Before the
NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION
Washington, DC

In the Matter of	)	
	)	
Public Wireless Supply Chain Innovation Fund	)	Docket No. NTIA-2022-0003
Implementation	)	
	)	
	)	

COMMENTS OF MAVENIR SYSTEMS, INC.

Mavenir Systems, Inc. ("Mavenir"), through its undersigned counsel, submits these comments in response to the National Telecommunications and Information Administration's ("NTIA") Notice and Request for Comments ("Notice") in the above referenced docket.[1] The Notice seeks comment on how NTIA should implement the Public Wireless Supply Chain Innovation Fund ("Innovation Fund"), as directed and appropriated by the *CHIPS and Science Act of 2022*[2] and authorized under section 9202(a)(1) of the *William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021*.[3] Specifically, this Notice welcomes comment on: (1) practical solutions to the key challenges posed by the adoption of open and interoperable, standards-based RAN ("Open RAN") and promoting vendor diversity; (2) recommendations for the types of projects that the Innovation Fund should support; and (3) the kinds of criteria that should inform how grants are awarded by NTIA.

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[1] "Public Wireless Supply Chain Innovation Fund Implementation," National Telecommunications and Information Administration, Notice (Dec. 13, 2022), https://www.federalregister.gov/documents/2022/12/13/2022-26938/public-wireless-supply-chain-innovation-fund-implementation ("Notice").
[2] Pub. L. 117-167, Div. A, Sect. 106, 136 Stat. 1392 ("*CHIPS and Science Act of 2022*").
[3] Pub. L. 116-288; 47 U.S.C. 906(a)(1) ("*2021 NDAA*").

I. BACKGROUND

a. Mavenir's Leadership in Open RAN Solutions

Mavenir is a U.S-headquartered supplier of end-to-end mobile network solutions for LTE and 5G with a U.S.-based owner.[4] Mavenir has been a pioneer and provider in the development and supply of virtualized platforms, already supplying many virtualized core elements to communications service providers in the United States for both LTE and 5G. Mavenir also works with over 250 Mobile Network Operators ("MNOs") in the United States and globally.

Mavenir has also been a leader in developing and deploying Open Radio Access Networks, including Open RAN, that are providing communications service providers more insight and security in their networks as compared to the traditionally "closed" proprietary RAN networks. Communications service providers adopting Open RAN will be able to compete at both a technical feature and commercial level, with more secure networks, as they will no longer be part of the same delivery and technical feature roadmap that is globally controlled by large foreign incumbent vendors.

b. Current Global Oligopoly in Marketplace

As noted by NTIA in the Notice, the 5G infrastructure market is highly consolidated.[5] From Mavenir's perspective, two vendors make up the majority of the global marketplace for U.S. allied countries. This lack of competition has resulted in a global oligopoly between two Scandinavian vendors – Ericsson and Nokia -- reducing supply chain resilience, resulting in a

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[4] Mavenir is primarily owned by affiliates of Siris Capital Group, LLC (Siris Capital), a private equity firm based in New York, New York. Siris Capital is a U.S. private equity firm founded in 2011 by Frank Baker, Peter Berger and Jeffrey Hendren with the mission of bringing new thinking and a unique approach to private equity investing in technology businesses. *See* https://siris.com/.

[5] Notice, at Section I.

single point of failure for both finished products and components, and increasing security risks.[6]

This oligopoly further contributes to higher prices for consumers, which exacerbates the digital

divide. It also makes it challenging for new, innovative U.S.-based companies to break into the

market as these new entrant suppliers are blocked from competing pricewise in the local U.S.

and global marketplace. These major equipment manufacturers essentially control the supply

chain and potentially control supplier participation in developing "open" competitive products

through their large volume purchase agreements. The lack of "open" competitive products

increases the national security risks of the United States. These risks are further compounded by

the current lack of financial support from the U.S. government to U.S. companies, which if put in

place, could enable U.S. companies to obtain competitive cost financing terms.

By enacting the *CHIPS and Science Act of 2022*, Congress has taken a monumental step

in accelerating the adoption of open, interoperable, and standards-based RAN. Mavenir believes

that the Innovation Fund, a $1.5 billion program, has the potential to create a more competitive

and diverse telecommunications supply chain that lowers costs for consumers and network

operators and strengthens the U.S. supply chain, which would, in turn, serve as a catalyst to

create scale that would result in a "big bang effect" to create competition, spur innovation and

increase U.S. jobs.

c. Differentiating "Open" Solutions in the Marketplace

Before launching into its comments, Mavenir would like to emphasize the distinction

between open and interoperable *external* interfaces, as specified by 3GPP or the O-RAN

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[6] "Open Architecture and supply chain diversity: securing telecoms into the future," *Mavenir Systems, Inc.*, White Paper (Jan. 2023) https://www.mavenir.com/resources/open-architecture-supply-chain-diversity-securing-telecoms-into-the-future/.

Alliance,[7] and open and interoperable *internal* interfaces. Some equipment vendors, such as Ericsson, claim that they are open on *internal* interfaces but not *external* interfaces. Such clarity is important in defining the type of solutions that should be supported by this program. All external interfaces should be specified and demonstrated as fully open – if they are not, then they should not be funded by this program.

Installing demonstrated open and interoperable, standards-based RAN can prevent vendor lock-in by facilitating competition. It is important to note that while an operator can purchase open and interoperable equipment from a single supplier, the operator still needs to ensure that the supplier demonstrates interoperability by having an equipment certification completed from that supplier or third party certification process. Furthermore, existing incumbents have been playing with words when promoting Cloud RAN/vRAN and Open RAN solutions and have promoted such solutions as "open." In fact, both these solutions are neither open nor interoperable. With Ericsson's defined Cloud RAN/vRAN, the interface between the radio unit ("RU") and the distributed unit ("DU") is proprietary, and their marketed Open RAN solution is open "internal interfaces," only allowing their own proprietary RU and software thereby restricting interoperability. An illustration of the difference between Cloud RAN/vRAN and Cloud-native true Open RAN can be found in the attached Appendix A. This funding program should not fund projects with communications service providers ("CSPs") or vendors that continue to restrict interoperability through proprietary interfaces or blocking interfaces that were designed to be Open such as the X2/Xn interface.[8]

II.   DISCUSSION

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[7] *See generally* "Publicly Available Specification (PAS); O-RAN Fronthaul Control, User and Synchronization Plane Specification v07.02," *ETSI*, Technical Specification (Sept. 2022), https://www.etsi.org/deliver/etsi_ts/103800_103899/103859/07.00.02_60/ts_103859v070002p.pdf.
[8] X2/Xn is required for demonstration of Open RAN with Brownfield networks.

In responding to the Notice, Mavenir, will focus its comments on: (1) the state of the Open RAN market; (2) Open RAN technology development and standards; (3) Open RAN integration, interoperability, and certification; (4) Open RAN trials, pilots, and uses cases; (5) Open RAN security; and (6) Innovation Fund execution and program monitoring.

a. State of the Industry

i. Major Challenges in Adopting and Deploying Open RAN (Question #1)

1. Vendor Lock-in

The major challenge for adoption and deployment of open and interoperable systems in the U.S. market is lack of adoption from the Tier 1 carriers that are vendor locked by the Scandinavian suppliers, who have formed the oligopoly described above. Other global markets are in differing stages of adoption and deployment but are essentially vendor locked because proprietary vendor RAN solutions are not interoperable. While opponents of the competition that open interfaces would bring may argue that most U.S. carriers are well into their deployment of 5G, such that bringing new suppliers is not practical, the reality is that the wireless market is continually evolving such as with 5G Standalone ("SA"), new spectrum, new market segments such as Fixed Wireless Access ("FWA"), and solutions for underserved markets that would allow for the deployment of open and interoperable solutions to be introduced. A figure, attached in Appendix B, demonstrates the current level of global adoption and includes a summary of global government funding initiatives of Open RAN.

2. Inability to Interoperate

It should also be noted that the features in 3GPP such as the X2/Xn interface, which allows interconnectivity of different LTE base stations (i.e., "gNB") vendors and was designed to be an open interface, has been deliberately and artificially kept closed, presumably for

commercial gain of the industry leaders and against the wishes of the CSPs. This, along with proprietary front haul interface, has prevented new vendors from entering the market. It is also worth noting that even the existing vendors are unable to interoperate amongst themselves and that geographic monopolies exist throughout the United States and most countries using both trusted and untrusted vendors.

Carrier aggregation is also another situation where it has been uniquely specified by the vendors and needs to be addressed as an open interface. U.S.-funded specification and standards groups (such as ATIS) need to ensure that standards are developed to be both open and interoperable. A figure, attached in Appendix C, shows how to ensure X2/Xn and Carrier Aggregation interoperability. Carrier aggregation will benefit regulators and users with better user experience and give CSPs the flexibility to add new spectrum without being constrained by their incumbent vendor roadmaps. In addressing funding for U.S. standards affiliation, U.S. representatives of those bodies should be from U.S.-headquartered companies rather than representing non-U.S. headquartered companies that act as gatekeepers to ensure continuation of an oligopoly.

3. Scale

It is Mavenir's experience that delivering networks at scale is also a requirement for adoption and deployment of Open RAN to achieve volume-based pricing that is competitive with incumbents. Adoption by the Tier 1 carriers in the U.S. and globally is needed to ensure volume-based pricing and should be the first consideration in the development of projects for inclusion in this funding.

There are many different terms now being used across the industry, but the terms "Greenfield" and "Brownfield" are being used to try to competitively differentiate the

performance and capability of a vendor- and operator-deployed Open vRAN solution, which adds confusion to the marketplace. "Greenfield" deployments are brand new deployments where the network is built from ground up. "Brownfield" deployments are built on existing systems, and therefore need to interoperate with existing systems. The vDU/vCUs that are available today support high-capacity features of 4G/5G, irrespective of whether it is a Greenfield or Brownfield deployment. Again, keeping the X2/Xn interface closed blocks further Brownfield integration.

Today, Open RAN RRU/vDU/vCU solutions are being tested under load for capacity and performance. System test, performance, and stability are also being tested. As a part of these tests both in the laboratory and in the field, Open vRAN performance is shown to be equal to and in some cases, exceed that of existing incumbent vendors. The Open RAN industry will add advanced features and vendors will compete on differentiated vDU/vCU solutions. It is expected that the O-RAN Alliance and other organizations will continue to standardize interfaces that enable more advanced features in an open environment. Thus, allowing companies such as Intel, Qualcomm and Mavenir to implement advanced vDU features on standard server hardware. Operators will be able to upgrade software and processor technology for more capacity and features as they add customers, akin to a Tesla customer boosting performance of their car with a software upgrade. Companies such as Vodafone, Intel, Cohere, and Mavenir have also demonstrated that advanced features that are not available from proprietary RAN providers are improving spectral efficiency with the O-RAN Radio Intelligent Controller ("RIC").

To date, no proprietary RAN network has been built as a multi-vendor, multi-featured network due to proprietary interfaces and algorithms among certain vendors. Although 3GPP has specified the X2/Xn interface to allow gNB to gNB connectivity, incumbent vendors have used this interface as a commercial obstacle by keeping it proprietary, thus prohibiting the

mixing of vendor proprietary or Open RAN solutions. Carrier Aggregation is similar and only

possible to gain the benefits of combining spectrum resources to gain increased performance as a

single vendor solution. Regrettably, all of the above-named features are proprietary solutions

and vendor-specific, so interworking between different vendor Open RAN and proprietary RAN

solutions is currently not possible. Further specification work from the O-RAN Alliance and

3GPP needs to continue to specify common radio frequency ("RF") optimization and high-

capacity features to include Carrier Aggregation.

ii. <u>Public and Private Sector Initiatives and Current Gaps (Question #2)</u>

Mavenir has provided an extensive table of announced assistance initiatives related to

Open RAN that is attached in Appendix D. Any funds that have been made available through

those programs have largely been targeted at companies that are headquartered in those regions.

To ensure that NTIA uses its limited funds to complement these initiatives, NTIA should

establish criteria to provide preferences for projects that utilize U.S.-headquartered companies

that utilize U.S.-based labor thereby creating more U.S. jobs that help drive manufacturing and

technology leadership back to the U.S. Global allied partners should be able to be part of

consortium projects, but such projects should be led by U.S.-headquartered companies ensuring

open knowledge and IP transfer. Any company leading or participating in those projects should

attest to adoption of the Prague Proposals[9] and maintaining the principles as supported by the

Four Eyes countries:[10]

- o Open disaggregation: allowing elements of the RAN to be sourced from different suppliers and implemented in new ways.

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[9] *See* "The Prague Proposals: The Chairman Statement on Telecommunications Supplier Diversity," *Prague 5G Security Conference 2021* (Nov. 30, 2021) ("Prague Proposals")
https://www.nukib.cz/download/Prague_Proposals_on_Telecommunications_Supplier_Diversity.pdf.
[10] *See* "Open RAN Principles," *UK Government*, Policy Paper (Apr. 29, 2022)
https://www.gov.uk/government/publications/uk-open-ran-principles/open-ran-principles.

- o Standards-based compliance: allowing all suppliers to test solutions against standards in an open, neutral environment.
- o Demonstrated interoperability: ensuring disaggregated elements work together as a fully functional system — at a minimum matching the performance and security of current solutions.
- o Implementation neutrality: allowing suppliers to innovate and differentiate on the features and performance of their products.

As a further condition for receiving funds, fund recipients who are providing components (such as semiconductor chips) should commit to fairly distributing components on the same time frame and price point to both incumbents and new entrants. Favoring large legacy incumbents with better timing and pricing for components delays the deployment of Open RAN and disadvantages new entrants.

NTIA should focus on securing global adoption of Open RAN that benefits U.S.-headquartered companies. This could include, not listed in any particular order: (1) providing semiconductor and component subsidies to allow consolidated supply chains to expand; (2) providing vendor project financing through suppliers at competitive rates to allow companies to grow; (3) providing working capital to support committed contracts in order to ensure companies can scale in sync with operator demand (4) requiring U.S. MNOs to have a certain percentage of their deployments with open and interoperable equipment (*e.g.*, the U.K. has a 35 percent condition);[11] (5) consolidating U.S. contributions to global standards, led by U.S.-headquartered companies and funding for U.S.-headquartered personnel; (6) setting up grants for power amplifier design and manufacturing to supply the global marketplace with preferences for U.S. frequency bands; (7) providing funding for Tier 1 operators to build minimum 100 site

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[11] "Pedro Tomas, Juan, "UK government sets O-RAN traffic ambition for 2030," *RCRWireless News* (Dec. 9, 2021) https://www.rcrwireless.com/20211209/open_ran/uk-government-sets-oran-traffic-ambition-2030#:~:text=In%20a%20statement%2C%20the%20U.K.%20Department%20of%20Culture%2C,network%20traffic%20is%20carried%20over%20O-RAN%20by%202030 (The U.K. Department of Culture, Media and Sport (DCMS) "set a goal to boost O-RAN deployments so that 35% of the U.K.'s mobile network traffic is carried over O-RAN by 2030").

(Brownfield operational at scale) commercial test beds, which could be done in the underserved or rural markets for both mobile and fixed wireless access; (8) providing funding to U.S.-headquartered companies for international projects to enable global competition in markets, such as India, to achieve deployments at scale with competitive pricing; (9) defining a reference configuration, including all virtualized/containerized software elements for all Department of Defense and reference projects, that is used to purchase from U.S.-headquartered and qualified companies; (10) providing funding for training activities; (11) providing funding for O-RAN Test Integration and Certification ("OTIC") labs to conduct product conformance testing and equipment certification and the maintenance of a global certification register; and (12) providing 5G funding for Tier 2 operators adopting Open RAN from U.S.-headquartered suppliers to be used in conjunction with the currently allocated FCC 4G Rip and Replace and Broadband Funding already available.

iii. Workforce Constraints (Question #3)

The mobile telecommunications market will continue to be constrained by the need for engineers. The Innovation Fund could provide opportunities to fund the necessary training, skills development, and transition training needed to convert hardware engineers to software engineers. The Innovation Fund could also provide funding for groups, such as the Open RAN Policy Coalition ("ORPC"), to support global activities on policy and market access as well as funding to other bodies for manufacturing training and system integration training. Funding for the above segments would help alleviate the current workforce challenges that the industry faces.

iv. Private Investment in Open RAN (Question #4)

There is an essential need for project capital to assist new entrants scale their business so that they do not have to take each opportunity onto their companies' balance sheet, which limits

the size and number of addressable opportunities. By providing funding to Open RAN vendors,

against contracts with carriers for commercial deployments, the Innovation Fund could alleviate

this concern. Once a few capital projects are launched and companies start to scale, private

funding may become more readily available and will address the opportunities associated with

the wide scale commercial deployment of Open RAN. Commercial banks should also be in the

position to assist with vendor financing as was the case when 2G and 3G were launched.

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v.   <u>Global Supply Chain Impact (Question #5)</u>

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Global supply chains have significantly impacted the open, interoperable, and standards-

based RAN market. Specifically, semiconductor foundries and fabricators frequently price their

semiconductor chips and components based on volume. This structure provides significant

discounts to the three large, foreign-headquartered suppliers who dominate the wireless supply

chain, but the similar discounts are not provided to smaller companies who purchase smaller

volume. For example, competitive communications technology required for Open RAN is

currently hindered by component pricing that disadvantages smaller suppliers that do not have

supply chain resources and leverage, resulting in cost disadvantages of 100 – 200 percent. A

further explanation of how component pricing has limited the benefits of Open RAN is provided

in Appendix E.

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b. Technology Development and Standards

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i.   <u>Elements in Need of Additional Research and Development (Question #6)</u>

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There are two standards/specifications setting bodies in the Open RAN space, 3GPP and

the O-RAN Alliance. These bodies need to be supported and overseen to ensure there is not

"proprietary creep" in the standards/specifications setting process. The Innovation Fund should

provide funding to support the specification activities by these bodies, which could also entail

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providing advanced research funds to universities and other eligible institutions, such as ATIS, to develop the 5G standard moving forward. These standards groups should be led by U.S.-headquartered companies that will represent U.S. interests in creating international standards so as not to allow for potential duplicity and control by the foreign headquartered companies, who also participate on other standard development organizations that participate in 3GPP and are self-interested in retaining U.S. and global market domination.

To be clear, the authorization statute for the Innovation Fund allows for, but is not limited to, research and development. Mavenir is concerned that incumbent companies will seek to have NTIA limit the funding to research and development and delay investments focused on commercial deployment. As provided in the *2021 NDAA*,[12] the funding is to be used for multiple purposes including commercial deployment. Limiting the funding or the bulk of the funding is a delay tactic designed to slow the growth and deployment of Open RAN.

Funding for successor generation technologies outside of support for the above 5G specification activities should only be provided after measurable milestones of the initial fund investments have been obtained in achieving vendor diversity. For example, having five new vendors in the mobile telecommunications supplier market would be a metric that could be reached before funding more speculative technologies. Innovation Fund monies should not be spent on 6G or other futuristic ideas outside of the support for standard setting activities.

ii. <u>Open RAN in Standards Environment (Question #7)</u>

In terms of barriers faced in the open and interoperable RAN standards environment, the main issue is the enforcement of open and interoperability standards. It was encouraging and an excellent step forward to see the public statement made by four of the Five Eyes countries on

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[12] *2021 NDAA*, at Section 9202(a)(1)(C).

open and interoperable interfaces. However, the Four Eyes countries should still take additional steps to implement regulations or measures to strengthen the statements and advance deployments. Concerningly, companies and standards groups are still able to take what are "open interfaces" and morph them into proprietary standards. Any framework used should continue to use the 3GPP framework, but within that framework, standards and specifications groups through international cooperation need to globally enforce open and interoperable standards.

Regarding market readiness from a standards perspective, it is essential that Tier 1 carriers adopt open and interoperable standards and that there are test beds conducted at scale. Additionally, component pricing subsidies or more favorable terms to expand the constrained supply chain and allow competition on a level playing field could be helpful. A formal certification process for open interfaces would also go a long way in improving standards stability. In defining equipment as compliant with open standards, NTIA should require two or more vendors to demonstrate interoperability and compliance with the O-RAN specifications for each network element in the RAN, including holding public plugfest events that encourage vendor cooperation and certification.

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iii. <u>Open RAN Foundation for 6G and Future Generation Standards</u>
      <u>(Question #8)</u>

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The best way to build a strong Open RAN foundation for future generation standards is to provide a well-coordinated standards resource pool. But again, funding for specific 6G projects based on Open RAN principles should be a secondary priority to establishing the U.S. as a global supplier of 5G Open RAN and the provision of standards resources and coordination.

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c. Integration, Interoperability, and Certification

i. <u>Interoperability Testing (Question #9)</u>

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Interoperability testing and debugging events are an effective mechanism to support the promotion and deployment of new 5G equipment but the time and resource limitations of such a tactic should be acknowledged. Vendor interoperability is best proven when vendors cooperatively work together for a commercial grade deployment and, with the support of operators, this could be assisted in their laboratories. The certification of vendors equipment should list not only compliance to a specification but also list vendors that have completed interoperability with the certified vendor. As discussed below, the process could allow for self-certification among the vendors with regulatory oversight.

ii. Projects Supporting Integration of Multi-Vendor Environments
(Question #10)

To ensure that projects funded through the Innovation Fund support the integration of multi-vendor environments, it is important for each component in a telecommunications network to be proven interoperable with other vendors. Test results for each interface could be provided from standard commercial test equipment and test environments. A declaration or certification could be required that all interfaces are open and no proprietary protocols and interfaces are required in the network. NTIA could also build and maintain an approved and certified product database that both funded projects and the industry could use.

iii. Certification Regime (Question #11 - #12)

Mavenir strongly supports the implementation of a certification regime as part of the Innovation Fund. Mavenir proposes that a regime be implemented that includes a self-certification process with regulatory oversight as used in 3GPP. NTIA should also support the O-RAN Alliance OTIC process as well as ensure that a complete standards process includes a complete test specification definition. Mavenir also believes that security compliance, with the appropriate regulatory oversight, is essential to any adopted certification regime. Currently

equipment providers are certified through the GSMA Network Equipment Security Assurance Scheme ("NESAS").[13] NESAS provides a security assurance framework to enable continued improvements in security levels across the mobile industry for secure product development and product lifecycle processes. NESAS is applicable to both traditional and Open RAN network equipment provider. NESAS helps avoid fragmentation of security requirements by providing a common set of security assurance and baseline against which network equipment has been developed in accordance with vendor's development and product lifecycle processes. Mavenir strongly recommends that existing 3GPP and GSMA process are adopted as part of any Open RAN initiative.

If NTIA decides to take an alternative to the certification regime, Mavenir would recommend that it require peer certification within the deployment process. In working together, Mavenir and DISH have found that peer certification is a fast and efficient process; however, it is important to note that because we operate in a global marketplace, the requirements of other foreign certification bodies may vary.

d. Trials, Pilots, Use Cases, and Market Development

i. Uses Cases for Open RAN (Question #13)

An immediately foreseeable use case for open and interoperable networks would be the replacement of existing trusted and untrusted RAN vendors through the Federal Communications Commission's ("FCC") Reimbursement Fund program, which is tasked to remove untrusted vendors RAN from the U.S. communications supply chain.[14] Other likely uses cases include: (1)

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[13] *See* "GSMA Network Equipment Security Assurance Scheme," *GSMA* (accessed Jan. 26, 2023), https://www.gsma.com/security/network-equipment-security-assurance-scheme/.

[14] *See generally Protecting Against National Security Threats to the Communications Supply Chain Through FCC Programs*, WC Docket No. 18-89, Second Report and Order, 35 FCC Rcd 14284 (2020) (Given that the Reimbursement Fund has not been fully funded by Congress it would be possible to utilize lower cost Open RAN for 4G deployment and then upgrade those facilities through the Innovation Fund to 5G Open RAN. Mavenir notes that the Reimbursement Fund cannot be used to support 5G, which, given the timing of the program, should be re-

proving Brownfield deployments; (2) new frequency band deployments; (3) inbuilding for private and fixed wireless access networks; (4) Open RAN energy savings in comparison to existing networks; (5) spectral efficiency gains; (6) Non-Terrestrial ("NTN") and IoT networks; and (7) deployment of new and advanced architectures and technologies for Open RAN.

ii. Prioritization of Testbeds, Trials, Uses Cases (Question #14)

Testbeds, trials, and pilots for commercial deployments with the support of U.S. communications service providers should be prioritized. In addition, testbeds, trials, and pilots should all be focused on the selection of the best solution provider and potential for commercial contracts that can support the industry in the future instead of basing it on low price vendors that create a race to the bottom without adding innovation, security, or other value. Rapid deployment tools for CI/CD should also be prioritized.

iii. Utilizing Existing Testbeds to Accelerate Adoption and Deployment (Question #15)

NTIA should be mindful of avoiding testbeds that slow down the advancement of open solutions as the current specifications have reached a level where deployments are being made based on private investment. Research testbeds should cover virtualization, containerization, element management solutions and techniques as well as be forward looking to advance new solution rather than being used to keep the status quo.

iv. Proof-of-Concept Pilots and Trials (Question #16)

To ensure that proof-of-concept pilots and trials enable widespread adoption and deployment of open and interoperable solutions, NTIA should require that such pilots and trials

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evaluated especially in areas where untrusted vendors are deployed in high-risk areas such as military bases, airports, and other government installations.).

meet commercial deployment acceptance criteria so that any operator or solution provider can easily go to the next stage of commercial deployment.

e. Open RAN Security

i. Open RAN Security Elements and Reporting (Question #17)

In adopting the Innovation Fund program criteria, NTIA should make sure that funded projects adopt and comply with the Prague Proposals.[15] NTIA should foster the development and training of the zero-trust process and other ongoing developments of open and interoperable security processes.

In terms of security reporting, NTIA should require security conformance specifications and proof of compliance for both Open and Closed RAN. NTIA should also develop a security lab and a certification process as discussed *infra*.

ii. Security Steps Taken in Industry (Question #18)

In terms of industry action on Open RAN security, the zero-trust process has become institutionalized. Other testing schemes, such as the GSMA Network Equipment Security Assurance Scheme (NESAS),[16] should be adopted as part of the equipment qualification process. GSMA's NESAS provides a security assurance framework to enable continued improvements in security levels across the mobile industry for secure product development and product lifecycle processes. NESAS is applicable to both traditional and Open RAN network equipment providers. NESAS helps avoid fragmentation of security requirements by providing a common set of security assurance and baseline against which network equipment has been developed in

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[15] *See* Prague Proposals.
[16] *See* "GSMA Network Equipment Security Assurance Scheme," *GSMA* (accessed Jan. 26, 2023), https://www.gsma.com/security/network-equipment-security-assurance-scheme/.

accordance with vendor's development and product lifecycle processes. Mavenir has already

qualified its Open RAN product offerings through the NESAS qualification process.[17]

iii.   Innovation Fund Role in Strengthening Security (Question #19)

Mavenir also suggests that the Innovation Fund provide funding for construction of

security labs that can be used for awareness and testing of Open RAN networks.

iv.   Current Zero-Trust Model Implementation (Question #20)

Mavenir has already qualified its Open RAN product offerings through the NESAS

qualification process, which includes development and supply of products on a zero-trust basis.

NTIA should ensure that all projects funded include demonstration of zero trust.

f. Program Execution and Monitoring

i.   Evaluating Impact of Funded Projects (Question #21)

In administering the Innovation Fund, NTIA should conduct face-to-face presentations

concerning the content of applications. In Mavenir's experience, when there is a bureaucratic

box ticking process, certain matters may not be clarified, resulting in funding projects that do not

advance the commercialization of Open RAN. NTIA should require applicants to provide: (1) a

presentation of plans in a common milestone format; (2) a clear statement of deliverables; (3) a

statement of the economic benefits of the project to the U.S. and global telecommunications

market; (4) commitment to Fair Reasonable and Non-Discriminatory ("FRAND") licensing; (5)

commitments from both Tier 1 and smaller operators (including global operators) to deploy

commercially; (6) commitments to the "Four Eyes principles" of open standards; (7) a five-year

business plan; (8) a use of funds statement; (9) a certification that funds will be spent in the U.S.;

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[17] *See* "GSM Association NESAS Audit Report," *GSMA* (Nov. 2021) https://www.gsma.com/security/wp-content/uploads/2021/12/14-Mavenir-NESAS-Audit-Summary-Report-Nov-2021.pdf.

(10) a notice of any use of vendor financing; and (11) an intention to provide a percentage of matching funds (0-5% presumably with a reasonable cap so as to not disadvantage small entities) to show "skin in the game" and to stretch funding to be able to include more projects. These matching funds could more heavily weigh an application by awarding additional preference points to the grant applicant.

ii.   Participants Eligible for Program Fund (Question #22)

NTIA should only allow U.S.-headquartered companies that have demonstrated their public support for Open Interfaces and Open RAN to participate in the Innovation Fund. NTIA should ensure that specific RAN component developments for RU/CU/DU are able to participate as well as training companies. Among eligible participants, funding should be heavily weighted towards U.S. headquartered companies that need it most.

Furthermore, as required by the statue, the Innovation Fund should be used for projects that significantly advance the adoption of open and interoperable networks. It should not be used for companies wanting to enter the Open RAN market and or to convert proprietary closed products to Open RAN. U.S. companies have seen constant roadblocks in getting funding and market acceptance of their offerings in European markets because of incumbent protection in those regions, and thus similar priority should be given to U.S.-headquartered companies in the U.S.

iii.   Promotion of Teaming and Consortiums (Question #23)

NTIA should encourage participation in joint projects from U.S. like-minded companies. But, in most cases, teaming and consortiums should only be necessary for scaling commercial silicon, software, standards, testing and interoperability consortiums as this program is not a

science exercise or new product development, but a global technology commercialization to scale program.

iv. Matching Contributions (Question #24)

If NTIA decides to mandate a matching contribution, it should only require a match of 0-5% presumably with a reasonable cap so as to not disadvantage small entities. Such a matching contribution will force entities to show "skin in the game" and stretch funding to be able to include more projects.

v. Promotion of U.S. Competitiveness in 5G Market (Question #25)

In promoting U.S. competitiveness in the 5G market, NTIA should require that grantees are U.S. headquartered companies. To date, non-U.S. companies have locked and continue to try to lock U.S. companies out of the market. It seems that one of the intents of Congress in enacting the *CHIPS and Science Act of 2022* was to promote vendor diversity, specifically in the U.S., not to continue supporting the same foreign incumbents.

In establishing requirements to ensure that network components are "American-made," NTIA should incorporate the Made in America ("MIA") provisions. The ability to achieve MIA is based on achieving component pricing and scale to compete with non-U.S. vendors. This can only be achieved through component pricing and volume strategies that support the MIA as a long-term goal. Continuing the practice of not requiring MIA for telecommunications equipment is delaying the ability to reestablish the U.S. as a global player in telecommunications.

vi. Collaboration with Like-Minded Governments (Question #26).

NTIA should collaborate with like-minded governments to boost the international presence of Open RAN, specifically Open RAN deployed in the U.S. By collaborating closely with like-minded governments and participating meaningfully with those entities working to

establish standards and commercial deployments, such as those mentioned in the authorizing statute – O-RAN Alliance, TIP, 3GPP, and the Open-RAN Software Community – NTIA will assure that the process of delivering Open RAN is not delayed or hijacked to advance incumbents' interests over new entrants. Again, the first principle for cooperation with like-minded countries, is the adoption of the Open RAN principles as adopted by the Four Eye countries.

III.   CONCLUSION

NTIA should seize the opportunity to implement the Innovation Fund in a manner that will not only booster Open RAN adoption and deployment in the U.S and internationally, but also fuel U.S.-headquartered company growth in the Open RAN 5G sector. Providing financial assistance for Open RAN commercial deployment will help restore U.S. competitiveness in numerous sectors, including 5G. Mavenir looks forward to working closely with NTIA as it implements this historic program.

Respectfully submitted,

MAVENIR SYSTEMS, INC.

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January 27, 2023

CloudRAN/vRAN is NOT the Same As **Cloud-native OpenRAN**
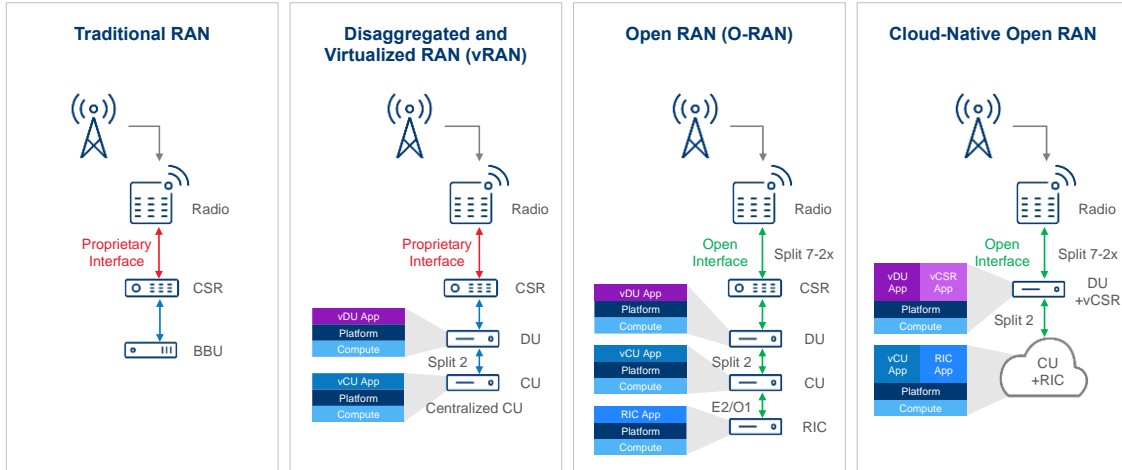
Courtesy of Dish Networks

MAVENIR™

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APPENDIX B

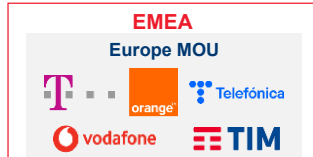# OpenRAN has Momentum | Commitment from Operators

Industry-Wide OpenRAN Deployments

Significant Government Funding
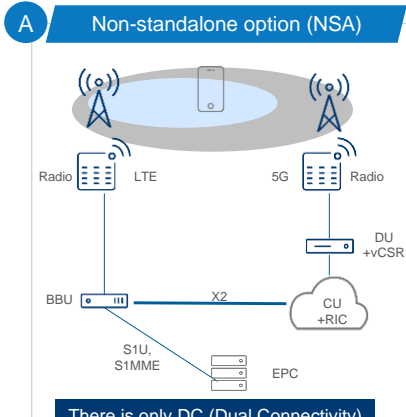
US & International governments have committed to over €4.4B to fund OpenRAN 5G deployment
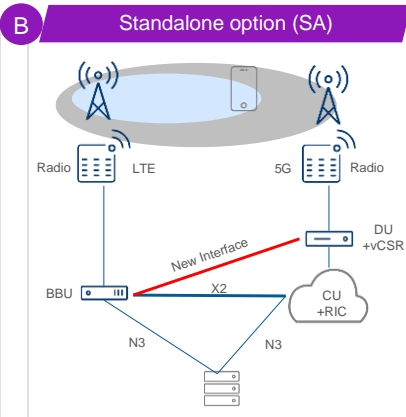
Source: Public disclosures, press releases

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Ensure X2 and CA interoperability with NSA and SA

Inter-vendor Carrier Aggregation (CA) interface needs standardization

Scenario:
A Incumbent LTE & Mavenir 5G

Today, without X2 interop Dual Connectivity (DC) across vendors would not be supported.

Gives NSA deployment advantage to incumbents

Scenario:
B Incumbent 5G & Mavenir 5G

Without a new standardized interface, inter-vendor interface CA across vendors would not be supported

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APPENDIX D

Country/Region	Announced Assistance Related to Open RAN
Australia	- Australia became the first country to ban both government and private sector use of untrusted vendors in 2018. - As a member of the Quad, Australia has committed to cooperate with other Quad nations to facilitate the development of Open RAN. However, the government has not made any announcements to-date regarding funding or other assistance to help meet this objective.
Brazil	The Brazilian government has earmarked 32.4mn reais (U.S. $5.76million) for the first phase of a program to foster Open RAN for 5G in the country, and the program, which is a partnership between the science, tech, and innovation ministry, the national education and research network, and Brazil's ICT R&D center, will run until November 2023.
Colombia	Colombia's Comision de Regulacio de Comunicaciones has selected two of three pilot projects to work on Open RAN under the country's *Regulatory Sandbox* initiative. One project will be on Open RAN connectivity; another on development of a Service Operations Centre; and the third aims to simplify fixed mobile services billing with a single unified contract.
France	In early 2021, the French Government unveiled the first four winners of a call for 5G projects. The four projects will share a public subsidy of £27million, more than one-third of their estimated cost.
Germany	- In early 2021, the government proposed spending £2 billion to reduce dependency on Huawei and boost its domestic suppliers, of which £300 million will be invested in Open Ran technology, £237million for a 6G research hub, and £250 million to boost demand and expand 5G networks. - The Ministry for Transport and Digital Infrastructure (BMVI) has since announced that £300million will be used to develop and test Open RAN technology for the country's 5G networks. Of that amount, the ministry will spend £17million to fund an Open RAN lab launched with Deutsche Telekom and other industry partners through a consortium called i14y, which will contribute the same amount over the next 3 years. The lab will be held in Neubrandenburg and Plauen, and the cities will receive £11.5 million as part of the initiative. - A German government broadband strategy unveiled in July included a mention of Open RAN. Specifically, the strategy is aimed at deploying gigabit broadband throughout the country by 2030. The report stated, "With Open RAN, we make ourselves more independent from international companies and can introduce 6G faster in Germany." A link to the strategy, which is written in German, can be found here.
India	- The Indian government released its procurement criteria and included a "Preference to Make in India" (PMA), under which suppliers who had a certain percentage of local content contribution were classified as "Make in India" eligible. - For its initial 5G trials, the country announced that operators were relying on the large incumbent suppliers (no U.S. company). However, Bharti Airtel later selected Mavenir to conduct the country's first Open RAN-based live 5G network validation. The Indian

	government is expected to make an announcement regarding its commitment to Open RAN in the coming weeks at a bilateral meeting with the U.S. • The 2022 Open RAN India Hybrid Conference was held on June 18 in New Delhi. India will hold a 5G spectrum auction in August. The conference featured participation from Shri Rajaraman, Chairman and Secretary of India's Department of Telecom, who said "Open RAN is primary to Digital India and Make in India initiatives. We aim at delivering new products for the customers, and for that innovation is a must. Open RAN brings in greater flexibility for all spectrums, which enables us to act in a highly competitive market."
Japan	• In May 2022, the Japanese Diet passed the Act on Promotion of Development, Supply, and System. The Act provides financial incentives for companies that develop, supply, or deploy 5G equipment that meets certification criteria in terms of: security safety and trustworthiness; stability of supply; and openness. The Government of Japan cited the need for equipment to be interoperable, based on open architecture, and utilize international standards to be certified. MNOs and private network owners are eligible for the tax benefits. • The country also committed to cooperating with the U.S. and Quad countries to accelerate Open RAN, an effort under which the U.S. pledged $2.5billion and Japan pledged $2billion. • The country also announced that it would set up a wide experimental network this year with 5G Open RAN, an initiative directly aimed at countering the rise of Chinese equipment makers. • The Ministry of Internal Affairs and Communications also announced creating a fund worth around ¥100 billion ($9.5 million US DOLLARs) with the Finance Ministry. With around half going to 6G development. • The Ministry of Economy, Trade and Industry launched the New Energy and Industrial Technology Development Organization (NEDO), a research and development management organization, in 2019 with 200 billion JPY (approx.. $1.7 billion) to fund R&D of post-5G information and communication systems and semiconductor technologies, using multi-vendor interoperability verification technology as one component. • The Japanese government provided tax incentives in 2020 and 2021 to invest in secure 5G infrastructure and products with open and interoperable interfaces (Tax incentives included: tax deductions of 15%; special depreciation of 30%; and fixed property tax exemption of 50%). These tax incentives were later extended to 2024. • The government also allocated 5G spectrum to Japanese operators that commit to nationwide deployment by 2024, rather than auctioning off the spectrum to the highest bidder. • As part of the U.S.-Japan Competitiveness and Resilience (CoRe) Partnership, Japan announced that it supported industry-led efforts to promote a diverse and competitive telecommunications marketplace with trusted suppliers through the launch of the Prague Proposals on Telecommunications Supplier Diversity; funded an R&D lab in Texas to help telecommunications companies evaluate and verify 5G mobile base station interoperability; and plans to fund, with the U.S., new joint R&D projects on 5G and beyond 5G, including those with Open RAN technologies. • The Governments of U.S. and Japan held an inaugural ministerial meeting of the U.S.-Japan Economic Policy Consultative Committee and released further commitments regarding Open RAN. The two nations "intend to continue supporting efforts to deploy secure and open 5G networks globally in view of an ambition to significantly expand market share of Open RAN in the global 5G market by 2030, particularly through workshops, seminars, and proof-of-

	concept projects in third countries, and to promote secure technology options for advanced communications networks, including Open RAN-based approaches to wireless network technology."
Quad Countries	• On May 23, the leaders of the Quad countries (Australia, India, Japan, and the United States) met in Tokyo and made several announcements, including a commitment to "responsible innovation in critical and emerging technologies." Building on the Quad's previously announced "Critical and Emerging Technologies Working Group," the countries announced a new "Memorandum of Cooperation on 5G Supplier Diversification and Open RAN", advanced technical-standards cooperation through the International Telecommunication Union's Telecommunication Standardization Sector, and stronger engagement with the private sector. • A closed-door Quads Standards Workshop was held on September 20. The workshop featured participation from the United States, Japan, India, and Australia governments as well as private sector entities. Discussion focused on how Open RAN alliance standards will co-exist with other industry-led international standards and the role of government in standards development. • The Third Quad Open RAN Forum was held on October 24-28 in India. The trip included meetings with Indian government officials, offsite visits to Open RAN deployments, a State Department-led Open RAN Roadshow, and a Forum with bilateral meetings with participating governments.
South Korea	• In 2020, the government launched a private-public partnership to develop open standards for 5G base station linkage and vendor diversity. • Korea's Telecommunications Technology Association (TTA) and Electronics and telecommunications Research Institute (ETRI) are running an Open RAN test and certification lab and recently selected Viavi Solutions as a partner. • In 2021, Presidents Biden and Moon met and affirmed their commitment to "recognize the importance of secure 5G and 6G networks, commit to supporting diverse and resilient supply chains, including innovative network architectures such as Open RAN technology, and commit to work together on Open RAN technology development and standardization issues." • South Korea's Ministry of Science announced their implementation plan for 6G R&D and rollout. The plan calls for investing around $194 million by 2025 in six focus areas, including performance, Terahertz bands, space communications, ultra-precision; artificial intelligence; and reliability.
Spain	• To date, the Spanish government has awarded €40 million to fund eight 5G pilots across the county with Open RAN being an active contributor of the projects' success. The Spanish government announced that it is providing more than €150 million in funding for 5G infrastructure in areas with poor mobile data coverage. The plan is part of the government's post-Covid national recovery plan.
Taiwan	• In January 2022, The Legislative Yuan passed amendments to the Statute for Industrial Innovation that extended tax incentives for smart machinery and 5G investments until 2024. • On October 14, the Taiwan Industrial Development Bureau (IDB) held an event in Washington, D.C. entitled "Taiwan Expo USA" that featured a panel focused on Open RAN. While no new government Open RAN efforts were announced, the IDB said that the panel, which included participation from several Taiwanese 5G companies, demonstrated the

	business potential that Taiwan offers for U.S. companies, "catering to the needs of both public and private networks in the global marketplace."
United Kingdom	• The UK government released a "5G supply chain diversification strategy," valued at £250 million, to help diversify and grow the supply chain and recently increased previous funding levels from £30 to £51 million for trials of Open RAN and next-generation technology. Of the £51 million, £36million will go to 15 winners of the Future RAN Competition (FRANC), a government-led effort to develop components, including radio transmitters and signal processing equipment needed for Open RAN deployments; and £15 million will be dedicated to SONIC Labs where suppliers can test early-stage products in real world environments. • The UK government's vendor diversity task force called for the country to use smaller equipment manufacturers for 35% of the nation's 5G networks by 2030. • On April 29, 2022, the country released four principles to promote the development and deployment of Open RAN equipment. • On May 1, the UK released Open RAN principles for industry and public bodies that included (1) open disaggregation; (2) standards-based compliance; (3) demonstrated interoperability; and (4) implementation neutrality. • On June 13, the UK's Department of Digital, Culture, Media and Sport (DCMS) agency released its Digital Strategy, outlining a number of commitments for the government to take related to 5G. • The UK and South Korean governments are jointly funding a £3m competition to boost the energy efficiency of Open RAN systems. More details on the collaboration can be found here. • On July 26, the UK announced the "Future Open Networks Research Challenge (FONRC)," a £25 million initiative that will enable universities to work with large RAN vendors to conduct research and development and "drive the openness and interoperability of future network architectures." The initiative will run through March 2025. During the Birmingham Tech Festival on October 14, UK Tech Minister Damian Collins announced that a new telecommunications lab would be opening in Solihull. The lab is intended to serve as a secure research facility to bring together telecom operators, suppliers, and academics to research and test ways of boosting the security, resilience, and performance of the UK's mobile networks. Additionally, the UK's announcement noted that the lab will aim to help new businesses enter the UK telecoms market by testing to ensure equipment is fully interoperable.

Areas to address **to accelerate Open RAN adoption (Contd.)**

4 Open RAN benefits **limited through component pricing**

Open RAN drives volume of common components

Smaller system suppliers do not have supply chain resources and leverage

> 20-50% price reduction through supply chain leverage (at same volumes)

Every system supplier treated singularly

> No aggregation of volume for common component pricing
> Represent high profit to design house
> 50% price reduction between 100 and 100K

Small system suppliers partly financing large suppliers
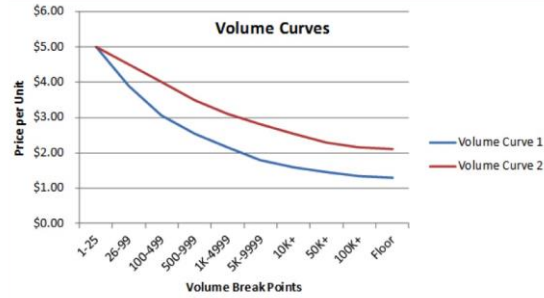
Note: A component is a chip or server

Need help from industry – Move to average consolidated pricing

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