Before the
NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION
Washington, DC 20230

In the Matter of	)	
	)	
Implementation of a National Spectrum	)	Document No. 2023-26810
Strategy	)	
	)	

COMMENTS OF WI-FI ALLIANCE

Wi-Fi Alliance®[1] submits these comments in response to the above-referenced Notice of

Opportunity for Public Input[2] issued by the National Telecommunication and Information

Administration ("NTIA") on the Implementation of the National Spectrum Strategy for the

United States ("National Spectrum Strategy").[3] Wi-Fi Alliance supports the Administration's

efforts to modernize spectrum policy and to maximize the efficient use of the nation's valuable

spectrum resources. As the demand for spectrum becomes more intense, driven by Americans'

ever-increasing need for wireless connectivity, spectrum managers must carefully consider

additional ways to maximize spectrum utilization. That is why it is appropriate that the National

Spectrum Strategy leverages technological innovations to emphasize dynamic spectrum access

for unlicensed technologies such as Wi-Fi, which is essential to ensure the Nation's connectivity.

Because Wi-Fi technology is ideally suited to take advantage of dynamic spectrum access on a

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[2]   *Implementation of the National Spectrum Strategy*, Notice of Opportunity for Public Input, 88 Fed. Reg. 85266 (Dec. 7, 2023).

[3]   *National Spectrum Strategy*, THE WHITE HOUSE (Nov. 13, 2023), https://www.ntia.gov/sites/default/files/publications/national_spectrum_strategy_final.pdf ("National Spectrum Strategy").

non-interference basis, it does not require exclusive or priority access to spectrum and, therefore, imposes no constraints on Federal operations, including the need for spectrum repurposing and incumbent relocation.

I.   A SPECTRUM PIPELINE MUST RECOGNIZE THE NEED FOR SPECTRUM FOR WI-FI

NTIA's strategic objectives under Pillar One of the National Spectrum Strategy are to ensure that there is sufficient spectrum for Federal and Non-Federal operations[4] and to maintain a spectrum pipeline.[5] In seeking to meet those objectives, NTIA must take into consideration the central role of Wi-Fi in the national telecommunications infrastructure and ensure that spectrum is available for Wi-Fi use. Wi-Fi delivers the majority of Americans' broadband connectivity.[6] In fact, over half of all Americans' internet traffic transits a Wi-Fi connection[7] and approximately 80% of mobile traffic is transmitted over Wi-Fi.[8]   Wi-Fi and other unlicensed technologies have changed the way people work, provide and receive healthcare, and learn.[9] Wi-Fi is also a critical component of Internet of Things ("IoT") connectivity and

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[4]   *Id.* at 3-7.

[5]   *Id.* at 7-8.

[6]   *Discover Wi-Fi*, WI-FI ALLIANCE, https://www.wi-fi.org/discover-wifi (last visited Jan. 2, 2024) (stating "Wi-Fi is [t]he primary medium for global internet traffic.").

[7]   The Future of Commercial Spectrum, *Spectrum and Wi-Fi*, NCTA, https://www.ncta.com/positions/spectrum-wifi#:~:text=More%20than%20half%20of%20U.S.%20internet%20traffic%20transits%20a%20Wi%2DFi%20network (last visited Jan. 2, 2024).

[8]   Comments of WifiForward, Docket No. NTIA-2023-0003, at 2 (Apr. 17, 2023), https://wififorward.org/wp-content/uploads/2023/04/FINAL-WifiForward-National-Spectrum-Strategy-NTIA-Comments.pdf.

[9]   See Wi-Fi is Essential for Remote Working, Learning, and Playing, INTEL, https://www.intel.com/content/www/us/en/products/docs/wireless/essential-for-remote-workinglearningplaying.html (last visited Jan 2, 2024) ("Wi-Fi is now the primary method for the remote workforce, students, and families to connect."); see also Wi-Fi CERTIFIED 6™ in Healthcare, WI-FI ALLIANCE, https://www.wi-fi.org/system/files/Wi-Fi_6_in_Healthcare.pdf (last visited Jan. 2, 2024) (noting several healthcare use cases for Wi-Fi such as patient monitoring, scheduling medicine delivery, imaging, and telemedicine); see also Wi-Fi® in Education, WI-FI ALLIANCE, https://www.wi-

supports an ever-expanding variety of applications and use cases, such as home control ("smart home" devices), security, and entertainment.[10/] In addition to the key role that Wi-Fi connectivity plays in enabling America's connectivity, Wi-Fi also delivers significant economic value.[11/] In the United States alone, Wi-Fi is on pace to contribute more than $1.5 trillion in economic value by 2025[12/] and it is estimated that between 2021 and 2025, Wi-Fi will have generated nearly 720,000 jobs.[13/]

However, the benefits of Wi-Fi deployment depend on sufficient access to spectrum. Without enough available spectrum, Wi-Fi-connected devices simply cannot provide the fast and reliable connectivity on which most Americans rely. While there are already an estimated 19.5

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fi.org/system/files/Wi-Fi_in_Education.pdf (last visited Jan. 2, 2024) (showing that Wi-Fi is changing education and allowing for new classroom innovations).

[10/] *Leveraging Wi-Fi for Home IoT Use Cases*, 1-3 (Nov. 2022), https://www.wi-fi.org/file/leveraging-wi-fir-home-iot-use-cases-2022; *See Internet of Things*, WI-FI ALLIANCE, https://www.wi-fi.org/discover-wi-fi/internet-things (last visited Jan 2, 2024). For example, using Wi-Fi-connected devices, consumers can turn on the lights in their homes, adjust their thermostats, and operate their appliances. *Leveraging Wi-Fi for Home Use Cases* 1-2. Similarly, Wi-Fi can serve as the backbone network for home and small business security systems. *Id.* at 2; *see also* Wendy Sheehan Donnell, *SimpliSafe Home Security System Review*, PCMAG, https://www.pcmag.com/reviews/simplisafe-home-security-system (last updated May 18, 2023) (noting the system is "easy to use," "DIY" and that individuals can "build their own custom system from scratch").

[11/] *Value of Wi-Fi*, WI-FI ALLIANCE, https://www.wi-fi.org/discover-wi-fi/value-wi-fi#:~:text=The%20global%20economic%20value%20of,grow%20to%20nearly%20%245%20trillion (last visited Jan. 2, 2024) (stating that in 2021 the estimated value of Wi-Fi across the globe was more than $3.3 trillion and by 2025 will increase to nearly $5 trillion).

[12/] *See 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 ("*Value of Wi-Fi Report*").

[13/] *See The Economic Value of Wi-Fi: A Global View (2021-2025)*, TELECOM ADVISORY SERVICES, at 31 (Feb. 2021), https://www.wi-fi.org/download.php?file=/sites/default/files/private/The_Economic_Value_of_Wi-Fi-A_Global_View_2021-2025.pdf.

billion Wi-Fi-enabled devices in use globally,[14/] *billions* more will be deployed in the coming years, supporting more spectrum-intensive use cases.[15/]

For instance, in 2022, global IoT connections, many of which utilize Wi-Fi, grew by 18%, reaching 14.3 billion active IoT endpoints, and that number was expected to increase by another 16% to a total of 16.7 billion in 2023.[16/] In fact, by some estimates, in 2027, there will be more than 29 billion global IoT connections.[17/] Wi-Fi, which enables many IoT use cases, must be able to accommodate the expected growth. Moreover, advanced Wi-Fi use cases, such as augmented and virtual reality, artificial intelligence, cloud computing, telemedicine, and industrial automation, require more bandwidth and lower latency.[18/] These critical performance parameters depend on spectrum access.

The optimal performance of the current generation of Wi-Fi – Wi-Fi 6E, depends on channels as wide as 160 megahertz to deliver wireless data at gigabit speeds with low latency.[19/]

[14/]   Wi-Fi Alliance, *Wi-Fi® by the numbers: Technology momentum in 2023*, THE BEACON BLOG (May 15, 2023), https://www.wi-fi.org/beacon/the-beacon/wi-fi-by-the-numbers-technology-momentum-in-2023.

[15/]   Ryan Daws, *IDC: Wi-Fi Product Shipments will Grow to 4.1B in 2024*, TELECOMS (Apr. 14, 2023), https://www.telecomstechnews.com/news/2023/apr/14/idc-wifi-shipments-grow-to-4-1b-in-2024/; Sue Marek, *Wi-Fi 7 Promises Big Leaps in Performance*, FIERCE WIRELESS (Sept. 20, 2023), https://www.fiercewireless.com/tech/wi-fi-7-promises-big-leaps-performance.

[16/]   Satyajit, Sinha, *State of IoT 2023: Number of Connected IoT Devices Growing 16% to 16.7 Billion Globally*, IOT ANALYTICS (May 24, 2023), https://iot-analytics.com/number-connected-iot-devices/.

[17/]   *Id.*

[18/]   *Value of Wi-Fi Report* at 16; Dmitry Akhmetov, et al., *Spectrum Needs of Wi-Fi 7*, White Paper, INTEL, at 2, 6, https://www.intel.com/content/www/us/en/products/docs/wireless/wi-fi-7/spectrum-needs-of-wi-fi-7.html (last visited Jan. 2, 2023). Further, Wi-Fi will contribute to the continued rise of "smart cities," which use real-time data gathering and analysis to manage, using connected devices, municipal infrastructure ranging from electric grids to water networks to traffic management. *See* Sarah Wray, *Smart City Market to Reach $300 Billion by 2032*, CITIESTODAY (May 3, 2023), https://cities-today.com/smart-city-market-to-reach-300-billion-by-2032/; *Smart City Traffic Management*, SPECTRUM (last visited Jan 2, 2024), https://spectrumsmartcities.com/articles/smart-city-traffic-management.html.

[19/]   *See Discover Wi-Fi: Wi-Fi CERTIFIED 6*, WI-FI ALLIANCE, https://www.wi-fi.org/discover-wi-fi/wi-fi-certified-6 (last visited Jan. 2, 2024).

The next iteration of Wi-Fi – Wi-Fi 7 – is designed to support data throughput of up to 30 gigabits per second while relying on even wider 320 megahertz channels.[20] In addition to supporting high data throughput capabilities that define the future of wireless connectivity, Wi-Fi often serves as the predominant connectivity solution for places where large numbers of people gather, such as libraries, schools, hospitals, or entertainment venues.[21] Ever-increasing deployments, more data-intensive applications, and the proliferation of Wi-Fi devices are all major demand drivers on the limited spectrum of resources available for Wi-Fi access. These looming spectrum requirements threaten to undermine Wi-Fi's reliability and performance and stifle the development of advanced communication services.[22]

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[20] *See Who We Are: Current Work Areas, Wi-Fi 7*, WI-FI ALLIANCE, https://www.wi-fi.org/who-we-are/current-work-areas#Wi-Fi%207 (last visited, Jan 2, 2024).

[21] *See Value of Wi-Fi Report* at 12; *see also Addressing the Homework Gap Through the E-Rate Program*, Notice of Proposed Rulemaking, WC Docket No. 21-31, FCC 23-91, ¶¶ 19-21 (2023) (proposing to make individual Wi-Fi hotspots eligible for E-rate funding); *Modernizing the E-Rate Program for Schools and Libraries*, Declaratory Ruling, WC Docket No. 13-184, FCC 23-84, ¶ 9 (2023) (clarifying that the use of Wi-Fi on school buses serves an educational purpose thereby making Wi-Fi devices on school buses eligible for E-rate funding); *Establishing the Emergency Connectivity Fund to Close the Homework Gap*, Report and Order, 36 FCC Rcd 8696, ¶ 61 (2021) (allowing schools and libraries to use Emergency Connectivity Fund program support the purchase Wi-Fi hotspots for school buses and bookmobiles to provide off-campus broadband services to students, school staff, and library patrons who currently lack sufficient broadband access); *Modernizing the E-rate Program for Schools and Libraries*, Report and Order, 29 FCC Rcd 8870, ¶¶ 7-9 (2014) (modifying the E-rate program to support the deployment of Wi-Fi connectivity in classrooms and libraries).

[22] *See*, *e.g.*, CTIA, *The United States Needs 400 Megahertz of Full-Power, Licensed Spectrum to Meet Demand for Wireless Broadband in Next Five Years, New Report Shows*, Press Release (April 17, 2023), https://www.ctia.org/news/the-united-states-needs-400-megahertz-of-full-power-licensed-spectrum-to-meet-demand-for-wireless-broadband-in-next-five-years-new-report-shows; *see also Wi-Fi Alliance 2022 Wi-Fi Trends*, WI-FI ALLIANCE, https://www.wi-fi.org/news-events/newsroom/wi-fi-alliance-2022-wi-fi-trends, (last visited Jan. 2, 2024) (discussing the increased "demand for high-quality Wi-Fi and more efficient, reliable connectivity in phones, tablets, and access points"); Paul Brodsky, *Internet Traffic and Capacity Remain Brisk*, TELEGEOGRAPHY BLOG (Sept. 13, 2022), https://blog.telegeography.com/internet-traffic-and-capacity-remain-brisk ("Global internet bandwidth rose by 28% in 2022, continuing the return to 'normal' from the pandemic-generated bump of 2020.").

Wi-Fi Alliance commends NTIA for recognizing that Wi-Fi will require additional spectrum in the future.[23/] To meet these acknowledged requirements, Pillar One's strategic objectives can best be realized through spectrum sharing. That is because while the National Spectrum Strategy recognizes the need for additional spectrum for Wi-Fi, it also seeks to preserve spectrum resources for Federal entities. Indeed, the National Spectrum Strategy observes that Federal operations often do not fully occupy their spectrum assignments at all times.[24/] That characteristic of Federal spectrum use makes sharing with Wi-Fi technologies particularly attractive. Wi-Fi has many inherent features designed to allow it to share spectrum with higher priority (*e.g.,* licensed) users. In particular, Wi-Fi devices operate at lower power levels and thus can exist around entities with primary spectrum rights that typically operate at significantly higher power.[25/] In addition, the typical uses for Wi-Fi devices – *i.e.*, work, school, and entertainment, as described above – often take place exclusively indoors, and thus operations can be restricted to "indoor-only" to mitigate potential interference with primarily outdoor uses like Federal operations.[26/] Wi-Fi also uses contention-based protocols to sense when spectrum is otherwise in use – ensuring that there is no interference to critical Federal operations.

The use of spectrum sharing to support Wi-Fi growth is particularly attractive with respect to the 7.125-8.4 GHz band, which NTIA targets for evaluation. This spectrum is

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[23/]   National Spectrum Strategy at 4.

[24/]   *Id.*

[25/]   *See, e.g.*, *Part 15 Subpart E U-NII 6 GHz General Guidance Bands 5, 6, 7, 8*, FCC Office of Engineering and Technology Laboratory Division Publication, Knowledge Database (May 20, 2022) https://apps.fcc.gov/kdb/GetAttachment.html?id=4iuZjuFgWiNypCLVpSN3cQ%3D%3D&desc=987594 %20D01%20U-NII%206GHz%20General%20Requirements%20v01r03&tracking_number=277034 ("The contention-based protocol can allow multiple users to share the same spectrum among low-power indoor access points, subordinates, and clients.").

[26/]   *See, e.g.*, *Unlicensed Use of the 6 GHz Band*, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 3852, ¶¶ 22, 99 (2020) ("*6 GHz Report and Order*"); *see Use of the 5.850-5.925 GHz Band,* 35 FCC Rcd 13440, ¶ 61 (2020).

immediately adjacent to the spectrum that the Federal Communications Commission ("FCC")

already designated for Wi-Fi use at 5.925-7.125 GHz ("6 GHz band"). The FCC's decision to

permit unlicensed operations in the 6 GHz band has already resulted in remarkable benefits for

American consumers, enterprises, and the economy.[27] Importantly, the benefits of the FCC's

decision have been realized without constraints on incumbent operations in the subject frequency

bands. Expanding Wi-Fi access to additional spectrum in the adjacent bands above 7.125 GHz

will create opportunities for additional, wider spectrum channels that can support future

generations of Wi-Fi technology and enable the advanced use cases described above.[28]

Although NTIA observes that there are a variety of Federal operations in the band,[29] that is

precisely why the band is ideal for shared use by Wi-Fi. With an appropriate regulatory

framework similar to the one adopted by the FCC in the 6 GHz band, Wi-Fi operations will not

impact or constrain incumbent Federal operations. Accordingly, as NTIA seeks to maximize

efficient spectrum use, ensure spectrum is available for private sector innovation, and establish a

spectrum pipeline, it should consider designating additional shared spectrum for Wi-Fi

operations.

II.   ACCESS TO FEDERAL SPECTRUM CAN BE FACILITATED BY COLLABORATION AND DATA EXCHANGE

The strategic objectives under Pillar Two relate to the development of a shared

information ecosystem that can lead to the designation of spectrum for non-Federal use.[30] Wi-Fi

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[27]   Chris Szymanski, *The unprecedented success of opening the entire 6 GHz band to Wi-Fi*, BROADCOM B-CONNECTED BLOG (May 16, 2023), https://www.broadcom.com/blog/unprecedented-success-opening-6ghz-band-to-wifi.

[28]   Wi-Fi Alliance, *Wi-Fi 7: Advanced Connectivity for the Next Generation*, THE BEACON BLOG (Oct. 31, 2023), https://www.wi-fi.org/beacon/the-beacon/wi-fi-7-advanced-connectivity-for-the-next-generation.

[29]   National Spectrum Strategy at 6.

[30]   *Id.* at 9-12.

Alliance encourages the exchange of information between Federal and non-Federal stakeholders to promote the full understanding of, for example, how Federal spectrum is used. Dynamic spectrum sharing techniques such as the automated frequency coordination system ("AFC") that will operate in the 6 GHz band depend on information about incumbent users in order to preserve their priority spectrum access.[31] The robust exchange of information among Federal and non-Federal spectrum users will permit an informed assessment of how that spectrum may be shared and form the basis of how sharing can occur. It will also allow Federal entities to understand how spectrum-sharing techniques may be used in specific spectrum bands, potentially facilitating additional sharing and even more efficient use of scarce spectrum resources.

III. TECHNOLOGY DEVELOPMENT MUST INCLUDE SPECTRUM SHARING TECHNIQUES

A focus on spectrum-sharing techniques will also help NTIA implement the strategic objectives under Pillar Three of the National Spectrum Strategy. Those strategic objectives seek to improve spectrum efficiency and sharing by continuing to improve regulators' understanding of spectrum and the new, innovative uses and technologies that can expand spectrum access.[32] Wi-Fi Alliance strongly agrees that the United States must invest in technologies that will facilitate real-time, dynamic spectrum sharing. As noted above, Wi-Fi relies on contention-based protocols to promote real-time sharing, and recent FCC actions have demonstrated that other methods can augment spectrum sharing and coexistence.[33] In particular, the FCC has

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[31]   *See The Commission Begins the Process for Authorizing 6 GHz Band Automated Frequency Coordination Systems*, Public Notice, 36 FCC Rcd 14098, ¶¶ 3-5 (describing the requirements of the AFC systems and how they will prevent harmful interference to incumbent users).

[32]   National Spectrum Strategy at 13-18.

[33]   *See*, *e.g.*, *6 GHz Report and Order* at 22 (requiring standard-power 6 GHz unlicensed devices to operate pursuant to an AFC system); *see also Promoting Efficient Use of Spectrum through Improved Receiver Interference Immunity Performance*, Notice of Inquiry, 37 FCC Rcd 5337 (2022) (seeking up-to-date information on the role receivers play in spectrum management and how the FCC may promote

permitted access to the 6 GHz band by standard-power access points (and associated devices) based on the use of AFC systems, and the FCC is expected to approve AFC use shortly.[34] The Federal government can take advantage of AFC-like access mechanisms to permit sharing between Federal and non-Federal operations. As NTIA observes, it can "leverage technology, expertise, and knowledge of the involved parties to safeguard incumbent missions."[35] Accordingly, Wi-Fi Alliance urges that the National Spectrum Research and Development Plan, contemplated by Strategic Objective 3.2,[36] feature the study of additional spectrum-sharing techniques to support Wi-Fi alongside the continued use of spectrum by Federal entities. Part of that work can be accomplished through the national testbed for dynamic spectrum sharing that the National Spectrum Strategy envisions.[37] That testbed should promote and facilitate (as the National Spectrum Strategy observes) the effectiveness of current techniques such as AFC systems.[38]

IV. CONCLUSION

Wi-Fi Alliance applauds and appreciates NTIA's National Spectrum Strategy implementation approach. As part of the implementation, Wi-Fi Alliance strongly encourages NTIA to continue focusing on the benefits and possibilities of spectrum sharing. In particular, Wi-Fi Alliance urges NTIA to consider designating additional spectrum in the 7.125-8.4 GHz

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improvements in receiver performance to maximize spectrum use); *Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, Report and Order, 30 FCC Rcd 3959, ¶¶ 54, 80 (2015) (adopting a three-tier authorization model with frequencies assigned by a Spectrum Access System (SAS) in the 3.5 GHz spectrum band).

[34] *See OET Announces Commencement of Testing of the 6 GHz Band Automated Frequency Coordination Systems*, Public Notice, ET Docket No. 21-352, DA 23-759 (Aug. 24, 2023).

[35] National Spectrum Strategy at 15.

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

[37] *Id.* at 16-17.

[38] *Id.* at 17.

band for Wi-Fi operations. As the National Spectrum Strategy recognizes, maximizing access to

spectrum for both non-Federal and Federal operations is vitally important as Americans' reliance

on internet connectivity and connected devices increases. Wi-Fi technology is ideally suited to

continue to support America's evolving connectivity needs. It is, therefore, critical that the

Administration continue to identify sufficient spectrum for Wi-Fi today and in the future,

especially as more bandwidth-intensive uses come online and spectrum becomes more

congested. Wi-Fi Alliance is eager to contribute to NTIA's and other Federal agencies'

implementation of the National Spectrum Strategy, maximize spectrum efficiency, and provide

the widespread connectivity on which Americans depend.

Respectfully submitted,

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