

Rivada Networks is pleased to have the opportunity to offer its comments on Docket # 2022-0003. Electronic communications, and wireless communications in particular, have never been more important to the security and economy of the United States and NTIA's program has an opportunity to make a significant difference in advancing the interests of the United States and its leadership in communications technology. We look forward to reviewing the NOFOs that emerge from this process.

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?

The chief challenge to the adoption and deployment of open and interoperable, standards-based RAN is that of operating and maintaining such a system. These challenges exist in both public and private networks, but become profoundly more challenging when many third-party component providers are in play.

Open RAN currently doesn't "just work" out of the box. Considerable integration and interoperability work is required to assemble configure and test the various components that make up a 5G wireless network. And, unlike a contract with a traditional, full-service vendor, it's not always clear what component supplier or sub-contractor is at fault if things are not working as intended. Vendors tend to blame each other in a circular fashion, and this increases the risks and costs of deploying Open RAN solutions. Until the industry can ensure both completeness of the Open RAN solution and openness of all its interfaces, the industry will struggle to agree on a collective standard that will promote straightforward interoperability and a true choice of suppliers across the disparate supply chains.

On the topic of operating and maintaining Open RAN or similar open and interoperable systems, the challenge of securing the network remains. Despite the idea that openness allows the government to select, secure and quickly replace every interoperable third-party component, the fact that is consistently overlooked is that such a system becomes extremely challenging to keep secure. The main issue is that openness, with many exposed interfaces, simply broadens the attack surface, making the challenge of security far more complex, costly and demanding.

3. What kind of workforce constraints impact the development and deployment of open and interoperable, standards-based RAN, such as Open RAN? How (if at all) can the Innovation Fund help alleviate some of these workforce challenges? 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?

To date, Open RAN has not proven itself to be a cost-effective alternative to the "traditional" integrated solutions offered by full-service telecom equipment manufacturers. And the risks of deploying Open RAN have not been proven to be lower than traditional single vendor end-to-end

solutions. As a result, no clear and strong business case for Open RAN has presented itself from the network operators' perspective.

In theory, most modern cellular technology solutions are being developed no differently than Open RAN, except their internal interfaces are not currently exposed. This makes compliance with Open RAN standards somewhat straightforward for large end-to-end cellular infrastructure suppliers, while it remains challenging to most small or upstart suppliers. Although many large wireless telecom infrastructure vendors claim to be willing to deliver Open RAN compliant solutions, none are in any hurry to do so. This is because Open RAN in its purest form is an existential threat to the industry bastions.

Test Labs and or Test Environments are required for pre deployment and interoperability testing and or new feature development and integration. These facilities are costly and represent a significant investment hurdle for small to mid-size network companies and limits innovators and development.

A funded, managed, standard, national lab environment for small to midsize companies and/or innovators or developers would address those limitations and open the ecosystem for more users and contributors.

5. How do global supply chains impact the open, interoperable, and standards-based RAN market, particularly in terms of procuring equipment for trials or deployments?

Global supply chains are vulnerable to manipulation and disruption, especially those originating in many of the traditional low-cost electronic manufacturing countries. Given this danger, it is critically important that we foster the equipment manufacturing capabilities not only in the U.S. but also in those of allied and friendly countries. To that end, it would be useful if the NTIA encouraged and aided the acquisition of the R&D equipment for this effort from companies located in friendly and allied countries as well as the U.S. A full and diverse ecosystem supply chain does not exist in the United States today. Innovation that is part of the global supply chain needs to be well understood, and leveraged, if we are to completely understand the gaps that exist between U.S.-based suppliers.

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:

The Open RAN industry is moving forward and interoperable multi-vendor solutions are starting to be commercially implemented as the supplier landscape is maturing. However, there is still a lot of work required to match the seamless interoperability, flexibility and breath of capability that end-to-end RAN suppliers have. For very simple Open RAN implementations the larger supplier solutions meet the most basic requirements of Open RAN and are well suited to private network implementations. As smaller suppliers gain more experience in working within the larger supplier framework, more innovation will flourish, because we can put the larger interoperability concerns aside.

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

The standards are more like guidelines than interoperability specifications. There exist differences of opinion in how the standards should be implemented, which leads to interoperability challenges and high testing/integration costs.

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

Interfaces need to be better defined and more testing needs to be done if ubiquitous interoperability is expected.

c. What criteria should be used to define equipment as compliant with open standards for multivendor network equipment interoperability?

Better standards and sponsored certification of component interoperability is required.

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?

To enable the efficient use of our spectrum resources, it is critical that the 6G standard have extensive sharing capabilities. In the United States and throughout the world, governments control a lot of spectrum for national security purposes. Although not almost heavily used, it must be available to governments when needed. Any underutilized spectrum could and should be intelligently and securely shared. This is important for both the commercial and government/defense applications, which must at some point interoperate to ensure government applications are not compromised while commercial innovation can be supported and capitalized upon.

Furthermore, spectrum is not the only resource that needs to be shared more effectively in 6G networks. To service remote areas, provide higher throughputs and lower the cost of connectivity generally, network operators are going to require mechanisms that will allow them to share RAN and core resources. The sharing of these network elements will require defined procedures and open interfaces that will need to be part of the standards if we are to significantly improve the economics of the industry and make universal low-cost access a reality.

It is critical that the NTIA fund and support projects that explore advanced sharing methodologies that will lead to American IP that must be incorporated into the coming 6G standards. This sharing capability will be both essential and will need to be highly secure; it is vital that these technologies are American made, defined, and secured.

9. How can projects funded through the Innovation Fund most effectively support promoting and deploying compatibility of new 5G equipment with future open, interoperable, and standards-based equipment?

a. Are interoperability testing and debugging events (e.g., “plugfests”) an effective mechanism to support this goal? Are there other models that work better?

“Plugfests” provide opportunities for participants to test their gear or code with others but do not ensure that unusual combinations are discovered. Another approach to consider is to develop a reference system that intentionally pushes tolerances to the limits and measures the performance of the systems under test. In other words, if the reference system can behave more like a real-world system that is often deployed in suboptimal conditions, it will create opportunities to stress test every component in a controlled manner with documented results.

10. How can projects funded through the program most effectively support the “integration of multi-vendor network environments”?

Many of the commercially available test environments are controlled by large operators, or by large vendors, which tend to limit the participation of smaller startup companies due to price constraints or concerns about theft of intellectual property. Projects funded through the program, including testbeds, should encourage and support small innovative suppliers to participate.

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

a. Is certification of open, interoperable, standards-based equipment necessary for a successful marketplace?

It is not clear that formal certification programs are the most effective strategy when the system buyers are large network operators that make their vendors liable for integration and performance. However, in markets with smaller operators or in applications such as CBRS where a collection of disparate operators may be more common, certifications that reflect the actual operational performance and interoperability in the field, are relevant to commercial and government use cases. The certification process must not be too onerous or costly for new/small vendors, but not so loose that interoperability becomes tenuous.

b. What bodies or fora would be appropriate to host such a certification process?

The O-RAN alliance is the primary organization that leads the charge for interoperability, open test labs and certification, but they are under performing due to lack of budget and dependencies on member support commitments. The TIP or Telecom Infra Project (TIP) is another such organization that is primarily focused on driving down the cost of RAN infrastructure and software licenses, but their focus is more on cost rather than functionality or quality. Global standards organizations such as ETSI, Small Cell Forum, Open RAN Policy Coalition, 3GPP, and others, are good places to start in the collaborative process. Many, however, are strongly influenced by foreign governments whose ideals do not align with the United States’. So, the United States needs to take a more proactive role in standards development if it wants to influence the path these organizations take. This can be done directly or indirectly by subsidizing or sponsoring trusted contractors that will help to support the U.S. strategic interests.

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

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

Certification has value if it is focused on things that are relevant to commercial operation and not enabled effectively in some other way. Being able to test on a system that simulates real world conditions has value.

b. What role, if any, should NTIA take in addressing gaps and barriers in open and interoperable, standards-based RAN certification regimes?

Anything that the NTIA can do to reduce the costs for new operators and suppliers to enter the market will be beneficial. A robust real-world simulation strategy would expose areas that suppliers need to address and give operators the confidence to try components from new suppliers.

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?

Among the benefits of increasing private 5G networks is the opportunity for synergy with the public network providers for their mutual benefit. Private Network providers build out to local and specific requirements and interoperate with the public network provider. The private network provider gets the benefit of the broader footprint and or services from the Public Network Provider, while the Public Network Provider gets managed access to the residual capacity of Private Network Provider. The symbiotic relationship optimizes investment and functionality.

14. What kinds of trials, use cases, feasibility studies, or proofs of concept will help achieve the goals identified in [47 U.S.C. 906\(a\)\(1\)\(C\)](#), including accelerating commercial deployments?

a. What kinds of testbeds, trials, and pilots, if any, should be prioritized?

The O-RAN Alliance makes extensive use of plugfests. These clearly must continue, but complimentary to these events, a reference test framework that stress test interoperability would enable developers to test their product without having to coordinate with many other parties. The individual companies would test against a representative challenging variable environment (with metering) and be able to collect data against the test scenarios. The test environment and conditions of the test system would be developed based on the results and experiences from plugfests and from other experiences of the participants.

15. How might existing testbeds be utilized to accelerate adoption and deployment?

Testbeds today are largely under the control of corporations and sponsors with external agendas (i.e. they are for-profit and selling something, or attempting to lock-in intellectual property rights as part of the sponsorship) or do not have the requisite baseline infrastructure in place to support the needs of innovative R&D efforts or true interoperability testing with other than their own proprietary infrastructure.

Testbeds need to be truly open and sponsored by either a collective budget from participating third parties or the government. Testbeds need to be staffed with expert technicians who can maintain and facilitate basic generic third-party network component access (e.g. fronthaul, test and measurement equipment, radios in licensed spectrum, etc.). Testbeds should coordinate the efforts of disparate suppliers and innovators to allow for the replication of real-world challenges as part of the testing effort. (e.g. It has much less value if party A's component only interoperates with party B's infrastructure.)

16. What sort of outcomes would be required from proof-of-concept pilots and trials to enable widespread adoption and deployment of open and interoperable, standards-based RAN, such as Open RAN?

If realistic simulations are developed with appropriate measurements and reporting, then the required outcomes would be reports that indicate that the prototype proof-of-concept system performs well in all of the test cases or that the failure rates are no worse than other systems in use. The performance standards must be consistent with the performance of existing systems.

The overall concept is that the collective expertise of the industry would be embodied in the simulator and new systems would be tested against simulated adverse conditions. Adverse conditions can include load testing, mediocre signal conditions, simulated component failures, etc.

17. “Promoting and deploying security features enhancing the integrity and availability of equipment in multi-vendor networks,” is a key aim of the Innovation Fund ([47 U.S.C 906\(a\)\(1\)\(C\)\(vi\)](#)). How can the projects and initiatives funded through the program best address this goal and alleviate some of the ongoing concerns relating to the security of open and interoperable, standards-based RAN?

The private sector needs help, and in some cases financial incentives, to develop U.S.-based manufacturing capabilities.

There is an imbalance in standards development work among nations. An investment in resources committed to future standards development is one way this program can help. Likewise, identifying safe sourcing alternatives and or assisting small and or medium size companies in making the right selection in equipment providers with funding is required.

20. How is the “zero-trust model” currently applied to 5G network deployment, for both traditional and open and interoperable, standards-based RAN?

Open RAN and or Open APIs on which Open RAN is based have Zero Trust security protocols based on specifications from standards technical bodies ie 3GPP, O-Ran Alliance and GSMA. We need representation and effective contributions in setting those standards and we need to “White Hat” test and verify activity to drive further enhancements.

What work remains in this space?

The GSMA Network Security Element Assurance Scheme and 3GPP and O-RAN Alliance and the Cloud Native Computing Foundation provide security testing specifications. The Innovation fund can support “certification “efforts against these standards, or others, to support safe choices and or to alleviate these costs and activities from small to midsize MNO’s and or Private Enterprise considering Private Networks.

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?

In order to get the widest and best group of stakeholders involved, NTIA needs to ensure that small, innovative companies are encouraged to participate. To achieve this, small & medium size companies need to be assured that they have a realistic chance of being awarded a contract/grant. NTIA should consider limiting the amount of funding that the large companies/incumbents receive. NTIA should also consider a “small-business set-aside” to encourage small and medium size companies to participate. NTIA should also consider allocating a certain amount to consortia that would include academia, small companies, and large companies.

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

There should be a process for submitting a joint or consortium proposal. The process needs to be clear on how the consortium should form their joint-bid and what funding gets paid to each party.

NTIA might also present a means for the proposal owners to write a “public summary” of their submitted proposal and invite new parties to express an interest in joining their proposal. This would have most impact if it’s encouraged before a proposal is submitted.

There may also be merit in NTIA forming a community element to the fund. In this community element, various companies can enter their details and see what other companies offer, such as their areas of expertise, where they are based, and what they might contribute to a joint application.

24. How can NTIA maximize matching contributions by entities seeking grants from the Innovation Fund without adversely discouraging participation? Matching requirements

can include monetary contributions and/or third-party in-kind contributions (as defined in [2 CFR 200.1](#)).

NTIA should have several participation models available. Matched funding should be a part of the mix of models used. However, small companies may not be in a position to apply matched funding. NTIA should include ‘in-lieu’ matched investment, where small companies can invest their employees time as a method of matched funding. NTIA should also award direct grants to small companies to encourage the broadest possible stakeholder involvement and solicit the most effective outcome.

25. How can the fund ensure that programs promote U.S. competitiveness in the 5G market?

If there is a valid reason for conducting experiments outside of the U.S., such as access to specific spectrum bands, partner resources/laboratories or third- party infrastructure (e.g. pre-commercial or existing commercial networks), then conducting select works outside of the U.S. is appropriate. Exceptions can be made on a case-by-case basis, depending on the scope of the specific exercise.

This makes sense when considering that almost all global infrastructure suppliers are not U.S. based, and when they are, very little if any of their manufacturing of telecom infrastructure exists in the United States. Hopefully this program will help to change that dynamic, but executing completely within the U.S. should not be a hinderance to progress or limit access to valued resources.

Awards involving external parties should be sponsored and managed by a U.S.-based company, but can include suppliers from approved friendly nations. Some approval by a U.S. government entity should be required before such foreign involvement is finalized as part of an award.

a. Should NTIA require that grantee projects take place in the U.S.?

No. But reasons for conducting any experiments outside of the U.S. must be compelling and government approved.

b. How should NTIA address potential grantees based in the U.S. with significant overseas operations and potential grantees not based in the U.S. (*i.e.*, parent companies headquartered overseas) with significant U.S.-based operations?

Lead contractors should have U.S. headquarters, subcontractors or partners can be foreign if good cause exists. But, awards should be made directly to the U.S. entity.

c. What requirements, if any, should NTIA take to ensure “American-made” network components are used? What criteria (if any) should be used to consider whether a component is “American-made”?

Components should not need to be American made, but must be produced in a friendly nation. Limiting production to the US will simply slow down progress and access to technology. However, once the project outcome is reached, it might be appropriate to expect that future key contracts that leverage the results of the grant will only be awarded to US based companies that leverage U.S. manufactured components.

26. How, if at all, should NTIA collaborate with like-minded governments to achieve Innovation Fund goals?

NTIA should look to international best practice in funding innovations in the technology and telecoms space. In particular, we would recommend that NTIA explores the model Business Finland have adopted, in which they have invested heavily in cutting-edge international projects.

27. Are there specific kinds of initiatives or projects that should be considered for funding that fall outside of the questions outlined above?

While the industry tends to focus on technological innovations, a key element of 5G and 6G innovation is *business-model innovation*. We urge the NTIA to consider projects that explore innovative ways of bridging the digital divide, or expanding coverage and capacity to the underserved, through innovations in industry structure and business approach.

In particular, dynamic network sharing that is pro-competitive and not captured by the large incumbents or subject to cartelization by them, is a key innovation for expanding wireless networks while lowering the cost of connectivity.

One way to think about this is on analogy with cloud-computing platforms, an area in which the U.S. is a world leader. Wireless Connectivity-as-a-Service will prove as profound an innovation for industry as any network-architecture innovation. The NTIA would be remiss if it overlooked this vital area of innovation.

At the turn of the century, most new Internet startups had to buy physical equipment, install that equipment in company-owned premises, and maintain and upgrade that hardware and its connections to the rest of the Net in order to stay online. Today, a startup can buy computing, storage and fiber connectivity all as services, without the need to maintain their own server farms or physical installations. These innovations have profoundly changed how businesses approach their IT and technology needs.

Wireless Connectivity-as-a-Service is the next logical piece of this process of virtualization. It allows for the same efficiencies that have transformed the markets for compute and storage to improve the economics of wireless.

We therefore urge the NTIA to consider for funding projects that aim to demonstrate the potential of Connectivity-as-a-Service to change the nature and structure of the wireless business as we know it today.