NOKIA

The O-RAN Alliance
The ORAN-SC Project
The near-RT RIC

thoralf.czichy@nokia.com
PTL, OSC near-RT RIC

Nov-05-2021

Agenda

1. The O-RAN alliance and the O-RAN Software Community
2. E2AP and E2SM (E2 Service Models)
3. The O-RAN SC near-RT RIC architecture
4. The E release (2H2021) and future releases of the near-RT RIC
5. Demo (seven minutes)

The O-RAN alliance was formed to increase competition

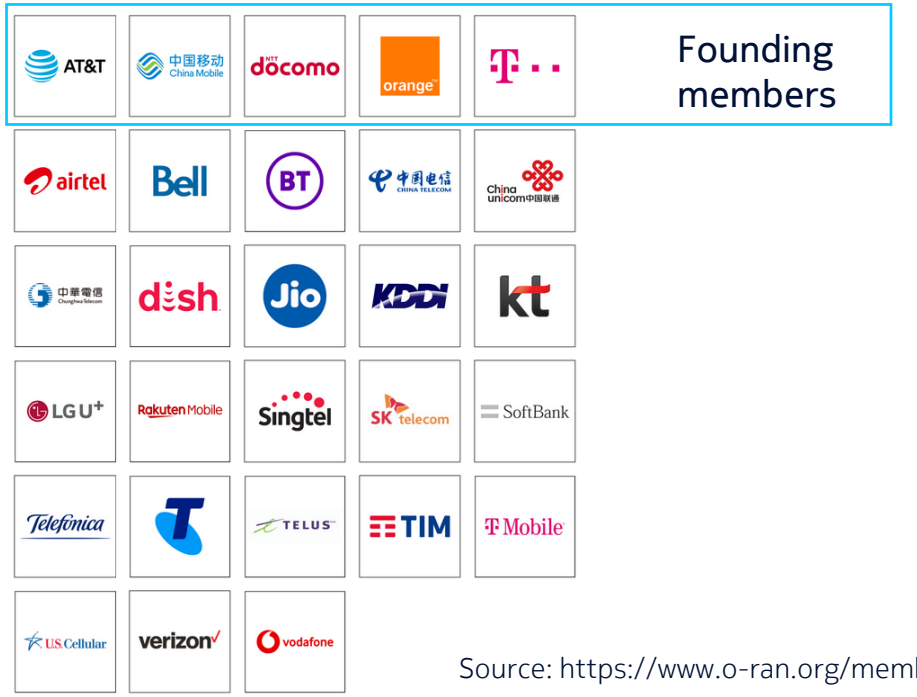
RAN openness, hardware vs software separation, programmability

O-RAN ALLIANCE

250+ contributors

- Launched June 2018
- Merging of the xRAN Forum with the C-RAN Alliance
- O-RAN Alliance announced collaboration with TIP (Telecom Infrastructure Project) in February 2020
- 9 key working groups led by operators with contributors co-chairing

28 mobile operators



Source: https://www.o-ran.org/membership

Key Objectives:

- Bring Cloud Scale Economies to RAN
- Bring Agility to RAN

Key Principles

- Lead the industry towards open, interoperable interfaces, RAN virtualization, and big data enabled RAN intelligence
- Maximize the use of common-off-the-shelf hardware and minimizing proprietary hardware
- Specify APIs and interfaces, driving standards to adopt them as appropriate, and **exploring open source** where appropriate

NOKIA

The working groups of the O-RAN alliance

#1 Use cases & overall architecture

#2 Non-real-time RIC and A1

#3 Near-real-time RIC and E2AP plus E2SM (service models) for RC, KPM, NI

#4 Open Fronthaul eCPRI 7.2x split

#5 Open F1/W1/E1/X2/Xn (re-use of 3GPP specs)

#6 Cloudification and Orchestration (O1 (3GPP reuse), O2)

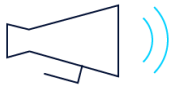
#7 White-Box hardware

#8 Stack Reference Design

#9 Open X-haul Transport

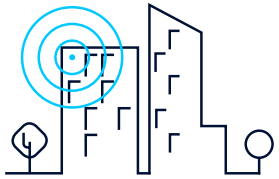
O-RAN-SC – The O-RAN software community

Want to participate? https://wiki.o-ran-sc.org/ → participate



Est. April 2019

- Project by the O-RAN Alliance and the Linux Foundation (LF)
- Open-source software aligned with the architecture specified by the O-RAN Alliance
- Re-using Series of LF Projects, LLC (common “master LLC”, but separate divisions with limited liabilities).
- LF also provides project infrastructure



>20 companies

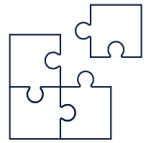
- Source code contributions from >20 companies
- 92% of the commits by the top 10 contributing companies
- License: Apache 2.0

4 releases

- A release every 6 months (in July and December):
- Amber (Nov-2019)
- Bronze (Jun-2020)
- Cherry (Dec-2020)
- D (Jul-2021)
- E (Dec-2021)
- F …
- https://wiki.o-ran-sc.org/display/REL/Releases

Tue + Wed

- Day-to-day management via the TOC (Technical oversight committee)
- Weekly meetings on Wednesdays, noon, UTC
- https://wiki.o-ran-sc.org/display/TOC
- Subprojects have own meeting practice
- For example, near-RT RIC has fortnightly meetings on Tuesdays, 1pm UTC
- https://wiki.o-ran-sc.org/display/RICP/Project+meetings



SCP + SCCL

- The O-RAN Specification Code Project has separate charter, and delegates administration to the O-RAN-SC TOC
- Shares infrastructure and meetings with O-RAN-SC,.
- License: O-RAN software license (SCP)
- License: Standards Collaboration Copyright License - SCCL = https://www.o-ran.org/sccl

O-RAN-SC subprojects

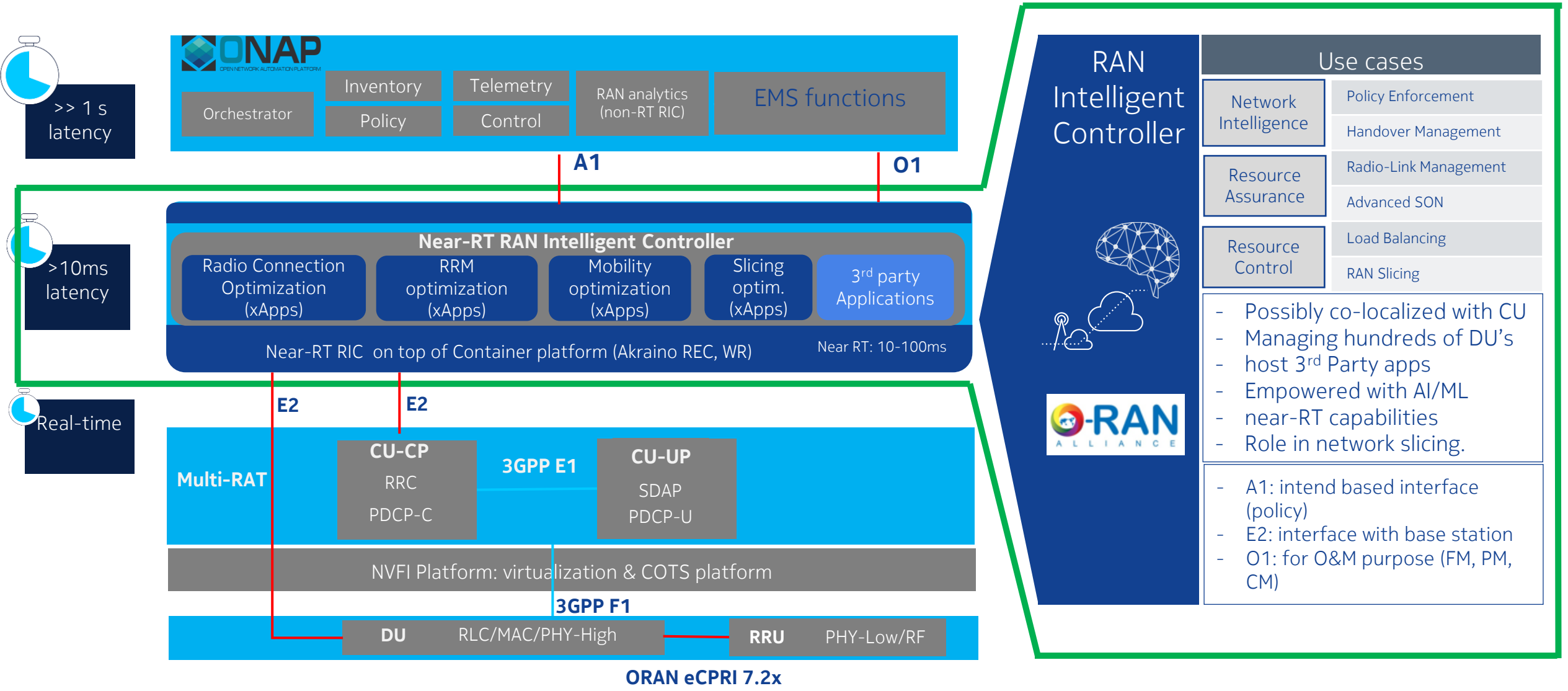
Project	PTL	Description
RICAPP	Sunil Kumar Singh HCL	Near-RT RIC XApps
Near-RT RIC	Thoralf Czichy Nokia	Near-RT RIC platform
OCU	Suzy Gu CMCC	UP implementations for SDAP and PDCP, eGTP-U as binary
ODUHIGH	Sachin Srivastava Radisys	Implementing L2, F1, MAC scheduler, RLC
ODULOW	Zhimin Yuan Intel	Implementing L1, Intel FlexRAN binary used
ORU	TBD NA	O-RAN Radio Unit No contributions

Project	PTL	Description
OAM	Martin Skorupski HST	yang models, RIC dashboard, O1 reference impl. + O1 client
SIM	Alex Stancu HST	Simulators for testing O-RAN, e.g, E2AP
INF	Xiahua Zhang Windriver	Cloud infra for O-RAN (WR)
INT	James Li China Mobile Technology, USA	Integration of O-RAN SC release
DOC	Weichen Ni CMCC	Documentation to readthedocs.io
NONRTRIC	John Keeney Ericsson	A1 policy mgr (used by rApps), r-app host, Enrichment data, (ML mgmt)
SMO	Mahesh Jethanandani Juniper	Integrated SMO & deployment scenarios with ONAP

Licenses of O-RAN-SC and the Specification code project

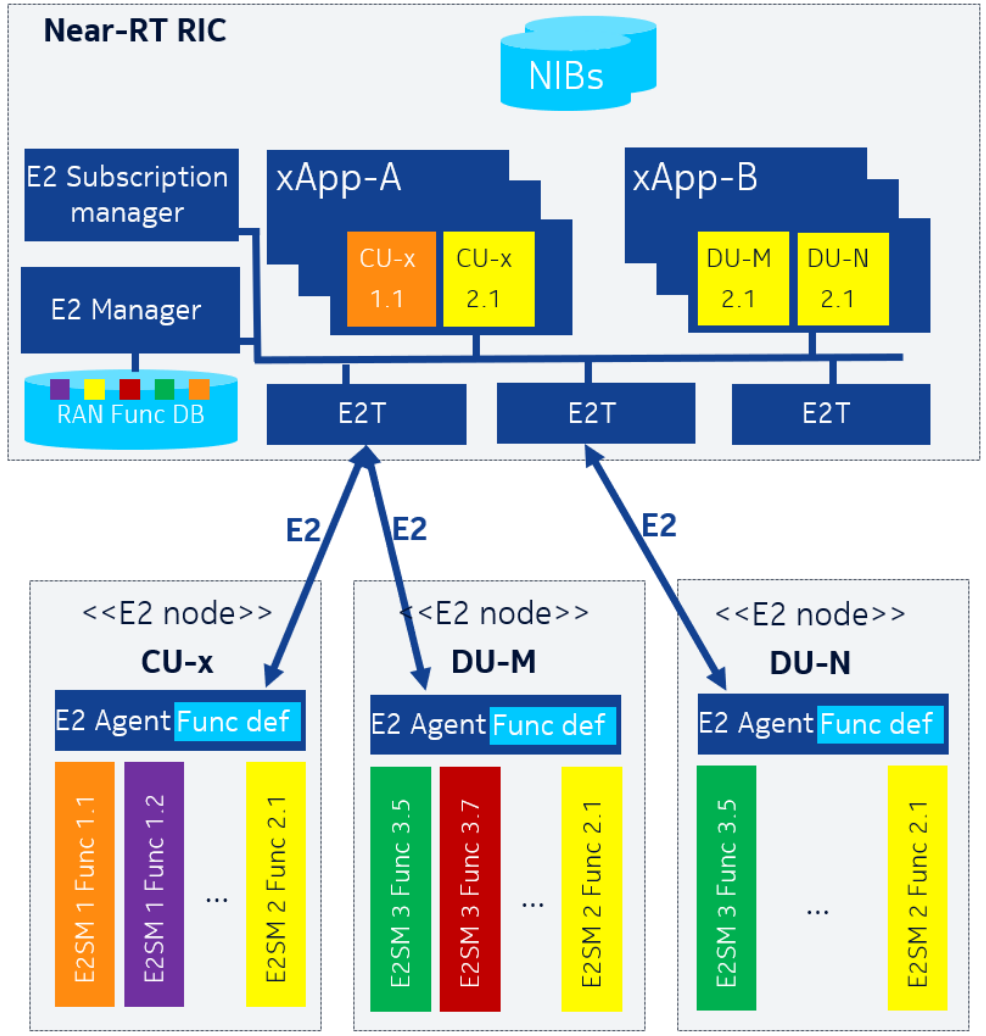
- The Specification code project shares infrastructure and meetings with O-RAN-SC
- We give repositories within subprojects the choice between contributions under **Apache 2 license** or under **ORAN Software license**, also referred to as SCP (Specification code project)
- Documentation to be contributed under **Creative Commons Attribution** 4.0 (CC BY 4.0)
- The Apache license is a very **liberal license** in terms of being able to use the source code, e.g., it includes an explicit patent license
  - For example, the Near-RT RIC subproject uses this license.
- ORAN Software license, also referred to as SCP (Specification code project) license is used in the specification code project
  - Details of the license: https://www.o-ran.org/software
  - Used for some xApps and OCU repo. Repos always in folder ”scp” in gerrit
- No contributions without an online-signed **contributor license agreement** (CLA)
  - https://wiki.o-ran-sc.org/display/ORAN/Signing+Contributor+License+Agreement
- Minor related contribution to **asn1c**
  - asn1c fork : https://github.com/nokia/asn1c (BSD2/3) - minor adaptations to make it work with the O-RAN ASN.1 specifications.
- SCCL – https://www.o-ran.org/sccl

What is the near-RT RIC: architecture and key requirements

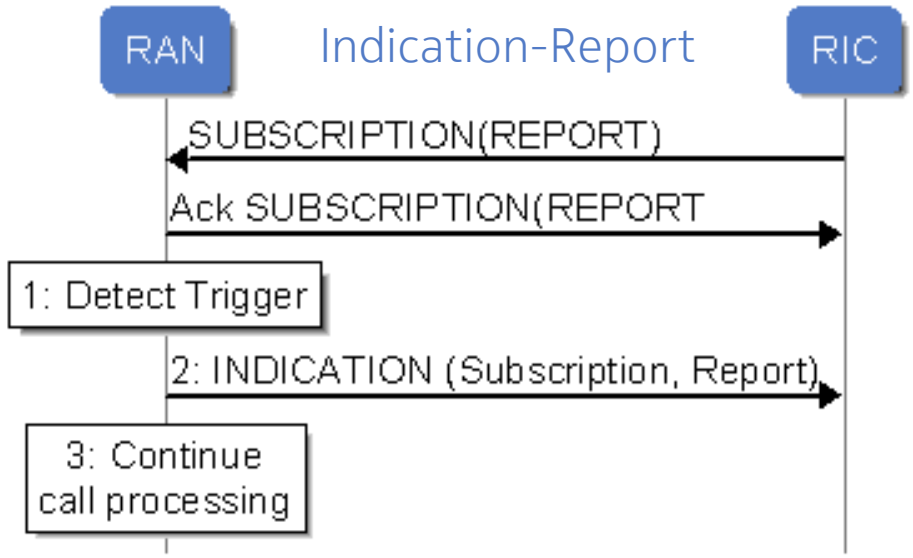


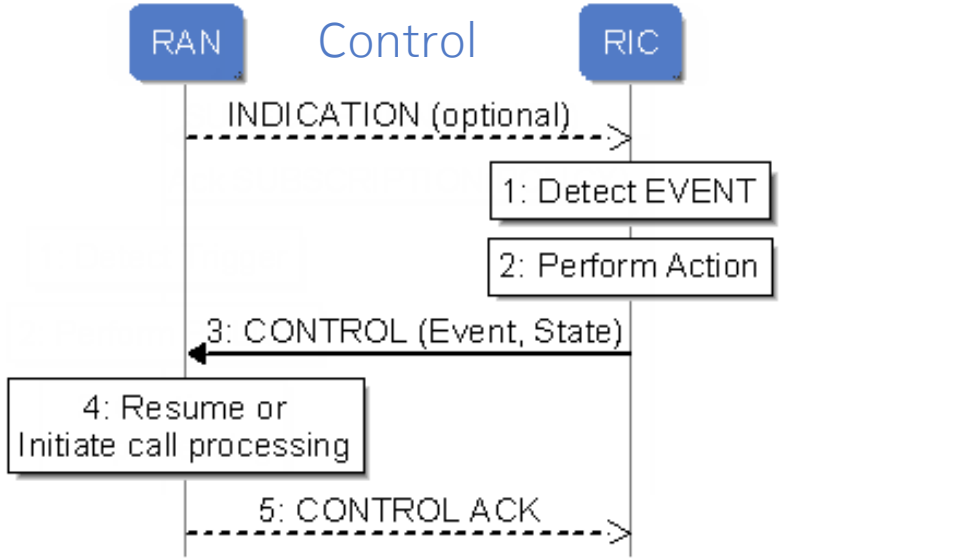
E2 principles

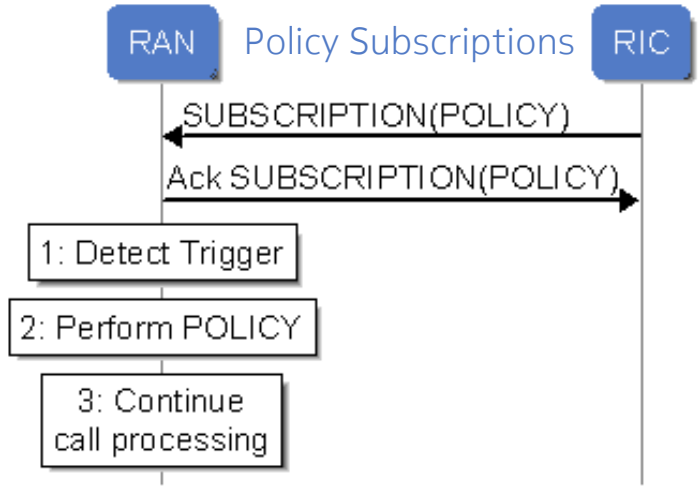
- Amber implemented a pre-spec version of E2AP. Bronze, Cherry and Dawn implement E2AP version v01.00. E2AP version 2.0 is currently in the O-RAN approval cycle.
- The RIC **E2AP** (Application protocol) specification (ORAN-WG3.E2AP-v01.00.00) defines the general protocol by which the near-RT RIC and RAN (gNB, eNB, CU-{CP,UP}, DU) communicate.
- More detailed **E2SM** (Service model) specifications define the function-specific protocol that is implemented on top of the E2AP specification. Typical functions are X2AP, F1AP, E1AP, S1AP, NGAP interfaces and RAN internal functions UE, Cell, Node.
  - Now: Formal O-RAN E2SMs: Network interface: ORAN-WG3.E2SM-NI-v01.00.00 and Key performance monitoring: ORAN-WG3.E2SM-KPM-v01.00.00
  - For example, while the E2 specification defines the concept of event triggers, it is the E2SM for NI that defines the specific triggers in the X2/F1/E1/… function based on matching X2/F1/E1/… AP message type, or X2/F1/E1/… IE.
  - E2SMs are an agreement between xApp and E2SM function on E2 node. To the RIC platform E2SMs are opaque.
  - The implementation of the E2 service model on gNB side requires explicit feature development on O-RAN CU/DU side.

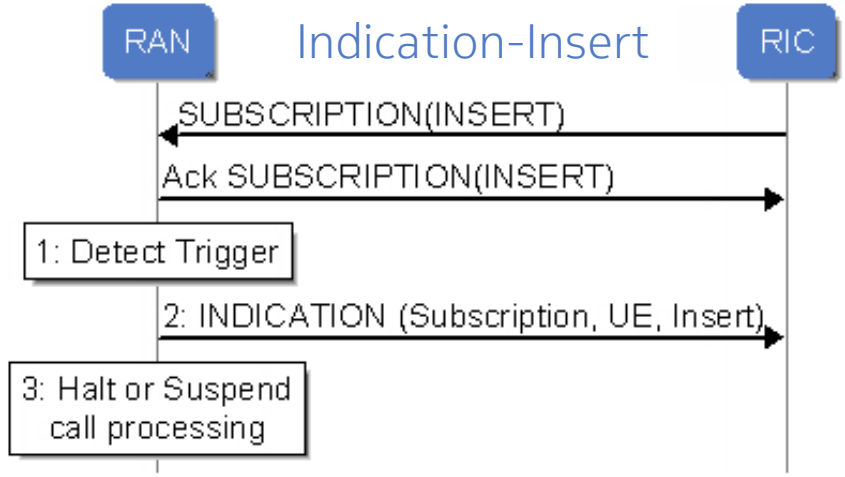


E2AP functional procedures

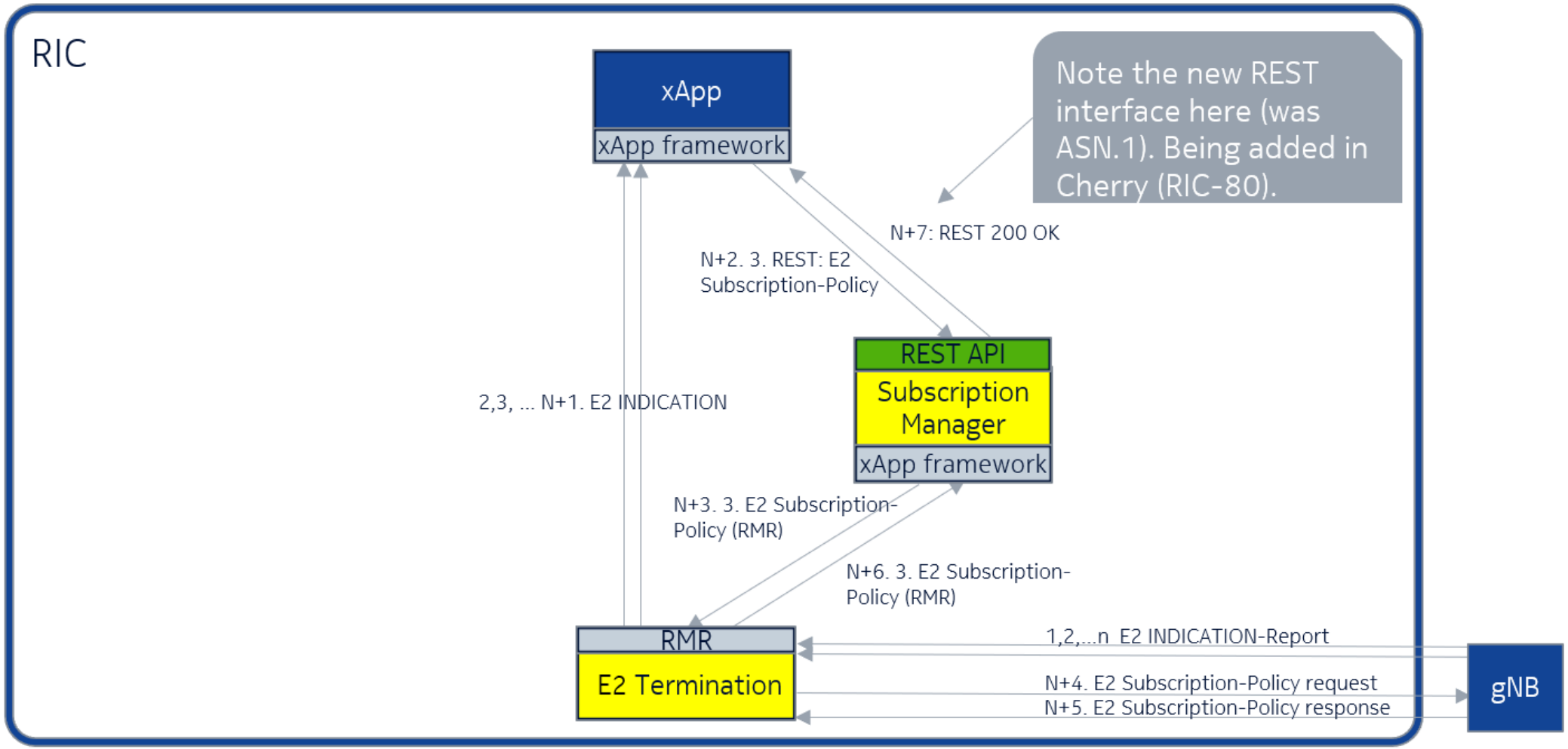




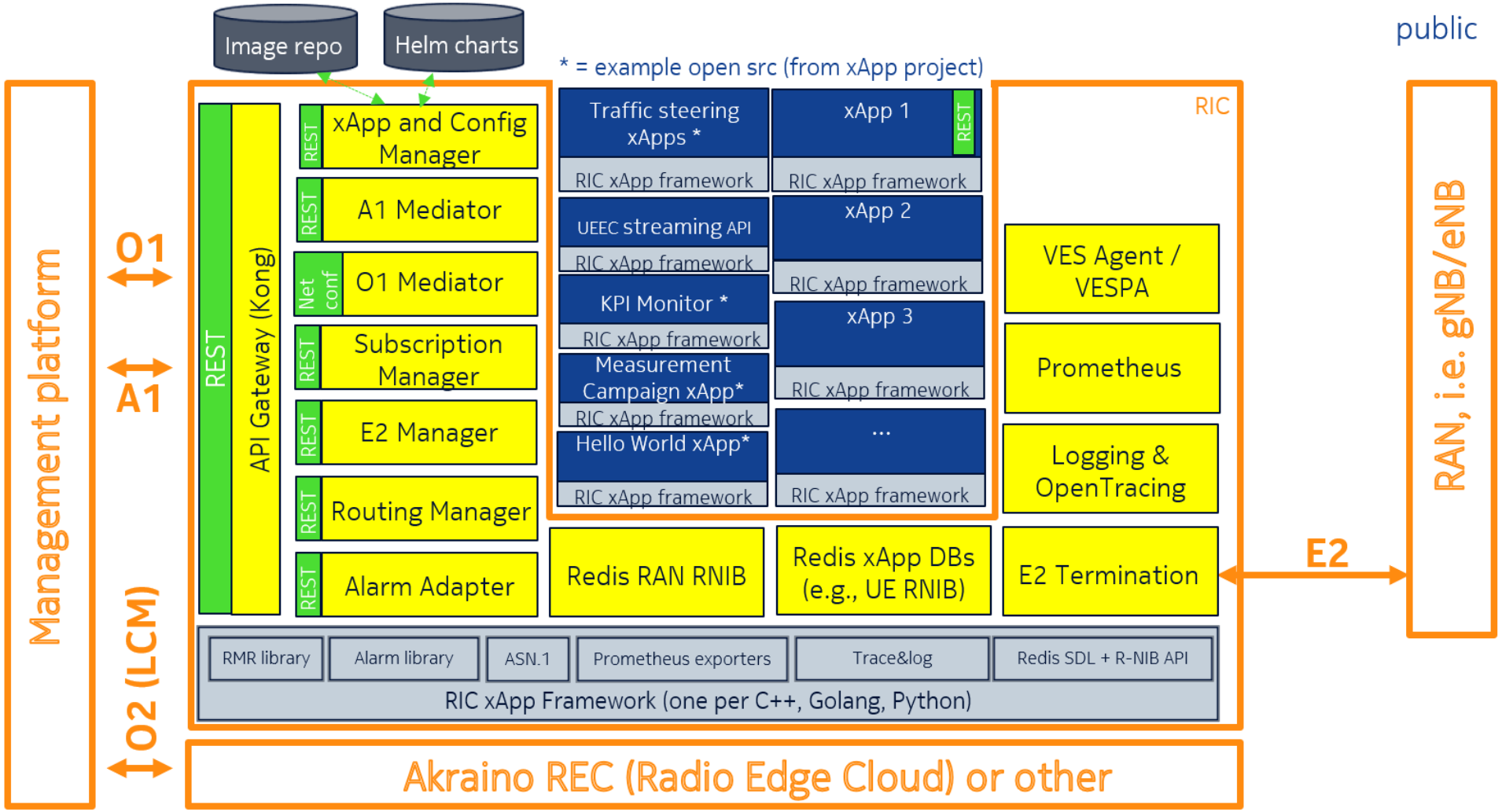




E2AP policy subscriptions

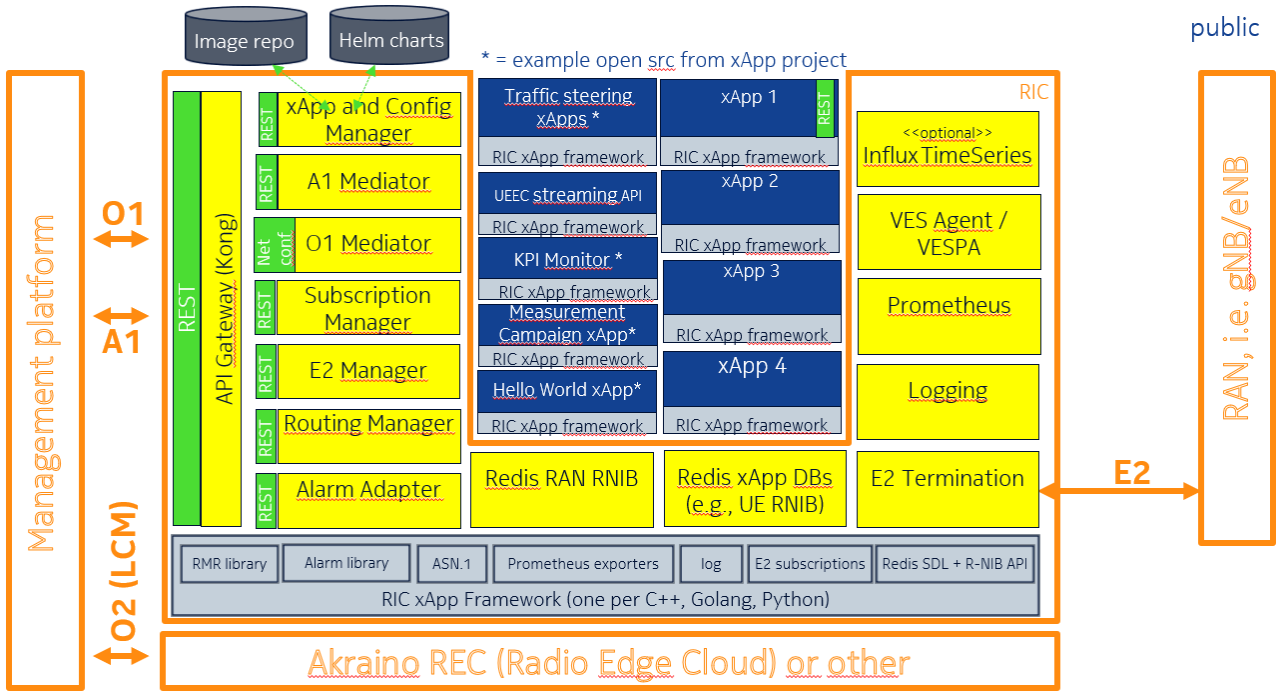


The near-RT RIC platform components



RIC platform updates (E release)

- RIC-809 Subscription manager to delete subscriptions in case of E2 disconnect (incl. Xapp changes)
- RIC-793 Prevent A1 Job ID conflicts from multiple RICs using the same A1 producer (SMO)
- RIC-647 Reimplement A1 mediator in golang to avoid A1 being the only python container in RIC platform
- RIC-709 E2 stats exposing individual counters instead of groups
- RIC-640 Adapt E2 manager to support OID scheme for E2SMs as defined in E2AP v1.1
- RIC-638 Adapt configuration transfer capabilities newly defined in E2AP v1.1
- RIC-714 support for DMS REST interface in addition to DMS CLI
- RIC-113 DB: SDL CLI for debugging and testing
- RIC-110 FindKeys/GetAllKeys SDL API to support glob-style patterns
- And 28 more, smaller JIRA items: see link in §7.6.b in https://wiki.o-ran-sc.org/display/RICP/Jira+usage+conventions



Upcoming changes for E2APv1.1 and E2APv2.0

Release "E"

E2APv1.1's E2 Node Configuration Update

- Provides basic RAN configuration to near-RT RIC for each E2 Node
- Study as per RIC-174 lead to RIC-638 implementation

E2APv1.1's OID in E2AP

- Assists E2SM RAN function description decoding (RIC-640)

Release "F" and future

E2APv1.1 TNL (Transport network layer) for E2 for scalability

- Provides support for E2 interface to use multiple SCTP connections
- Study as per RIC-173 lead to RIC-639 implementation
- E2APv2.0 further clarifies role of E2 NODE CONFIGURATION UPDATE as first message in new TNL association

E2APv2.0 "RIC Subscription Delete Required" procedure

- Enables E2 node to request deletion (E2 node overload, or subscription not relevant anymore)

E2APv2.0 Clarified role of (optionally requested) RIC CONTROL ACKNOWLEDGE and (mandatory) RIC CONTROL FAILURE messages (RIC-784, RIC-783)

- FAILURE to be sent if control timer on E2 expired, or if E2 node fails to execute RIC CONTROL request.

E2APv2.0 Adds transaction ID in various procedures

E2APv2.0 E2 Node Component Configuration {Addition, Update,Remove} Item now contains additional component types by interface type (F1, X2, Xn, S1, …) and re-uses (by reference) the SETUP REQUEST/RESPONSE, CONFIGURATION UPDATE [ACKNOWLEDGE] of the underlying interface type.

E2APv2.0 E2 SETUP REQUEST makes RAN function list and E2 node component configuration mandatory (at least one entry)

* Transaction ID added (Non-backwards compatible)
# Message content modified (Non-backwards compatible)

Functional procedures	Status (v2.0)
RIC Subscription	
RIC Subscription Delete	
RIC Subscription Delete Required	New
RIC Indication	
RIC Control	Updated#

Global procedures	Status (v2.0)
Error Indication	Updated*
E2 Setup	Updated*#
Reset	Updated*
RIC Service Update	Updated*
RIC Service Query	Updated*
E2 Node Configuration Update	Updated*#
E2 Node Connection Update	Updated*

A demo

Demo

https://wiki.o-ran-sc.org/display/RICP/2021-11-05+Demo+video+release+Dawn

Want to use the OSC near-RT RIC?

https://wiki.o-ran-sc.org/display/RICP/Introduction+and+guides

Want to participate?

https://wiki.o-ran-sc.org/ → participate

Thank you! Any comments?