



**Before the
DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration
Washington, DC 20230**

In the Matter of)
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Implementation of the National Spectrum Strategy) Notice of Opportunity for Public Input
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COMMENTS OF NOKIA



1 Introduction

Nokia respectfully submits these comments to the National Telecommunications and Information Administration (“NTIA”) in response to its Notice of Opportunity for Public Input on the Implementation Plan for the National Spectrum Strategy (“Strategy”). Nokia applauds NTIA’s publication of the Strategy on November 13, 2023, one week ahead of the start of ITU World Radiocommunication Conference 2023. A comprehensive strategy on spectrum is essential to ensuring the United States remains the global spectrum innovation leader and our national and economic security is protected. Common goals and strategic objectives among the federal government and commercial users are necessary to lead the nation in this desired direction. Nokia hopes these comments assist NTIA with the Strategy implementation, and more broadly anticipates this discussion will help promote technology innovation and the global economy that is so dependent on the rare and extremely valuable national resource that is spectrum.

Federal agencies and the private sector play very important roles that drive technological and economic progress in the country, and they must act together in the best interest of the American people. It is critical that there is a proper framework and open exchange of information to build trust while protecting matters of national security, consumer privacy and business interests.

Implementation of the Strategy should include not only a spectrum roadmap but also the building blocks of that strategy which include: a data-driven process for creating the spectrum pipeline, relevant data to implement the process, application of the most appropriate governance models (licensed, shared, unlicensed), the scientific and engineering models to drive the decisions, and the skilled workforce to develop new technology. These building blocks, which correspond closely with

the Strategy's four pillars¹, must be supported by solid economic analyses and systems that incentivize innovation and investment.

2. The Fundamentals

As NTIA seeks public input on implementation of the Strategy and the four pillars at its core, we are reminded of the numerous stakeholders that are impacted by spectrum allocations. We have seen a wide array of interested parties during the NTIA's public "Listening Sessions" and this opportunity for public input is certain to draw numerous commenters. It is important that all parties have a common interpretation of key terminology and agree on basic principles. The following terms are often misunderstood and cause friction among parties vying for the same spectrum range. Therefore, it is essential to provide proper definitions in the Strategy implementation documentation.

1. Efficiency of Spectrum Use: This is a highly disputed phrase among the spectrum community. Some interpret it as "spectrum efficiency", which is incorrect. Per channel spectrum efficiency has reached close to its theoretical limit in the mobile industry² and so any implication that there is room for significant spectrum efficiency improvement is erroneous. Another interpretation is that a large amount of spectrum is allocated to various users, but it is not fully utilized, and thus other parties are being deprived of their chance to use the spectrum. Mobile operators spend enormous sums of money to acquire spectrum licenses in preparation for long-term network planning and deployment. Even if these assets are not deployed right away, they have no incentive to hoard spectrum unnecessarily. On the

¹ *The National Spectrum Strategy*, 88 FR 85266 at 14, (Nov. 13, 2023).

² FCC-TAC August 2023: "A Preliminary View of Spectrum Bands in the 7.125 - 24 GHz Range; and a Summary of Spectrum Sharing Frameworks."

other hand, inadequate amounts of spectrum will likely lead to higher network densification which adversely affects network economics as well as sustainability.

At the same time, the spectrum “owner” cannot be expected to use all the spectrum simultaneously in every location, especially for certain federal usage scenarios. That does not, however, give certain federal agencies the right to block out spectrum from commercial use or use by other federal agencies.

The NTIA and the FCC, in collaboration with federal and non-federal users, need to establish a common definition of what is considered “efficient use of spectrum” while also being cognizant of the fact that it may have different implications for different spectrum users.

2. **Spectrum Sharing**: This terminology often means different things to different stakeholders. Various interpretations of the term (e.g., among mobile operators, between licensed and unlicensed spectrum users, between federal and non-federal users, etc.) need to be clearly defined in the context of spectrum sharing in different bands.

3. Pillar One: A Spectrum Pipeline to Ensure U.S. Leadership in Advanced and Emerging Technologies

A comprehensive spectrum strategy involves earnest participation by all stakeholders. The first step in the process is the comprehensive data collection on actual usage of spectrum by all users. The FCC recently initiated the process of understanding spectrum usage³ by commercial users, but the same effort needs to be established for federal users. Without this crucial information, any

³ FCC NOI, August 3, 2023: “Advancing Understanding of Non-Federal Spectrum Usage”



discussion on spectrum strategy is likely to be incomplete. A comprehensive database needs to be created to account for geographic and temporal spectrum usage by both federal and non-federal users.

It is understandable that some federal agencies may have reservations about sharing this information publicly but an independent agency, with the right representation from diverse stakeholders, needs to assess this comprehensive spectrum usage data and evaluate the appropriateness of usage. This evaluation process should consider the different nature of various services making use of spectrum.

The spectrum pipeline should include a phased approach of releasing more and more spectrum as technology evolves for both the spectrum users as well as spectrum management platforms. However, this phased approach should not add uncertainty about the amount and/or timing of release. Next generation technologies often improve spectrum efficiencies of both federal and non-federal users; at the same time, the demand for spectrum keeps increasing, driven by newer applications and higher usage patterns. In parallel, emerging, sophisticated technologies, including artificial intelligence and machine learning, will likely enable higher degrees of spectrum sharing in more challenging scenarios which may require near real-time actions by the spectrum management systems.

The commercial mobile industry has highlighted the need for 1.5-2 GHz of spectrum⁴ to meet the demands of next generation technologies. Focus should be on the lower parts of the spectrum for terrestrial communications, and they should be allocated with minimal operational restrictions to maximize their commercial attractiveness. It should be noted that the lower part of the spectrum band is far more valuable than the upper part due to its better propagation characteristics, resulting in

⁴ Vision 2030: Spectrum Needs for 5G, <https://www.gsma.com/spectrum/vision-2030-spectrum-needs-for-5g/>



better coverage and a superior end user experience. The spectrum bands 3.1-3.45 GHz and 7.125-8.4 GHz are extremely important for the emerging mobile technologies. Priority should be given for exclusive licensing, followed by shared licensing models, to derive the highest economic benefits of these bands.

4. Pillar Two: Collaborative Long-Term Planning to Support the Nation’s Evolving Spectrum Needs

In the recent PATHSS study of 3.1-3.45 GHz for viability of spectrum sharing between the Department of Defense (“DoD”) and commercial operators, a baseline work was undertaken which is an excellent starting point. The discussions revealed the underlying model was highly conservative to protect DoD operations from commercial mobile operations. Furthermore, the mitigation techniques that both DoD and commercial equipment could potentially use were not fully developed. It is essential that the most advanced features and functionalities are considered, and the most accurate models and tools are used for establishing the feasibility of spectrum sharing.

It is in the DoD’s best interest to develop capabilities to operate at a high level of performance even in the presence of interference because this provides real-life experience of functioning in “contested and congested” environments which the military is likely to encounter in unfriendly territories. The commercial mobile industry is already working on advanced techniques to minimize interference towards other users of the spectrum while concurrently having the capability to accept a certain level of interference from other units and yet be able to maintain reasonable performance.

We recognize that the 7.1-8.4 GHz spectrum range is occupied by federal users interested in efficiently using spectrum technologies to maintain U.S. spectrum superiority. To further this critical objective, Nokia recommends that the least complex spectrum sharing techniques proposed for



common use by federal and commercial entities be given top consideration. The lessons learned from the deployment of CBRS (3.55-3.7 GHz), AMBIT (3.45-3.55 GHz) and the study of EMBRSS (3.1-3.45 GHz) spectrum should be applied to the 7.1-8.4 GHz band, as well as the spectrum sharing techniques proposed for common use by federal and commercial entities in the 37-37.6 GHz band. It is understood that actual implementations may vary for different bands as individual incumbents with disparate operating conditions necessitate the need for a diverse set of solutions. In establishing new paradigms, we must consider both past experiences and emerging technologies to make the solutions more practical.

It is important that the Strategy requires periodic review and adjustments. While the plan itself may be long term, there should be focused, actionable items identified as short term (e.g., 1-2 years), mid-term (e.g., 2-5 years) and long term (e.g., 5+ years) goals. While the short-term activities should be focused on immediate needs, the mid- and long-term activities should account for emergent technical, economic, and geopolitical developments.

Creating a task force consisting of industry representatives employing best practices developed through collaboration between federal and commercial stakeholders is the best way to move forward. Members of this task force would be required to have the necessary security clearance (similar to the process used for PATHSS-C) to deal with sensitive information. This is a very important step in forming the right level of trust among various stakeholders.

The information provided to the task force may include both current and planned usage data and contain both geographical and temporal information. For planning purposes, equipment upgrade information, including timeframes and new operating characteristics, should be made available. Federal equipment generally has a long refresh cycle, and such technology generation information



should also be factored into the Strategy. Only a task force furnished with the proper security tools, detailed information, and empowered with the requisite authority can finetune the Strategy and assure its successful implementation.

5. Pillar Three: Unprecedented Spectrum Innovation, Access, and Management Through Technology Development

While all spectrum governance models – licensed, shared, and unlicensed – should be considered for making new spectrum available for next generation communications, priority in the Strategy should be given to exclusive licensing and high-power use of spectrum. These technology developments create important and equitable incentives for private sector initiatives and innovations. Removing uncertainties about the availability of these critical national resources encourages network operators to invest with confidence at a time when the cost of deployment has outpaced return on investment.

The commercial mobile industry has embraced advanced technologies at an unprecedented pace, buoyed by an innovative global ecosystem. As the federal government continues to construct the Implementation Plan for the Strategy, NTIA should leverage many of these fundamental developments. There are multiple levers that can be used for spectrum management – geography, time, frequency, and power - and none not mutually exclusive. The ideal system should include any combination of these levers, depending upon use cases and operating characteristics of relevant user equipment and systems.

Interference estimates for CBRS, AMBIT and EMBRSS all depended heavily on theoretical models and simulations, many parameters for which were established based on historical practices. There is a critical need to challenge some of these practices and investigate state-of-the-art



alternatives. Furthermore, it is imperative that the results are verified against real-life measurements emulating practical operating conditions of relevant systems.

In the spirit of American innovation, techniques beyond technological advancements may also be used for spectrum management. Incumbents may need subsidies to move operations to a different spectrum band or consolidate operations within a smaller spectrum range. Incumbents may also be provided economic incentives to release unused spectrum permanently or temporarily. Near real-time auctions can be used for the purpose of dynamic spectrum sharing. Such a system can be incorporated within the larger spectrum management system that allocates geography, time, frequency, power, etc., to different users.

6. Pillar Four: Expanded Spectrum Expertise and Elevated National Awareness

While expanding spectrum expertise among the U.S. workforce is a noble and necessary endeavor, expertise in many adjacent disciplines will also advance technology policy development. Leveraging artificial intelligence and machine learning techniques for spectrum management has already been highlighted in the Strategy. In addition, other evolving technologies like cloud computing, cyber-security and quantum computing can be used to scale solutions and to safeguard sensitive information, which may be critical for implementing any dynamic spectrum management system while protecting national security interests.

As part of NTIA’s awareness campaign to advance “the public’s understanding of radio frequency spectrum and raise awareness of its role in everyday life”, we also need to continue the conversation on the impact spectrum has on sustainability. Use of higher band spectrum for terrestrial communication services will likely necessitate greater densification of cell-sites which will, in turn, result in construction of more sites and the generation of more greenhouse gases on an on-



going basis. On the other hand, lower band spectrum generally results in fewer cell sites and can even enable monitoring of environmental sensors located far away from the base stations, sometimes even in deep indoor conditions. Thus, it is critical to include the impact of spectrum strategy on the environment and sustainability in the awareness campaign and Implementation Plan.

7. Conclusion

The successful implementation of the NTIA's Strategy is a matter of national importance, not only for maintaining America's technological leadership and security but also for future economic development and innovation. At Nokia, we create technology that helps the world act together, and as a leader in spectrum innovation, we urge NTIA and commercial entities to work closely with each other to develop thoughtful national standards for the optimal use of spectrum. While working on a long-term strategy, it is critical to have actionable near-term strategic objectives and incorporate the recommendations above into the Implementation Plan for the Strategy, so the United States is fully prepared for the next generation mobile technology (6G) expected to be introduced before the end of the decade.

Respectfully submitted,

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