

National Telecommunications and Information Administration
U.S. Department of Commerce
1401 Constitution Avenue NW
Room 4725
Washington, DC 22030

January 27, 2023

Re: Comments of Kernel Labs Inc. in Response to the Public Wireless Supply Chain Innovation Fund Implementation

Dear Sir or Madame:

Kernel Labs Inc., a start-up studio based in Seattle with deep expertise in creating technology companies in strategic domains such as AI, cloud services, and telecom, provides this response to the Request for Comment on the National Telecommunications and Information Administration paper, titled *Public Wireless Supply Chain Innovation Fund Implementation*.

Kernel Labs recommends the development of open-source solutions to the challenges of Open RAN software and hardware integration. This supports NTIA's conclusion that the adoption of open, interoperable, and standards-based RAN is a matter of critical importance to national security and the ability of the domestic market to drive technological innovation. The United States must invest in domestic companies to address a critical shortfall in a vital industry.

The telecommunications sector increasingly uses open-source software, presenting significant advantages, such as cost-effectiveness and adaptability¹. However, it also poses potential security vulnerabilities. "Rather than buying all of the core components from a small set of suppliers, they now have the ability to adjust it themselves and add in third-party software," David Stehlin, CEO of the Telecommunications Industry Association, said. "That's one of the benefits of open source. But one of the downsides is you have more software providers and many more ways to get into the network, which adds in risk." The implementation of 5G technology has resulted in increased operational efficiency for service providers. However, this shift towards utilizing open source and white box solutions within the network infrastructure introduced potential risks. Global standards for telecommunications industry supply chain security can mitigate these risks.

While having a standard is crucial, it is not enough to ensure successful integration². An integration platform can greatly decrease the time, resources, and costs associated with integration. Detractors of Open RAN point to the difficulty of software integration³. Without a standard base layer of integration, like a middleware platform, there is no guarantee of compatibility, consistency, or performance. Nevertheless, the Open RAN specification alone is

¹ **Question 18.** What steps are companies already taking to address security concerns?

² **Question 7a.** What barriers are faced in the standards environment for open and interoperable RAN?

³ **Question 1.** What are the chief challenges to the adoption and deployment of open and interoperable, standards-based RAN, such as Open RAN? Are those challenges different for public vs. private networks?

not sufficiently mature to produce stable, interoperable, cost-effective, and market-ready RAN products⁴.

Current standards such as Open RAN do not effectively address the implementation of various components from different vendors hindering the integration of open and interoperable, standards-based Open RAN technology.⁵ Before any assurance of compatibility can be made, these components must be individually certified by organizations like the O-RAN Alliance. Even with certification, manual and custom integration implementation is still required. Fully functional Open RAN requires open-source middleware free from the control of a single dominant entity,⁶ mitigating concerns about proprietary monopolies. This ensures a neutral integration and certification process.

Lacking an open-source implementation, the O-RAN Alliance introduced a Certification and Badging program to ensure the conformity and interoperability of equipment and solutions in accordance with O-RAN specifications.⁷ These certifications and badges are issued by Open Testing and Integration Centers (OTICs), which provide a collaborative, open, and impartial testing environment. These tests include compliance with O-RAN Conformance specifications and plugtests. These can be time-consuming and costly, potentially slowing down commercial adoption and deployment versus utilizing automated software integration.

Luckily, alternatives exist to this lengthy certification system⁸⁹. A middleware platform can automate this process and allow for efficient and cost effective compatibility and certification. Consider how your computer's operating system (OS) manages the software and hardware on the computer. At any time, there are several different programs running concurrently, and they all need to access your computer's central processing unit (CPU), memory, and storage. The operating system coordinates all of this to make sure each program gets what it needs. For hardware functions such as input and output and memory allocation, the operating system acts as an intermediary between programs and the computer hardware.

The middleware software solution could do these same tasks for telecom infrastructure. The middleware would be an intermediary between the purpose-driven hardware, like physical antennas and radios, and the virtualized software components. It would ensure compatibility and integration and ensure all components work together.

Automated integration via this middleware within the telecommunications industry will result in a more efficient and cost-effective system, with heightened flexibility and scalability.¹⁰ Open-

⁴ **Question 7.** Are the 5G and open and interoperable RAN standards environments sufficiently mature to produce stable, interoperable, cost-effective, and market-ready RAN products? If not:

⁵ **Question 12.** What existing gaps or barriers are presented in the current RAN and open and interoperable, standards-based RAN certification regimes?

⁶ **Question 2a.** What gaps exist from an R&D, commercialization, and standards perspective?

⁷ **Question 11.** How do certification programs impact commercial adoption and deployment?

⁸ **Question 11a.** Are there alternative processes to certification that may prove more agile, economical, or effective than certification?

⁹ **Question 7b.** What is required, from a standards perspective, to improve stability, interoperability, cost effectiveness, and market readiness?

¹⁰ **Question 8.** What kinds of projects would help ensure 6G and future generation standards are built on a foundation of open and interoperable, standards-based RAN elements?

source technology fundamentally ensures that no singular entity holds a monopolistic control over a crucial aspect of the RAN platform. An open-source approach will facilitate a level playing field, providing competitive space for small companies and fostering innovation. By adopting an open-source strategy, U.S. companies can maintain a strategic advantage in the industry.

The deployment of Open RAN in a pre-existing infrastructure (like a brownfield environment) requires a constructive relationship between traditional and Open RAN suppliers¹¹. Telecommunications operators play a crucial role in fostering trust, as they will be the crucial factor in the interoperability of Open RAN. Brownfield networks have several benefits, such as reduced deployment efforts and shortened development time due to the presence of pre-existing infrastructure. Brownfield's reliance on legacy systems can lead to deployment challenges, requiring re-engineering to accommodate these systems. In comparison, Greenfield networks do not have this issue as they are built from scratch. For brownfield operators seeking to provide nationwide coverage, Open RAN suppliers must provide radios that operate across a broad range of spectrum and provide the features offered by traditional OEMs. The presence of multiple vendors in the network leads to a complex ecosystem. Implementing automation and orchestration frameworks and solutions that can operate across the ecosystem minimizes friction in deployment.

The implementation of Open RAN interface standards facilitates seamless communication between artificial intelligence systems and the network infrastructure, enhancing the overall quality of experience for users¹². AI algorithms can analyze traffic patterns and network performance and resources can be allocated accordingly. Furthermore, the training of AI machine learning models can occur offline in a non-real-time RIC environment, as there is no need for immediate response to real-time events.

In one implementation, several telecommunications providers can share infrastructure utilizing open standards for radio access networks (RAN). In this scenario, a single operator would possess and manage the deployment, while also accommodating out portions of the resources to hosted operators. The hosted operators must have access to open interfaces to configure and control the resources that service their clients. The hosted operator uses Open RAN's near real-time RIC and its interfaces to remotely control the virtual network functions (VNFs) to run the network. Additionally, the hosted operator monitors and interacts with the RAN infrastructure, which is vital for adhering to service level agreements (SLAs) with their customers. SLAs are agreements that establish various key performance indicators (KPIs) between network operators and their clients, and it is no different in 5G networks than any other type of network. However, what sets 5G networks apart from other mobile networks is the capability to network slice.

¹¹ **Question 1a.** What are the challenges for brownfield deployments, in which existing networks are upgraded to incorporate open, interoperable, and standards-based equipment?

¹² **Question 13.** What are the foreseeable use cases for open and interoperable, standards-based networks, such as Open RAN, including for public and private 5G networks? What kinds of use cases, if any, should be prioritized?

NTIA should evaluate proposals according to a few criteria¹³ in order to ensure the success of the Open RAN market in the United States:

1. How does the proposal accelerate the deployment and development of Open RAN solutions?
2. Does the proposal improve the efficiency and velocity of integration between Open RAN components?
3. Does the proposal encourage and accelerate the development of standard Open RAN compatible components?
4. To what extent will this proposal facilitate the seamless incorporation of various components for parties? Is there a significant burden imposed upon parties, even with components that have been certified to comply with standards, regarding assembly and implementation?
5. Does this proposal have the potential to result in the formation of monopolies, which could impede technological advancement and inhibit competition among multiple parties, thereby decreasing costs?

Alongside these criteria, incentivizing major corporations such as Dell, Microsoft, Amazon, Intel, VMWare, Mavenir, and Qualcomm to contribute software and potentially intellectual property for use by smaller entities will drive innovation in the development of tools for integrating virtualized software components.¹⁴ In addition, grants provide financial assistance for crucial recovery endeavors, cutting-edge research, and other initiatives¹⁵. The United States must invest in domestic companies to address a critical shortfall in a vital industry. Investing in foreign allies detracts from the stated aim of increasing domestic involvement in Open RAN and strengthening national security.

In summary, Kernel Labs believes that open-source solutions offer the best opportunity to increase innovation, lower consumer costs, and speed deployment of Open RAN networks. This investment will serve to fortify the nation's position in telecommunications for 5G and beyond.

Respectfully Submitted,

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¹³ **Question 21.** Transparency and accountability are critical to programs such as the Innovation Fund. What kind of metrics and data should NTIA collect from awardees to evaluate the impact of the projects being funded?

¹⁴ **Question 23.** How (if at all) should NTIA promote teaming and/or encourage industry consortiums to apply for grants?

¹⁵ **Question 25a.** Should NTIA require that grantee projects take place in the U.S.?