

Open RAN for Rural Industries and Communities: the Rural Dimension of Innovation Fund Implementation

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Preface: This response addresses the opportunities and challenges of applying open RAN for rural industries and communities (e.g., digital agriculture and telehealth), and it emphasizes the importance of the rural dimension of the innovation fund implementation. It addresses questions on the Use Cases, Trials, Pilots, and Certification (Questions 11, 13, 14, 15 and 16), Technology R&D (Questions 2, 5, 6 and 8), Workforce Development (Question 3), as well as Program Execution (Questions 22 and 24). In what follows, we will note in bracket and green-colored text the specific questions addressed at different locations of this response.

Rural Opportunities and Challenges for Open RAN. To ensure that the Innovation Fund program meets Americans' *evolving* needs in the coming 5 – 10 years and beyond, we need to consider the unique context of open RAN technologies and applications:

- We are still at the early stage of open RAN development and deployment. Both the architecture and implementation of open RAN systems are expected to evolve continuously to reach the maturity of product use and to meet the needs of continuously evolving broadband applications (e.g., those envisioned for 6G and beyond). Therefore, there is the need for continuous R&D in open RAN and streamlined commercialization of R&D results in real-world use cases. In addition, the continuous evolution of open RAN poses the challenge of ensuring equitable access and adoption of latest open RAN technologies throughout America as they evolve.
- Major broadband challenges exist in rural America. The sparse population and unique industry use cases (e.g., digital agriculture) in rural regions call for rural-focused technology innovations that enable affordable, high-capacity broadband services. Given that innovators in urban regions such as Silicon Valley may lack first-hand experience and insight into unique rural use cases and may lack motivation to prioritize addressing rural needs due to the relatively smaller rural markets, empowering rural communities in open RAN innovations and rural applications is critical for ensuring that rural regions do not always lag behind in the access and adoption of fast-evolving open RAN and broadband services.
- Wireless is expected to become an integral element of rural broadband solutions. Novel high-capacity rural wireless systems are expected to reduce broadband cost by a factor of 10 or more (as compared with fiber-only solutions)³, and wireless is the only mechanism to connect mobile

¹ ARA wireless living lab: <https://arawireless.org/>

² Center for Wireless, Communities and Innovation (WiCI): <https://wici.iastate.edu/>

³ Hongwei Zhang, Yong Guan, Ahmed Kamal, Daji Qiao, Mai Zheng, Anish Arora, Ozdal Boyraz et al.,

ground and aerial vehicles in digital agriculture. In the meantime, many high-priority wireless applications (e.g., automated ground and aerial vehicles) are best tried first in the rural regions before their urban pilots. Therefore, rural-focused wireless and open RAN innovations will also help advance the frontiers of open RAN technologies in general, thus helping advance open RAN beyond rural regions too.

- Open RAN and telecom softwarization are such that major innovations in future-generations of wireless and broadband solutions will be driven by innovations in software systems. The emergence of open-source telecom software platforms (e.g., open-source SD-RAN and srsRAN platforms for 5G) further speeds up innovations and reduces barriers to innovation at the same time. Accordingly, different stakeholder communities (e.g., open RAN researchers, innovators, and end-users) can collaborate more closely to shape open RAN technology and services evolution, and rural regions can play an active role in open RAN innovation.

Recommendations for Innovation Fund Implementation. To address the challenges of open RAN R&D and commercialization while leveraging the opportunities in rural industries and communities, the Innovation Fund Implementation is recommended to pay special attention to the following aspects:

- Given that rural industries and communities provide a wide range of use cases for open RAN systems, the Innovation Fund Implementation shall support open RAN initiatives for unique rural use cases and the nurturing of organizations leading those initiatives. The National Science Foundation Platforms for Advanced Wireless Research ([NSF PAWR](#)) program has been supporting the development of the [ARA wireless living lab](#) to enable research, education, and innovation in rural-focused wireless technologies, and ARA has engaged broad public-private partners from the wireless industry and end-user communities. With ARA being the first-of-its-kind rural wireless testbed and led by Iowa State University [Center for Wireless, Communities and Innovation \(WiCI\)](#), an organization independent of specific industry groups, ARA can serve as an invaluable testbed for open RAN trials, pilots, certification, and adoption. **(Questions 11, 13, 14 and 15)**
- The current effort in open RAN has mainly focused on establishing the architecture framework and initial implementation platforms. Open RAN R&D is still needed to leverage the architecture to develop specific solutions for advanced services such as ultra-reliable, low-latency communications (URLLC) as required by 6G and beyond applications in digital agriculture and other rural industries. Rural-focused open RAN R&D shall also be pursued in the context of affordable, reliable, and high-capacity wireless middle-mile and last-mile solutions³ that are expected to become available in 3-5 years after their research and field-pilots in the ARA wireless living lab. Open RAN R&D can also leverage the ARA testbed to experiment with technologies of different technology-readiness-levels (TRLs) throughout the whole R&D life cycle. **(Questions 2, 5, 6 and 8)**
- Given the fast-paced evolution of open RAN technologies and applications, it will be important for open RAN deployment teams to collaborate with organizations leading open RAN technology research and innovation in planning, pilot, deployment and adoption as well as post-deployment

[ARA: A Wireless Living Lab Vision for Smart and Connected Rural Communities](#), ACM Workshop on Wireless Network Testbeds, Experimental evaluation and CHaracterization (WiNTECH), 2021

measurement and evaluation. This will help ensure that both the near-term broadband service needs and the long-term open RAN challenges and opportunities are considered in project execution, and that the independent post-deployment measurement and evaluation can provide insight and guidance on the spiral technology evolution, deployment, and adoption. NSF research and innovation facilities such as the [ARA](#) wireless living lab can help facilitate these collaborations, and the [WiCI Center](#) leading the ARA project also welcomes [collaborations](#) with the broad communities. **(Questions 16 and 22)**

- The fast-paced open RAN technology and application evolution requires the Innovation Fund Implementation program to consider digital equity in the long-term. In particular, we need to enable and empower rural regions to participate in and lead rural-focused open RAN innovation. Therefore, the Innovation Fund Implementation shall engage higher-education organizations such as the Iowa State University [WiCI Center](#) in education and workforce development that address the need for rural-focused open RAN technology innovators and users now and in the future. In addition, to leverage the benefits of both open-source and private industries, open RAN workforce development and R&D shall consider the development open-source ecosystems as well as general innovation ecosystems around rural-focused open RAN solutions. **(Question 3)**
- Given that university teams can be invaluable partners of open RAN projects in aspects such as R&D, workforce development, testbed and certification, and that it is difficult for academic teams to come up with matching fund, it will be critical for the Innovation Fund Implementation program to waive the matching fund requirements for university teams. **(Questions 22 and 24)**