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Request for Information on the National Spectrum Research and Development Plan

Verizon

Before the
NATIONAL SCIENCE FOUNDATION
Alexandria, VA 22314

In the Matter of	)	
	)	
Request for Information: National Spectrum Research and Development Plan	)	Fed. Reg. Document No. 2024-03400
	)	

COMMENTS OF VERIZON[1]

The National Spectrum Research and Development Plan ("R&D Plan") will serve as a key element to advance the National Spectrum Strategy ("Strategy"), and Verizon welcomes the opportunity to provide comment in response to the National Science Foundation's ("NSF") Request for Information.[2] We support a coordinated, strategic view of research and development ("R&D") spectrum initiatives, as expressed in the Strategy's just-released Implementation Plan:

> The spectrum research community must enhance the coordination of its [R&D] endeavors and identify and address critical areas of spectrum R&D. By doing so, we can amplify the impact of collective efforts and foster important advancements. Our spectrum policies also must be designed to optimize flexible use and support emerging technologies.[3]

The RFI calls for spectrum research that "ensures that all essential spectrum research areas are sufficiently explored,"[4] and the R&D Plan, therefore, should embrace a broad view of

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[2] *See* National Spectrum Strategy, The White House (Nov. 13, 2023), https://www.ntia.gov/sites/default/files/publications/national_spectrum_strategy_final.pdf ("Strategy"); Request for Information on the National Spectrum Research and Development Plan 89 Fed. Reg. 12871 (Feb. 20, 2024) ("RFI").

[3] National Spectrum Strategy Implementation Plan, National Telecommunications and Information Administration, at 15 (Mar. 12, 2024) ("Implementation Plan").

[4] RFI, 89 Fed. Reg. at 12872.

sharing[5] – one that encompasses mechanisms such as "repacking, relocation, and compression."[6] To that end, the R&D Plan should promote opportunities to advance full-power commercial spectrum with assured access. Such access supports wide-area mobile networks that are critical to enable the technologies that fuel the U.S. economy, encourage competition, further connectivity, and protect national security. In particular, the R&D plan should account for the incentives and disincentives for commercial investment and emphasize that any spectrum research must result in commercially viable solutions. Projects to study dynamic spectrum sharing ("DSS") should take into account lessons learned from previous efforts – including the importance of accurate coexistence models. Spectrum R&D should also support increased transparency and information sharing between federal and commercial stakeholders.

Finally, the Administration should move swiftly to advance the near-term study of key mid-band spectrum with a key goal of repurposing for commercial, full-power, licensed use.[7] The Implementation Plan reinforces the Strategy's intent to study these bands independent of, and in advance of, the R&D initiative presented here.

I. SPECTRUM R&D SHOULD EXPLORE WAYS TO ADVANCE FULL-POWER COMMERCIAL SPECTRUM LICENSES WITH ASSURED ACCESS. (Q1, Q2)

A. The R&D Plan Must Prioritize Efforts That Can Support Full-Power, Licensed Spectrum with Assured Access That Enables the Wide-Area Deployments Critical to U.S. Interests. (Q1; Q2, Bullets 3, 8)

The RFI recognizes that "priority areas" for spectrum R&D should account for "[e]conomic-, market-, social-, and human-centric concerns" and "[b]usiness and economic

[5] *Id.* (Q1; Q2, Bullet 3). The NSS references a "moonshot" effort to research spectrum access, "with an emphasis on dynamic forms of spectrum sharing for all users," Strategy at 13, Strategic Objective 2.3, but the R&D Plan led by NSF is distinct from this moonshot effort and must take a broader view of spectrum R&D.

[6] Implementation Plan at A-3.

[7] *See* Comments of Verizon, Docket No. NTIA-2023-0003, at 14 (filed Apr. 17, 2023) ("Verizon Strategy Comments"); Comments of Verizon, Docket No. NTIA-2023-26810, at 1 (filed Jan. 2, 2024).

models," among other factors.[8] The R&D Plan should therefore recognize the value of wide-area, full-power commercial wireless networks, which are critical to enable innovation, expand connectivity and coverage, promote broadband competition, and advance U.S. economic and national security interests.

The wireless industry contributes heavily to our nation's economy, thanks in large part to wide-area networks deployed at scale that are the foundation for mobile connectivity, innovation, and ever-growing reliance on all things wireless. The numbers back this up:

- During the 4G decade, from 2010 to 2020, the wireless industry supported one out of every six American jobs,[9] and gross output from the U.S. wireless industry topped $9.5 trillion; [10] and
- 5G is projected to create an additional 4.6 million jobs and contribute up to $1.7 trillion to U.S. GDP over the next decade, spurring activity across the consumer, industrial, and public sectors.[11]

This economic success is grounded in wireless providers' access to full-power, licensed, reliable spectrum, which provides the certainty and reliability to enable investment in networks at scale.[12] Of course, these networks are also driving competition that directly benefits consumers today and advances consumer welfare. As but one example, fixed wireless access continues to grow in scale and bring new competition in the home broadband market, which is especially important for underserved and marginalized communities. In fact:

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[8] RFI, 89 Fed. Reg. at 12872, Q2, Bullet 8.

[9] *The 4G Decade: Quantifying the Benefits*, Recon Analytics, at 3, 6 (July 29, 2020), https://api.ctia.org/wp-content/uploads/2020/07/The-4G-Decade.pdf.

[10] Aren Megerdichian, *The Importance of Licensed Spectrum and Wireless Telecommunications to the American Economy*, Compass Lexecon, at 3 (Dec. 7, 2022), https://api.ctia.org/wp-content/uploads/2022/12/Compass-Lexecon-Licensed-Spectrum-Report.pdf.

[11] Enrique Duarte Melo et al., *5G Promises Massive Job and GDP Growth in the US*, Boston Consulting Group, at 3 (Feb. 2021).

[12] *See* Verizon Strategy Comments at 4-5. Note that Verizon uses the term "reliable spectrum" in these comments to capture the idea that the licensees would have assured access and protection from harmful interference.

- In 2022, fixed wireless access accounted for 90% of net broadband additions, over traditional options like cable, fiber, or DSL;[13] and
- Verizon expects to cover 50 million homes with its fixed wireless access service by the end of 2025.[14]

Wide-area networks do not just power the economy and promote competition; they also profoundly shape the American experience today. Wireless networks at scale support critical spectrum-based services including smart manufacturing, smart cities, telehealth, and remote learning. These networks allow Americans to work remotely, stream videos or calls, attend telehealth appointments, access connected education in the classroom and at home, and much, much more. It has never been more important to promote spectrum access models that will enable all Americans to access next-generation technologies from wherever they are.

Continued support for commercial, wide-area, full-power, reliable networks is also critical for protecting our national security interests.[15] The United States is competing with China and other rival nations for technological superiority.[16] If the U.S. is not strategic about investing in opportunities to make wide-area, full-power, reliable, harmonized spectrum opportunities available for commercial providers, it may find itself on the outside looking in on future bands and policies that will be used for 5G and serve as a foundation for 6G. Similarly, pursuing novel or unique spectrum policies isolates the U.S. wireless marketplace and puts the country on a

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[13] *Annual Survey Highlights*, CTIA, at 6 (2023), https://api.ctia.org/wp-content/uploads/2023/11/2023-Annual-Survey-Highlights.pdf.

[14] *See Investor Day 2022*, Verizon, at 53 (Mar. 3, 2022), https://www.verizon.com/about/sites/default/files/2022-05/Investor-Day-2022-Presentation_rv1.pdf.

[15] RFI, 89 Fed. Reg. at 12872, Q1.

[16] Verizon Strategy Comments at 2, 6. Today, China and other nations are identifying additional bands for 5G, for wide-area, full-power licensed networks. By 2027, China is expected to have more than double, and perhaps more than three times, the amount of licensed spectrum than the United States. Janette Stewart, Chris Nickerson, & Juliette Welham, *Comparison of total mobile spectrum in different markets*, Analysys Mason, at 11 (Sept. 2022), https://api.ctia.org/wp-content/uploads/2022/09/Comparison-of-total-mobile-spectrum-28-09-22.pdf.

spectrum island, increasing costs for unique network equipment and devices while positioning other nations to advance their technology leadership in countries with aligned spectrum allocations and frameworks. Additionally, there is little evidence that international partners and allies are moving away from traditional licensed models for spectrum, necessitating continued domestic focus on similar spectrum access models. Spectrum R&D should focus on projects that will ultimately foster a strong U.S. presence in global bands for 5G and for 6G in the future.

B. The R&D Plan Should Consider Incentives and Disincentives for Innovation and Investment When Evaluating Spectrum R&D Opportunities. (Q1; Q2, Bullet 3)

The Implementation Plan appropriately calls for an R&D working group to "survey key Federal and non-Federal spectrum users to identify motivating factors for investing in spectrum innovation, as well as those that disincentivize investment or that pose challenges to research efforts."[17] For commercial wireless operators, full-power, wide-area spectrum that offers assured access and protection from harmful interference is essential to incentivizing investment and innovation. A comparison of two bands in the 3 GHz frequency range demonstrates the incentives and disincentives associated with spectrum access rights. The 3.7 GHz band, with full-power, wide-area, reliable spectrum has been extensively deployed on an aggressive timeframe. Meanwhile, the low-power, experimental Citizens Band Radio Service ("CBRS") has seen less deployment even though it has been available to operators longer due in part to its unreliability, and power limitations that result in small cell sizes and poor coverage. [18] The commercial value of these different spectrum access models is also reflected in the per-MHz PoP

[17] Implementation Plan at 15, Outcome 3.1(b) (citing Outcome 2.1(a)).

[18] *See, e.g.*, Doug Brake, *CBRS Spectrum Is Lightly Used, Whereas C-Band Is Deployed Extensively*, CTIA Blog (Sept. 25, 2023), https://www.ctia.org/news/cbrs-spectrum-is-lightly-used-whereas-c-band-deployed-extensively.

prices at auction, as the 3.7 GHz band raised five times more on a per MHz-PoP basis than CBRS.[19]

Research related to spectrum efficiency, resilience, mitigation tools, coexistence modeling, and more can all contribute to more opportunities for spectrum repurposing that will drive massive investment in commercial networks at scale. Thus, NSF should ensure that R&D projects not only include dynamic frameworks, but also advance targeted and predictable sharing regimes that ensure licensees and spectrum users have certainty as to their access rights and obligations. Specifically, the R&D Plan should prioritize efforts that will advance static sharing models that have proven effective and workable in past federal/commercial sharing frameworks, and which create more certainty for all affected stakeholders. Such efforts would be more likely to result in viable near-term economic and business solutions.

C. The R&D Plan Should Promote Several Key Areas of R&D to Advance the Goals Set Forth in the Presidential Memorandum – Including Licensed Spectrum. (Q2)

The Presidential Memorandum on spectrum accompanying the Strategy identifies several important goals including increased efficiency of spectrum use and increased transparency into current and future spectrum use.[20] These goals hold the promise of expanding opportunities for

[19] The 3.7 GHz auction had net winning bids of more than $81 billion for 180 megahertz of spectrum while the CBRS auction had net winning bids of $4.5 billion for 70 megahertz of spectrum. *See Auction of Flexible-Use Service Licenses in the 3.7-3.98 GHz Band Closes, Winning Bidders Announced for Auction 107*, Public Notice, 36 FCC Rcd 4318 (2021), https://www.fcc.gov/document/fcc-announces-winning-bidders-37-ghz-service-auction, for 3.7 GHz auction results; *compare* to *Auction of Priority Access Licenses in the 3550-3650 MHz Band Closes, Winning Bidders Announced for Action 105*, Public Notice, 35 FCC Rcd 9287 (2020), https://www.fcc.gov/document/fcc-announces-winning-bidders-35-ghz-band-auction, for CBRS auction.

[20] *Memorandum on Modernizing United States Spectrum Policy and Establishing a National Spectrum Strategy*, The White House, at Sec. 3(c) (Nov. 13, 2023), https://www.whitehouse.gov/briefing-room/presidential-actions/2023/11/13/memorandum-on-modernizing-united-states-spectrum-policy-and-establishing-a-national-spectrum-strategy/ ("Presidential Memorandum").

wide-area, full-power spectrum use, and the R&D Plan can have a real impact by enabling spectrum research investments that support the President's goals.[21]

Spectrum Efficiency. Efforts across government are necessary to ensure that finite spectrum resources are efficiently used and that all spectrum users are good stewards of the airwaves. R&D that could lead to more efficient federal spectrum use is critical to unlocking spectrum necessary to support the growing demands being placed on our scarce spectrum resources, including by encouraging agencies to enhance spectrum sharing amongst themselves and to explore opportunities to compress or channelize their operations.[22] Where possible, spectrum research should focus on ways to incentivize and enable federal spectrum efficiency, as is the case with full-power, wide-area commercial spectrum use.[23] Given the economics of acquiring spectrum, wireless providers are geared to leverage more bits out of every megahertz of spectrum available and "refarm" legacy spectrum to the extent possible to replace older technologies with advanced, more efficient services. And network slicing will enable already efficient 5G networks to be used to deliver specialized offerings.

Transparency and Shared Knowledge. To achieve meaningful advances in spectrum R&D, the R&D Plan should promote processes that build on and improve information sharing between commercial and federal stakeholders.[24] To achieve meaningful research around spectrum efficiency, assured access for critical mission applications, DSS, modeling, coexistence analysis, etc., the R&D Plan should reflect the following:

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[21] RFI, 89 Fed. Reg. at 12872, Q1, Q2.

[22] *Id*. at Q2, Bullet 1.

[23] For example, commercial wireless licensed spectrum use became 42 times more efficient during the 4G decade, and 5G networks will further increase spectral efficiencies by as much as 52 percent by some estimates in the mid-band range. *See Smarter and More Efficient: How America's Wireless Industry Maximizes Its Spectrum*, CTIA, at 3, 7 (July 9, 2019), https://www.ctia.org/news/smarter-and-more-efficient-how-americas-wireless-industry-maximizes-its-spectrum.

[24] RFI, 89 Fed. Reg. at 12872, Q1; Q2, Bullets 6, 4; Q 4.

Commercial operators need to better understand incumbent federal operations, including visibility into the federal operating environment, the capabilities of federal systems (not just operating parameters), as well as information about the inputs and assumptions made in interference analyses and technical parameters of the federal operations, and information about how, when, and where federal users operate. With greater transparency around federal spectrum needs, industry could be a strong partner on R&D that would promote greater spectrum efficiency by federal operators.

Federal stakeholders would benefit from a better understanding of commercial operating parameters.[25] The R&D Plan should promote this knowledge exchange – which will lead to better R&D – by leveraging NTIA's Institute for Telecommunication Sciences ("ITS"). ITS is well-positioned to serve as the U.S. government's resident expert on commercial technologies and network operations. For example, ITS could work with other government entities in bands of interest to understand commercial systems, as a necessary part of evaluating how government and commercial systems may impact one another, or finding solutions to enable coexistence.

Additionally, processes for collaboration and sharing of classified, unclassified, controlled unclassified information, and commercial proprietary information should be improved.[26] Collaborative dialogue across industry and government should build and improve on the processes undertaken in prior spectrum analyses – in particular, the Partnering on Advancing Trusted and Holistic Spectrum Solutions ("PATHSS") task group evaluation of the lower 3 GHz band. Finally, to promote information sharing, the R&D Plan could seek to expand use of Cooperative Research and Development Agreements (CRADAs).

[25] *Id*. at Q1; Q2 Bullets 4, 7.

[26] *Id*. at Q1, Bullet 2.

II. R&D FOR DYNAMIC SPECTRUM SHARING SHOULD BUILD OFF LESSONS LEARNED ALREADY. (Q2, BULLET 3; Q7)

While the R&D Plan should explore DSS, it is not a panacea for the current spectrum crunch facing the wireless industry. To date, DSS remains unproven – or more precisely, DSS frameworks have proven not to serve wide-area deployments – and an overreliance on such approaches risks undermining the U.S. wireless ecosystem and isolating the United States as other, rival nations advance a harmonized, fully licensed framework across the globe. Any R&D for DSS should consider models that would allow for full-power commercial use with assured access or near-assured access rather than focusing on frameworks that do not result in commercially viable solutions.[27] Dynamic sharing models such as CBRS are better viewed as opportunities to augment capacity and coverage in limited geographical areas rather than as a playbook for successful nationwide deployments at scale given the limitations associated with channel availability, reliability, and decreased power levels.[28] Thus, it is important that the R&D Plan not premise research into DSS on a CBRS-like model, but explore foundational questions about other possible forms of DSS.

When designing the R&D Plan and any DSS research projects, there are lessons to be learned from CBRS. First, transparency and modeling are key. But so too is a process to update the modeling inputs over time. In the CBRS band, through collaboration and better modeling, the U.S. government was able to shift to "dynamic protection areas" from "exclusion zones." But huge swaths of CBRS spectrum remain affected by these dynamic protection zones. Improving and refining the coexistence modeling could narrow these zones without jeopardizing

[27] The Implementation Plan acknowledges that the CBRS framework could benefit from leveraging new technologies and capabilities. Implementation Plan at 19, Outcome 3.2(f).

[28] The CBRS technical rules only allow low-power use, which restricts deployments at scale, and in any event the service is preemptible. Further, service may be disrupted if the Spectrum Access System ("SAS") or Environmental Sensing Capability network goes down or the governing SAS loses connectivity or becomes congested.

federal operations, but there is not a clear process for revisiting those models today. The R&D Plan should ensure that any co-existence models resulting from R&D do not become static.

Second, the CBRS band also demonstrates that additional R&D is needed to develop workable spectrum situational access and management tools. The Environmental Sensing Capability ("ESC") networks create large areas where networks cannot be deployed, even when no incumbent operations are present. This is problematic for a sharing framework that is intended to maximize efficient spectrum use. The R&D Plan should support the exploration of alternate solutions for identifying incumbent presence.

III. CONCLUSION.

We look forward to partnering with U.S. government stakeholders on R&D efforts that will advance spectrum access for full-power, wide-area, reliable commercial networks, as well as emerging technologies, while ensuring continued access to spectrum for federal operations.

Respectfully submitted,

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