The Role of Universities in O-RAN Workforce Development and Research

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O-RAN represents a significant opportunity to increase supply chain diversity and resilience, promote innovations, and benefit American consumers and American companies. This 2-page note responds to NTIA's notice (RFC) on the implementation of the Public Wireless Supply Chain Innovation Fund. **Specifically, this note responds to following three questions: Q3, Q8, and Q22.**

Question 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?

Response to Question 3.

O-RAN creates yet another dimension to technology training for students who would be part of tomorrow's workforce as well as industry personnel who comprise today's workforce. The importance of training cannot be understated. Unfortunately, there is a dearth of engineers who understand O-RAN, including among those who may have been building traditional, single-vendor RANs for many years. **Simply put, it is hard to achieve progress in developing O-RAN and building the US O-RAN ecosystem if the talent is unavailable.** This can only be quickly accomplished if a concerted effort develops the educational part of the O-RAN ecosystem.

Universities can play a critical role in educating both university students and industry personnel. Universities can educate students in the practices of modern RAN design and providing foundational research and research tools for industrial practice. O-RAN can revolutionize university training and research in the way that USRPs and open-source software have done in the research and education space. Furthermore, universities can also help the industry personnel develop O-RAN awareness and O-RAN expertise to accelerate O-RAN development and develop innovative solutions.

While creating funded projects in support of O-RAN workforce development, NTIA can consider the following key items.

1. **O-RAN Training and Associated Testbeds**. Develop O-RAN training courses with different technical depths that can be used for diverse types of audience and encourage development of educational materials such as labs, video tutorials, and textbooks. For example, a 1-hour course would be suitable for management and executives, a 1-day course would be suitable for people requiring more detailed knowledge of O-RAN, and an in-depth 2- or 3-day workshop would be most relevant for students doing research and engineers using and/or designing O-RAN products (e.g., people developing or using xApps and rApps). **Hands-on training on the implementation of O-RAN-compliant solutions is critical.** 5G O-RAN testbeds should be developed that enable hands-on learning for university students and practicing engineers. These testbeds often rely on inexpensive software-defined radios and/or radio simulators and open-source software for affordability and flexibility. There should be a community of developers sharing their knowledge and expertise (as we saw with the GNU software project, for example). In other words, don't rely on centralized infrastructure for a testbed; we should have many testbeds with standard software and common low-cost hardware platforms with researchers collaborating to help each other with their testbed developments.

2. **Tools for O-RAN Research and Development**. Create tools for O-RAN that allow for rapid prototyping xApps and rApps by students without having to go through unnecessary reams of code to modify O-RAN. Furthermore, develop testing tools for O-RAN so that students do not have to reinvent testing processes and that industry can harvest for testing or develop testing suites of their own. The university also helps develop the future O-RAN-savvy workforce that is ready to start contributing immediately upon hiring.

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?

Response to Question 8.

We envision two types of projects for 6G and future technologies.

Projects that fund 6G research for the 6G network architecture that meets expected 6G requirements including openness would be helpful. Such forward-looking architecture would ensure open interfaces while allowing both AI-based and non-AI-based innovations.

Projects that support universities, small companies, and technology experts to collaborate and to contribute to standards bodies such as the 3GPP and the O-RAN Alliance would also be highly productive to ensure US leadership in 6G while meeting the NTIA goal of an open and standards-based RAN.

Question 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?

Response to Question 22.

Since **universities can help build testbed infrastructure to (i) accelerate O-RAN development; (ii) provide hands-on training for students and professionals; and (iii) expand applications or use cases of O-RAN** due to a large pool of research resources consisting of professors and students, the project team should include at least one university for a class of NTIA-funded projects focusing on acceleration of O-RAN development and development of O-RAN use cases (e.g., xApps and rApps).

We further observe that the active involvement of universities helps with the workforce development issues. Additionally, the universities can address some of the fundamental issues that industry tends not to address. Universities can be viewed as excellent venues to do research cost effectively. Finally, universities widely distribute their results, significantly increasing O-RAN awareness and expertise.