Federal Register Notice: 89 FR 12871, https://www.federalregister.gov/documents/2024/02/20/2024-03400/request-for-information-on-the-national-spectrum-research-and-development-plan, February 20, 2023.

Request for Information on the National Spectrum Research and Development Plan

The Internet & Television Association (NCTA)

March 21, 2024

Networking and Information
Technology Research and Development (NITRD)
National Coordination Office (NCO),
National Science Foundation
2415 Eisenhower Ave.
Alexandria, VA 22314

Re: Request for Information on the National Spectrum Research and Development Plan

NCTA – The Internet & Television Association ("NCTA") appreciates the opportunity to comment[1] in response to the Networking and Information Research and Development ("NITRD") National Coordination Office ("NCO") Request for Information on the National Spectrum Research and Development Plan ("R&D RFI").[2] The Nation stands to benefit greatly from next-generation spectrum coexistence tools. New technologies are advancing coexistence among diverse groups and types of users, making it possible to open previously inaccessible bands for new commercial services. Dedicated and collaborative spectrum research and development efforts can yield a new generation of technologies and tools that will allow coexistence to produce even greater utility gains for the country. In these comments, we offer suggestions for how the National Spectrum R&D Plan can best achieve that objective while also promoting the use of existing spectrum sharing technologies—and the spectrum sharing frameworks they enable—to meet near-term needs.

Spectrum sharing and coexistence-based frameworks, of course, are not new. Shared-licensing frameworks and rules enabling unlicensed operations, for example, rely on well-established spectrum coexistence tools, such as those used in the Citizens Broadband Radio Service ("CBRS") and 6 GHz bands. Such coexistence mechanisms have facilitated commercial access to important spectrum bands, protected incumbents, and are currently available to expand utility in the bands that are being considered in the National Spectrum Strategy ("NSS"), especially the 3.1 GHz band and 7/8 GHz range.

Spectrum sharing offers significant benefits, and it is increasingly the most realistic solution to create more commercial bandwidth to meet consumer needs given scarce or nonexistent greenfield spectrum resources. It also significantly reduces the cost and impact of those efforts on U.S. government operations by minimizing or eliminating the need for incumbents to clear or relocate from particular frequencies. A shared-licensed framework—using reasonable geographic license sizes, with lower-site, lower-power transmitters compared to exclusive-licensed bands—promotes innovation and competition by making spectrum accessible

---

1 This document is approved for public dissemination. The document contains no business-proprietary or confidential information. Document contents may be reused by the government in the National Spectrum R&D Plan and associated documents without attribution.

2 Request for Information on the National Spectrum Research and Development Plan, 89 Fed. Reg. 12871 (Feb. 20, 2024) ("R&D RFI").

to a diverse set of users and new entrants. Clearing incumbents and using large license areas designed for nationwide carriers' high-power transmitters limits diversity and innovation, as only a handful of companies operate the wide-area coverage networks that make high power levels and large license areas technically and economically feasible. In contrast, spectrum sharing approaches using lower power levels and smaller license areas enable *both* the deployment of mobile wireless networks *and* new, innovative uses such as private wireless networks—while also promoting coexistence among federal incumbent users and new entrants.

The R&D Plan is an opportunity to explore additional spectrum sharing capabilities and build new coexistence tools, to advance the state of the art, and to expand already-successful frameworks, such as in the national dynamic spectrum sharing ("DSS") testbed. In parallel with those efforts, it is critical that, as a country, we also continue to press ahead with using existing sharing tools for near-term objectives.

Topic #1—Recommended Strategies to Minimize Spectrum R&D Duplication

The R&D RFI seeks comment on "[r]ecommendations on strategies for conducting spectrum research in a manner that minimizes unnecessary duplication, ensures that all essential spectrum research areas are sufficiently explored, and achieves measurable advancements in state-of-the-art spectrum science and engineering."[3] NCTA agrees that progress on spectrum R&D requires forward movement rather than delaying progress. But productive R&D also requires long lead times and involves risk. It is, therefore, critical to pursue the study of next-generation spectrum sharing in a way that allows the country to move ahead, in parallel, with expanding the use of the bands identified in the NSS more rapidly than permitted by R&D schedules.[4]

The R&D Plan should focus on developing the next generation of spectrum sharing technologies for future bands. With increasing consumer demands for unlicensed Wi-Fi and technologies supported by shared-licensed approaches, continued access to new frequencies will be required. Bands already identified for consideration generally require action on a more aggressive schedule than those for long-term R&D. We should adapt existing sharing tools for near-term objectives and invest in finding new sharing tools for longer-term objectives.

The NSS identifies the 3.1 GHz band and 7/8 GHz range for near-term action.[5] These bands are primed for commercial deployment by adapting today's proven coexistence approaches—specifically those already in use in the CBRS and 6 GHz bands.

---

3 *Id.* at 12872.

4 Comments of NCTA – The Internet & Television Association on Implementation Plan for National Spectrum Strategy at 22, NTIA-2023-0003 (filed Jan. 2, 2024), *available at* https://www.ntia.gov/sites/default/files/ncta-written-input.pdf ("NCTA NSS Implementation Comments").

5 *National Spectrum Strategy*, THE WHITE HOUSE 6 (Nov. 13, 2023), *available at* https://www.ntia.gov/sites/default/files/publications/national_spectrum_strategy_final.pdf ("National Spectrum Strategy" or "NSS").

The NSS and NSS Implementation Plan rightly call for study of these bands as soon as possible,[6] and it is important that those studies will consider coexistence approaches alongside other possibilities for these bands. Stalling action on these bands pending their study as part of the R&D Plan would be significantly duplicative of previous work and would delay action longer than the country can afford. In the 3.1 GHz band, for example, the Partnering to Advance Trusted and Holistic Spectrum Solutions ("PATHSS") Task Group conducted a two-year, multi-stakeholder study—known as the Emerging Mid-band Radar Spectrum Study ("EMBRSS")—that merged the expertise of the Department of Defense, interagency partners, industry, and academia to evaluate the future use of the band, including to "explore dynamic spectrum sharing."[7] As the NSS stated, the EMBRSS Study found that "sharing is feasible" with advanced mitigation and a coordination framework.[8]

While the NSS has determined that additional study is needed for the 3.1 GHz band, opening this band for sharing does not require R&D on next-generation coexistence technologies. Basing a spectrum sharing framework in the 3.1 GHz band on the CBRS band's coexistence approach will open it up for use by nationwide carriers, cable providers developing their own competitive networks, wireless internet service providers, universities, manufacturing centers, utilities, and many more potential users. Using adapted versions of current sharing approaches, this diverse ecosystem of spectrum users would be able to access the 3.1 GHz band without disrupting critical military operations.

The NSS Implementation Plan calls for an initiative to "substantially improve the efficiency of spectrum use" by "leveraging new technologies and capabilities."[9] The National Telecommunications and Information Administration's ("NTIA") projected timeline appropriately reflects that technical work on sharing approaches in the 3.1 GHz band should run simultaneously to that effort, with input from the initiative "augment[ing]" the already-underway sharing studies.[10] The R&D Plan should similarly reflect that the best use of R&D in this area is to fine-tune existing technologies, rather than multi-year study that would further delay consideration of spectrum sharing in this band and undermine the goals of the NSS.

The 7/8 GHz range is similarly poised for near-term action based on current coexistence approaches. Because of its proximity to the 6 GHz band, which is currently the biggest growth band for unlicensed innovation, the 7/8 GHz range has the promise to unlock enormous consumer benefits and economic value. Importantly, opening this band to commercial operations also does not require R&D to explore next-generation technologies. Rather, NCTA has explained to NTIA that the lowest frequencies in the range can be made available using the same rules the Federal Communications Commission ("FCC") has used to protect commercial Fixed Service

---

6 *National Spectrum Strategy Implementation Plan*, NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION A-6, A-7, A-9 (Mar. 12, 2024), *available at* https://www.ntia.gov/sites/default/files/publications/national-spectrum-strategy-implementation-plan.pdf ("NSS Implementation Plan").

7 NSS at 6.

8 *Id.*

9 NSS Implementation Plan at 19.

10 *Id.* at A-6, A-7.

("FS") incumbents in the 6 GHz band. Federal incumbents with different coexistence needs higher in the range may require additional study coordinated by NTIA, but that study can focus on the right application of existing tools, rather than a longer-term R&D strategy.

We also recommend minimizing duplication and achieving measurable advancements by bringing together federal stakeholders and commercial users early in the R&D planning process. Critically, to foster such collaboration, those efforts should include representatives of all industry perspectives who are interested in advancing spectrum sharing technologies, and not only particular segments of industry.

Topic #2—Recommended Priority Areas for Spectrum R&D

The R&D RFI asks for "[r]ecommended priority areas for spectrum research and development." We will focus on three of the RFI's recommended priority areas: (1) spectrum utilization efficiency; (2) dynamic spectrum access and management; and (3) modeling for coexistence analysis.[11] The R&D Plan should prioritize advancements in these areas.

Spectrum Utilization Efficiency. First, to promote spectrum efficiency, it is important that R&D measure the total utility created by a set of frequencies rather than treating received power or channel occupancy as a proxy for utility or efficiency. Measuring only channel occupancy or received power does not accurately capture spectrum utilization. For example, merely assessing the presence of signals—without also measuring how much total data signals of that type carry in a particular frequency range in a particular geographic area—does not provide reliable data into how much utility the service produces. Moreover, a measurement system that relies on received energy at outdoor listening points as a proxy for overall band utilization risks undervaluing low-power, low-activity-factor, and predominantly indoor operations, such as Wi-Fi, compared to higher-power, high-activity-factor, outdoor operations, even if those operations create less overall utility for consumers than Wi-Fi. Instead, the assessment of utility should measure how much total data is carried by all users of a particular service in a particular spectrum range, recognizing differences between technologies rather than designing a measurement system with one technology or service in mind.

Second, over-conservative spectrum sharing approaches undermine efficiency. To this end, the R&D plan should consider how to reduce false positives in sensing of incumbent uses of spectrum and how to more accurately implement database-protection zones so that commercial operations are not inefficiently blocked. Such inefficient blocking of use can occur as a result of (1) overly conservative propagation models; (2) assumptions regarding incumbent operations based on the use of substandard receivers; or (3) models that undervalue building entry loss or far-field losses from proximity to the body or objects.

Third, the use of lower power levels promotes overall efficiency by supporting a variety of diverse uses in nearby geographic areas, even if it may require the use of more transmission facilities than high-power coverage networks. As described above, lower-power levels make spectrum more widely accessible to new and diverse entrants, promoting competition and new, innovative uses. It also facilitates greater spectrum reuse and coexistence among operators. The

---

[11] R&D RFI at 12872.

R&D Plan should consider how network densification and these lower-power approaches maximize flexibility and efficient spectrum use.

Dynamic Spectrum Access and Management. The R&D Plan should support the development of technologies that permit new uses to coexist with incumbent federal and non-federal uses. For example, the Incumbent Informing Capability ("IIC") is a promising development that could improve on the Environmental Sensing Capability in the CBRS band by allowing Spectrum Access System operators and users to rely on government notifications in near real-time. If implemented effectively, it could help reduce both false positives of government use and overbroad preemption of spectrum availability. Similarly, the Telecommunications Advanced Research and Dynamic Spectrum Sharing System ("TARDyS3") provides spectrum scheduling, interference protection, detection, and resolution capacity. Additional R&D can move these technologies forward and make other dynamic approaches effective for both incumbents and new users.

R&D efforts should also focus on advancing the state of databases modeling buildings and other structures for use in interference-protection mechanisms and propagation models. Such databases could allow for a more accurate determination of how to maximize use of a spectrum band without causing harmful interference. Other areas of focus to improve dynamic spectrum access and management include studying methods to (1) reduce the complexity of the process of aggregate interference protections to lower the computational load on DSS systems; (2) address potential over-reservation of spectrum by Federal users in DSS bands; and (3) improve advanced notification of scheduled Federal events to commercial users. Some R&D efforts may target large jumps in technology, but these more incremental advances would have an outsized benefit.

Modeling for Coexistence. The R&D Plan should also focus on developing updates to existing propagation models. As discussed below, existing propagation models are outdated and should be improved to better account for advances in our understanding of signal propagation. Importantly, in updating propagation models, the R&D Plan should recognize that modern wireless systems are not characterized by the use of only high-site/high-power transmitters. Clutter measurements should emphasize the use of lower sites, indoor operations, and other network designs that operate in higher clutter environments than those used in past propagation modeling. In addition, the R&D Plan should invest in developing better use of probabilistic analysis for interference analyses rather than static analyses based on worst-case assumptions. As the FCC has explained in the context of unlicensed operations, for example, static analyses "neglect the effects of the sporadic nature of most unlicensed transmissions . . . and the probability of co-channel operation of the unlicensed device and licensed service."[12] Instead, coexistence analyses "should take into consideration the specific behavior of services involved and the complexity of the propagation environment where the services operate."[13] Static analyses and worst-case assumptions will not support the coexistence needed between Federal systems and commercial use in new bands.

---

12 *See Unlicensed Use of the 6 GHz Band; Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd. 3852, 3893 ¶ 116 (2020) ("*6 GHz First Report and Order*").

13 *Id.*

Topic #3—Recommendations on "Grand Challenge" Problems

The R&D RFI seeks comment on "[r]ecommendations on grand challenge problems for spectrum R&D" and describes such grand challenge problems as "problems that if attacked will help motivate and coalesce R&D efforts."[14] NCTA identifies two such challenges that are fundamental to moving the needle forward in spectrum research: (1) accurately measuring spectrum utility and (2) accurately measuring spectrum propagation characteristics.

Measuring Spectrum Utility. Accurate and reliable data on spectrum use and utility is critical to understanding and developing a successful spectrum sharing ecosystem. The FCC recently published a Notice of Inquiry to gain greater insight into measuring non-Federal spectrum use.[15] The NSS R&D Plan presents an opportunity to harmonize the Administration's measurement efforts with the FCC's measurement efforts. Specifically, as described above, any measurement approach should be neutral to avoid over- or under-valuing a particular service or technology. For instance, a measurement approach that mistakes received power as a proxy for utility will likely produce unreliable results.[16]

Propagation Modeling. Propagation modeling often has a significant impact on technical and policy decisions regarding commercial spectrum use. However, existing propagation models have become outdated. For example, current propagation models used in spectrum sharing, such as Free Space and the Irregular Terrain Model used in the 6 GHz band for shorter and longer distances respectively, are now many years old and in need of an update. There are now tools and technologies available that could help evolve the existing models so that they better account for signal propagation and attenuation due to clutter such as buildings and foliage. It is also important that assumptions in propagation models' clutter measurements account for modern wireless systems. Modeling should include not only high-site/high-power transmitters, but also the lower-site and indoor transmitters that operate in a different clutter environment. This work is important so propagation loss is not underestimated and predicted interference levels are not overestimated. Further study should prioritize improving propagation models to inform both existing and future spectrum sharing models.

Topic #4—Recommendations on Spectrum R&D Accelerators: Shared Public Datasets, Testbeds, and Collaboration Support

The R&D RFI requests "[r]ecommendations on spectrum R&D accelerators" such as shared public datasets as well as "testbeds, research infrastructure, and collaboration support."[17] Such efforts to simulate real-world shared-spectrum ecosystems as well as efforts to increase transparency will significantly boost spectrum R&D efforts.

---

[14] R&D RFI at 12872.

[15] *Advancing Understanding of Non-Federal Spectrum Usage*, Notice of Inquiry, FCC No. 23-63, WT Docket No. 23-232 (rel. Aug. 4, 2023).

[16] *See* Comments of NCTA – The Internet & Television Association at 5-7, WT Docket No. 23-232 (filed Oct. 3, 2023).

[17] R&D RFI at 12872.

Testbeds. NCTA supports efforts to research a national testbed for dynamic spectrum sharing.[18] We agree with SpectrumX's recommendation that testbeds "should consider commercial use cases beyond high-power, outdoor, mobile cellular which are the most difficult for sharing."[19] Such commercial use cases include local-area networks and private cellular networks. Because they use lower-power, localized transmissions, they would be able to share spectrum with incumbents.[20] As SpectrumX explains, "[i]f future Federal systems that are being designed today continue to assume access to exclusive spectrum for perpetuity, then real progress will be limited since the onus of dynamic sharing will continue to fall fully on new entrants."[21]

In addition, it is critical that research testbeds do not interfere with the application of existing coexistence tools to bands that are primed for near-term use. The testbeds should be focused on next-generation technologies and approaches for future bands. For example, the NSS Implementation Plan calls for near-term sharing studies in the 3.1 GHz band, augmented by work from the DSS initiative rather than delayed pending that work's completion. Opening this band does not require next-generation coexistence technologies, even as additional work may build upon and improve existing approaches, such as those already in use in the CBRS band. The R&D Plan should ensure that the DSS initiative focuses on fine-tuning and is designed to supplement the existing and upcoming spectrum sharing studies.

Public Datasets and Collaboration. NCTA agrees with SpectrumX that increased transparency in the spectrum R&D process requires including as many stakeholders as possible. As Spectrum X explains, "[w]e recommend that NTIA along with other Federal agencies convene the relevant stakeholders, including academia as a neutral participant, in studies that evaluate fairly how spectrum may be repurposed, reallocated, and/or shared."[22] It is important that the country develop better mechanisms for including the full range of spectrum users in the discussions about new bands—restricting access to Federal agencies for the critical early stages of consideration of a band is counterproductive. Moreover, involving industry in these processes earlier on will help focus the research to include analysis of which commercial use cases are feasible, rather than addressing those questions after significant work already has been done.

NCTA also recommends that the R&D Plan consider improvements to the mechanism for obtaining security clearances to participate in R&D fora.[23] While the current PATHSS process fosters important technical discussions, it is also difficult to participate if an organization does not have large numbers of engineers with security clearances.[24] Security clearances, needed for PATHSS process participation, currently require a government agency sponsor and are tied to a

---

[18] NSS at 16; NCTA NSS Implementation Comments at 22.

[19] Comments from SpectrumX, the NSF Spectrum Innovation Center at 6, *available at* https://www.ntia.gov/sites/default/files/comments-from-spectrumx.pdf.

[20] *Id.*

[21] *Id.*

[22] *Id.* at 3.

[23] NCTA NSS Implementation Plan Comments at 20.

[24] *Id.*

contract with that agency. This can be limiting for smaller organizations that do not have active government contracts. Further, NCTA suggests that technical and operational information related to spectrum R&D should be unclassified whenever possible to further increase collaboration.[25]

Topic #5—Recommendations on Near-Term Federal Activities to Make Progress on Activities Discussed in Topics ##1-4

In the short term, NCTA recommends that the Federal government should work to apply existing co-existence tools and approaches to the 3.1 GHz band and 7/8 GHz range. As described above, facilitating coexistence between Federal operations and new commercial use of the 3.1 GHz band does not require the development of new coexistence technologies. Applying the coexistence approaches used in the CBRS band, adapted for the incumbent users present in the 3.1 GHz band, will protect Federal operations while opening the band for commercial operations. Additional work on DSS can expand those sharing possibilities and make even more efficient use of the band, but it is not a precondition to sharing. Similarly, the 7/8 GHz range does not require the development of new co-existence technologies. Co-existence techniques used in the 6 GHz band, such as rules for low-power indoor use and the Automated Frequency Coordination ("AFC") systems recently approved for standard-power operations, will protect incumbent Federal operations and bring next-generation Wi-Fi to American consumers.

Topic #7—Terminology and Definitions for Spectrum R&D

The RFI specifically seeks comment on the definition of "Dynamic Spectrum Sharing," as it "is a focus of the [NSS] but was not defined."[26] DSS by its nature will need to be flexible and capable of implementation in a variety of circumstances and incumbent use environments. Any definition of DSS should recognize several important aspects of the concept:

First, spectrum sharing is "dynamic" when a sharing mechanism enables frequent or even constant change to promote coexistence and intensity of use. Sharing is not dynamic if sharing is made possible through episodic change or stable relationships between different spectrum users.

Second, a spectrum sharing approach can be dynamic with regard to how one set of entities shares spectrum with another set of entities with superior use rights. For example, the CBRS band's DSS approach is dynamic in how Priority Access Licenses ("PAL") and General Authorized Access ("GAA") licensees share spectrum with incumbent Federal systems. Here, the Spectrum Access System protects Federal spectrum users by using sensing to require channel vacation. Similarly, the U-NII-2 band's use of Dynamic Frequency Selection is dynamic because it permits unlicensed operations to share the band as Federal radar systems by using sensing to require channel vacation.

Third, a spectrum sharing approach can also be "dynamic" among entities with the same access rights. Wi-Fi's contention-based protocol, for example, permits DSS among a wide range of diverse spectrum users with the same access rights to unlicensed bands. Specifically, these

---

25 *See id.* at 21.

26 R&D RFI at 12872.

users can operate in the same channel without pre-coordination because of politeness protocols that facilitate such use.

Fourth, a spectrum sharing approach can allow a band to be shared with entities with superior use rights in a manner that is not "dynamic" but is still appropriate and effective, especially when use of the band by the entities with superior rights is not itself dynamic. For example, the FCC's 6 GHz rules require standard-power Wi-Fi access points to share the 6 GHz band with incumbent Fixed Service operations, managed by AFC systems.[27] These systems use an FCC database to protect Fixed Service operations that (because they are fixed) do not require dynamic protection—change is needed only episodically when a new Fixed Service facility comes online. Importantly, imposing extra regulation by forcing Wi-Fi devices to employ a dynamic protection method in this band would have been unnecessary and inefficient. While AFC systems must be updated in a timely manner, these updates do not make AFC "dynamic" because they are not characterized by frequent or constant change.

Fifth, a sharing approach can be effective if it is not "dynamic." For example, Low-Power Indoor ("LPI") access points in the 6 GHz band effectively share the band with incumbent Fixed Service operations and other incumbent users because they are limited in power and may only be used indoors.[28] LPI devices do not need to consult a database or be governed by a spectrum sensing mechanism to protect those operations. Instead, the lower power levels and building entry loss are effective in allowing coexistence, and they permit the design of LPI devices that are more cost effective and energy efficient than would be the case for a more dynamic approach.

For the purposes of the R&D plan, it is essential to recognize that certain aspects of dynamic sharing—such as incumbent alerting systems or new sensing approaches, as described above—may benefit from R&D efforts. However, that does not mean that these kinds of dynamic spectrum sharing approaches are not already primed for commercial use. Or that DSS is always the right approach to promoting coexistence when non-dynamic sharing accomplishes the goal with more simplicity and lower cost than either DSS or a clear-and-auction approach. Rather, as the above examples demonstrate, spectrum sharing is a success today precisely because of its dynamic *and* non-dynamic characteristics. To this end, as a country, we must work to advance DSS to address tomorrow's challenges while, at the same time, recognizing its existing substantial contributions to resolving today's challenges.

* * *

NCTA stands ready to work with the NITRD working group, NSF, and other federal partners to prepare an R&D Plan that facilitates the development of new tools and technologies that promote spectrum sharing. Next-generation technologies will advance coexistence among a wide range of users and open previously inaccessible bands for new commercial services, yielding significant benefits for the Nation. At the same time, it is important that the R&D Plan pursue the study of next-generation spectrum sharing in a way that allows the country to move

---

27 *6 GHz First Report and Order* ¶ 17.

28 *Id.* ¶¶ 98-99.

forward with the bands already primed for commercial use—and to provide the significant benefits offered by spectrum sharing.

Respectfully submitted,

[redacted]

Rick Chessen
Becky Tangren
Traci Biswese
NCTA – The Internet & Television Association
25 Massachusetts Avenue NW
Suite 100
Washington, DC 20001
[redacted]

Paul Margie
Jason Neal
Annick Banoun
HWG LLP
1919 M Street NW
8th Floor
Washington, DC 20036
[redacted]

Counsel for NCTA

March 21, 2024