Before the
National Telecommunications and Information Administration
United States Department of Commerce
Washington, DC 20230

In the Matter of	)
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A Plan to Implement the National Spectrum	)
Strategy of the United States	)

Comments of DeepSig Inc.

DeepSig Inc. is a product-centric company developing revolutionary wireless processing software solutions using cutting-edge machine learning techniques to transform 5G, sensing, and critical wireless applications. By weaving AI machine learning into radio signal processing functions, DeepSig makes the future of wireless more intelligent, efficient, autonomous, and affordable for 5G and lays the foundation for 6G. Open RAN allows for this transformation to occur by disaggregating and virtualizing the majority of 5G base station functionality on commercial servers or in the cloud. DeepSig is delivering a family of AI software products that improve wireless user experience through enhanced connectivity while reducing power consumption, costs, and providing spectrum awareness to detect security threats and interference and to help enable more efficient future spectrum sharing.

INTRODUCTION

We begin by expressing our gratitude for the Biden-Harris Administration's commitment to advancing the global technology leadership of the United States.[1] More than ever, Americans are using wireless devices for work, entertainment, and other purposes. The demand for access to wireless electronic magnetic spectrum ("EMS" or "spectrum") spectrum grows exponentially each year. To ensure maximum connectivity and wireless innovation, it is imperative that more spectrum is made available for commercial use. The *National Spectrum Strategy* ("*Strategy")* is a critical step towards maximizing the ever-valuable, finite resource that is spectrum.[2] We echo the sentiments from our colleagues – in industry, academia, and the halls of Congress – that

[1] See P*resident Biden Signs Executive Order on Addressing United States Investments in Certain National Security Technologies and Products in Countries of Concern*, White House (Aug. 9, 2023), https://www.whitehouse.gov/briefing-room/statements-releases/2023/08/09/president-biden-signs-executive-order-on-addressing-united-states-investments-in-certain-national-security-technologies-and-products-in-countries-of-concern/.

[2] *National Spectrum Strategy (Nov. 9, 2023)*
https://www.ntia.gov/sites/default/files/publications/national_spectrum_strategy_final.pdf

new sharing technologies must be explored for sake of commercial innovation. We believe commercial solutions are critical to the implementation of the *Strategy*.

Spectrum sensing is critical to efficient use of spectrum. Highly-effective sensing is essential for identifying unoccupied and underutilized bands – known as white space. The ability to detect spectrum usage and reallocate underutilized bands is critical as demand for spectrum increases. We acknowledge that a use study of the bands identified in the *Strategy* are critically important to the future of spectrum allocation.

To support next-generation spectrum sharing, the *Strategy* must support innovative research and development of spectrum technologies, and the inclusion of a research-and-development-focused strategic objective underscores the importance of innovation. As iterated above, commercial solutions will play a fundamental role in the implementation of the Strategy. These solutions can range from advanced spectrum management technologies to novel methods of spectrum allocation that prioritize efficiency and adaptability. The integration of machine learning and artificial intelligence in spectrum management, for instance, could revolutionize how spectrum is monitored, allocated, and used. These technologies can dynamically manage spectrum allocation in real-time, responding to changes in demand and usage patterns, thereby maximizing the utility of this finite resource.

ARTIFICIAL INTELLIGENCE-DRIVEN SPECTRUM SENSING IS CRITICAL TO EFFICIENT, ECONOMICAL, & ENVIRONMENTALLY-FRIENDLY STUDY

AI-driven spectrum sensing has transformed the *economics, efficiency, and environmental impact*, making pervasive spectrum sensing vastly more viable than it has been in the past. Driven by several technologies:

- Deep learning based sensing technologies, pioneered and matured by DeepSig have led to a significant increase in sensing performance, leading to ease of identifying many different types of emitters, at larger distances, leading to better sensing interference margin.
- High volume neural processor chips such as GPUs, DPUs, NPUs, TPUs and similar are now available to perform near real time spectrum awareness processing for nearly negligible cost and carbon footprint, likely adding very minimal costs to future radio devices.
- Pervasive data-driven activity information about in-network and out-of-network interferers, propagation and coverage, and multi-user MIMO / spectrum re-use, can now attain much higher levels of efficiency by using AI-driven sensing, processing, and orchestration allowing for machine speed automated control of infrastructure and spectrum to maximize spectrum efficiency, energy efficiency, reliability, and cost in near real time.

SHARED COMMERCIAL USE OF DEPARTMENT OF DEFENSE SPECTRUM

Tasked with achieving superiority in air, land, sea, and space, the United States Department of Defense (“DoD”) acts to further its mission: to deter war and secure the nation. To this end,

spectrum is the glue that connects military operations around the globe. Furthermore, spectrum is the lifeblood of the leading United States` wireless industry. Here, we recognize that progress towards DoD spectrum sharing and explain critical needs for its expansion.

The Citizens Broadband Radio Service ("CBRS") is a successful spectrum sharing program between DoD and commercial users. Operationing in the 3.5 GHz band, CBRS increases the commercial availability of preferable, 5G-focused mid-band spectrum. A May 2023 report on CBRS found that more than 70 percent of active devices were in rural census blocks, expanding rural wireless coverage. Further, close to 45 percent of active devices were deployed in counties in which spectrum is shared with DoD. This is a tremendous step forward to a system where federal spectrum is shared without disruption to incumbent users.

CBRS, consisting of only 150 MHz of spectrum, is an example of how spectrum policy must serve the *broadest* public interest: maximizing both federal spectrum and commercial use where needed. More broadly, embedding AI-driven spectrum sensing within both DOD and commercial devices (e.g. Radio Units) offers a path by which coexistence can be efficiently achieved and optimized by future CBRS-like services.

DEEPSIG'S NTIA-FUNDED INITIATIVE: LEVERAGING ADVANCED AI FOR BREAKTHROUGHS IN OPENRAN AIR-INTERFACE PERFORMANCE

DeepSig has been incredibly fortunate to be one of the first recipients of the NTIA's Public Wireless Supply Chain Innovation Fund (PWSCI) grant, seeking to advance the performance and competitiveness of 5G OpenRAN systems.[3]

First, the initiative to improve OpenRAN (ORAN) Air-Interface performance through data-driven and generative AI testing aligns well with several key pillars of the National Spectrum Strategy. This strategy emphasizes the importance of innovation, efficient spectrum use, and adapting to evolving technology needs in the telecommunications sector.
For one, this initiative is to enhance the efficiency of spectrum utilization. This goal directly supports Pillar Three of the National Spectrum Strategy, which focuses on "Unprecedented Spectrum Innovation Access and Management through Technology Development." By employing AI to more accurately learn and simulate real-world propagation and interference effects, this effort contributes directly to the efficient and effective use of spectrum resources in telecommunications networks, within ORAN and beyond, a vital aspect of the strategy.[4]

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[3] *Biden-Harris Administration Awards First Grants from Wireless Innovation Fund,* National Telecommunications and Information Administration (Aug. 8, 2023), https://www.ntia.gov/press-release/2023/biden-harris-administration-awards-first-grants-wireless-innovation-fund.

[4] *National Spectrum Strategy, supra* note 2, at 13.

For another, the ORAN initiative fosters innovation and competition in the wireless technology sector, aligning with the same pillar. The open and interoperable nature of ORAN encourages diverse companies to participate in the network equipment market, promoting a competitive environment that is conducive to innovation and the ability to leverage new capabilities quickly.[5]

The strategy also highlights the need for ensuring equitable access to spectrum resources. The ORAN initiative's focus on improving network reliability and accessibility supports Pillar Four of the strategy, "Expanded Spectrum Expertise and Elevated National Awareness," especially in terms of providing reliable network services in densely populated, underserved areas, and rural environments, through link margin increases from AI-Native processing.[6]

Additionally, adapting to evolving technologies and demands is a crucial aspect of the strategy, outlined in Pillar Two. The ORAN initiative's integration of advanced AI in testing represents a forward-looking approach that resonates with the strategy's emphasis on adapting to the rapidly changing requirements of wireless communication (Id. at Pillar Two).

More efficient propagation models allow for better spectrum reuse and more efficient allocation, especially in the context of an automated spectrum access service (SaS) (e.g. CBRS). Propagation models allow for denser reuse of spectrum through accurate prediction of interference or non-interference. Further combining AI driven sensing with Generative AI channel modeling can allow for unprecedented abilities to monitor spectrum usage and optimize re-use and allocation jointly.

CONCLUSION

In December 2023, Assistant Secretary Alan Davidson reiterated that technological innovation, a spectrum pipeline, and the release of the *Strategy* central to the work of the NTIA.[7]

Emphasis on advanced spectrum sensing and advanced propagation modeling is critical to the availability of spectrum to meet the burgeoning demands of an increasingly connected world. The adoption and development of AI-driven spectrum sensing and propagation modeling technologies are critical for this forward-looking approach. These technologies promise a transformation in how spectrum resources are identified, allocated, and managed. By harnessing

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[5] *Id.*
[6] *Id.* at 19.
[7] *Oversight Of The National Telecommunications And Information Administration*, *Before the Subcomm. on Communications and Technology of the H. Comm. on Energy and Commerce,* 118th Congress (2022) (statement of Alan Davidson, Assistant Secretary of Commerce for Communications and Innovation, National Telecommunications and Information Association).

the power of AI, we anticipate a future where spectrum utilization is not just efficient but also predictive and responsive to the ever-changing demands of wireless users.

The current trajectory of the *Strategy* sets the stage for groundbreaking collaborations between government and industry. Such partnerships are essential for fostering innovation and ensuring that the United States remains at the forefront of global wireless technology leadership. They also play a crucial role in developing regulatory frameworks that are adaptable to new technologies, ensuring a balanced approach between innovation and responsible spectrum management.

Looking forward, the potential for spectrum sensing to facilitate more equitable access to wireless resources is immense. By efficiently utilizing the spectrum, we can bridge the digital divide, bringing connectivity to underserved and rural areas, and opening up new avenues for economic and social development.

DeepSig is excited about the implementation of the *Strategy* and stands ready to serve as a resource.

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