

The Linux Foundation Response to NTIA 5G Challenge Inquiry

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Introduction:

The Linux Foundation's goal is to create the greatest shared technology investment in history by enabling open collaboration across companies, developers and users.

We are the nonprofit organization of choice to build ecosystems that accelerate open source technology development and commercial adoption on a global scale. You can learn more about the Linux Foundation at www.linuxfoundation.org and in our [annual report](#).

Using the COCOMO II model to estimate the value of code, the Linux Foundation hosts the shared R&D effort of over 450 open source projects worth over \$54B USD. Developed openly under neutral governance, these projects are a result of the collaboration of the private sector, government, and academia.

Recently DARPA has selected the Linux Foundation as its open source foundation partner for its 5G, Edge, and IoT efforts, which include defining, integrating, and testing a fully open source 5g end to end stack.

We welcome a successful NTIA 5G Challenge and propose that any challenge be in partnership with the Linux Foundation to build on this open source end to end 5g stack collaboration. The Linux Foundation has a commercial ecosystems built on multi-vendor interoperable open source projects that span 1000 members and 890,000 contributors.

Existing Collaboration with DARPA and The Linux Foundation:

- The Linux Foundation established an umbrella project (US Gov Ops) for US Government driven end user ecosystem around a Open Source Software driving a new era of US technology leadership
- The first project under the umbrella, in collaboration with DARPA, is OPS-5G (Open, Programmable Secure) established to accelerate 5G, Edge & IoT technologies creation and deployment
- Open Ecosystem efforts aligns on a common open source architecture and set of open source projects and focuses on integrations and enhancements to the secure open source end to end 5G stack.
- Effort leverages the existing networking open source projects and community efforts at the Linux Foundation and industry disruptions like disaggregation, SDN/NFV, and cloud native.

Why DARPA chose Linux Foundation, de-facto partner for open source:

- Expertise in building sustainable commercial ecosystems around open technology: open source software, specs, hardware, data
- Neutral governance plus open source development, creates even playing field for contributions and a technology transfer path for new innovations
- Ability to quickly onboard new ecosystem players into the open source community through robust training, certification, and guidance
- Home to 15 of 16 of the top Open Source Networking projects, leveraged by over 75% of WW Telecom Operators

In addition to hosting Linux, the Linux Foundation is also home to the private, government, and academia collaboration around open source projects that define the end to end 5G stack including: ONAP, Magma, FD.IO, Tugsten Fabric, OpenDaylight, ORAN Alliance Software Community, Kubernetes and related Cloud Native Computing Foundation (a Linux Foundation initiative) projects, Akraino, Project Eve, Zephyr, and many many more.

I. Challenge Structure & Goals

A. How could a Challenge be structured such that it would take advantage of DOD's role as an early U.S. Government adopter of 5G technology to mature the open 5G stack ecosystem faster, encourage more participation in open 5G stack development including encouraging new participants, and identify any roadblocks to broader participation?

The Linux Foundation proposes that 5G Challenge work products be focused on existing or new open source projects hosted at the Linux Foundation with its neutral governance and open, transparent development model. In addition to the projects hosted at the Linux Foundation listed earlier, on February 3rd, 2021, Facebook contributed the Magma Project, an open source 5G core network function to the Linux Foundation. The Magma Project closely cooperates with and has contributions from Open Air Interface.

B. How could a Challenge be structured to focus on the greatest impediments to the maturation of end-to-end open 5G stack development?

The Linux Foundation recommends the Challenge coordinate with US DoD 5G Initiative and DARPA OPS-5G and other DARPA initiatives. The coordination can further support the center of gravity and momentum around the common set of open source projects accelerating time to innovation in the open source 5G end to end architecture hosted at the Linux Foundation.

C. What should be the goals of a Challenge focusing on maturation of the open 5G stack ecosystem? How could such a Challenge be structured to allow for the greatest levels of innovation? What metrics should be used in the assessment of proposals to ensure the best proposals are selected?

In addition to encouraging development in all of the open source projects already selected with DARPA to define the end to end 5G stack, we recommend additional focus to be encouraged in the area of ORAN. Specifically, we encourage additional open source development, contributed by private industry, government and academia, to the ORAN Software Community, hosted at the Linux Foundation, in order to accelerate readiness of the ORAN stack for inclusion in the fully open source 5g end to end reference architecture.

D. How will the open 5G stack market benefit from such a Challenge? How could a Challenge be structured to provide dual benefit to both the Government and the open 5G stack market?

The challenge will further enhance the sustainable commercial ecosystems at the Linux Foundation around open technology, be it open source software, specs, hardware, or data.

The challenge will invite new ecosystem players to the open source community. The Linux Foundation has the methodologies and resources to onboard these new players with robust training, certification, and technical guidance.

By executing the Challenge in partnership with Linux Foundation, the neutral governance and open source development will provide a playing field for contributions and a technology transfer path for new innovations.

II. Incentives and Scope

A. What are the incentives in open 5G stack ecosystem development that would maximize cooperation and collaboration, promote interoperability amongst varied open 5G stack components developed by different participants, and mature desired featured sets faster with greater stability?

Collaborating in an open development model, as is the Linux Foundation methodology, is critical to maximizing cooperation and collaboration. For example, we recommend that code be developed iteratively in the open, as existing project communities do not respond well to large code drops from developers and entities not previously working within the project community.

B. Could a Challenge be designed that addresses the issues raised in previous questions and also includes test and evaluation of the security of the components?

Test and Evaluation is a very important component of OPS-5G as well as many open source projects. We encourage all open source projects to consider including test and evaluation as part of the development process.

C. Could a Challenge be designed that would require participants to leverage software bill of materials design principles in the development of components for an open 5G stack?

It is common in the build process of an open source project to include the software BoM, that is, a list of all the upstream open source components used to build the project and their open source software licenses. The Linux Foundation can assist the Challenge participants to follow established best practices in this area.

D. Many open 5G stack organizations have developed partial implementations for different aspects of an open 5G stack. What portions of the open 5G stack has your organization successfully developed with working code? What portions of the open 5G stack does your organization believe can be developed quickly (6 months or less)? What development support would best enable test and evaluation of the different elements of an open 5G stack?

The Linux Foundation facilitates the collaboration of developers worldwide from private sector, government, and academia on open source projects that have the potential to become the defacto-standard implementation in their respective industries. Please see previous comments on the end to end 5G stack collaboration efforts hosted at The Linux Foundation.

E. What 5G enabling features should be highlighted in the Challenge, such as software defined networking, network slicing, network function virtualization, radio access network intelligent controller, radio access network virtualization?

Any of these can be highlighted but should build upon and leverage open source projects already selected by the collaboration with DARPA in order to further accelerate developer momentum in those projects.

III. Timeframe & Infrastructure

A. What software and hardware infrastructure will be needed to successfully execute this Challenge?

The Linux Foundation is home to a multitude of software and hardware infrastructure leveraged by open networking projects. We recommend coordinating with and leveraging existing infrastructure as much as possible.

B. What is a reasonable timeframe to structure such a Challenge? Should there be different phases for such a Challenge? If so, what are appropriate timelines for each suggested phase?

The Linux Foundation is flexible to the timeframe for such a Challenge. We look forward to collaborating with the 5G Challenge to even further accelerate the open source end to end 5G stack reference architecture, test and integration work done with DARPA.