Questions on the State of the Industry

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Understanding the current state of the telecommunications industry is important to determining how any topics should be prioritized in the Innovation Fund, and what level of funding a topic should receive.

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?

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

Because of interoperability issues, the brownfields will likely introduce Open RAN in new expansion networks such as the ones they will build in rural areas. We anticipate that at the next regular upgrade cycle, Open RAN will be considered for other parts of the network.

2. What ongoing public and private sector initiatives may be relevant to the Innovation Fund?

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

R&D: The last few years have seen AI make a dramatic impact in a variety of domain areas, yet the application of AI/ML to 5G and 6G wireless networks remains nascent. Although some mobile network operators and telecom infrastructure vendors are applying AI/ML techniques, as in other domains, innovation by startups is typically needed for breakthroughs. In particular, techniques to apply AI/ML at the lower layers of the stack are still unexplored and untested.

Standards: There is progress in standardization of open RAN networks, interoperability testing remains an area that needs more investment by the industry with a push from additional federal funding.

b. How might NTIA best ensure funding is used in a way that complements existing public and private sector initiatives?

In the public sector, large private sector companies including mobile network and telecom infrastructure vendors have large departments dedicated to working on government funded programs and grants.

The telecom infrastructure sector receives very little venture capital funding.

The NTIA can jump-start investment in this space by providing grants to innovative startups in the telecom infrastructure space. Federal grants in this space will signal to VCs the

government's interest in developing this space, and they (i.e.the VCs) will then take more of an interest in investing in this space.

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?

Existing telecom workforce have not necessarily been trained in cloud and AI, new technologies required for ORAN adoption. Additionally, Open RAN based infrastructure is relatively new, requiring retraining of the telecom workforce on interoperability and manageability issues.

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?

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In the public sector, large companies including mobile network and telecom infrastructure vendors have large departments dedicated to working on government funded programs and grants.

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?

Standards based Open RAN systems are for the most part based on commodity-off-the-shelf hardware and software; consequently, they are both benefited by global supply chains from a cost efficiency standpoint, but also create the opportunity for a US based Open RAN infrastructure provider, thus reducing dependency on overseas RAN infrastructure suppliers.

Questions on Technology Development and Standards

Understanding the current state of open and interoperable, standards-based RAN and the standards that inform its development will assist NTIA in maximizing the impact of grants. Questions in this section will be used to assess the maturity of the technology and related standards to help determine which topics should receive additional investment.

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?

Disaggregated RAN components, including CU and DU, RIC, Open DU needs additional R&D. Particular emphasis should be given to funding innovation in applying AI to the RAN.

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:

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

The biggest barrier to adoption of Open RAN based systems is interoperability. Interoperability of Open RAN systems can be greatly improved via funding for test labs, and, by providing funding for automating elements of Open RAN manageability.

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

Much more investment is needed in interoperability testing with multiple vendors. While many mobile network operators are setting up their own interoperability labs, this is an area that can benefit from NTIA investment. In particular existing pre-competitive consortia should be funded to establish a *well-staffed*, *well-equipped* national interoperability lab for Open RAN which can offer a suite of interoperability certifications.

We do not have a single organization to recommend, but potential organizations could be Cellular Telecommunications Industry Association (CTIA), Telecom Infrastructure Project (TIP), Open Networking Foundation (ONF) and others such as Cable Labs.

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

Need funding of true multi-vendor testbeds. This is not an area that has attracted PE or VC to date. Incumbent MNOs have not signed on whole-heartedly to deploy ORAN.

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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?

See response to 7 above.

Questions on Integration, Interoperability, and Certification

Challenges associated with systems integration and component interoperability can hinder the adoption of open and interoperable, standards-based RAN. This section will help NTIA structure the NOFOs in a way that most effectively addresses these challenges and facilitates adoption. NTIA also welcomes feedback on the effectiveness of certification regimes in driving open and interoperable, standards-based RAN adoption.

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?

Yes, plugfests can work and have been shown to work. However, they need to be truly vendor neutral and there needs to be sufficient sustained funding for interoperability labs to be able to discharge their functions (see response to 7(c) as well).

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

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

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

YES - it is critical.

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

See 10 above.

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

The O-RAN standards do a good job of providing standardized interfaces to enable effective disaggregation of the RAN infrastructure. However, besides interoperability which we have addressed in the questions above - much attention needs to be given to improving the performance of O-RAN based systems. In addition to addressing the interoperability gap, addressing the performance gap is critical. In this regard, innovative applications of machine learning to all layers of the RAN stack can be a very effective tool to improve performance. This would not only enable the US to improve performance of the O-RAN stack, it would also allow the US to leap-frog the world in the applicability of ML to the RAN stack. Funding for innovative startups is essential to achieve this.

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

Certification works well (eg WiFi alliance), so does making available open source code base to reduce the barrier to commercialization for small companies.

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

NTIA should fund certification by identified entities above.

Questions on Trials, Pilots, Use Cases, and Market Development

A key aim of the Innovation Fund is to promote and deploy technologies that will enhance competitiveness of 5G and successor open and interoperable, standards-based RAN. We have seen a range of Open RAN trials, pilots, and use cases underway across the United States and internationally to date. This section will inform the types of NOFOs NTIA publishes and administers as the Department works to accelerate adoption.

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?

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?

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

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?

Questions on Security

Strengthening supply chain resilience is a critical benefit of open and interoperable, standards-based RAN adoption. In line with the Innovation Fund's goal of "promoting and deploying security features" to enhance the integrity and availability of multi-vendor network equipment, and Department priorities outlined in the National Strategy to Secure 5G Implementation Plan, this section will inform how NTIA incorporates security into future Innovation Fund NOFOs.

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?

a. What role should security reporting play in the program's criteria?

b. What role should security elements or requirements, such as industry standards, best practices, and frameworks, play in the program's criteria?

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

19. What role can the Innovation Fund play in strengthening the security of open and interoperable, standards-based RAN?

20. How is the "zero-trust model" currently applied to 5G network deployment, for both traditional and open and interoperable, standards-based RAN? What work remains in this space?

Questions on Program Execution and Monitoring

The Innovation Fund is a historic investment in America's 5G future. As such, NTIA is committed to developing a program that results in meaningful progress toward the deployment and adoption of open and interoperable, standards-based RAN. To accomplish this, we welcome feedback from stakeholders on how our program requirements and monitoring can be tailored to achieve the goals set out in 47 U.S.C. 906.

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?

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?

Small startups do not have the staffing to be able to participate in multiple industry bodies, consortia, and government bodies. Yet, much breakthrough innovation occurs in small startups while large vendors continue to push incremental changes to their product line.

If small startups were assured of a voice at the table, Aira would be glad to participate in the NTIA process.

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

NTIA should avoid funding consortiums that are intermediate brokers that dilute the impact of the funding by spreading the funds across their membership. We recommend that NTIA directly fund innovative companies to maximize the impact of the funds.

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).

Matching funds is another method by which large vendors corner government grants and funding programs. Often large companies have entire divisions dedicated to government projects, and those employees are offered part time as matching funds for government grants.

Thus the need for matching funding makes small innovative startups unable to compete for government grants. We recommend that NTIA should fund innovative start-ups directly.

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

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

YES

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?

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"?

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

Additional Questions

NTIA welcomes any additional input that stakeholders believe will prove useful to our implementation efforts.

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 focus of the program is Open RAN investment and commercialization, we would like to highlight that Open RAN will lead to innovation in the telecom infrastructure space.

The last few years have seen AI make a dramatic impact in a variety of domain areas, yet the application of AI/ML to 5G and 6G wireless networks remains nascent. Although some mobile network operators and telecom infrastructure vendors are applying AI/ML techniques and enhancements, as in other domains, investment by startups is typically needed for breakthroughs. In particular, techniques to apply AI/ML at the lower layers of the wireless networking stack are not being commercialized by incumbent infrastructure vendors.

Aira is one of very few companies in this space and is uniquely positioned to innovate and impact this space.

28. In addition to the listening session mentioned above and forthcoming NOFOs, are there other outreach actions NTIA should take to support the goals of the Innovation Fund?