Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Promoting the Deployment of 5G Open Radio Access Networks	)	GN Docket No. 21-63
	)	
	)	

NOTICE OF INQUIRY COMMENTS OF INTEL CORPORATION

Jayne Stancavage
Intel Corporation
1155 F Street N.W.
Suite 1025
Washington, D.C. 20004

April 28, 2021

TABLE OF CONTENTS

I. Introduction and summary

Intel Corporation ("Intel") respectfully submits this comment to the Commission's Open Radio Access Network (RAN) Notice of Inquiry.[1] Intel appreciates this opportunity to provide our views on the status of standards and specifications development, the state of Open RAN solutions and the Open RAN ecosystem, and recommendations. Intel is the largest global semiconductor supplier; our processors, memory, storage, and other products power much of the world's computing capability. Intel is also a leader in 5G and as the world's leading network silicon provider (including as the leading silicon provider for base stations), one of our roles is to supply high volume and high-quality products to telecom equipment manufacturers. In the context of this proceeding, Intel is a leading provider of the technologies enabling traditional RAN, virtualized RAN and Open RAN solutions.

II. Standards and Specifications Status.

Intel participates in over 300 standards and industry groups worldwide including industry alliances, regional standards organizations, international industry-led standards groups and formal international standards bodies. With respect to 5G standards involvement, Intel employees hold leadership positions in 3GPP, IEEE, and the International Telecommunications Union. Intel employees serve on the Board of Directors of the Telecom Infra Project and the Open RAN Policy Coalition. Intel is a member of the O-RAN Alliance and we are an Open Networking Foundation partner.

---

[1] *Promoting the Deployment of 5G Open Radio Access Networks*, Notice of Inquiry, GN Docket No. 21-63, released March 18, 2021 ("NOI")

The O-RAN Alliance develops conformance testing, interoperability testing and end-to-end (E2E) system testing specifications, certification and badging procedures, and also provides Open Testing and Integration Center (OTIC) criteria and guidelines. The O-RAN Alliance releases specifications three times per year. Several testing specifications have already been developed within the O-RAN Alliance including the Open Fronthaul conformance test, Open Fronthaul interoperability test, X2/F1/Xn interface interoperability test, and the E2E system testing framework specifications. It should be noted that the version numbers for these specifications increase as more test cases for new features are incorporated. Specifications have also been developed for Cloud architecture for O-RAN, Cloud Platform Reference Design, Radio Intelligent Controller architecture, hardware architecture and requirements, hardware reference design, stack reference design, and O1/A1/E2 interface. Conformance and interoperability testing specifications for Xhaul transport, security and RIC interfaces are either under development or are expected to begin shortly (*e.g.* security specifications are expected to be available in H2'21). A full list of O-RAN Alliance specifications is available at https://www.o-ran.org/specifications .

The O-RAN Alliance has been improving coordination among the various working groups to align feature set and technical development cycles by mechanisms such as a release roadmap (similar to 3GPP system release roadmaps). The O-RAN Alliance is led by operators. A variety of large and small vendors, including leading telecommunications equipment vendors, participate in working groups of interest to their companies.

III. State of Development and Deployment of Open RAN Solutions

Operators carry tremendous influence on the technology solutions that are deployed across the entire network. For example, over a decade ago operators wanted to deliver the same scale and flexibility of the cloud to the networking world; using technologies that have been honed in the cloud, such as containers and virtualization, they could gain more agility, flexibility and efficiency as they scaled their networks for new use cases and services. As a result, the journey to transform telecommunications started more than a decade ago in the core of the wireless network with Intel playing a leading role in the transition from legacy, hardware-based networks to agile, programmable and software-based infrastructures.

Decoupling software from hardware allows network functions to be "virtualized" on standards-based servers. This shift from proprietary systems to server-based networks has broadened the ecosystem, fostered more technology innovation, improved network automation and made it possible to better leverage artificial intelligence and machine learning in the network, giving operators a more flexible way to scale network capacity and deliver new services in a faster, more efficient way. Operators are now starting to extend virtualization from the core of the wireless network out into the Radio Access Network (RAN); the virtualization of RAN functions on a cloud-based server infrastructure creates what is called a virtual RAN, or vRAN.

In addition, operators increasingly want an "open" architecture that allows them to utilize technology from multiple vendors and have a more flexible way to update subcomponents in their network. As a result, operators are driving a shift to "open" the protocols and interfaces between the various elements of RAN hardware and software. This allows operators to use

hardware and software solutions from different vendors including new entrants to the technology ecosystem, leverage innovations happening in the ecosystem, and update or replace individual pieces of software as needed.

The global 5G standard developed by 3GPP will be implemented in networks worldwide. Network operators, however, are not monolithic entities. In addition to the differences between existing cellular operators and new entrants, there are differences in use cases, deployment scenarios, network complexity, etc. Service providers will take steps in network virtualization on varying timelines or for various deployment scenarios, so different options will exist ranging from what the FCC refers to as "traditional RAN" to variations of vRAN. Some service providers are also taking steps, on varying timelines, to deploy open and interoperable interfaces within and between various subcomponents of the RAN (Open RAN).

IV. Open RAN Ecosystem

As a result of the significant investment we have made over the past decade, Intel has been enabling many companies to develop 5G network solutions with a foundation of Intel technology from the core to the edge. Intel provides a variety of hardware products that can be utilized in the creation of industry-leading 5G ORAN solutions. This includes Central Processing Units (CPU), Field Programmable Gate Arrays (FPGA), structured ASIC (eASIC), Solid State Drives (SSD) and ethernet adaptor cards. These products are integrated into Remote Radio Units (RRU), Distributed Unit (DU) and Centralized Unit (CU) platforms and more recently, O-RU reference platforms. Intel is also a pioneer in developing O-RAN compliant FlexRAN reference software, which has enabled over 100 companies (large and small) including leading Open RAN

software vendors and many OEM hardware providers, by serving as a basis for them to develop and optimize their commercial 5G software. Intel's Network Builder program brings together a community of over 400 network software and solution providers including hardware Original Design Manufacturers (ODMs), software developers, test equipment vendors, and system integrators. They have optimized on Intel technology for the last decade, with thousands of tested, real world implementations.

A vibrant Open RAN ecosystem needs extensive fiber deployment, as well as hardware and software solution providers for the CU and DU and ODM server solutions. The U.S. ecosystem has few RAN hardware and Virtual Network Function (VNF) software vendors especially for macro-cell solutions. These are important areas for the Open RAN ecosystem which should be considered in efforts to expand the ecosystem.

V. Recommendations.

Frequently, gaining access to new spectrum resources and/or shifting to a new generation of technology are the drivers of network deployments. Currently, the U.S. is at a momentous time with some new spectrum resources becoming available as a new generation of technology (5G) is also coming of age. This presents a great opportunity for 5G deployments in the U.S.

Identity Potential Barriers: To be clear, widespread 5G deployments will be the strongest driver of RAN architectures (traditional, vRAN, and Open RAN). Therefore, the FCC should do everything possible to enable 5G deployments including access to spectrum, removing regulatory barriers, facilitating 5G network deployment, facilitating the deployment of fiber networks, etc.,

without imposing any technology mandates.

Testbeds and Demonstration Projects: The Open Testing and Integration Centre (OTIC) provides a collaborative, open, and impartial working environment through a vendor-independent, open and qualified physical space for testing and verification of RAN equipment for conformance to specifications and interoperability, among other things.[2] North America would benefit from an OTIC, which could facilitate and accelerate adoption of Open RAN by certifying the most common tests required by operators. The presence of an OTIC in North America would likely be particularly helpful for smaller companies. As the U.S. Congress considers funding proposals related to Open RAN, any support for a North American OTIC from the FCC, as appropriate, would be useful.

The FCC could also facilitate mechanisms, as appropriate, related to knowledge-sharing such as the creation of blueprints for various network deployment types (e.g. rural, smaller carriers, private networks such as agency use, etc.) with end-to-end disaggregated hardware, software platform and interface testing to support and cultivate the technical capabilities of system integration (SI) with respect to configuration changes.

USF/Rip & Replace: Financial incentives and funding mechanisms to be used for deployments

[2] See https://www.o-ran.org/testing-integration.

such as the Rural Digital Opportunity Fund, Rip and Replace, etc. provide opportunities for 5G deployments including Open RAN. Funding proposals related to improving our nation's broadband infrastructure are currently under consideration by the U.S. Congress and could similarly spur 5G deployments, including Open RAN, in the U.S.

Commission Outreach & Information Gathering: Other U.S. government agencies are considering use of 5G networks, including Open RAN, for agency use. The ORAN ecosystem, including companies in the RAN hardware and VNF software solution space, could greatly benefit from program-based funding, such as deployment of their technology by U.S. agencies. This approach would also facilitate hardware and software system integration, which would help more companies be involved in the Open RAN ecosystem. The FCC has considerable technical expertise on communications networks which could be of great benefit to these agencies in their decision-making process. In addition, any support the FCC could provide via Commission outreach would be helpful.

VI. Conclusions.

As noted by the FCC, this is "an important time for our nation's service providers" and "Many carriers are currently considering which equipment to deploy as they transition to 5G…" Intel Corporation appreciates the opportunity to provide comments in this proceeding.

Respectfully submitted,

/s/ Jayne Stancavage
Global Executive Director,
Digital Infrastructure Policy

Intel Corporation
1155 F Street N.W.
Suite 1025
Washington, D.C. 20004

April 28, 2021