

# Release E

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## Summary

### Primary Goals for Non-RealTime RAN Intelligent Controller (Non-RT-RIC)

- The primary goal of Non-RT-RIC is to support intelligent RAN optimization by providing policy-based guidance, ML model management and enrichment information to the near-RT RIC function so that the RAN can optimize, e.g., RRM under certain conditions.
- It can also perform intelligent radio resource management function in non-real-time interval (i.e., greater than 1 second).
- Non-RT-RIC applications (rApps) can use data analytics and AI/ML training/inference to determine the RAN optimization actions for which it can leverage SMO services such as data collection and provisioning services of the O-RAN nodes.
- Non-RT-RIC define and coordinates rApps (Non-RT-RIC applications) to perform Non-RT-RIC tasks.
- Non-RT-RIC hosts the new R1 interface (between rApps and SMO/NONRTRIC services)

### Overall objective for the E Release

*In the E Release we focus mainly on studying and providing some building blocks to support the emerging Non-RT-RIC Apps ("rApps") and R1 interface concepts from O-RAN.*

*Support and improvement of functions for the O-RAN A1 interface continue.*

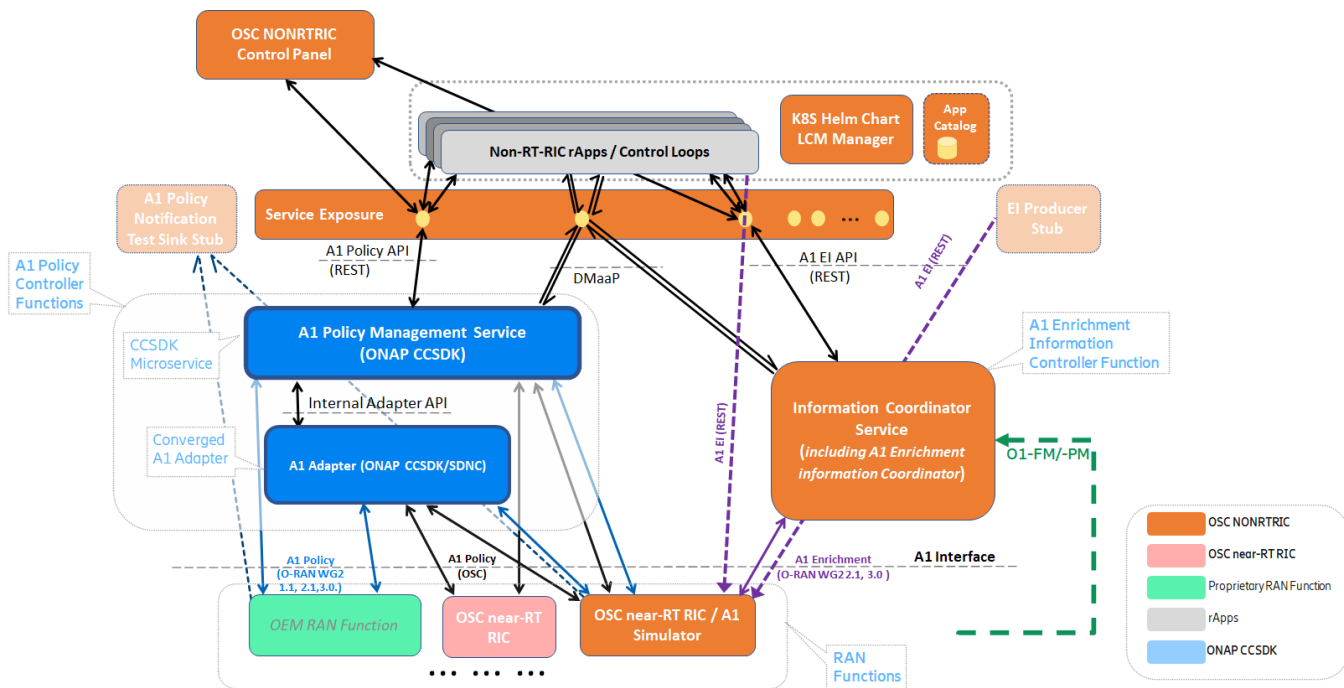
### E Release Priorities

- ONAP Control Loop -> O-RAN rApp : "The *rApp-ification* of ONAP Control Loops"
  - Adopt ONAP CL work as a starting point, continue to identify gaps, then extend
  - Identify & motivate where an rApp is different from a CL
  - Types of rApps:
    - Microservice-based rApps
    - Non-Microservice-based rApps
- NONRTRIC Service Exposure/Gateway -> O-RAN R1 : "The *R1-ification* of Service Exposure"
  - Service-independent aspects
  - Types of exposure support in R1:
    - Microservice-based rApps & Service
    - Non-Microservice-based rApps & Service
- Use cases of rApps & Exposing specific Services via R1
  - Requirements drivers & demonstrators
  - O-RU FH recovery (multiple), O-DU Slice Assurance (multiple), Existing Function Tests, various other use cases in ONAP
- Continued Evolution & Support for A1 functions

## E Release Feature Scope

- NONRTRIC Functions:
  - Integrated A1 Adapter from ONAP (A1 Policy (A1-P) controller – mediation)
  - Integrated A1 Policy Management Service from ONAP (A1 Policy (A1-P) controller)
  - rApp/Control Loop Manager (ONAP & OSC)
  - OSC Information Coordinator (controller – Data Management & Exposure & A1 Enrichment Information (A1-EI) Job management)
  - OSC Non-RT-RIC Control Panel (GUI – for A1-P & A1-EI Job management)
  - OSC A1 Simulator (a stateful test stub to simulate near-RT-RIC end of A1 interface – A1-P & A1-EI)
  - Initial OSC APP catalog (for registering/querying APPs)
  - K8S Helm Chart LCM Manager - for APP μServices etc. (ONAP & OSC)
  - Exposure Gateway Functions
  - Coordinated service exposure for R1 interface
  - DMaaP Information Producer Mediator/Adapter (multiple)
- In E Release:
  - Deployment, Integration & Configuration– Continued improvements for Docker & Kubernetes
  - Extended/Easier deployment options with OSC IT/DEP project (SMO/NONRTRIC deployment)
  - O-RAN A1-AP evolution (v3.0)
  - Evolution of A1-EI functions to a more generic Information Coordination functions, moving beyond A1-EI
  - Further improvement in security management
  - Re-architect & improve usability of Non-RT-RIC Control Panel (GUI)
  - Extend NONRTRIC Control Panel to sort and filter A1 Policies
  - Extend NONRTRIC Control Panel to sort and filter A1 Enrichment Types/Jobs
  - Extend NONRTRIC Control Panel to configure A1 Policy Management Service
  - Configurable Service Exposure function – Extends/Replaces static exposure gateway in OSC D-release
  - K8S Helm Chart LCM function for App μServices
  - Update NONRTRIC demo/test environment (one-click tests/use-cases, docker & single/multi-node K8s env)
  - OSC e2e integration use case – O-RU-FH-HelloWorld recovery
    - App to instigate O-RU-FH connection recovery after failure – via O-DU
      - Multiple implementation options – standalone μService and/or deployable ONAP-PF policy script
  - OSC e2e integration use case – O-DU-HelloWorld-SliceAssurance
    - Closed loop tuning of RRM policies to assure Slice performance - via O-DU
      - Multiple implementation options – standalone μService and/or deployable ONAP-PF policy script

## Architecture for Release E



## NONRTRIC components

1. Non-RT-RIC Control Panel
2. Non-RT-RIC (Spring Cloud) Service Gateway
3. Non-RT-RIC (Kong) Service Exposure Prototyping
4. A1 Policy Management Service
5. Information Coordinator Service
6. DMaaP/Kafka Information Producer Adapters
7. Initial Non-RT-RIC App Catalogue
8. A1 Policy Controller / Adapter
9. Near-RT RIC A1 Simulator
10. Initial K8S Helm Chart LCM Manager
11. Test Framework
12. "Helloworld" O-RU Fronthaul Recovery use case
13. "Helloworld" O-DU Slice Assurance use case

The code base for "E" Release is in the [NONRTRIC](#), [NONRTRIC-ControlPanel](#), and [A1-Simulator](#), source repositories (Gerrit: 'e-release' branch)

## Non-RT-RIC Control Panel

*Graphical user interface to interact with the Non-RT-RIC services.*

- View and Manage A1 policies in the RAN (near-RT-RICs)
- Graphical A1 policy creation/editing is model-driven, based on policy type's JSON schema
- View and manage producers and jobs for the Information Coordination Service
- Configure A1 Policy Management Service (add/remove near-rt-rics)
- Interacts with the A1-Policy Management Service & Information Coordination Service (REST NBIs) via Service Exposure gateway
- Implementation:
  - Frontend: Angular framework
  - Repo: [portal/nonrtic-controlpanel/web-frontend](#)

Please refer [this developer guide](#) to set up in your local environment. More information about Non-RT-RIC control panel can be found [here](#).

## Non-RT-RIC (Spring Cloud) Service Gateway

*Support Apps to use A1 Services (May be replaced by Service Exposure function in later releases)*

Spring cloud Gateway provides the library to build the API Gateway for Micro-service architecture. In Non-RT-RIC we build the basic API gateway using spring cloud gateway which then exposes two Non-RT-RIC functions; Policy Management Service & Enrichment Coordinator Service. You can add predicates through code or yaml and in Non-RT-RIC we prefer to use yaml.

NONRTRIC gateway code can be found at:

- <https://gerrit.o-ran-sc.org/r/gitweb?p=portal/nonrtic-controlpanel.git;a=tree;f=nonrtic-gateway>

More information on the Spring Cloud Gateway can be found in the documentation [here](#).

## Non-RT-RIC (Kong) Service Exposure Prototyping

*Support Apps to use NONRTRIC, SMO and other App interfaces*

*A building block for coming releases as the R1 Interface concept matures*

- Support dynamic registration and exposure of service interfaces to Non-RT-RIC applications (& NONRTRIC Control panel)
- Extends a static gateway function specifically for NONRTRIC Control panel
- Initial version based on Kong gateway function
- Initial exposure candidates include A1 (NONRTRIC) services & O1 (OAM/SMO) services

Kong is a cloud-native, high performance, scalable & Open source API Gateway. Kong comes in 2 flavors

- Without Database
- With Database like PostgreSQL or Cassandra

The NONRTRIC Kubernetes deployment will deploy Kong if the *installKong* flag is set to true. During uninstallation of *nonrtic* components it will also remove Kong if it's deployed by *nonrtic* script.

If the ingress enabled flag is set to true then it will create the ingress objects for A1 Policy & Enrichment Service so the Kong gateway (acts as ingress controller) will expose these functions.

NONRTRIC Kubernetes deployment can be found at:

- <https://gerrit.o-ran-sc.org/r/gitweb?p=it/dep.git;a=tree;f=nonrtic/helm>

More information on Kong API Gateway can be found a,

<https://docs.konghq.com/gateway-oss/>

<https://github.com/Kong/charts/blob/main/charts/kong/README.md>

## NOTE:

Kong installation done by *nonrttric* script is 'Without Database'.

## A1 Policy Management Service (from ONAP CCSDK – Istanbul)

A1 Controller Service above A1 Adapter that provides:

- Unified REST & DMaaP APIs for managing A1 Policies in all near-RT-RICs
- Operations:
  - Query A1 Policy Types in near-RT-RICs
  - Create/Query/Update/Delete A1 Policy Instances in near-RT-RICs
  - Query Status for A1 Policy Instances
- Maintains (persistent) cache of RAN's A1 Policy information
  - Support RAN-wide view of A1 Policy information
  - Streamline A1 traffic
  - Enable (optional) re-synchronization after inconsistencies / near-RT-RIC restarts
  - Added support for multiple near-RT-RICs (& multi-version support)
- Unified REST & DMaaP NBI
- Converged ONAP & O-RAN-SC A1 Adapter/Controller functions in ONAP SDNC/CCSDK
  - (Optionally deploy without A1 Adapter to connect direct to near-RT-RICs)
- Support for different Southbound connectors per near-RT-RIC - e.g. different A1 versions, different near-RT-RIC version, different A1 adapter / controllers supports different or proprietary A1 controllers/EMSs

Documentation about the service can be found at:

- <https://docs.o-ran-sc.org/projects/o-ran-sc-nonrttric/en/e-release/>
- <https://docs.onap.org/projects/onap-ccsdk-oran/en/latest/>
- [A1 Policy Management Service in ONAP](#)

## Information Coordinator Service

*Coordinate/Register Information Types, Producers, Consumers, and Jobs.*

*Coordinate/Register A1-EI Types, Producers, Consumers, and Jobs (A1 Enrichment Information Job Coordination).*

- Maintains a registry of:
  - Information Types / schemas
  - Information Producers
  - Information Consumers
  - Information Jobs
- Information Query API (e.g. per producer, per consumer, per types)
- Query status of Information jobs
- After Information-type/Producer/Consumer/Job is successfully registered delivery/flow can happen directly between Information Producers and Information Consumers
- The Information Coordinator Service natively supports the O-RAN A1 Enrichment Information (A1-EI) interface, supporting coordination A1-EI Jobs where information (A1-EI) flow from the SMO/Non-RT-RIC/rApps to near-RT-RICs over the A1 interface.

Documentation about the service can be found at:

- <https://docs.o-ran-sc.org/projects/o-ran-sc-nonrttric/en/e-release/>

## DMaaP/Kafka Information Producer Adapters

*Configurable mediators to take information from DMaaP (& Kafka) and present it as a coordinated Information Producer*

Two alternative implementations to allow Information Consumers to consume DMaaP or Kafka events as coordinated Information Jobs.

These configurable adapters/mediators act producers of Information Coordinator Service (ICS) jobs by polling topics in DMaaP Message Router (MR) or Kafka and pushing the messages to a consumer.

- A version implemented in Java (Spring) - Supporting DMaaP and Kafka mediation:
  - [Release E - Run in Docker#RuntheDmaapAdaptorServiceDockerContainer](#)
  - <https://gerrit.o-ran-sc.org/r/gitweb?p=nonrttric.git;a=tree;f=dmaap-adaptor-java;hb=refs/heads/e-release>
- A version implemented in Go - Supporting DMaaP mediation:
  - [Release E - Run in Docker#RuntheDmaapMediatorProducerDockerContainer](#)
  - <https://gerrit.o-ran-sc.org/r/gitweb?p=nonrttric.git;a=tree;f=dmaap-mediator-producer;hb=refs/heads/e-release>

## (Initial) Non-RT-RIC APP catalog

*Register for NONRTTRIC APPs*

- APPs can be registered / queried
- Limited functionality/integration for now
- A building block for coming releases as the R-APP concept matures

- <https://docs.o-ran-sc.org/projects/o-ran-sc-nonrtic/en/e-release/>

## A1 Policy Controller / Adapter (*from ONAP CCSDK – Istanbul*)

*Mediation point for A1 interface termination in SMO/NONRTIC*

- Implemented as CCSDK OSGI Feature/Bundles
- A1 REST southbound
- RESTCONF Northbound
- NETCONF YANG > RESTCONF adapter
- Mapping logic / Provider
- Can be included in an any controller based on ONAP CCSDK

Documentation about the adapter / controller can be found at:

- <https://docs.o-ran-sc.org/projects/o-ran-sc-nonrtic/en/e-release/>
- <https://docs.onap.org/projects/onap-ccsdk-oran/en/latest/>
- [CCSDK A1 Adapter for A1 Policies in ONAP](#)

## Near-RT-RIC Simulator

*Stateful A1 test stub*

- Used to create multiple stateful A1 providers (simulated near-rt-rics)
- Supports A1-Policy (A1-P) and A1-Enrichment Information (A1-EI)
- Implemented as a Python application
- Swagger-based northbound interface, so easy to change the A1 profile exposed (e.g. A1 version, A1 Policy Types, A1-EI consumers, etc)
- All A1-AP versions supported

Documentation about the simulator can be found at:

- <https://docs.o-ran-sc.org/projects/o-ran-sc-sim-a1-interface/en/e-release/>

## Initial K8S Helm Chart LCM Manager

*Onboard, start, stop, and modify Non-RT-RIC App μServices as Helm Charts*

*A building block for coming releases as the rApp concept matures*

- Interfaces that accepts Non-RT-RIC App μServices Helm Charts
- Support basic LCM operations
- Onboard, Start, Stop, Modify, Monitor
- Initial version co-developed with [v. similar functions in ONAP](#)
- Limited functionality/integration for now

## NONRTIC Test Platform

Information about the test platform can be found at:

- <https://wiki.o-ran-sc.org/display/RICNR/Function+Test>

## Use Cases

### "Helloworld" O-RU Fronthaul Recovery use case

*A very simplified closed-loop rApp use case to re-establish front-haul connections between O-DUs and O-RUs if they fail. Not intended to be 'real-world'*

Information about the use case can be found at:

- [Release E: O-RU Fronthaul Recovery usecase](#)

Code for the use case can be found at:

- <https://gerrit.o-ran-sc.org/r/gitweb?p=nonrtic.git;a=tree;f=test/usecases/oruclosedlooprecovery;hb=refs/heads/e-release>

### "Helloworld" O-DU Slice Assurance use case

*A very simplified closed-loop rApp use case to re-prioritize a RAN slice's radio resource allocation priority if sufficient throughput cannot be maintained. Not intended to be 'real-world'*

Information about the use case can be found at:

- [Release E: O-DU Slice Assurance usecase](#)

Code for the use case can be found at:

- <https://gerrit.o-ran-sc.org/r/gitweb?p=nonrtrc.git;a=tree;f=test/usecases/odusliceassurance;hb=refs/heads/e-release>