OOF-SON: 5G Self-Organizing Network (SON) using ONAP Optimization Framework (OOF): Release 11 Kohn
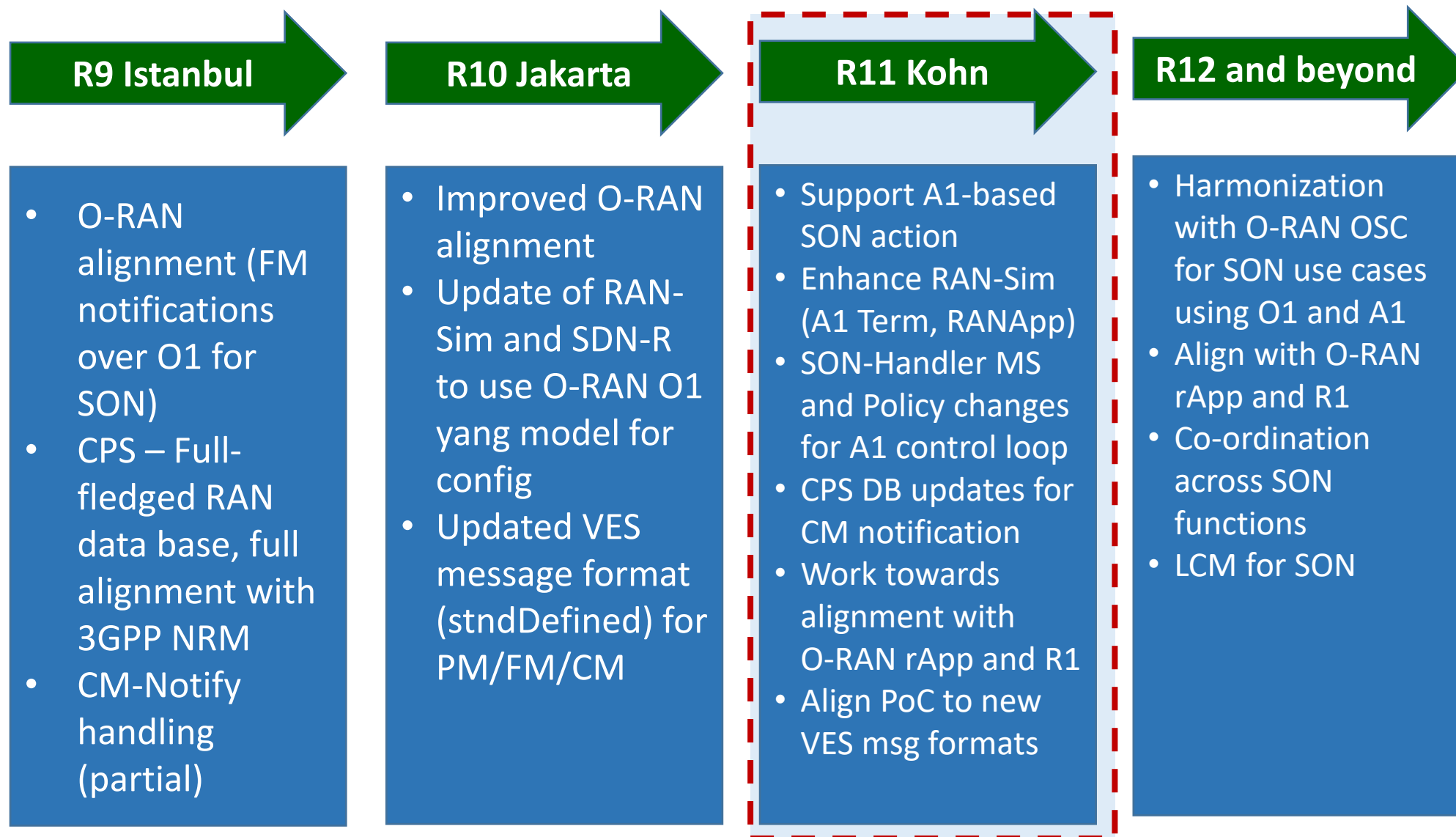
May 16, 2022

Presenters : N.K. Shankaranarayanan

Roadmap

R9 Istanbul

- O-RAN alignment (FM notifications over O1 for SON)
- CPS – Full-fledged RAN data base, full alignment with 3GPP NRM
- CM-Notify handling (partial)

R10 Jakarta

- Improved O-RAN alignment
- Update of RAN-Sim and SDN-R to use O-RAN O1 yang model for config
- Updated VES message format (stndDefined) for PM/FM/CM

R11 Kohn

- Support A1-based SON action
- Enhance RAN-Sim (A1 Term, RANApp)
- SON-Handler MS and Policy changes for A1 control loop
- CPS DB updates for CM notification
- Work towards alignment with O-RAN rApp and R1
- Align PoC to new VES msg formats

R12 and beyond

- Harmonization with O-RAN OSC for SON use cases using O1 and A1
- Align with O-RAN rApp and R1
- Co-ordination across SON functions
- LCM for SON

ONAP-based SON: O-RAN O1 focus (Rel.3 – Rel.10)

Optimization (**OOF**)

Co-ordination, Decisions (**Policy**)

Data Collection, & Analysis (**DCAE**)

Control loop

Action (**SDN-R**)

RIC (non-RT)

Data, CM, FM, PM

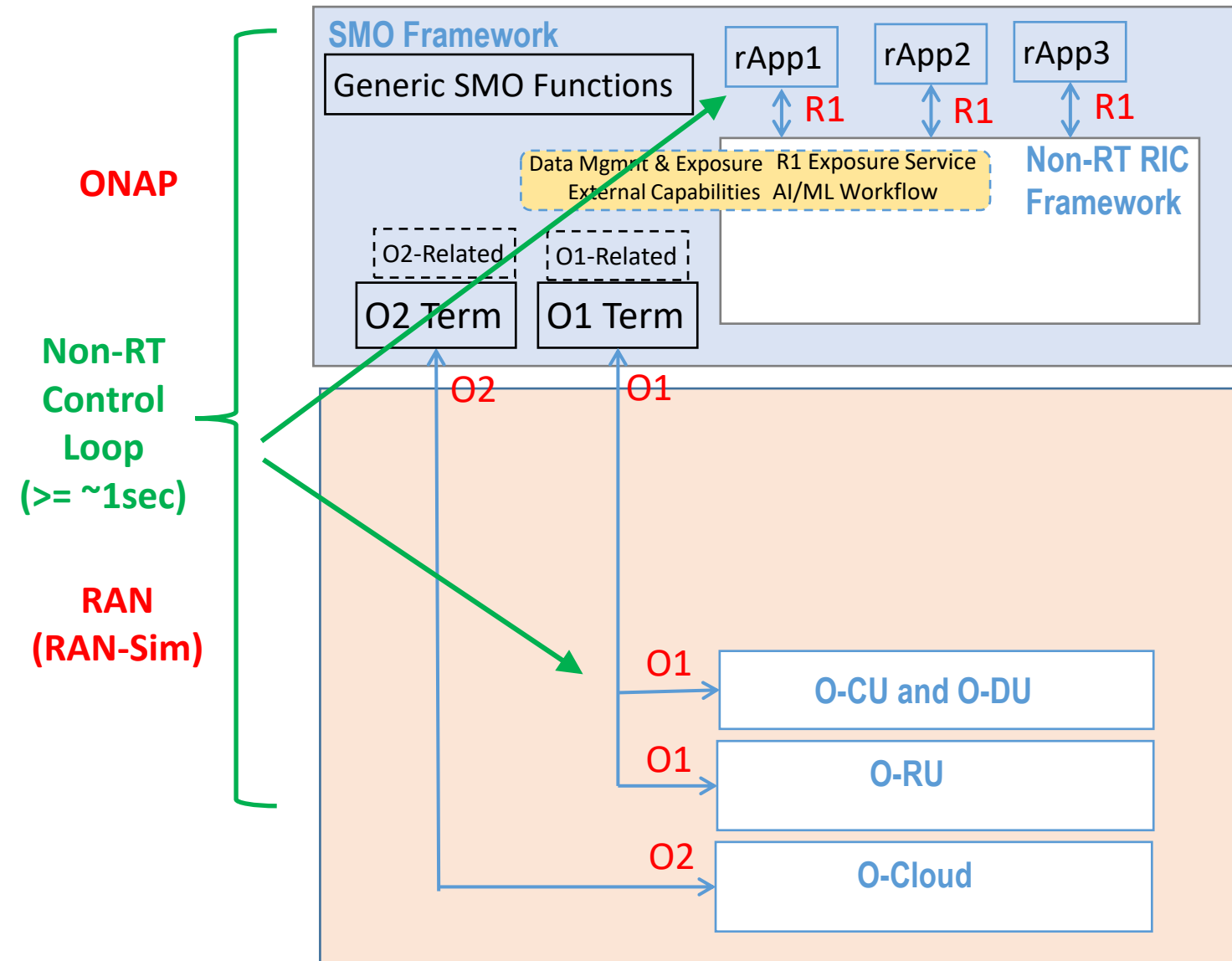**O1** CM notify

O-RAN Radio Network (**RAN-Sim**)

O1

Config ack

- SON ⇔ Control Loop (CL)
- ONAP: Open-source platform, with basic open-source code
- Companies can use framework to add proprietary SON solutions, including optimization algorithms, etc.

- OOF-SON use case has built a foundation for ONAP/O-RAN integration
- Radio network uses common netconf/yang model

Data flows
- SDN-R to RAN: netconf-based configuration
- RAN to DCAE: VES format for FM alarms, PM KPI, CM Notification
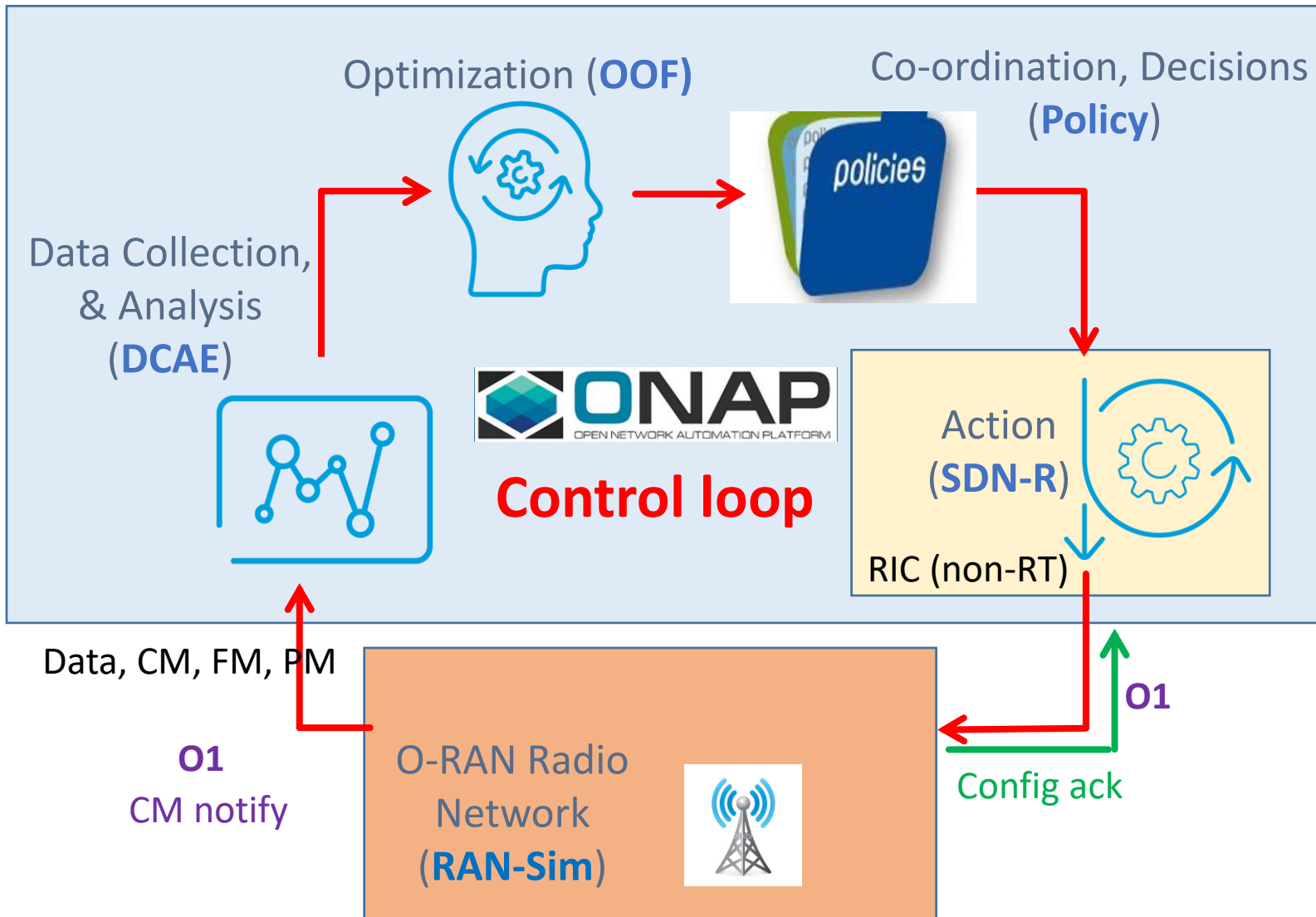
ONAP / O-RAN Control Loops

ONAP

Non-RT Control Loop (>= ~1sec)

RAN (RAN-Sim)

SMO Framework

Generic SMO Functions

rApp1 rApp2 rApp3

R1 R1 R1

Data Mgmt & Exposure R1 Exposure Service
External Capabilities AI/ML Workflow

Non-RT RIC Framework

O2-Related O1-Related

O2 Term O1 Term

O2 O1

O1 → **O-CU and O-DU**

O1 → **O-RU**

O2 → **O-Cloud**

- Non-RT Loop
  - Time scale: ~ secs/mins
  - Direct config of CU/DU
  - Policy Guidance, Coordination

- SON examples
  - Non-RT: Changes based on operational state, averaged behavior

ONAP / O-RAN Control Loops
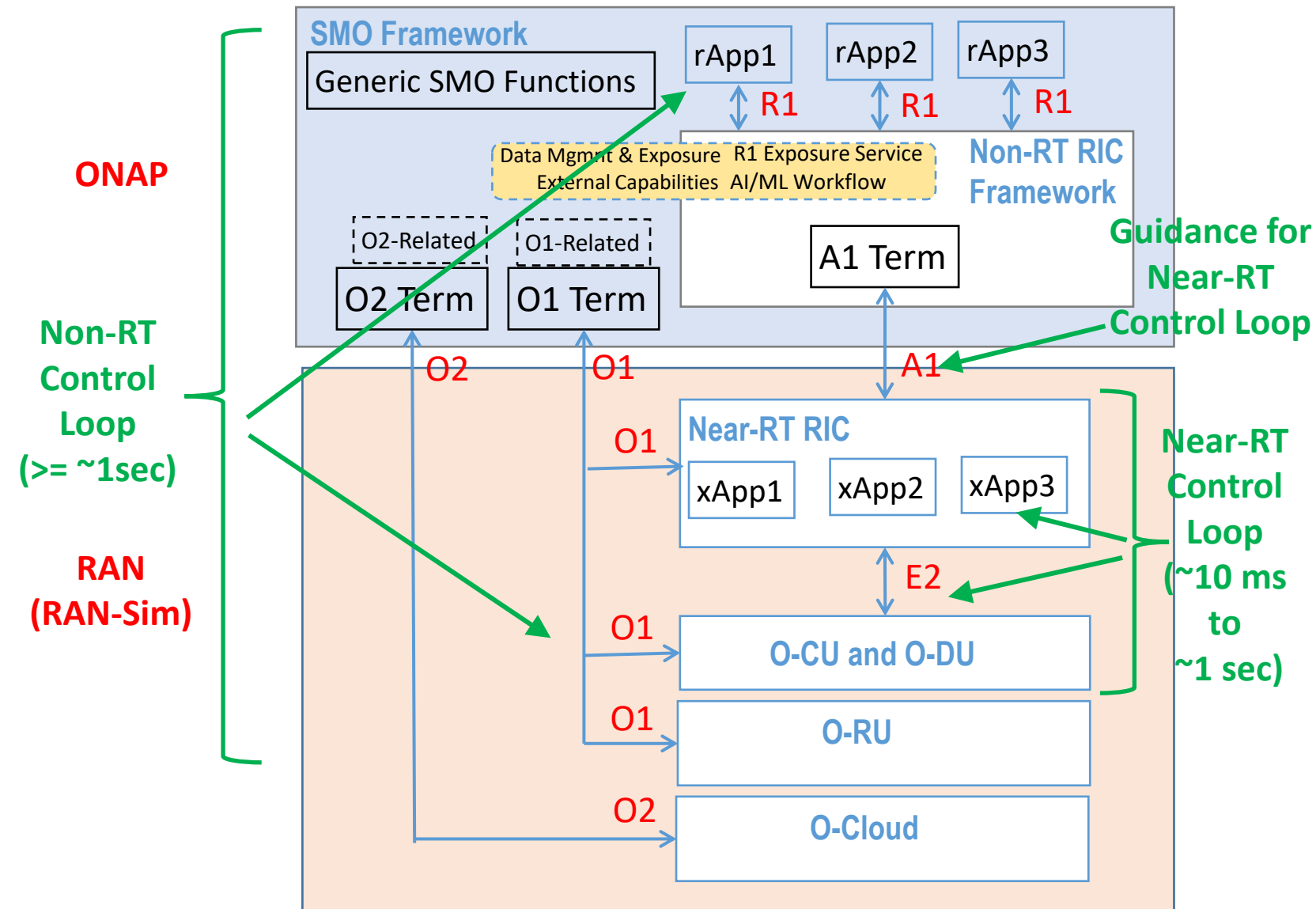
- Non-RT Loop
  - Time scale: ~ secs/mins
  - Direct config of CU/DU
  - Policy Guidance, Coordination
- Near-RT Loop
  - Near-Real-Time (~100ms)
  - Based on E2 service models
- SON examples
  - Non-RT: Changes based on operational state, averaged behavior
  - Near-RT: Changes based on radio channel, mobility

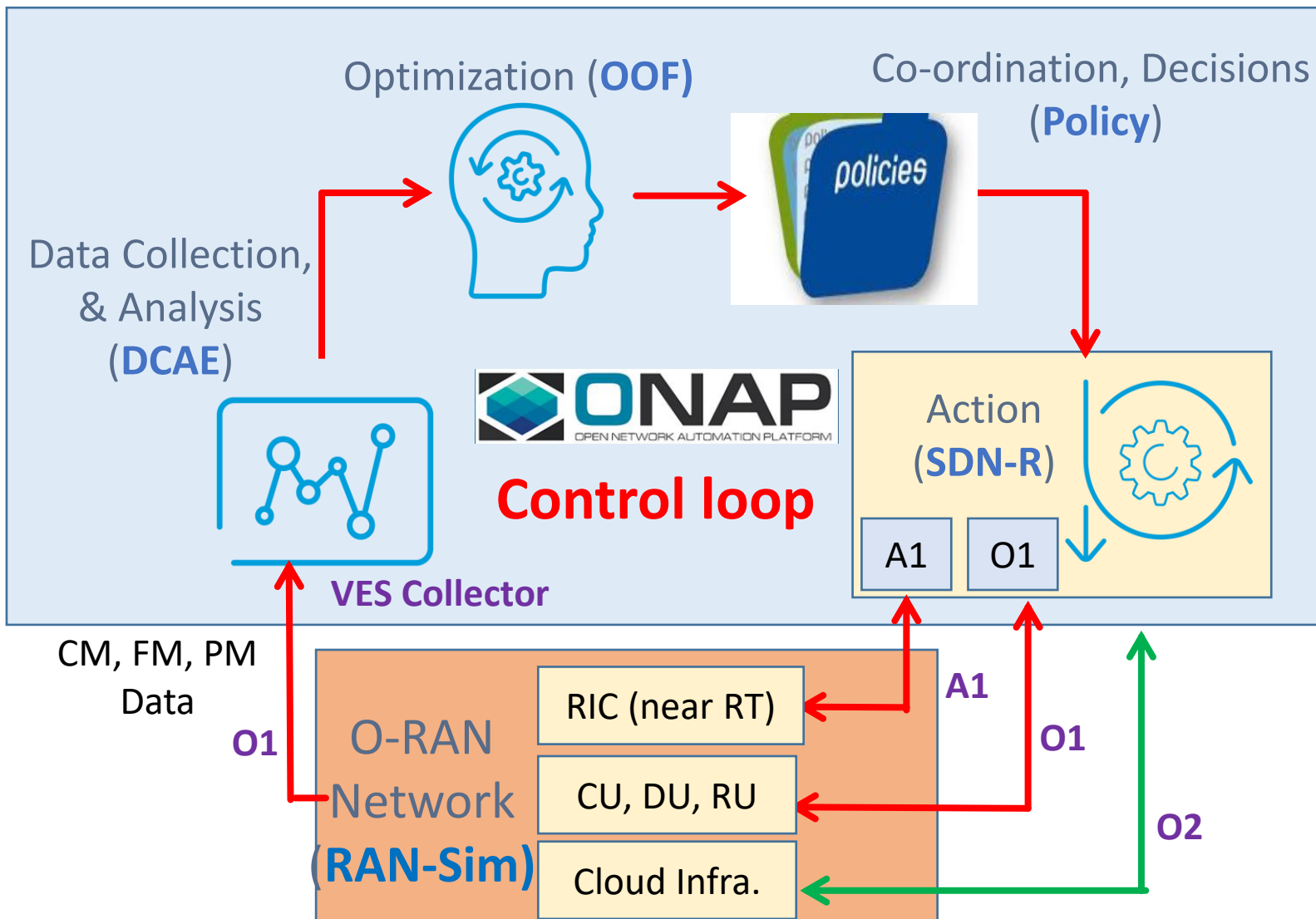# ONAP-based SON: O-RAN O1 focus (Rel.3 – Rel.10)

Optimization (**OOF**)

Co-ordination, Decisions (**Policy**)

Data Collection, & Analysis (**DCAE**)

Control loop

Action (**SDN-R**)

RIC (non-RT)

Data, CM, FM, PM

O1
CM notify

O-RAN Radio Network (**RAN-Sim**)

O1

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ONAP-based SON: Target - with O-RAN O1, A1, O2

Optimization (**OOF**)

Co-ordination, Decisions (**Policy**)

policies

Data Collection, & Analysis (**DCAE**)

ONAP OPEN NETWORK AUTOMATION PLATFORM

Action (**SDN-R**)

Control loop

A1   O1

VES Collector

CM, FM, PM Data

O1

O-RAN Network (**RAN-Sim**)

RIC (near RT)

A1

O1

CU, DU, RU

Cloud Infra.

O2

- SON ⇔ Control Loop (CL)
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- RAN to SDN-R: Netconf ack

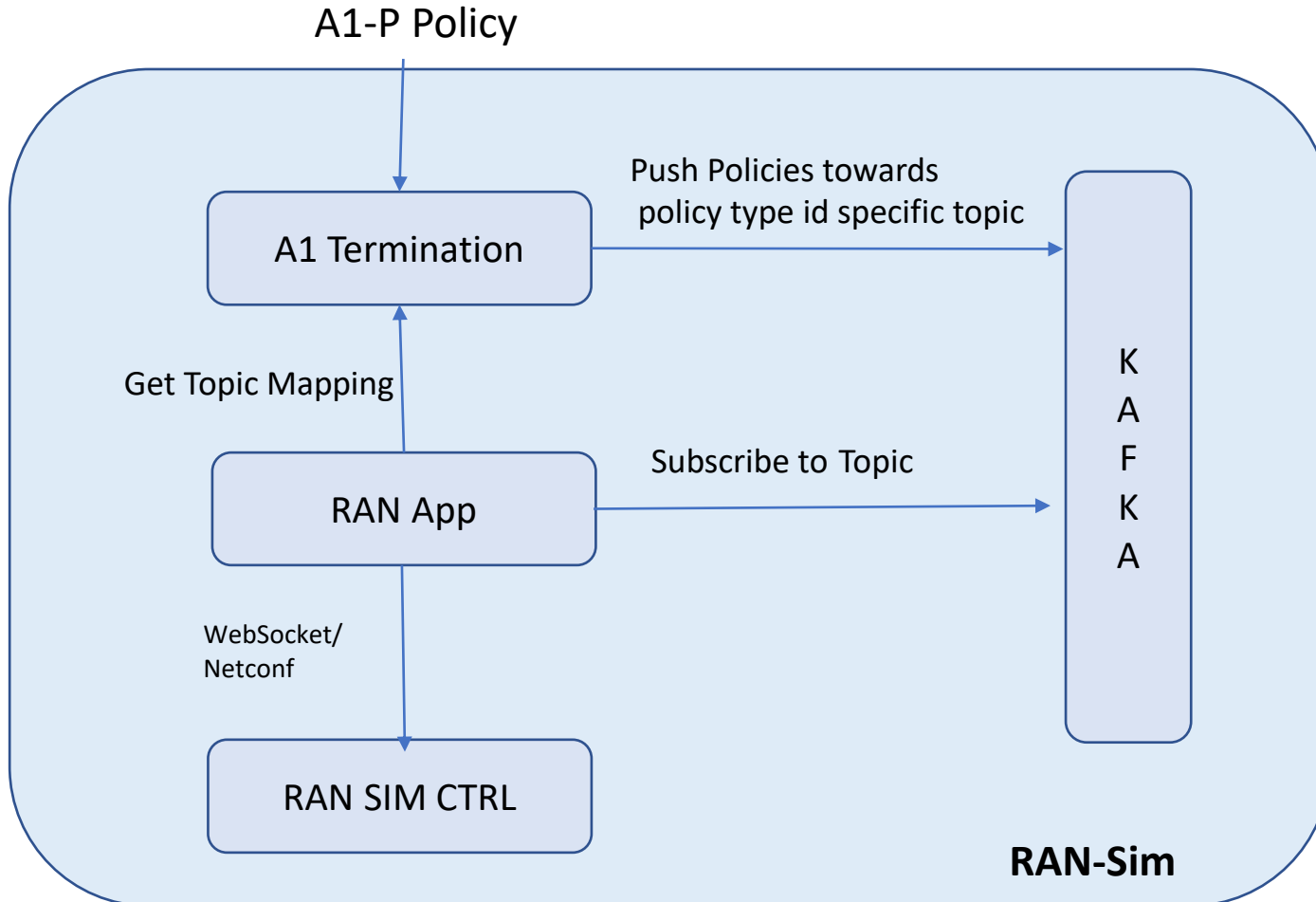# ONAP SON Use Case – Control Loop with O1 (Rel 3-10)
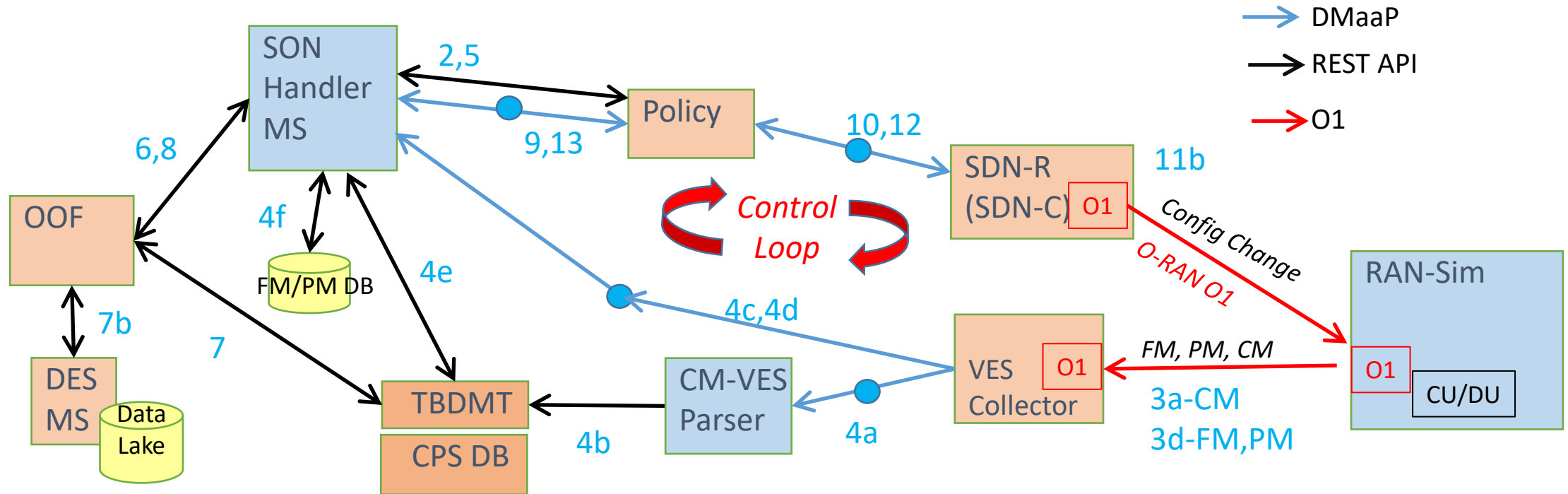
Steps 3a,4a,4b,4c: CM data received from RAN, update of state in CPS DB
Steps 3d,4d: FM/PM data received from RAN, processing in SON MS
Steps 2,4e,4f, 5:   SON MS analyzes need for optimization
Steps 6,7,7b,8:   Optimization using OOF
Steps 9,10,11b: Automated action to make change in RAN (O1)
Steps 11,12,13:   Action status

ONAP SON Use Case – Control Loop with O1 & A1 (Rel 11)
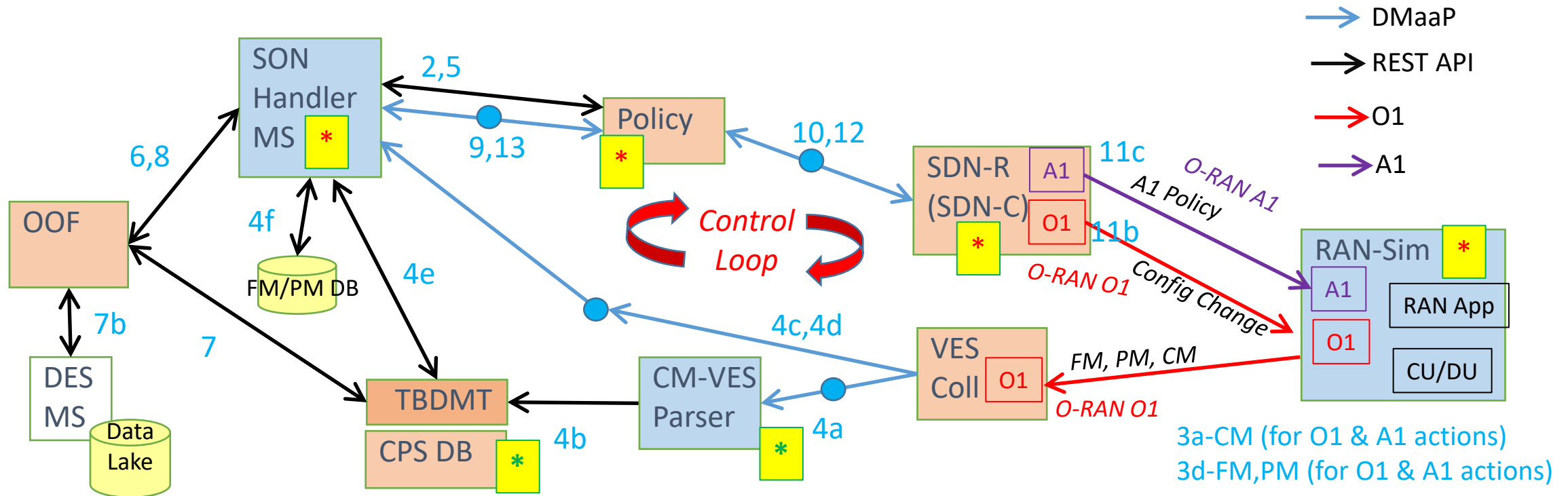
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RAN-Sim Enhancement for A1

A1 Termination & RAN App are different Modules

A1-P Policy

A1 Termination

Push Policies towards
policy type id specific topic

Get Topic Mapping

RAN App

Subscribe to Topic

K A F K A

WebSocket/
Netconf

RAN SIM CTRL

RAN-Sim

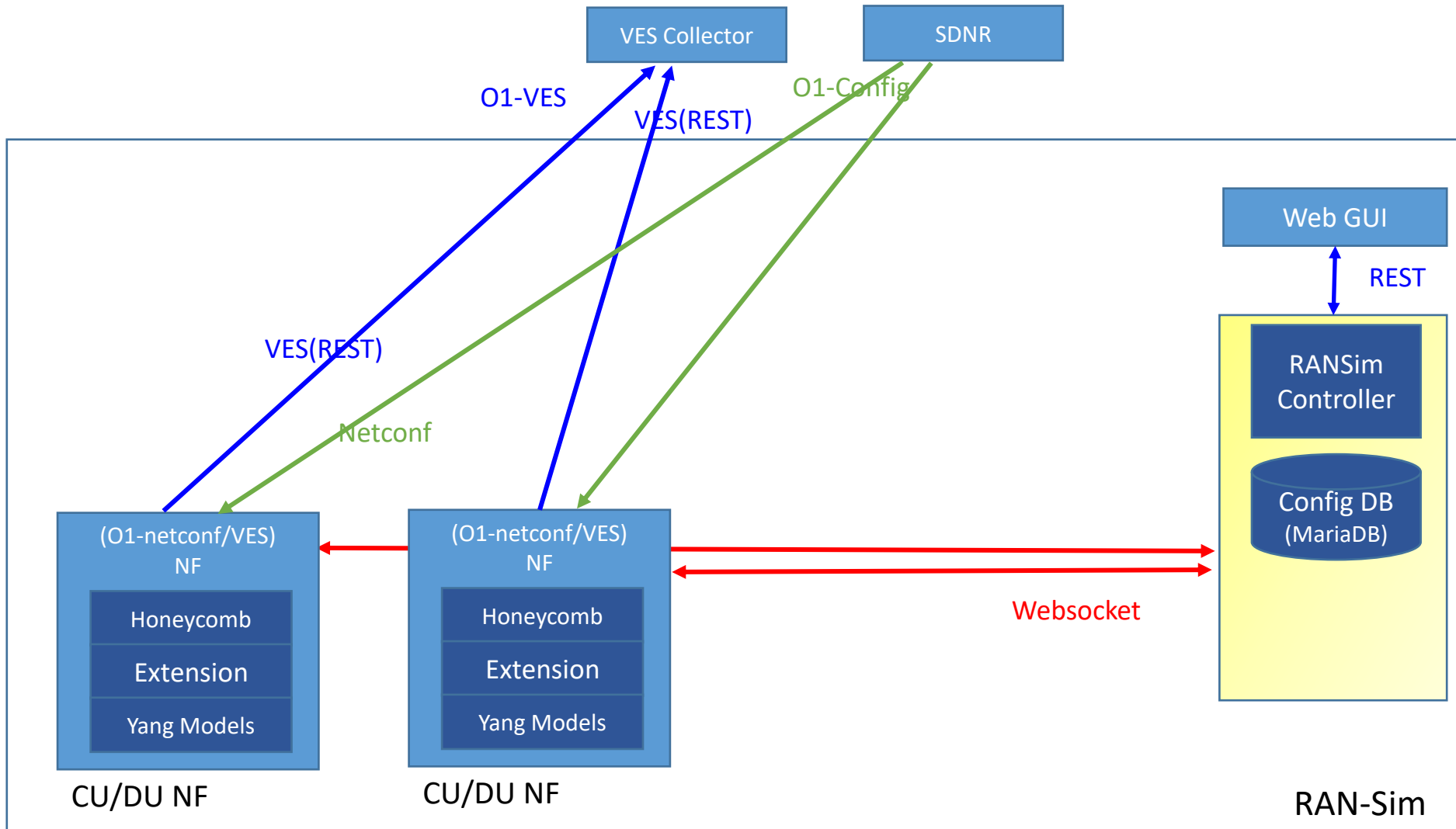**A1 Termination hold Mapping of PolicyTypeId to TopicName:**

```
{
"PolicyTypeID":"TopicName",

"ORAN_QoSTarget_2.0.0":"TopicA",

"ORAN_QoETarget_2.0.0":"TopicB"
}
```

Kafka Message Format

Need further changes in message format, to support policy instance id etc.

```
{
"action":"CreatePolicy/DeletePolicy/GetPolicyStatus/..",
"payload":"{}",
"policy_type_id":" ORAN_QoSTarget_2.0.0"
"ric_id":""
}
```

Current RAN-Sim - support for O1-based config

VES Collector

SDNR

O1-VES

VES(REST)

O1-Config

Web GUI

REST

VES(REST)

RANSim Controller

Netconf

Config DB (MariaDB)

(O1-netconf/VES) NF

Honeycomb

Extension

Yang Models

(O1-netconf/VES) NF

Honeycomb

Extension

Yang Models

Websocket

CU/DU NF

CU/DU NF

RAN-Sim

New module in RAN-Sim
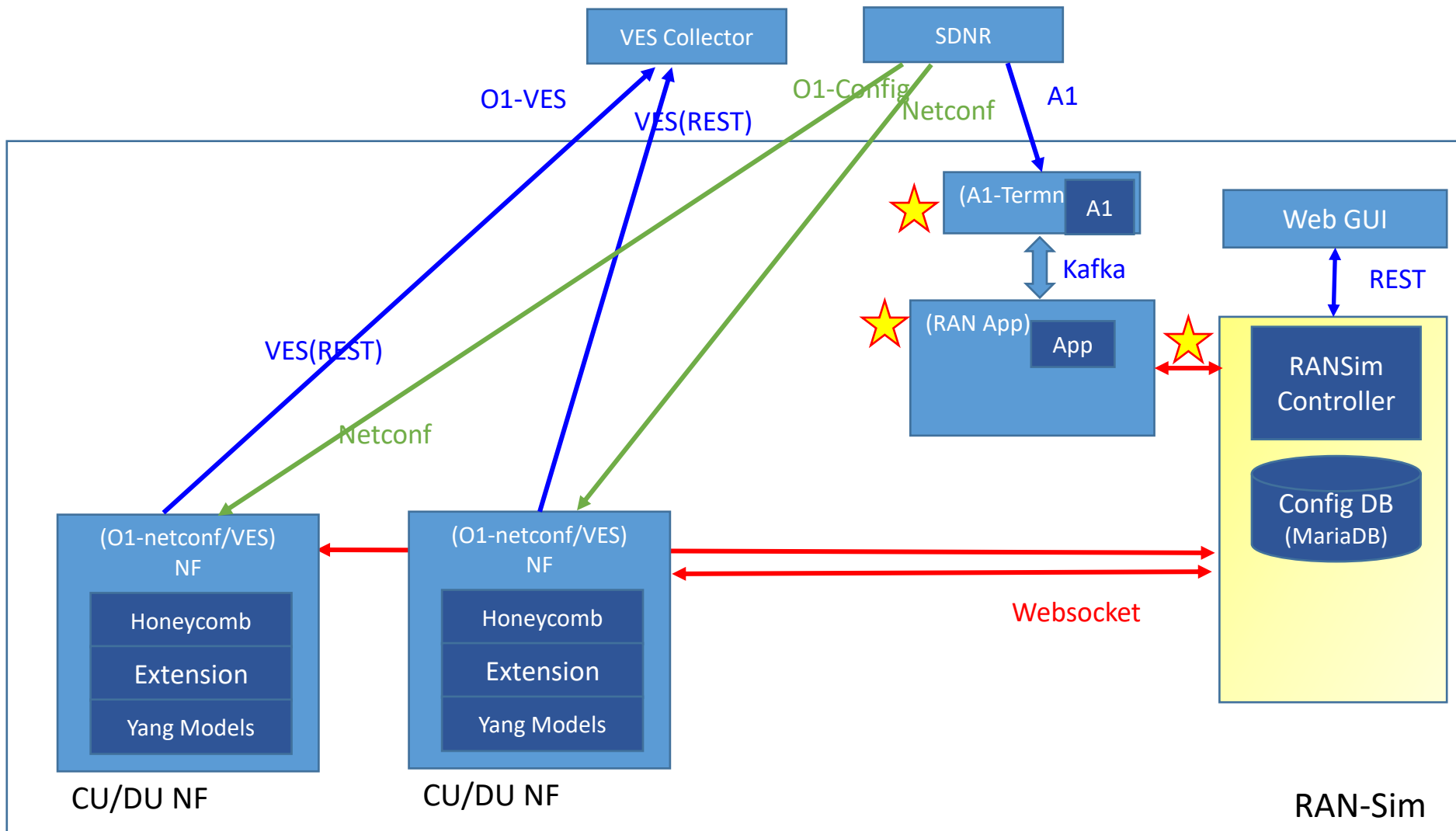- Near-RT RIC
- xApp
- A1 termination

Areas of work
A. A1 termination
B. xApp functionality
C. O1 functionality in Near-RT RIC (netopeer)
D. Connection from Controller* to xApp/Near-RT RIC
   - websocket (simpler?)
   - Netconf (need client in Controller)
E. E2 abstraction options:
   - Via controller (simpler?)
   - Direct interfaces (working towards E2)

* From Alex:
1. Choice of interface will depend on team doing the development. RAN-Sim is Java based, netopeer is C/C++ based
2. For netconf client in RAN-Sim for netconf options, see for example https://github.com/Juniper/netconf-java

ONAP
OPEN NETWORK AUTOMATION PLATFORM

Enhancing RAN-Sim to support both O1 and A1

VES Collector

SDNR

O1-VES

VES(REST)

O1-Config

Netconf

A1

(A1-Termn   A1)

Kafka

(RAN App)   App

Web GUI

REST

VES(REST)

Netconf

RANSim Controller

Config DB (MariaDB)

Websocket

(O1-netconf/VES) NF

Honeycomb

Extension

Yang Models

CU/DU NF

(O1-netconf/VES) NF

Honeycomb

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Yang Models

CU/DU NF

RAN-Sim

New module in RAN-Sim
• Near-RT RIC
• xApp
• A1 termination

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A. A1 termination
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A1 Functions in ONAP / OSC

Functional view of ONAP A1 Policy functions
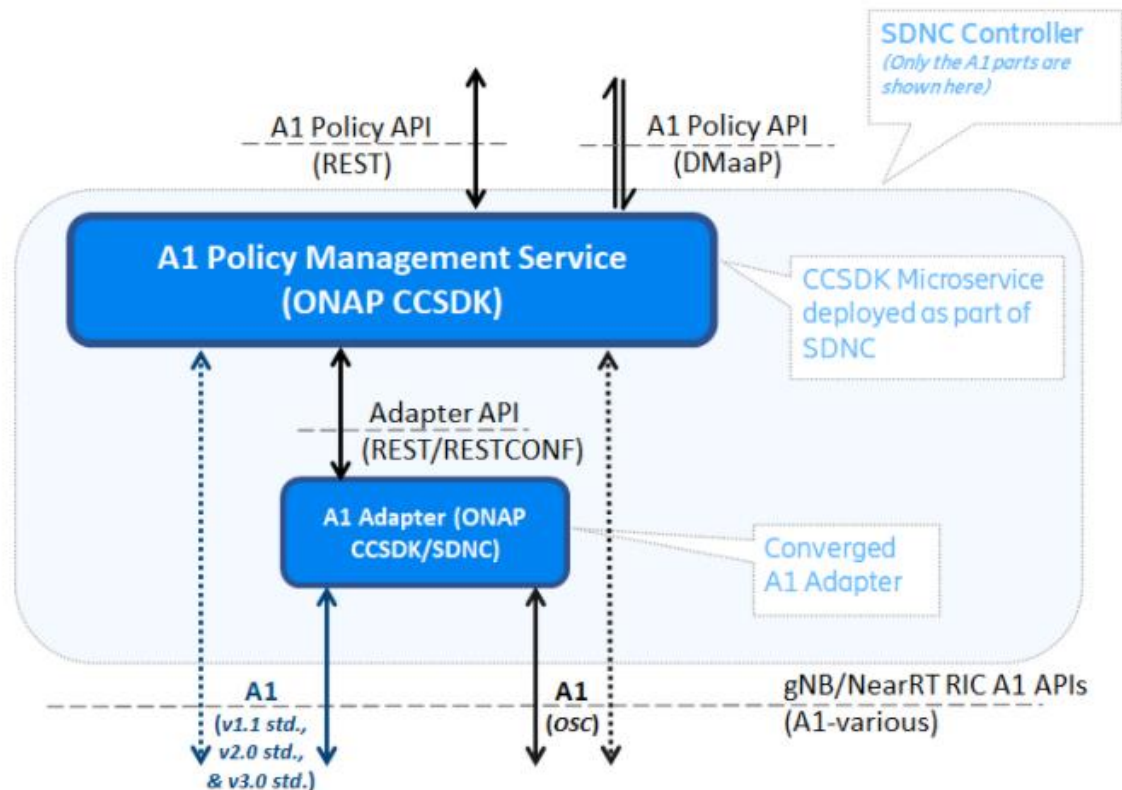
The figure above shows a functional view of the A1 policy functions in ONAP.

- A1-related message can be sent from Policy to SDN-R/CCSDK
- Current Control Loop architecture would use DMaaP CL message
- A1 Policy Management Service can connect to A1-termination in the Near-RT RIC with or without an A1 Adapter
- In the SON Use Case context, the A1-termination in Near-RT RIC would be part of the simulated RAN (RAN-Sim) with usecase logic in the simulated/abstracted xApp which results in events from CU/DU over O1

SON Use Case: O1 and A1 based action

- Current
  - O1 based action for PCI config-change to *NRCellDU/nRPCI value*
    (based on analysis in SON Handler MS)
  - O1 based action for ANR config-change to
    NRCellCU/CellRelation/isHOAllowed value
    (based on analysis of poor HO kpi values by SON Handler MS)

- Planned Change for Rel 11 Kohn
  - O1 based action for PCI config-change to *NRCellDU/nRPCI value*
    (based on analysis in SON Handler MS)
  - A1 based action for ANR guidance message to RAN App for CellRelation
    (send poor HO kpi values to RAN App) – with end result of config change to
    NRCellCU/CellRelation/isHOAllowed value

High-level options for A1 based action

- Option 1 - Minimal change to existing code
  - No change to header of ANR Control Loop (DMaaP) message
  - Change in payload of ANR Control Loop message (from O1 to A1)
  - SDN-R processes new A1 payload in Control Loop message
  - No/minimal change in Policy

- Option 2 – Changes in Policy and Control Loop design
  - Work towards packaging application as an rApp
  - Separate control message format for O1 and A1 based message
  - Separate policies in Policy module
  - Re-use A1 support in ONAP/SDN-R to work with A1 Termination in RAN-Sim
  - Policy to A1 policy manager message may not be DMaaP
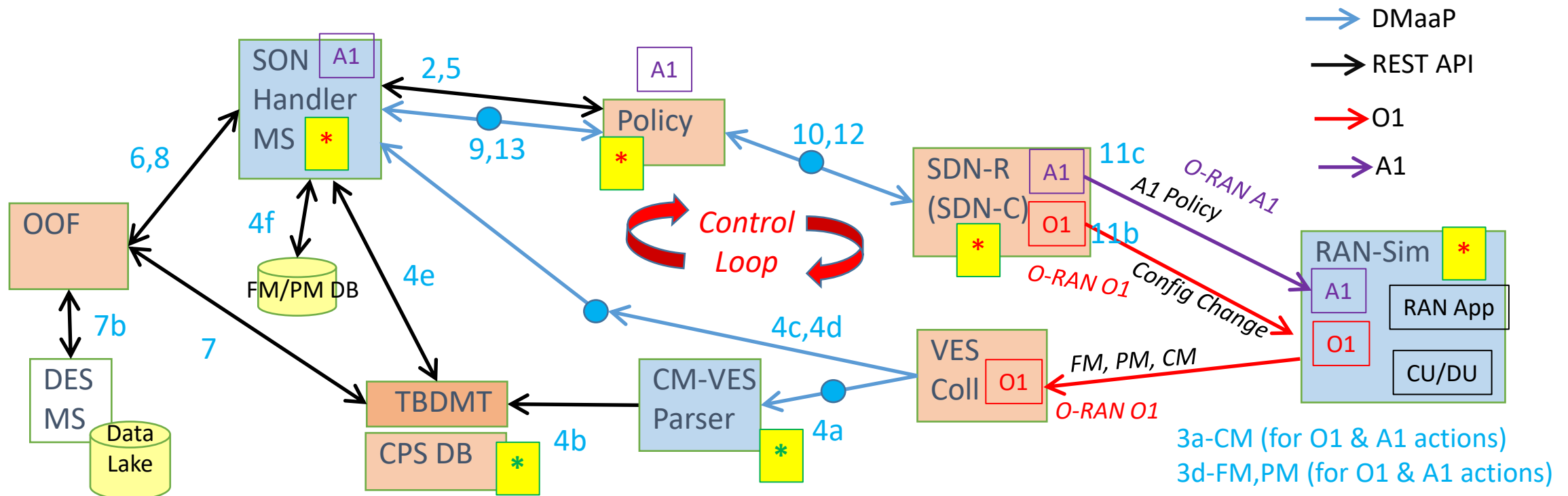
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Requirements

- SON Use Case:
https://jira.onap.org/browse/REQ-1212

- A1 Support in SDN-R/CCSDK:
https://jira.onap.org/browse/CCSDK-3644

- DCAE:
https://jira.onap.org/browse/DCAEGEN2-3148

- Policy:
https://jira.onap.org/browse/POLICY-4108

SON Use Case: O1 and A1 based action

SON_A1_cl_msg_sample_20220510.txt

ONAP Component Impacts for Kohn release

COMPONENT	IMPACT(S)
SDN-C (SDN-R)	• Implementation of A1 interface • Receive and parse Configuration Management (CM) notifications from VES Collector (support TBD) • Interface to CPS (support TBD)
DCAE	• Generate modified CL message for A1 action • Interface to CPS (test-only?) • Adapt to modified VES message format for PM, FM, CM (?stretch goal)
Policy	• Modification of policy and control loop to support both O1 and A1 based control action (Impact on DCAE and SDN-R TBD)
OOF (test-only)	• Interface to CPS (test-only?)
CPS (test-only)	• TBDMT to support required APIs (test-only?)
RAN-Sim (Simulators)	• Enhancements for A1 Termination and RAN App • Reporting PM, FM, CM messages using new VES format (stndDefined)

Summary of Requirements

Category	Requirement	Content	Priority
Functional	Include A1-based action	Implement A1 Support in SDN-R Enhance RAN-Sim to include A1 Termination and RAN App Addition of new CL msg for A1-based action	**HIGH**
Interoperability	O-RAN alignment (VES, O1 interface)	Modify RAN-Sim and SON-Hander MS to use new VES format for PM,FM	MED
		Modify RAN-Sim and SON-Hander MS to use new VES format for CM	MED
Functional	Maintain RAN Config Data	Process CM Notification and update CPS DB	**HIGH**
Functional	Package application as rApp	Ongoing discussion	**HIGH**

Thank You!