Before the
NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION
Washington, DC 20230

In the Matter of	)	
	)	
5G Challenge Notice of Inquiry	)	Docket No. 210105-0001
	)	RIN 0660-XC049

COMMENTS OF
THE TELECOM INFRA PROJECT

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February 10, 2021

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The Telecom Infra Project (TIP)[1] respectfully files these comments in response to the Notice of Inquiry (NOI) in the above-captioned proceeding.[2] As the leading global association for the development and deployment of open network architecture solutions, TIP is excited by the opportunities for advancing the ecosystem that the 5G Challenge represents.

INTRODUCTION AND SUMMARY

TIP strongly supports the creation of a 5G Challenge as a collaborative effort between the National Telecommunications and Information Administration (NTIA) and the Department of Defense (DoD). A program that leverages the resources and organizational heft of DoD to promote open 5G architectures could significantly bolster the ecosystem, particularly at this moment when open architectures and products implementing them are just beginning to come to market. The federal government in general, and DoD in particular, often drive the development of new technologies through government procurement and other funding mechanisms, and doing so here would have similar effects. Moreover, encouraging the broader trend toward open

[1] TIP is a global community founded in 2016 that includes hundreds of companies, from service providers and technology partners to systems integrators and other connectivity stakeholders. TIP and its members work together to develop, test, and deploy open, disaggregated, and standards-based solutions. Visit https://telecominfraproject.com for more.

[2] NTIA, *5G Challenge Notice of Inquiry*, 86 Fed. Reg. 1,949 (Jan. 11, 2021) ("NOI").

network architectures will help the United States achieve its larger strategic goal of being a technology leader in 5G and future-generation networks.

Section I of these comments describes the significant role that TIP and its community play as a convening organization for the movement toward open network architectures, both wireless and wired. TIP's product groups and other activities are primarily focused on the productization of open technologies, beginning where the work of standards bodies like the 3GPP and the O-RAN Alliance leave off. TIP conducts lab testing and field trials to evaluate interoperability at both the interface and end-to-end system levels, maintains a network of Community Labs and Ecosystem Acceleration Centers, operates a badging program for product validation, and maintains the TIP Exchange as an online marketplace for connectivity providers to easily find open networking solutions and services. Much of this work can and should be directly leveraged by NTIA and DoD in the design of the 5G Challenge.

Section II articulates a proposed set of principles and goals for what constitutes "openness," including the use of open interfaces, software and hardware disaggregation, the ability of service providers to have multiple architecture options, and more. However, while the Challenge should focus on *open interfaces* and *open architectures* to address the problem of vendor lock-in, it need not and should not focus narrowly on *open-source code*. Moreover, in evaluating Challenge participants, the government should consider not just interoperability across specific interfaces, but end-to-end system testing that is more revealing of practical challenges in real-world environments.

Section III explains how the government can leverage existing industry work in these areas, including the use of integrated technical standards, frameworks, and testing from TIP and organizations like the O-RAN Alliance. In addition, the government should consider pointing to

TIP directly as a means for evaluating Challenge participants, by demonstrating product success in TIP field trials or obtaining TIP badging. Section IV explains that any security requirements should be limited to well-understood frameworks such as the NIST Cybersecurity Framework, in order to avoid slowing down processes or creating barriers to entry for small and new entrants seeking to participate. Finally, any technical areas of emphasis should be focused on near-term commercial needs, rather than trying to comprehensively implement all aspects of the underlying technical standard.

I. TIP AND ITS COMMUNITY PLAY A LEADING ROLE IN THE OPEN NETWORK ARCHITECTURE ECOSYSTEM.

Founded in 2016, TIP is a community of diverse members that includes hundreds of telecom companies, from service providers and technology partners to systems integrators and other connectivity stakeholders. TIP and its members work together to *develop*, *test* and *deploy* open architecture solutions based on industry standards. Where bodies including 3GPP and the O-RAN Alliance are focused on standardization, TIP's focus is on real-world productization and commercialization of open architecture solutions that are driven by operator needs.

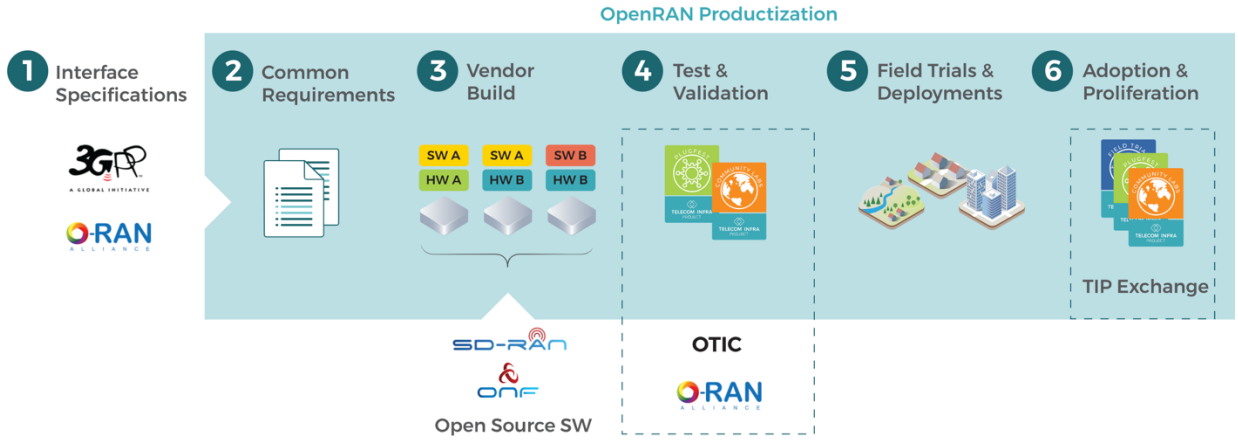
TIP's work is wide-ranging and includes several programs that are directly on point, or highly relevant, to what the 5G Challenge seeks to achieve. As explained below, TIP's programs include technical project groups that help companies develop common open-architecture solutions, programs to promote innovation and testing in the open-architecture space, and programs to help companies bring their validated open-architecture solutions to market.

A. TIP Technical Project Groups Focus on Real-World Productization of Open Network Solutions.

TIP has ten different product groups that are product-oriented and focus on the development of requirements, minimum viable products (MVPs), white papers, and lab and field

trial results.[3] While the standards process can occasionally find itself ahead of the marketplace, TIP's product groups are driven by operators' demonstrated commercial priorities and form the heart of TIP's technical work. Three groups of particular relevance are highlighted below: TIP OpenRAN, TIP Open Core Network (OCN), and TIP Open Optical & Packet Transport (OOPT). Other TIP groups are exploring Open Wi-Fi and solutions supporting connected cities and open automation.

TIP OpenRAN. The TIP OpenRAN product group supports the productization of disaggregated and interoperable solutions ranging from 2G through 5G NR based on service provider requirements.[4] Essentially, the work of TIP OpenRAN begins where the work of standards specification groups like 3GPP and the O-RAN Alliance end. Working in partnership with the O-RAN Alliance, TIP OpenRAN's productization work focuses on developing common requirements, vendor build, testing & validation, field trials, and adoption & proliferation, as represented by the blue rectangle in the figure below:[5]



[3] TIP, *Project groups*, https://telecominfraproject.com/project-groups/

[4] TIP, *OpenRAN*, https://telecominfraproject.com/openran/

[5] *Id.*

The OpenRAN project group includes several subgroups, including subgroups focused on the RU, the DU + CU, and RAN Intelligence & Automation (RIA), among others. Participation in some subgroups is limited to companies that are members of *both* TIP and the O-RAN Alliance, which is illustrative of the well-defined collaboration between the two leading technical organizations in the OpenRAN space. The OpenRAN project group played an important role in TIP's field trial work with Vodafone in Turkey (*see* section I-B below).

TIP Open Core Network (OCN). The TIP Open Core Network project group is working to develop an open, cloud-native, and converged core that is a collection of services implementing various core network functions.[6] The TIP OCN group's core will have the following open, flexible and extensible characteristics:

- Running on standardized software & hardware infrastructure;
- Supporting 3GPP 5G Core (5GC) and LTE Evolved Packet Core (EPC) for licensed, unlicensed, and shared spectrum networks; and
- Enabling seamless migration from 4G EPC to 5GC in both Non Stand-Alone (NSA) and Stand-Alone (SA) modes.

TIP Open Optical & Packet Transport (OOPT) group. The TIP Open Optical & Packet Transport group works on defining open technologies, architectures and interfaces in optical and IP networking.[7] For example, the TIP OOPT group has produced technical requirements for an open and disaggregated broadband network gateway (BNG) device that operators can deploy to provision *fixed* broadband services.[8]

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[6] TIP, *Open Core Network*, https://telecominfraproject.com/open-core-network/

[7] TIP, *OOPT*, https://telecominfraproject.com/oopt/.

[8] TIP, *Open BNG Technical Requirements*, https://cdn.brandfolder.io/D8DI15S7/as/jx5654t6f5bx94crvfxwm57w/TIP_OOPT_Open_BNG_Technical_Requirements_v10docx.pdf.

B. TIP Community Labs, Integration Testing, Field Trials, and Acceleration Centers Promote Testing and Innovation in the Open Network Ecosystem.

As an important aspect of productization, TIP has established an extensive framework of programs that promote testing and innovation in the open network ecosystem. TIP programs include field trials to prove OpenRAN and open architecture concepts in real-world settings, a network of Community Labs hosted by service providers and others, a test and integration project group for interoperability testing, and TIP Ecosystem Acceleration Centers (TEACs) to promote innovation by smaller vendors.

TIP Field Trials. TIP has facilitated field trials of OpenRAN and other open architecture solutions as an important element of product testing and validation. For example, Vodafone, with the support of the TIP community, issued an RFI in 2018 that led to the selection of Parallel Wireless for a field trial in Turkey based around OpenRAN technologies.[9] The project concluded that over time, OpenRAN systems "will yield both CAPEX and OPEX cost efficiencies" for operators, while also suggesting best practices and identifying challenges in need of work.[10]

TIP Test and Integration Group. The TIP Test and Integration project group tests TIP-fostered technologies that have been developed by the substantive project groups in end-to-end environments to evaluate product maturity toward commercial readiness of such technologies.[11] This group coordinates with other groups towards the development of test materials, test plans,

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[9] TIP, *Playbook – OpenRAN Trials w/ Vodafone Turkey*, at 6, https://cdn.brandfolder.io/D8DI15S7/as/c5tx5crn45cch6w3nrz39s/OpenRAN_VF_TK_Playbook_FINAL.pdf.

[10] *Id.* at 30, 33-35.

[11] TIP, *PlugFest*, https://telecominfraproject.com/plugfest/. The former PlugFest group is being re-chartered as the Test and Integration group.

or other documents that will support phased evaluation of TIP technologies toward product maturity. In July 2019, the group held an event focusing on interoperability between selected RAN partners (eNodeB) and commercial Evolved Packet Core (EPC) at the S1 interface.[12]

TIP Community Labs. TIP coordinates a network of 14 TIP Community Labs, including four labs in the United States (hosted by CableLabs, Facebook, and T-Mobile) for various TIP project groups to share best practices, infrastructure blueprints, processes, and experiences with each other. The space and basic equipment are sponsored by individual TIP member companies, but the labs are dedicated to TIP projects. Each TIP Community Lab must satisfy a set of criteria that includes specific requirements regarding physical space, lab equipment and tools, and networking.[13]

TIP Ecosystem Acceleration Centers (TEACs). TIP has partnered with three of the world's largest service providers to host TEAC programs in Germany (Deutsche Telekom), South Korea (SK Telecom), and the United Kingdom (BT).[14] Since the program launched in 2018, over 25 startups have been selected for programs at the three global TEACs. TEAC UK's areas of focus include 5G, while TEAC Germany's areas of focus include OpenRAN and network disaggregation.

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[12] *Id.*; *see also* ETSI TS 136 410 (explaining the S1 interface), https://www.etsi.org/deliver/etsi_ts/136400_136499/136410/09.01.01_60/ts_136410v090101p.pdf.

[13] TIP, *TIP Community Lab License Criteria*, https://telecominfraproject.com/wp-content/uploads/TIP-Community-Lab-Criteria_url.pdf.

[14] TIP, *Startups – TEAC*, https://telecominfraproject.com/teac/.

C. TIP Badging and the TIP Exchange Help Bring OpenRAN and Other Open Architecture Solutions to Market.

To facilitate the final steps in bringing open network solutions to market, TIP operates a badging program for vendors and products to indicate that their solutions are ready for integration into a commercial network. In addition, the TIP Exchange is a marketplace for vendors to showcase their offerings, and TIP makes RFI templates and resources available to facilitate actual procurements of open solutions.

TIP Badges. As noted above, TIP facilitates product-level testing, end-to-end testing, and field trials of open solutions. TIP also manages a series of badges used to validate the level of maturity toward commercial deployment of the various network elements developed by the TIP community.[15] For example, TIP Field Trial badges identify products and solutions used in TIP Field Trials that provide evidence of meeting criteria agreed upon with the service provider hosting the trial, and that are deployment-ready.

TIP Exchange. The TIP Exchange is an online database for companies to showcase their TIP-qualified offerings, allowing service providers to easily evaluate technology and potential partnerships.[16] Vendors and products in the database are searchable, for example, based on their association with various TIP project groups such as those described above, or achievement of TIP badges. Collecting a list of equipment and solutions is an important step in giving service providers and system integrators the assurance that they will be able to fully source all necessary network components, particularly in situations where a single-vendor solution is being transitioned to a multi-vendor solution.

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[15] TIP, *TIP Badges*, https://exchange.telecominfraproject.com/about-exchange/badges.

[16] TIP, *TIP Exchange*, https://exchange.telecominfraproject.com

TIP RFI Templates. As part of its Exchange, TIP makes several RFI templates and resources available to its members to facilitate sourcing (procurement) of disaggregated open-architecture solutions.[17] Several of the templates include detailed specifications for particular components to satisfy. For example, TIP's template for a disaggregated cell site gateway (DCSG) includes a technical specification for an open white-box device that operators can widely deploy in current 2G/3G/4G cell sites, but that also supports the port speeds and densities required for 5G networks.[18]

II. THE 5G CHALLENGE SHOULD PROMOTE OPEN ARCHITECTURE PRINCIPLES AND COMPREHENSIVE SOLUTIONS.

In defining the goals and objectives of the 5G Challenge, NTIA and DoD should begin by more clearly articulating what is meant by "open." As described below, TIP's work in recent years has led to the adoption of several basic goals or tenets for open network infrastructure, including open interfaces between network elements, multiple architecture options for providers, software and hardware disaggregation, and more. However, while open architectures, interfaces, and frameworks should be an important focus, the Challenge need not and should not focus narrowly on *open source code*. Finally, evaluation of solutions should include both end-to-end testing as well as the interoperability of specific components across well-defined interfaces.

A. The Challenge Should Advance Established Principles of Open Network Architectures.

While the NOI refers generally to "open 5G" architectures and "open interfaces,"[19] NTIA and DoD should articulate more specifically what is meant by "open" – and thus what the

[17] TIP, *RFI templates*, https://exchange.telecominfraproject.com/rfi

[18] TIP, *RFI template for DCSG*, https://exchange.telecominfraproject.com/rfi/dcsg

[19] NOI, 86 Fed. Reg. at 1,950.

ultimate end goals of the 5G Challenge will be. In doing so, they can leverage existing industry work on this topic. Notably, TIP and its members have articulated several "tenets" or bedrock principles of open architectures that should shape the Challenge goals, as follows:

1. **Software and Hardware Disaggregation.** Open architectures should facilitate separation of network infrastructure hardware and software by using vendor neutral, general purpose processor (GPP)-based platforms.

2. **Open Interfaces.** Implementations should use open interface specifications between components. For example, in the RAN context, the use of open interfaces between the radio unit (RU) / distribution unit (DU) / core unit (CU) / RAN intelligent controller (RIC) with vendor neutral hardware and software.

3. **Multiple Architecture Options.** An open network infrastructure framework should provide multiple architecture options for operators, including allowing for disaggregation at various levels. In the RAN context, this could include, for example:

    a. An all-integrated RAN with disaggregation at software & hardware level
    b. A split RAN with RU + baseband unit (DU/CU)
    c. A split RAN with RU, DU and CU
    d. A split RAN with integrated RU/DU + CU

4. **Flexibility.** Multi-vendor solutions should enable a diverse ecosystem for service providers (or governments) to choose best-of-breed options for their network deployments.

5. **Virtualization Optional.** Open network architecture solutions that leverage open interfaces can be implemented on either bare metal or virtualized or containerized platforms.

6. **Innovation Through New Technologies.** Open architectures should create a framework for innovation via the adoption and incorporation of new technologies, such as artificial intelligence and machine learning (AI/ML) and the continuous integration / continuous delivery (CI/CD) paradigm for software deployment.

7. **Supply Chain Diversity.** By enabling multi-vendor solutions, open architectures should promote supply chain diversity. This includes diversity for service providers and system integrators as they source components, but may also include supply chain diversity further upstream as particular elements of traditional network infrastructures are disaggregated.[20]

[20] *See generally* TIP, OpenRAN, https://telecominfraproject.com/openran/ (articulating these tenets in a RAN-specific context).

Incorporating this set of principles for "openness," or at least some subset or version of them, will help ensure that the Challenge is working in tandem with existing industry efforts to promote an open network ecosystem.

B. The Challenge Should Promote Open Interfaces and Open Architectures While Avoiding a Narrow Focus on Open-Source Code.

In discussing the "open stack," the NOI appears at times to conflate the use of architectures built around *open interfaces* with the use of *open-source code*. However, the use of open interfaces as the basis for open architectures, and the implementation of network elements using open-source code, are distinct concepts that seek to address different challenges. The 5G Challenge should be focused primarily on open interfaces and architectures, but in any event NTIA and DoD should be clear about their intended goals. In TIP's understanding, an "open stack" ecosystem is not necessarily built upon open-source code, but rather is an ecosystem in which different vendors have opportunities to compete by providing different network elements that are interconnected across open interfaces and architectures.

Open interfaces and architectures. Open interfaces and architectures, such as those promoted by TIP and its member companies, seek to address the problem of vendor lock-in. This problem arises when an operator's entire network, or major segments thereof, are sourced from a single vendor whose equipment is not interoperable with equipment other vendors. In the future, the use of equipment that (A) complies with standards from organizations such as the O-RAN Alliance, and then (B) complies with productization and validation requirements and processes from organizations such as TIP, will alleviate this problem. Network operators will be able to replace or upgrade different elements of their network, at different times, using different vendors.

However, while the interfaces and architectures may be open, the resulting implementations of the specific network elements by particular vendors will typically still be proprietary. Notably, the distinction between hardware and software implementations is not relevant because software running on general-purpose processors – a goal that TIP supports – can still be proprietary. Even software that incorporates some open-source code or modules can still lead to proprietary solutions, either because the vendor has incorporated additional features or because the vendor is adding a level of assurance that does not, and perhaps cannot, manifest from the code itself.

Open-source implementations. The NOI alludes to the fact that various projects and organizations are developing software implementations of various portions of the 3GPP specifications using open-source code.[21] However, the organizations and projects working on open source code are quite diverse and not always synchronized, as the NOI recognizes.[22] Thus, while certainly notable, these efforts should not be the primary focus of the Challenge. Instead, a 5G Challenge that is truly focused on advancing DoD missions and the ecosystem as a whole must encompass the complete range of "open stack" solutions – that is, solutions based on open interfaces and architectures – including those based on proprietary implementations.

C. The Challenge Should Evaluate End-to-End Solutions in Addition to Interoperability at Specific Interface Points.

5G network architectures – and indeed, 4G architectures – incorporate several well-defined interface points between the network elements. For example, the S1 interface connects one or more gNodeBs (or in 4G, an eNodeB) to the Evolved Packet Core (EPC). In simpler but also reductive language, the S1 interface connects the RAN to the core. Meanwhile, the X2

[21] NOI, 86 Fed. Reg. at 1,950.

[22] *Id.*

interface allows two eNodeBs / gNodeBs to communicate with each other directly. The LTE architecture specifies several other interface points, and many of these interfaces have been continued forward into 5G architectures in various forms. In addition to these RAN-focused interfaces, TIP's Open Core Network Project Group and others have done work toward defining open interface points in core networks as well.[23]

Evaluating the interoperability of different solutions at well-defined interface points is therefore a foundational component of any open architecture evaluation. TIP has experience with such evaluations, including TIP's first PlugFest held in July 2019 that focused on testing interoperability between selected RAN partners and commercial EPC at the S1 interface.[24] Such testing based around well-defined interface points should also form an important element of any 5G Challenge evaluation. Moreover, a comprehensive challenge would ideally include the evaluation of open architecture technologies not just for RAN, but for backhaul transport and core network segments as well.

End-to-end testing. Importantly, the 5G Challenge should also incorporate end-to-end testing rather than testing across specific interfaces only. The ability to evaluate end-to-end solutions, especially in simulated (or real) deployment environments, ultimately provides more practical experience than focusing on a single interface. TIP's Community Lab program and Field Trials have demonstrated that practical testing in end-to-end environments may yield insights that are not readily apparent in single-interface testing. Such insights are invaluable for real-world deployment of open network architectures.

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[23] *See, e.g.,* TIP, *Open Core Network Project Group Applications and Services, Technical Requirements v1.0*, https://cdn.brandfolder.io/D8DI15S7/as/94qj5rmgkhcmsgf6tb693bm/TIP_OCN_WS1_Applications_and_Services_Technical_Requirements_v10_Final.pdf

[24] TIP, *InterOp PlugFest '19*, https://telecominfraproject.com/event/interop-plugfest-19/

III. THE 5G CHALLENGE SHOULD LEVERAGE EXISTING INDUSTRY EFFORTS.

When defining the Challenge parameters – and especially in considering how to test or evaluate the participants – NTIA and DoD are not beginning with a blank state. As described below, there is a well-established group of leading industry organizations including TIP that have been establishing common technical standards, specifications, and productization requirements for open network architectures. Moreover, TIP has been instrumental in facilitating precisely the type of testing that NTIA and DoD will need to properly evaluate Challenge participants. The government should therefore leverage this work in the design of the Challenge.

A. The Challenge Should Incorporate Industry Standards and Frameworks from TIP and Its Partner Organizations.

In searching for suitable technical frameworks for open network interoperability, the government need not look very far. There is a well-defined group of organizations working on these issues and they have partnered with each other. For example, TIP and the O-RAN Alliance have a liaison agreement that involves information being shared between the O-RAN Alliance, which develops standards, and TIP's OpenRAN project group, which focuses on productization and validation. Meanwhile, TIP continues leading the way on developing frameworks for open transport and open core solutions, as described above.

Notably, the vast majority of ecosystem participants have at least some degree of buy-in with these established technical frameworks. While implementation approaches may vary – hardware vs. software, proprietary vs. open-source – the underlying work toward open interfaces and architectures appears to be funneling toward commonality based around the work of TIP and the O-RAN Alliance. Indeed, TIP and the O-RAN Alliance are two of the four organizations

that were specifically recognized by Congress in the recently-enacted FY21 National Defense Authorization Act as key players in this space.[25]

In essence, the move toward open network technologies has not yet presented the challenge of dueling architectures in the marketplace, as happened in the past with LTE vs. WiMAX, Blu-Ray vs. HD-DVD, or VHS vs. BetaMax. This is due in significant part to TIP's global reach, which now encompasses hundreds of member companies from around the world, and to TIP's collaboration with the O-RAN Alliance and others. Thus, while not necessarily closing the door to other frameworks, the 5G Challenge would most effectively achieve its objectives by leveraging the advantages of the existing industry frameworks.

B. The Government Should Consider Evaluating Challenge Participants by Pointing to TIP's Validation Processes.

NTIA and DoD could directly leverage TIP's work as the vehicle through which 5G Challenge participants will have their performance evaluated. The Challenge could specify, for example, that a given participant will be deemed successful if its products can meet specified benchmarks through testing in existing TIP Community Labs, or if a particular vendor or product can successfully obtain a certain TIP badge. Notably, this approach would significantly advance the government's dual objective of "maximiz[ing] the benefit to both the open 5G stack market and the DoD" because vendors already seek to obtain TIP Badges to validate their products for their commercial customers. To serve DoD-specific needs, the government could potentially

[25] William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021, Pub. L. No. 116-283, Jan. 1, 2021, at § 9202(a)(1)(C)(ii). (Public law text not yet available, *see* H.R. 6395 enrolled bill at pp. 1401-02.) The other two organizations mentioned in the law are the 3GPP and the Open-RAN Software Community, the latter of which is itself a collaboration between the O-RAN Alliance and the Linux Foundation. *See* O-RAN Alliance, *O-RAN Software Community*, https://www.o-ran.org/software.

partner with existing Community Lab sponsors to provide any additional specific operator conditions as appropriate.

Assuming, however, that NTIA and DoD choose to establish their own product testing and evaluation program, the TIP Community Lab program is still the leading framework for vendor-neutral and provider-neutral testing of technologies in the open network architecture space. The agencies should leverage this work by using the specifications in the TIP Community Lab criteria as a baseline for designing a testing environment for the Challenge.[26]

IV. THE 5G CHALLENGE SHOULD FOCUS ON CURRENT NEEDS AND AVOID UNNECESSARY REQUIREMENTS THAT WOULD CREATE DELAYS.

The NOI asks several questions about incorporating security-related items into the Challenge and also identifies several specific technologies as potential areas of focus. As explained below, any security requirements should be limited to widely-adopted frameworks like the NIST Cybersecurity Framework in order to avoid creating undue delays or preventing participation by new or smaller vendors. Meanwhile, specific areas of technical focus should emphasize meeting near-term commercial needs rather than trying to implement every aspect of the 5G technical standards.

A. Any Security Requirements Should Be Limited to Widely Adopted Frameworks.

The 5G Challenge should avoid imposing any new or untested security requirements on participants. Doing so could limit or prevent participation by several vendors, especially newer or smaller entrants, and thus delay or frustrate the underlying goal of promoting open architectures. Instead, any security requirements should be based upon well-established existing

[26] TIP, *TIP Community Lab License Criteria*, https://telecominfraproject.com/wp-content/uploads/TIP-Community-Lab-Criteria_url.pdf.

frameworks, such as the NIST Cybersecurity Framework that is now understood and accepted by many telecommunications ecosystem participants both in the United States and abroad.

Software bill of materials. TIP supports the principle of supply chain diversity. As such, TIP believes that NTIA's recent multi-stakeholder process to develop a software bill of materials ("SBOM") process is a laudable step toward advancing supply chain best practices.[27] However, the SBOM work is still very preliminary, and the process has not yet achieved the level of maturity and industry acceptance now evidenced for the NIST Cybersecurity Framework. Moreover, imposing an SBOM requirement could dissuade participation by smaller vendors, particularly given that the SBOM process has not yet been widely adopted by even large vendors in the telecom sector. At this early stage, imposing an SBOM requirement with many unknowns could also potentially have unfair differential effects on participants seeking to provide hardware-based vs. software-based open architecture solutions in response to the Challenge.

B. The Challenge Should Focus on Technical Features Necessary to Support the Greatest Practical Near-Term Needs.

The NOI identifies several "5G enabling features" that could be highlighted in the Challenge, including software defined network ("SDN"), network function virtualization ("NFV"), RAN intelligent controller ("RIC"), and RAN virtualization. TIP agrees that these four technology concepts are each in demand in the near term and can play a role in moving networks toward an open, full-cloud-native architecture. Indeed, TIP and its members have prioritized the productization of technologies that serve the initial 5G commercial use cases. However, other technologies such as network slicing, while certainly part of the relevant standards, are less

[27] NTIA, *Software Bill of Materials*, https://www.ntia.gov/SBOM.

mature. Focusing on such technologies may be less appropriate for a 5G Challenge being designed primarily with the goal of advancing open architectures in the near term.

CONCLUSION

TIP and its members are excited by the opportunities that a 5G Challenge presents for advancing the open network architecture ecosystem. TIP looks forward to working with the U.S. government as it continues to explore this and other ways to advance the movement toward open networks.

Sincerely,

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February 10, 2021