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4075 Wilson Blvd 9th floor
Arlington, VA 22203

support@federatedwireless.com
+17036500585

April 17, 2023

Ms. Stephanie Weiner
Acting Chief Counsel
National Telecommunications and Information Administration
U.S. Department of Commerce
1401 Constitution Avenue, NW
Washington, DC 20230

Re: Development of a National Spectrum Strategy; Docket Number: 230308-0068

Dear Ms. Weiner -

Federated Wireless, Inc. ("Federated Wireless"), the industry leader in the development and deployment of commercial dynamic spectrum management solutions ("DSMS"),[1] offers these comments in response to the Request for Comments ("RFC") issued by the National Telecommunications and Information Administration ("NTIA") on the scope and content of a National Spectrum Strategy that "will help the United States continue to lead the world in advanced technology and enhance our national and economic security."[2]

Federated Wireless applauds NTIA for its efforts to ensure there is sufficient access to spectrum for both federal and non-federal users, which "is vital to national security, critical infrastructure, transportation, emergency response, public safety, scientific discovery, economic growth, competitive next-generation communications, and diversity, equity, and inclusion."[3] We support NTIA's goal of identifying ways in which it can repurpose spectrum to allow more intensive use and "fully address the needs of spectrum reliant services and missions."[4]

To that end, Federated Wireless recommends that the National Spectrum Strategy incorporate policies and practices that will achieve the following objectives:

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[1] Federated Wireless is a certified Spectrum Access System ("SAS") administrator for the Citizens Broadband Radio Service ("CBRS") band and a conditionally approved Automated Frequency Coordination ("AFC") system operator for the 6 GHz band.

[2] National Telecommunications and Information Administration, U.S. Department of Commerce, Request for Comments, Development of a National Spectrum Strategy [Docket Number: 230308-0068]; *available at* https://www.federalregister.gov/documents/2023/03/16/2023-05406/development-of-a-national-spectrum-strategy ("RFC").

[3] Id.

[4] Id.

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+17036500585

- Ensuring federal users of spectrum have sufficient access to the resources needed for mission-critical operations;
- Maximizing spectrum access options for a wide range of non-federal users, including consumers, enterprises, and other private network users;
- Encouraging efficient spectrum usage by all users; and
- Fostering innovation and the development of pioneering tools, technologies, and use cases that will achieve the above-mentioned goals.

Automated dynamic spectrum sharing technology is an essential tool to enable NTIA and other federal agencies to achieve these objectives in both the near term and over time. By leveraging DSMS capabilities, the United States can stop playing a zero-sum game of economic growth versus national security and instead focus on meeting federal users' spectrum requirements, maximizing spectrum efficiency, offering non-federal users spectrum access options that meet their individual needs, and increasing cost-effective connectivity for all Americans – the core tenants of a sound and robust National Spectrum Strategy.

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Federated Wireless Responses to NTIA RFC Questions

Pillar #1 – A Spectrum Pipeline to Ensure U.S. Leadership in Spectrum-Based Technologies

Question 1. What are 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?

Federated Wireless anticipates that spectrum demand for both federal and non-federal users will continue to grow over time. We agree with NTIA's assessment that spectrum reliance by both federal and non-federal users will encompass a wide range of use cases and technologies, including but not limited to:

- Fixed and mobile wireless broadband services;
- Next-generation satellite communications and other space-based systems;
- Advanced transportation technologies;
- Industrial and commercial applications, (i.e., manufacturing, agriculture, and utilities);
- Wireless medical devices and telemedicine;
- Internet of things (IoT) and smart cities;
- National defense and homeland security;

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+17036500585

- Safeguarding the national airspace and ports;
- Securing the Nation's critical infrastructure;
- Earth and space exploration and research; and
- Climate monitoring and forecasting, and other scientific endeavors.[5]

Recognition of this reality as part of the National Spectrum Strategy will be essential to achieve the identification of at least 1,500 megahertz of spectrum that could be repurposed and used more intensively. Recognizing there is no greenfield spectrum and that it is costly, time consuming, and disruptive to relocate incumbent systems, we must accept the fact that legacy "clear-and-auction" approaches are not sustainable. Instead, we should harness the power of DSMS technology and innovative spectrum licensing models in our National Spectrum Strategy to create a win-win for both the public and private sectors. DSMS solutions can be leveraged to increase and intensify use of both federal and non-federal spectrum and to support the anticipated demand growth for all users.

Question 2. Describe why the amount of spectrum now available will be insufficient to deliver current or future services or capabilities of concern to stakeholders. We are particularly interested in any information on the utilization of existing spectrum resources (including in historically underserved or disconnected communities such as rural areas and Tribal lands) or technical specifications for minimum bandwidths for future services or capabilities. As discussed in greater detail in Pillar #3, are there options available for increasing spectrum access in addition to or instead of repurposing spectrum (i.e., improving the technological capabilities of deployed systems, increasing or improving infrastructure build outs)?

Federated Wireless recommends that NTIA seek information on how it can meet the spectrum needs of both consumer-oriented services as well as private wireless networks. The majority of studies of spectrum requirements to date have focused on consumer-related services, which is certainly an important constituency. However, we recommend NTIA seek to accurately capture and account for the growing demand for high-speed, low-latency capabilities by enterprises, municipalities, educational institutions, and other non-traditional operators. These entities need sufficient quantities of spectrum, as well as flexible and streamlined access options (e.g., unlicensed or license-by-rule) to achieve their specific objectives and accelerate growth of the U.S. economy.

Question 3. What spectrum bands should be studied for potential repurposing for the services or missions of interest or concern to you over the short, medium, and long term? Why should opening or expanding access to those bands be a national priority. For each band identified, what are some anticipated concerns? Are there spectrum access models (e.g., low-power

[5] RFC.

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4075 Wilson Blvd 9th floor
Arlington, VA 22203

support@federatedwireless.com
+17036500585

unlicensed, dynamic sharing) that would either expedite the timeline or streamline the process for repurposing the band?

Federated Wireless encourages NTIA to prioritize bands that are in close proximity to existing commercial bands so that the ecosystem for the new bands can develop quickly. For example, three bands that Federated Wireless recommends prioritized consideration of are: a) 37.0-37.6 GHz; b) 7.125-8.4 GHz, and c) 4400-4950 MHz.

37.0-37.6 GHz. Under Federal Communications Commission (FCC) rules, the lower 37 GHz band (37.0-37.6 GHz) is available for coordinated co-primary sharing between federal and non-federal users. The framework for this coordinated sharing has not yet been decided, however. To accelerate use of these frequencies, meet demonstrated demand, and maintain optionality for future federal use, Federated Wireless encourages NTIA and the FCC to prioritize the development of a sharing approach that leverages DSMS capabilities. The band is already being used on an experimental basis by commercial users for consumer-oriented wireless broadband services. It is also being used by the U.S. Marine Corps and other private wireless users to support a variety of 5G use cases, including data-intensive applications such as robotics, telehealth, AR/VR, high-definition video transmission, and holograms.[6] Finalizing a sharing framework using proven DSMS solutions will accelerate the band's use for both federal and non-federal operations.

7.125-8.4 GHz. The 7 GHz band is another near-term opportunity for sharing between federal and non-federal users. The lower part of the band is immediately adjacent to the 6 GHz band where the FCC has authorized Part 15 license-exempt device operations on a shared basis. Standard power and outdoor Part 15 devices are able to operate in the 6 GHz band under management of an AFC, which ensures protection of incumbent commercial systems. Extension of this sharing framework to the lower part of the 7 GHz band would enable use of an additional 320 MHz channel by devices using Wi-Fi 7 technology. The remainder of the 7 GHz band could also be explored for sharing with commercial licensed, licensed-exempt, or license-by-rule systems.

4400-4950 MHz. The 4400-4950 MHz band also holds promise for near-term sharing with commercial systems. In many Asia Pacific countries, this band is used for 5G deployments, making the development of a commercial ecosystem for the United States achievable. We encourage NTIA, DoD, FCC, and industry to explore how DSMS solutions could be adapted to protect incumbent systems while also opening the band for a variety of non-federal use cases.

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

[6] *See* https://www.fiercewireless.com/private-wireless/federated-demo-dod-highlights-benefits-shared-spectrum.

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4075 Wilson Blvd 9th floor
Arlington, VA 22203

support@federatedwireless.com
+17036500585

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?

As NTIA develops the National Spectrum Strategy and identifies spectrum for the pipeline, it should explicitly promote diverse spectrum access opportunities, including widespread, intensive, low-cost access to spectrum-based services for consumers. It should also promote similar access options for private wireless networks.

Historically, the FCC has made spectrum available for wireless broadband services, such as 5G and its predecessor technologies, by auctioning exclusive licenses for different sized, albeit generally large, geographic areas. While today the FCC's service and technical rules are flexible and permit a variety of mobile and fixed use cases by operators with different business models, one obvious result of the FCC's auctions over the past thirty years is that a limited number of large mobile network operators have acquired rights to utilize spectrum.

In recognition of the limitations of traditional auctions, the FCC developed rules for the CBRS band that would provide multiple access options, including both licensed and licensed-by-rule opportunities. As a result of this decision, the CBRS licensing framework has resulted in a record number of users having access to "carrier-grade" spectrum for the first time. The CBRS Priority Access License ("PAL") auction resulted in 228 entities acquiring licenses, while the CBRS General Authorized Access ("GAA") tier has seen more than 900 different users emerge within only three years of commercial operation.

The existence of multiple spectrum access options under the CBRS licensing framework has led to increased competition by a diverse set of operators and stimulated investment in innovative business models. It has also spurred the development of a larger equipment supplier ecosystem where over 40 vendors, many of whom are domestically based, are providing solutions for both PAL licensees and GAA users.

This massive expansion of non-traditional network operators is reaching every aspect of the U.S. economy. From agriculture to automotive, manufacturing to media, energy, retail, commercial real estate, in addition to schools, libraries, and civil society groups, private wireless networks are springing up as the result of the combination of easily available spectrum, lower cost equipment, and tailor-made solutions from multiple vendors.

Achieving a similar level of diverse spectrum usage in other bands should be an explicit goal of the National Spectrum Strategy. In addition, the National Spectrum Strategy should seek to

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4075 Wilson Blvd 9th floor
Arlington, VA 22203

support@federatedwireless.com
+17036500585

replicate the success of the CBRS band by balancing the needs of both federal and non-federal users. By leveraging DSMS capabilities, it is neither necessary nor beneficial to continue to play a zero-sum game of economic growth vs. national security. Instead, the CBRS experience has shown that we can meet federal users' spectrum requirements, offer non-federal users spectrum access options that meet their individual needs, maximize spectrum efficiency by all users, and increase cost-effective connectivity for all Americans.

Question 5. Spectrum access underpins cutting-edge technology that serves important national purposes and government missions. Are there changes the government should make to its current spectrum management processes to better promote important national goals in the short, medium, and long term without jeopardizing current government missions?

NTIA has at its disposal tools to help optimize ongoing and future federal use of spectrum. In order to accurately understand, model, and measure current as well as anticipated future use of spectrum, real-world measurements (not just modelling) should be used to progressively refine propagation models, use patterns, as well as interference to continually improve spectrum access and efficiency. Visibility into how intensively bands are being used will better enable us to identify opportunities for improving co-existence in the future.

API-enabled DSMS technology embedded with reporting mechanisms can be used for such real-world data gathering, measurement, and validation of actual use. Together with a regular heartbeat or check-in, a DSMS API can be leveraged to report interference, while measurement reports can provide the data and justification necessary to more quickly and automatically resolve interference incidents. API-enabled DSMS technology can also be utilized by incumbent federal users to dynamically reserve and release spectrum in real-time rather than reserving for longer periods of time than actually necessary.

By leveraging automated spectrum management technology to make more intensive sharing of spectrum among federal users, NTIA will have greater visibility into current uses and future needs, make the process of sharing with the commercial sector less burdensome, spur fundamental product research and development that can be ported to the commercial sector, and ensure a more coordinated and comprehensive approach to federal spectrum management.

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

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4075 Wilson Blvd 9th floor
Arlington, VA 22203

support@federatedwireless.com
+17036500585

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?

In 2012, the President's Council of Advisors on Science and Technology ("PCAST") released a seminal report in which it concluded that, given the continuing spectrum needs of federal users and the exploding demand for commercial wireless spectrum, the traditional practice of clearing portions of federally held spectrum for exclusive commercial use was not a sustainable model for future spectrum policy.[7] Instead, PCAST argued that the best way to increase the availability of spectrum for commercial broadband would be to leverage new technologies, such as dynamic frequency coordinators, spectrum databases, and improved interference mitigation tools, to allow spectrum to be shared among federal and commercial users. The PCAST Report concluded that sharing should be the preferred model for spectrum management and that implementation of sharing regimes could increase the effective capacity of federal spectrum by a factor of 1,000.

NTIA should look to the guidance from the PCAST Report as it seeks to develop a definition of spectrum sharing for inclusion in the National Spectrum Strategy. Repacking, compressing, or vacating spectrum by federal users is a costly, disruptive, time-consuming, and unsustainable approach. NTIA should leverage DSMS technologies that were developed in response to the PCAST Report so that future sharing between federal and non-federal users results in a win for both the public and private sectors.

Additional research and development may provide opportunities to improve upon existing DSMS implementations, such as the CBRS SAS, so that even greater spectrum efficiency can be achieved. For example, today, the SAS manages commercial access to the band by listening for naval radar operations via a network of ESC sensors, via an online scheduling portal, or through statis exclusion zones. In many cases, commercial operations can be interrupted for longer periods of time or over larger geographic areas than necessary to protect actual incumbent use. The use of more real-time information, provided via automated notification, to manage access to frequencies and assign transmit power levels would improve shared spectrum access usage by commercial users. Similarly, the use of newer propagation models than those currently used by the SAS would enable more efficient use of available spectrum for commercial operations while still providing sufficient protection for incumbent operations.

Question 7. What are the use cases, benefits, and hinderances of each of the following spectrum access approaches: exclusive-use licensing; predefined sharing (static or predefined sharing of locations, frequency, time); and dynamic sharing (real-time or near real-time access, often with secondary use rights)? Are these approaches mutually exclusive (i.e., under what circumstances could a non-federal, exclusive-use licensee in a band share with government users, from a non-federal user point of view)? Have previous efforts to facilitate sharing, whether statically or dynamically, proven successful in promoting more intensive

[7] President's Council of Advisors on Science and Technology, Report to the President: Realizing the Full Potential of Government-Held Spectrum to Spur Economic Growth, at vi (rel. July 20, 2012) ("PCAST Report"), *available at* https://bit.ly/2odsHi2; at vi.

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4075 Wilson Blvd 9th floor
Arlington, VA 22203

support@federatedwireless.com
+17036500585

spectrum use while protecting incumbents? Please provide ideas or techniques for how to identify the potential for and protect against interference that incumbents in adjacent bands may experience when repurposing spectrum.

As described above, Federated Wireless recommends that the National Spectrum Strategy aim to ensure there are multiple spectrum access options available to non-federal users, not only exclusive-use licenses. The success of the shared CBRS band demonstrates how important it is for both licensed and licensed-by-rule options to be available to meet the diverse needs both of consumer-oriented services providers as well as myriad private wireless network use cases. The availability of multiple spectrum access options, together with an equipment interoperability requirement, has proven to be the winning combination from the perspective of both ecosystem development and increased spectrum user diversity.

With regard to the benefits of dynamic sharing solutions over static sharing or manual coordination, it is widely recognized that prescribing pre-defined separation distances based on worst-case scenarios without considering factors such as the actual technical characteristics of the operations will produce results that are spectrally inefficient and overly conservative. Indeed, the adoption of static protection zones based on worst case assumptions results in overprotection of incumbents at the expense of new uses in shared bands and effectively prohibits new deployment in some geographic areas without any demonstration that such deployments would in reality cause interference to individual incumbent stations. Such static approaches are inconsistent with the goal of making more intensive use of spectrum and will impede innovation.

Conversely, it has been proven that a DSMS-administered sharing model that accounts for real-world deployment conditions and calculates interference effects based on average measurements will present a more realistic picture of the actual RF environment for the purpose of determining protection of incumbent systems and maximizing spectrum efficiency. The automated CBRS sharing model is far preferrable to static or manual coordination approaches. Although, as mentioned above in response to Question 6, improvements to the CBRS protection methods, such as newer propagation models and less conservative protection methods, could further enhance sharing between incumbents and new users.

Question 8. What mechanisms should be considered to meet some of the current and future federal mission requirements by enabling new spectrum access opportunities in non-federal bands, including on an "as needed" or opportunistic basis?

In addition to assessing opportunities for use of federal bands on a shared basis by non-federal users, Federated Wireless encourages NTIA and the FCC to identify opportunities for federal users to access non-federal bands to meet requirements of their varied and critical missions, while leveraging the economies and efficiency of commercial deployments and devices where appropriate. This could include leasing of licensed non-federal bands, which would provide new revenue sources for non-federal users, especially in remote areas where federal users have spectrum needs and there is otherwise no compelling business case for commercial deployments. Alternatively, allowing non-federal users to satisfy their substantial service obligations by

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4075 Wilson Blvd 9th floor
Arlington, VA 22203

support@federatedwireless.com
+17036500585

helping federal users access the spectrum needed to support their missions could be considered. Finally, the innovative CBRS licensing framework that provides for opportunistic use of the non-federal PAL and GAA tiers has already proven to be an effective way for federal users, such as the U.S. Marine Corps,[8] to access commercial spectrum and equipment to meet their mission critical needs.

Question 9. How do allocations and varying spectrum access and governance models in the U.S. compare with actions in other nations, especially those vying to lead in terrestrial and space-based communications and technologies? How should the U.S. think about international harmonization and allocation disparities in developing the National Spectrum Strategy?

The United States is the clear global leader on innovative spectrum-based technologies and licensing frameworks. Since the commercial launch of the CBRS band, regulatory authorities worldwide have followed the progress of CBRS deployments and sought to emulate the FCC's licensing and sharing framework. Numerous countries, including the United Kingdom, Germany, France Sweden, Norway, Brazil, Bahrain, Japan, South Korea, amongst others, have implemented local shared licensing frameworks to support "industrial verticals" in much the same way the CBRS GAA tier supports a wide variety of enterprise private wireless networks. Several countries, including the United Kingdom, Saudi Arabia, and South Africa, are also in the process of implementing automated DSMS solutions, like our SAS and AFC, to streamline the process of local spectrum licensing and minimize unnecessary human involvement in the licensing process. By incorporating automation, these countries are seeking to replicate the automated spectrum assignment process administered by the SAS for CBRS.

In the 6 GHz band, the United States is again the world leader in novel spectrum management approaches, being the first to introduce license-exempt operations on a shared basis with incumbent systems. The use of the homegrown AFC capability to protect 6 GHz incumbents from new standard power license-exempt operations is being implemented by several countries in different regions across the globe.[9]

Federated Wireless encourages NTIA to actively promote U.S. leadership in the development of cloud-based spectrum sharing technology and to include establish DSMS as an integral component of the National Spectrum Strategy.

[8] *See* https://www.fiercewireless.com/private-wireless/private-5g-network-supports-holograms-and-x-ray-vision-for-marines.

[9] *See* https://6ghz.info/.

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4075 Wilson Blvd 9th floor
Arlington, VA 22203

support@federatedwireless.com
+17036500585

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?

Federated Wireless recommends that NTIA involve a wide range of spectrum-reliant stakeholders in its long-term spectrum planning. This list should obviously include the traditional public mobile network operators, WISPs, and other consumer-oriented service providers, along with the technology and equipment vendors that support them. But importantly, it should also include a broad swath of companies and organizations representing manufacturing, automotive, agriculture, energy, retail, commercial real estate, communications, media, and supply chain industries, as well as schools, libraries, and civil society groups. It is these organizations that are the bulk of new spectrum users investing in advanced networks to power the "5G economy." Developers of industrial automation, artificial intelligence, and edge computing are also critical stakeholders on spectrum planning as we look to spur American innovation and advanced industrial practices.

The working group and process established by DoD and the National Spectrum Consortium to explore sharing solutions for the 3.1-3.45 GHz band, known as the Partnering to Advance Trusted and Holistic Spectrum Solutions (PATHSS), could be an interesting model for NTIA to consider as it looks to ensure that all stakeholders have the ability to participate in as well as visibility into long-term term spectrum planning. The National Spectrum Consortium is another model for public/private partnership that we encourage NTIA to exploit.

Question 2. What type of timeline would be defined as a "long-term" process? What are key factors to consider and what are the key inputs to a long-term planning process? What data are required for planning purposes? Do we need data on spectrum utilization by incumbent users, including adjacent band users, and, if so, how should we collect such data and what metrics should we use in assessing utilization?

As mentioned above in response to Question 5 under Pillar#1, Federated Wireless strongly recommends that NTIA seek to collect data about incumbent spectrum use. To accurately understand, model, and measure current as well as anticipated future use of spectrum, real-world measurements (not just modelling) should be used to progressively refine propagation models, use patterns, as well as interference. Visibility into how intensively bands are used will better enable us to identify opportunities for improving co-existence, spectrum access, and efficiency. DSMS technologies are available today that can be tailored to enable collection of such data about incumbent spectrum use.

Question 3. How can federal and non-federal stakeholders best engage in productive and ongoing dialogue regarding spectrum allocation and authorization, repurposing, sharing, and

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4075 Wilson Blvd 9th floor
Arlington, VA 22203

support@federatedwireless.com
+17036500585

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

As mentioned above in response to Question 1 of Pillar #2, Federated Wireless encourages NTIA to consider how the PATHSS task group and NSC processes might serve as a model for productive ongoing dialogue with both federal and non-federal stakeholders.

In addition, we recommend reliance on groups such as the Interagency Joint Working Group (IJWG) that was formed to facilitate discussion between incumbent DoD users and the CBRS SAS administrators. The IJWG has proven to be an effective forum for detailed technical discussions on spectrum coordination, compatibility, and interference protection mechanisms improvements for the CBRS band. As NTIA and the federal agencies identify candidate bands for sharing opportunities, we recommend the formation of similar groups to delve into the details to identify both challenges and solutions.

The PCAST is an example of another group whose work has been especially relevant to the development of sound spectrum policy and strategy. PCAST members worked together with prominent spectrum experts from both the public and private sectors to develop the recommendations contained in its 2012 report, "Realizing the Full Potential of Government-Held Spectrum to Spur Economic Growth" – a report that is just as relevant today as it was 11 years ago.[10]

The recommendations in the PCAST Report could act as guidance for NTIA and the other federal agencies in the development of a National Spectrum Strategy to ensure productive ongoing dialogue regarding spectrum allocation, authorization, repurposing, sharing, and coordination, including:

- Formation of an Executive Office of the President Spectrum Management Team (SMT), led by the White House Chief Technology Officer, to work with NTIA;
- Creation of an accounting and incentive system to promote more effective federal spectrum use;
- Beginning a pilot program involving spectrum sharing;
- Formation of a Spectrum Sharing Partnership Steering Committee (SSP) of industry executives (e.g. CEOs) to advise on a policy framework to maximize commercial success; and
- Creation of an urban Test City and a Mobile Test Service that can support rapid learning in spectrum management technology and practice.[11]

[10] *See* PCAST Report.

[11] PCAST Report at iii.

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4075 Wilson Blvd 9th floor
Arlington, VA 22203

support@federatedwireless.com
+17036500585

While many of the 2012 PCAST Report's recommended courses of action have been realized through the establishment and commercialization of the CBRS sharing framework, improvements upon that framework and applicability of lessons learned to sharing of other federal bands will be invaluable.

Pillar #3 – Unprecedented Spectrum Access and Management through Technology Development

Question 1. What innovations and next-generation capabilities for spectrum management models (including both licensed and unlicensed) are being explored today and are expected in the future to expand and improve spectrum access (and what are the anticipated timelines for delivery)?

As described above, Federated Wireless applauds the U.S. government agencies involved in spectrum policy for their innovative and collaborative approaches to solving spectrum challenges. The work of the PCAST in 2012 laid the groundwork for the innovative licensing frameworks established by the FCC for the CBRS and 6 GHz bands. We recommend continuing to iterate on the success of those novel spectrum management models so we can expand and further improve spectrum access and enable greater competition, innovation, efficiency, and American leadership.

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

As the PCAST Report recommended, we believe that a key policy of the National Spectrum Strategy should be to share underutilized spectrum to the maximum extent consistent with the federal missions. Put simply, this means that we must ensure federal users of spectrum have sufficient access to the resources they need, while we leverage and enhance spectrum sharing technologies and tools so that we can also maximize spectrum access options for a wide range of non-federal users, including consumers, enterprises, and other private network users.

We should also encourage efficient spectrum usage by all users, be they federal or non-federal. This will involve use of automated spectrum management and machine learning technologies by both the public and private sectors to enable greater visibility into current uses and future needs and lead to a more coordinated and comprehensive approach to spectrum management.

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

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Arlington, VA 22203

support@federatedwireless.com
+17036500585

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 non-federal 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)?

As Federated Wireless recommended in our submission to NTIA's Request for Comments on the implementation of the Public Wireless Supply Chain Innovation Fund, we see numerous opportunities for the government to promote and support research in technological advancements in spectrum management and spectrum-dependent technologies. For example, we recommend that the government establish testbeds and projects that use and enhance dynamic spectrum management systems to:

- Facilitate the broadest range of services and maximize competition by a diverse set of operators;
- Increase access to and quality of information to assess current spectrum utilization and necessary protections of federal spectrum usage;
- Support spectrum sandboxes, experiments, laboratory testbeds to assess and/or prove feasibility of opening new bands for sharing;
- Solve practical business challenges and speed the transition from testbed to market;
- Improve workforce efficiency through use of autonomous vehicles, machine learning, and augmented/virtual reality applications;
- Enable experimental exploration of new wireless devices, communication techniques, networks, systems, and services, including those based on Open RAN; and
- Support a low-rate initial production (LRIP) of new software and hardware solutions aimed at Open RAN and spectrum management advancements.
- Facilitate development of open standards for control and management of radio networks to break the network provider/management silo.

While DSMS tools and solutions exist today that can protect both co-channel and adjacent channel incumbent users, we recommend that the government support ongoing research and development to further enhance these capabilities. We also recommend that the government apply DSMS techniques to take measurements of spectrum usage to refine propagation models, identify patterns of use, as well as interference patterns, to continually improve spectrum access and increase efficiency. API-enabled DSMS with reporting mechanisms can be used for real-world data gathering, measurement, and validation of actual use, while also enabling quicker and automated interference resolution.

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Finally, Federated Wireless recommends that NTIA promote public/private collaborations, like the NSC, and align the research and development priorities of the DoD with spectrum strategy research and development priorities.

Question 4. NTIA is pursuing a time-based spectrum sharing solution called the incumbent informing capability (IIC) to support spectrum sharing between federal and non-federal users. What are some recommendations for developing an enduring, scalable mechanism for managing shared spectrum access using the IIC or other similar mechanism, with the goal of increasing the efficiency of spectrum use? What challenges do non-federal users foresee with potentially having limited access to classified or other sensitive data on federal spectrum uses and operations as part of the IIC or similar capabilities, and what recommendations do users have for ways to mitigate these challenges? What are the costs and complexities associated with automating information on spectrum use?

Federated Wireless supports NTIA's efforts to develop an IIC, which could complement and/or improve upon existing incumbent notification approaches, such as sensing and scheduling portals, that enable SAS-managed dynamic sharing of the CBRS band. To ensure that the ICC is a meaningful improvement upon existing notification methods, we recommend reliance on automation as a key component. The goal of the IIC should be to eliminate to the greatest extent possible human involvement in the notification process.

Incorporating cloud-computing and automation together with local sensing capabilities, for example, could greatly increase efficiency, ensure that spectrum needs by both federal and non-federal users can be accommodated in as close to real-time as feasible, and assist in obfuscating classified or other sensitive data on federal operations. Automation together with secure, federally controlled information flow, would also help avoid disruptions to ongoing federal missions or the need to retrain key federal personnel in the field. Our experience in working with DoD and NTIA on current notification methods for the CBRS band leads us to believe similar collaboration between industry and government could accelerate development of the IIC and achieve scalable solutions that increase spectrum efficiency.

Question 5. What other technologies and methodologies are currently being, or should be, researched and pursued that innovate in real-time dynamic spectrum sharing, particularly technologies that may not rely on databases?

As described in response to the previous question, Federated Wireless recommends that the government initiate research and development projects that, together with industry experts, can leverage cloud-computing and automation to maximize the efficiency of federal use, while also enabling more responsive, real-time sharing of spectrum between federal and non-federal users.

With each iteration of DSMS technology, we have been able to greatly accelerate access to new spectrum bands. NTIA's visionary leadership will be vital to ensure further enhancements to and evolution of DSMS solutions continue at a brisk pace. Rather than reinvent the wheel with each

federated wireless

4075 Wilson Blvd 9th floor
Arlington, VA 22203

support@federatedwireless.com
+17036500585

new band, we should build upon the successes of prior dynamic sharing frameworks and identify opportunities to iterate and improve.

Conclusion

Federated Wireless appreciates the opportunity to submit these comments on the development and implementation of a National Spectrum Strategy. We stand ready to assist NTIA and other federal agencies involved in spectrum policy to exploit DSMS solutions to ensure both federal and non-federal users have sufficient access to spectrum now and in the future, maximize spectrum access options for the widest and most diverse group of users, and foster innovation that will drive U.S. economic growth and leadership.

Respectfully submitted,

/s/ Jennifer M. McCarthy
Jennifer M. McCarthy
Vice President, Legal Advocacy
Federated Wireless, Inc.
4075 Wilson Boulevard
9th Floor
Arlington, VA 22203
jmccarthy@federatedwireless.com