O-RAN Software Community
PROJECT PROPOSAL
For inclusion from Release A

Non Real-Time RAN Intelligent Controller (RIC non-RT)

Project Name:

- Proposed name for O-RAN SC project:
  Non Real-Time RAN Intelligent Controller (RIC non-RT)
- Proposed name for the repository:
  non-rt-ric

Project description:

The primary goal of *RIC non-RT* is to support non-real-time intelligent radio resource management, higher layer procedure optimization, policy optimization in RAN, and providing guidance, parameters, policies and AI/ML models to support the operation of *RIC near-RT* to achieve higher-level non-real-time objectives. *RIC non-RT* functions include service and policy management, RAN analytics and model-training for the *RIC near-RT* functionality.

With the amount of L1/L2/L3 data collected from eNB/gNB (including CU/DU), useful data features and models can be learned or abstracted to empower intelligent management and control in RAN. For example, network spatial-temporal traffic patterns, user mobility patterns, service type/patterns along with the corresponding prediction models, network quality of service (QoS) prediction patterns, massive MIMO parameters configuration, and more can be reused, abstracted or learned. This information can then be combined with additional network-wide context and policies to drive fine-grained near-real-time network radio resource management in the *RIC near-RT* and non-real-time optimization within *RIC non-RT*.

Analytics, intents and policies defined for the *RIC non-RT* in many cases will need to be mapped to sub-policies, actions, parameter changes, analytics/learning tasks, etc., to steer the operation of the RAN via the *RIC near-RT*. Such changes will enhance the local analytics/learning and decision processes in the *RIC near-RT* to be enriched by higher-level context and goals. For example, localized near-real-time decisions about

load-balancing, ID allocations, handover decisions, resource allocations, etc., can greatly benefit from adjustment and guidance about the high-level network-wide intents of the network operators. The core algorithms executing in or above the of *RIC non-RT* will be developed and owned by operators, some aspects of which may be proprietary. This will provide the capability to modify the RAN behaviors by deployment of different policies and models optimized to individual operator intents and objectives. The policies passed from *RIC non-RT* to *RIC near-RT* are created, modified and deleted by the *RIC non-RT*, guided by context information or policy state information received over A1 or O1, e.g. from the RAN indicating intent fulfillment (O1).

The A1/O1 interfaces together will support communication & information exchange between the *RIC non-RT* and the *RIC near-RT*, while also supporting the exchange of FCAP information to the Orchestration and Automation layer above. The use of the A1/O1 interface must be coordinated in a holistic manner.

Key functions that the A1/O1 interfaces are expected to provide include:

- Network & UE-level information/context exposure from network elements to *RIC non-RT* to support various requirements such as network management, online learning and offline training of AI/ML models and driving non real-time optimization into the network.
- Support for policy-based guidance of *RIC near-RT* functions/use-cases, deploying/updating AI/ML models into *RIC near-RT*, and feedback mechanisms from *RIC near-RT* to ensure that operator's intents and objective are met.

Scope – Release A:

The following features are in scope for the RIC non-RT project within O-RAN SC release A:

- Enhancements to support O-RAN SC release A use cases that can be delivered "on top of" ONAP release 4 Dublin (in other words, without Dublin code impacts):
    - Yang models based on O-RAN IM/UML or YANG files imported from O-RAN WGs
    - Directed graphs (DG) for SDN-R / CCSDK
    - New Adapters needed to support use cases (details to be determined during planning phase)
    - Netconf, Ansible, and Chef interfaces
    - Initial ML model catalogue access for model training performed for *RIC non-RT* (details to be determined during planning phase based on identified use cases)
    - Non real-time automated control via CM changes in network functions based on an initial O-RAN Yang model as an output of the analytics performed for the *RIC non-RT* (ML-assisted or otherwise, exact use case to be determined during planning phase)

- Support for third party controllers
    - Adapter to allow DG to connect to NetConf devices

- High availability (local)

- The following features may be defined for this project:
    - Configuration versioning: ability to roll back the configuration
    - Support for third party controllers
        - Adapter layer to interface with downstream controllers
    - Support for geographically distributed network resources

Scope / Ambition – 2020+

The *RIC non-RT* will form a significant part of the Orchestration and Automation (O&A) layer of O-RAN, situated on top of the A1 interface. In addition to the *RIC non-RT* activities already mentioned the O&A layer together with the *RIC non-RT* must also handle configuration and deployment FCAP activities (e.g. data collection for information to be received over O1 interface). There must exist functions that handle AI/ML workflow, e.g. training and update of ML Models, both inside the O&A layer and for deployment to *RIC near-RT*. There must also be access to other non-RAN related data to enhance the RAN operation and optimization functions, again within the O&A layer and the *RIC near-RT*.

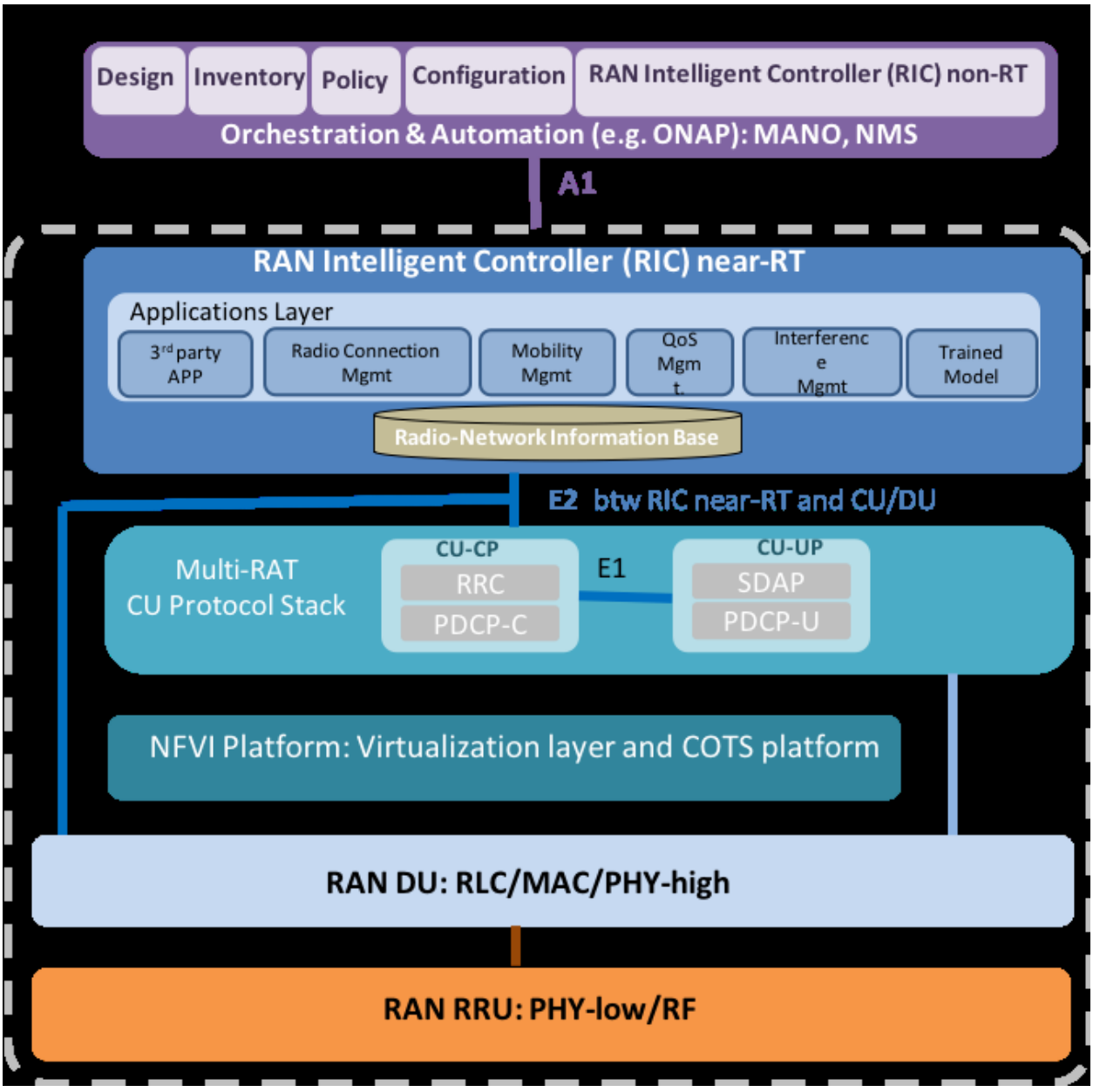
The *RIC non-RT* must support these activities in the O&A layer. Some longer-term questions that must be addressed include:

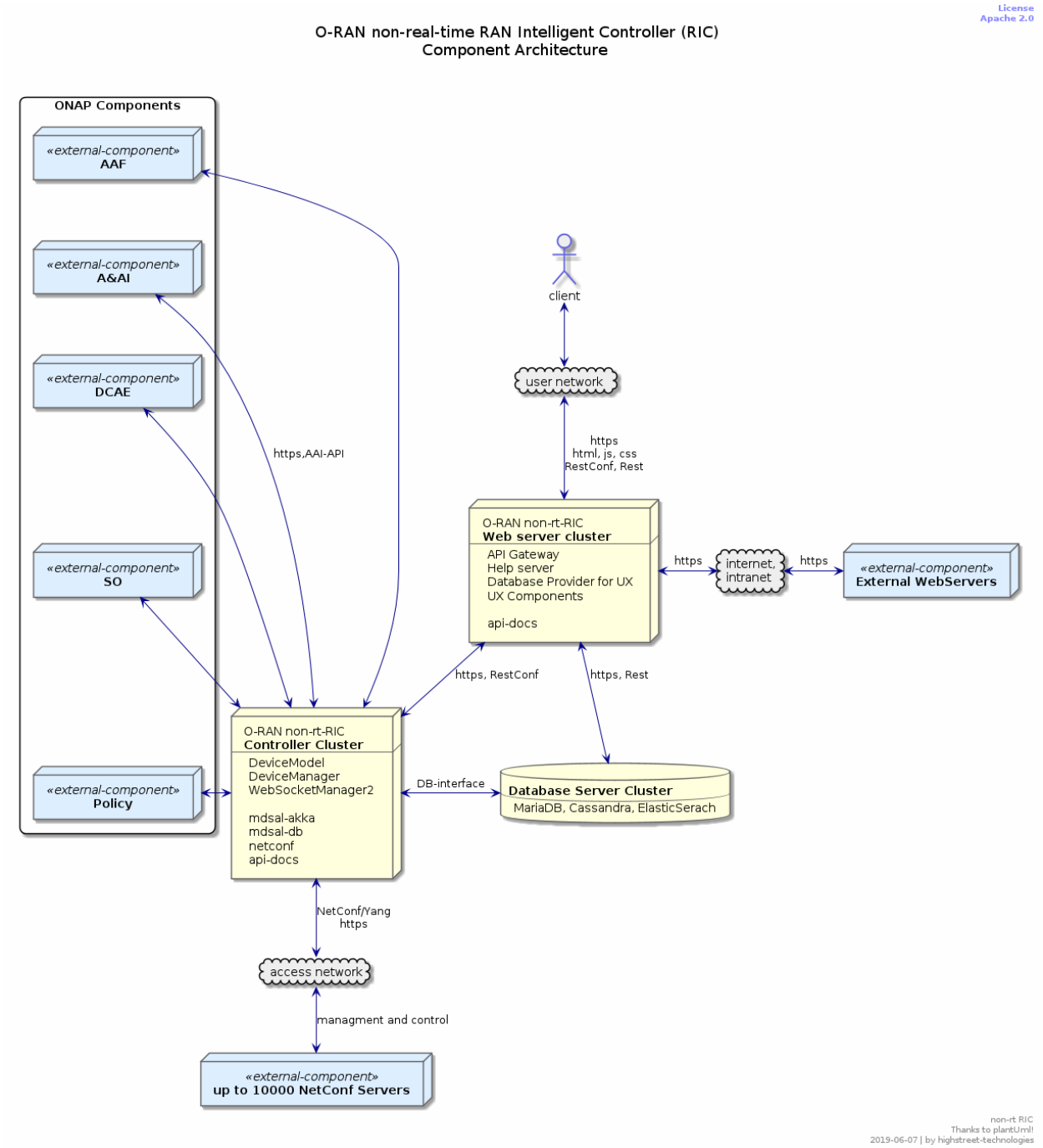
- How are non real-time control loops designed, modelled, packaged, deployed, monitored, and adapted after deployment?
- How are the high-level operator goals/intents mapped to actionable/deployable policies for the *RIC near-RT*?
- How are the monitoring activities to monitor intent satisfaction derived from intent-based policies, then deployed and managed?
- How are ML/analytics models in the O&A layer and *RIC near-RT* coordinated, dynamically updated and tuned in a coordinated manner?
- Automated decomposition of intents and ML/analytics functions requires accurate comprehensive details of underlying target infrastructure and capabilities. How will these models be specified, populated and updated in a coordinated manner to achieve this decomposition?
- How are conflicting models or intents handled in a coordinated manner?
- How can proprietary/black-box models/policies/services/loops be handled in a manner that enough detail is available to support their coordinated operation while protecting their internal operation?

Architecture Alignment:

How does this project fit into the rest of the O-RAN Architecture?

This project uses the O-RAN A1/O1 interface specifications to integrate wireless xNFs with RIC non-RT which is a component within the Orchestration & Automation layer depicted within the O-RAN architecture diagram below:





RIC non-RT is built on ONAP and intended to be used within ONAP; however, there are other options within the Orchestration & Automation layer.

How does this align with external standards/specifications?

TOSCA, NETCONF, YANG, and the O-RAN Information Model (OIM) for control of multi-vendor wireless network elements through open management interfaces, as defined in O-RAN WG interface specifications.

Are there dependencies with other open source subprojects?

- Acumos
- Akraino
- Open RAN Alliance
- Open Daylight
- ONAP
- Open Networking Foundation
- OPNFV

Resources:

Project Technical Lead (PTL):

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<completion of roster in progress>

We propose weekly open meetings chaired by the PTL (Current proposal: Mondays 16:00-17:00 UTC).

Project requirements

The project requests the following facilities form Facilities from LF/ORAN SC:

- Mailing list, or hashtag: https://lists.o-ran-sc.org/g/main
- Confluence site: https://wiki.o-ran-sc.org/display/RICNR (TBC)
- JIRA: https://jira.o-ran-sc.org/
- Gerrit repo: https://gerrit.o-ran-sc.org/r/admin/repos
- Slack Channel
- Zoom account

Lifecycle State: incubation