

## OVERVIEW

The National Spectrum Consortium (NSC) appreciates the opportunity to respond to NTIA's Request for Comment (RFC) on the development of a National Spectrum Strategy (NSS).

With 400 members including startup companies, mobile network operators, equipment vendors, universities, and nonprofits, NSC is uniquely positioned to offer insight into many of the technical and operational issues under consideration in the development of an NSS. Opinions on how spectrum should be allocated and controlled in the future vary widely. However, there is consensus that demand will only continue to grow, even while viable spectrum remains a finite resource.

Given the value and scarcity of spectrum, the NSC believes that an optimal national spectrum strategy should:

1. Vastly increase research and development into new spectrum sharing technologies that improve spectrum efficiency
2. Foster coordination across federal stakeholder groups to ensure alignment on spectrum goals and priorities
3. Encourage multi-stakeholder collaboration across government, industry, and academic researchers to help inform a long-term roadmap for spectrum development and use.

We address these issues below as they relate to questions outlined in the NTIA's request for comment. We also recommend a role that NSC can play in helping to address the inherent challenges these issues pose.

## About the NSC

The NSC serves as a crucial bridge between federal agencies, commercial stakeholders, and the innovators advancing spectrum use for next-generation wireless applications. We are the single largest pool of scientists and engineers who understand spectrum and wireless communications systems and technologies like 5G and Open RAN.

To date, the NSC has used the Department of Defense (DoD)'s Other Transaction Authority (OTA) to execute more than 100 projects worth \$1.2 billion, delivering innovative new solutions to difficult problems in wireless technology.

NSC's large and diverse membership includes a balance of telecom industry incumbents and new entrants, as well as traditional government contractors and new organizations looking for federal partnerships. While we cannot take a position on every aspect of the request for comment, we offer a unique perspective allowing for strategic input and guidance to NTIA and other federal agencies. Understanding stakeholders' needs and uses provides for a more

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developed national spectrum strategy to spur our nation's economic growth, global competitiveness, and technological innovation.

Our members have executed projects including:

- A Next Generation Spectrum Situational Awareness System/Spectrum Usage Management System – Rapidly deployable, cost effective, highly tailorable, networked sensing systems that collect, store, conduct edge processing, and transmit real-time spectrum activity data for cloud-based storage and retrieval.
- An AI/ML analytic capability to estimate operational risks associated with projections of impaired or limited access to spectrum. These assessments will support optimal spectrum allocations under constrained, congested and contested conditions for operations, training, and testing.
- An architecture to support a common control channel for both DSA-enabled and non-DSA-enabled systems, setting the foundation for an automated command and control capability that dynamically adjusts spectrum resources based on availability, risk assessments, policies and rules, and real-time environmental feedback from multiple sensors.

In addition to these specific projects, NSC members collaborate through Working Groups, intended to leverage expertise to inform national policy and commercial standards through recommended practices, white papers, reports, or inputs to standards bodies. These Working Groups provide opportunities for collaboration across government and private stakeholders to benefit the entire wireless ecosystem.

This year, we released two reports on Open-RAN: one presenting current capabilities for Open RAN testing and development at research facilities across the U.S., and the other detailing the many use cases of the technology. Our members have also recently collaborated with each other and DoD to make contributions to 3GPP standards on 5G sidelink.

Our increasingly connected world means that spectrum is becoming increasingly scarce. The federal government, enterprises, and consumers alike need wireless solutions, but we cannot make more spectrum. As such, innovation in spectrum management, spectrum sharing, and efficient spectrum usage are key to American economic and technical progress.

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## **PILLAR #1 - A SPECTRUM PIPELINE TO ENSURE U.S. LEADERSHIP IN SPECTRUM-BASED TECHNOLOGIES**

***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?***

There is very little greenfield spectrum left for clean auction and, at the same time, commercial and innovation needs are exploding. A robust spectrum pipeline is critical to American competitiveness, which is why we believe there must be significant research and development conducted in the areas of spectrum management, spectrum sharing, and efficient spectrum usage.

In the short term, the federal government needs to make experimentation, demonstration, and prototyping new spectrum solutions faster, easier, and more flexible. Programs like the FCC's Innovation Zones and NSF's National Radio Dynamic Zones (NRDZ) are important first steps, but each of those programs needs to be expanded to allow more innovators to deploy additional experiments in spectrum bands of interest for future sharing. In addition, finding ways in which to get further buy-in for these programs from DoD, FAA, and other federal spectrum stakeholders is critical to allow for further research and development.

In the medium term, federal spectrum users will need new spectrum sharing and management techniques to enable joint usage of spectrum for both communications and mission operations. Likewise, commercial spectrum users will need to realize new solutions for coordinating spectrum usage across both communications and sensing applications. We cannot afford for these technologies to be developed entirely independent of one another. While there are unique requirements for both the federal and commercial sectors, the foundational work to develop new spectrum management systems can and should be done collaboratively. Joint research and prototyping exercises will be crucial for ensuring spectrum solutions are flexible and effective across a range of federal and commercial needs.

Sharing can benefit federal users, such as DoD, as well as commercial users by:

1. Encouraging joint capability development across agencies and missions that will result in larger volumes and lower costs;
2. Encouraging dual-use technology that can provide for both commercial and federal users at a lower cost than purpose-built military hardware and software; and
3. Driving closer alignment between commercial and federal users, which will encourage partnership on technology development and standards advocacy.

***Question 4. What factors should be considered in identifying spectrum for the pipeline? Should the Strategy promote diverse spectrum access opportunities including widespread, intensive, and low-cost access to spectrum-based services for consumers? Should the Strategy promote next-generation products and services in historically***

***underserved or disconnected communities such as rural areas and Tribal lands? Should the Strategy prioritize for repurposing spectrum bands that are internationally harmonized and that can lead to economies of scale in network equipment and devices? How should the Strategy balance these goals with factors such as potential transition costs for a given band or the availability of alternative spectrum resources for incumbent users? How should the Strategy balance these goals against critical government missions? How should the Strategy assess efficient spectrum use and the potential for sharing? What is an ideal timeline framework suitable for identifying and repurposing spectrum in order to be responsive to rapid changes in technology, from introduction of a pipeline to actual deployment of systems?***

The strategy must balance incumbent needs (both commercial and federal incumbents) with distributed, more broadly accessible spectrum access for new and innovative concepts. While it is critical to preserve the robustness and security of existing networks, it is equally important that we accelerate innovation to maintain global competitiveness. This can only be done if we enable greater spectrum access flexibility.

Given that demand for spectrum is greater than supply, the only way to drive up capacity is to increase efficiency of use. This underscores the argument for spectrum sharing and suggests the vital need to prioritize research and development around new spectrum sharing technologies. There is huge room for growth in this area. As network operations increasingly transition from hardware- to software-driven, the opportunity to allocate spectrum automatically, dynamically, and in fine-grained increments, expands significantly. Efficiency improvements are virtually assured if critical investments in spectrum sharing R&D and technology prototyping happen quickly.

The timeline for identifying additional spectrum capacity is unfortunately short. Both commercial and federal users claim overwhelming spectrum needs, citing economic and security requirements in a globally competitive environment. There is a short window of time for investing in technologies to meet those capacity needs before new auctions tie up additional spectrum bands for the long term.

***Question 6: For purposes of the Strategy, we propose to define “spectrum sharing” as optimized utilization of a band of spectrum by two or more users that includes shared use in frequency, time, and/or location domains, which can be static or dynamic. To implement the most effective sharing arrangement, in some situations incumbent users may need to vacate, compress or repack some portion of their systems or current use to enable optimum utilization while ensuring no harmful interference is caused among the spectrum users. Is this how spectrum sharing would be defined? If not, please provide a definition or principles that define spectrum sharing. What technologies, innovations or processes are currently available to facilitate spectrum sharing as it should be defined? What additional research and development may be required to advance potential new spectrum sharing models or regimes, who should conduct such research and development, and how should it be funded?***

Spectrum sharing should be defined broadly and in multiple dimensions:

- Sharing among federal users/agencies/applications
- Sharing between federal and non-federal users
- Sharing between fully licensed and unlicensed/lightly licensed uses

NTIA should encourage testing with each of these different user groups and the establishment of an information-sharing regime to build on successes and lessons learned. Key in this testing will be neutral, independent data that can be easily shared with and among these user groups.

The NSC is a trusted partner and well-suited to coordinate this type of research. We have diverse membership, history, and expertise in the space, and the OTA funding vehicle to quickly and efficiently solicit commercial and academic prototypes and demonstration projects that can highlight new spectrum sharing opportunities for federal and commercial users alike.

As a neutral party:

- We are a non-profit partnership with a history of managing complex wireless and telecom projects
- We are not a standards-making organization
- We are not a trade association with a single-industry point of view
- We are, through our members, at the research forefront and bring a ground truth technical perspective on spectrum technology development

As a multi-stakeholder group:

- We are a consortium of more than 400 members representing industry players of all sizes and types
- We place an emphasis on fostering innovation via public-private partnership to provide opportunities to new market entrants
- We can partner with multiple federal agencies and coordinate joint federal efforts on spectrum technology development

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## PILLAR #2 - LONG-TERM SPECTRUM PLANNING

*Question 1: Who are the groups or categories of affected stakeholders with interests in the development of the National Spectrum Strategy and participating in a long-term spectrum-planning process? 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?*

The NSC had its origin in assisting DoD in executing prototyping projects designed to assist with spectrum relocation and sharing, dating back to the creation of the Spectrum Relocation Fund. NSC is proud of this history and is pleased to continue its role in catalyzing innovation in spectrum management and technology.

One of our most recent and extensive efforts is a working group co-chaired by NSC members, NTIA, and the DoD CIO. This working group, Partnering to Advance Trusted and Holistic Spectrum Solutions (PATHSS), is a collaboration with DoD on a study of spectrum sharing in 3.1-3.45 GHz.

As a part of the Infrastructure Investment and Jobs Act (IIJA), Congress mandated that DoD examine the potential for sharing in this band. So as a service to our members and DoD, we launched PATHSS in November 2021, a working group with representatives from DoD, NTIA, the FCC, telecom, cable, military equipment manufacturers, academia, and NGOs. There is also a classified subgroup that discusses classified information and shares a deeper understanding of DoD missions with non-federal spectrum stakeholders to build trust and confidence in sharing spectrum.

This group is hard at work now on a series of recommendations that will be submitted to DoD and the administration later this year. Without this level of collaboration between spectrum users and regulators, the U.S. will not resolve its complex spectrum sharing issues and may have challenges remaining technologically competitive on the global stage.

NTIA should ensure that smaller and/or non-traditional companies, innovators, and academic researchers have an equal chance to participate in the long-term spectrum planning process. Through our work, the NSC has seen that these organizations are often left out of these conversations but provide much of the necessary input needed for technology development.

The NSC's membership includes a balance of stakeholders – large and small, traditional and non-traditional, industry and academic. With telecom industry incumbents and new entrants, as well as traditional government contractors and new organizations looking for federal partnerships, we have been able to hold productive and meaningful conversations on spectrum planning resulting in efficient and effective use of the nation's spectrum resources.

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***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? Learning from prior experiences, what can be done to improve federal/nonfederal spectrum coordination, compatibility, and interference protection assessments to avoid unnecessary delays resulting from nonconsensus?***

The NSC has deep expertise in convening and engaging federal and non-federal stakeholders in productive, technical conversations surrounding spectrum sharing and coordination. As previously mentioned, our PATHSS process has been a productive, collaborative effort among these stakeholders, resulting in increased trust among these spectrum users and other insights that will be shared later this year.

Through these experiences, we have learned that federal policymakers from NTIA, FCC, DoD, and elsewhere should receive input from these entities in shared, joint sessions. This creates transparency, allows for open debate, and avoids technical misunderstandings.

NSC and PATHSS focus discussions on the technical possibilities in each band, not on desired policy or auction outcome – there are other venues for those discussions. Future federal and nonfederal dialogues should be solutions-oriented and involve senior technical and business and academic leaders who can effect change.

Furthermore, NSC’s mission has always been focused on funding and executing real-world prototyping and demonstration projects, led by multi-stakeholder groups that include both traditional and non-traditional federal contractors. These prototype projects are a critical element in ensuring that there are real-world, tangible inputs for any assessment of coordination and interference effects. Many of the delays currently seen in efforts to modernize spectrum allocation and sharing are the result of debates over competing results of lab studies or propagation predictions. NSC urges NTIA and other federal stakeholders to increase funding for prototyping and demonstration projects that can cut through theoretical debates and provide visible examples of new spectrum technologies.

***Question 5: Are additional spectrum-focused engagements beyond those already established today (e.g., FCC’s Technical Advisory Committee (TAC), NTIA’s Commerce Spectrum Management Advisory Committee (CSMAC), and NTIA’s annual Spectrum Policy Symposium) needed to improve trust, transparency, and communication among the federal government, industry, and other stakeholders (including Tribal Nations) and why? What would be the scope of such engagements, how would they be structured, and why would establishing new engagements be preferable to expanding the use of existing models? If existing models are sufficient, how (if needed) should FCC and NTIA maximize their usefulness or leverage their contributions to enhance and improve coordination?***

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Given the centrality of spectrum policy to any number of important federal missions, there is an important role for formal Federal Advisory Committees such as the TAC and CSMAC. These organizations gather formal, public input from a variety of stakeholders.

However, there are two additional recommendations that NTIA should consider:

First, federal agency positions on spectrum-related R&D are not always aligned and coordinated. As part of the National Spectrum Strategy, the U.S. could create a National Coordination Office (NCO) for Spectrum Innovation to holistically guide spectrum-related research and development activities as well as workforce development efforts.

Second, while formal input to the federal government can come from the Federal Advisory Committees, there is also an important need for more iterative, informal technical partnership between government and industry to help develop new spectrum strategies. NSC believes that its working groups, including PATHSS, provide an important forum for coordination between agencies engaging in spectrum R&D, including DoD, and industry.



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## **PILLAR #3 - UNPRECEDENTED SPECTRUM ACCESS AND MANAGEMENT THROUGH TECHNOLOGY DEVELOPMENT**

***Question 2: What policies should the National Spectrum Strategy identify to enable development of new and innovative uses of spectrum?***

First and foremost, the strategy must provide for substantial and sustained R&D funding for spectrum innovation. Currently, spectrum sharing research and prototyping funds are spread out among multiple federal agencies, and even among programs within those agencies. Technology companies and researchers looking for opportunities to showcase innovative new solutions often have to spend valuable time and resources determining agency priorities and funding mechanisms that could be better coordinated across the government.

In addition, there must be coordination across federal stakeholders as to which spectrum R&D areas of interest – including which spectrum bands – are of the highest priority for investigation. These funds should further be awarded in a manner that benefits multiple federal agencies and commercial innovators.

Finally, the increased R&D spending should be highly indexed toward real-world demonstration and prototyping projects designed to quickly establish whether or not complex spectrum sharing and interference mitigation techniques are showing promise. NSC's OTA funding vehicle is an ideal tool for this investigation, as it is flexible and can quickly solicit from among NSC's 400 members with deep expertise in relevant technologies.

***Question 3: What role, if any, should the government play in promoting research into, investment in, and development of technological advancements in spectrum management, spectrum dependent technologies, and infrastructure? What role, if any, should the government play in participating in standards development, supporting the use of network architectures, and promoting tools such as artificial intelligence and machine learning for spectrum coordination or interference protections? What technologies are available to ensure appropriate interference protection for incumbents in adjacent bands? What spectrum management capabilities/tools would enable advanced modeling and more robust and quicker implementation of spectrum sharing that satisfies the needs of nonfederal interests while maintaining the spectrum access necessary to satisfy current and future mission requirements and operations of federal entities? How can data-collection capabilities or other resources, such as testbeds, be leveraged (including those on Tribal lands and with Tribal governments)?***

Spectrum is a highly regulated commodity, shared between public and private uses. It is also a crucial input into an industry dominated by a few large incumbent service providers and equipment manufacturers. Because of these factors, spectrum is not generally seen as an open

playing field for innovators and disruptors, but the federal government has a pivotal opportunity to change that perception.

The government must be a key funder and supporter of R&D in order to include the innovators and disruptors, which can often come from smaller or non-traditional companies and organizations.

NSC is a crucial bridge between federal agencies, their missions, and the technology companies that can create the new ideas and technology necessary to modernize the U.S. spectrum ecosystem. For instance, NSC members have executed projects including a testbed for radar interference management with Open RAN architecture at Hill Air Force Base in Utah which enables co-resident use of 3.1-3.45GHz spectrum via rapid interference mitigation in space, time, and frequency that enables a 5G network to quickly adapt (within tens of milliseconds) to mitigate interference with airborne radars. Because of the investment of the federal government in an organization like the NSC, which already coordinates among federal and commercial stakeholders, Hill AFB now has a sophisticated wireless communications architecture to support its missions.

## IMPLEMENTATION PLAN

*What specific steps should be included in the Implementation Plan that could be taken in the next 12-24 months to ensure the successful execution of the National Spectrum Strategy?*

To reiterate, the NSC believes that an optimal National Spectrum Strategy should:

- Vastly increase R&D into new spectrum sharing and communications technology;
- Foster coordination across federal stakeholders on spectrum sharing goals; and
- Encourage multi-stakeholder collaboration between government, industry, and academic researchers.

We believe that the NSC can and should take a leading role in this process, serving as a crucial bridge between federal agencies, their missions, and the technology companies doing this innovation. Thank you again for the opportunity to share the NSC's vision for a National Spectrum Strategy. We look forward to working together on this.



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