTIA and the FCC with a golden opportunity to use the same mitigation techniques in both bands. This and other similar characteristics of the two bands facilitate the implementation of low-power unlicensed Wi-Fi in the 7/8 GHz band. The band also is internationally harmonized, which helps reduce the cost of devices and is crucial from an economic standpoint. NTIA has been reviewing the 7125-8400 MHz band since 2019,[61] and further delay is unnecessary. Therefore, NTIA should act in coordination with the FCC to immediately open the lower 125 megahertz of the 7/8 GHz band for unlicensed use, while studying the remainder of the band on an expedited basis to reallocate the remainder of the band for unlicensed and shared-licensed use.

B. The Lower 3 GHz Band Should Be Made Available for Shared Use as Soon as Possible.[62]

NTIA and the FCC should initiate a proceeding to make the Lower 3 GHz band available

[61] *See* Aug. 1, 2019 Memorandum.

[62] *See* Pillar 1, Question 3: "What spectrum bands should be studied for potential repurposing for the services or missions of interest or concern to you over the short, medium, and long term?"; Pillar 1, Question 4: "What [are the] factors [that] should be considered in identifying spectrum for the pipeline?" and "How should the Strategy balance these goals against critical government missions?"; Pillar 2, Question 1: "How do we best ensure that all stakeholders can participate in a long-term spectrum planning process in order to facilitate transparency to the greatest extent possible, ensure efficient and effective use of the nation's spectrum resources?"; Pillar 2, Question 3:

for shared use immediately after DoD completes its review and report to Congress. The work is well underway to make sharing possible in the Lower 3 GHz band. NTIA has been reviewing the 3100-3550 MHz band since 2019.[63] As part of the Infrastructure Investment and Jobs Act, Congress authorized DoD to determine whether sharing in the Lower 3 GHz band is feasible given that DoD is the incumbent user of the band. The DoD and National Spectrum Consortium's Partnering to Advance Trusted and Holistic Spectrum Solutions Task ("PATHSS") Group has continued to evaluate this band and created a forum for industry stakeholders and the DoD to exchange sensitive and classified information on current and projected military and commercial requirements in this band. NTIA can look to this as a model for ensuring that all stakeholders can participate in the spectrum planning process.

The Lower 3 GHz band is located in prime mid-band spectrum with a balance of coverage and throughput needed to support next-generation wireless uses, and is proximate to the CBRS band, which already supports sharing. A sharing framework similar to CBRS can and should be applied to the Lower 3 GHz band, and a shared-licensed framework would avoid the costly, time-intensive process that it would otherwise take to relocate incumbent federal operations, which are critical to our national security.[64] As with CBRS, opening the Lower 3 GHz band for shared use will promote competition by making spectrum available to a wide diversity of users and use cases.

"How can federal and non-federal stakeholders best engage in productive and ongoing dialogue regarding spectrum allocation and authorization, repurposing, sharing, and coordination?"

[63] *See* Aug. 1, 2019 Memorandum.

[64] NTIA also should consider expanding this approach to the 12.7 GHz band after further study to minimize the risk of disruption to federal users. It is possible that the 12.7 GHz band could support a shared-licensed framework, but the propagation characteristics of the band make it more challenging for mobile use than those in the Lower 3 GHz band. NTIA should conduct additional studies to determine whether and how to optimize shared use of the 12.7 GHz band.

C. NTIA Should Take a Holistic Approach to Identifying Additional Spectrum Bands for Potential Repurposing.[65]

With respect to approaches for optimizing access to spectrum and identifying bands that may be repurposed, an important first step is assessing the intensity of incumbent use of a band—with respect to geographic scope, how frequently the band is used (e.g., activity factor), and how much spectrum is used during those periods. It is equally important for NTIA and the FCC to examine which bands lend themselves to which frameworks and use cases based on the unique characteristics of each band, the existing incumbent users, and harmonization with surrounding or adjacent bands.

IV. AS PART OF THE NATIONAL SPECTRUM STRATEGY, NTIA SHOULD CONTINUE TO INVEST IN TECHNOLOGICAL SOLUTIONS AND SUPPORT POLICIES AND RULES THAT PROMOTE EFFICIENT USE OF SPECTRUM AND DO NOT UNDERMINE ITS CHOSEN SPECTRUM ALLOCATIONS

A. NTIA Should Continue to Pursue and Refine the Incumbent Informing Capability ("IIC").[66]

Comcast supports NTIA's work on IIC, which is an example of a still-developing technology that holds great promise for advances in spectrum sharing in congested and contested spectrum environments.

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[65] *See* Pillar 1, Question 4: "What [are the] factors [that] should be considered in identifying spectrum for the pipeline?"

[66] *See* Pillar 1, Question 2: "[A]re there options available for increasing spectrum access in addition to or instead of repurposing spectrum (i.e., improving the technological capabilities of deployed systems, increasing or improving infrastructure build outs)?"; Pillar 1, Question 7: "What are the use cases, benefits, and hindrances of each of the following spectrum access approaches [exclusive use, predefined sharing, and dynamic sharing]"; Pillar 1, Question 8: "What incentives or policies may encourage or facilitate the pursuit of more robust federal and non-federal spectrum sharing arrangements, including in mid-band and other high priority/demand spectrum?"; Pillar 2, Question 3: "How can federal and non-federal stakeholders best engage in productive and ongoing dialogue regarding spectrum allocation and authorization, repurposing, sharing, and coordination?"; Pillar 2, Question 4: "What technical and policy-focused activities can the U.S. Government implement that will foster trust among spectrum stakeholders and help drive consensus among all parties regarding spectrum allocation decisions?"; Pillar 3, Question 1: "What innovations and next-generation capabilities for spectrum management models (including both licensed and unlicensed) are being explored today and are expected in the future to expand and improve spectrum access . . ."; Pillar 3, Question 2: "What policies should the National Spectrum Strategy identify to enable development of new and innovative uses of spectrum?"; Pillar 3, Question 3: "What role, if any, should the government play in promoting research into, investment in, and development of technological advancements in

IIC relies on an informing mechanism to initiate the coordination process as opposed to CBRS's SASs relying on ESCs' sensing mechanism to initiate the coordination process. Use of an informing mechanism inherently offers numerous benefits over a sensing mechanism. For example, ESCs require a "whisper zone" in the area directly surrounding the sensor to ensure that the ESC does not encounter false positives and needlessly halt non-federal operations. Moreover, ESCs' sensors need protection not just from in-band signals, but also from adjacent band signals in the 3.45 GHz band. By contrast, IIC does not require such a whisper zone and instead can enable use of the full geography for each license. Additionally, because IIC does not rely on a sensing mechanism, it does not face the same threats as ESCs. Where ESC sensors have been rendered inoperable at times due to natural disasters and similar occurrences, IIC offers greater reliability. This enhanced reliability is quite valuable as it prevents the default activation of dynamic protection areas that occurs when an ESC sensor is down.

IICs can offer flexibility for testing situations that ESCs do not. In a scenario where an incumbent is performing testing which does not require protection, the incumbent can simply not seek protection which would allow other users in the band to continue their operations unabated, whereas under an ESC framework, the dynamic protection area is automatically activated upon signal detection. As part of IIC development, NTIA, in coordination with DoD, should explore the efficacy of using high-resolution terrain and clutter data coupled with advanced ray-tracing propagation models to protect DoD systems in CBRS, the Lower 3 GHz band, and other bands being considered for shared access. Comcast's experience in CBRS reveals that the current CBRS incumbent protection model is very conservative and suggests that PAL and GAA access

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spectrum management, spectrum-dependent technologies, and infrastructure?"; Pillar 3, Question 4: Recommendations for using the IIC or some other mechanism; Pillar 3, Question 5: "What other technologies and methodologies are currently being, or should be, researched and pursued that innovate in real-time dynamic spectrum sharing, particularly technologies that may not rely on databases?"

could be expanded (or interrupted less often) by adopting these available and well-known modeling techniques. In these ways, IIC can offer additional capabilities that ESCs lack and which provide both privacy and efficiency to both federal and non-federal users. NTIA should continue to refine IIC to enhance spectral efficiency and try to avoid overly conservative assumptions that might dampen the consumer benefits of shared spectrum use.

B. The Policies and Rules That Will Apply to Repurposed Bands Are Equally Important.[67]

Beyond identifying bands that can be repurposed, NTIA and the FCC must carefully consider the policies and technical rules that govern each of these bands in order to optimize their use. Technical rules that overprotect or unduly burden spectrum can drive down investment and dampen consumer benefits. At the same time, certain technical and service rules have proven highly successful in promoting innovation in competition.

NTIA and the FCC should consider technical and service rules that promote competition. County-sized licenses, as opposed to Partial Economic Areas or Cellular Market Areas, enable entities of all sizes and business models to obtain meaningful access to spectrum and participate in auctions, as evidenced by the CBRS proceeding. Additionally, use of a reasonable spectrum aggregation limit helps further ensure competitive access to spectrum. In the CBRS proceeding, these factors together meant that many smaller entities were finally able to participate competitively at auction and resulted in over 200 winning bidders in the CBRS auction with wide-ranging planned uses.[68]

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[67] *See* Pillar 1, Question 8: "What incentives or policies may encourage or facilitate the pursuit of more robust federal and non-federal spectrum sharing arrangements, including in mid-band and other high priority/demand spectrum?"

[68] *See Auction of Priority Access Licenses in the 3550-3650 MHz Band Closes*, Public Notice, 35 FCC Rcd. 9287, ¶ 1 (OEA & WTB 2020).

Additionally, power levels should be considered on a band-by-band basis. Specifically, NTIA should set power levels to maximize total utility for a wide array of potential bidders and use cases.

V. CONCLUSION

Comcast appreciates the opportunity to provide responses to the NTIA's RFC. To maintain and further advance U.S. leadership in spectrum-based technologies, NTIA should adopt an NSS that incorporates unlicensed, shared-licensed, and exclusive-licensed frameworks. NTIA should act promptly to make the 7/8 GHz band available for unlicensed and shared use and make the Lower 3 GHz band available for shared use. In identifying additional spectrum bands to be studied and repurposed, NTIA should consider the characteristics of each band and the needs of stakeholders, and decline to base such decisions on oversimplified megahertz-to-megahertz comparisons. Finally, NTIA and other federal agencies should ensure that the technical and other rules it adopts optimize use of the bands and promote competition and innovation.

Respectfully submitted,

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