

# E2E Network Slicing use case – Architecture Review for Jakarta

**Participants:** CMCC, Wipro, STL, Huawei, AT&T, IBM, LTTS, DT, TIM, QCT, Amdocs, Tech Mahindra, Reliance Jio, Tencent, China Telecom, Aarna Networks

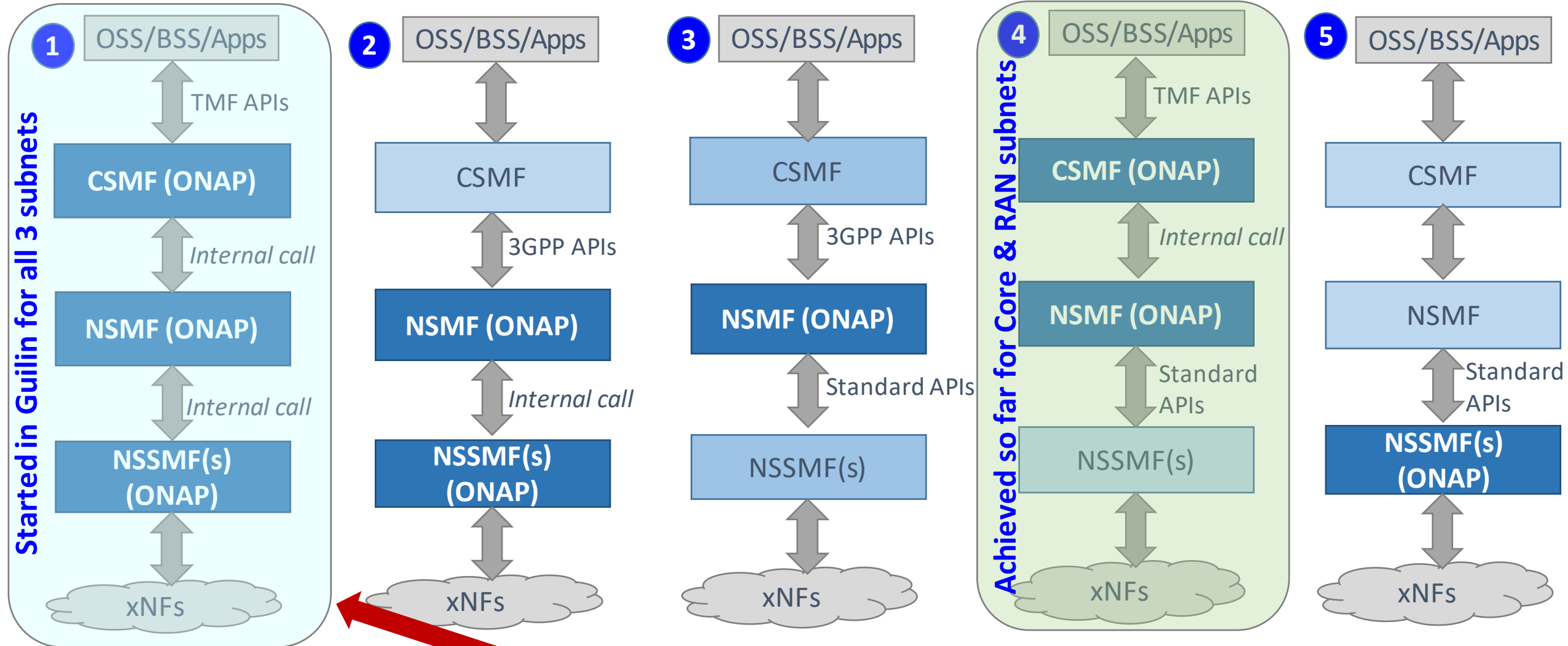
Presenters: Ahila P (Wipro), Lin Meng (CMCC), Henry Yu (Huawei)

# 3GPP Slice Management Functions (3GPP-defined)

Management Function	Key tasks
<b>Communication Service Management Function (CSMF)</b>	<ul style="list-style-type: none"><li>• Responsible for translating the communication service related requirement to network slice related requirements.</li><li>• Communicate with Network Slice Management Function (NSMF).</li></ul>
<b>Network Slice Management Function (NSMF)</b>	<ul style="list-style-type: none"><li>• Responsible for management and orchestration of NSI.</li><li>• Derive network slice subnet related requirements from network slice related requirements.</li><li>• Communicate with the Network Slice Subnet Management Function (NSSMF) and Communication Service Management Function.</li></ul>
<b>Network Slice Sub-net Management Function (NSSMF)</b>	<ul style="list-style-type: none"><li>• Responsible for management and orchestration of NSSI.</li><li>• Communicate with the NSMF.</li></ul>

Ref.: 3GPP 28 series

# ONAP-based Slice Management Overall Architecture Choices

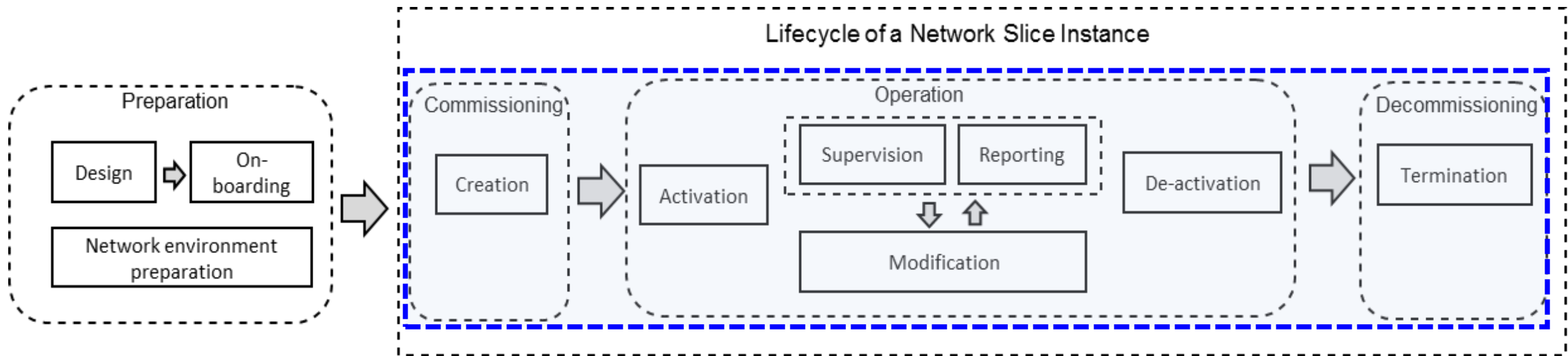


3<sup>rd</sup> party component


In J-release, we will continue with the enhancements for Scenario 1

# ONAP-based Slice Management - NSI Life Cycle view

**Objective:** Demonstrate e2e slice design instantiation and operation, including RAN, core and transport slice sub-nets

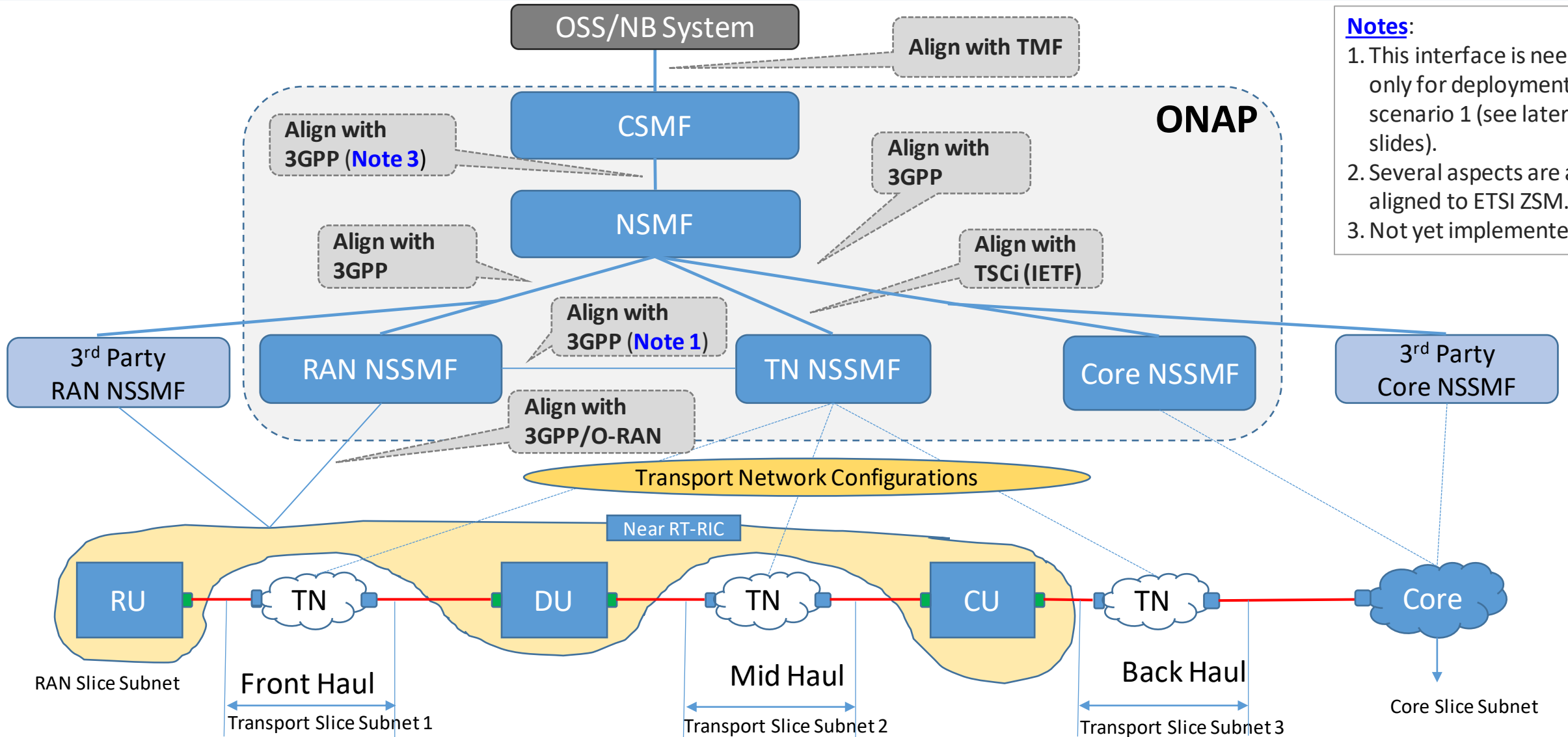


Ref.: 3GPP TS 28.530

 Focus area for enhancements in Jakarta

- **Design and pre-provision:** Creation of necessary slice/slice sub-net templates.
- **Instantiation/Configuration & Activation/Deactivation** of NSIs, including instantiation/mapping of its constituent slice sub-nets (RAN, Core and Transport).

# E2E Network Slicing: Architecture & Interfaces

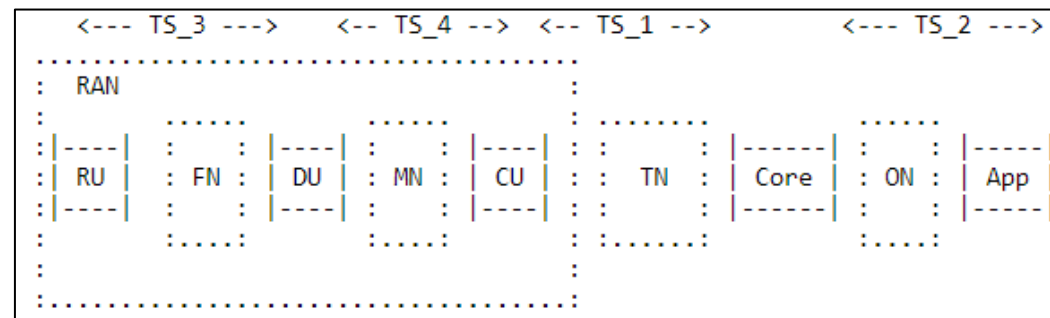
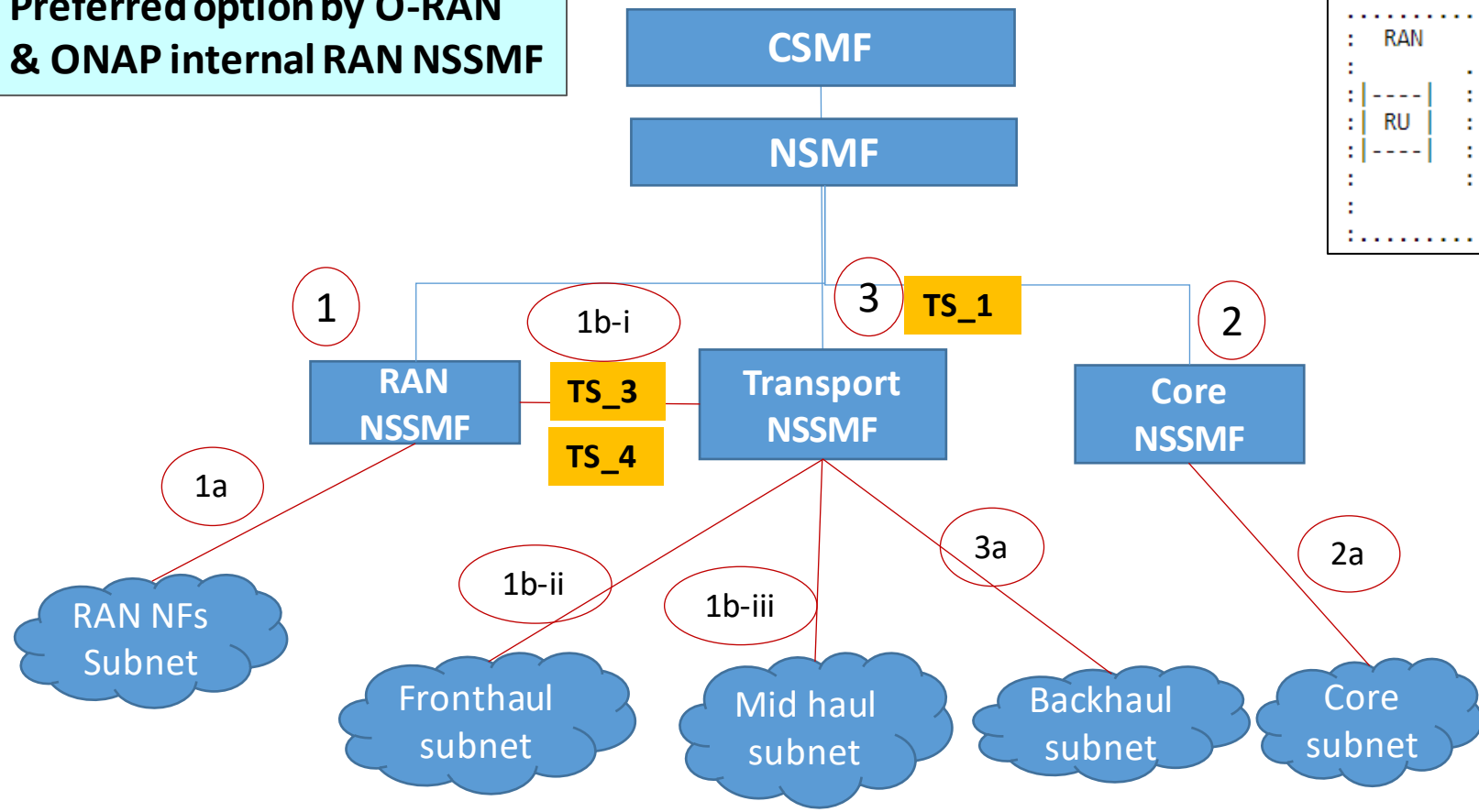


## Notes:

1. This interface is needed only for deployment scenario 1 (see later slides).
2. Several aspects are also aligned to ETSI ZSM.
3. Not yet implemented

# RAN & Transport Subnet: Interaction Scenario 1

Preferred option by O-RAN & ONAP internal RAN NSSMF



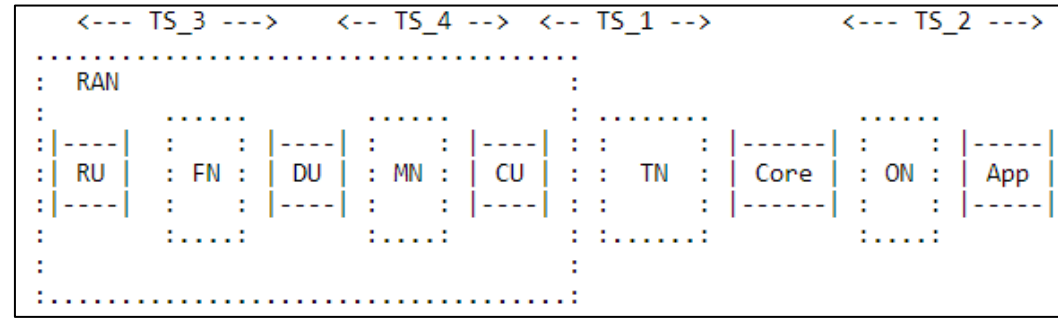
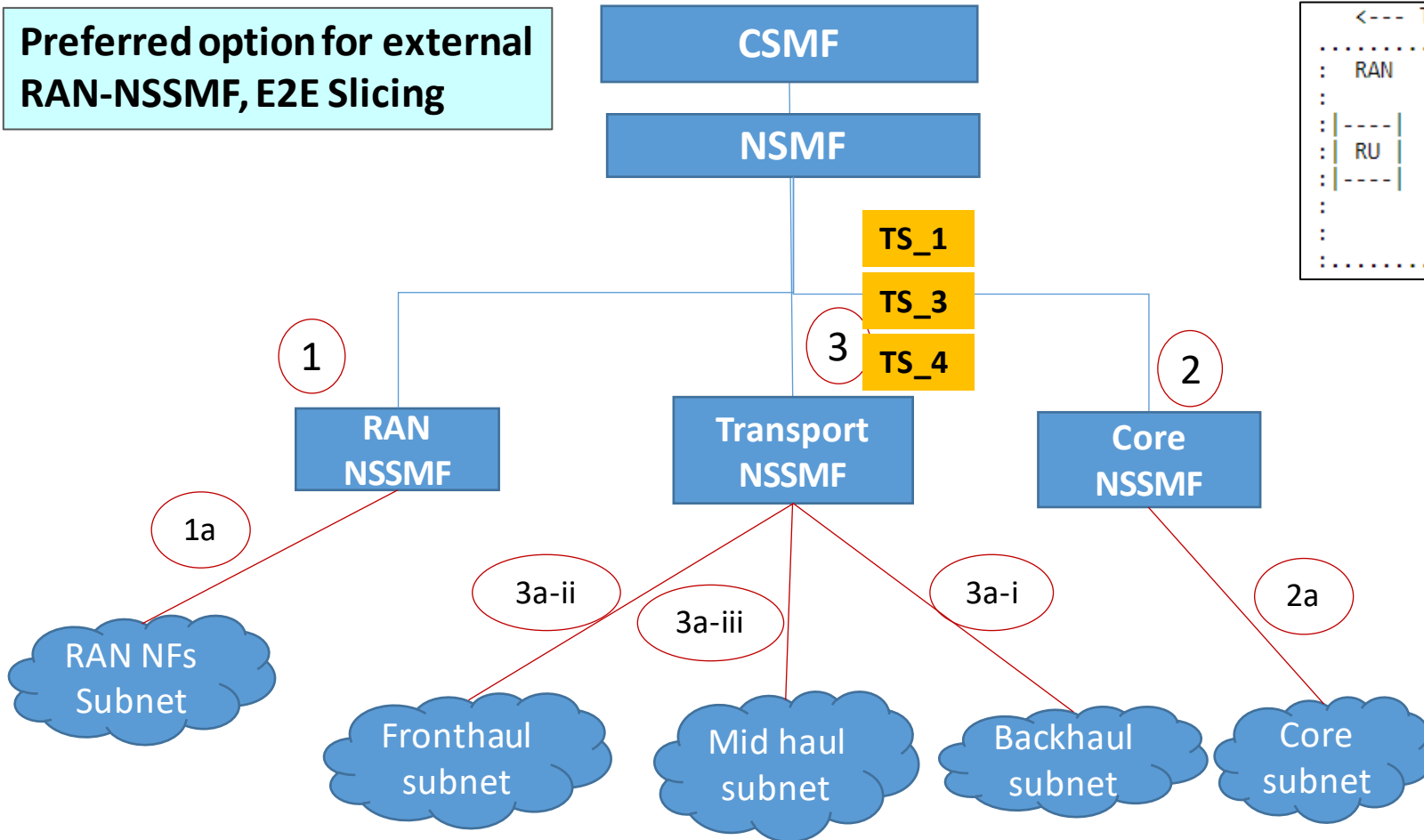
- TS\_1 is backhaul transport slice; TS\_3, fronthaul; TS\_4, midhaul.
- TN MD (T-NSSMF) receives TS\_1 from NSMF (step 3), and TS\_3 and TS\_4 from RAN NSSMF (step 1b-i).
- TN MD then configures backhaul (3a), fronthaul (1b-ii), and midhaul (1b-iii), respectively.

**Enhancements in Jakarta release**

- RAN NSSMF shall be responsible for determination of Slice Profile of FH, MH and RAN NFs.
- RAN NSSMF shall be responsible for entire RAN subnet comprising FH and MH (stitching together, CL actions, etc.)

# RAN & Transport Subnet: Interaction Scenario 2

Preferred option for external RAN-NSSMF, E2E Slicing



- TS\_1 is backhaul transport slice; TS\_3, fronthaul; TS\_4, midhaul.
- TN MD (T-NSSMF) receives TS\_1, TS\_3 and TS\_4 from NSMF (step 3).
- TN MD then configures backhaul (3a-i), fronthaul (3a-ii), and midhaul (3a-iii), respectively.

Complete the activation, termination testing and other enhancements as in scenario1

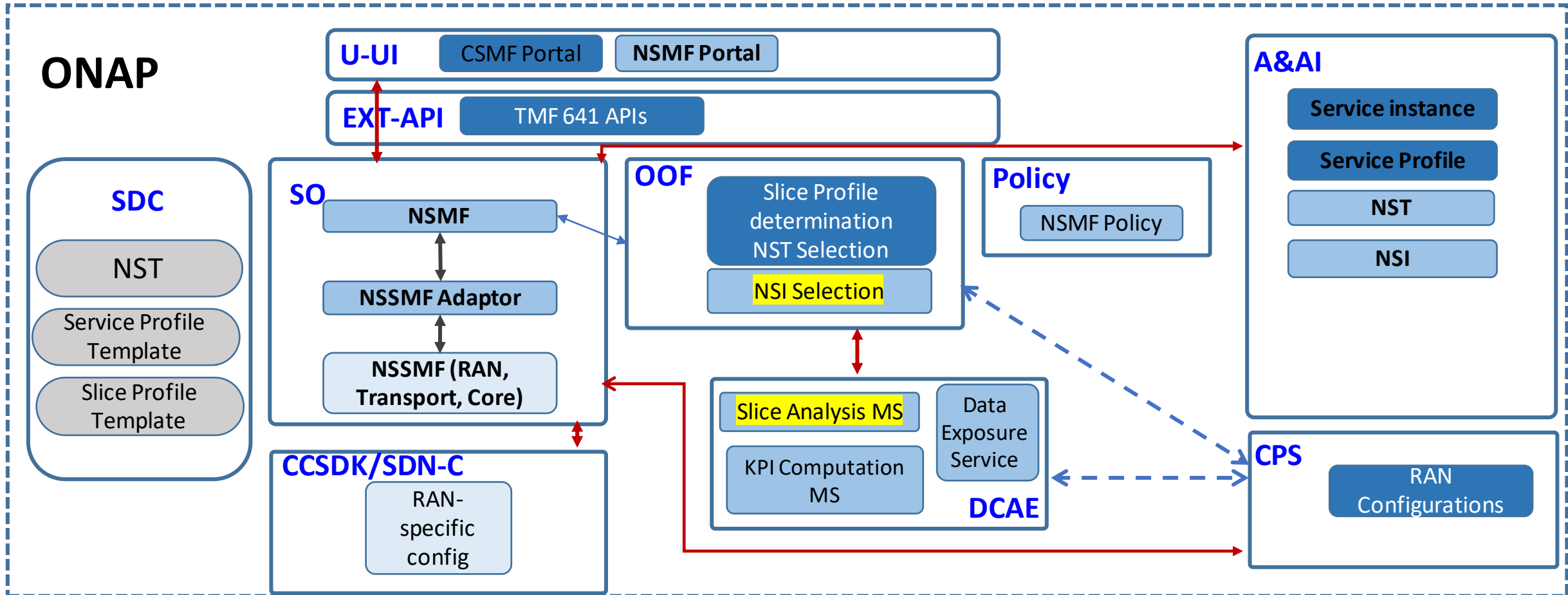
- NSMF shall be responsible for determination of Slice Profile of FH, MH and RAN NFs.
- NSMF shall be responsible for stitching together e2e slice including FH and MH.

# Jakarta release proposal for E2E Slicing solution involving Core, RAN & Transport

- **REQ-1a: E2E Integration testing**
  - Carry over test cases from Istanbul release – activation, deactivation & termination scenarios
  - NSMF driven TN Slices – E2E Testing of activation & termination scenarios
- **REQ-1b: Use case test automation**
  - Carry out Test automation for slicing use case in phases
  - Target to accomplish test automation for manual configurations
- **REQ-1c: Slice selection taking into account capacity, resource occupancy levels, etc.**
  - NSI selection and NSSI selection based on capacity, resource occupancy levels
  - NSMF to support monitoring and update of resource levels at NSI level
  - NSSMF to support monitoring and update of resource levels at NSSI level
  - RAN NSSMF's resource occupancy is considered for this release. Core and TN NSSMFs will be considered in future releases
- **REQ-1d: Dynamic discovery of endpoints at NSMF**
  - NSMF discovers the Core and RAN endpoints for back haul dynamically at the time of slice allocation/reuse
  - Front haul and mid haul end points discovery is a stretch goal



# E2E Network Slicing: CSMF/NSMF enhancements

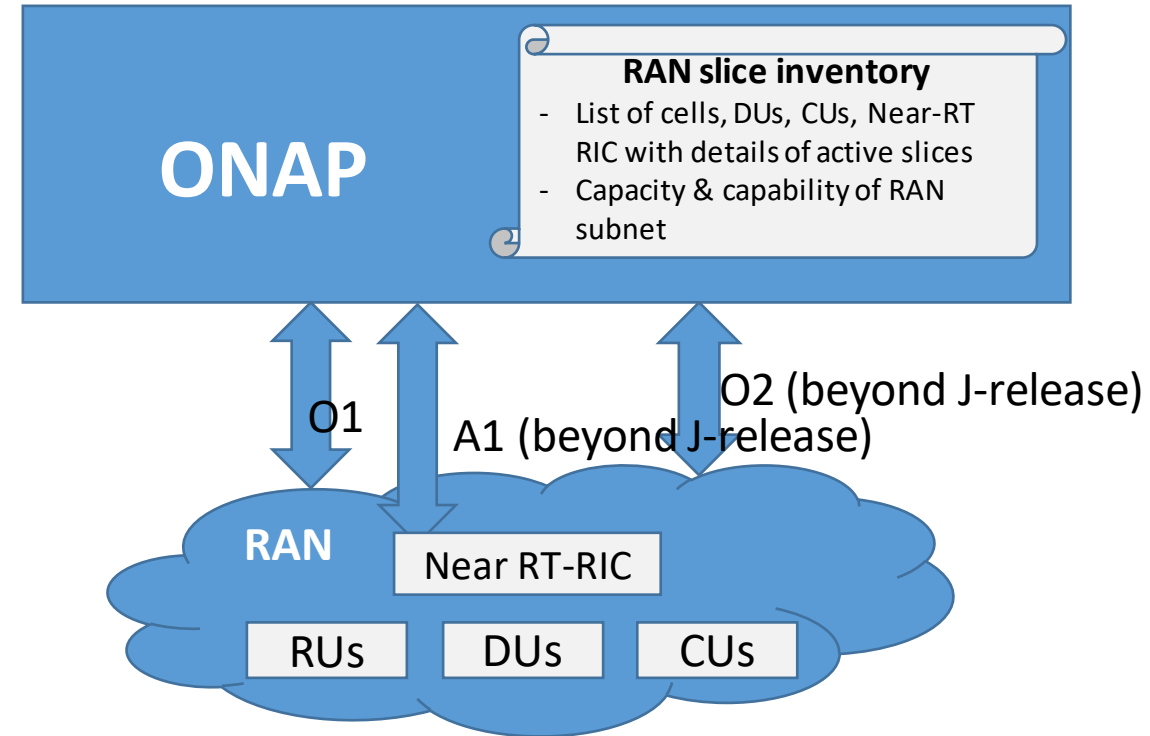


↔ New interface    ↔ Enhanced interface

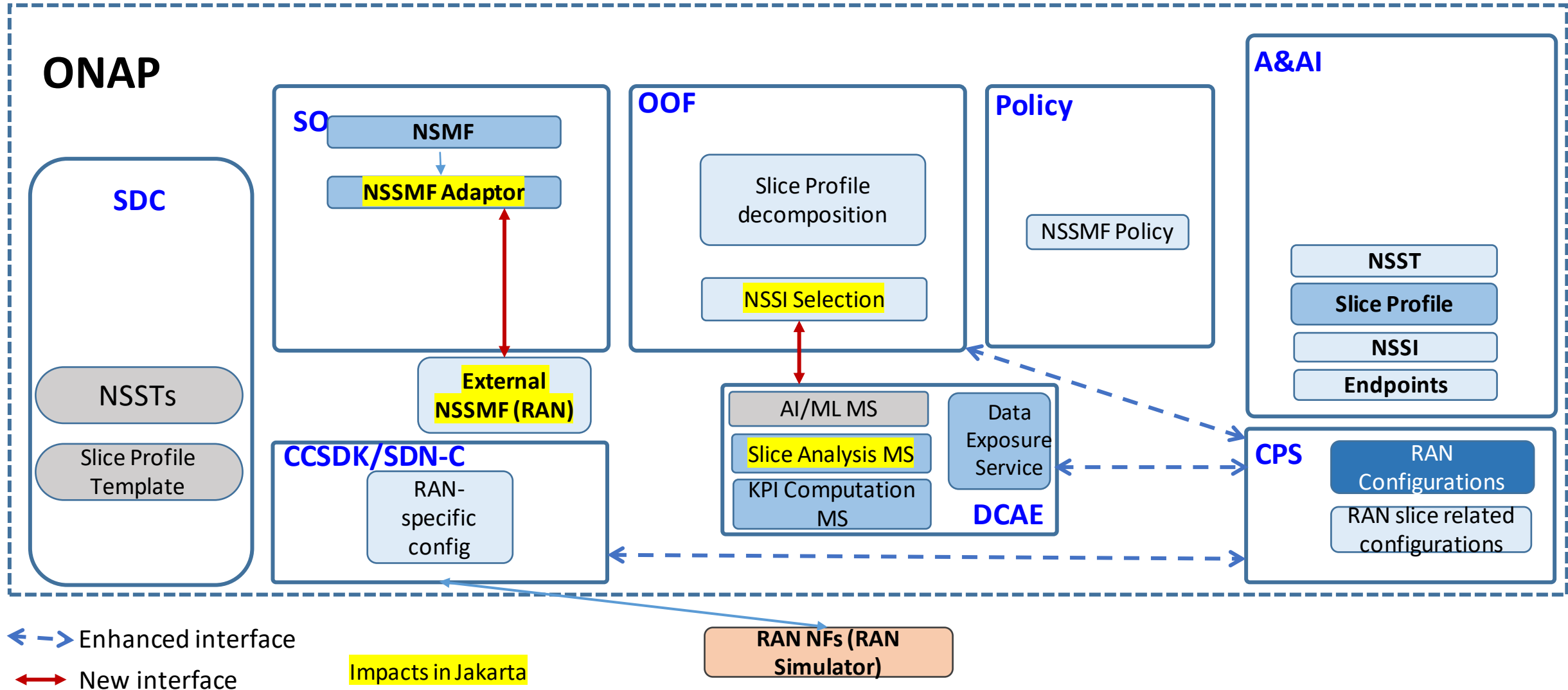
Impacts in Jakarta

# RAN Slicing – Jakarta Release Impacts

- 1. REQ-2a:** RAN-Configuration enhancements including:
  - RRM Policy update in RAN Slice Termination
  - Sending AI/ML based config updates to Near-RT RIC
- 2. REQ-2b:** Complete integration with CPS for Network Slicing related config.
  - RAN Slice allocation
  - RAN Slice Activation/deactivation updates
  - Closed Loop
- 3. REQ-2c:** NCMP endpoints usage in place of CPS Core for RAN Slice configurations
- 4. REQ-2d:** activation/deactivation support in external RAN NSSMF (option 2)
- 5. REQ-2e:** Capacity based NSSI Selection



# RAN Slicing: Impact overview



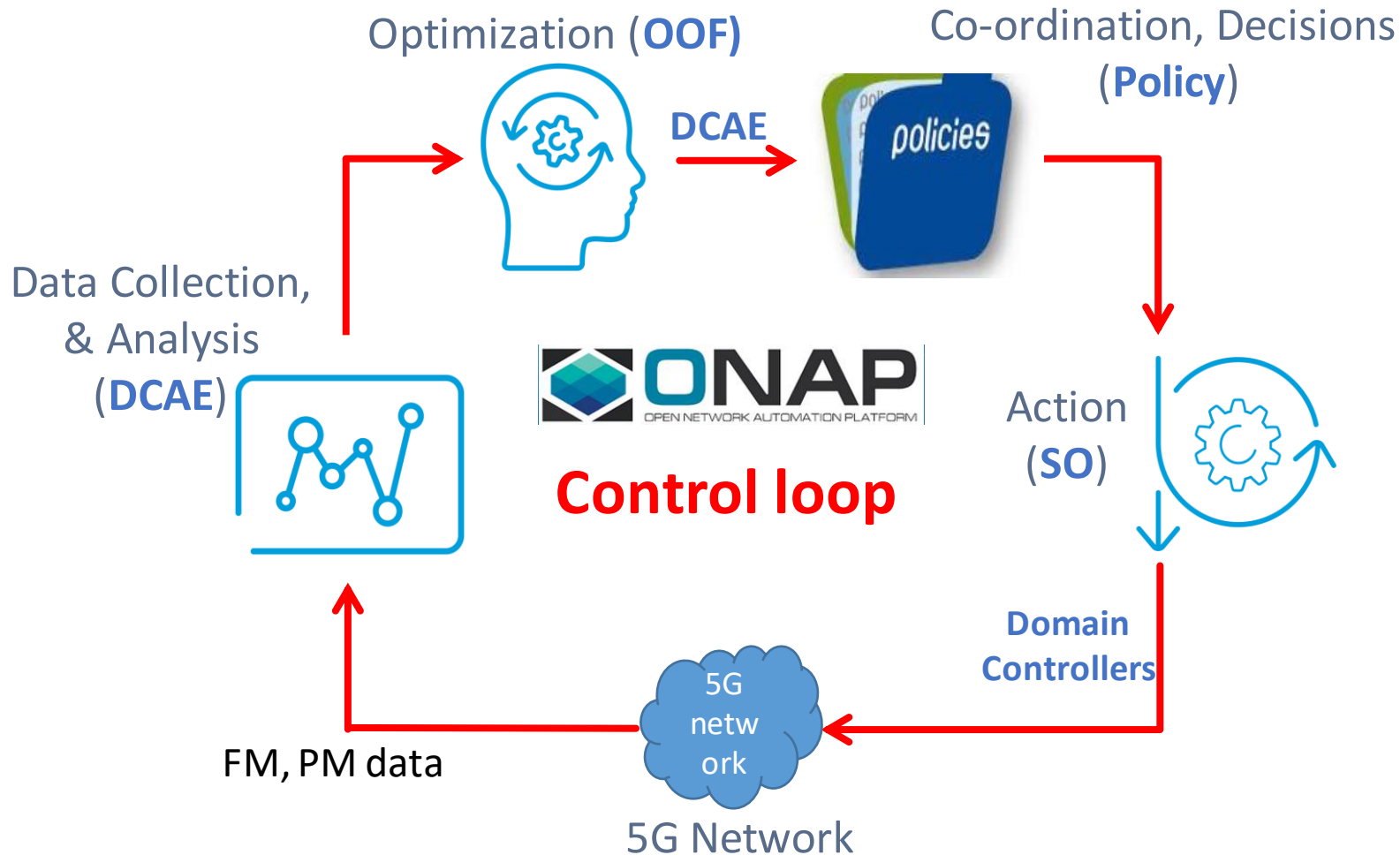
# Core Slicing – Jakarta Release Impacts

- **REQ-3a:** Completion of carry-over test cases and Bug Fixes

# TN Sub-net Slicing: Jakarta Release impacts

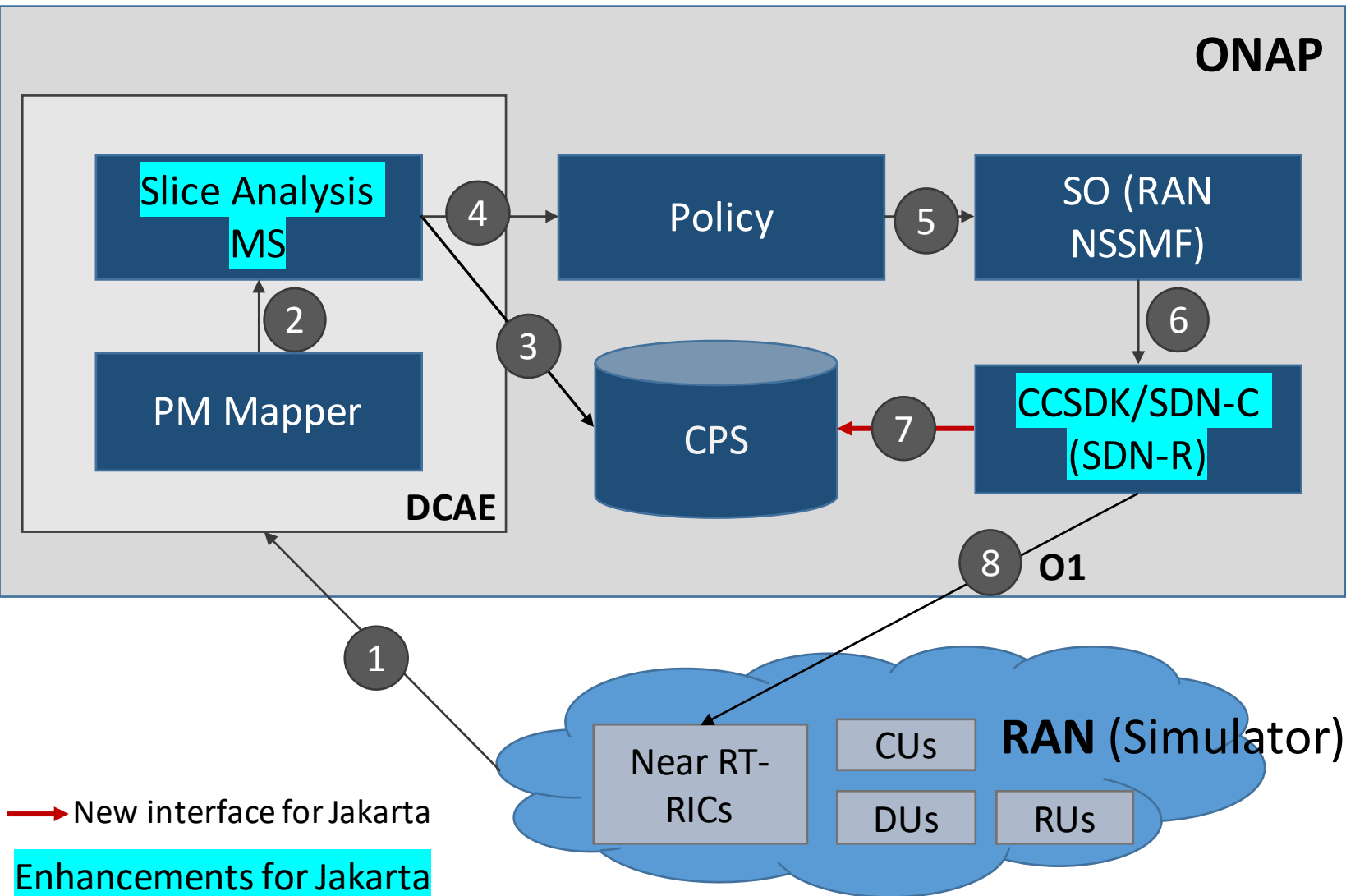
- **REQ-4a:** OOF involvement in TN slice Reuse and terminate scenarios
- **REQ-4b:** TN Model enhancements according to latest IETF specification
- **REQ-4c:** Transport Slicing enhancements to support IBN (covered in CCVPN use case)
- **REQ-4d:** Closed-loop enhancement in CCVPN to support Transport Slicing's closed-loop (covered in CCVPN use case)

# Closed Loop: Overview



- Leverage the SON ↔ Control Loop (CL) framework in ONAP
- Based on PM/FM data, analyze NSI/NSSI traffic patterns, KPI adherence, and resource occupancy in NSI/NSSI
- Based on analysis, trigger OOF for NSI resource optimization/re-allocation to guarantee KPI adherence and optimal use of resources
- Perform necessary resource adjustments via SO and Domain Controllers (modify NSI/NSSI/S-NSSAI mapping/etc.)

# Closed Loop: Jakarta Release Impacts

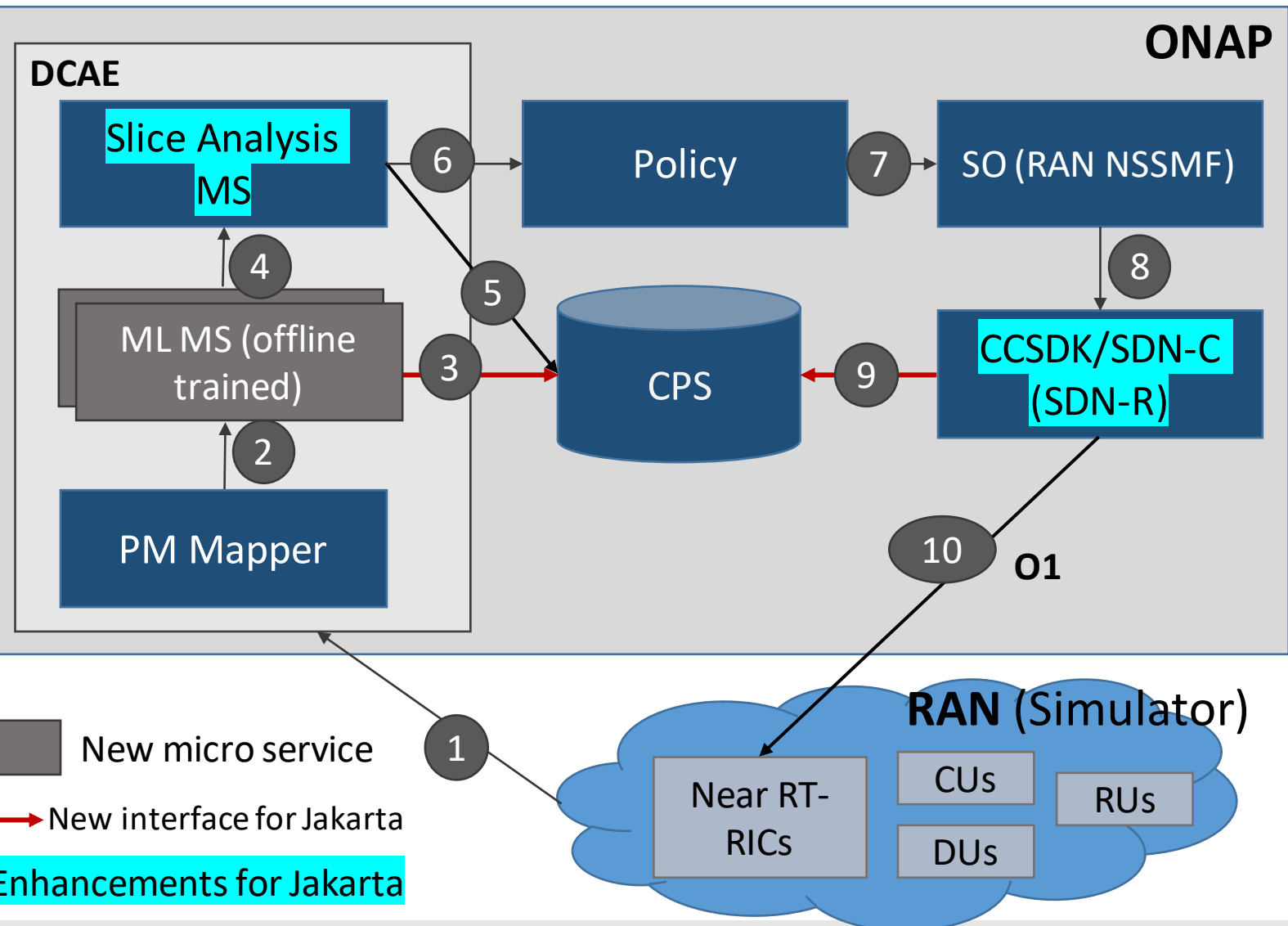


- The PM data collected from RAN in Step 1 is DL/UL PRB used for data traffic.
- The configuration update determined by Slice Analysis MS and triggering Policy in Step 4 is slice specific throughput guidance for Near-RT coverage area (i.e., at Near-RT RIC level).
- Step 8 is over **O1** in Jakarta, it will be over **A1** in beyond Jakarta release.

**Notes:**

1. DFC and VES Collector are not shown in the flow but are used.

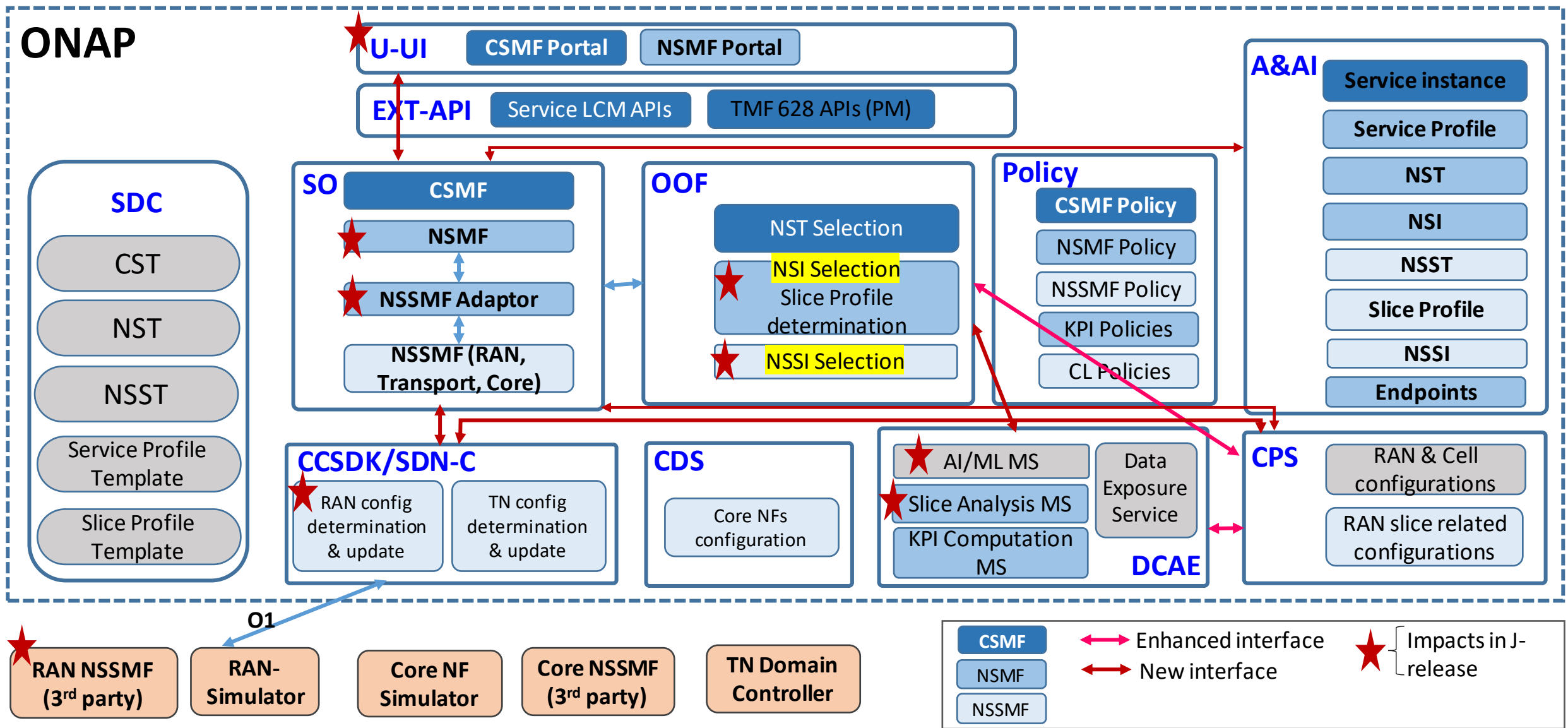
# Intelligent Slicing (IBN Based Closed Loop): Jakarta Release Impacts



- The PM data collected from RAN in Step 1 is PDU sessions requested, setup successfully & failures.
  - The configuration update determined by ML MS and triggering Slice Analysis MS in Step 3 is slice specific maxNumberOf Conns for each cell (i.e., cell level for each S-NSSAI).
  - Step 10 is over O1 now, it will continue to be in O1 based on latest discussions with O-RAN community.
- Notes**
1. DFC and VES Collector are not shown in the flow but are used.
  2. ML MS – 2 micro services are required, one for training and another for prediction. Yet to confirm the exposure to ONAP



# E2E Network Slicing: Impact Summary



# API impact summary

Interacting components	API impact?	Remarks
ExtAPI -> Northbound	No	
UUI -> SO	<b>Yes</b>	
SO -> OOF	<b>Maybe</b>	NSI/NSSI selection - additional inputs for capacity, endPoints info
OOF -> CPS	No	
SO (NSMF) -> SO (NSSMF)	No	
SO (NSSMF Adapter) -> SO (External RAN NSSMF)	<b>Yes</b>	Activate, Deactivate flows support in external RAN NSSMF
SO -> SDN-C/SDN-R	<b>Yes</b>	To fetch the RAN network Topology
SO -> CDS	No	
Any component -> AAI	<b>Yes</b>	SO invokes AAI to read the nextHopinfo
DCAE Slice Analysis MS -> CPS	No	
CCSDK/SDN-C -> CPS	<b>Yes</b>	Use CPS instead of Config DB
UUI -> DES	No	
ExtAPI -> DES	No	
OOF -> DCAE	<b>Yes</b>	For capacity/occupancy based NSI/NSSI selection

# E2E Network Slicing Alignment with SDOs

Standards Body	Alignment Reference(s)
<b>3GPP (Rel. 16)</b>	<ul style="list-style-type: none"><li>○ TS 28.530 (Concepts, requirements)</li><li>○ TS 28.531 (Slice and Slice sub-net LCM)</li><li>○ TS 28.541 (Network Resource Models)</li><li>○ TS 23.501 (Procedures in Control Plane)</li><li>○ TS 28.552 and TS 28.554 (PM and KPIs)</li></ul>
<b>TMF</b>	<ul style="list-style-type: none"><li>○ TMF 641 (Service Order – CSMF NB)</li><li>○ TMF 628 (PM and KPI monitoring – just started)</li></ul>
<b>ETSI</b>	<ul style="list-style-type: none"><li>○ ZSM 002 ZSM Framework</li><li>○ ZSM 003 E2E Network Slicing Architecture</li><li>○ ZSM 009 Closed-loop Automation</li></ul>
<b>IETF</b>	<ul style="list-style-type: none"><li>○ draft-rokui-5g-ietf-network-slice-00</li><li>○ draft-ietf-teas-actn-vn-yang</li><li>○ RFC 8795: YANG models for TE topologies</li></ul>
<b>O-RAN</b>	<ul style="list-style-type: none"><li>○ O1 (RAN Configuration, notifications, PM data) – in progress</li><li>○ O2 (not started yet)</li><li>○ A1 – just started</li><li>○ RAN architecture and functional split (Non-RT RIC, Near-RT RIC, SMO) – in progress</li></ul>



**ONAP**

OPEN NETWORK AUTOMATION PLATFORM

Thank You!