

SMO Architecture and Open Source Implementation

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Background and Acknowledgments

- Speaker background
 - AT&T (Bell) Labs, STL, Rutgers WINLAB
 - ONAP/LFN, O-RAN WG1, O-RAN SC
 - Member: LFN TAC, ONAP TSC
- Acknowledgment:
 - This presentation is partly based on the following ONAP/OSC/O-RAN presentation:
OSC/ONAP SMO Framework: Exploring interactions among SMO-related projects in OSC and ONAP,
https://wiki.o-ran-sc.org/download/attachments/3604609/OSC_ONAP_SMO_Framework_v5.pptx?api=v2
 - This presentation incorporates input/ideas from interactions with teams in O-RAN SC, ONAP, O-RAN, Rutgers WINLAB including: Andrea Buldorini, Rittwik Jana, John Keeney, David Kinsey, Seshu Mudiganti, Timo Perala, Ivan Seskar, Martin Skorupski, Joseph Thaliath, Tracy van Brakle

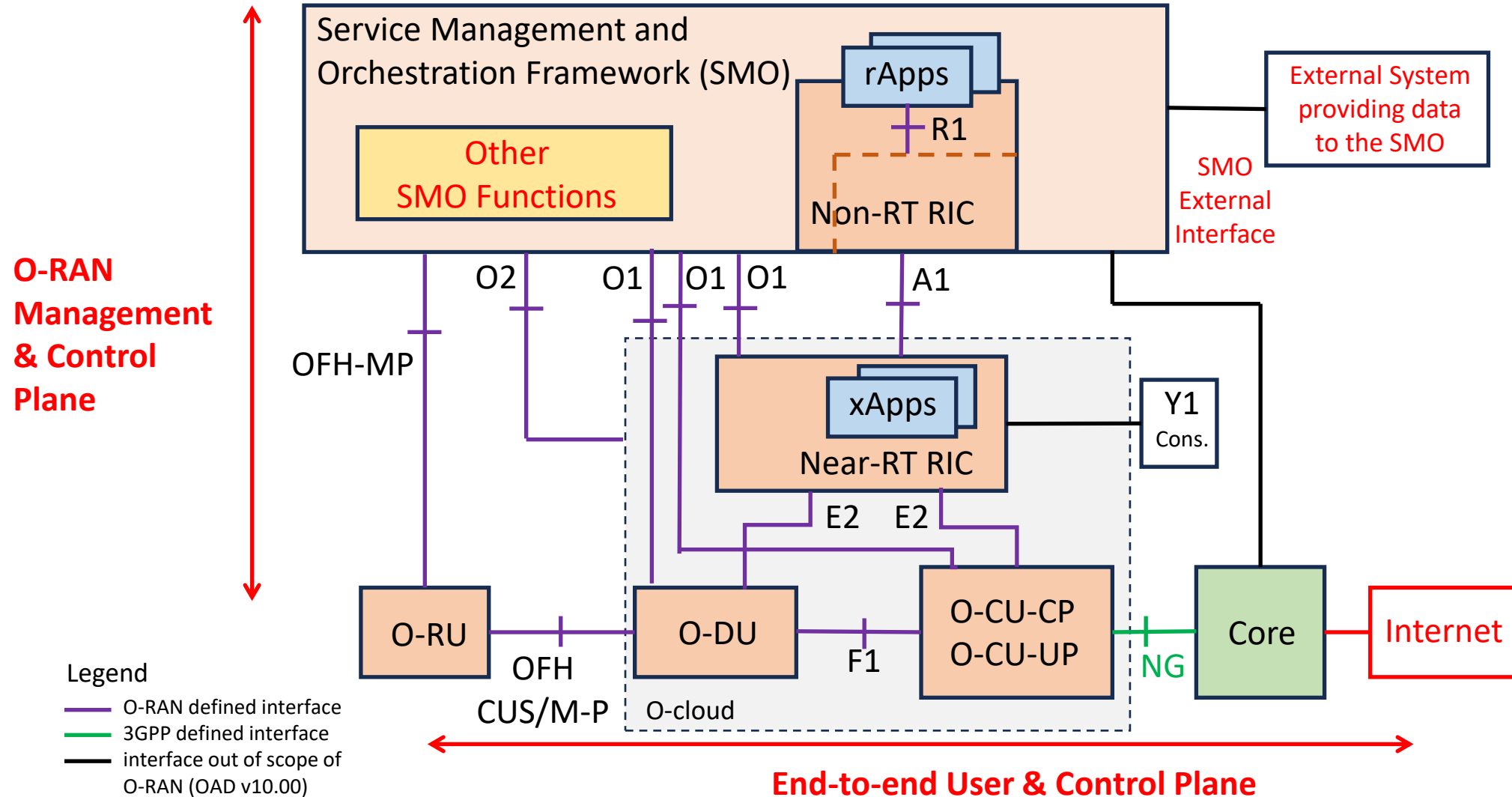


Talk Outline

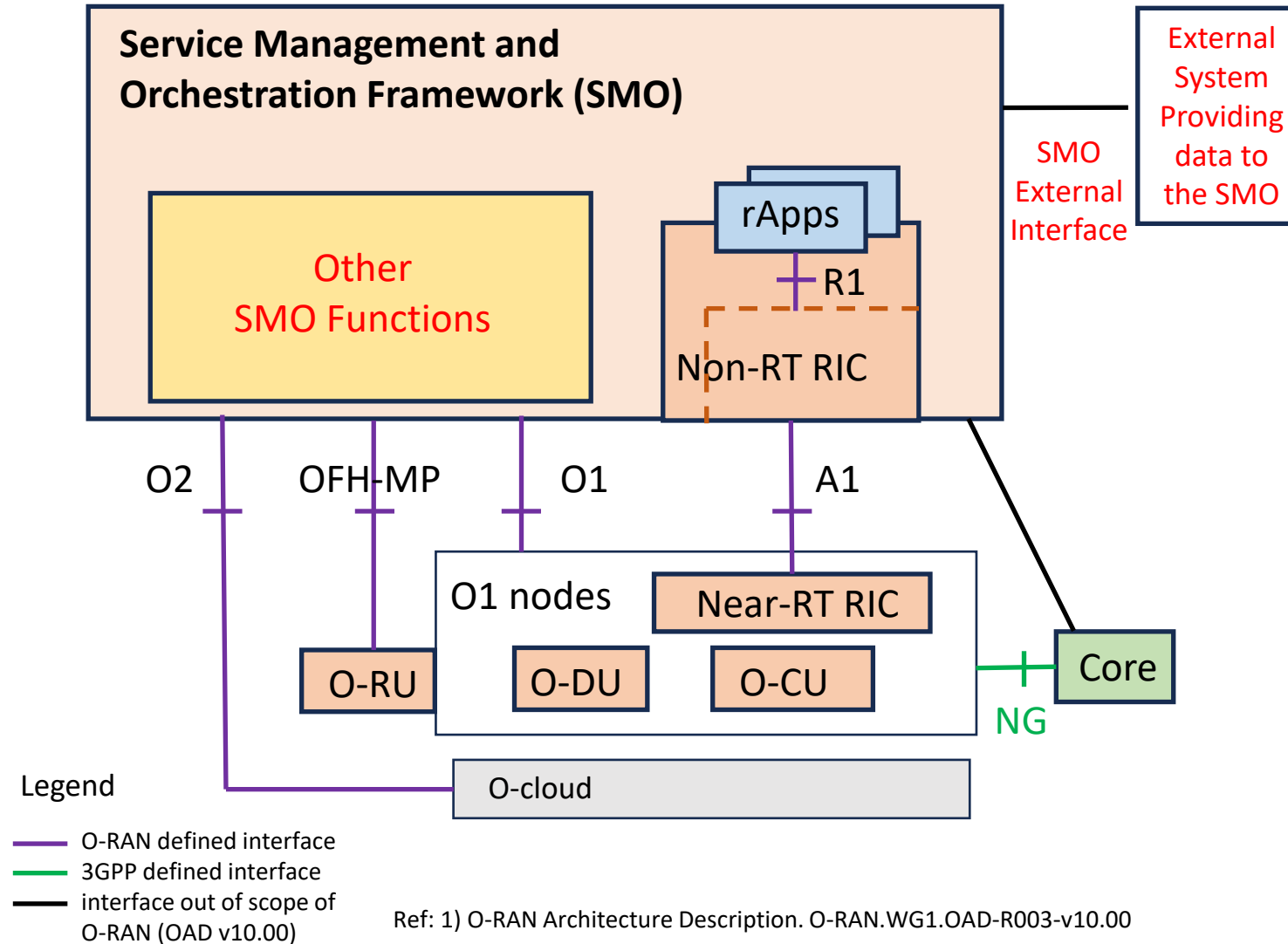
- SMO in O-RAN Architecture
- Ongoing SMO Architecture standardization discussion
- Importance of Open Source
- SMO-related Open Source Projects (OSC, ONAP focus)
- Alignment and synergy in Open Source
- Conclusion



O-RAN Architecture: User, Control, Management Plane

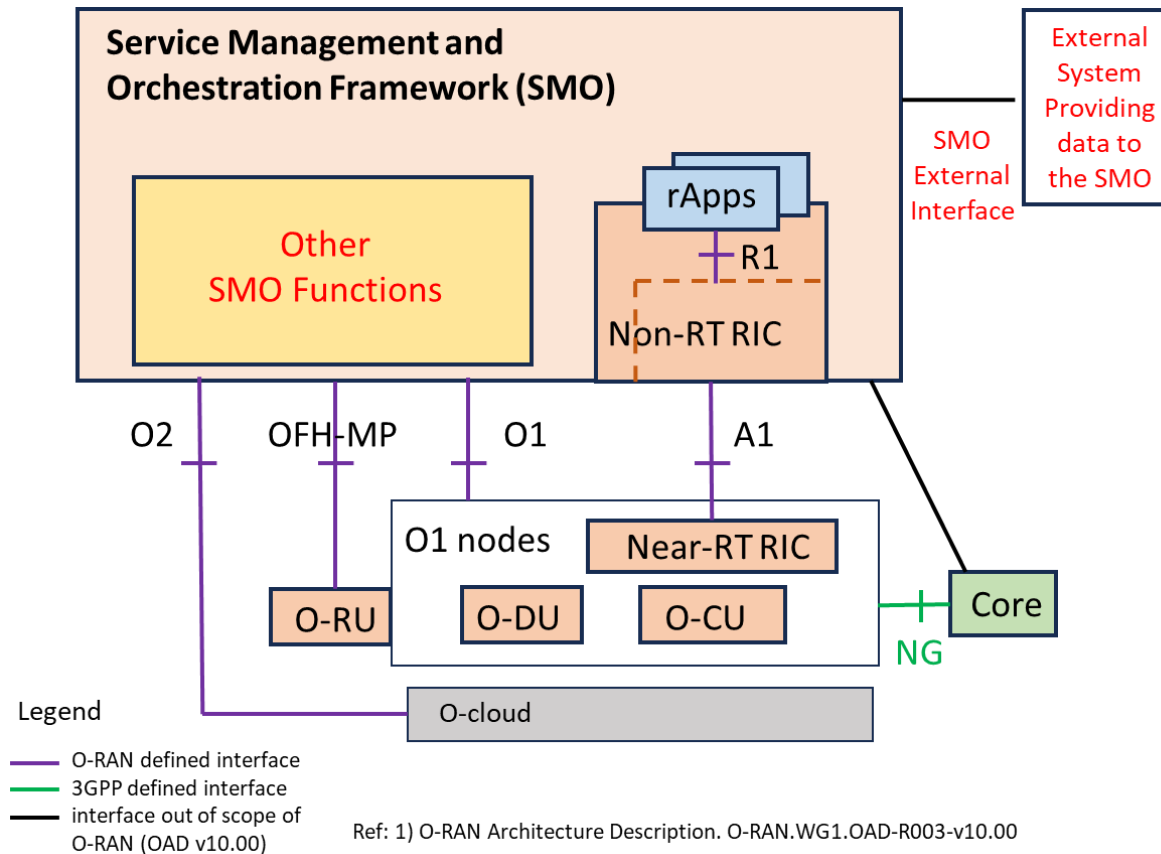


Focus on role of SMO in O-RAN Architecture ..

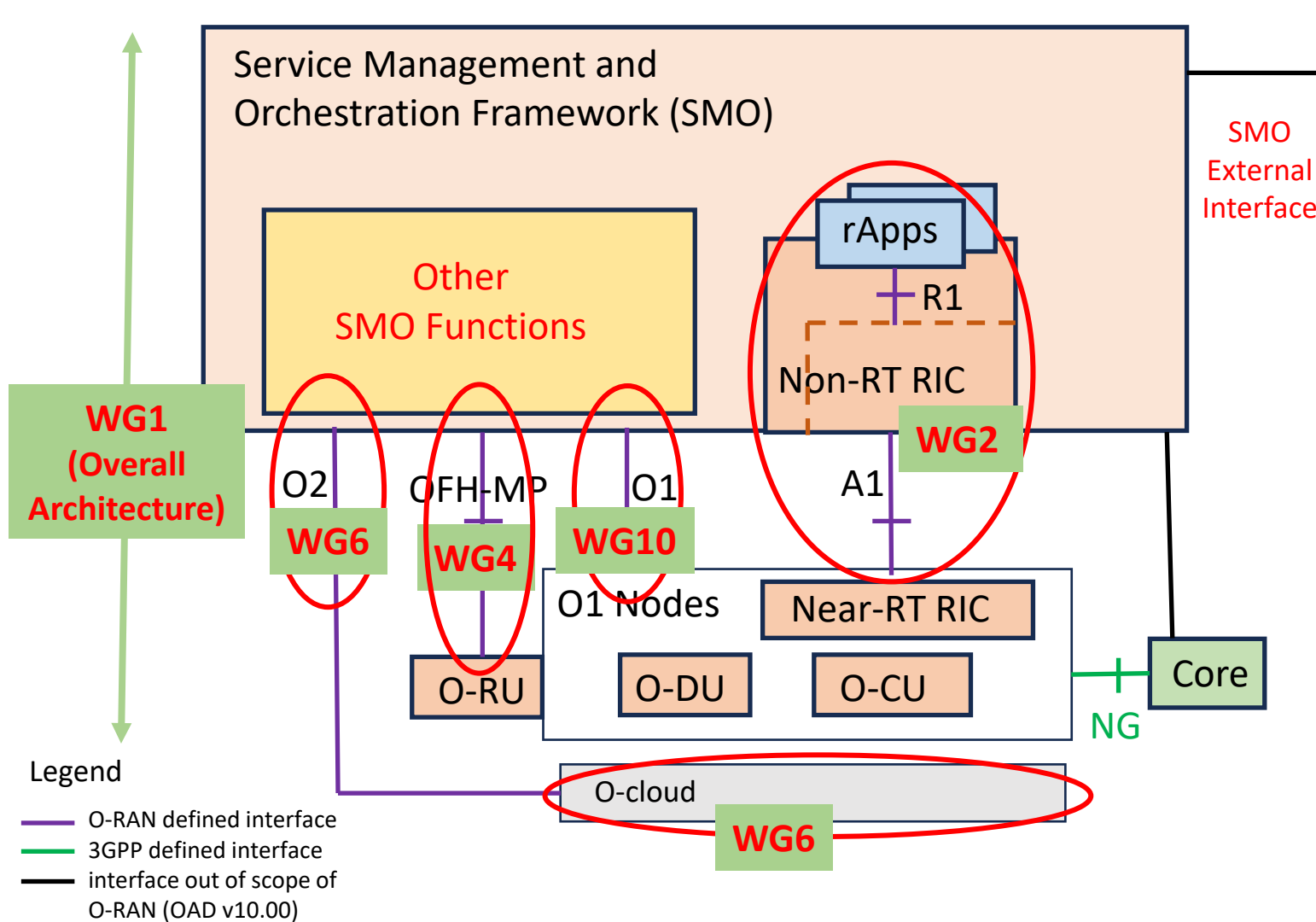


Role of SMO - RAN domain management

- Responsible for RAN domain management and non-real-time control, optimization, automation
- Includes Non-Real Time RIC which provides:
 - Support for rApp applications (via R1)
 - Non-real-time intelligent control, optimization, radio resource mgmnt and other functions
 - Policy-based guidance to Near-RT RIC (via A1)
- FCAPS support to O-RAN Network functions (via O1 and to O-RU (via OFH-MP interface)
 - PM, FM, CM, File management
 - Software management
- O-Cloud Management, Orchestration and Workflow Management (via O2 interface)
 - Discovery and administration of O-Cloud Resources
 - Scale-in, Scale-out, FCAPS for O-Cloud
- **Interfaces to external systems**
 - **OSS/BSS, transport, core, other RAN networks**

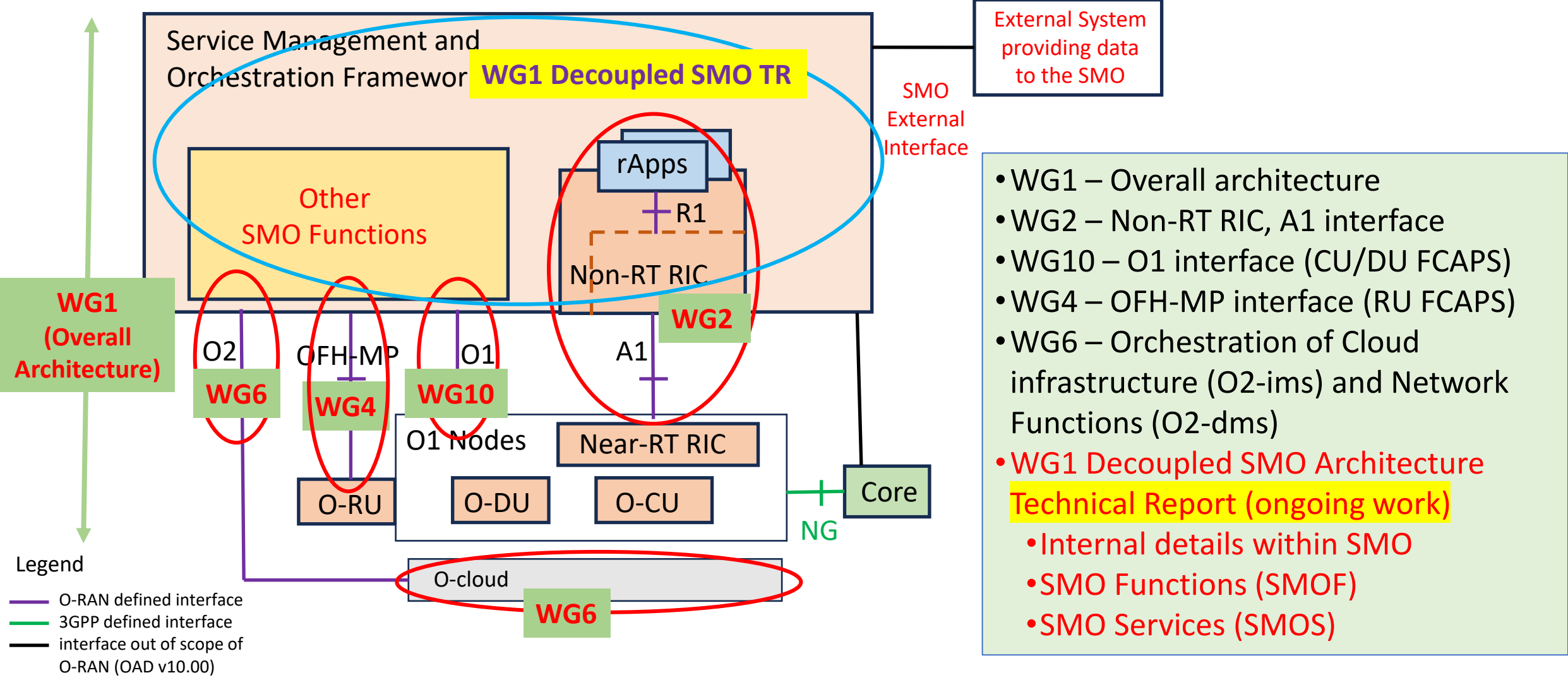


SMO-Related O-RAN Standardization (June 2023 specs)



- External System providing data to the SMO
- SMO External Interface
- WG1 – Overall architecture
 - WG2 – Non-RT RIC, A1 interface
 - WG10 – O1 interface (CU/DU FCAPS)
 - WG4 – OFH-MP interface (RU FCAPS)
 - WG6 – Orchestration of Cloud infrastructure (O2-ims) and Network Functions (O2-dms)
 - No WG covering entire SMO
 - Internal SMO architecture not specified
 - Details of “Other SMO Functions” implied but not specified

SMO-Related O-RAN Standardization (including ongoing work)

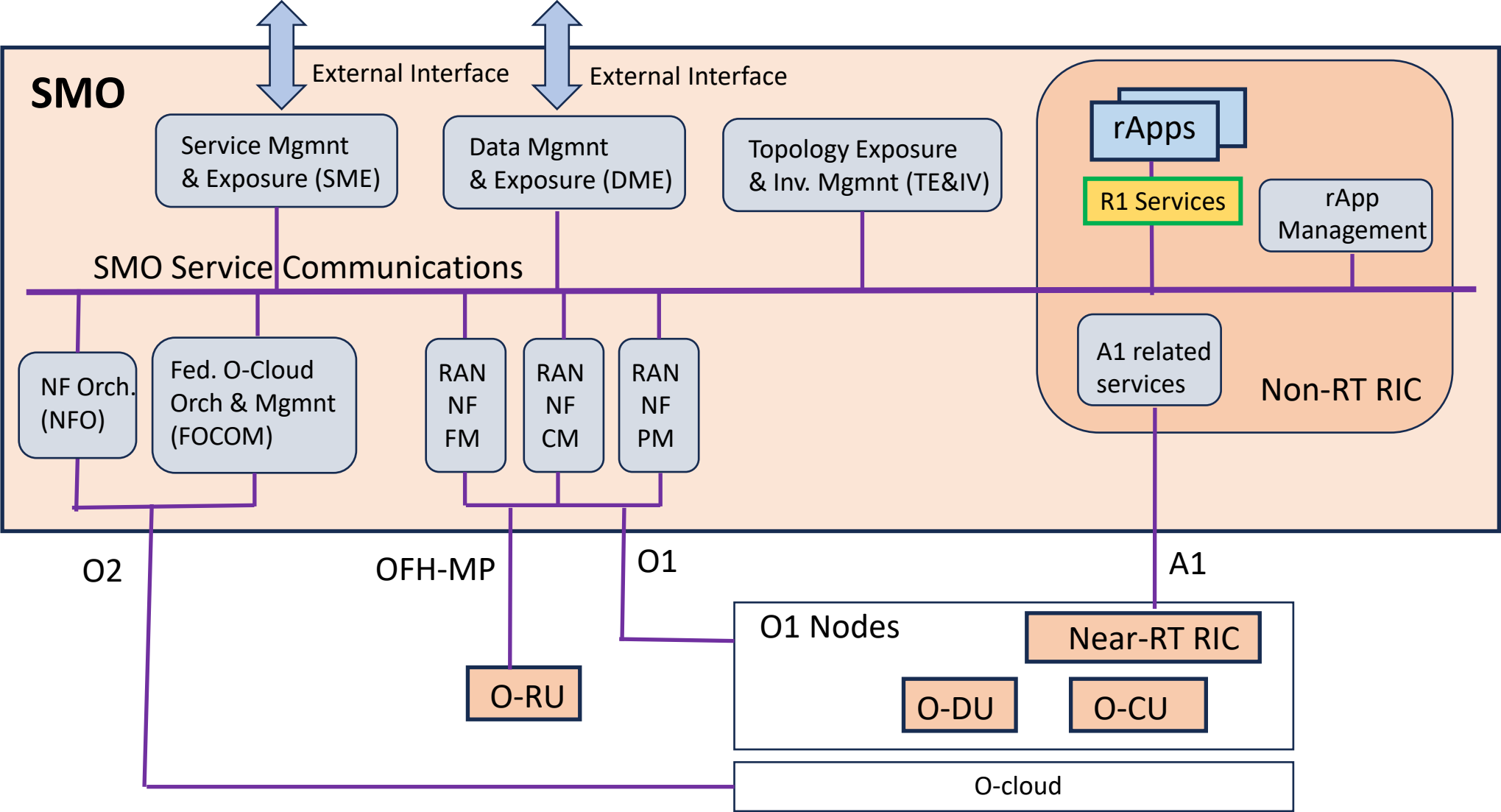


Ref: 1) O-RAN Architecture Description. O-RAN.WG1.OAD-R003-v10.00 2) O-RAN Decoupled SMO Architecture Decoupled SMO Architecture TR-R003-v01.00

O-RAN WG1 Decoupled SMO Technical Report

- Ongoing study in O-RAN WG1 Architecture Task Group
 - Decoupling of functions within SMO architecture
 - Objective: Define reference architecture for SMO, identify SMO functions and interfaces which are candidate for standardization
- Consensus till now:
 - SMO architecture is service-based – included in WG1 OAD v09
 - Definition of **SMO Functions (SMOF)** which offer **SMO Services (SMOS)** included in WG1 OAD v09
 - SMO Services identified and described:
 - Non-RT RIC
 - RAN NF (Network Function) OAM (FM, PM, CM)
 - Service Management and Exposure (SME)
 - Data Management and Exposure (DME)
 - O-Cloud resources management and orchestration (NFO, FOCOM)
 - Topology Exposure and Inventory Management (TE&IV)
- **This is ongoing work – changes and more details to be expected**

Current draft view of O-RAN SMO Architecture (June 2023) – Active ongoing work

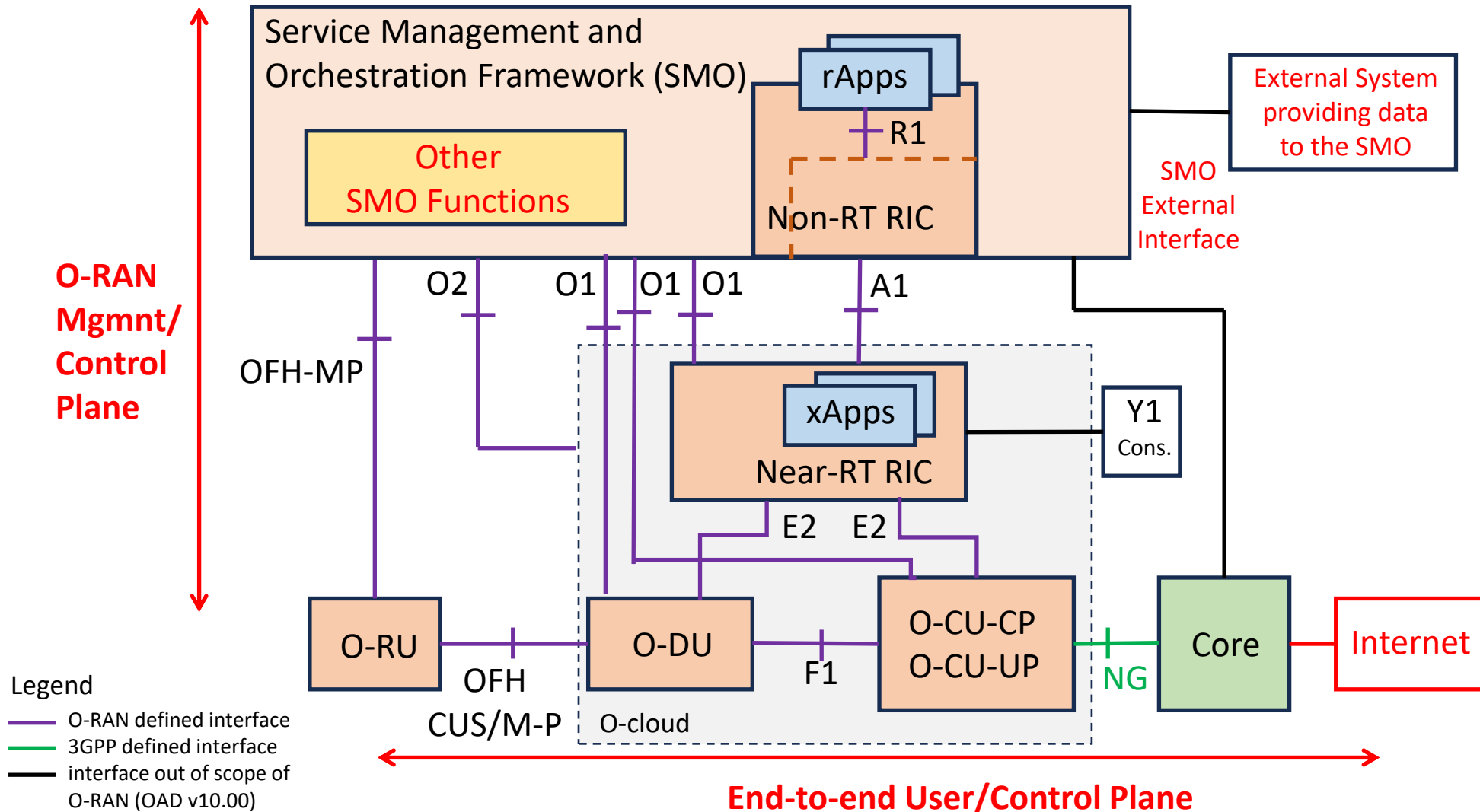


Ref: O-RAN Decoupled SMO Architecture Decoupled SMO Architecture TR-R003-v01.00.09

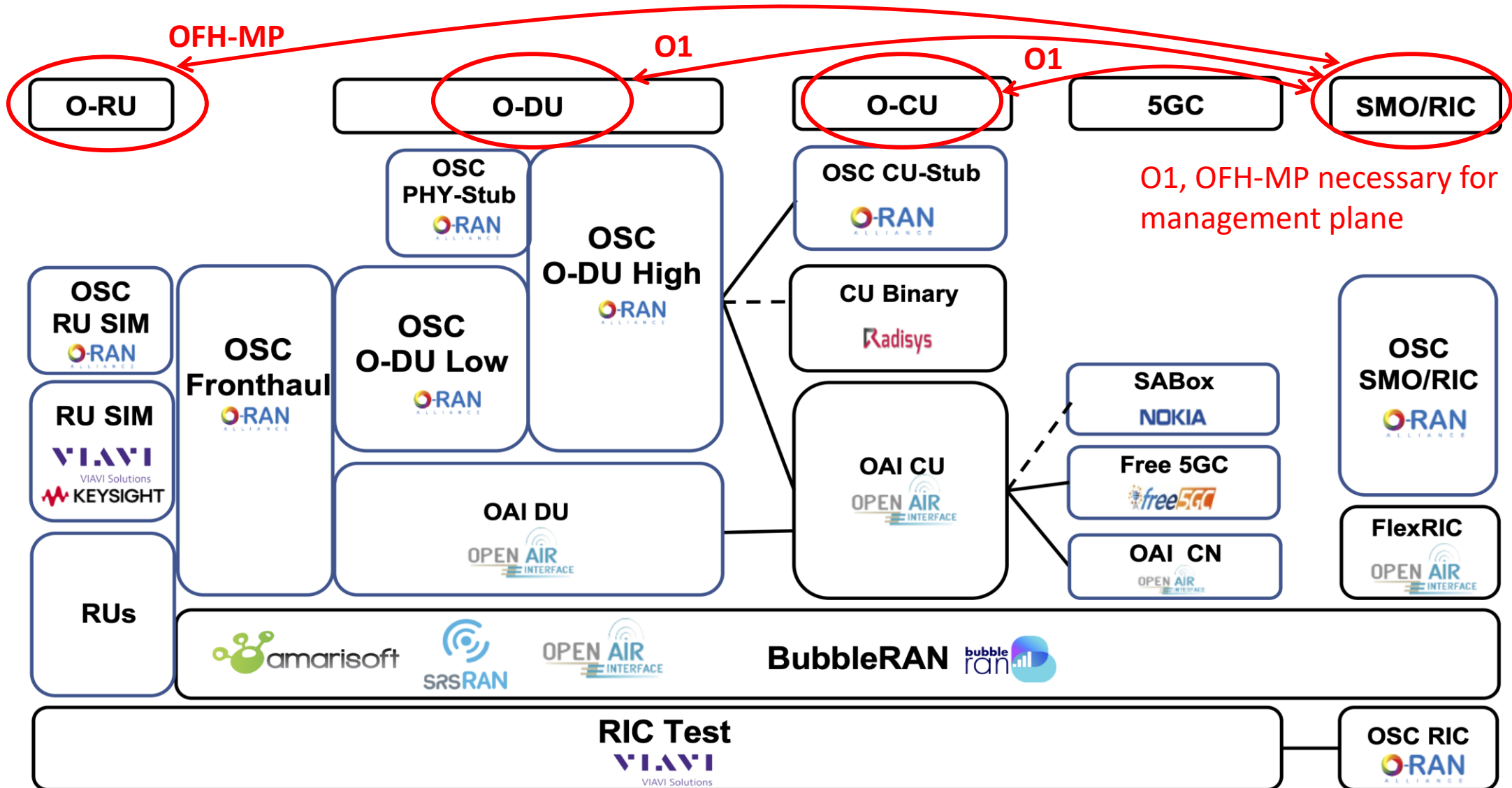
SMO-Related Open-source Projects

- Open-source projects are very important for the O-RAN ecosystem
 - Openly accessible implementation of standards/pre-standards
 - Foster use of innovative software best practices
 - Provide insights and input for standardization
 - **Enabler for research, pre-standards/standards collaboration**
 - **Enabler for university hands-on education, pipeline of talent pool, workforce training**
 - Enabler for innovation in rApp ecosystem
- O-RAN Alliance Open Source Focus Group (OSFG)
 - Recognizes important of open-source projects
 - Provides guidance, co-ordination for O-RAN related open source
- Linux Foundation/Linux Foundation Networking
 - **O-RAN SC, ONAP**, Nephio, Sylva, 5G Super Blueprint, etc.
- O1 and OFH-MP compliant end-to-end RAN options important for SMO-related work
- End-to-end 5G open source solutions: e.g., OAI, srsRAN
 - Enable end-to-end instantiation – pre-O-RAN 5G work with ongoing work to support O-RAN

O-RAN Architecture: User, Control, Management Plane



Example instances of O-RAN OSFG Super Wireless RAN BluePrint



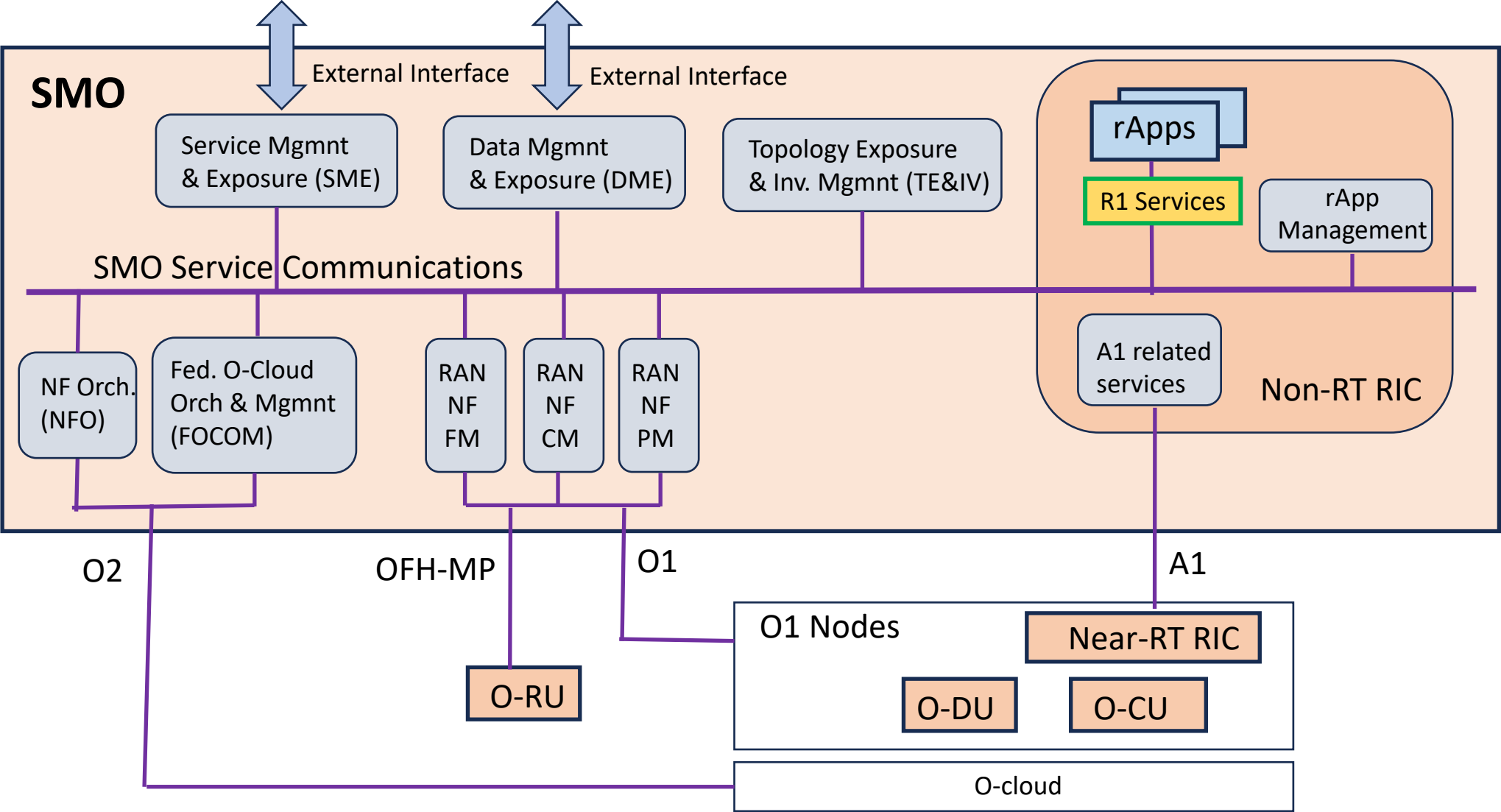
SMO-Related Projects in O-RAN SC and ONAP

- O-RAN Software Community (OSC)
 - Open-source project under auspices of O-RAN Alliance – guided by OSFG
 - Early focus on RAN (Near-RT RIC, OFH, RU, DU, CU) – later expansion to SMO
- ONAP - Network automation technologies for cloud-based networks, including focus on 5G/O-RAN
 - Several projects directly relevant to SMO – cloud-based automation, policy, orchestration, database, son and slicing use cases, etc.
 - Early work was pre-O-RAN – continuous effort to align to O-RAN
- OSC/ONAP harmonization – continuous process with increased attention
- Open source projects in SMO space tend to be modular components
 - Examples: oam/sdnr, ves, non-rt-ric, a1, control loop
 - Work is aligned with standards where available
 - Also includes pre-standards work – aligned with trends in standards discussions

Synergy/alignment for SMO-related open source projects

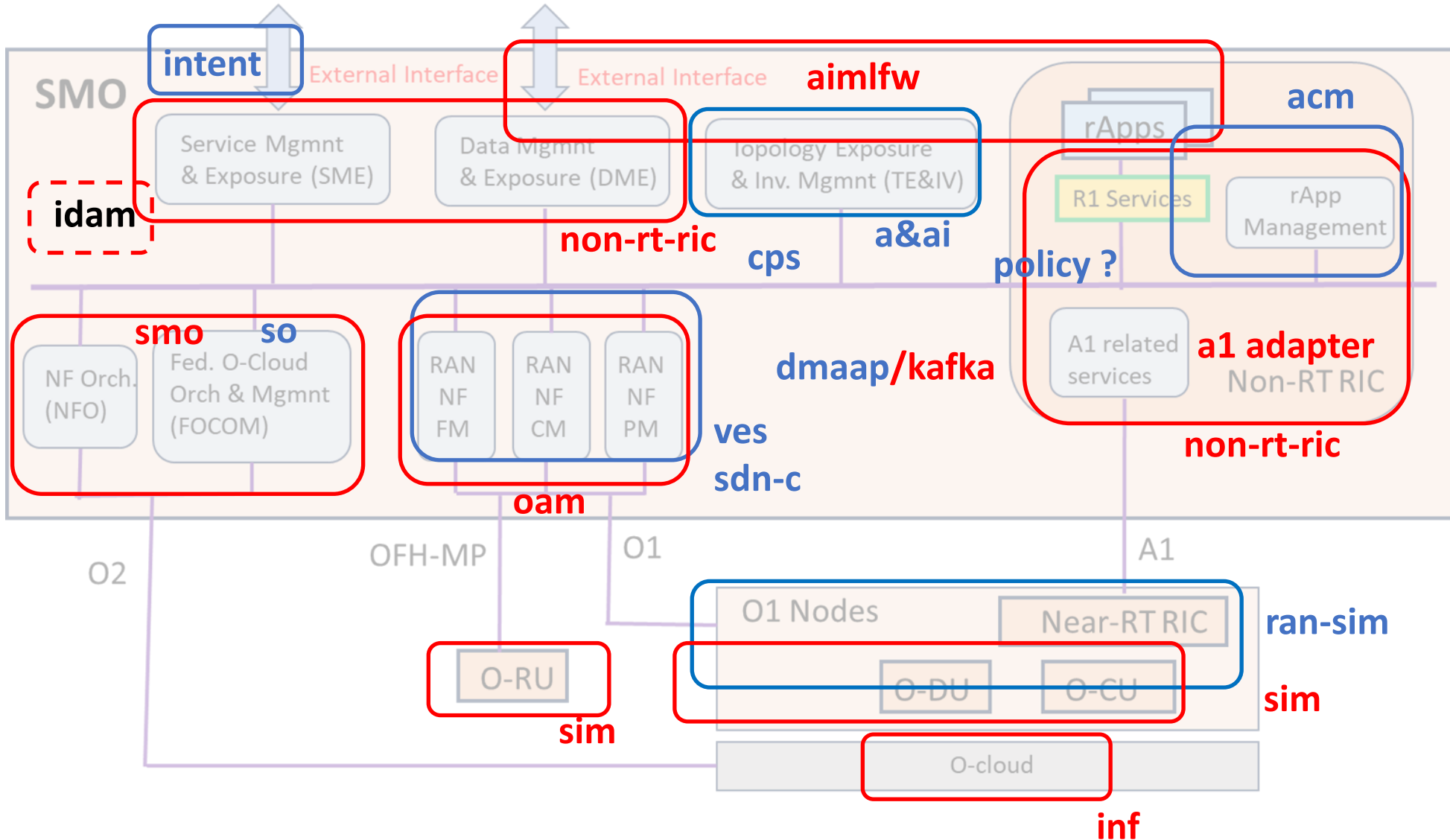
- There is consensus in OSC and ONAP at TOC/TSC level:
 - SMO-related work in OSC and ONAP should align with trends in SMO-related discussion in O-RAN Alliance, especially WG1 SMO Decoupled Architecture TR
 - Avoid duplication, improve synergy and collaboration between OSC and ONAP
- Build on existing OSC/ONAP harmonization – improve interworking and alignment
 - oam (o1,ofh-mp), sdn-c, ves collector, pm handler
 - aimlfw, dmaap/kafka, policy, cps db
 - non-rt-ric (a1,r1,rapp)
 - smo (o2), so
 - intent
- Ref: OSC/ONAP SMO Framework: Exploring interactions among SMO-related projects in OSC and ONAP, [https://wiki.o-ran-sc.org/download/attachments/3604609/OSC ONAP SMO Framework v5.pptx?api=v2](https://wiki.o-ran-sc.org/download/attachments/3604609/OSC_ONAP_SMO_Framework_v5.pptx?api=v2)
- Ref: Discussion on Architectural Principles for integration and interoperability of SMO Services in OSC, [https://wiki.o-ran-sc.org/download/attachments/3604609/TIM-2023.03.22-OSC-RSAC Architectural principles for SMO Services integration.pdf?api=v2](https://wiki.o-ran-sc.org/download/attachments/3604609/TIM-2023.03.22-OSC-RSAC_Architectural_principles_for_SMO_Services_integration.pdf?api=v2)

Current draft view of O-RAN SMO Architecture (June 2023) – Active ongoing work



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OSC and ONAP projects related to SMO (draft, expect changes)



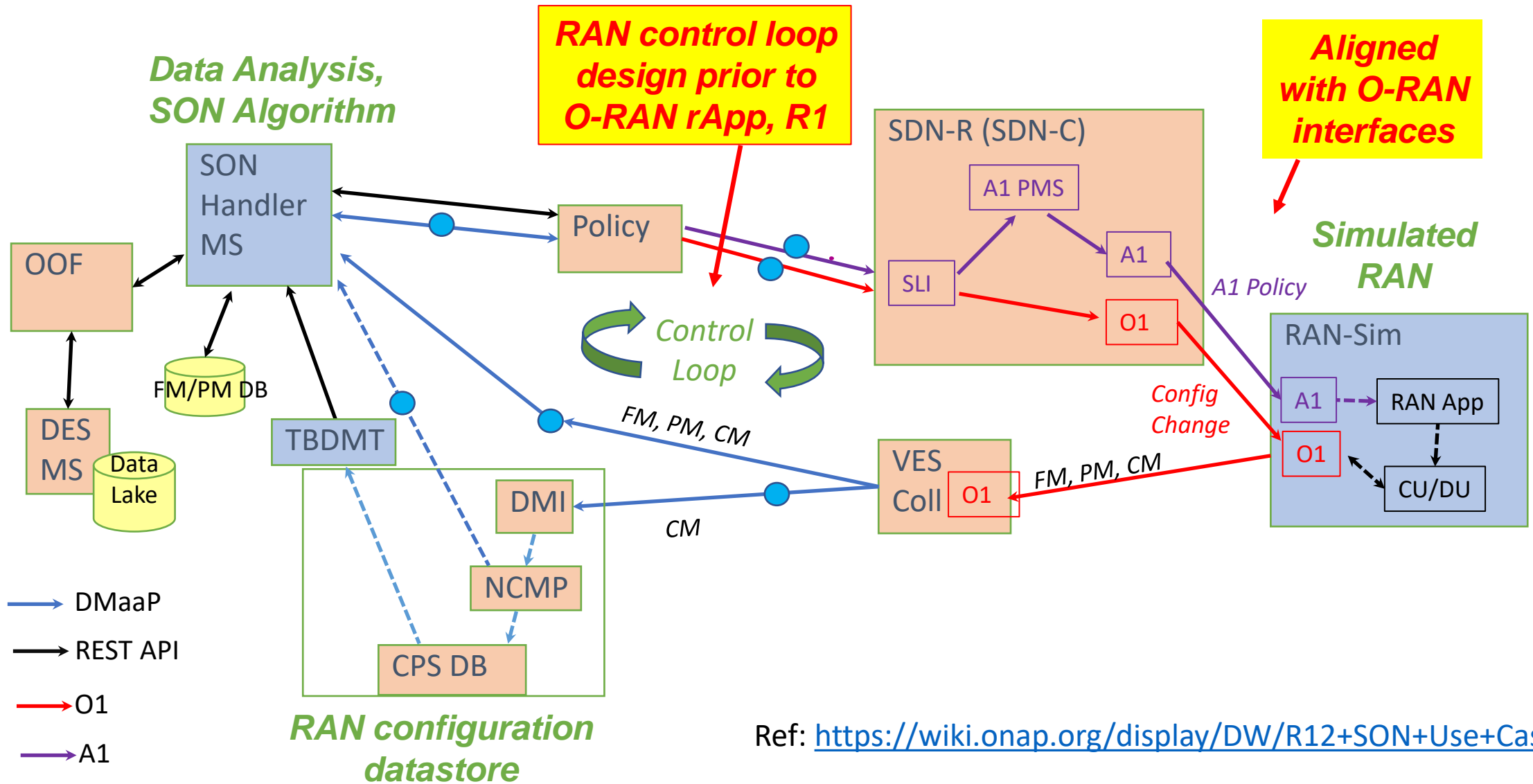
Relevant projects

- int** **smo-pkg**
- dcae**
- oof? sdc ?**
- security-framework**
- 5gson**
- e2e-slicing**

Notes:

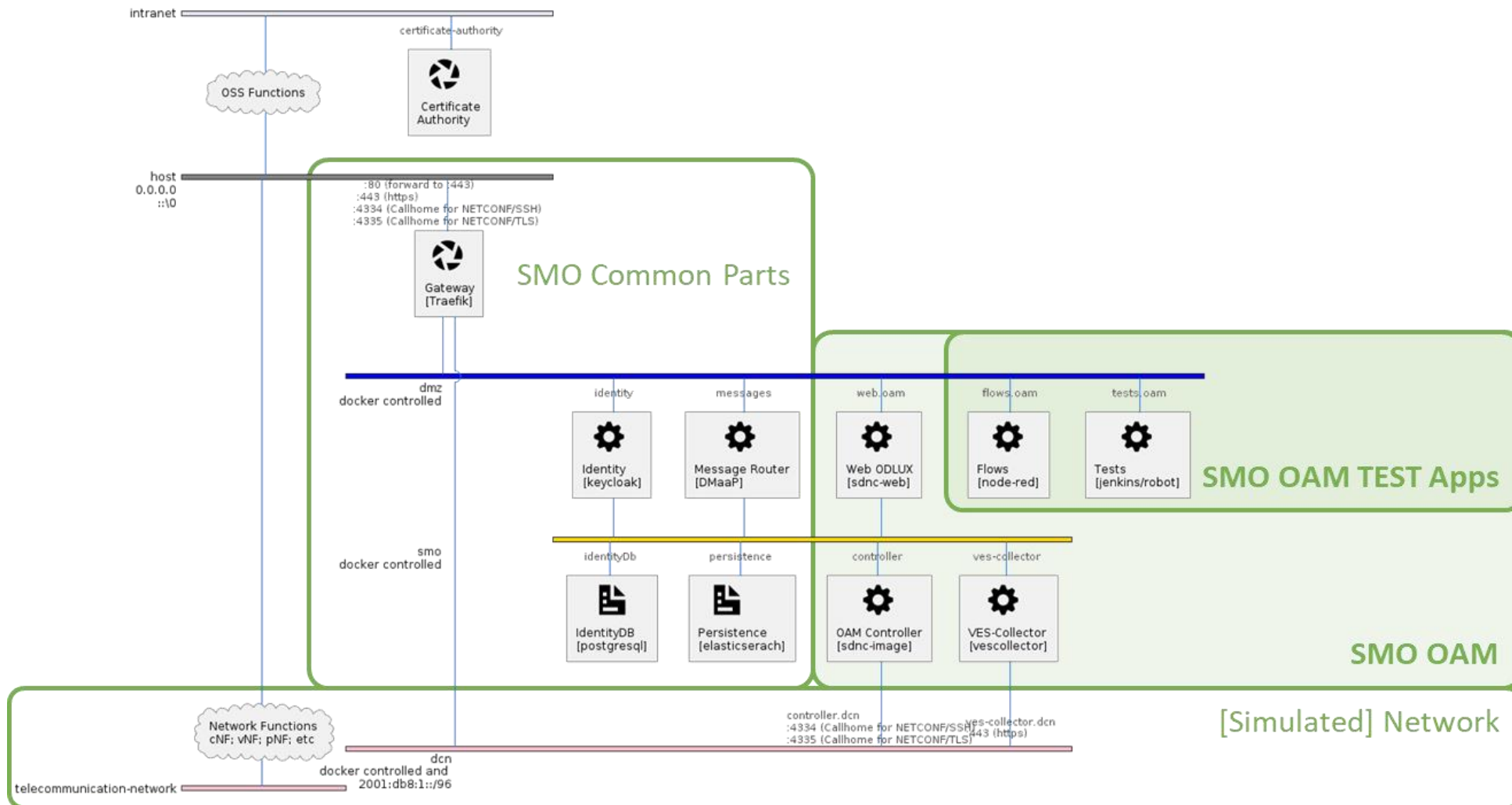
- Figure is meant to explore alignment to O-RAN architecture
- Each red/blue label is an osc/onap open source project/component
- We may/do not have or need 1:1 mapping between projects and architecture blocks

ONAP 5G SON Use Case



Ref: <https://wiki.onap.org/display/DW/R12+SON+Use+Case>

OSC OAM project



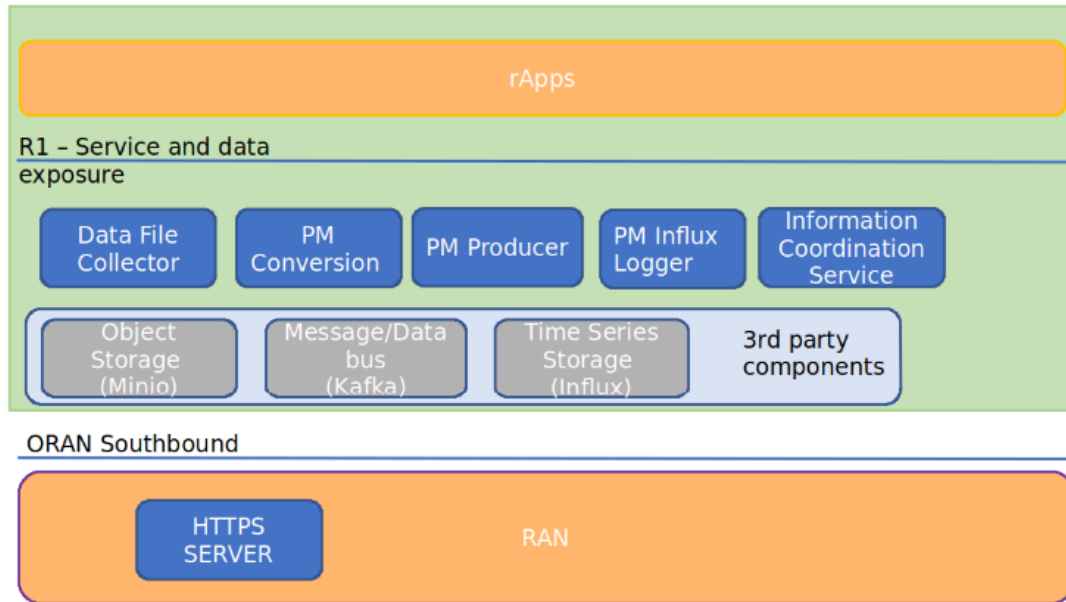
May 11, 2023

O-RAN Software Community – OAM Project

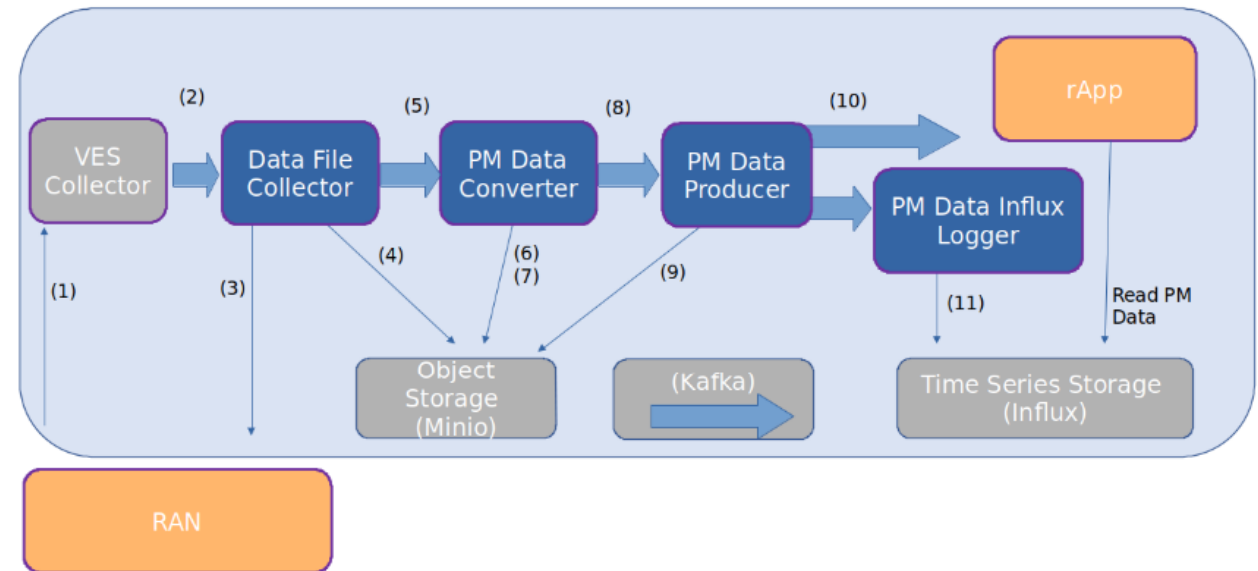
Ref: <https://wiki.o-ran-sc.org/download/attachments/78217260/2023-05-11-OAM-TOC-report.pptx?api=v2>

OSC RAN PM Measurement

Components

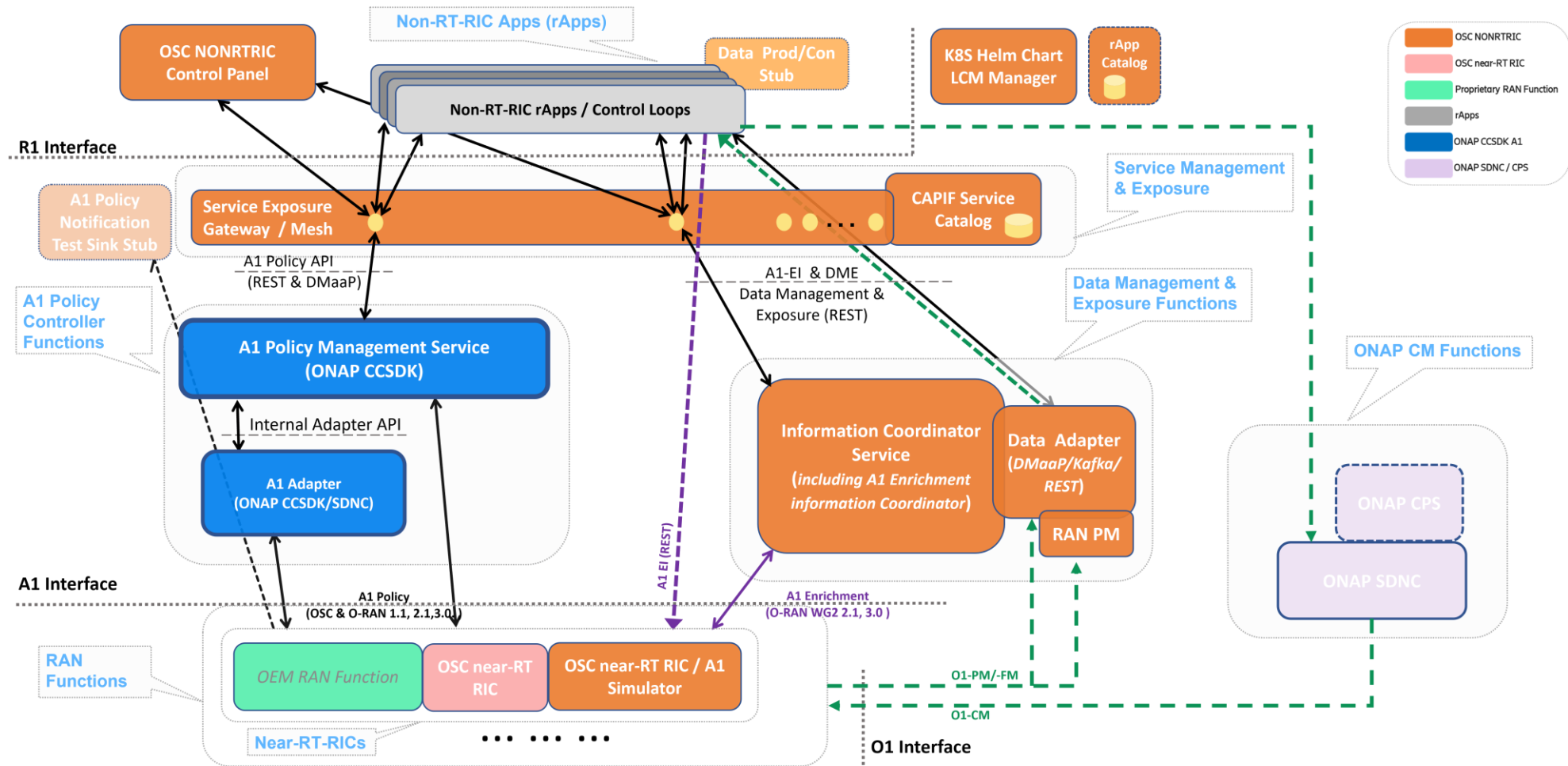


Data Flow

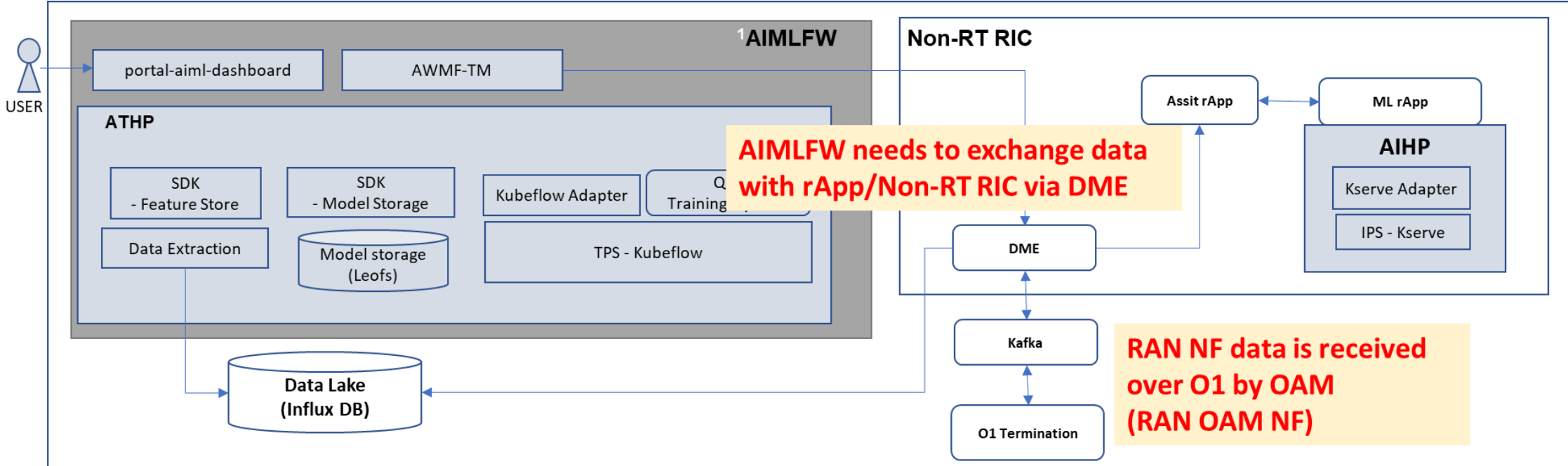


Source: <https://docs.o-ran-sc.org/projects/o-ran-sc-nonrtric-plt-ranpm/en/latest/overview.html#data-flow>

OSC Non-RT-RIC project (Rel H)

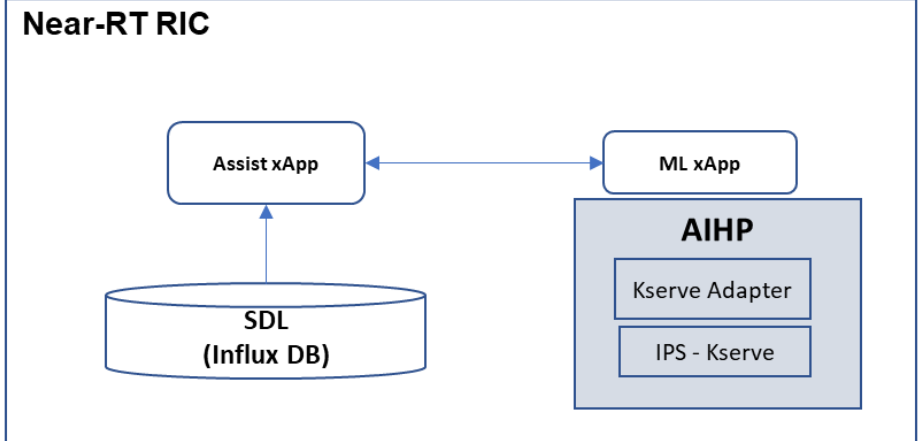


SMO interaction example: AIMLFW, Non-RT RIC, OAM



AIMLFW	AI/ML Framework
AWMF	AI Workflow Management Function
TM	Training Manager
TPS	Training Platform Service (e.g. Kubeflow)
ATHP	AI Training Host Platform
IPS	Inference Platform Service (e.g. Kserve)
AIHP	AI Inference Host Platform

AI/ML can also be applied for O2-related data



¹Location of AI Training functions is not fixed and may vary according to usecase.

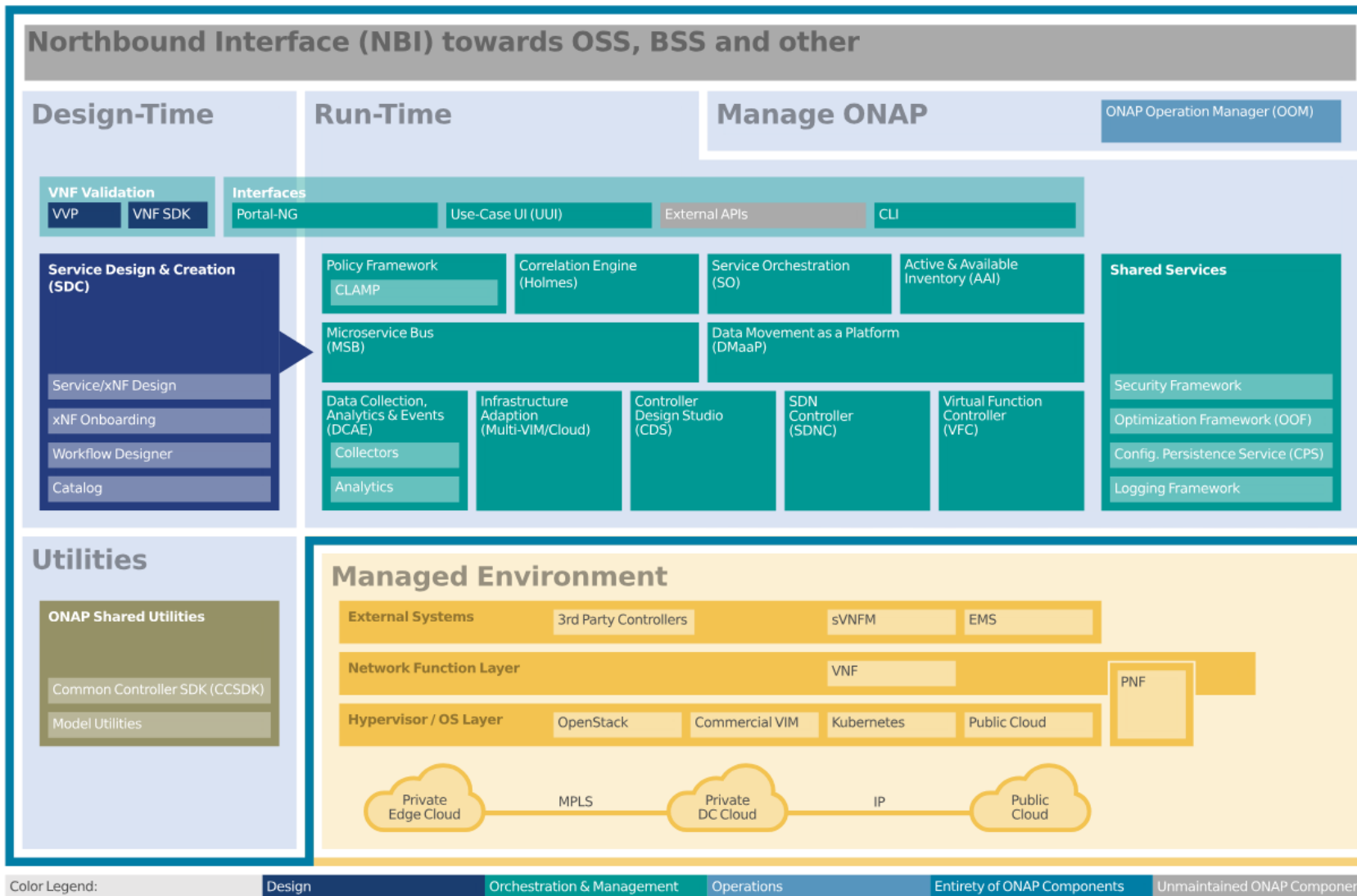
Summary

- SMO is a critical part of the O-RAN Architecture
- Ongoing work in O-RAN on Decoupled SMO Architecture
- Ongoing SMO-related open-source implementations (e.g., OSC, ONAP) – important for ecosystem
- Momentum in alignment/synergy of SMO-related open-source projects – improves efficiency
- Contributions to open-source is encouraged



THANK YOU





OSC SMO proposal for O2

(Integration options with other open-source projects)

