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Submitted via Regulations.gov

The Honorable Lawrence E. Strickling
Assistant Secretary of Commerce for Communications and Information
National Telecommunications and Information Administration
U.S. Department of Commerce
1401 Constitution Avenue NW
Washington, DC 20230

Re: Public Wireless Supply Chain Innovation Fund Implementation; Docket No. NTIA-2022-0003; RIN No. 0693-XC05

Dear Administrator Strickling,

Aalyria Technologies, Inc. ("Aalyria") appreciates the opportunity to provide initial input to the National Telecommunications and Information Administration ("NTIA") regarding its Request for Comment ("RFC") on the implementation of the Public Wireless Supply Chain Innovation Fund ("Innovation Fund") as directed by the CHIPS and Science Act of 2022.[1]

The Innovation Fund will help drive U.S. wireless innovation, foster competition, and strengthen supply chain resilience. It will also open opportunities for U.S. companies, particularly small and medium enterprises, to compete in a market historically dominated by a few foreign suppliers, including high-risk suppliers that raise security concerns. Ensuring that grants under the Innovation Fund are available to recipients on a technology neutral basis will be instrumental in ensuring that NTIA is enabling operators to "procure the best solutions for their specific needs by mixing and matching network components, rather than procuring proprietary end-to-end solutions from a single supplier."[2] NTIA should also adopt research and development priorities that include dedicated support for 5G Advanced use cases, such as Non-Terrestrial Networking (NTN), to ensure that work to develop open, interoperable standards encapsulates and maximizes the potential of the whole telecommunications ecosystem.

[1] See Public Wireless Supply Chain Innovation Fund Implementation, Request for Comment, 87 Fed. Reg. 76182 (Dec. 13, 2022) ("RFC"); see also CHIPS and Science Innovation Fund of 2022, 136 Stat. 1366, Pub. L. 117-167 (Aug. 9, 2022).
[2] RFC at 76183.

1. Introduction

Aalyria, based in Livermore, California, launched as an independent company in 2022, spinning out two technologies originally developed at Google and Alphabet as part of their wireless connectivity efforts: (i) an atmospheric laser communications technology ("Tightbeam," f.k.a. Sonora) and (ii) a software platform for orchestrating networks across land, sea, air, space and beyond ("Spacetime," f.k.a. Minkowski)[3]. With the original technical teams and their decades of experience—and additional leadership from engineers with Google, Facebook, NASA, Cisco, Lawrence Livermore National Laboratory, and Amazon backgrounds—Aalyria is working to commercialize this fully functional all-domain network-service-management orchestration platform.

Aalyria's platform is designed to orchestrate and manage the most complex networks in the world, extending these networks to places where there is no connectivity infrastructure, at exponentially greater scale and speed than anything that exists today. Described in greater detail below, Spacetime is a general purpose network orchestration platform that supports contemporary and heritage communications links in any radio frequency band, while Tightbeam allows Spacetime customers to optionally incorporate 400Gbps+ atmospheric-capable laser communications links into their networks – and to have those links automatically orchestrated around the changing geometry and weather conditions.

Together, these technologies enable complex networks at a scale and speed that has never been possible. For example, Aalyria's technology platform presently supports communications networks with up to 15 million possible links and wireless connection speeds up to 1.6 Tbps. In the future, the Aalyria platform will facilitate the coordination and sharing of network resources across multiple networks with unlimited connections.

1.1 Spacetime

Spacetime is a software platform for orchestrating and managing networks of ground stations, aircraft, satellites, ships, urban meshes, and more. Spacetime is the first commercial off-the-shelf solution for commercial companies engaged in the development of steerable-beam mesh networks. Using an artificial intelligence powered network solving engine, Spacetime optimizes and continually evolves the antenna link scheduling, network traffic routing, and spectrum resources – responding in real time to changing network requirements. Spacetime operates networks across land, sea, air, and space, at any altitude or orbit type, supports all radio frequency bands and optical wavelengths, and is designed for interoperability with legacy, hybrid space, 5G NTN and FutureG network architectures.

Spacetime is a unique network management system in that it is asset and domain agnostic, meaning it can orchestrate networks across nearly all connectivity-equipped devices on Earth or in

[3] See Press Release, "Aalyria Launches to Revolutionize Communications Networks Across Land, Sea, Air, and Space," BusinessWire (Sept. 13, 2022), https://www.businesswire.com/news/home/20220913005840/en/Aalyria-Launches-to-Revolutionize-Communications-Networks-Across-Land-Sea-Air-and-Space.

space – ships, planes, satellites, and space assets in near and deep space. Spacetime has already conducted millions of flight hours orchestrating and managing airborne communications systems around the world. As the number of networks adopting Spacetime continues to expand, it will provide those network operators with unprecedented flexibility to negotiate agreements to dynamically share spectrum or network resources across space and time.

Aalyria is currently working with several commercial space companies and government agencies to make their networks more resilient – and their spectrum more efficient.

1.2 Tightbeam

Tightbeam is the world's most advanced coherent light free space optics technology. At 100-1000x faster than anything else available today and covering greater distances than previously imagined, Tightbeam's coherent light laser moves data intact through the atmosphere and weather, and offers connectivity where no supporting infrastructure exists. Tightbeam radically improves satellite communications, Wi-Fi on planes, and ships, and cellular connectivity everywhere.

"These technologies set the new standard for intelligently orchestrating, managing, and extending mesh networks across all domains - land, sea, air, and space - to create connectivity everywhere – no matter the protocol," said Chris Taylor, founder and CEO of Aalyria. "The connectivity on your plane, train, car, cruise ship, space station, lunar base camp, or Mars rover - and anywhere else in the solar system - ought to be as good as it is in your home. We are able to orchestrate cross-constellation inter-satellite links that enable the internetworking of government and commercial constellation providers. We can orchestrate high-speed urban meshes and global unified network operations, and we can help connect the next three billion people. We can do this today – and at scale. Aalyria is the digital cartilage and autonomous brain that allows everything to internetwork."

"Aalyria offers a cutting-edge Software Defined Network capability and optical network technology that is designed to deal with dynamic links, like space to ground, air to air, air to space and every combination between," said company advisor and former Google VP of Wireless Services, Milo Medin. "The future of communications marries ground-based fiber with space, wireless, and optical links to enable the creation of a survivable on-demand network infrastructure, anytime and anywhere, at speeds that remove the network as a bottleneck. This is critical not just for the future of the Joint Force, but for extending the capabilities of the cloud to anywhere on the planet and beyond where the modern enterprise is delivering value."

Aalyria is currently working with commercial space companies and governments to make their networks more resilient, and make their spectrum more profitable.

2. Response to RFC Questions

2.1. What open and interoperable, standards-based network elements, including RAN and core network elements, would most benefit from additional research and development (R&D) supported by the Innovation Fund? (Question 6)

Open, interoperable, standards-based RAN infrastructure and Radio Intelligence Controller (RIC) platforms have been announced or are now commercially available from leading network equipment manufacturers. But these solutions are focused squarely on traditional, terrestrial 5G mobile and fixed broadband use cases. The greatest opportunity for additional research and development to impact innovation, foster competition, and strengthen supply chains can be found with the new "5G Advanced" use cases in 3GPP Release 17 and beyond, and Non-Terrestrial Networking (NTN) in particular.

Today's commercial satellite supply chain represents <10% of global telecommunications. Despite "standards" like DVB-S2(X) for modems, interoperability between satellite baseband and gateway hub vendors has never been achieved, fragmenting an already small ecosystem. Emerging 3GPP NTN standards provide an opportunity to realign satellite and high-altitude platform stations (HAPS) around the economies of scale of the larger mobile telecom industry – enabling cellular chipsets used in 5G/6G base stations and handsets to be used natively in non-terrestrial networks. Such a realignment would also unlock converged cellular + satellite 5G Advanced and 6G Networks.

This year saw significant progress with the first over-the-air satellite-to-user link demonstration of the 5G NTN air interface. However, existing 3GPP Service Management & Orchestration (SMO) platforms are designed for traditional, fixed terrestrial cell towers and incapable of complex orchestration of non-geostationary constellations – especially those with steerable beams and/or inter-satellite links. Meanwhile, a new approach called Temporospatial Software Defined Networking (TS-SDN) has already been demonstrated by Alphabet[4] and Aalyria to support such functions.

Aalyria recommends that the Innovation Fund include dedicated support for research and development of a US-based supply chain with commercial providers of 5G NTN-capable SMO platforms, Radio Intelligence Controllers (RICs), RAN infrastructure (gNodeB CU/DU/RU) and User Equipment (UE) chipsets.

2.2. Are the 5G and open and interoperable RAN standards environments sufficiently mature to produce stable, interoperable, cost-effective, and market-ready RAN products? (Question 7)

NTN in 3GPP Release 17 added support for signaling messages to provide the coordinates (latitude, longitude, height) and heading of aircraft or the orbit of satellites to a gNodeB or UE to facilitate handovers in non-terrestrial networks. But existing open and interoperable RAN standards have no apparent support for providing such information to the RAN infrastructure. NTIA should

[4] Frank Uyeda, Marc Alvidrez, Erik Kline, Bryce Petrini, Brian Barritt, David Mandle, Aswin Chandy Alexander. "SDN in the Stratosphere: Loon's Aerospace Mesh Network," ACM SIGCOMM. August 2022.

consider including research and development support as part of the Innovation Fund for evolving existing O-RAN ALLIANCE interfaces to support the Radio Intelligence Control of Integrated Access and Backhaul (IAB) and NTNs.

2.2.1. What is required, from a standards perspective, to improve stability, interoperability, cost effectiveness, and market readiness? (Question 7b)

Aalyria recommends expanding the Telecom Infra Project (TIP) to improve stability, interoperability, cost effectiveness, and market readiness of 5G and open and interoperable RAN standards. TIP plays a key role in supporting the market readiness of open and interoperable RAN infrastructure for emerging 5G Advanced features like NTN. Often, with these emerging features, an infrastructure vendor is unwilling to invest in the speculative development of support for every new feature in the latest 3GPP Release given the lack of a clear market signal indicating demand for such a product. Meanwhile, the network operators are reluctant to baseline network architectures around the new features given the dearth of available infrastructure. This deadlock slows the market readiness of the solutions.

TIP's Project Groups (PGs) help to solve this problem. For example, TIP's Non-Terrestrial Connectivity Solutions (NTCS) PG is *operator* led (co-chaired by executives from some of the largest commercial satellite companies), and these operators have collaborated with other participants to codify the use cases that the companies plan to deploy first (i.e.., direct-to-handset from a satellite, maritime connectivity, etc.). The technical experts at these participating organizations then map the subsets of capabilities outlined in the 3GPP Release to the specific use cases. The outcome is a requirements document that clearly specifies the minimum viable product requirements of a solution that is deployable for a specific use case of known interest to one or more network operators. This effectively lowers the barrier to entry (reduced scope) and risk (clear market signals, reduced uncertainty) for infrastructure vendors to commit to develop a market-ready product.

2.2.2. What criteria should be used to define equipment as compliant with open standards for multi-vendor network equipment interoperability? (Question 7c)

TIP has an established framework that NTIA can adapt and apply to define equipment compliance. TIP's three-tier badging system[5] – bronze, silver, gold – is a test and validation framework designed to demonstrate the increasing maturity and interoperability of individual products, product combinations, or solutions with requirements like OpenRAN. Bronze badges demonstrate a vendor's self-assessed compliance with TIP requirements, while silver and gold badges involve increasing levels of testing. The bronze, silver, and gold badge requirements are based on use cases emerging from TIP's various project groups. For silver and gold badges, the project groups also define relevant test requirements and/or test plans. Gold badges indicate that products, combinations, or solutions have

[5] See Tip Badging, https://exchange.telecominfraproject.com/about-exchange/badges

been tested and validated comprehensively in accordance with test plans prepared by TIP – typically in live production environments with real customer traffic. Badged products are listed on the TIP Exchange[6].

2.3. What kinds of projects would help ensure 6G and future generation standards are built on a foundation of open and interoperable, standards-based RAN elements? (Question 8)

Continued work towards converged terrestrial / non-terrestrial networks, including integrated access and backhaul support with non-geostationary satellites and high-altitude platforms, will likely be a cornerstone of 6G and future generation standards. NTN, for example, is a key feature introduced in 3GPP Release 17, with further enhancements planned in 5G Advanced (3GPP Release 18+). Given the importance and relevance of such systems to the commercial and public sectors alike, the Innovation Fund should consider projects to continue to foster research and development towards market ready solutions.

2.4. In addition to the listening session mentioned above and forthcoming NOFOs, are there other outreach actions NTIA should take to support the goals of the Innovation Fund? (Question 28)

Europe has a number of existing programs supporting the research and development of 5G NTN, which may offer opportunities for international collaboration, harmonization, and identification of economies of scale. The European Space Agency' (ESA) supports 5G NTN standardization through the ALIX program[7] and funds competitiveness and growth of ESA member states in this area through an ARTES Competitiveness & Growth program called Space for 5G[8]. The European Union (EU) Horizon program has been funding 5G NTN work through its Horizon 2020 program[9] and recently chartered a new 6G Non-Terrestrial Networks (6G-NTN) program. The UK Space Agency is also supporting[10] 5G NTN research and development. The comparative lack of public sector research and development support for 5G NTN in the United States presents a risk to the competitiveness and growth of a US-based supply chain. There may be opportunities for outreach and collaboration with such organizations towards shared roadmaps, goals, and development milestones.

6 See https://exchange.telecominfraproject.com/marketplacev

7 See https://artes.esa.int/projects/alix

8 See https://artes.esa.int/space-5g

9 See https://5g-ppp.eu/sat5g/

10 See https://www.gov.uk/government/news/uk-space-agency-announces-50-million-for-satellite-communications

3. Conclusion

Aalyria appreciates NTIA's leadership in this program and looks forward to working with the agency and the Executive Branch to enhance competition for U.S. companies providing 5G, consumer access to the internet, and overall American leadership in telecommunications. Leveraging tools, such as Aalyria's existing, production-validated platform, will be instrumental in increasing supply chain resiliency, lowering prices, and facilitating new entry and market competition for American wireless infrastructure. NTIA should explore opportunities to dedicate support for the research and development of NTN and other 5G Advanced use cases, and work expeditiously to make the Innovation Fund funds available to U.S. providers on a technology neutral basis.