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Rebecca Dorch
National Telecommunications and Information Administration
U.S. Department of Commerce
325 Broadway
Boulder, CO 80305

Submitted via email to 5GChallengeNOI@ntia.gov

Re: Google NTIA 5G Challenge NOI Response, Docket No. 210105–0001, RIN 0660–XC049

Dear Ms. Dorch:

Google LLC appreciates the opportunity to present its contribution to the National Telecommunications and Information Assocation's (NTIA) Notice of Inquiry on its 5G Challenge. Google operates a leading global communications network. Cloud resources are core to using the high performance characteristics of 5G, and our cloud-based services are the most used in the world. We recognize that this contest is still in its early stages, and therefore have limited the scope of this response to some of the overarching questions and opportunities that such a contest provides.

Google has an extensive history of involvement in previous Government wireless initiatives, as well as current 5G efforts. Google's former Chairman and CEO participated in the Obama Administration's President's Council of Advisors and Science and Technology (PCAST) spectrum study; and other Google staff made key contributions to PCAST's report as well. This spectrum study led to the establishment of the highly innovative and commercially successful Citizens Broadband Radio Service (CBRS). Google helped to found and lead both of the industry organizations (OnGo Alliance, previously the CBRS Alliance, and Wireless Innovation Forum Spectrum Sharing Committee) that worked with the NTIA, DoD, and FCC to establish the CBRS spectrum sharing structure. Google is also very familiar with the details and recommendations of the Defense Innovation Board's (DIB) study on 5G, and is currently working with the Defense Advanced Research Projects Agency (DARPA) to create a framework for a direct industry-DARPA interchange on 5G private sector and DoD-researched technology.

Google understands, and is highly supportive of, Government-sponsored challenges. One of the first of these challenges was the DARPA Grand Challenge for Autonomous Vehicles. The winning team (Stanford University) became the basis for the Google self-driving car initiative, which is now the Waymo subsidiary of Alphabet Inc., Google's parent company. The autonomous vehicle initiative ignited wide-ranging private industry research and investment that

is now moving to successful commercialization, even providing commercial ride-hailing service in several cities. The experience of taking this project from a DARPA contest "winner" to a transformative technology demonstrates an institutional skillset that Google can provide to NTIA for this contest.

The focus should be on commercial adoption of the eventual open source solution. Google has an established track record of innovating within, fostering, and contributing to open source communities (examples include incubating and launching Kubernetes and, more recently, Istio). Based on that experience, we believe the ultimate goal of this contest should not be to declare a winner. Rather, it should be to establish a vibrant and self-sustaining ecosystem that will support, maintain, and enhance an open source solution that benefits technology vendors and customers with accelerated innovation and enhanced security. This requires commercial adoption of the resulting product(s). In addition to traditional mobile networks as customers for these products, DoD is an influential 5G adopter for both administrative and tactical uses, and so are private 5G networks, industrial Internet of things (IIoT) users, real estate companies, and myriad other parties that will make up a much more heterogeneous 5G ecosystem. Therefore, NTIA should contemplate the widest range of application and deployment scenarios in structuring the contest.

Commercial adoption also requires a competitive support ecosystem. To rival proprietary products and be viable in the market, open source products must have a competitive support infrastructure. Therefore, the contest should consider ensuring a competitive support structure of cloud service providers, professional service providers, maintenance, and the entire gamut of services required to achieve low-risk commercial use.

A public-private partnership (PPP) is an optimal way to execute the vision of this contest. Successful adoption of open source 5G will require concerted action by both industry and the Government. This dual responsibility should be reflected in how the contest is structured and completed. To that end, the PPP framework has many advantages to the success of this effort:

- Industry can interact directly with the NTIA in developing the contest framework, metric and qualitative criteria, and other aspects of the contest;
- Industry can provide its assessment of the key obstacles to the NTIA's and DoD's objectives in this concept and 5G more generally (for example, Google was a member of the successful DARPA Spectrum Challenge II Advisory Board);
- Industry may be able to provide resources to reduce obstacles to participation;
- Industry may choose to provide additional incentives to participation, either jointly with the Government or as separate awards;
- Industry has knowledge to identify the key issues in making such a large-scale solution deployable; the experience of industry in deploying large-scale, ubiquitous services, such as search, email, and retail, is essential to this effort; industry (including Google) has deep experience in optimizing deployments in ways that could be utilized for the Government's benefit;

- Industry support during the formulation of the contest provides participants confidence that the outcome will be meaningful in terms of follow-on opportunities for the open source solution; industry involvement furthermore supports the critical belief among participants that the conclusion of the contest is the beginning of technological advancement, not the end of it. That goal is best achieved through industry commercialization of this product, for no Government contest can by itself achieve this; and
- Obtaining the industry's, and the entire wireless ecosystem's, perspective early in the process, and then continuing to reflect it in the challenge will enhance 5G security through both reflecting the industry security experience, and increasing the likelihood and extent of the open source solution adoption.

There are critical attributes of a 5G open source solution. It would be premature to assign a specific metric or criteria to each of the following attributes. However, these attributes are central to the ultimate adoption of open source 5G software, and must be reflected in the criteria for this contest. As the contest concept is further refined, Google would be pleased to have the opportunity to further clarify these attributes. As discussed in the preceding paragraph, the PPP is an advantageous framework in which to develop definitions and metrics of success.

- **Portability:** There is little benefit in replacing a proprietary core framework with an open source framework that is itself tethered to a single, proprietary support infrastructure. There are standards and modern architectural approaches (e.g., cloud-native) for products that provide high degrees of portability across computing platforms, and these standards should be reflected in the competition. Similarly, the interfaces to the non-software aspects of the 5G system should be as portable as possible, such as provided by ORAN, or other applicable and widely-adopted standards.
- **Security:** Security is one of the driving factors in DoD's interest in an open source solution, so those components should be open and inspectible wherever possible. Unfortunately, security is not often amenable to a metric ranking and quantification of solutions. It is therefore important that the widest range of "best practices" by industry be reflected in any competitive bid, including the use of open source security solutions. Deployers and operators of Internet service are constantly developing and refining these best practices and are best-positioned to define this attribute, as previously discussed in the section on partnerships.
- **Automated Deployment, Configuration, and Operation:** Current mobile systems require extensive and ongoing human interaction to be deployed, configured, and operated. No matter how secure the underlying code might be, the large number of staff with direct access to the network, the control framework, and even the encryption tools are themselves each a major security concern. Additionally, the high cost of managing these networks makes their adoption less practical and scalable, even for DoD. The open source solution should not replicate this condition. Rather, modern cloud technology, such as that developed by Google and other major U.S. cloud vendors, operates millions of compute cores without direct human involvement. Achieving this level of secure automation must be a fundamental objective of the contest.

- **Scalability and Adaptability:** 5G will see a wide range of adopting business models and entities. Google has already seen this dynamic in the CBRS band, where the adopters of CBRS cellular technology include traditional mobile operators as well as fixed wireless providers, private LTE (and soon 5G), IIoT, neutral host, Government, and other providers of non-mobile services. An open source solution therefore must be not only suitable for mobile operator-scale deployments, but also scalable down to very small deployments of dozens of radios and unique non-traditional use cases.

For the reasons mentioned above, should NTIA proceed with this challenge, Google intends to be a willing partner.

Sincerely,

Austin Schlick
Director, Communications Law