# Response to the NTIA 5G Challenge Notice of Inquiry

## Responder

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## Aarna Networks Background

Aarna Networks, Inc. is an open source software company headquartered in San Jose, CA. Our Aarna Networks Multi Cluster Orchestration Platform (AMCOP) product is an open source orchestration, lifecycle management, and policy driven closed loop automation platform for 5G network services and edge computing applications. We package open source components from the Linux Foundation Open Network Automation Platform (ONAP) project to create our product.

With 5G becoming almost entirely software driven (through NFV) and the advent of edge computing applications, the stress on application management will explode. The stress on application management may be described as:

$$\text{Stress on application management} \propto \text{Number of sites} \times \text{Number of application instances} \times \text{Rate of application change.}$$

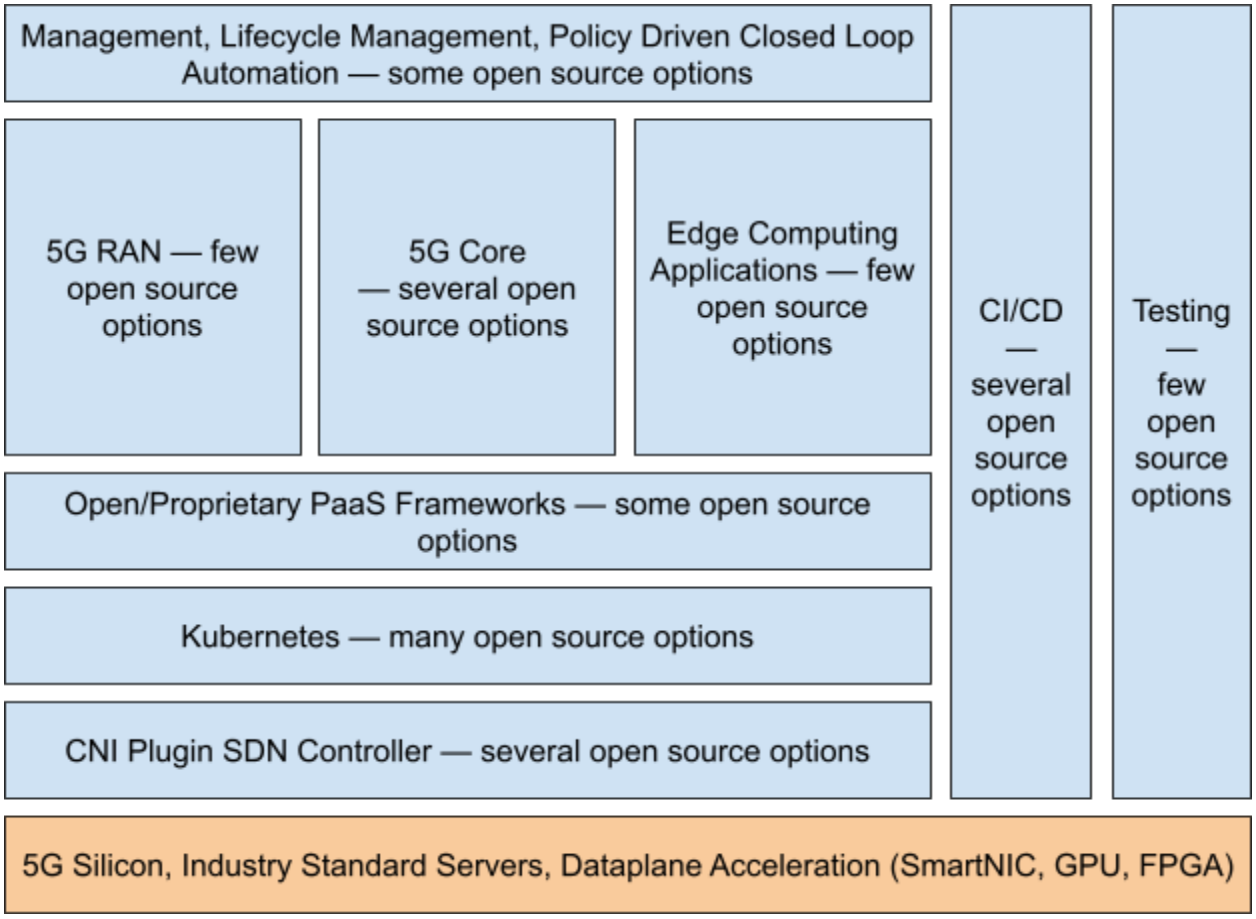
With 5G and edge computing the number of sites could be in the 10,000 if not 100,000 range (to run 5G RAN and subsequently to run other edge computing applications). The number of applications could be in the 1,000s which could go up to 10,000s of instances with 5G network slicing. Moreover, the edge will be a very dynamic environment. Existing mechanisms will not work when it comes to managing 5G networks and edge computing applications. This is the problem AMCOP solves.

## Overview

We agree with the central premise of the inquiry and feel that a well structured Challenge could unleash innovation to improve US competitiveness in 5G as well as that of US companies. We feel the Challenge should incorporate these key components:

- Application focus—a clear use case focus, whether it be Industry 4.0, healthcare, public safety, V2X etc. will provide the participants a set of concrete requirements and a well defined value proposition.
- Organization/company diversity—the Challenge could invite multiple stakeholders for a given stack to put together a given stack to foster innovation, demonstrate interoperability, and promote the disaggregation of the stack.
- Mix of open source, open standards compliant technologies—As an open source company, we feel that open source is the purest form of “open”. However, some components such as parts of the 5G RAN or edge computing applications may not all be open source. At a minimum, they should adhere to open standards such as the O-RAN specification (in the case of RAN components) or ETSI/ONAP application packaging (in the case of edge computing applications).
- Financial support for startups/academic institutions—A Challenge structured as a competition with a grant award for the “winners” could bring an additional level of innovation to the Challenge.
- Modeled after Linux Foundation Edge Akraino—The LF Edge Akraino project includes a large number of blueprints (some are 5G related others are pure edge). Regardless, the philosophy and methodology could be adopted for the Challenge.

In terms of focus on the components, we believe the Challenge should include the software components (in blue):




# Response to Section I: Challenge Structure & Goals

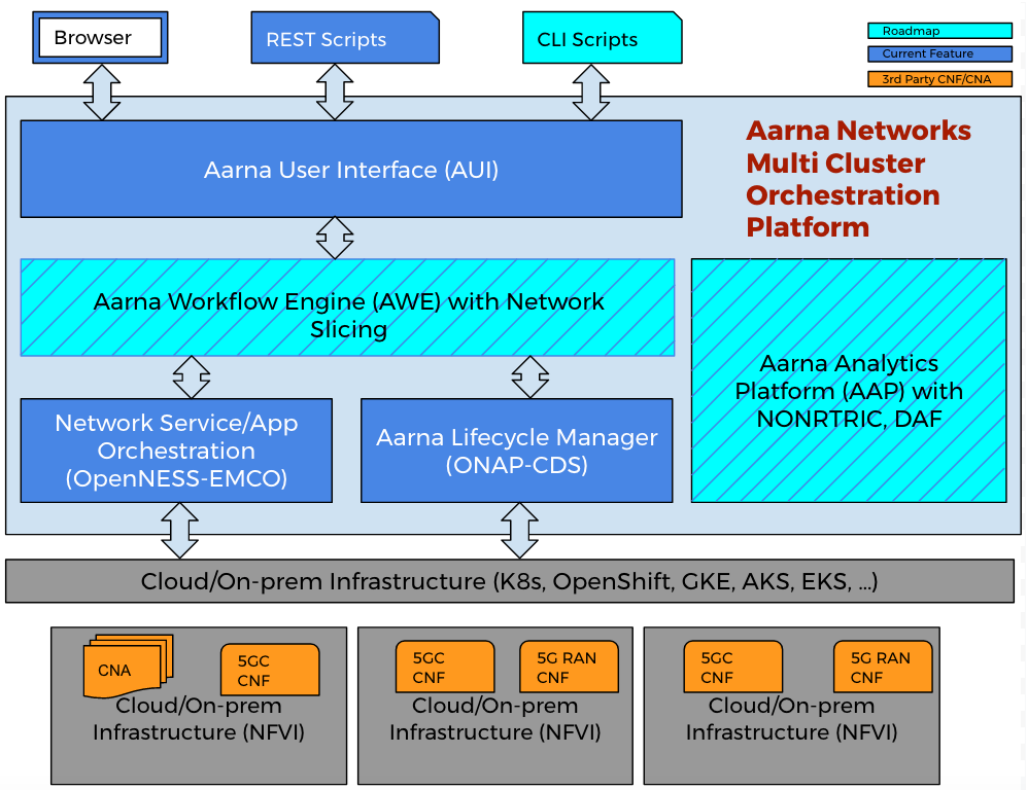
A. If the Challenge is structured around clear use cases as defined by the DOD, it could take advantage of the DOD's role as being an early adopter of 5G. If the Challenge is anticipating that groups of organizations will form a consortium before responding, then a match making mechanism will help expand the Challenge to more participants and remove a key roadblock. However, if the Challenge expects individual organizations to respond on their own, the point is moot.
B. A guiding use case and a clear expectation of which components are expected to be open source vs. open standards will help mature the end-to-end 5G stack faster.
C. An agile methodology could be used to allow for the greatest amount of innovation. The first phase could focus on functionality. Subsequent phases could focus on stability, security, scalability, performance, manageability, usability, and resilience. In addition to openness (open source, open standards), a subset of the above metrics could also help choose participants for the Challenge.
D. Similar government-led Challenges in countries such as the UK have shown the power of these initiatives to help both the government and the industry. A well formulated Challenge can help mature the stack, promote a more open stack, and create a greater

diversity of companies providing different components of the stack in a disaggregated and interoperable manner.

Additional Comment: The DOD could consider partnering with an open source organization to bring proven methodologies and neutral governance to the Challenge. Any joint work from the Challenge could also be upstreamed to an open source repository through this mechanism making it that much easier for others to replicate the results of the Challenge.

# Response to Section II: Incentives and Scope

A. The greatest incentive for participants is for NITA to demonstrate a path to production use for the technologies involved. A secondary incentive, important to smaller organizations, is an award grant to defray the costs of participating in the Challenge.
B. An agile approach could allow for the previous questions *and* testing/security aspects to be included in the Challenge. In this sense, the Challenge could be ongoing with increasingly complex issues being tackled as time progresses.
C. We believe that the 5G world will inherently be a software-driven environment. For this reason, the Challenge must focus almost entirely on a software bill of materials. The hardware components are well understood and are mostly provided by cash rich larger companies. For this reason, they could be a secondary aspect of the Challenge while the primary aspect could be the software components. The RU could be an exception.
D. As Aarna Networks, we have developed an open source orchestration, lifecycle management, and real-time policy driven closed loop automation platform for 5G network services and edge computing applications.




Aarna Networks Multi Cluster Orchestration Platform Architecture

We will also develop proprietary components on top of the platform such as A) 5G Network Slicing Manager, B) O-RAN Non-Real-Time RIC, C) Network Data Analytics Function (NWDAF).

The components in dark blue are successfully available with working code. The light blue components will be delivered within the next 6 months. The development support that will help us most in terms of establishing interoperability are: 1) testing of the O1 interface for O-RAN, 2) clearer definitions and testing of the O2 and A1 interfaces for O-RAN, and 3) Cloud Native Network Function (CNF) and Cloud Native Application (CNA) packaging standards with compliance testing.

E. The following table shows what features should be highlighted:

| Include and highlight | Include but do not highlight (since these are mature) | De-emphasize |
|---|---|---|
| CNFs with dataplane acceleration | Kubernetes | VNFs |
| Orchestration, management, automation | SDN | OpenStack |

| | | |
|---|---|---|
| End-to-end Network Slicing | Rel 15 compliant 5G Core | 4G and 5G NSA |
| nRT-RIC and NONRTRIC | | |
| NWDAF | | |
| O-RAN components | | |
| Rel 16 compliant 5G Core | | |
| Edge computing apps | | |

# Response to Section III: Timeframe & Infrastructure

A. The following are required:
    a. Industry standard servers (with storage and networking)
    b. 5G radio
    c. Hardware acceleration as required
B. As per the above discussions, we believe it is important to have an agile methodology. The following might be a reasonable timeframe:
    a. Functional stack: June 2020
    b. Stability/security testing: +3-6 months
    c. Performance/scalability/resilience testing: +3-6 months