LF NETWORKING

LFN Developer & Testing Forum
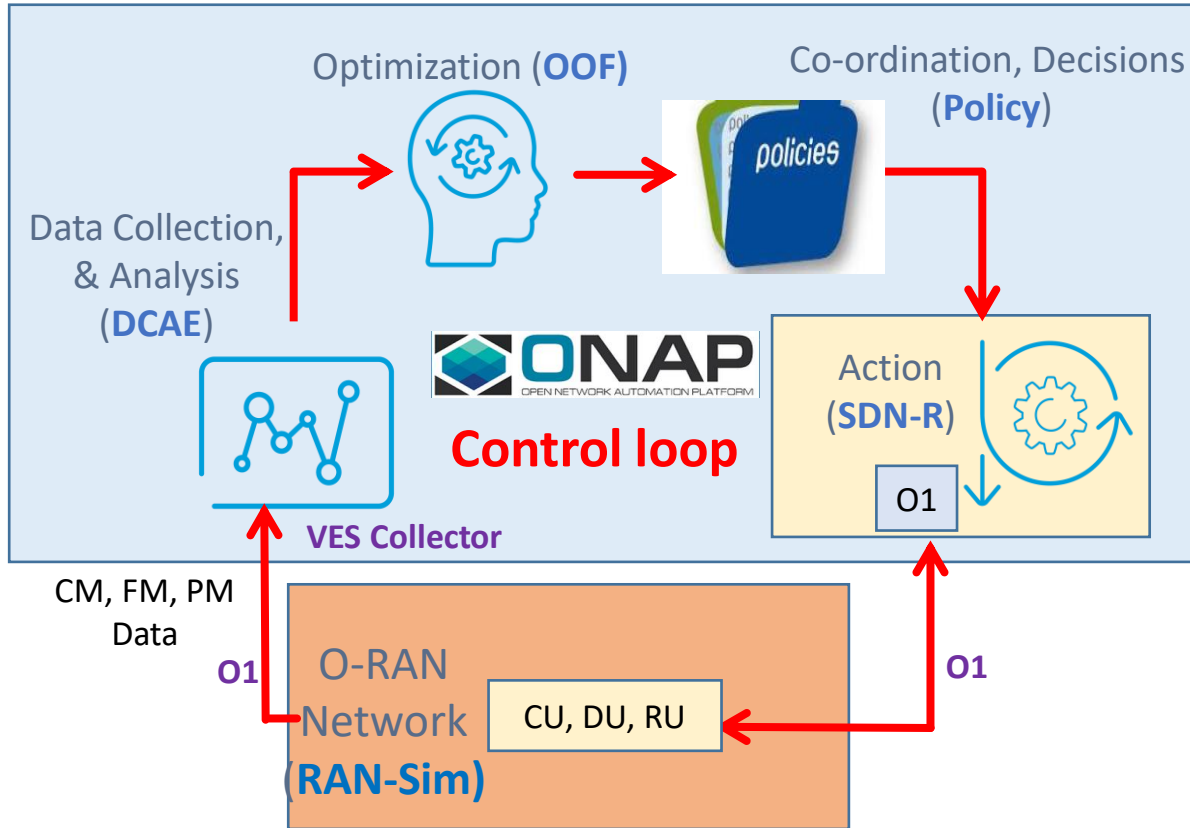
5G SON Use Case update for ONAP R11 (Kohn)

N.K. Shankaranarayanan, Vishal Varvate, Malarvizhi Paramasivam, John Keeney, Halil Cakal, Murali Parthasarathy, Jorge Hernandez, Ahila Pandaram

AT&T, CapGemini, Ericsson, STL, Wipro
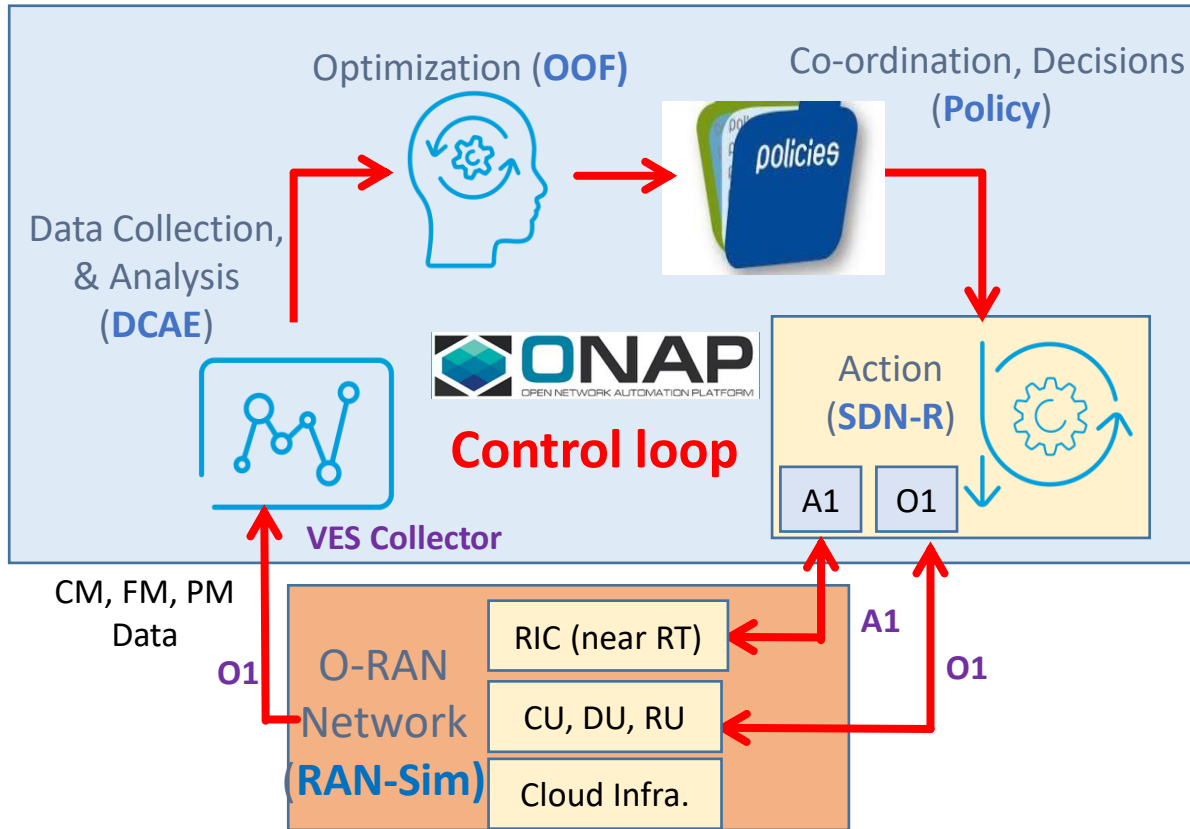
Anti-Trust Policy Notice

- Linux Foundation meetings involve participation by industry competitors, and it is the intention of the Linux Foundation to conduct all of its activities in accordance with applicable antitrust and competition laws. It is therefore extremely important that attendees adhere to meeting agendas, and be aware of, and not participate in, any activities that are prohibited under applicable US state, federal or foreign antitrust and competition laws.

- Examples of types of actions that are prohibited at Linux Foundation meetings and in connection with Linux Foundation activities are described in the Linux Foundation Antitrust Policy available at http://www.linuxfoundation.org/antitrustpolicy. If you have questions about these matters, please contact your company counsel, or if you are a member of the Linux Foundation, feel free to contact Andrew Updegrove of the firm of Gesmer Updegrove LLP, which provides legal counsel to the Linux Foundation.

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

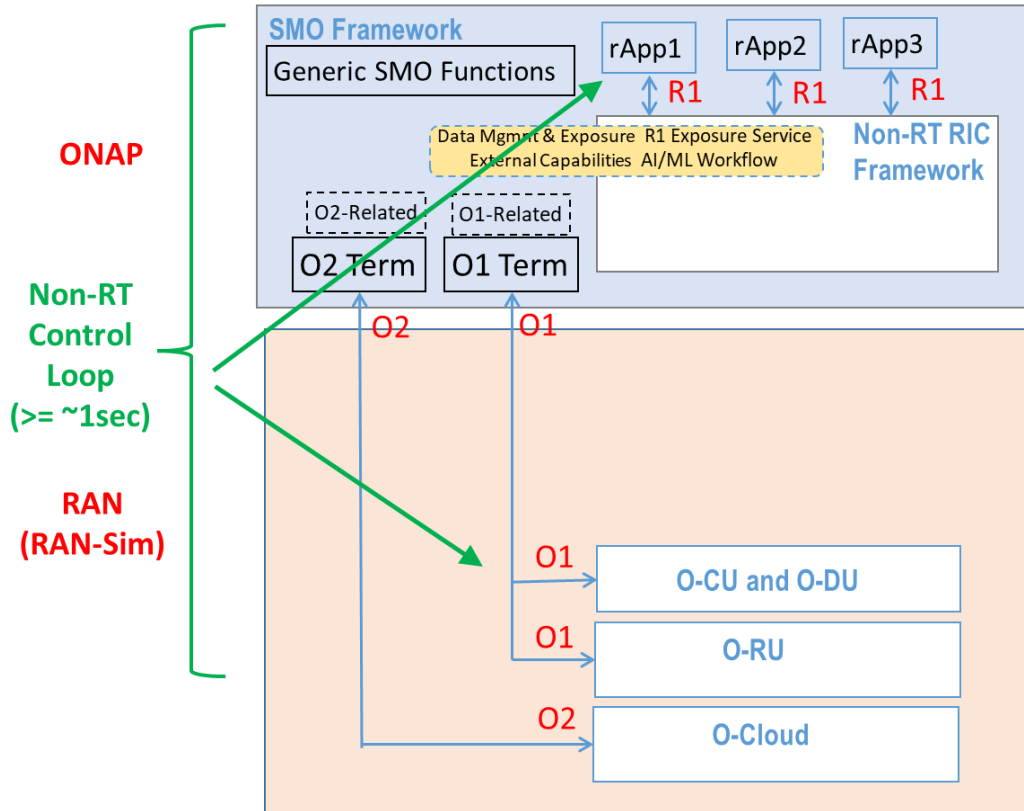- SON ⇔ Control Loop (CL)
- ONAP: Open-source platform, with basic open-source code
- Companies can use framework to add proprietary SON solutions, including optimization algorithms
- OOF-SON use case framework designed with O-RAN interfaces to RAN

ONAP-based SON Rel 11: Adding O-RAN A1 support

Optimization (**OOF**)

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

policies

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

ONAP
OPEN NETWORK AUTOMATION PLATFORM

Control loop

Action (**SDN-R**)

A1 O1

VES Collector

CM, FM, PM Data

O1

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

RIC (near RT)

CU, DU, RU

Cloud Infra.

A1

O1

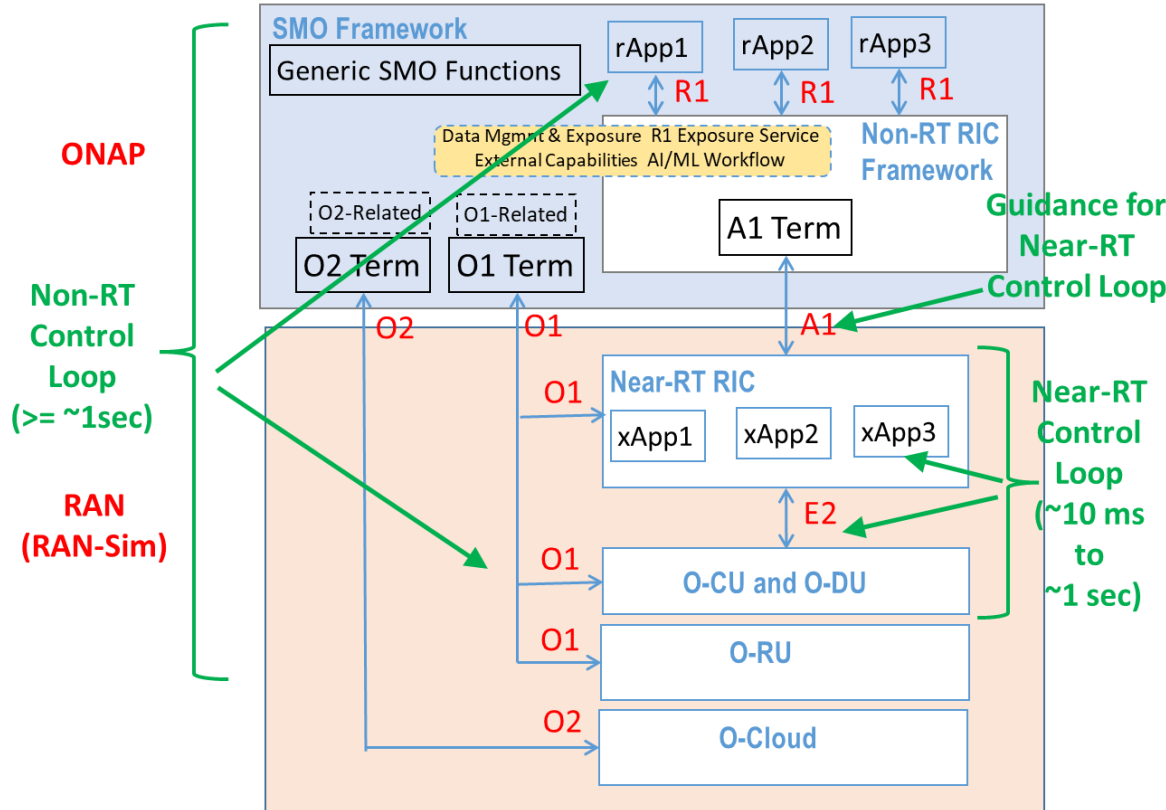- SON ⇔ Control Loop (CL)
- ONAP: Open-source platform, with basic open-source code
- Companies can use framework to add proprietary SON solutions, including optimization algorithms
- OOF-SON use case framework designed with O-RAN interfaces to RAN
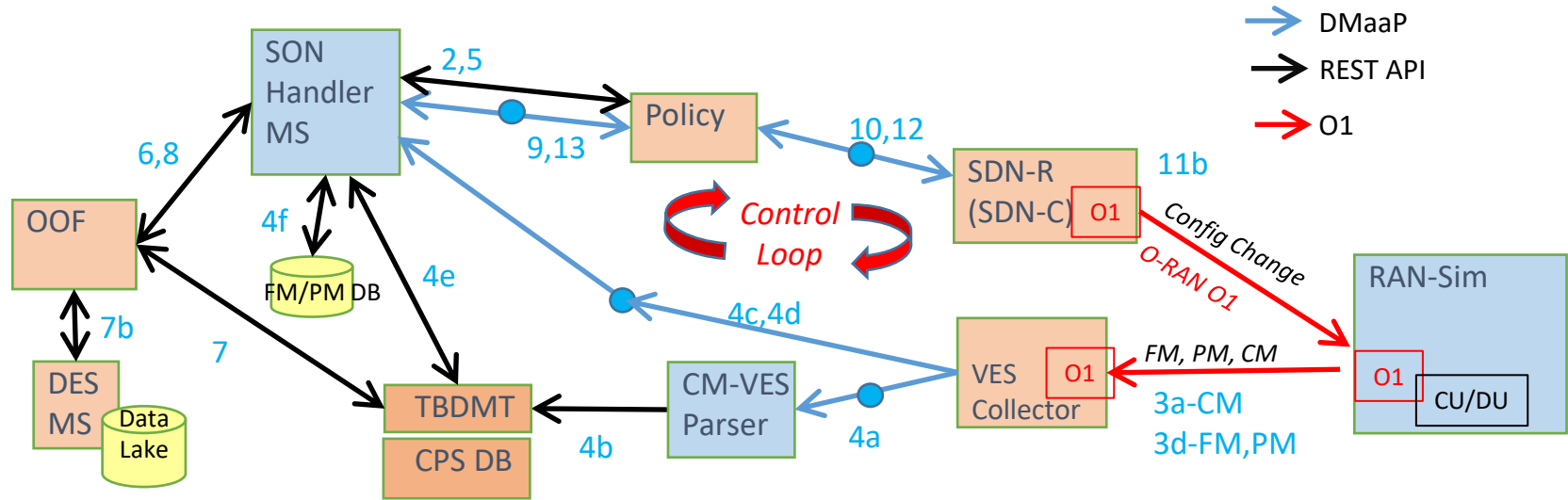
ONAP / O-RAN Control Loops

- 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

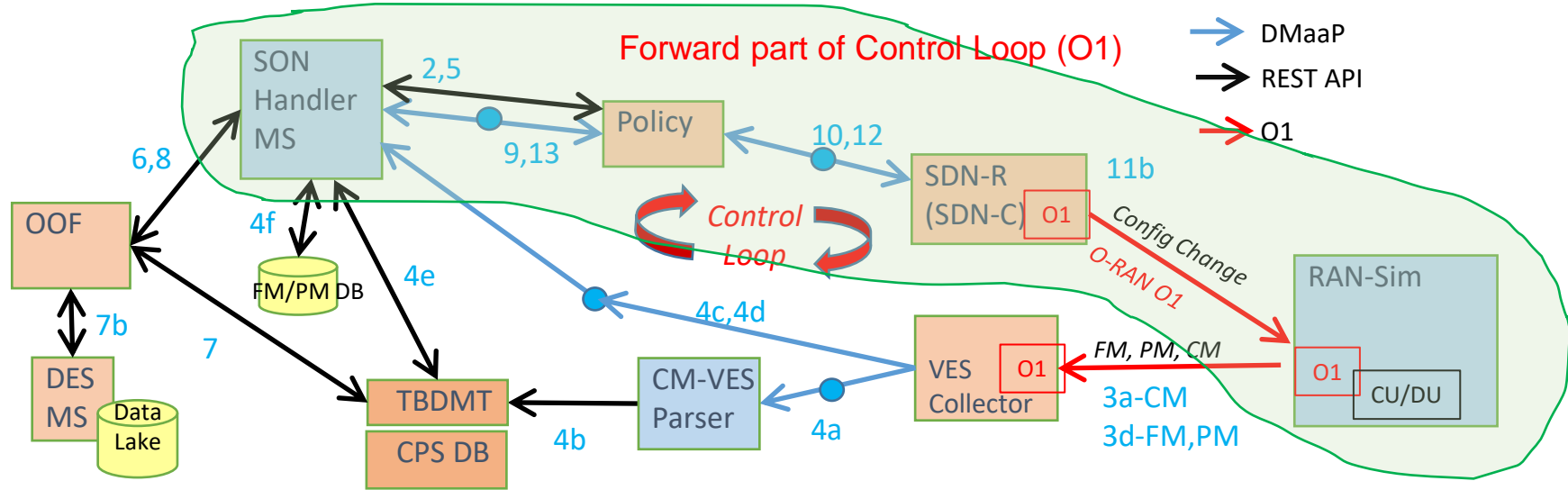# ONAP / O-RAN Control Loops

- 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

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 12,13:   Action status

ONAP SON Use Case – Control Loop with O1 (Rel 3-10)

Steps 9:   Request msg from MS for O1/A1
Steps 10o/11o/12o: Automated action to make change in RAN (O1)
Steps 10a/11a/12a: Automated action to make change in RAN (A1)
Steps 13:   Action status

ONAP SON Use Case – Control Loop with O1 & A1 (Rel 11)

Forward part of Control Loop (O1 & A1)

DMaaP
REST API
O1
A1

SON Handler MS
2,5
9,13
Policy

SDN-R (SDN-C)
A1 PMS
10a,12a
A1
11a
A1 Policy
SLI
10o,12o
O1
11o

Control Loop

RAN-Sim
Config Change
A1
RAN App
O1
CU/DU

4f
FM/PM DB
4e
4c,4d

VES Coll
O1
FM, PM, CM
O-RAN O1

TBDMT
CM-VES Parser
4a
4b
CPS DB

3a-CM (for O1 & A1 actions)
3d-FM,PM (for O1 & A1 actions)

* Changes needed to support A1 based SON action

* Carry over CM update work

Steps 9:   Request msg from MS for O1/A1
Steps 10o/11o/12o: Automated action to make change in RAN (O1)
Steps 10a/11a/12a: Automated action to make change in RAN (A1)
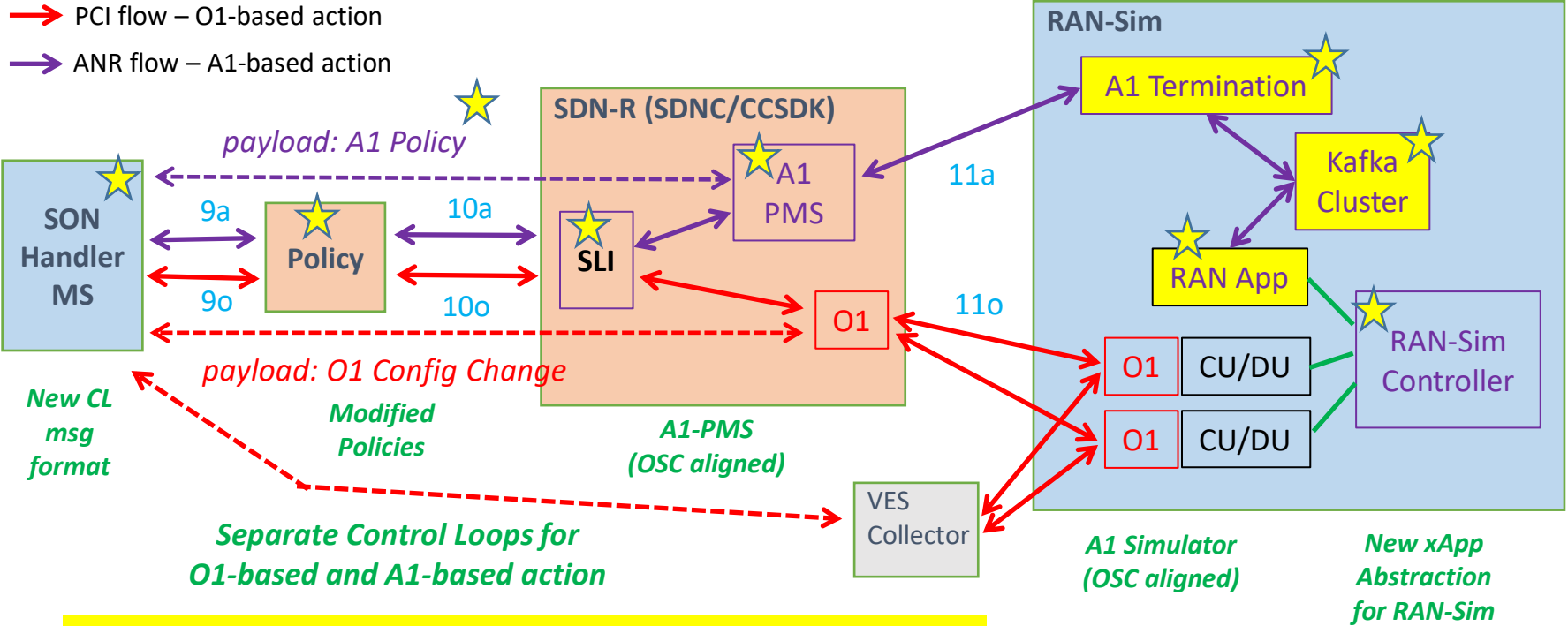Steps 13:   Action status

ONAP SON Use Case – Control Loop with O1 & A1 (Rel 11)

ONAP SON Use Case – Control Loop with O1 & A1 (Rel 11)

- Generates appropriate Control Loop (CL) messages for O1-based and A1-based SON action requests to Policy

- The CL message format was modified for Kohn release

- If the incoming message from RAN-Sim is a PCI-related fault notification, an O1-based Control Loop message is triggered

- If the incoming message from RAN-Sim is an ANR-related performance measurement notification, an A1-based Control Loop message is triggered

PM data sent from RAN-Sim to SON-Handler MS

M1   **PM KPI VES message sent over O1 interface from RAN-Sim CU/DU NF (Honeycomb)**

PM Data

```
2022-11-14 22:45:30.010 UTC [WebSocketSimpleContainer@802833029-17] INFO  com.wipro.www.ves.PmDataHandler - Pm url: https://10.31.4.51:30417/eventListener/v7
2022-11-14 22:45:30.098 UTC [WebSocketSimpleContainer@802833029-17] INFO  c.w.www.ves.restclient.HttpRequester - response code: 202
2022-11-14 22:45:30.098 UTC [WebSocketSimpleContainer@802833029-17] INFO  com.wipro.www.ves.PmDataHandler - PmDataHandler Response: Successfully send event
2022-11-14 22:45:30.098 UTC [WebSocketSimpleContainer@802833029-17] INFO  com.wipro.www.ves.PmDataHandler - PmDataHandler requestBody: {"event":{"commonEventHeader":{"domai
n":"measurement","eventId":"measurement001888","eventName":"Measurement_RansimAgent-Wipro_HandoffMetric","lastEpochMicrosec":1.668465928849E15,"priority":"Normal","reportin
gEntityName":"cucpserver2","sequence":0,"sourceName":"15548","startEpochMicrosec":1.66846592883E15,"version":"4.0.1","nfNamingCode":"RansimAgent","sourceId":"18e1f194-f232-
4722-983e-567f5ef69cec","nfVendorName":"Wipro","vesEventListenerVersion":"7.2","timeZoneOffset":"UTC+05:30"},"measurementFields":{"measurementInterval":180,"measurementFiel
dsVersion":"4.0","additionalMeasurements":[{"name":"15549","hashMap":{"InterEnbOutSucc_X2HO":"220","networkId":"RAN001","InterEnbOutAtt_X2HO":"250"}},{"name":"14427","hashM
ap":{"InterEnbOutSucc_X2HO":"220","networkId":"RAN001","InterEnbOutAtt_X2HO":"250"}}]}}}
2022-11-14 22:45:30.099 UTC [WebSocketSimpleContainer@802833029-17] INFO  com.wipro.www.ves.PmDataHandler - Pm url: https://10.31.4.51:30417/eventListener/v7
2022-11-14 22:45:30.203 UTC [WebSocketSimpleContainer@802833029-17] INFO  c.w.www.ves.restclient.HttpRequester - response code: 202
2022-11-14 22:45:30.204 UTC [WebSocketSimpleContainer@802833029-17] INFO  com.wipro.www.ves.PmDataHandler - PmDataHandler Response: Successfully send event
2022-11-14 22:45:30.204 UTC [WebSocketSimpleContainer@802833029-17] INFO  com.wipro.www.ves.PmDataHandler - PmDataHandler requestBody: {"event":{"commonEventHeader":{"domai
n":"measurement","eventId":"measurement001889","eventName":"Measurement_RansimAgent-Wipro_HandoffMetric","lastEpochMicrosec":1.668465928869E15,"priority":"Normal","reportin
gEntityName":"cucpserver2","sequence":0,"sourceName":"10896","startEpochMicrosec":1.668465928849E15,"version":"4.0.1","nfNamingCode":"RansimAgent","sourceId":"aa40057f-fcb8
-4b91-8f4f-1f87efc5cabd","nfVendorName":"Wipro","vesEventListenerVersion":"7.2","timeZoneOffset":"UTC+05:30"},"measurementFields":{"measurementInterval":180,"measurementFie
ldsVersion":"4.0","additionalMeasurements":[{"name":"10897","hashMap":{"InterEnbOutSucc_X2HO":"220","networkId":"RAN001","InterEnbOutAtt_X2HO":"250"}},{"name":"14655","hash
Map":{"InterEnbOutSucc_X2HO":"220","networkId":"RAN001","InterEnbOutAtt_X2HO":"250"}},{"name":"14656","hashMap":{"InterEnbOutSucc_X2HO":"220","networkId":"RAN001","InterEnb
OutAtt_X2HO":"250"}}]}}}
2022-11-14 22:45:30.204 UTC [WebSocketSimpleContainer@802833029-17] INFO  com.wipro.www.ves.PmDataHandler - Pm url: https://10.31.4.51:30417/eventListener/v7
2022-11-14 22:45:30.300 UTC [WebSocketSimpleContainer@802833029-17] INFO  c.w.www.ves.restclient.HttpRequester - response code: 202
2022-11-14 22:45:30.301 UTC [WebSocketSimpleContainer@802833029-17] INFO  com.wipro.www.ves.PmDataHandler - PmDataHandler Response: Successfully send event
```

Control Loop (CL) Message Format for O1-based SON action M2

 # PCI message format till Jakarta release

```
{
"closedLoopControlName":" ControlLoop-vPCI-fb41f388-
a5f2-11e8-98d0-529269fb1459 ",
"closedLoopAlarmStart":1606805921693,
"closedLoopEventClient":"microservice.PCI",
"closedLoopEventStatus":"ONSET",
"target":"pnf.pnf-name",
"from":"PCIMS",
"version":"1.0.2",
"policyName":"PCI",
"policyVersion":"1.0.2",
"target_type":"PNF",
"requestID":"82feb01e-4f3e-40e2-b8df-683adabae893",
"AAI":{"generic-vnf.prov-status":"ACTIVE",
"generic-vnf.is-closed-loop-disabled":"false",
"pnf.pnf-name":"ncserver1"},
"Action":"ModifyConfig",

"payload":
"{"Configurations":
[{"data":{"FAPService":
{"alias":"Chn0008","X0005b9Lte":{"phyCellIdInUse":0,"pnfName
":"cucpserver1"},"CellConfig":{"LTE":{"RAN":{"Common":{"CellId
entity":"Chn0008"}}}}}},{"data":{"FAPService":{"alias":"Chn0009
","X0005b9Lte":{"phyCellIdInUse":3,"pnfName":"cucpserver1"},"
CellConfig":{"LTE":{"RAN":{Common":{"CellIdentity":"Chn0009"}
}}}}}]]"
}
```

 # new O1 (PCI) message format for Kohn Release

```
{
"closedLoopControlName":" ControlLoop-SONO1-
fb41f388-a5f2-11e8-98d0-529269fb1459 ",
"closedLoopAlarmStart":1606805921693,
"closedLoopEventClient":"microservice.PCI",
"closedLoopEventStatus":"ONSET",
"target":"pnf.pnf-name",
"from":"PCIMS",
"version":"1.0.2",
"policyName": SONO1"",
"policyVersion":"1.0.2",
"target_type":"PNF",
"requestID":"82feb01e-4f3e-40e2-b8df-683adabae893",
"AAI":{"generic-vnf.prov-status":"ACTIVE",
"generic-vnf.is-closed-loop-disabled":"false",
"pnf.pnf-name":"ncserver1"},
"Action":"ModifyConfig",

"payload":
"{"Configurations":
[{"data":{"FAPService":
{"alias":"Chn0008","X0005b9Lte":{"phyCellIdInUse":0,"pnfName
":"cucpserver1"},"CellConfig":{"LTE":{"RAN":{"Common":{"CellId
entity":"Chn0008"}}}}}},{"data":{"FAPService":{"alias":"Chn0009
","X0005b9Lte":{"phyCellIdInUse":3,"pnfName":"cucpserver1"},"
CellConfig":{"LTE":{"RAN":{Common":{"CellIdentity":"Chn0009"}
}}}}}]]"
}
```

ANR message format till Jakarta release

{
"closedLoopControlName":"ControlLoop-v**SONH**-7d4baf04-8875-4d1f-946d-06b874048b61",
"closedLoopAlarmStart":1606805921693,
"closedLoopEventClient":"microservice.PCI",
"closedLoopEventStatus":"ONSET",
"target":"pnf.pnf-name",
"from":"PCIMS",
"version":"1.0.2",
"policyName":"PCI",
"policyVersion":"1.0.2",
"target_type":"PNF",
"requestID":"82feb01e-4f3e-40e2-b8df-683adabae893",
"AAI":{"generic-vnf.prov-status":"ACTIVE",
"generic-vnf.is-closed-loop-disabled":"false",
"pnf.pnf-name":"ncserver1"},
"Action":"ModifyConfigANR",

"payload":
"{"Configurations":
[{"data":{"FAPService":
{"alias":"Chn0014","CellConfig":{"LTE":{"RAN":{"Common":
{"CellIdentity":"Chn0014"},
"NeighborListInUse":
{"LTECell":[
{"PNFName":"ncserver1","PLMNID":"ran-
1","CID":"Chn0000","PhyCellID":0,"Blacklisted":"true"},
{"PNFName":"ncserver1","PLMNID":"ran-
1","CID":"Chn0001","PhyCellID":0,"Blacklisted":"true"}],"LTECellNumberOfEntries":"2"}}}}}
}]}"
}

New A1 (ANR) DMaaP message format

{
"closedLoopControlName":"ControlLoop-**SONA1**-7d4baf04-8875-4d1f-946d-06b874048b61",
"closedLoopAlarmStart":1606805921693,
"closedLoopEventClient":"microservice.PCI",
"closedLoopEventStatus":"ONSET",
"target":"pnf.pnf-name",
"from":"PCIMS",
"version":"1.0.2",
"policyName":"SONA1",
"policyVersion":"1.0.2",
"target_type":"PNF",
"requestID":"82feb01e-4f3e-40e2-b8df-683adabae893",
"AAI":{"generic-vnf.prov-status":"ACTIVE",
"generic-vnf.is-closed-loop-disabled":"false",
"pnf.pnf-name":"cucpserver1"},
"Action":"putA1Policy"

"payload":"{\"input\":{\"near-rt-ric-url\":\"https://10.31.4.43:30294/a1-policy/v2/policies\",\"body\":{\"policy_id\":\"08f450b1-c872-4cdf-83fa-b7d8084fb010\",\"policytype_id\":\"ANR\",\"ric_id\":\"a1-terminator\",\"policy_data\":{\"PNFName\":\"cucpserver1\",\"PLMNID\":\"RAN001\",\"CellID\":\"15689\",\"neighbours\":[{\"PNFName\":\"cucpserver1\",\"PLMNID\":\"RAN001\",\"CellID\":\"15825\",\"ho-kpi1\":88},{\"PNFName\":\"cucpserver1\",\"PLMNID\":\"RAN001\",\"CellID\":\"15826\",\"ho-kpi1\":88},{\"PNFName\":\"cucpserver1\",\"PLMNID\":\"RAN001\",\"CellID\":\"13999\",\"ho-kpi1\":88}]},\"service_id\":\"\",\"transient\":false,\"status_notification_uri\":\"\"}
}}"

CL Request message sent from SON-Handler to Policy for A1 based action

M2

10:04:30.213 [pool-5-thread-7] INFO c.att.nsa.apiClient.http.HttpClient -   --> HTTP/1.1 200 OK
10:04:30.214 [pool-5-thread-7] INFO o.o.d.s.d.PmNotificationCallback - Performance notification org.onap.dcaegen2.services.sonhms.entity.PerformanceNotifications@2890
10:04:30.320 [Thread-2] INFO o.o.d.services.sonhms.PmThread - New PM notification from Dmaap
10:04:30.331 [Thread-2] INFO o.o.d.s.sonhms.PmNotificationHandler - no history of srcCell found
10:04:30.331 [Thread-2] INFO o.o.d.s.sonhms.PmNotificationHandler - triggering policy to remove bad neighbors
10:04:30.331 [Thread-2] INFO o.o.d.s.sonhms.PmNotificationHandler - payload : Payload [input=Input [url=https://10.31.4.43:30294/a1-policy/v2/policies, anrPayload=ANRPa
ad [policy_id=542cafdb-9155-46e1-b2da-9bb8cea6fe22, policy_type_id=ANR, ric_id=a1-terminator, policy_data=PolicyData [pnfName=cucpserver2, plmnId=RAN001, cellId=11561,
ghbours=[Neighbours [pnfName=cucpserver2, plmnId=RAN001, cellId=11562, hoKpi=88], Neighbours [pnfName=cucpserver2, plmnId=RAN001, cellId=11568, hoKpi=88], Neighbours [pn
me=cucpserver2, plmnId=RAN001, cellId=11569, hoKpi=88]]], service_id=, transient1=false, status=]]]
10:04:30.333 [Thread-2] INFO o.o.d.s.sonhms.PmNotificationHandler - After converting A1Paylod to String: {"input":{"near-rt-ric-url":"https://10.31.4.43:30294/a1-policy
/policies","body":{"policy_id":"542cafdb-9155-46e1-b2da-9bb8cea6fe22","policytype_id":"ANR","ric_id":"a1-terminator","policy_data":{"PNFName":"cucpserver2","PLMNID":"RAN
","CellID":"11561","neighbours":[{"PNFName":"cucpserver2","PLMNID":"RAN001","CellID":"11562","ho-kpi1":88},{"PNFName":"cucpserver2","PLMNID":"RAN001","CellID":"11568","h
pi1":88},{"PNFName":"cucpserver2","PLMNID":"RAN001","CellID":"11569","ho-kpi1":88}]},"service_id":"","transient":false,"status_notification_uri":""}}}
10:04:30.334 [Thread-2] ERROR o.o.d.s.s.child.ChildThreadUtils - Config policy not found. Using default
10:04:30.335 [Thread-2] INFO o.o.d.s.sonhms.PmNotificationHandler - Policy Notification: {"closedLoopControlName":"ControlLoop-SONA1-7d4baf04-8875-4d1f-946d-06b874048b
"closedLoopAlarmStart":1668506670334,"closedLoopEventClient":"microservice.PCI","closedLoopEventStatus":"ONSET","target":"pnf.pnf-name","from":"PCIMS","version":"1.0.2"
licyName":"SONA1","policyVersion":"1.0.2","payload":"{\"input\":{\"near-rt-ric-url\":\"https://10.31.4.43:30294/a1-policy/v2/policies\",\"body\":{\"policy_id\":\"542caf
155-46e1-b2da-9bb8cea6fe22\",\"policytype_id\":\"ANR\",\"ric_id\":\"a1-terminator\",\"policy_data\":{\"PNFName\":\"cucpserver2\",\"PLMNID\":\"RAN001\",\"CellID\":\"1156
\"neighbours\":[{\"PNFName\":\"cucpserver2\",\"PLMNID\":\"RAN001\",\"CellID\":\"11562\",\"ho-kpi1\":88},{\"PNFName\":\"cucpserver2\",\"PLMNID\":\"RAN001\",\"CellID\":\"
3\",\"ho-kpi1\":88},{\"PNFName\":\"cucpserver2\",\"PLMNID\":\"RAN001\",\"CellID\":\"11569\",\"ho-kpi1\":88}]},\"service_id\":\"\",\"transient\":false,\"status_notificat
uri\":\"\"}}}","target_type":"PNF","requestID":"cb80b81e-f7d3-4188-a799-727bfbc79a5a","AAI":{"generic-vnf.prov-status":"ACTIVE","generic-vnf.is-closed-loop-disabled":"f
","pnf.pnf-name":"cucpserver2"},"Action":"putA1Policy"}
10:04:30.420 [Thread-2] INFO o.o.d.s.sonhms.PmNotificationHandler - send notification to policy result true
10:04:30.421 [Thread-2] INFO o.o.d.s.sonhms.PmNotificationHandler - Sent ANR update to policy true
10:04:30.421 [Thread-2] INFO o.o.d.services.sonhms.PmThread - pm notification handler result true
10:04:30.616 [pool-2647-thread-1] INFO c.a.n.c.c.i.CambriaSimplerBatchPublisher - sending 1 msgs to /events/unauthenticated.DCAE_CL_OUTPUT. Oldest: 196 ms
10:04:30.617 [pool-2647-thread-1] INFO c.att.nsa.apiClient.http.HttpClient - POST http://message-router:3904/events/unauthenticated.DCAE_CL_OUTPUT (anonymous) ...
10:04:30.632 [pool-2647-thread-1] INFO c.att.nsa.apiClient.http.HttpClient -   --> HTTP/1.1 200 OK
10:04:30.632 [pool-2647-thread-1] INFO c.a.n.c.c.i.CambriaSimplerBatchPublisher - cambria reply ok (16 ms):{"serverTimeMs":2,"count":1}
10:04:31.421 [Thread-2] INFO o.o.d.services.sonhms.PmThread - New PM notification from Dmaap
10:04:31.425 [Thread-2] INFO o.o.d.services.sonhms.PmThread - Queue is empty

LFN Developer & Testing Forum

Policy Enforcement Function

- Two Control Loop (CL) flows for O1- and A1- based actions
- New CL message formats
- Different policies for O1-based and A1-based action
- CL messages forwarded to different DMaaP topics: SDN-CL for O1, A1-P for A1
- Foundation for Policy-based rules for O1 and A1 flows
- Backward compatible

CL message from Policy to A1-PMS/SDN-R for A1-based SON action (payload is A1-P Policy)
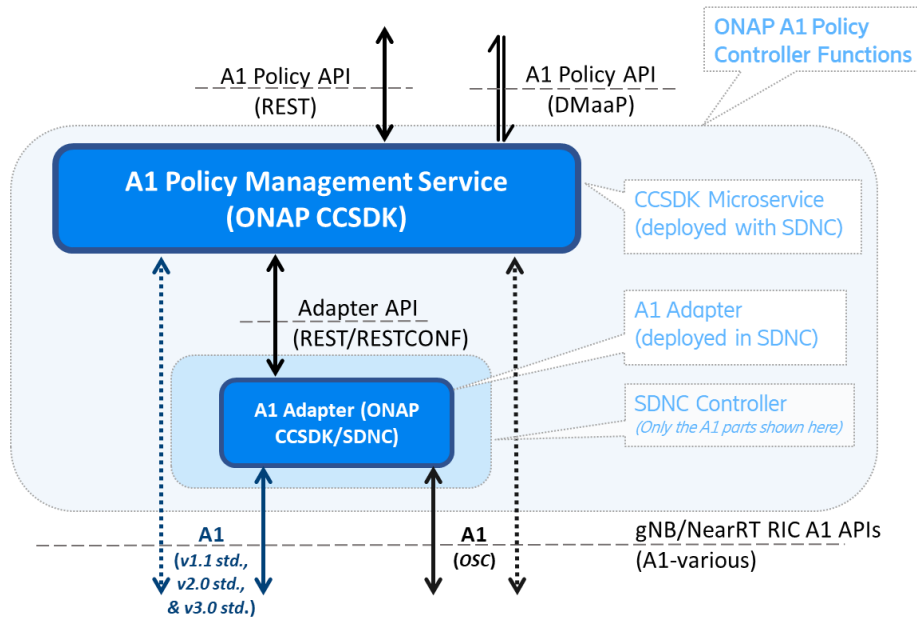
M3

```
"policyName": "op.5g.son.a1",
"policyVersion": "1.0.0",
"notification": "OPERATION",
"message": "actor=A1P,operation=putA1Policy,target=OperationalTarget(targetType=PNF, entityIds=null),subRequestId=772ff066-5cd5-4f11-b529-d51ca46c26b6",
"notificationTime": "2022-11-15 10:04:31.920175+00:00",
"history": []
}
[2022-11-15T10:04:31.923+00:00|Thread-60675][OUT|DMAAP|A1-P]
{
  "body": {
    "input": {
      "CommonHeader": {
        "TimeStamp": "2022-11-15T10:04:31.920091Z",
        "APIVer": "1.0",
        "RequestID": "cb80b81e-f7d3-4188-a799-727bfbc79a5a",
        "SubRequestID": "772ff066-5cd5-4f11-b529-d51ca46c26b6",
        "RequestTrack": {},
        "Flags": {}
      },
      "Action": "putA1Policy",
      "Payload": "{\"input\":{\"near-rt-ric-url\":\"https://10.31.4.43:30294/a1-policy/v2/policies\",\"body\":{\"policy_id\":\"542cafdb-9155-46e1-b2da-9bb8cea6fe22\",\"poli
    }
  },
  "version": "1.0",
  "rpc-name": "puta1policy",
  "correlation-id": "cb80b81e-f7d3-4188-a799-727bfbc79a5a-772ff066-5cd5-4f11-b529-d51ca46c26b6",
  "type": "request"
}
```

Payload is A1-P Policy

A1 Policy Functions in ONAP / O-RAN SC

- A1 Policy Controller functions in ONAP CCSDK / SDNC
- A1 Policy Management Service
  - Controller function for managing A1 Policies in the RAN.
  - Terminates A1 Interface in Non-RT-RIC / SMO / ONAP
  - Implements O-RAN A1 Application Protocol for A1 Policies
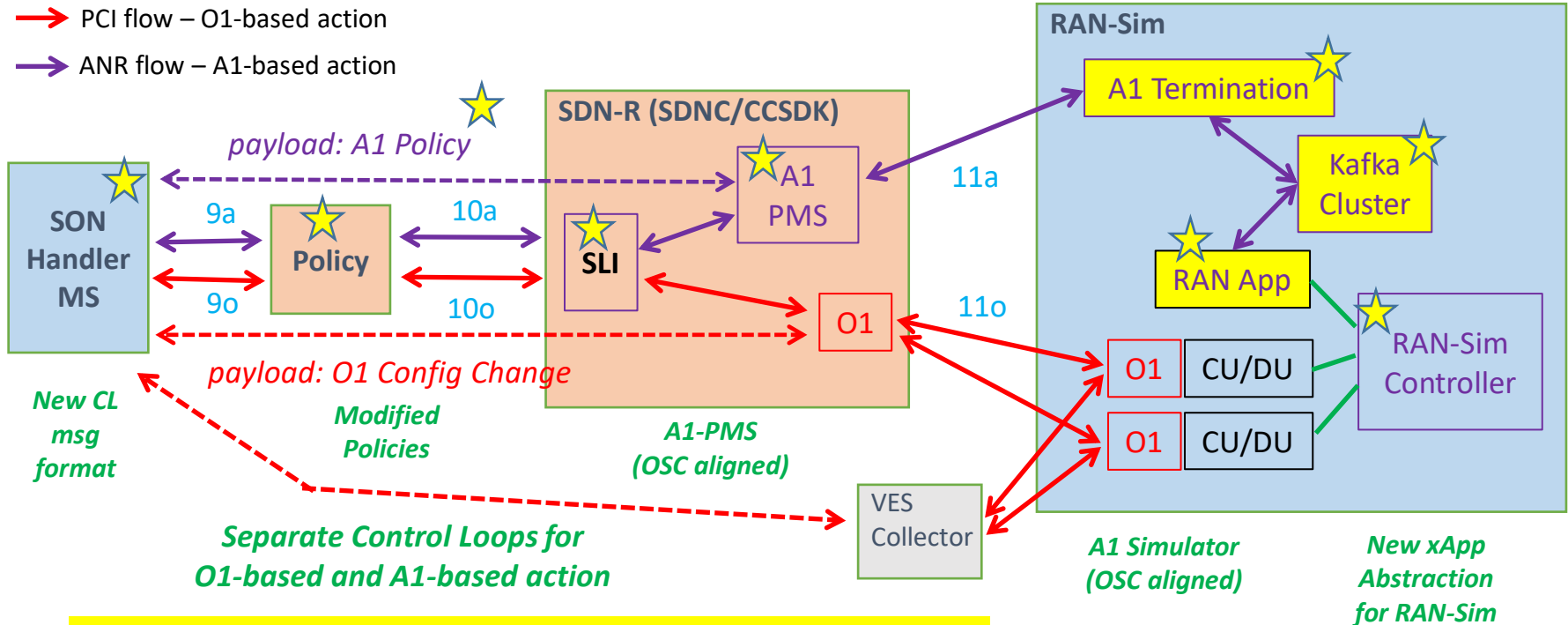 - Co-deployed with ONAP SDNC

Ref: https://wiki.onap.org/display/DW/O-RAN+A1+Policies+in+ONAP

SDN-R (SDNC/CCSDK)

- New CL message formats for O1 and A1

- New support for A1-based SON action

- Leverages existing A1-PMS work in ONAP/OSC to develop solution which interworks with RAN-Sim
  - A1-PMS supports A1-P interface v2.0, v2.1
  - Leverage OSC A1-Sim as A1 Termination in RAN-Sim

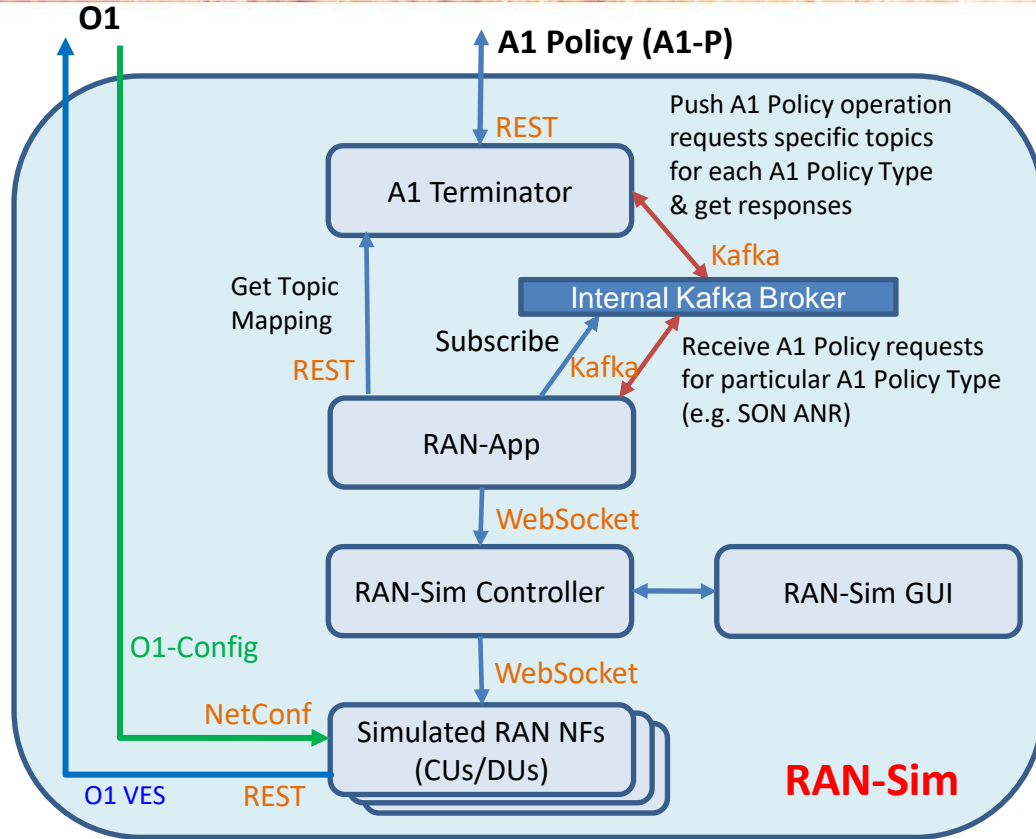# ONAP SON Use Case – Control Loop with O1 & A1 (Rel 11)

A1-P Policy Type initialization

- New ANR A1-P Policy Type is added in A1 Terminator (RAN-Sim) to support ANR use case. The Policy Type Schema is shown below.

    - {"policySchema":{"$schema":"http://json-schema.org/draft-07/schema#","description":"ANR policy type","title":"ANR","type":"object","properties":{"PNFName":{"type":"string"},"neighbours":{"type":"array","items":{"properties":{"PNFName":{"type":"string"},"CellID":{"type":"string"},"ho-kpi1":{"format":"uint8","type":"integer"},"PLMNID":{"type":"string"}}}},"CellID":{"type":"string"},"additionalProperties":false,"PLMNID":{"type":"string"},"required":["PNFName","PLMNID","CellID","neighbours"]}},"statusSchema":{"$schema":"http://json-schema.org/draft-07/schema#","title":"STD_2_0.2.0","description":"ANR policy type status","type":"object","properties":{"enforceStatus":{"type":"string"},"enforceReason":{"type":"string"},"additionalProperties":false,"required":["enforceStatus"]}}}

- A1-PMS supports O-RAN standard specified A1-P interfaces and non-standard OSC interfaces as well.

SDN-R processing for A1 Messages

- SON Handler MS sends below control loop message to Policy, and payload (contains A1-P policy) is forwarded to SDN-R

{"closedLoopControlName":"ControlLoop-SONA1-7d4baf04-8875-4d1f-946d-06b874048b61","closedLoopAlarmStart":1668749521327,"closedLoopEventClient":"microservice.PCI","closedLoopEventStatus":"ONSET","target":"pnf.pnf-name","from":"PCIMS","version":"1.0.2","policyName":"SONA1","policyVersion":"1.0.2","payload":"{\"input\":{\"near-rt-ric-url\":\"https://10.31.4.43:30294/a1-policy/v2/policies\",\"body\":{\"policy_id\":\"08f450b1-c872-4cdf-83fa-b7d8084fb010\",\"policytype_id\":\"ANR\",\"ric_id\":\"a1-terminator\",\"policy_data\":{\"PNFName\":\"cucpserver1\",\"PLMNID\":\"RAN001\",\"CellID\":\"15689\",\"neighbours\":[{\"PNFName\":\"cucpserver1\",\"PLMNID\":\"RAN001\",\"CellID\":\"15825\",\"ho-kpi1\":88},{\"PNFName\":\"cucpserver1\",\"PLMNID\":\"RAN001\",\"CellID\":\"15826\",\"ho-kpi1\":88},{\"PNFName\":\"cucpserver1\",\"PLMNID\":\"RAN001\",\"CellID\":\"13999\",\"ho-kpi1\":88}]},\"service_id\":\"\",\"transient\":false,\"status_notification_uri\":\"\"}}}","target_type":"PNF","requestID":"14f5cac5-22a2-4847-ad9b-ec276d226d21","AAI":{"generic-vnf.prov-status":"ACTIVE","generic-vnf.is-closed-loop-disabled":"false","pnf.pnf-name":"cucpserver1"},"Action":"putA1Policy"}

- A1 DMaaP Listener receives the request from Policy (PEF), forwards to an SLI graph, which forwards it to A1-PMS using REST API.
- A1-PMS handles all A1 interface protocol to A1 Terminator in RAN-Sim
- A1-PMS validates it against the A1 Policy Type registered with the A1-PMS.
- A1 DMaaP Listener sends appropriate responses back to Policy Framework

RAN-Sim Enhancement to add A1 Support

- A1 Terminator based on O-RAN SC A1 Simulator
- Kafka distributes A1 Policy requests from A1 Terminator to appropriate RAN-Sim RAN-App
- WebSockets used for internal RAN-Sim communications

A1 Terminator holds a mapping of A1PolicyTypeId to Kafka topic

A1-Policy-Type-ID	TopicNames
ANR	kafkatopicreq / kafkatopicres
STD_1	kafkatopicreq2 / kafkatopicres2
ORAN_QoSTarget_2.0.0	topicA / topicB
...	...

RAN-Sim Enhancement: A1 flow

- Two new functions have been added to RAN-Sim
  - A1 Terminator: Supports A1 interface to A1-PMS (in SMO)
  - RAN-App: Abstracts the function of xApp
- ANR RAN-App serves the ANR SON Use Case.
- RAN-App interacts with the A1 Terminator to receive the ANR A1 policy payload from the A1-PMS (in SMO).
- RAN App Receives the A1 Policy message which is in below format.

{"policy_id":"08f450b1-c872-4cdf-83fa-b7d8084fb010","payload":{"PNFName":"cucpserver1","neighbours":[{"PNFName":"cucpserver1","CellID":"15825","ho-kpi1":88,"PLMNID":"RAN001"},{"PNFName":"cucpserver1","CellID":"15826","ho-kpi1":88,"PLMNID":"RAN001"},{"PNFName":"cucpserver1","CellID":"13999","ho-kpi1":88,"PLMNID":"RAN001"}],"CellID":"15689","PLMNID":"RAN001"},"action":"CreatePolicy","policy_type_id":"ANR"}

RAN-Sim Enhancement: A1 flow

- RAN-App processes the incoming message and performs the business logic using the ho-kpi parameter available in the payload.

- RAN App may trigger a new config for a serving cell to change its neighbour cell relations.

- To mimic the O-RAN E2 interface functionality, RAN App sends configuration changes for the CU/DU NF through the interface to RAN Simulator Controller.

- Message from RAN App to the RAN Simulator Controller (Websocket).

{"Configurations":[{"data":{"FAPService":{"CellConfig":{"LTE":{"RAN":{"Common":{"CellIdentity":"15689"},"NeighborListInUse":{"LTECell":[{"idGNBCUCPFunction":"cucpserver1","PLMNID":"RAN001","idNRCellRelation":"15825","nRTCI":0,"isHOAllowed":"true"},{"idGNBCUCPFunction":"cucpserver1","PLMNID":"RAN001","idNRCellRelation":"15826","nRTCI":0,"isHOAllowed":"true"},{"idGNBCUCPFunction":"cucpserver1","PLMNID":"RAN001","idNRCellRelation":"13999","nRTCI":0,"isHOAllowed":"true"}],"LTECellNumberOfEntries":"3"}}}},"idNRCellCU":"cucpserver1"}}}]}

- Message from RAN-App to A1 Terminator (Kafka)

{ "response-code":200, "error-info":Neighbour Cell Relation changed Successfully}

Conclusion

- ONAP 5G SON Use Case has been updated to support both A1 and O1 based actions

- Better alignment with O-RAN

- Built on existing ONAP/OSC work for better ONAP/O-RAN/OSC harmonization

For more information

- SON Use Case Links:

  [5G-SON (earlier name was OOF-SON) — onap master documentation](#)

  [R11 SON Use Case Overview - Developer Wiki - Confluence (onap.org)](#)

- JIRA tasks:

  - https://jira.onap.org/browse/REQ-1212

  - https://jira.onap.org/browse/CCSDK-3644

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

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

LF NETWORKING

LFN Developer & Testing Forum

Thank You

Kafka Message Format from A1 Terminator to RAN-App

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

SON Use Case: O1 and A1 based action

- Current (Rel 10 Jakarta)
  - 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/NRCellRelation/isHOAllowed value* (based on analysis of poor HO kpi values by SON Handler MS)

- 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*

ONAP
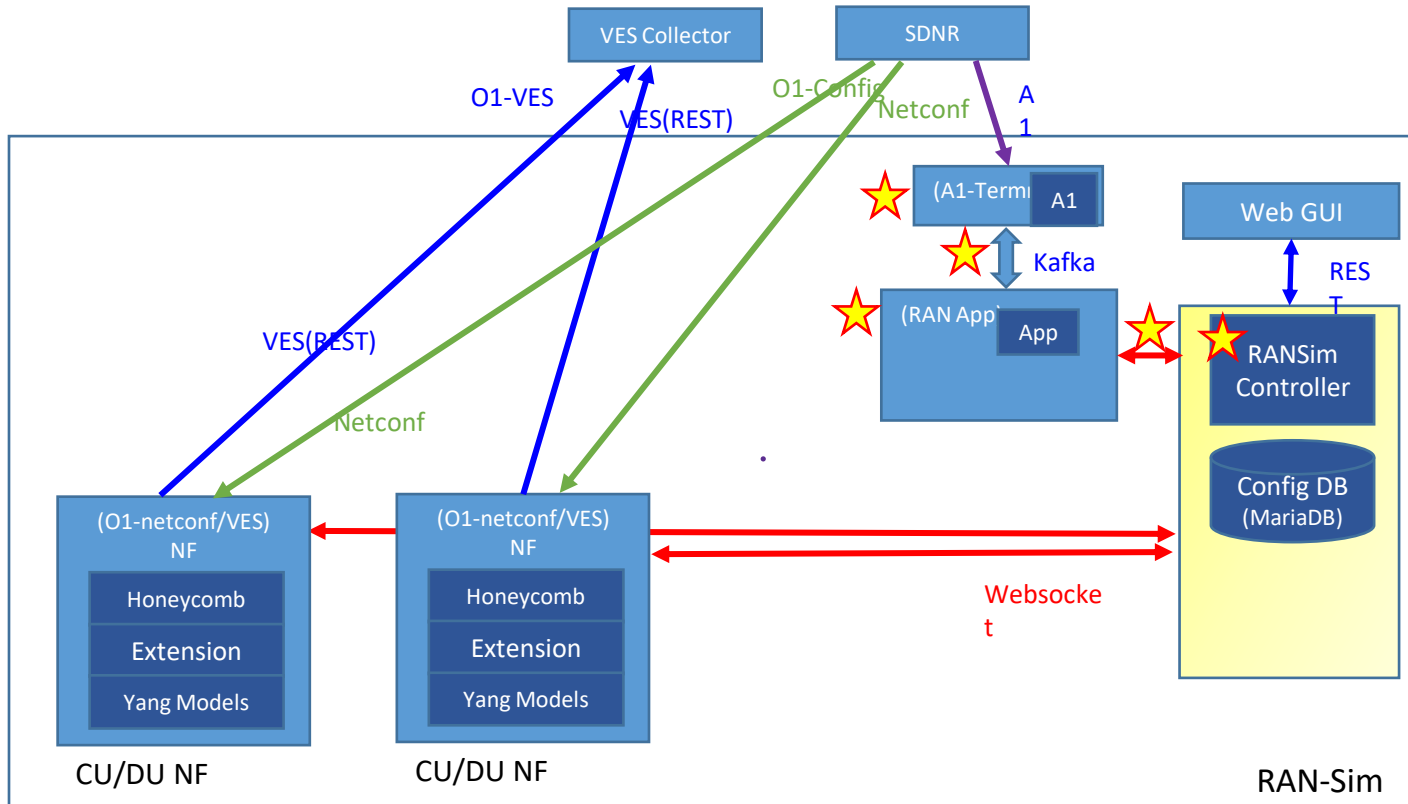OPEN NETWORK AUTOMATION PLATFORM

Control Loop for A1-based and O1-based actions

- Design approach
    - ONAP Use Cases: Use similar solution for SON, Slicing, and other use cases
    - ONAP/OSC: Harmonize with O-RAN SC work for non-rt-ric and smo
    - Leverage existing work, phased approach towards target

- Target architecture
    - Separate control loop names, PEF Policies for O1 and A1
    - O1 control loop directed to SDN-R netconf client
    - A1 control loop directed to A1 Policy Management Service (in SDN-R)
    - Progress towards alignment with O-RAN rApp and R1 interface

ONAP Component Impacts for Kohn release

COMPONENT	IMPACT
DCAE	• Generate modified Control Loop messages for PCI and ANR flows
Policy	• Modification of control loop messages for O1 and A1 based control action • Modification of operational policies and actions for O1 and A1 messages
SDN-C (SDN-R)	• Implementation of A1 interface (A1-PMS) • Modifications in handling of O1 and A1 control loop messages
RAN-Sim (Simulators)	• New support for A1 interface • New A1 Termination modules (based on OSC) • New RAN App for abstraction of xApp and Near-RT RIC • Enhancement to RAN-Sim controller

THE LINUX FOUNDATION

ONAP
OPEN NETWORK AUTOMATION PLATFORM

Enhancing RAN-Sim to support both O1 and A1

New module in RAN-Sim
- RAN App (abstraction of xApp)
- A1 termination

Areas of work
A. A1 termination (aligned with OSC)
B. RAN App (for 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

THE **LINUX** FOUNDATION