OVERVIEW

The National Spectrum Consortium (NSC) appreciates the opportunity to respond to NTIA's request for Comment (RFC) on the implementation of the Public Wireless Supply Chain Innovation Fund.

The NSC builds bridges between key stakeholder groups – government, industry, startups, and civilian and military suppliers and users. Our more than 400 members consist of companies, labs, universities, and nonprofits, many of whom are small, innovative technology companies. 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, we have used the Department of Defense (DoD)'s Other Transaction Authority (OTA) to execute 116 projects worth $1.2 billion, delivering innovative new solutions to difficult problems in wireless technology. NSC's membership includes a balance of telecom industry incumbents and new entrants, as well as traditional government contractors and new organizations looking for federal partnerships. This provides the NSC with a unique perspective to offer on the way in which NTIA and other federal agencies can accelerate Open RAN development in the United States.

In our role as a convener, at the request of the Office of the Undersecretary of Defense for Research and Engineering (OUSD R&E), the NSC has hosted discussions to facilitate the development of programs and policies that might accelerate the development of a robust, U.S.-based wireless networking ecosystem. The discussion resulted in the formation of our Open RAN Advisory Group, which convened 200 individuals from more than 100 companies and organizations to deliver 80+ white papers with recommendations on advancing Open RAN in the U.S.

Since its inception, the NSC Open Ran Advisory Group has been deeply involved in:
- Gathering input from the government, industry, and academic wireless communities on the types of resources needed for accelerating Open RAN development and deployment
- Identifying the Open RAN testing and integration capabilities at existing research facilities in the U.S. through surveys and interviews
- Analyzing and articulating the gaps between what is needed and what existing facilities can provide to accelerate Open RAN efforts

Truly open, interoperable wireless networking systems will increase the pace of technology development, which is critical to U.S. competitiveness in this area, including any number of industries and infrastructure sectors. Leadership in an Open RAN-enabled, U.S.-based wireless equipment and systems ecosystem is, thus, critical for national and economic security.

Open RAN technology is not the same as 5G technology, and it has specific requirements for ensuring interoperability with both new and existing network systems (greenfield and brownfield network deployments, respectively). Our Advisory Group seeks to explore these requirements and recommend steps to grow and scale the Open RAN ecosystem in the U.S.

Our response to this RFC will draw from the work of the Advisory Group members, as well as our deep expertise in facilitating conversations across the private and public sectors. Specifically, it will highlight:
- While Open RAN is past the point of basic research, most Open RAN test and development platforms today are not accessible to non-traditional telecom technology providers, and those that are broadly available are under-resourced
- The Open RAN research and testing support needs of the wireless community
- How the NSC can support NTIA's goals for the Innovation Fund and develop open, interoperable wireless technologies

Questions 2 and 2a: What ongoing public and private sector initiatives may be relevant to the Innovation Fund? What gaps exist from an R&D, commercialization, and standards perspective?

The NSC Advisory Group gathered detailed information on more than 20 organizations offering or proposing to offer research and testbed facilities for Open RAN development. Broadly, the organizations break down into several categories:
- Independent organizations with facilities that can support commercial Open RAN testing
- Facilities designed for advanced Open RAN research and development
- Wireless carriers with Open RAN resources and expertise, as well as broad partnership reach
- Technology solution providers with internal labs focused largely on their own commercial objectives
- Advanced research labs with resources that could be dedicated to Open RAN research and development by agreement if interests and goals aligned

1. Facilities with Commercial Testing Services: There are facilities outside of internal company labs with the ability to do commercial Open RAN interoperability and performance testing in the U.S., but in their current form, they cannot provide the complete assurance network operators need for commercial deployments of new Open RAN technology. The tests and demos at these facilities largely require customized set-ups each time they are run, and funding limits what equipment, processes, and personnel these facilities can dedicate toward those efforts and maintain on an ongoing basis.

2. University and Other Research Labs and Testbeds: Many companies in the wireless industry have their own labs and testbeds for Open RAN research, but the work supported at these facilities is primarily (and rightly) motivated by individual corporate objectives. Therefore, these sites are difficult for startups and other small or non-traditional network engineers and developers to access.

Additionally, there are numerous 5G testbeds across the U.S., including the testbeds designated by the DoD at select military bases beginning in 2020. However, these testbeds leverage traditional commercial network components for application-driven research. They were not designed as networking testbeds, but instead were built with the goal of testing specific network-enabled use cases (e.g., smarter warehousing technology). They are not broadly capable of supporting advanced Open RAN research, which requires an open, flexible, and fully configurable environment.

The U.S. facilities that are tailored for advanced Open RAN research overwhelmingly exist at academic institutions. These test environments have the advantage of being both flexible and accessible, but they often have limited operational capacity for serving customers with distinct support requirements. Different university facilities also have different areas of focus within Open RAN and are at different stages of development and deployment. All need additional funding to support research efforts that are not directly sponsored by individual companies.

3. Operator Labs and Testbeds: All U.S. wireless carriers operate labs and other test facilities that are geared toward commercial product development and the testing and integration of new technologies – including value-added applications – that can be deployed in their own networks. To varying degrees, U.S. carriers also support research to benefit the wireless community at large, whether through participation in organizations like the O-RAN Alliance or through partnerships with academic researchers and some smaller companies that can demonstrate the potential value of their technology innovations.

The operators, however, are an integral part of accelerating Open RAN adoption and deployment. They are a driving force behind the open networking movement, network standards development, Open RAN plugfests, and proof-of-concept demonstrations. Their participation in directing Open RAN development – and specifically enabling a larger innovation ecosystem and more diverse supply chain – is critical.

In particular, the carriers have three important assets: vast expertise (including leadership in the O-RAN Alliance and other wireless innovation organizations), partnership reach, and spectrum holdings.

4. Vendor Labs and Testbeds: Vendor companies in the telecom industry invest significant money in their own research and development. However, as with the wireless carriers – and in many cases even more so – their efforts are directed toward commercial product development along with testing to ensure successful integration with partner solutions. Many telecom technology providers could support testing, prototyping, and deployments to prove Open RAN capabilities at scale if the government chose to fund projects with those objectives. Where they are less likely to step in is where more fundamental research still needs to take place.

5. Government Labs and Testbeds: As a counterpoint to technology labs run by commercial companies, there are a number of national labs specifically dedicated to advanced research and to furthering the aims of federal government departments and agencies. These facilities do not focus on product development, but rather on advancing a particular field of study in ways that complement the efforts of the private sector. All of the national labs are generally not open to the public, but they do conduct sponsored research and commercial collaborations. Resources can be made available by agreement, particularly if there is government interest and a national need.

Given this environment, there are two broad and important areas where Open RAN research and development gaps exist. First, most of the facilities working on Open RAN in the U.S. and serving external users need additional personnel. There is a significant need for more researchers with radio frequency (RF) and network computing expertise; personnel with extensive wireless telecommunications, science, technology, and standards/specifications development experience; and engineers that can support system operations at Open RAN labs and testbeds.

Very few of the facilities the NSC Advisory Group has analyzed have the human resources to take equipment and/or software and a test case from numerous external, third-party users and run experiments on their behalf. If the goal is to enable small-to-medium-sized companies and academic innovators to demonstrate new Open RAN technology and concepts at scale, then more support is needed to configure experiments and troubleshoot operations.

Second, many facilities rely or plan to rely on revenue from users, and some also require that those users bring in their own project-specific equipment and software, which can be expensive. The inherent cost of test equipment and environments is a critical barrier to entry for new, small U.S. companies entering the Open RAN marketplace. Reducing usage costs will be necessary to address the accessibility challenges.

Beyond personnel and the issue of usage costs, there are two additional gaps in the current R&D ecosystem for the two types of testing and development required to accelerate Open RAN.

For interoperability and performance testing, the wireless community needs facilities with a wide mix of commercial equipment (traditional RAN and Open RAN) and software available on demand. It is not enough for labs to work with partners to set up the configuration of hardware and software needed just for a one-time, pre-planned plugfest.

In addition, the wireless community needs the ability to test commercial solutions with actual over-the-air data transmissions in a real-world environment.

Question 4. What is the current climate for private investment in Open RAN, and how can the Innovation Fund help increase and accelerate the pace of investment by public and private entities?

The mass commercial deployment of Open RAN depends on the power efficiency, network performance and end-to-end resiliency and security of its infrastructure and software components. Solutions that are not competitive in terms of performance, power efficiency, and security would not be able to transition from proof-of-concept (PoC) trials to mass deployment. As such, optimized silicon components particularly for Open RAN Central Unit (O-CU), Open Ran Distributed Unit (O-DU), and Open Ran Radio Unit (O-RU), are key enablers of global commercial deployment for the Open RAN ecosystem.

The cost of design and development of such complex silicon solutions are quite significant, in the order of hundreds of millions of dollars. Without sponsorship from the government or a committed customer, individual companies are reluctant to make such an investment. With NTIA's leadership and funding through the Wireless Innovation Fund, semiconductor companies can provide the required silicon components that will meet the bandwidth, reliability, and latency requirements of the emerging 5G use cases.

Question 6: What open and interoperable, standards-based network elements, including RAN and core network elements, would most benefit from additional research and development (R&D) supported by the Innovation Fund?

NTIA can best support the development of open and interoperable, standards-based network elements by focusing on the testing and research needs of the wireless community.

Recent Open-RAN plugfests and PoC demonstrations are an important step. Still, these tests and demos largely require customized set-ups each time they are run, and funding limits what equipment, processes, and personnel can be maintained on an ongoing basis. Furthermore, these plugfests — and indeed even the U.S. Open Test and Integration Center (OTIC) facilities — have not yet certified Open RAN solutions as meeting commercial-grade performance and interoperability requirements in end-to-end testing. As previously noted, most Open RAN test and development platforms today are not accessible to non-traditional telecom technology providers, and those that are broadly available are under-resourced.

The wireless community, particularly the small and non-traditional organizations, need access to an at-scale, multi-vendor Open RAN test and development platform. They will need to leverage existing investments and potentially take advantage of resources at multiple locations. This will enable U.S. innovators to demonstrate Open RAN viability, prove system integration capabilities, and develop new features and functions within an Open RAN architecture beyond just lab work, plug fests, or single-integrator/single-operator efforts.

Our Advisory Group has a set of specific recommendations about the test environments. They should be:
- Accessible to a broad user base, including:
  - Academic and commercial users
  - Large and small entities
  - Entities requiring support and assistance and those able to conduct their own experimentation
  - Up to full-cost subsidies for startups, smaller commercial entities, or research organizations
- Predictably available
- Representative of current or pending commercial Open RAN deployments (i.e., containing primarily commercial O-RU offerings currently in use versus lab-grade equipment and/or test and measurement gear
- Supported by full-time experts and operations staff tasked with testbed management and maintenance
- Inclusive of a technical support team designed to onboard users and provide end-to-end project support for both individual experiments and long-term research
- Able to provide subsidized usage for startups and non-commercial researchers
- Able to provide access to licensed and/or shared spectrum through coordination with federal agencies and commercial spectrum holders
- Inclusive of a mechanism for reporting research findings to government, industry and academic stakeholder communities (can be anonymized, and sensitive details can be protected under NDA)

There is also a need for a rapid-paced R&D fund to create demonstration/prototype deployments that showcase various use cases for Open RAN networks. A coordinated system of labs and operators focused on live testing could help address this need. Such an approach would leverage and make the most of existing facilities and allow NTIA to allocate resources strategically to various labs and smaller operators that can serve as both the testbed and as a commercial deployment. These labs would provide an opportunity to test Open RAN interoperability among multiple suppliers and expand 5G deployment where 5G does not already exist.

It is also important for Open RAN to be based on standardized technology, which is the cornerstone for multi-vendor interoperability testing and integration. The U.S. should maintain a high interest in the development of Open RAN standards and test specifications, and use all leverage the US has to bring the standards/test specifications into maturity. Open RAN standards are necessary for the success of subsequent Open RAN development activities, and therefore, U.S. investment in Open RAN standard/test specification development to propel its progress is highly encouraged.

To this end, the Innovation Fund should also be used to support an open-source reference software architecture for Open RAN prototyping and innovation. This would enable academic and commercial R&D by lowering the cost and complexity of participation and the need for purchasing software licenses ahead of R&D.

Questions 22 and 23: 22. How can NTIA ensure that a diverse array of stakeholders can compete for funding through the program? Are there any types of stakeholders NTIA should ensure are represented? How (if at all) should NTIA promote teaming and/or encourage industry consortiums to apply for grants?

NSC, its membership, and its OTA are the perfect vehicle for funding these efforts. The NSC has a track record of rapidly funding prototype projects in networking and communications. The NSC's history has been focused on public-private partnerships to advance wireless technology and it can bring together key partners and stakeholders from the federal and commercial sectors to competitively source demonstration, prototype, and testbed projects.

The NSC membership includes 400 of the most innovative organizations in the wireless and networking space, with more than 60 percent of those representing non-traditional and/or small businesses or academic research organizations.

NSC can assist NTIA to execute funding projects in 2023 that will quickly accelerate Open RAN commercial deployments so that it can be a viable option for the remaining 5G build cycle and future 6G infrastructure builds.

NTIA can best advance the administration's priorities by striking a partnership with NSC. A grant, perhaps matched with additional DoD funding to advance Open RAN, could be structured to put NTIA in a position to rapidly close the gap in research and development by creating an Open RAN innovation ecosystem at one or more locations across the country. Such an effort, funded by NTIA and led by NSC, could show organized, tangible results in less than 12 months. Like the DoD 5G test beds, NSC, with its partners that include US Ignite and other well-known Open RAN advocacy organizations, would apply for a grant to spearhead research and development of component integration starting in 2023, arguably the most important goal of the Public Wireless Fund. The collective organizations would leverage funding against possible DoD funding thereby amplifying multi-government funds and organizational outreach. These organizations would then work closely with NTIA to outline milestones, goals, and partners, and to ensure deliverables are met.

By leveraging well-known and well-structured organizations, NTIA has the ability to make an impact in Open RAN immediately. NTIA becomes not just a source of grant funding, but an important partner in Open RAN acceleration efforts.

If the federal government truly has the goals of "supporting a more competitive and diverse telecommunications supply chain…[and]…fostering competition," then we must address known technical and accessibility gaps in the development of open networking technologies as quickly as possible. Only by solving these resource challenges can we take full advantage of Open RAN to diversify the telecom supply chain and expand our telecom innovation ecosystem.

The NSC stands ready to support the NTIA in achieving these goals, particularly by providing access to small and non-traditional organizations in the space, to ensure U.S. wireless technology leadership and therefore strengthen our national and economic security.

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National Spectrum Consortium

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