Open RAN Policy Coalition
January 27, 2023

Before the
DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration
Washington, DC 20230

In the Matter of	)	
	)	
Public Wireless Supply Chain Innovation Fund Implementation	)	Docket No. 221202-0260
	)	RIN 0693-XC05
	)	

COMMENTS OF THE OPEN RAN POLICY COALITION

The Open RAN Policy Coalition ("ORPC" or "Coalition") appreciates the opportunity to respond to the National Telecommunications and Information Agency's ("NTIA's") request for comment ("RFC") on implementing the Public Wireless Supply Chain Innovation Fund ("Wireless Innovation Fund" or "WIF").[1]

I. INTRODUCTION.

The Wireless Innovation Fund is a critical linchpin in the combined once-in-a-generation broadband and technology infrastructure investments under NTIA's stewardship. Enhancing interoperability and diversity throughout communications network supply chains will foster innovation, drive competition, and bolster resiliency in ways that augment and amplify the goals of related programs under the CHIPS Act and the Infrastructure Investment and Jobs Act. This, in turn, will serve as a catalyst to accelerate open radio access network ("Open RAN") advances in the immediate near term and create scale as soon as possible. Therefore, time is of the essence, and ORPC urges NTIA to fund key projects as soon as possible this year.

ORPC shares the goals of expanding access to broadband and fostering innovation; these goals are at the heart of the Coalition's core mission. Communications network operators and suppliers formed ORPC to support policies and initiatives that will advance the adoption of open and interoperable solutions in the wireless RAN to promote innovation, spur competition, and expand the supply chain for advanced wireless communications technologies. Coalition members represent a cross-section of the wireless communications industry, ranging from network operators to network solutions providers, systems integrators, cloud providers, edge device manufacturers, test laboratories, and others. For years, ORPC and its members have assiduously advocated for the enactment of this $1.5 billion investment and to bring national focus to what is ultimately a global imperative: standardizing and driving market-led development and adoption of open and interoperable network interfaces to invite more competition and optionality into the

[1] Public Wireless Supply Chain Innovation Fund Implementation, 87 Fed. Reg. 76182 (Dec. 13, 2022), https://www.federalregister.gov/documents/2022/12/13/2022-26938/public-wireless-supply-chain-innovation-fund-implementation.

broadband marketplace, expand access to broadband, and provide a foundation for rapid innovation and deployment going forward without delay.

With targeted funding in the immediate near term, the Wireless Innovation Fund can promote a virtuous and continuous cycle of innovation, design, testing, and trial/pilot deployments, proofs of concept, and commercial deployments. Rather than distinguishing between these phases, NTIA should seek out opportunities to help stakeholders invest in ecosystem developments that provide the full ecosystem – from operators to vendors to developers – the market-based framework to deploy commercial Open RAN networks at scale as soon as possible. This would promote ongoing innovation of commercial deployments iteratively over time as the ecosystem develops the cost-effective replacement to traditional RAN.

ORPC also cautions against the creation of significant bureaucratic "red tape" that would slow deployment, innovation, and new high-skilled jobs. Again, it is crucial to accelerating Open RAN advances that this funding is disbursed as soon as possible.

Based on its members' industry experience, ORPC also makes certain observations about the state of Open RAN deployment and recommends potential ways in which the WIF could, through targeted and strategic grants, help drive and accelerate the commercial deployment of Open RAN at scale in the United States and other key markets so that it will be a competitive option immediately in 5G deployments, which will also have benefits for the longer term future for 6G next generation development cycle globally. NTIA should expedite WIF investments in order to affect 5G deployments in the near future and to get ahead of next-generation developments; NTIA should not delay funding 5G deployments to wait for 6G.

To that end, these comments provide below:

- Recommendations for program execution and collaboration to achieve NTIA's goals;
- An overview of the state of the Open RAN industry;
- Discussion regarding technology development and standards;
- Analysis of challenges and opportunities in integration, interoperability, and certification;
- Perspectives regarding trials, pilots, use cases, and market development; and
- Suggestions regarding next steps to bolster the security of Open RAN networks.

II. TARGETED RECOMMENDATIONS FOR SUCCESSFUL PROGRAM EXECUTION AND COLLABORATION.

As discussed throughout these comments, the Open RAN community is driving towards a vibrant, competitive market, poised to foster innovation throughout communications networks and the technologies that rely on them. NTIA has a unique opportunity to supercharge the development of this market through targeted grants that help address technology gaps, spur demand for Open RAN products, support development of a skilled workforce, and promote widespread interoperability. As NTIA drafts the Wireless Innovation Fund Notice of Funding Opportunity ("NOFO"), it should:

- Prioritize projects that will broadly benefit the competitive Open RAN ecosystem for 5G, 6G, and future generations of wireless technology;[2]

- Create incentives that drive industry cooperation and alignment on initiatives that will create efficiencies and scale, with attention to end-to-end testing and commercial deployment environments;[3]

- Encourage the findings/product/results of WIF-supported projects to be made widely available;

- Complement private investment in Open RAN solutions, integration, and commercial deployment on a timeline that is conducive to near-term advances, including for innovative small businesses and start-ups;[4]

- Ensure that global entities are eligible for grants so long as the direct funding from the grant is targeted at diversifying the global Open RAN ecosystem, including through spending on research, testing, demonstrations, trials, and commercial deployment acceleration in the United States;[5]

- Consider the complementarity of projects (i.e., opportunities for multiple projects to augment each other);[6]

- Consider the full range of activities needed to spur innovation and commercial deployment (including R&D, lab coordination/certification, technical skills, international coordination, etc.);[7]

- Prioritize funding projects which clearly develop products or offerings with a path to commercial deployment and impact on key Open RAN competitiveness metrics;[8] and

- Prioritize funding projects in 2023 that will accelerate Open RAN commercial deployments as an increasingly competitive option for remaining 5G builds, and to benefit the longer-term future for next generation development.[9]

[2] Public Wireless Supply Chain Innovation Fund Implementation, Questions #8-9.

[3] Public Wireless Supply Chain Innovation Fund Implementation, Questions #9-10, 23.

[4] Public Wireless Supply Chain Innovation Fund Implementation, Questions #4, 24

[5] Public Wireless Supply Chain Innovation Fund Implementation, Questions #22, 25(a)-(b).

[6] Public Wireless Supply Chain Innovation Fund Implementation, Questions #1(b), 10, 14, 21.

[7] Public Wireless Supply Chain Innovation Fund Implementation, Question #14.

[8] Public Wireless Supply Chain Innovation Fund Implementation, Questions #13, 21.

[9] Public Wireless Supply Chain Innovation Fund Implementation, Questions #13, 25.

NTIA should avoid conditions or requirements that will unnecessarily delay or exclude beneficial projects that can meaningfully accelerate commercial deployment in the short term. For example, NTIA should not require matching contributions.[10] While NTIA can encourage matching contributions by grant applicants, NTIA should not require matching contributions, either monetary or in-kind, as such requirements present barriers to small businesses and non-profits. NTIA should also clarify how matching contributions will be considered in line with the language from section 9202(a)(1)(D) of the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021 that states: "[t]o the greatest extent practicable, the Secretary, acting through the NTIA Administrator, shall ensure that any research funded by a grant awarded under this paragraph avoids duplication of other Federal or private sector research."[11]

NTIA should continue to facilitate robust stakeholder engagement throughout the development and implementation of the Wireless Innovation Fund.[12] First, ORPC suggests that NTIA hold at least one additional listening session after commenters submit their responses to the RFC and before the NOFOs are released to allow NTIA to ask questions or answer questions raised by the comments that may influence the NOFO. There are additional topics not covered by this RFC that commenters may wish to raise, including grant evaluation criteria, period of performance, and certain statutory provisions. This will also provide an opportunity for NTIA and participants to discuss information presented in the comments that may have varying views. Second, because this is a new grant program, applicants will appreciate the opportunity to ask questions during webinars once the NOFOs are released. If the NOFOs are distinct in the type of projects that may be funded, a webinar covering each NOFO may be warranted. As with other NTIA funding programs, an FAQ website covering the NOFOs and grant process would be helpful, including a mechanism to submit questions and receive answers in a timely manner before grant application deadlines.

III. THE OPEN RAN INDUSTRY IS GROWING AND SEES KEY OPPORTUNITIES FOR ACCELERATION.

In the spring of 2021, the Coalition described the state of the Open RAN industry at an inflection point of increasing offerings and deployments.[13] Two years later, we now see steady progress in the Open RAN ecosystem, with the possibility of exponential growth resulting from targeted Wireless Innovation Fund investments.

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[10] Public Wireless Supply Chain Innovation Fund Implementation, Question #24.

[11] William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021, H.R.6395, 116th Cong., § 9202(a)(1)(D) (2021).

[12] Public Wireless Supply Chain Innovation Fund Implementation, Question #28.

[13] *See* Comments of the Open RAN Policy Coalition, GN Docket No. 21-63 (Apr. 28, 2021), https://www.openranpolicy.org/wp-content/uploads/2021/04/ORPC-FCC-NOI-Comment-Final-4-28-21-c3.pdf; Reply Comments of the Open RAN Policy Coalition, GN Docket No. 21-63 (May 28, 2021) ("ORPC Reply Comments"), https://www.openranpolicy.org/wp-content/uploads/2021/06/ORPC-Open-RAN-NOI-Reply-Comment-Letter-as-filed-May-28-2021-c3.pdf.

A. Technical Advances and Notable Deployments.

Over the last two years, the industry has made significant strides and achieved several key milestones, including:[14]

- The O-RAN Alliance has expanded to include membership of more than 330 companies and institutions. In addition, the O-RAN Alliance has published 53 new technical specifications since July 2022, and in October 2022 announced a further alignment with Telecom Infra Project ("TIP") on value propositions and deliverables.[15]

- TIP grew to 650 participants in 2022, including over 100 service providers, 90 vendors and OEMs, and over 120 integrators, infrastructure providers, and system aggregators. This community has helped deliver over 150 trials and deployments across nearly 50 countries.

- On public networks:
    - As of December 2022, DISH has deployed over 15,000 cell towers using Open RAN and is adding new cell towers to its network at the rate of 1,000 per month.[16]
    - In April 2020, Rakuten Mobile launched the world's first commercial cloud-native Open RAN network, which now has over 56,848 cell sites and covers 98% of the population in Japan, meeting coverage and capacity targets and growing its commercial customer base.
    - The new fourth mobile network operator in Germany, 1&1, partnered with Rakuten Symphony to roll out a network with the objective to be the first in Europe to deploy nationwide using Open RAN.
    - Deutsche Telekom ("DT"), as the co-founder of O-RAN Alliance, is fully committed to deploying an Open RAN network and is preparing for a commercial rollout during 2023/24 in Germany. In 2021/22 DT conducted a friendly user trial in "O-RAN Town" in Neubrandenburg using a truly multi-vendor O-RAN-based solution. Europe's first multi-vendor massive multiple-input multiple-output ("Massive MIMO") capability was demonstrated in O-RAN Town.

[14] Public Wireless Supply Chain Innovation Fund Implementation, Questions #2, 14.

[15] Press Release, O-RAN Alliance, *O-RAN ALLIANCE Announces New Leadership, New Specifications, 3 Face-to-Face Meetings in 2023 and Further Alignment with TIP* (Nov. 16, 2022), https://assets-global.website-files.com/60b4ffd4ca081979751b5ed2/637528b1911d4e358a523aa6_O-RAN.EC.2022-11-16.O-RAN%20New%20Leadership%2BSpecifications%2BF2F%20Meetings%20in%202023%2BAlignment%20with%20TIP.pdf.

[16] Mike Dano. *Looking ahead: Why 2023 should be a big year for Dish*, Light Reading (Dec. 20, 2022), https://www.lightreading.com/open-ran/looking-ahead-why-2023-should-be-big-year-for-dish/d/d-id/782117.

- Vodafone is building Europe's first commercial Open RAN network. The company announced the deployment of the UK's first Open RAN site in January 2022 and has committed to building 2,500 sites across the UK.[17]

- In March 2022, the Department of Defense awarded Hughes Network Systems an $18 million contract to deploy a standalone Open RAN 5G network at Naval Air Station Whidbey Island in Washington, with DISH Wireless providing spectrum for the network.[18]

- Telefónica is in the process of conducting Open RAN pre-commercial trials in Spain, Germany, the UK, and Brazil, and in November 2022 announced a goal of reaching 50% radio network growth based on Open RAN by 2025.[19]

- Since 2021, Samsung has partnered, separately, with Vodafone UK[20], NTT DOCOMO[21], KDDI[22], and DISH[23] to provide Open RAN solutions as a primary vendor for their 5G deployments. In addition, Samsung has provided Open RAN radios and baseband units for Verizon's[24] vRAN deployment since 2018.

- In the fall of 2022, Vodafone and Nokia announced joint work in cooperation with Marvell to enable the Open RAN system in Europe to reach functionality and performance parity with traditional mobile radio networks.

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[17] Press Release, Vodafone, *Vodafone switches on UK's first 5G Open RAN site* (Jan. 21, 2022), https://www.vodafone.com/news/technology/5g-open-ran-first-uk-site; Vodafone, Open RAN – all you need to know, https://www.vodafone.com/about-vodafone/what-we-do/technology/open-ran (last visited Jan. 27, 2023).

[18] Masha Abarinova, *Hughes wins $18M private 5G contract with U.S. Navy*, Fierce Wireless (Mar. 21, 2022), https://www.fiercewireless.com/private-wireless/hughes-wins-18m-private-5g-contract-us-navy; Stephen Bye, *DISH Wireless Delivers Agile and Secure 5G Connectivity to DoD*, DISH Wireless (June 22, 2022), https://www.dishwireless.com/blog_defense.

[19] Bevin Fletcher, *Telefónica, NEC scaling 4 open RAN pilots to 800 sites*, Fierce Wireless (Sept. 15, 2021), https://www.fiercewireless.com/operators/telefonica-nec-scaling-4-open-ran-pilots-to-800-sites; Press Release, Telefónica, *Telefónica and NEC to build Open RAN live pilots in 4 global markets as a key milestone toward mass deployment* (Nov. 14, 2022), https://www.telefonica.com/en/communication-room/telefonica-and-nec-to-build-open-ran-live-pilots-in-4-global-markets-as-a-key-milestone-toward-mass-deployment/.

[20] Press Release, Samsung, *Samsung to Bring Open RAN to Europe with Vodafone UK* (June 14, 2021), https://www.samsung.com/global/business/networks/insights/press-release/0611-samsung-to-bring-open-ran-to-europe-with-vodafone-uk/.

[21] Press Release, Samsung, *Samsung Collaborates With NTT DOCOMO on 5G* (Mar. 22, 2021), https://news.samsung.com/global/samsung-collaborates-with-ntt-docomo-on-5g.

[22] Press Release, Samsung, *KDDI Successfully Turns On the World's First 5G Standalone Open RAN Site Powered by vRAN in Japan* (Feb. 18, 2022), https://www.samsung.com/global/business/networks/insights/press-release/0216-kddi-successfully-turns-on-the-worlds-first-5g-standalone-open-ran-site-powered-by-vran-in-japan/.

[23] Press Release, Samsung, *DISH Wireless Selects Samsung Electronics for 5G Open Radio Access Network Rollout* (May 3, 2022), https://www.samsung.com/global/business/networks/insights/press-release/0502-dish-wireless-selects-samsung-electronics-for-5g-open-radio-access-network-rollout/.

[24] Press Release, Samsung, *Samsung Selected as a 4G LTE Open RAN Provider on Verizon's 4G LTE Network* (Feb. 22, 2018), https://news.samsung.com/us/samsung-4g-lte-open-ran-provider-verizons-4g-lte-network/.

  - NTT DOCOMO of Japan has deployed over 20,000 Open RAN 5G base stations in Japan covering over 10 million subscribers. In February 2021, it established a 5G Open RAN Ecosystem with twelve global vendors in order to promote the dissemination of Open RAN globally.

  - DeepSig uses artificial intelligence and machine learning to improve radio signal processing in 5G networks, including through intelligent base stations that will improve the efficiency, latency, and reliability of network applications. In December 2021, DeepSig completed the world's first AI-Native 5G over-the-air telephone call, featuring a commercial 5G handset and 5G standalone network to data services on the public internet.[25]

  - NEC has been a major supplier of Open RAN radio units and a leading global systems integrator supporting Open RAN network deployments and projects with NTT DOCOMO, Rakuten Mobile, 1&1 Drillisch, Vodafone, Deutsche Telekom, and Telefonica, among others. In addition, NEC has been a leading participant in public-private partnerships to accelerate Open RAN, supporting UK Government's NeutrORAN project and Government of NSW, Australia's Open RAN pilot program.[26]

  - In the past five years, Mavenir has announced over 100 Open RAN developments and deployments in the U.S. and globally.[27]

- On private networks, several verticals such as airports, air space, and manufacturing are deploying Open RAN technologies: Gogo is using Open RAN for its Air to Ground 5G connectivity to airplanes;[28] airports (including Bonn and Frankfurt) are using Open RAN

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[25] Press Release, DeepSig, Inc., *DeepSig Achieves Industry's First AI-Native 5G Call* (Dec. 15, 2021), https://www.businesswire.com/news/home/20211215005155/en/DeepSig-Achieves-Industry%E2%80%99s-First-AI-Native-5G-Call.

[26] Press Release, NEC, *NEC to jointly develop RIC for advanced operations of Open RAN with NTT DOCOMO* (June 22, 2021), https://www.nec.com/en/press/202106/global_20210622_02.html; Press Release, NEC, *Rakuten Mobile and NEC Partner to Promote Open RAN in Global Telecom Markets* (May 18, 2021), https://www.nec.com/en/press/202105/global_20210518_02.html; Anne Morris, *Germany's United Internet goes down Rakuten route with plan to build 5G network based on open RAN*, Light Reading (June 22, 2020), https://www.lightreading.com/open-ran/germanys-united-internet-goes-down-rakuten-route-with-plan-to-build-5g-network-based-on-open-ran/d/d-id/761857; Press Release, NEC, *Vodafone names NEC as a key partner for 5G massive MIMO radio units supporting commercial deployment of Open RAN in the UK* (June 15, 2021), https://www.nec.com/en/press/202106/global_20210615_02.html; Press Release, NEC, *NEC and Mavenir collaborate with Deutsche Telekom for a live 5G Open RAN mMIMO deployment at O-RAN Town in Germany* (June 29, 2021), https://www.nec.com/en/press/202106/global_20210629_03.html; Press Release, NEC, *Telefónica and NEC to build Open RAN live pilots in 4 global markets as a key milestone toward mass deployment* (Sept. 14, 2021), https://www.nec.com/en/press/202109/global_20210914_01.html; Press Release, NEC, *NEC participates in the UK Government-led 5G Open RAN trial program with the NeutrORAN testbed* (Nov. 30, 2020), https://www.nec.com/en/press/202011/global_20201130_02.html.

[27] Mavenir, Asset & Resources Report List, https://www.mavenir.com/report-list/?cat=7&type=press-releases (last visited Jan. 27, 2023).

[28] Press Release, Gogo Business Aviation, *The Gogo 5G Network is Nationwide* (Oct. 17, 2022), https://business.gogoair.com/news/2022/10/gogo-completes-5g-network/.

for their private networks;[29] ports (including Wismar, Germany, and Bristol, U.K.) are using Open RAN;[30] manufacturer and warehouse networks like Betacom are also using Open RAN.[31]

- In addition, numerous 5G testbeds in the U.S. utilize commercial network components to conduct application-driven research, including those designated by the Department of Defense at select military bases beginning in 2020. These testbeds leverage traditional commercial network components for application-driven research. However, they were built to support testing of specific network-enabled use cases and are not broadly capable of supporting advanced Open RAN research, which requires an open, flexible, and fully configurable environment. The U.S. facilities that do support advanced Open RAN research overwhelmingly exist at academic institutions, but often have limited operational capacity for serving customers with distinct support requirements.

- Vendor-neutral testbeds, such as the O-RAN Alliance Open Testing and Integration Center ("OTIC") hosted by Kyrio, provide end-to-end testing, interoperability testing, and conformance testing to any interested vendor. While this capability became available in the United States just last year, it is a significant step towards progress of the Open RAN ecosystem through well-organized testing and integration.

- Additional efforts include NTIA's 5G Challenge. In 2022, CableLabs and Kyrio hosted the 5G Challenge and provided testing capabilities and expert resources to achieve NTIA's goal of advancing 5G interoperability towards true plug-and-play operation. This work will continue in 2023.

Building on this foundation, the Wireless Innovation Fund is designed to accelerate deployment and fill in gaps to advance deployment activities in the United States and other key markets. To achieve a meaningful impact on Open RAN innovation and deployment, NTIA must promote a globally scaled market rather than the U.S. only.[32] The U.S. and its partners are best served by a robust and resilient global marketplace, large enough to support the diversity of trusted suppliers that U.S. carriers and next-generation networks will need in the future.

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[29] *Cologne Bonn Airport and NTT collaborate on 5G network project*, Airport Technology (May 26, 2021), https://www.airport-technology.com/news/cologne-bonn-airport-ntt/.

[30] Press Release, COCUS, *Seaport Wismar & COCUS make 5G portable* (Feb. 23, 2021), https://www.cocus.com/en/seaport-wismar-cocus-make-5g-portable/; West of England Combined Authority, *Exploring new ways for 5G to boost business*, https://www.westofengland-ca.gov.uk/what-we-do/innovation/5g-logistics/ (last visited Jan. 27, 2023).

[31] Press Release, Betacom, *Betacom Selected to Deliver One of US' First Indoor Private 5G Networks to Accelerate Manufacturing Innovation at The Digital Manufacturing and Cybersecurity Institute (MxD)* (May 24, 2022), https://www.businesswire.com/news/home/20220524005415/en/Betacom-Selected-to-Deliver-One-of-US%E2%80%99-First-Indoor-Private-5G-Networks-to-Accelerate-Manufacturing-Innovation-at-The-Digital-Manufacturing-and-Cybersecurity-Institute-MxD.

[32] Public Wireless Supply Chain Innovation Fund Implementation, Questions #22, 25.

B. NTIA Should Promote a Robust and Trusted Global Market That Leverages U.S. Innovation.

ORPC members recognize that Congress appropriated $1.5 billion of U.S. taxpayer money for the purposes of advancing the interests of the United States and its workers and companies. In the case of investments in Open RAN, this means promoting a global marketplace in which U.S. research and innovation thrive, U.S. manufacturing capabilities are robust, and U.S. operators have a diverse and competitive set of trusted suppliers from which to choose.[33]

This has not been the case in recent years, particularly with regard to RAN. Two decades ago, the United States had a vibrant ecosystem of wireless development led by U.S. companies that had strong ties to universities to develop and feed talent. In recent years, though, wireless and RAN technology supplier capabilities in the United States have been significantly reduced, with commensurate reductions of these disciplines in the research and development arenas. This is the problem that Congress sought to address in establishing the WIF, recognizing that Open RAN provides a unique opportunity to leverage U.S. strengths to promote a robust and trusted global market.

In practical terms, serving the interests of U.S. taxpayers will require WIF investments to be utilized by a wide variety of global operators, manufacturers, and research and development institutions. The interests of the United States and its companies and workers are best served by a robust and resilient trusted global marketplace of companies within the United States and in partner countries with deeply integrated technology markets that compete to develop and sell components and software for use at all layers of the network stack. A global trusted market will support the diversity of trusted suppliers that U.S. operators and the 5G market will need in the future, and also support the sales needs of U.S.-based suppliers. Further, efforts to promote a global market that encourages vendors based in both the United States and its global partners will not only advance competition and innovation but will also help ensure those partners themselves benefit from secure networks, satisfying another core U.S. national security interest.

Only a multinational, diverse vendor base of trusted suppliers will have the capacity to provision components and software capable of servicing the U.S. and other global partner countries' markets.[34] For instance, the total combined GDP and population of the markets in which there are existing Open RAN deployments, trials, or testing facilities is $55 trillion and 3.3 billion people, respectively, comprising 58.7 percent of global GDP and 42.6 percent of the global population. The "addressable market" that remains available for open and interoperable competitive RAN solutions is even larger than that. As President Biden stated in his February 24, 2021 *Executive Order on America's Supply Chains*, "close cooperation on resilient supply chains with allies and partners who share our values will foster collective economic and national security and strengthen the capacity to respond to international disasters and emergencies." As the ORPC has long argued, U.S. policy therefore should expressly promote a diverse, competitive collection of suppliers in the United States and other partner countries.

[33] Public Wireless Supply Chain Innovation Fund Implementation, Questions #22, 25.

[34] Public Wireless Supply Chain Innovation Fund Implementation, Question #5.

In the case of the WIF, this means that global entities should be eligible for grants so long as the direct funding from the grant is targeted at diversifying the global Open RAN ecosystem, including through spending on research, testing, demonstrations, trials, and deployment acceleration in the United States.[35] ORPC's expectation is that such funding for U.S. innovation will benefit the broader trusted global market and, in turn, both U.S. and allies' interests.

ORPC therefore strongly supports NTIA's role in the recent U.S. announcement, with Australia, Canada, and United Kingdom, on principles of telecommunications supplier diversity.[36] ORPC also commends NTIA for its recent Memorandum of Cooperation with Japan's Ministry of Internal Affairs and Communication on open, resilient telecommunications networks, which reiterates the countries' continued support for the development and adoption of Open RAN networks, including in the bilateral U.S.-Japan relationship and in multilateral settings such as Japan's 2023 G7 presidency, the Quad and the Indo-Pacific Economic Framework for Prosperity.[37]

Further, on a related topic, NTIA should seek to amplify the effect of its WIF investments by working with the State Department, USAID, and the Development Finance Corporation, in coordination with other governments, to maximize the benefits of the Multilateral Telecommunications Security Fund (now embedded in the International Security and Innovation Fund).[38] As noted, this ideally should mean that strategies are coordinated where possible with allied countries and strategic partners wrestling with how to manage non-technical risk from the current lack of supply chain diversity where governments elect to manage technical risk of untrusted vendors via exclusion. A number of ORPC members have participated in Commercial Law Development Program events aimed at raising awareness and providing education about the future benefits of a RAN built using open, interoperable, standards-based components. We see potential for these programs to be more effectively leveraged as part of a broader strategy that targets markets with characteristics identified as being markers of "Open RAN readiness" combined with milestones along the path to deployment, including MOUs and small-scale deployments.

IV. TECHNOLOGY DEVELOPMENT AND STANDARDS.

The Open RAN ecosystem has made significant strides in recent years to develop, test, and deploy technologies based on specifications for Open RAN. The authorizing statute mentions four entities in particular: the O-RAN Alliance, TIP, the 3rd Generation Partnership Project ("3GPP"), and the Open-RAN Software Community.

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[35] Public Wireless Supply Chain Innovation Fund Implementation, Question #22.

[36] *See* Press Release, NTIA, *Joint Statement Between the United States of America, Australia, Canada, and the United Kingdom on Telecommunications Supplier Diversity* (Dec. 8, 2022), https://ntia.gov/press-release/2022/joint-statement-between-united-states-america-australia-canada-and-united.

[37] *See* NTIA, *Readout of Deputy Secretary Graves' Meeting with Japan's Minister for Internal Affairs and Communications Takeaki Matsumoto* (Jan. 18, 2023), https://www.commerce.gov/news/press-releases/2023/01/readout-deputy-secretary-graves-meeting-japans-minister-internal.

[38] Public Wireless Supply Chain Innovation Fund Implementation, Questions #26.

3GPP is a standards development organization initially tasked with producing technical specifications and reports for a 3G mobile system in 1998, and has since evolved to address changes in radio access, core network, and service capabilities.[39] Founded in 2016, TIP is a global, community-based non-profit organization that convenes hundreds of member companies – from vendors to operators to system integrators – to develop, test, deploy, and accelerate the commercial adoption of open, disaggregated, and standards-based network solutions for all deployment use cases through test and system validation.[40] The O-RAN Alliance is a global multi-stakeholder coalition created in 2018 to devise detailed blueprints that enable a more competitive and vibrant RAN supplier ecosystem with faster innovation to improve user experience.[41] Finally, the Open RAN Software Community is a collaboration between the O-RAN Alliance and Linux Foundation started in 2019 with the mission of supporting the creation of software for the RAN that addresses challenges in performance, scale, and 3GPP alignment.[42]

A. NTIA Can Facilitate Standards and Technology Development Through Targeted Investments in Widely Accessible End-to-End Testing Environments.

To unlock the full potential of Open RAN for 5G and next-generation networks, the ecosystem needs additional resources to make it easier for more players (e.g., application developers; hardware, software, and platform suppliers; and network integrators) to participate in both basic and applied research and development, and to deliver innovations that meet the greatest challenges of next-generation wireless connectivity.[43] Today in the United States, numerous labs and testbeds support wireless testing and research. Still, some network operators and the R&D community (industry-, university-, and government-led) voice concerns that few of these facilities – outside of closed vendor and mobile network operator ("MNO") labs and the recently designated OTICs – can perform end-to-end Open RAN testing.[44] Further, the National Spectrum Consortium's Open RAN Advisory Group notes that additional Open RAN test and development platforms are needed to facilitate access for non-traditional telecom technology providers. [45] Additional coordination between and across labs and operators focused on live testing could help address this need.[46] Such an approach would leverage and make the most of existing facilities while also assuring that NTIA is not "kingmaking" by investing in a single lab environment. Instead, NTIA should strategically allocate resources to various labs and to various

[39] 3rd Generation Partnership Project, Introducing 3GPP, https://www.3gpp.org/about-us/introducing-3gpp (last visited Jan. 27, 2022).

[40] Telecom Infra Project, About Us, https://telecominfraproject.com/who-we-are/ (last visited Jan. 27, 2023).

[41] O-RAN Alliance, About Us, https://www.o-ran.org/about (last visited Jan. 27, 2023).

[42] O-RAN Alliance, O-RAN Software Community (SC), https://oran-osc.github.io/#oran_sc (last visited Jan. 27, 2023).

[43] Public Wireless Supply Chain Innovation Fund Implementation, Questions #6, 14, 22

[44] Public Wireless Supply Chain Innovation Fund Implementation, Question #7(b).

[45] National Spectrum Consortium, *NSC Releases Executive Summary of Report on U.S. Resources and Capabilities for Accelerating Open RAN* (Jan. 24, 2022), https://www.nationalspectrumconsortium.org/2023/01/24/nsc_releases_executive_summary_01242023.

[46] Public Wireless Supply Chain Innovation Fund Implementation, Question #14.

smaller operators that can (i) test for Open RAN interoperability among multiple suppliers and (ii) support Open RAN 5G deployment where 5G does not already exist.[47]

In addition, NTIA could consider ways to assist private sector participation in Open RAN standards development, particularly through grants to entities that may be under-resourced, to enable them to participate in standards activities. NTIA and other federal agencies, including the State Department, should facilitate the development of Open RAN specifications and standards by (i) promoting participation in standards processes (including via financial support for costs and fees of such participation), and (ii) prioritizing processing of visa applications for standards meetings that are to be hosted in the United States.[48] In recent years international standards organizations have either refrained from hosting meetings in the United States to avoid members being unable to obtain U.S. visas in a timely manner or have had to move planned standards meetings in the U.S. for those reasons.[49] Holding standards meetings in the United States is an important element of demonstrating U.S. technology leadership globally.

B. NTIA Should Recognize the Nexus Between Workforce Development and Technology Advances.

The RFC seeks input on the effect of workforce constraints on the development and deployment of open and interoperable, standards-based RAN, such as Open RAN, asking for suggestions regarding how, if at all, the WIF can "help alleviate some of these workforce challenges."[50] ORPC recognizes and supports the Administration's extensive efforts to bolster workforce and technical skills development. Certain WIF funded projects may advance technical skills as a natural effect of project implementation, and NTIA should recognize and encourage this positive effect. Still, ORPC believes that the substantial workforce development funding in the CHIPS and Science Act is the most efficient use of funding for workforce and skills development, and we urge NTIA to coordinate with the National Science Foundation to maximize the impact of this funding. While WIF grants should generally benefit workers' technical skills, NTIA should prioritize the development of Open RAN in making decisions regarding grant applications and should not make workforce requirements a prerequisite to the approval of grants.

C. NTIA Should Fund Projects That Accelerate Open RAN Infrastructure Products, High-Demand Features, High-Performance Applications, Spectral Efficiency, and Promote Energy Efficiency.

a. Accelerate Supply of Open RAN Infrastructure Products.

O-RAN Alliance specifications compliant radio units ("RUs"), central units ("CUs"), and distributed units ("DUs") are fundamental building blocks for Open RAN networks. The market must offer a broad portfolio of RUs and CU/DU systems to meet carrier demands and create new

[47] Public Wireless Supply Chain Innovation Fund Implementation, Questions #9-10, 22.

[48] Public Wireless Supply Chain Innovation Fund Implementation, Questions #22, 26.

[49] Public Wireless Supply Chain Innovation Fund Implementation, Question #7(a).

[50] Public Wireless Supply Chain Innovation Fund Implementation, Question #3.

supply options to deploy Open RAN networks. Vendors must develop RUs for numerous spectrum bands in the United States (and for even more spectrum bands to support Open RAN networks in other countries). In particular, U.S. rural carriers serving large geographic areas with low population densities use several 4G bands that pose a business case challenge to develop RUs given the low volume demanded and bespoke needs of each. Additionally, operators will need to deploy different configurations of RUs. NTIA should consider projects that support development of RUs to create a broad portfolio of these critical elements of Open RAN networks.[51] In addition, vendors must continue to develop CU/DU systems to support a range of features and help create a stronger value proposition for Open RAN networks.

b. Accelerate High Demand Features, High-Performance Applications, and Spectral Efficiency to Drive Leadership in Next Generation Wireless.

5G networks – including, of course, Open RAN 5G networks – provide an excellent platform for innovation, value-creation, and next-generation wireless leadership for the U.S. and its partners. Open RAN wireless networks will help unlock and enable groundbreaking innovation in key use cases across the board, including defense, socio-economic, and life sciences sectors. These include extremely high throughput and low latency applications, including high-fidelity virtual reality and augmented reality (training, live simulation, telemedicine, industrial safety, etc.), enhanced automation and robotics in warehouses and factories, dense Internet of Things, and real-time video. Such applications require extremely spectrally efficient, high-performance wireless networks. Arguably, spectrum continues to be the most valuable and strategic asset for wireless networks. In addition to enabling demanding applications, spectral efficiency improvements would drive better return on investment, increase shared spectrum use by network operators, defense and enterprises, and strengthen the United States and its partners' positioning for next-generation wireless leadership.

A focus on high-performance, high-value application Open RAN projects could enable Open RAN to leapfrog closed RAN systems and create a virtuous cycle of economic value creation by leveraging a strong U.S.-led ecosystem of webscalers, application developers, software developers, and robotics companies. This would bolster technical skills development across the industry in the United States and among its partners.

Examples of high demand, high performance features and applications include the following:[52]

- RAN Intelligent Controller ("RIC")
- Location services
- Ultra-Reliable Low Latency Communications ("URLLC")
- Slicing
- RU
- Spectral efficiency improvement features

[51] Public Wireless Supply Chain Innovation Fund Implementation, Question #27.

[52] Public Wireless Supply Chain Innovation Fund Implementation, Questions #25, 27.

- Warehouse automation and Industry 4.0 applications
- High resolution virtual reality and augmented reality applications
- Vendor-neutral Network Management Systems and Operation Support Systems
- Artificial intelligence and machine learning
- Advanced Radio Resource Management
- Precision agriculture applications

Additionally, NTIA should support technology development into specific areas that drive Open RAN performance and competitiveness today, but which will also lead toward technology, intellectual property, and standards leadership and development in the U.S. for 5G Advanced and next generation networks on the international stage, for example, efforts funding the AI-Native Air Interface, Semantic Communications, Joint Sensing and Communications, and Distributed Massive MIMO.[53]

NTIA should also use the WIF as a catalyst by providing early financial support to enable open RU development where a large part of the R&D and manufacturing is done in the United States.[54] This investment can start with simpler radio products based upon the 7.2a open interface. Interoperability testing with ORAN compliant DU/CU can then be proven with this first set of products. NTIA should support investments in technology development for Massive MIMO, including projects related to silicon development, algorithms, and software.

Finally, cloud and network virtualization approaches are well utilized in other telecommunications applications and platforms, and these efficiencies are poised to play an even more significant role in Open RAN implementations, transformation, and innovation.[55] As is the case in 5G deployments today, Open RAN must be paired with cloud and network function virtualization capabilities to reach its full potential. Cloud technology can accelerate innovation. Open RAN security will depend on cloud, software, and server security. Cloud security is based on international security and risk management standards, coupled with unparalleled access to security telemetry and integrated artificial intelligence capabilities to prevent, detect, and respond to old and emerging threats across the network, and across the software and firmware supply chains.[56] Cloud technology, including edge computing, will enable scaling of Open RAN both up and down, to match requirement for public and private networks.[57] Service providers will need multi-cloud, multi-vendor management for Open RAN to be deployed.

c. Promote Energy Efficiency and System Performance

Projects that support the development of hardware or software reference designs can promote smaller form factors and better energy efficiency. This is particularly important for

[53] Public Wireless Supply Chain Innovation Fund Implementation, Question #8.

[54] Public Wireless Supply Chain Innovation Fund Implementation, Questions #25, 27.

[55] *See* ORPC Reply Comments at 5.

[56] Public Wireless Supply Chain Innovation Fund Implementation, Questions #17, 19.

[57] Public Wireless Supply Chain Innovation Fund Implementation, Question #6.

small cell deployments, specifically for Open RAN-compliant RU vendors and radio frequency component vendors. Examples of these types of projects include the following:[58]

- Rapid technology improvement in critical RAN edge network functions, such as performance in the RU and DU, which often constitutes 80% of network costs, such as improving air-interface capacity, energy efficiency, and costs to make Open RAN more competitive and pervasive.

- Design and development of O-CU, O-DU, and O-RU state-of-the-art silicon components that meet the power efficiency, security, bandwidth, reliability, and resiliency requirements of 5G and next-generation technologies.

- R&D of non-real-time RIC and near real-time RIC applications that comply with pertinent O-RAN Alliance RIC specs.

- Creation of over-the-air RU outdoor antenna test ranges or equipment to help test different suppliers' Open RAN RU solutions.

- Development of capabilities to improve Open RAN compliant RU and DU performance through new algorithms and software capabilities such as artificial intelligence and machine learning.

- Fully or massively automated Open RAN networks, which significantly reduce the need for service trucks to drive to cell sites for maintenance and provisioning purposes.

The Open RAN ecosystem recognizes that climate change represents an unprecedented challenge to our planet, society, and economy. The most recent survey of GSMA Intelligence clearly demonstrates that energy efficiency has become one of the most important criteria in the selection of RAN solutions. Open RAN products must not only meet the capabilities specified by the O-RAN Alliance and other industry standard forums but also improve performance, capacity, and security to ultimately improve energy efficiency during product use. This will make the world's wireless infrastructure more efficient and, by extension, reduce our collective impact on climate change.

Additionally, Open RAN chip development would improve system performance, programmability, and efficiency, providing benefits as follows:

- Next-generation wireless leadership – enabling American vendors to leap-frog current wireless technology and gain global leadership in the mobile network infrastructure market currently dominated by non-American companies (for instance, partnerships that demonstrate 5G enhancements or NextG software in partnership with silicon vendors and next-generation chip designs);[59]

[58] Public Wireless Supply Chain Innovation Fund Implementation, Question #27.

[59] Public Wireless Supply Chain Innovation Fund Implementation, Question #25.

- Spectral efficiency improvements – operators in the U.S. and its partner countries can increase network capacity, maximizing the return on spectrum investments by delivering higher levels of performance;[60]

- Investment protection – operators, governments, and enterprises benefit from next-generation networks that serve the most demanding mobile broadband and industry 4.0 needs for several years to come;

- Ultra-reliable coverage – wireless coverage that can reliably support millions of devices in an industrial environment;

- Application advancement – facilitating a new ecosystem of commercial and government applications and use cases; and

- Workforce development – incubating workers needed for developing and operating the new application ecosystem.[61]

V. INTEGRATION, INTEROPERABILITY, AND CERTIFICATION ARE IMPORTANT STEPPING STONES TO ACHIEVE WIDESPREAD OPEN RAN DEPLOYMENT AND ARE RIPE TARGETS FOR NTIA INVESTMENT.

In the market today, there is no sequential process for certifying Open RAN interoperability. Interoperability testing often happens during deployment when the operator requires interoperability. Even as operators play an important role in promoting interoperability and integration through deployment, the ecosystem will benefit from having open-source reference architecture, automation, and eventually formal certification for all aspects of ongoing lifecycle management.[62] Labs capable of providing such testing and certification will help operators verify interoperability.

To date, Open RAN stakeholders have invested considerable effort in standardizing open interfaces between disaggregated sub-systems and compliance testing of these interfaces at plugfests, proofs of concept, and limited field trials. While currently there is no industry process for certifying Open RAN systems, several groups have made significant contributions to establish assurances in the Open RAN ecosystem. For example:[63]

- TIP has done critical foundational work with its Open RAN Project Group and badging processes. The focus of the TIP Open RAN Project Group is to produce open and disaggregated products and solutions. The group, in cooperation with leading operators, vendors, systems integrators, and other stakeholders worldwide, seeks to harmonize requirements for open RAN solutions that comprise RUs, DUs, and CUs, as well as the RIC platforms and applications. TIP's process encompasses technical roadmaps, test and

[60] Public Wireless Supply Chain Innovation Fund Implementation, Question #25.

[61] Public Wireless Supply Chain Innovation Fund Implementation, Question #3.

[62] Public Wireless Supply Chain Innovation Fund Implementation, Question #11.

[63] Public Wireless Supply Chain Innovation Fund Implementation, Question #7.

validation activities, and the resulting listing of a range of deliverables in TIP Exchange, its marketplace, including blueprints, that receive "badges" signifying their maturity level. In 2022, TIP's Open RAN Project Group published the Open RAN Release 2 Roadmap, continuing to accelerate Open RAN toward commercialization. This roadmap harmonizes the prioritized operator requirements, including the five European Open RAN MoU signatories, with vendor's product readiness, categorized in key features and functions, mapping them into a series of minor releases over time.

- To facilitate the buildout of its 5G networks, DISH Wireless has entered into multi-year agreements with over 30 partners, including Mavenir, Rakuten Symphony, Amazon, Cisco, Dell, VMware, Nokia, Fujitsu, MTI, Intel, and Qualcomm.[64] By integrating hardware and software from multiple vendors, DISH has greater flexibility to optimize deployments, reduce radio costs, and increase spectral efficiency.[65]

- The O-RAN Alliance vets labs across the world to provide certification and badging of Open RAN equipment and components. An OTIC provides certification of conformance by equipment or a component to an Open RAN interface or reference design specification. An OTIC can provide badges for interoperability or end-to-end integration of a group of components or equipment that meet the requirements of O-RAN Alliance test specifications.

    - In August 2022, Kyrio became the first OTIC in the Americas providing this service to all interested vendors.

    - In December 2022, COSMOS, a National Science Foundation PAWR testbed which is run by an academic team from Rutgers University, Columbia University, and New York University Brooklyn, was designated as an OTIC under the sponsorship of AT&T and DISH.

- Several labs and testbeds have hosted Open RAN plugfests conducted by the O-RAN Alliance. These include TIP, CableLabs/Kyrio, and COSMOS, as well as POWDER, another National Science Foundation PAWR testbed based at the University of Utah and the University of New Hampshire Interoperability Lab.

These collective efforts have laid the foundations for Open RAN deployment, but the ecosystem must now focus on two key enablers to attain global mass-market adoption in the short-to-medium term: purchaser confidence and supply chain efficiency.

Today, there are only two OTIC labs in North America for small vendors to get their gear tested or for operators to vet vendors' offerings. Further, operators must integrate solutions

[64] Petition of Dish Wireless L.L.C. for Designation as an Eligible Telecommunications Carrier, WC Docket No. 09-197, at 2 (Nov. 29, 2021), https://www.fcc.gov/ecfs/document/112959216542/1.

[65] Comments of Dish Network Corporation, GN Docket No. 21-63 (Apr. 28, 2021), https://www.fcc.gov/ecfs/document/10428931000397/1.

themselves. As a result, the status quo is inefficient, resulting in delays, increased costs and a duplication of efforts.[66]

Recent Open RAN plugfests and demonstrations are a step in the right direction, but these tests and demonstrations largely require customized set-ups each time they are run, and available funding limits the types of equipment, processes, and personnel that can be maintained on an ongoing basis. These plugfests, and indeed even the U.S. OTIC facilities, have not yet certified Open RAN solutions as meeting commercial-grade performance and interoperability requirements in end-to-end testing.[67]

Effectively and sustainably solving these challenges requires coordination across the industry. The most efficient solution would be for the industry to align on a framework that (1) helps coordinate the entire roadmap and lifecycle process, from the pooling of requirements at an industry level to establishing a "marketplace" of commercial-ready products and solutions, and (2) creates a system release validation and certification process.[68]

Pooling these efforts would eliminate the need for each operator to conduct their own testing, thereby establishing supply chain efficiencies that currently only the single-vendor, closed system process provides and would accelerate the market by building consumer confidence that will result in scale and lowered costs. Moreover, a full certification system would break down barriers for entry for both new vendors and operators trying to get the benefits of open networks. This does not mean creating fully integrated solutions but rather blueprints that meet specified operator requirements and a process that tests, validates, and certifies products that will fit into that blueprint.[69]

Funding for U.S. labs providing technical resources to lead the integration activities between vendors and creating guidelines of standard configurations could speed up the process of reaching a "plug-and-play" level in the Open RAN ecosystem. This effort would translate to open libraries of configurations that any Open RAN vendor can embed in their systems to quickly interoperate with another vendor.[70]

NTIA should look favorably on grants that are aimed at solving these interoperability and certification needs. Specifically, NTIA can promote interoperability through supporting:[71]

- An at-scale, multi-vendor Open RAN test and development platform – leveraging existing investments, bolstering existing trusted global industry processes, and potentially taking advantage of resources at multiple locations – that allows innovators to

[66] Public Wireless Supply Chain Innovation Fund Implementation, Question #7, 12.

[67] Public Wireless Supply Chain Innovation Fund Implementation, Question #7, 9(a).

[68] Public Wireless Supply Chain Innovation Fund Implementation, Question #12.

[69] Public Wireless Supply Chain Innovation Fund Implementation, Question #11.

[70] Public Wireless Supply Chain Innovation Fund Implementation, Questions #8-10.

[71] Public Wireless Supply Chain Innovation Fund Implementation, Questions #8-10.

demonstrate Open RAN viability, prove system integration capabilities, and develop new features and functions within an Open RAN architecture.

- Additional and increased capacity of existing open interoperability multi-vendor labs that are accessible to vendors for interoperability testing and end-to-end certification.

- Certifying vendor compliance with O-RAN Alliance specifications and re-certification with new specification releases, i.e., conformance testing.

- Trials to promote true "plug-and-play" interoperability without any custom system integration work for the trial deployment. The participating vendors, and potentially operators, should agree to a specific profile/configuration (a.k.a. "blueprint") prior to trials and only use equipment previously tested and certified compliant to that profile/configuration in the trial. This should result in the trial deployment requiring little if any custom system integration work and being easily replicated in other trials and real-world deployments.

VI. TRIALS, PILOTS, USE CASES, AND MARKET DEVELOPMENT.

Stakeholders across the globe are participating in innovative trials, pilots, use cases, and joint efforts to develop the market for Open RAN. To achieve scale and scope, it is critically important that Open RAN products have commercial adoption in operator networks, as well as private and government/military networks, as soon as possible.

Interoperability testing and plugfests provide important opportunities to work out kinks and demonstrate compatibility but are most effective if designed to test components in a true interoperable multi-vendor environment.[72] Today, plugfests may be conducted between components from the same vendor that have been modified to satisfy a particular network operator. While these events will test the vendor components, it would only be for the purposes of a unique network operator, not for the purpose of deploying open, interoperable, and standards-based equipment.

To enable such testing, additional steps such as establishing a common set of test cases shared across Open RAN testbeds and developing automation tools for continuous integration, deployment, and testing are important.[73] Such steps can decrease time to market for functionalities and features of individual Open RAN sub-systems. Finally, testing and certification facilities and vendors should share learnings as contributions to O-RAN Alliance specifications in relevant industry working groups.[74]

Generally, the WIF should refocus its 5G funding away from academic trials and onto those applied projects that can accelerate and deliver on the 5G rollout, especially helping to accelerate small businesses and industry bringing new innovative products and Open RAN

[72] Public Wireless Supply Chain Innovation Fund Implementation, Questions #9, 14.

[73] Public Wireless Supply Chain Innovation Fund Implementation, Question #14.

[74] Public Wireless Supply Chain Innovation Fund Implementation, Question #14.

components to market through the trial process. ORPC members see several opportunities for funding in this area:[75]

- Proof-of-concept ("PoC") testing is necessary to advance commercial deployment. MNOs will still want to know that they will achieve the benefits of Open RAN in their specific operating environment. NTIA should ensure that the WIF directly supports Open RAN PoCs that lead to commercial deployments.

- On the public network side, we believe that rural and urban trials could bring many benefits alongside other such deployments already underway in the United States and elsewhere. An urban trial in the United States can bring insights due to unique traffic load and interference issues. Rural trials could provide insights given the different unique characteristics of such deployments (different geography and terrain, less traffic load, etc.). Likewise, several small-scale brownfield trial deployments in hubs across the United States would accelerate adoption. Such trials could be demonstrated concurrently in a variety of topographical and geographical areas.

- On the private network side, ORPC believes that funding should focus on developing key features for this market (e.g., location services, URLLC, QoS, RU, network slicing, etc.), simplifying integration in a multi-vendor architecture by creating standard configurations for the open interfaces.

VII. ADVANCES IN SECURITY.

A common issue raised about Open RAN is the security challenge created by shifting to a disaggregated or "open" environment. Some of the issues that are identified as being Open RAN security issues are common to any advanced next-generation wireless network where intelligence is moved to the edge and there is increased reliance on software, cloud, and virtualization. NTIA should ensure that any effort to assess and address issues pertaining to Open RAN security are specific to the notion of open, interoperable, standards-based, multivendor deployments separate and apart from those one might also find in a proprietary RAN architecture that leverages software, cloud, and virtualization as well.[76]

While there are certainly generic security risks such as malware, botnets, and other forms of attacks that are potential risks regardless of the underlying architecture, security controls exist in enterprise-grade security to meet the common challenges, and there are new capabilities enabled by 5G that will improve security both for traditional and Open RAN. At the same time, the benefits of innovation and supplier diversity in an open ecosystem will bring forward additional diverse security solutions to address potential threats and mitigate risk because of the ability to monitor, detect, prevent, and respond more quickly, especially in layers of the RAN not previously accessible such as near real-time air interface sensing.[77] In a closed proprietary RAN,

[75] Public Wireless Supply Chain Innovation Fund Implementation, Questions #8-9, 14.

[76] Public Wireless Supply Chain Innovation Fund Implementation, Questions #17, 19.

[77] Open RAN Policy Coalition, *Open RAN Security in 5G* (Apr. 2021), https://www.openranpolicy.org/wp-content/uploads/2021/04/Open-RAN-Security-in-5G-4.29.21.pdf.

the ability of the network operator to mitigate risk is limited because access to the proprietary features is limited. This, in turn, makes it difficult for the operator to monitor, detect, prevent, and respond quickly to threats targeted at the RAN.

As noted in the Enduring Security Framework's recent Open RAN assessment, security considerations with applications, open-source software, supply chain, and zero trust in Open RAN networks are largely consistent with the same concerns found in the information and communications technology ("ICT") industrial sector and Open RAN participants should adopt ICT best practices to mitigate these concerns. Since Open RAN leverages technologies found in 5G core networks, such as multi-vendor core network functions and 5G cloud infrastructures, any Open RAN networks would benefit from following the best security practices applied today in 5G specifications, deployments, and operations. As Open RAN brings new capabilities with an xApps/rApps application frameworks and AI/ML technology, it must confront similar security considerations to the ICT industrial sector regarding software application frameworks and AI/ML technology. Further, differing Open Fronthaul deployment scenarios for consumer, enterprise, and military applications will drive the required mitigations to meet the security objectives and Open RAN cost goals within the Open Fronthaul. Security considerations always emerge in new open systems aiming for improved cost, performance, and supply chain benefits. Open RAN shares these security considerations too, and, with continuing efforts by the Open RAN ecosystem, they can be overcome.[78]

Similarly, the FCC's Communications Security, Reliability, and Interoperability Council ("CSRIC") VIII found that some concerns exist in both Open RAN and closed, proprietary RAN and that Open RAN security considerations along most vectors (including applications, open-source software, supply chain, and zero trust) are consistent with those from the ICT sector. CSRIC VIII found that with the continued evolution of Open RAN, security and reliability continues to be addressed by appropriate standards groups such as O-RAN Alliance and 3GPP.[79]

Industry standards and customer requirements are critical for security and enhancing open competition. Supporting and contributing to organizations like the O-RAN Alliance is essential since these organizations are defining security requirements and interoperable interface APIs. A specific example is the security controls for the Open Fronthaul as defined in O-RAN's WG11.

The "zero-trust model" is also critical to the long-term security posture of RAN.[80] The O-RAN Alliance WG11 has been defining security standards based on the "zero-trust model." Work is still ongoing in 15 areas: Security Testing, O1, Fronthaul C/U/S-Plane, SW Bill of Materials, Near RT RIC, Non-RT RIC, O-Cloud, Shared O-RU, Certificate Management, App

[78] CISA & NSA, *Open Radio Access Network Security Considerations*, at 4 (Sept. 2022) https://media.defense.gov/2022/Sep/15/2003077576/-1/-1/0/ESF_OPEN_RADIO_ACCESS_NETWORK_SECURITY_CONSIDERATIONS.PDF.

[79] Communications Security, Reliability, and Interoperability Council VIII, *Report on Challenges to the Development of ORAN Technology and Recommendations on How to Overcome Them*, at 4 (Dec. 2022), https://www.fcc.gov/file/24520/download.

[80] Public Wireless Supply Chain Innovation Fund Implementation, Question #20.

LCM, Security Log, SMO, AI/ML, O-RU Centralized User Management, and Blockchain. Similar to ongoing advances in other standards processes, work continues in all the above areas.

VIII. CONCLUSION.

The Open RAN Policy Coalition and its members appreciate the opportunity to respond to NTIA's RFC on implementing the Wireless Innovation Fund, and we urge NTIA to begin funding key projects as soon as possible this year.

Respectfully submitted,

OPEN RAN POLICY COALITION

/signed/
Diane Rinaldo

January 27, 2023