



Red Hat

Response of Red Hat, Inc. (“Red Hat”)

to the “5G Challenge” Notice of Inquiry (NOI) (Docket No.210105-0001, January 11, 2021)

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Red Hat appreciates the opportunity to comment on the above-referenced matter. Red Hat is a leading provider of open source software solutions, using a community-powered approach to deliver resilient and high-performing cloud, Linux, middleware, storage and virtualization technologies.

Red Hat has a deep interest in this area. Our customers are demanding high-quality, trusted and affordable technology solutions that are found throughout mission-critical systems in the financial, transportation, telecommunications and government (civilian and defense) sectors in the United States and around the world. Red Hat is recognized as one of the world's most innovative companies.¹

The creation of a “5G Challenge” to accelerate the development of the open 5G stack ecosystem in support of the U.S. Department of Defense mission is a further step toward creating resilient, trusted, reliable and interoperable next generation networks. This Challenge recognizes the importance of fifth generation wireless technologies (5G) and creates the opportunity to explore important questions about how to optimize its growth. Our comments below touch on a number of questions included in the three categories posed in the Notice.

¹ See Forbes, “The World’s Most Innovative Companies”, 2018, found at: <https://www.forbes.com/companies/red-hat/>.

Introduction

The widespread adoption of 5G technologies has the potential to make connectivity an even more powerful tool, transforming how we live and work for the better. The increases in network speed and capacity that 5G offers will not just improve existing technologies such as video streaming but also enable entirely new applications that existing networks cannot easily support.

This opportunity is about more than the mobile networks that every citizen has come to rely on. It will touch on -- indeed potentially revolutionize -- a wide array of sectors, including automotive and connected vehicles; telemedicine services that can support real-time, high-quality video streaming in rural areas; manufacturing and supply chain; as well as the prospect for smart cities to reach their potential. As a leading voice of the IT industry observes:

“Beyond infrastructure investment, the use cases for 5G are projected to generate significant economic growth. In particular, the increased speed, capacity, and functionality of 5G networks will help to enable the next generation of data enabled innovations such as the Internet of Things (IoT) and artificial intelligence (AI). 5G networks will enable increased speeds and staggering amounts of data – mobile traffic is expected to grow by a factor of 4 from 38 exabytes in 2019 to 160 exabytes per month in 2025 (exabyte = one billion gigabytes).”²

To ensure, to the greatest degree possible, that this potential is both achieved and positive, the “5G Challenge” must rely on open standards³ (including interfaces) and open source technologies, including effective utilization of the hybrid cloud model. It should have a governance and operational structure that is lightweight, does not assume one model of 5G implementation (which may involve multiple project implementations), promotes reusability and modularity, and have transparency in its work and outcomes.

With each generation of wireless technology, the reliance on a hardware-dependent architecture has evolved into incorporating more agile, modular and componentized software solutions. In 5G networks, software can manage network operations and perform operations previously controlled by hardware through network virtualization and cloud computing. In existing wireless communications infrastructure, network performance hinges largely on the technical limitations and proper functioning of specific hardware. Through, for example, network virtualization and effective hybrid cloud strategies, 5G networks will likely be less dependent on hardware limitations, as software can emulate the performance of different kinds of specialized hardware and be updated, replaced and repaired remotely.

This more software-centric approach, coupled with effective (especially hybrid) cloud computing architecture, can enable innovation on a massive scale and support new kinds of applications not

² Information Technology Industry Council, “5G Policy Principles for Global Policymakers”, June 18, 2020, p. 2 , citing <https://www.ericsson.com/en/mobility-report/reports>. Found at: https://www.itic.org/policy/ITI_5G_Full_Report.pdf.

³ The following are generally recognized characteristics of an open standard: The standard is adopted and maintained by a not-for-profit organisation, and its ongoing development occurs on the basis of an open decision-making procedure available to all interested parties; the intellectual property - i.e. patents possibly present - of (parts of) the standard is made irrevocably available without encumbrances (e.g., on a royalty-free, irrevocable basis); there are no constraints on the re-use of the standard; and the standard has been published and the standard specification document is available either freely or at a nominal charge.

possible on 4G networks. The **use of open source software supported by a known and recognized vendor** allows greater control by the user; facilitates greater confidence and resiliency by providing the enhanced ability to examine every aspect of code and change what's not working; and increased stability due to less dependence on hardware which must be maintained and replaced regularly to keep up with changes.

An important corollary to use of open source software, **open standards (including interfaces) can ensure that all the components of a 5G network, from the edge to the core, can more easily interoperate**. This not only makes the user experience more efficient, it enables greater competition. Together, the combination of open standards (including interfaces) and open source, especially when driven by effective hybrid cloud strategies, will most likely enable the full import of the potential of 5G.

Thus, reference to the “open 5G stack ecosystem” is unclear and potentially obfuscates the objective. Discussion of 5G often assumes that it is merely an update of prior generations of mobile networks. While 5G entails similar qualities as found in 4G and its predecessors, it is at its core a fundamental shift in its breadth and scope. As highlighted above, 5G utilizes an unprecedented amount of software, is less hardware-centric and seeks to effectively utilize strategic assets via cloud computing (especially through a hybrid cloud model). A meaningful “5G Challenge” will necessarily require industry and governments in the United States and abroad to agree on a common model that clearly defines what 5G infrastructure entails and to reach a common understanding of various tiers and implementations that are now underway and foreseeable in the future, which is likely to be more software and cloud-centric in its actual practice.

Towards Diversity and Resilience in the 5G Ecosystem

The dynamics and economics of reaching the full potential of 5G are, at risk of understatement, complicated and reflect an evolution of the marketplace over many decades. The stark reality is that the “5G Challenge” must start with the fact that there is a global choke point facing the availability of essential 5G technologies in all facets of its architecture.

The efforts to promote the 5G ecosystem, unfortunately, confront the stark horizon of use of closed technologies that often prevent the integration of hardware or software from different vendors. This impedes competition and inhibits third parties from developing offerings that will work with those systems. Rather than facilitating a “plug and play” approach to the rollout of 5G, it exacerbates vendor dependency and technology lock-in, and contributes to driving up costs. It also jeopardizes efforts to promote reliability. With a heavy reliance on closed technology from only one provider, the reliability and trustworthiness of the network is risked if the provider becomes unable to maintain these technologies.

Each facet of the 5G network ecosystem can be seen independently in this light.⁴ Take, for example, the radio access network (RAN) at the edge of 5G networks. The radio access network relies on various hardware and software components working together to foster connectivity between devices like smartphones, connected vehicles, and sensors and the network core. The use of closed,

⁴ See discussion above on the fundamental shift that 5G represents from prior generations.

black-box architectures by some companies prevents their technology from easily, seamlessly, and securely working with technology from any other provider, limiting innovation and competition in the RAN layer.

In response, many companies new and old, in the United States and globally, are striving to apply an open approach to the 5G space, both at the RAN edge and elsewhere, with hopes of driving even greater vendor diversity, resilience and promoting innovation and economic growth. This is a reflection of the growing recognition by many in industry that collaborating around an open architecture and open technologies are vital to their business and a robust 5G network, just as they are vital to national security and the economy. Open technologies have been critical to the success of generations of technological advancement, including the Internet itself.

The O-RAN published specifications⁵ is a multiplier, potentially enabling exponential growth in 5G by fostering healthy competition in software communities. Contributors define open specifications so that components from different companies can work together to form a “best of breed” solution. Industry efforts like the O-RAN standard break down “walled gardens” and drive innovation.

Next Steps

The NOI asks how to accelerate the development of the open 5G stack ecosystem. We have noted above several key areas for consideration. Below are some additional recommendations on how to approach this challenge. We also call to your attention other, more detailed approaches that have been published.⁶

The “5G Challenge” recognizes that 5G must be “open” so that a diverse pool of suppliers can compete to develop the most innovative, resilient, and cost-effective products. To maximize the potential benefits of this initiative, we urge consideration of the following:

- **The “5G Challenge” will benefit from providing more specific definitions of the terms being used in the NOI which include open 5G stack ecosystem, open architecture, and open source.** In particular, the initiative should consider where in the ecosystem its contribution would be most valuable, working with the private sector, based on a transparent assessment of what may be lacking in the market and avoid a ‘boil the ocean’ approach.
- **If the “5G Challenge” does envision building development communities around any emerging technologies (especially software) it is essential that it use existing open source licenses.** This is important for a number of reasons, particularly to avoid the creation of government-unique licenses, which would be an impediment to the initiative’s overall goal of

⁵ See <https://www.o-ran.org/specifications>. “O-RAN Alliance members and contributors have committed to evolving radio access networks around the world. Future RANs will be built on a foundation of virtualized network elements, white-box hardware and standardized interfaces that fully embrace O-RAN’s core principles of intelligence and openness. An ecosystem of innovative new products is already emerging that will form the underpinnings of the multi-vendor, interoperable, autonomous, RAN, envisioned by many in the past, but only now enabled by the global industry-wide vision, commitment and leadership of O-RAN Alliance members and contributors.”

⁶ See generally, Information Technology Industry Council, “[5G Policy Principles for Global Policymakers](#)”, June 18, 2020 cited above.

being ‘open’ and promoting broad reuse and acceptance. The utilization of existing licenses facilitates building developer support for projects, and minimizes the risk of a go-it-alone government-off-the-shelf (GOTS) outcome. A valid open source license is one that is approved by the Open Source Initiative (<https://opensource.org/licenses>).

- As stated above, ensure, to the greatest degree possible, that the “5G Challenge” relies on open standards (including interfaces) and open source technologies, including effective utilization of the hybrid cloud model. It should have a governance and operational structure that is lightweight, does not assume one model of 5G implementation (which may involve multiple project implementations), promotes reusability and modularity, and have transparency in its work and outcomes

The deployment of 5G networks is underway, but many challenges and questions surrounding its evolution remain. The more quickly that national governments move to focus on how to encourage and accelerate the adoption of open 5G technologies and architectures, the more likely that we will maximize the potential of and resilience of the 5G ecosystem – for consumers, the economy, and national security. Otherwise, there will be a repeat of the previous experience of new generations of mobile networks that relied on closed architecture.

Please do not hesitate to contact us if you have any questions.

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