MVP

Open RAN Minimum Viable Profile

An ATIS Initiative

ATIS Open RAN Minimum Viable Profile V2

Published February 10, 2025

ABSTRACT

Mobile network operators are adopting Open RAN (Radio Access Network) with the goal of furthering innovation and interoperability in their RAN deployments. Existing standards and specifications provide the technical basis for Open RAN deployment, but contain considerable optionality in areas including Open RAN architecture, functional capabilities, and performance. Navigating the range of optionality may be challenging for vendors and mobile network operators. This profile can assist that process by establishing a minimum common set of requirements based on existing standards and specifications as guidance for the North American Open RAN Market.

FOREWORD

As a leading technology and solutions development organization, the Alliance for Telecommunications Industry Solutions (ATIS) brings together the top global ICT companies to advance the industry's most pressing business priorities. ATIS is accredited by the American National Standards Institute (ANSI). The organization is the North American Organizational Partner for the 3rd Generation Partnership Project (3GPP), a member of and major U.S. contributor to the International Telecommunication Union (ITU) – Radio Sector, as well as a member of the Inter-American Telecommunication Commission (CITEL).
For more information, visit www.atis.org.

The ATIS Open RAN Minimum Viable Profile Initiative aims to promote innovation, diversity and accelerated adoption in the Open RAN market by establishing guidance on North American Open RAN Market requirements.

Suggestions for improvement of this document may be sent to the Alliance for Telecommunications Industry Solutions, Open RAN Initiative, 1200 G Street NW, Suite 500, Washington, DC 20005.

MVP
Open RAN Minimum Viable Profile
An ATIS Initiative

Open RAN Minimum Viable Profile
An ATIS Initiative

ii

Open RAN Minimum Viable Profile

An ATIS Initiative

1 SCOPE, PURPOSE, & APPLICATION

1.1 Scope and Purpose

The current Open Radio Access Network (RAN) market faces challenges that may impede innovation, diversity, and accelerated adoption:

> The present vendor market is established, and Mobile Network Operators (MNOs) have distinct requirements.

> Interoperability is difficult because of multiple interpretations of the same specification, varying vendor implementations and configurations, and the existence of numerous optional features/parameters.

The goal of this Minimum Viable Profile (MVP) is to establish a minimum common set of requirements based on existing standards and specifications as guidance for the North American Open RAN market. Adherence to the requirements defined in this document is intended to serve as an enabler for leveraging Open RAN opportunities in the North American market. The scope of the MVP requirements encompasses the following areas:

> Architectural related

> Common feature/functional capabilities

> Performance

It also encompasses a set of requirements for key Open RAN interfaces.

This MVP is limited to 5G standalone (SA) based deployment of outdoor macro/micro cells.

1.2 Application

Vendors that are seeking to meet the Open RAN requirements of MNOs may use this MVP as a baseline to build products. This MVP is not exhaustive and is intended that practical solutions augment this MVP with the vendor's unique technology innovations and performance capabilities.

Figure 1 illustrates the development process of the MVP and the possible use of it within the industry.
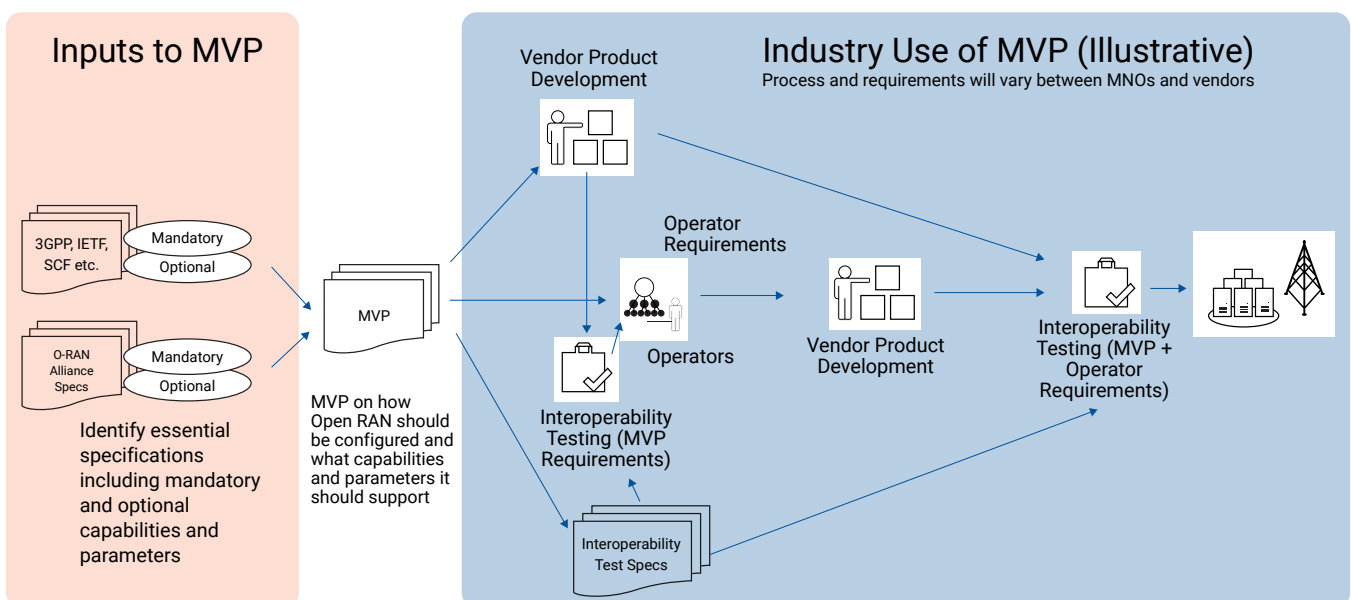
Figure 1: Inputs to and use of the MVP

As highlighted in Figure 1, the specifications developed within the 3rd Generation Partnership Project (3GPP), O-RAN Alliance, and other standards groups will be used to develop the MVP.

The right-hand side of Figure 1 illustrates potential use of the MVP. It can serve as a guide to vendors and assist them in development of interoperable Open RAN products that support a set of features and performance that the North American MNOs desire. It can also facilitate test equipment vendors and test laboratories to develop equipment and test cases to assist not only with interoperability testing across Open RAN products but also to verify their functional capabilities and performance. Finally, the MVP can also be leveraged by the MNOs as an input to the development of incremental operator specific requirements required for deployment within their networks as well as streamlining the integration of the solutions.

2 REFERENCES

O-RAN-1 .... O-RAN TS: "O-RAN Architecture Description", O-RAN.WG1.OAD-R003-v12.00

O-RAN-2 .... O-RAN TS: "Control, User and Synchronization Plane Specification", O-RAN.WG4.CUS.0-R004-v16.01

O-RAN-3 .... O-RAN TS: "Management Plane Specification", O-RAN.WG4.MP.0-R004-v16.01

O-RAN-4 .... O-RAN TS: "O-RAN Operations and Maintenance Interface Specification", O-RAN.WG10.O1-Interface.0-R004-v14.00

O-RAN-5 .... O-RAN TS: "O1 Interface specification for O-CU-UP and O-CU-CP", O-RAN.WG5.O-CU-O1.0-R003-v07.00

O-RAN-6 .... O-RAN TS: "O1 Interface specification for O-DU", O-RAN.WG5.O-DU-O1.0-R003-v09.00

O-RAN-7 .... O-RAN TS: "O2ims Interface Specification", O-RAN.WG6.O2IMS-INTERFACE-R004-v07.00.00

O-RAN-8 .... O-RAN TS "Security Requirements and Controls Specifications". O-RAN WG11.SecReqSpecs.0-R004-v10.00

O-RAN-9 .... O-RAN TS: "O2dms Interface Specification: Kubernetes Native API Profile for Containerized NFs", O-RAN.WG6.O2DMS-INTERFACE-K8S-PROFILE-R003-v05.00

O-RAN-10 .... O-RAN TS: "O2dms Interface Specification: Profile based on ETSI NFV Protocol and Data Models", O-RAN.WG6.O2DMS-INTERFACE-ETSI-NFV-PROFILE-R004-v08.00

O-RAN-11 .... O-RAN TS: "O-Cloud Notification API Specification for Event Consumers", O-RAN.WG6.O-Cloud Notification API-v04.00

O-RAN-12 .... O-RAN TS: "O2 Interface General Aspects and Principles", O-RAN.WG6.O2-GA&P-R004-v08.00

O-RAN-13 .... O-RAN TS: "Acceleration Abstraction Layer Common API", O-RAN.WG6.AAL-Common-API-R003-v087.00

O-RAN-14 .... O-RAN TS: "O-RAN Acceleration Abstraction Layer General Aspects and Principles", O-RAN.WG6.AAL-GAnP-R004-v10.00

O-RAN-15 .... O-RAN TS: "Cloud Platform Reference Designs", O-RAN.WG6.CLOUD-REF-v02.00

O-RAN-16 .... O-RAN TS: "O-RAN O1 Interface Specification," O-RAN.WG10.O1-Interface.0-R004-v14.00

O-RAN-17 .... O-RAN TS: "O-RAN Operations and Maintenance Architecture", O-RAN.WG10.OAM-Architecture-R004-v13.00

O-RAN-18 .... O-RAN TS, "Non-RT RIC: Architecture", O-RAN.WG2.Non-RT-RIC-ARCH-R004-v06.00

O-RAN-19 .... O-RAN TR, "Cloud Architecture and Deployment Scenarios for O-RAN Virtualized RAN" O-RAN.WG6.CADS-v08.00

O-RAN-20 .... O-RAN TS: "O-RAN Cloudification and Orchestration Use Cases and Requirements for O-RAN Virtualized RAN", O-RAN.WG6.ORCH-USE-CASES-R003-v11.00

O-RAN-21 .... O-RAN TS: "NR C-plane profile", O-RAN.WG5.C.1-R003-v12.02

O-RAN-22 .... O-RAN TS: "R1 interface: General Aspects and Principles", O-RAN.WG2.R1GAP-R004-v09.00

O-RAN-23 .... O-RAN TS: "Fronthaul Interoperability Test Specifications (IOT), O-RAN.WG4.IOT.0-R004-v12.00

O-RAN-24 .... O-RAN TS: "R1 Interface: Use Cases and Requirements", O-RAN.WG2.R1UCR-v08.00

O-RAN-25 .... O-RAN TS: "Non-RT RIC & A1/R1 interface: Use Cases and Requirements", O-RAN.WG2.Use-Case-Requirements-R004-v10.01

O-RAN-26 .... O-RAN TS: "R1 Interface: Application Protocols for R1 Services",O-RAN.WG2.R1AP-R004-v06.00

O-RAN-27 .... O-RAN TS: "Security Protocols Specification", O-RAN.WG11.Security-Protocols-Specification.O-R004-v10.0000

3GPP-1 .... 3GPP TS 38.300, "NR; NR and NG-RAN Overall Description; Stage 2", Rel 16

3GPP-2 .... 3GPP TS 38.401, "NG-RAN; Architecture description", Rel 16

3GPP-3................. 3GPP TS 38.104, "Base Station (BS) Radio Transmission and reception," Rel 16

3GPP-4................. 3GPP TS 33.501, v16.18.0, "Security Architecture and Procedures for 5G System"

3GPP-5................. 3GPP TS 38.473, "F1 application protocol (F1AP)", Rel 16

3GPP-6................. 3GPP TS 38.425, "NR user plane protocol", Rel 16

3GPP-7................. 3GPP TS 38.463, "E1 Application Protocol (E1AP)", Rel 16

3GPP-8................. 3GPP TS 38.141-1, "BS conformance testing, Part 1: Conducted conformance testing", Rel 16

3GPP-9................. 3GPP TS 39.141-2, "BS conformance testing, Part 2: Radiated conformance testing", Rel 16

3GPP-10............... 3GPP TS 28.314, "Management and orchestration; Plug and Connect; Concepts and requirements," Rel 17.0.0

3GPP-11............... 3GPP TS 28.532, "Management and orchestration; Generic management services," Rel 17.6.0

3GPP-12............... 3GPP TS 28.537, "Management and orchestration; Management capabilities," Rel 17.3.0

3GPP-13............... 3GPP TS 28.550, "Management and orchestration; Performance assurance," Rel 17.1.0

3GPP-14............... 3GPP TS 28.622, "Telecommunication management; Generic Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)," Rel 17.7.0

3GPP-15............... 3GPP TS 28.623, "Telecommunication management; Generic Network Resource Model (NRM) Integration Reference Point (IRP); Solution Set (SS) definitions," Rel 17.7.0

3GPP-16............... 3GPP TS 32.341, "Telecommunication management; File Transfer (FT) Integration Reference Point (IRP); Requirements," Rel 17.0.0

3GPP-17............... 3GPP TS 32.421, "Telecommunication management; Subscriber and equipment trace; Trace concepts and requirements," Rel 17.4.0

IETF-1................... IETF RFC 6022, "YANG Module for NETCONF Monitoring", October 2010

IETF-2................... IETF RFC 6241, "Network Configuration Protocol (NETCONF)", June 2011

IETF-3................... IETF RFC 6243, "With-defaults Capability for NETCONF", June 2011

IETF-4................... IETF RFC 7950, "The YANG 1.1 Data Modeling Language", August 2016

OTH-1................... NIST SP 800-207, Zero Trust Architecture

OTH-2................... CSRIC VIII Report: Report on Challenges to the Development of ORAN Technology and Recommendations on How to Overcome Them, December 2022. (Communications Security, Reliability, and Interoperability Reports | Federal Communications Commission (fcc.gov))

OTH-3................... NIST DevSecOps: Software Supply Chain and DevOps Security Practices (2022), https://www.nccoe.nist.gov/sites/default/files/2022-11/dev-sec-ops-project-description-final.pdf.

OTH-4................... NIST SSDF: NIST, SP 800-218, Secure Software Development Framework (SSDF) Version 1.1: Recommendations for Mitigating the Risk of Software Vulnerabilities (2022), https://csrc.nist.gov/pubs/sp/800/218/final.

OTH-5................... BSA Framework for Secure Software: The BSA Framework for Secure Software, version 1.1, Sept 2020, https://www.bsa.org/reports/updated-bsa-framework-for-secure-software

OTH-6................... SAFECode: SAFEcode, Resource: Secure Development Practices, https://safecode.org/category/resource-secure-development-practices/

OTH-7................... Secure by Design, CISA, Published in April 2023, updated October 2023, https://www.cisa.gov/resources-tools/resources/secure-by-design.

OTH-8................... Kubernetes Hardening Guide, NSA and CISA, version 1.2, August 2022.

3 ACRONYMS & ABBREVIATIONS

For a list of common communications terms and definitions, please visit the ATIS Telecom Glossary, which is located at https://glossary.atis.org/.

3.1
Acronyms & Abbreviations

3GPP .... The 3rd Generation Partnership Project
ACLR .... Adjacent Channel Leakage Ratio
ANR.. Automatic Neighbor Relations
API...Application Programming Interface
ATIS... Alliance for Telecommunications Industry Solutions
BMC .... Board Management Controller
BWP .... Bandwidth Part
CCO.. Coverage and Capacity Optimization
CG .... Configured Grant
CMP ....Certificate Management Protocol
CNF .... Cloud-Native Network Function
CNRMS ....Cloudified NF Registration Management Service
CPU ....Central Processing Unit
CRD ....Custom Resource Definition
CSI...Channel State Information
CUS .... Control User Synchronization
DDoS.. Distributed Denial of Service
DL .... Downlink
DME ....Data Management and Exposure
DM-RS..Demodulation Reference Signal
DNS.. Domain Name System
DPDK.. Data Plane Development Kit
DRX ....Discontinuous Reception
DTLS .... Datagram Transport Layer Security
ECID ....Enhanced Cell Identity
EPS... Evolved Packet System
ETSI..European Telecommunications Standards Institute
FCAPS.. Fault, Configuration, Accounting, Performance, and Security
FDD ....Frequency Division Duplex
FH.. Fronthaul
FMS... File Management Service
FPGA... Field Programmable Gate Array
FSMS ....Fault Supervision Management Service
GBR ....Guaranteed Bit Rate
GPU ....Graphics Processing Unit

The following Sections specify the architecture and requirements of the MVP.

The O-RAN reference architecture for an Open RAN system supported by the present MVP specification is shown in Figure 2. The basis for the O-RAN architecture is the normative and informative specifications developed by the O-RAN Alliance in WG1, WG2, WG4, WG5, WG6, WG10 and WG11. Figure 2 depicts functions and interfaces that are normatively and informatively specified as part of the O-RAN Alliance specifications.

Refer to [O-RAN-1] for descriptions of each network function and associated interfaces.

The Open RAN system is expected to meet all mandatory aspects of 3GPP and O-RAN specifications irrespective of whether they are explicitly listed as requirements in this MVP or not.

The O-RAN based deployments compliant to the present MVP specification must comprise the in-scope functions and interfaces shown in Figure 2 and listed in Sections 4.1 and 4.2.

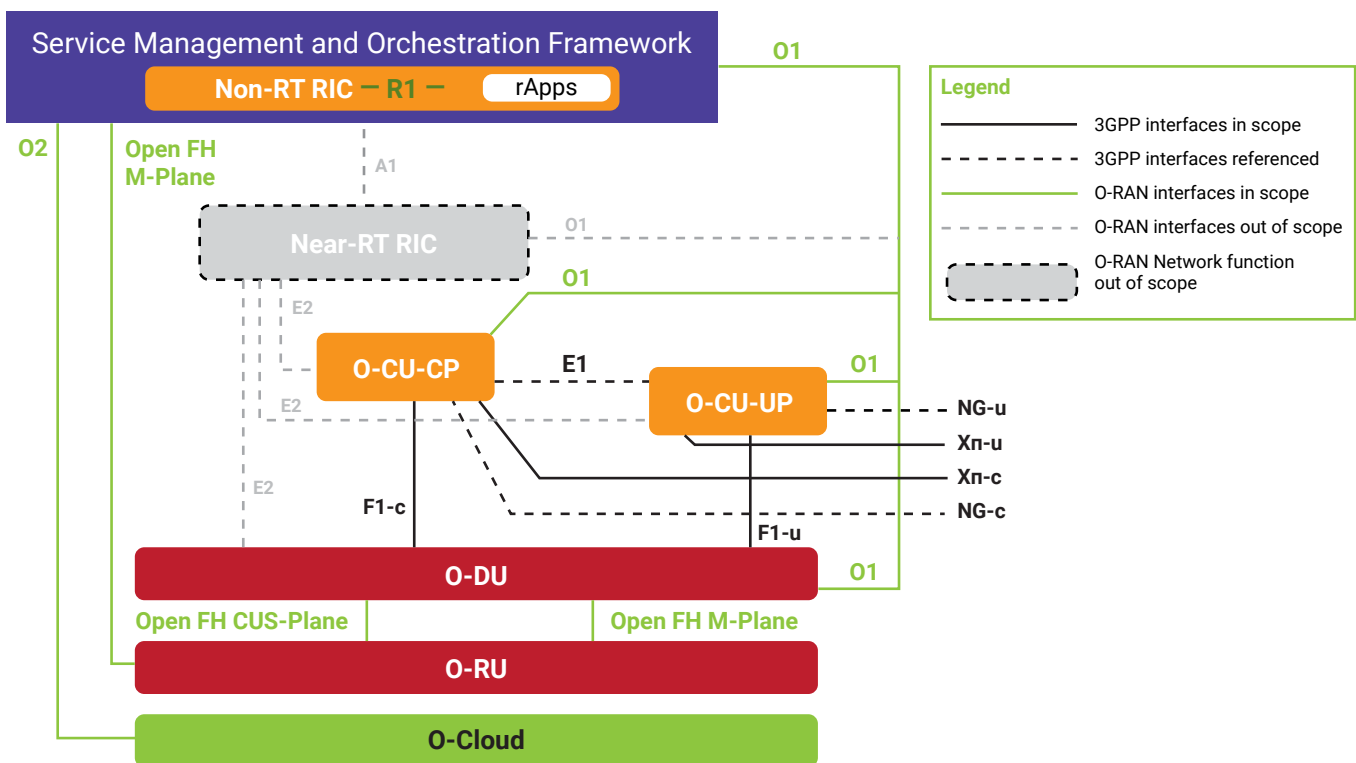Figure 2: Open RAN Functional Architecture of this MVP (Source: [O-RAN-1])

NOTE: 3GPP referenced interfaces – Interfaces that are required to be supported by the network function but the Interoperability Testing (IOT) profile for that interface is not in the scope of this MVP.

NOTE: Out of scope O-RAN interfaces – Interfaces that do not need to be supported by the network functions as part of this MVP.

4.1   Supported Network Functions

MVP-ARCH-GEN-1: The Open RAN functional architecture shall support the following O-RAN functions:

> **O-RU**
> **O-DU**
> **O-CU-CP**
> **O-CU-UP**
> **SMO including Non-RT RIC**
> **O-Cloud**

NOTE: The scope of the present MVP excludes the Near Realtime RAN Intelligent Controller (Near-RT RIC). The Near-RT RIC and associated interface profiles will be developed in a subsequent release of the MVP.

NOTE: All other out-of-scope network functions and interfaces may be considered in a future revision of the MVP based upon operator needs.

MVP-ARCH-GEN-2: The network functions shall support the functional requirements specified in Section 5 of this MVP.

MVP-ARCH-GEN-3: The network functions shall support the performance requirements specified in Section 6 of this MVP.

MVP-ARCH-GEN-4: The network functions shall support the O-Cloud requirements specified in Section 7 of this MVP.

MVP-ARCH-GEN-5: The network functions shall support the management requirements specified in Section 8 of this MVP.

MVP-ARCH-GEN-6: The network functions shall support the security requirements specified in Section 9 of this MVP.

4.2   Supported Interfaces

MVP-ARCH-INTF-1: The O-RU shall support the following O-RAN specified interfaces including associated protocol stacks:

> **O-RAN Fronthaul (FH) Control User Synchronization (CUS)-Plane interface specified in O-RAN Alliance [O-RAN-2]**
> **O-RAN FH Management (M) -Plane interface specified in O-RAN Alliance [O-RAN-3]**

MVP-ARCH-INTF-2: The O-RU shall be capable of being configured to be managed using hybrid M-Plane specified in O-RAN Alliance [O-RAN-3].

MVP-ARCH-INTF-3: The O-RU shall support of being configured and managed using the hierarchical M-Plane specified in O-RAN Alliance [O-RAN-3].

MVP-ARCH-INTF-4: The O-DU shall support the following O-RAN specified interfaces including associated protocol stacks:

> **O-RAN FH CUS-Plane interface specified in O-RAN Alliance [O-RAN-2]**
> **O-RAN FH M-Plane interface specified in O-RAN Alliance [O-RAN-3]**

MVP-ARCH-INTF-5: The O-DU shall support the management O1 interface to SMO specified in O-RAN Alliance [O-RAN-6].

MVP-ARCH-INTF-6: The O-DU shall support F1-C interface to O-CU-CP specified in 3GPP [3GPP-5].

MVP-ARCH-INTF-7: The O-DU shall support F1-U interface to O-CU-UP specified in 3GPP [3GPP-6].

MVP-ARCH-INTF-8: The O-CU-CP shall support the management O1 interface to Service Management and Orchestration (SMO) specified in O-RAN Alliance [O-RAN-5].

MVP-ARCH-INTF-9: The O-CU-CP shall support F1-C interface to O-DU specified in 3GPP [3GPP-5].

MVP-ARCH-INTF-10: The O-CU-UP shall support F1-U interface to O-DU specified in 3GPP [3GPP-6].

MVP-ARCH-INTF-11: O-CU-CP shall support E1 interface to O-CU-UP specified in 3GPP [3GPP-7].

MVP-ARCH-INTF-12: The Non-RT RIC framework of the SMO shall support the R1 interface as specified in O-RAN Alliance [O-RAN-22].

MVP-ARCH-INTF-13: The SMO shall support O1 interface to O-DU, O-CU-CP and O-CU-UP functions specified in O-RAN Alliance [O-RAN-4].

NOTE: NG-c (N2) and NG-u (N3) interfaces will be profiled in a future MVP release.

5 FUNCTIONAL REQUIREMENTS

This Section captures the overall functional requirements for an end-to-end O-RAN based Open RAN system as specified in section 4. The functional capabilities identified are a subset of those specified in 3GPP as part of following Releases 16 and 17 specifications [3GPP-1] and [3GPP-1].

5.1 Functional Requirements based on 3GPP Release 16

This Section specifies Open RAN system's functional capabilities as specified in 3GPP Release 16.

5.1.1 Functional Requirements on Architecture

MVP-FUNC-ARCH-16-1: The Open RAN system specified in Section 4.1 shall support 5G core SA option as specified in 3GPP [3GPP-1] and [3GPP-2].

5.1.2 Functional Requirements on Basic Physical Layer Capabilities

MVP-FUNC-PHY-16-1: The Open RAN system specified in Section 4.1 shall support mixed numerology in O-DU across different bands (e.g., Subcarrier Spacing (SCS) 30 kHz for n41 band and 15 kHz for n66 band).

MVP-FUNC-PHY-16-2: The Open RAN system specified in Section 4.1 shall support Physical Random Access Channel (PRACH) preamble formats of 0, 1, A3, B4, C0, C2.

MVP-FUNC-PHY-16-3: The Open RAN system specified in Section 4.1 shall support periodic Sounding Reference Signal (SRS).

MVP-FUNC-PHY-16-4: The Open RAN system specified in Section 4.1 shall support aperiodic SRS.

MVP-FUNC-PHY-16-5: The Open RAN system specified in Section 4.1 shall support wideband SRS.

MVP-FUNC-PHY-16-6: The Open RAN system specified in Section 4.1 shall support narrowband SRS.

MVP-FUNC-PHY-16-7: The Open RAN system specified in Section 4.1 with outdoor O-RU shall support 4T4R downlink (DL) for low bands authorized in North America.

MVP-FUNC-PHY-16-8: The Open RAN system specified in Section 4.1 with outdoor O-RU shall support 4T4R DL for mid bands authorized in North America.

MVP-FUNC-PHY-16-9: The Open RAN system specified in Section 4.1 with outdoor O-RU shall support 8T8R DL for mid bands authorized in North America.

MVP-FUNC-PHY-16-10: The Open RAN system specified in Section 4.1 with outdoor O-RU shall support 2T2R uplink (UL) for low bands authorized in North America.

MVP-FUNC-PHY-16-11: The Open RAN system specified in Section 4.1 with outdoor O-RU shall support 2T2R UL for mid bands authorized in North America.

MVP-FUNC-PHY-16-12: The Open RAN system specified in Section 4.1 shall support SCS of 15 kHz for FR1 Frequency Division Duplex (FDD) bands as specified in [3GPP-3].

MVP-FUNC-PHY-16-13: The Open RAN system specified in Section 4.1 shall support SCS of 30 kHz for FR1 Time Division Duplex (TDD) bands as specified in [3GPP-3].

MVP-FUNC-PHY-16-14: The Open RAN system specified in Section 4.1 shall support SCS of 120 kHz for FR2 bands as specified in [3GPP-3].

MVP-FUNC-PHY-16-15: The Open RAN system specified in Section 4.1 shall support modulation of up to 256QAM DL and 256QAM UL.

MVP-FUNC-PHY-16-16: The Open RAN system specified in Section 4.1 shall support UL transmit (Tx) switching.

5.1.3   Functional Requirements on Basic Capabilities

MVP-FUNC-BAS-16-1: The Open RAN system specified in Section 4.1 shall support the configuration, transmission, and reception of the following features:
   a)   Paging
   b)   System Information Broadcast (SIB)
   c)   DL unicast transmission
   d)   UL unicast reception
   e)   Random access by the UE

MVP-FUNC-BAS-16-2: The Open RAN system specified in Section 4.1 shall support the configuration and broadcast of the following SIBs, e.g., SIB1-5 and SIB8.

MVP-FUNC-BAS-16-3: The Open RAN system specified in Section 4.1 shall support Closed Loop Power Control.

MVP-FUNC-BAS-16-4: The Open RAN system specified in Section 4.1 shall support Access Barring with Unified Access Control (UAC).

5.1.4.   Functional Requirements for Multiple Input Multiple Output (MIMO)

MVP-FUNC-MIMO-16-1: The Open RAN system specified in Section 4.1 shall support Channel State Information (CSI) report for periodic and aperiodic Type-I codebook.

MVP-FUNC-MIMO-16-2: The Open RAN system specified in Section 4.1 shall support CSI report for periodic and aperiodic Type-II codebook.

MVP-FUNC-MIMO-16-3: The Open RAN system specified in Section 4.1 shall support CSI feedback for Type-I and Type-II codebook.

MVP-FUNC-MIMO-16-4: The Open RAN system specified in Section 4.1 shall support Single User MIMO with 2T2R and up to 2 DL layers and up to 2 UL layers.

MVP-FUNC-MIMO-16-5: The Open RAN system specified in Section 4.1 shall support Single User MIMO with 4T4R and up to 4 DL layers and up to 4 UL layers.

MVP-FUNC-MIMO-16-6: The Open RAN system specified in Section 4.1 shall support UL Multiuser MIMO with up to 2 layers per user and up to a total of 8 layers.

MVP-FUNC-MIMO-16-7: The Open RAN system specified in Section 4.1 shall support DL Multiuser MIMO with up to 4 layers per user and up to a total of 16 layers.

MVP-FUNC-MIMO-16-8: The Open RAN system specified in Section 4.1 shall support Massive MIMO with 32T32R and up to 16 DL layers and up to 8 UL layers.

MVP-FUNC-MIMO-16-8a: The Open RAN system specified in Section 4.1 shall support Massive MIMO with 64T64R and up to 16 DL layers and up to 8 UL layers.

MVP-FUNC-MIMO-16-9: The Open RAN system specified in Section 4.1 shall support Reciprocity -based beam forming for FR1 TDD bands.

MVP-FUNC-MIMO-16-10: The Open RAN system specified in Section 4.1 shall support Reciprocity -based beam forming for FR2 TDD bands.

MVP-FUNC-MIMO-16-11: The Open RAN system specified in Section 4.1 shall support hybrid beam forming for FR2.

MVP-FUNC-MIMO-16-12: The Open RAN system specified in Section 4.1 shall support Release 15/16 legacy beam management for FR2.

MVP-FUNC-MIMO-16-13: The Open RAN system specified in Section 4.1 shall support SRS Antenna Switching.

MVP-FUNC-MIMO-16-14: The Open RAN system specified in Section 4.1 shall support Demodulation Reference Signal (DM-RS) enhancement of Peak-to-Average Power Ratio (PAPR).

5.1.5   Functional Requirements for Bandwidth

MVP-FUNC-BW-16-1: The Open RAN system specified in Section 4.1 shall support the following carrier bandwidths:
   a) FR1 bands:
      > FDD bands: 5, 10, 20, 25, 30, 40, 45 MHz if that specific bandwidth is specified for a band specified in TS 38.104
      > TDD bands: 10, 15, 20, 30, 40, 50, 60, 70, 80, 90, 100 MHz if that specific bandwidth is specified for a band specified in TS 38.104
   a) FR2 bands:
      100 MHz bandwidth as specified in TS 38.104

MVP-FUNC-BW-16-2: The Open RAN system specified in Section 4.1 shall support UL pre-scheduling.

MVP-FUNC-BW-16-3: The Open RAN system specified in Section 4.1 shall support UL Configured Grant (CG) Type 1 and Type 2.

MVP-FUNC-BW-16-4: The Open RAN system specified in Section 4.1 shall support Bandwidth Parts (BWPs) for FDD and TDD bands in both DL and UL and for both Primary Cell (Pcell) and Secondary Cell (Scell) with the following:
   a) Minimum 2 BWPs, including one initial BWP and one dedicated BWP
   b) Maximum 4 BWPs, including the initial BWP

5.1.6   Functional Requirements for TDD Pattern

MVP-FUNC-TDD-16-1: The Open RAN system specified in Section 4.1 shall support configurable TDD patterns through static or semi-static configuration, via Radio Resource Control (RRC).

MVP-FUNC-TDD-16-2: The Open RAN system specified in Section 4.1 shall support TDD pattern 4:1 DDDSU where S slot has 10 DL, 2 GP, 2 UL symbols for FR1 bands as defined for relevant Open FH CUS IOT profiles.

MVP-FUNC-TDD-16-3: The Open RAN system specified in Section 4.1 shall support TDD pattern 4:1 DDDSU where S slot has 10 DL, 2 GP, 2 UL symbols for FR2 bands as defined for relevant Open FH CUS IOT profiles.

MVP-FUNC-TDD-16-4: The Open RAN system specified in Section 4.1 shall support TDD pattern 8:2 DDDSUUDDDD where S slot has 6 DL, 4 GP, 4 UL symbols for FR1 bands as defined for relevant Open FH CUS IOT profiles.

MVP-FUNC-TDD-16-5: The Open RAN system specified in Section 4.1 shall support TDD pattern 6:4 DDDSUUUUDD where S slot has 6 DL, 4 GP, 4 UL symbols for FR1 bands as defined for relevant Open FH CUS IOT profiles.

5.1.7   Functional Requirements on Carrier Aggregation

MVP-FUNC-CA-1: The Open RAN system specified in Section 4.1 shall support both Intra-band and Inter-band Carrier Aggregation.

MVP-FUNC-CA-2: The Open RAN system specified in Section 4.1 shall support Intra-DU Carrier Aggregation.

MVP-FUNC-CA-3: The Open RAN system specified in Section 4.1 shall support FR1 FDD Carrier Aggregation across both inter-band and intra-band component carriers, with up to 4 Component Carriers in DL and up to 2 Component Carriers in UL.

MVP-FUNC-CA-4: The Open RAN system specified in Section 4.1 shall support FR1 FDD and TDD Carrier Aggregation both inter-band and intra-band, with up to 6 Component Carriers in DL and up to 2 Component Carriers in UL.

MVP-FUNC-CA-5: The Open RAN system specified in Section 4.1 shall support FR1 TDD Carrier Aggregation both inter-band and intra-band, with up to 3 Component Carriers DL and 1 Component Carrier in UL.

MVP-FUNC-CA-6: The Open RAN system specified in Section 4.1 shall support FR2 Carrier Aggregation both inter-band and intra-band, with up to 8 Component Carriers in DL and up to 4 Component Carriers in UL.

MVP-FUNC-CA-7: The Open RAN system specified in Section 4.1 shall support NR-Dual Connectivity with FR1 and FR2 Dual Connectivity with 1 FR1 FDD or TDD along with FR2 up to 8 Component Carriers in DL, and FR2 up to 4 Component Carriers in UL.

5.1.8   Functional Requirements on Mobility

MVP-FUNC-MOB-1: The Open RAN system specified in Section 4.1 shall support Intra-band mobility within supported FR1 and FR2 bands for the following scenarios:
   a)   Intra-RU, Intra-DU, Intra-CU
   b)   Inter-RU, Intra-DU, Intra-CU
   c)   Inter-RU, Inter-DU, Intra-CU
   d)   Inter-RU, Inter-DU, Inter-CU handovers without CU-UP change
   e)   Inter-RU, Inter-DU, Inter-CU handovers with CU-UP change

MVP-FUNC-MOB-2: The Open RAN system specified in Section 4.1 shall support Inter-band mobility such as between supported FR1 bands, between supported FR1 and FR2 bands, and between supported FR2 bands for the following scenarios:
   a)   Intra-multiband RU, Intra-DU, Intra-CU
   b)   Inter-RU, Intra-DU, Intra-CU
   c)   Inter-RU, Inter-DU, Intra-CU
   d)   Inter-RU, Inter-DU, Inter-CU handovers without CU-UP change
   e)   Inter-RU, Inter-DU, Inter-CU handovers with CU-UP change

MVP-FUNC-MOB-3: The Open RAN system specified in Section 4.1 shall support Xn-based Handover.

MVP-FUNC-MOB-4: The Open RAN system specified in Section 4.1 shall support Next-Generation (NG)-based Handover.

MVP-FUNC-MOB-5: The Open RAN system specified in Section 4.1 shall support Intra-Master Node (MN) Handover with Secondary Node (SN) change.

MVP-FUNC-MOB-6: The Open RAN system specified in Section 4.1 shall support Intra-MN Handover without SN change.

MVP-FUNC-MOB-7: The Open RAN system specified in Section 4.1 shall support Inter-MN Handover with SN change.

MVP-FUNC-MOB-8: The Open RAN system specified in Section 4.1 shall support Inter-MN Handover without SN change.

MVP-FUNC-MOB-9: The Open RAN system specified in Section 4.1 shall support RRC_CONNECTED state mobility.

MVP-FUNC-MOB-10: The Open RAN system specified in Section 4.1 shall support RRC_INACTIVE state mobility.

MVP-FUNC-MOB-11: The Open RAN system specified in Section 4.1 shall support RRC_IDLE state mobility.

MVP-FUNC-MOB-12: The Open RAN system specified in Section 4.1 shall support FR2 coverage-based SN release.

MVP-FUNC-MOB-13: The Open RAN system specified in Section 4.1 shall support Secondary Cell Group (SCG) Radio Link Failure (RLF) detection and recovery.

MVP-FUNC-MOB-14: The Open RAN system specified in Section 4.1 shall support Fast Handover failure recovery based on T312.

MVP-FUNC-MOB-15: The Open RAN system specified in Section 4.1 shall support Conditional handover.

5.1.9   Functional Requirements for Essential Services

This Section will enumerate the functional requirements for Services.

MVP-FUNC-SVCS-16-1: The Open RAN system specified in Section 4.1 shall support Admission control, Priority, and Preemption.

MVP-FUNC-SVCS-16-2: The Open RAN system specified in Section 4.1 shall support User Equipment (UE) Power Savings enhancements for the following:
   a)   Wake Up Signal (WUS)
   b)   UE Assistance Information

MVP-FUNC-SVCS-16-3: The Open RAN system specified in Section 4.1 shall support Emergency Call Prioritization.

MVP-FUNC-SVCS-16-4: The Open RAN system specified in Section 4.1 shall support Wireless Priority Service (WPS) and Multimedia Priority Service.

MVP-FUNC-SVCS-16-5: The Open RAN system specified in Section 4.1 shall support Public Warning Systems (PWS).

MVP-FUNC-SVCS-16-6: The Open RAN system specified in Section 4.1 shall support Connected Mode Discontinuous Reception (DRX).

MVP-FUNC-SVCS-16-7: The Open RAN system specified in Section 4.1 shall support Evolved Packet System (EPS) Fallback to Voice over Long-Term Evolution (VoLTE).

MVP-FUNC-SVCS-16-8: The Open RAN system specified in Section 4.1 shall support the following Voice over New Radio (VoNR) features:
   a)   Robust Header Compression (RoHC) Profile 1
   b)   Guaranteed Bit Rate (GBR) support
   c)   5G QoS Indicator (5QI) 1, 2 for GBR
   d)   Slot Aggregation (TTI bundling)

5.1.10   Functional Requirements for other Capabilities

MVP-FUNC-OTH-16-1: The Open RAN system specified in Section 4.1 shall support Remote Interference Management (RIM) for RIM-RS Type 1 backhaul framework.

MVP-FUNC-RANS-16-1: The Open RAN system specified in Section 4.1 shall support Multi-Operator Core Network (MOCN).

MVP-FUNC-RANS-16-2: The Open RAN system specified in Section 4.1 shall support Multi-Operator RAN (MORAN).

MVP-FUNC-POS-16-1: The Open RAN system specified in Section 4.1 shall support New Radio Positioning Protocol (NRPPa) based Enhanced Cell Identity (ECID) positioning method.

MVP-FUNC-POS-16-2: The Open RAN system specified in Section 4.1 shall support DL Positioning Reference Signal (PRS) for FDD and TDD bands with Comb-4 or higher configuration.

MVP-FUNC-POS-16-3: The Open RAN system specified in Section 4.1 shall support for the following positioning methods:
   a)   Power
   b)   Time for all bands
   c)   Angle for FR2 bands

MVP-FUNC-RLM-16-1: The Open RAN system specified in Section 4.1 shall support both SSB and CSI-RS based Radio Link Monitoring.

MVP-FUNC-RACH-16-1: The Open RAN system specified in Section 4.1 shall support the 4-step Random Access Channel (RACH).

MVP-FUNC-RACH-16-2: The Open RAN system specified in Section 4.1 shall support the 2-step RACH as specified in Release 16.

5.2 Functional Requirements based on 3GPP Release 17

This Section specifies Open RAN system's functional capabilities as specified in 3GPP Release 17.

5.2.1 Functional Requirements for MIMO

MVP-FUNC-MIMO-17-1: Void.

MVP-FUNC-MIMO-17-2: The Open RAN system specified in Section 4.1 shall support Type-II codebook Release 17 enhancements related the following:
   a) Reliability
   b) Repetition and time bundling
   c) Aperiodic SRS triggering

MVP-FUNC-MIMO-17-3: The Open RAN system specified in Section 4.1 shall support SRS coverage enhancements related the following:
   a) Reliability
   b) Repetition and time bundling
   c) Aperiodic SRS triggering

5.2.2 Functional Requirements for Bandwidth

MVP-FUNC-BW-17-1: The Open RAN system specified in Section 4.1 shall support UL Dynamic Physical Uplink Control Channel (PUCCH) repetition factor indication.

MVP-FUNC-BW-17-2: The Open RAN system specified in Section 4.1 shall support UL Tx switching Release 17 enhancements.

5.2.3 Functional Requirements for Essential Services

MVP-FUNC-SVCS-17-1: The Open RAN system specified in Section 4.1 shall support Power Classes of 1, 1.5, and 2.

MVP-FUNC-SVCS-17-2: The Open RAN system specified in Section 4.1 shall support Reduced Capability (RedCap) features for both TDD and FDD.

MVP-FUNC-SVCS-17-3: The Open RAN system specified in Section 4.1 shall support the following RAN slicing enhancements:
   a) Slice aware reselection
   b) Slice specific RACH configuration
   c) Slice specific Maximum Bit Rate (MBR)
   d) Slice specific multi-carrier resource sharing
   e) Slice specific resource partitioning

5.2.4 Functional Requirements for Other Capabilities

MVP-FUNC-SMO-17-1: The Open RAN system specified in Section 4.1 shall support appropriate data to be ingested by the SMO to enable the following use cases via rApps:
   a) Automatic Neighbor Relations (ANR)
   b) Physical Cell ID (PCI) Optimization
   c) Mobility Load Balancing (MLB)
   d) Mobility Robustness Optimization (MRO)
   e) Coverage and Capacity Optimization (CCO)
   f) RACH Optimization

6 PERFORMANCE REQUIREMENTS

This Section lists a minimum number of performance metrics related to the Open RAN system specified in Section 4 that the MNOs will be considering in evaluating the viability of the developed Open RAN system as part of their deployment.

For each metric, the recommended test method and configuration and a value range are also listed.

NOTE 1: The value ranges provided are for guidance only, and individual MNOs may require values for certain metrics that fall outside the specified value range. Some metrics do not have a value range specified. Irrespective of whether a value range is specified or not, vendors are expected to submit the measured value for all metrics as part of the test report. MNOs may also have additional operator specific performance metrics that the system may have to meet.

NOTE 2: The test procedure is assumed to include enough repetitions to ensure adequate confidence in the measured value of each performance metric.

6.1   Accessibility Related Metrics

MVP-PERF-ACC-1: PRACH Success Rate:

Description	Test Method and Configuration	Performance Value Range
Measure of successfully resolving contentions and assign initial resources. PRACH failure is RACH procedure getting aborted due to no MSG2 from the Open RAN system.	3GPP TS 38.141-1, TS 38.141-2 (Note 2)	>99% (Note 1)

MVP-PERF-ACC-2: RRC Setup Success Rate:

Description	Test Method and Configuration	Performance Value Range
Measure of successfully setting up radio resource connection and represents the percentage of radio connection attempts that were successful.	NOTE: There is no Test and Integration Focus Group (TIFG) or 3GPP specification clause that directly specifies configuration and method for performing tests to evaluate this performance metric. However, test methods and procedures in clause 6.4/6.7/8.3 could be leveraged to develop the procedure/configuration for this performance metric (Note 2).	>99% (Note 1)

MVPC-PERF-ACC-3: 5G SA registration success rate:

Description	Test Method and Configuration	Performance Value Range
Measure of successfully registering the UE with the SA core and represents the ratio of the number times Registration Complete was successful to the number of Registration Request attempts.	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clause 5.3 (Note 2)	100% (Note 1)

MVPC-PERF-ACC-4: 5G SA deregistration success rate:

Description	Test Method and Configuration	Performance Value Range
Measure of successfully registering the UE with the SA core and represents the ratio of the number times Connection Release was successful to the number of De-Registration Request attempts (Note 2).	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clause 5.3 (Note 2)	100% (Note 1)

6.2   Retainability Related Metrics

MVP-PERF-RET-1: RRC Dropped Call Rate:

Description	Test Method and Configuration	Performance Value Range
Measure of drop call over the total number of successfully established RRC calls for radio conditions varying from excellent to poor. A RRC dropped call refers to release of an RRC connection for reasons other than inactivity and radio link failures (RLF).	**NOTE:** There is no TIFG or 3GPP specification clause that directly specifies configuration and method for performing tests to evaluate this performance metric. However, test methods and procedures in clauses 6.4/6.7/8.3 could be leveraged to develop the procedure/configuration for this performance metric (Note 2).	<0.01% (Note 1)

MVP-PERF-RET-2: VoNR Dropped Call Rate:

Description	Test Method and Configuration	Performance Value Range
Measure of VoNR drop call over the total number of successfully established VoNR calls.	O-RAN.TIFG.E2E-Test.0-R003-v06.00 **NOTE**: This metric and associated value has not been captured in the TIFG specifications **NOTE**: The VoNR call duration for this may repetition of shorter call duration than those specified in clause 7.5.1-4 as per typical values for the call hold time. This may require further updates to clause 7.5.1-4 of the TIFG specifications (Note 2)	<0.05% (Note 1)

6.3   Throughput Related Metrics

MVP-PERF-THR-1a: L1 Downlink peak throughput,
MVP-PERF-THR-1b: Application-level Downlink peak throughput,
MVP-PERF-THR-1c: L1 Downlink peak spectral efficiency:

Description	Test Method and Configuration	Performance Value Range
Measure of sustaining 100% allocation of available DL resource assignments to a single user in excellent signal condition at the highest Modulation and Coding Scheme (MCS) based on UE capability.	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clauses 4.8, 6.1, 6.2 (Note 2)	As per formula in clause 6.1.2 for a given numerology, frequency band, channel bandwidth and TDD configuration using DL overhead specified for FR1/FR2.

MVP-PERF-THR-2a: L1 Uplink peak throughput,
MVP-PERF-THR-2b: Application-level Uplink peak throughput,
MVP-PERF-THR-2c: L1 Uplink peak spectral efficiency:

Description	Test Method and Configuration	Performance Value Range
Measure of sustaining 100% allocation of available UL resource assignments to a single user in excellent signal condition at the highest MCS based on UE capability.	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clauses 4.8 6.1, 6.3 (Note 2)	As per formula in clause 6.1.2 for a given numerology, frequency band, channel bandwidth and TDD configuration using UL overhead specified for FR1/FR2.

MVP-PERF-THR-3a: Bidirectional L1 Downlink and Uplink throughput in excellent, good, fair and poor radio conditions,
MVP-PERF-THR-3b: Bidirectional Application-level Downlink and Uplink throughput in excellent, good, fair and poor radio conditions,
MVP-PERF-THR-3c: Bidirectional L1 Downlink and Uplink spectral efficiency in excellent, good, fair and poor radio conditions:

Description	Test Method and Configuration	Performance Value Range
Measure of DL and UL throughputs for simultaneous bidirectional data transmissions for excellent, good, fair and poor radio conditions.	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clauses 4.8, 6.6 (Note 2)	

MVP-PERF-THR-4a: Downlink L1 throughput for varying channel conditions to plot between throughput and Signal-to-Interference-plus-Noise Ratio (SINR),
MVP-PERF-THR-4b: Downlink Application throughput for varying channel conditions to plot between throughput and SINR,
MVP-PERF-THR-4c: Downlink Spectral Efficiency (SE) for varying channel conditions to plot between SE and SINR:

Description	Test Method and Configuration	Performance Value Range
Measure of UE DL throughput when the radio conditions of UE change gradually.	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clauses 4.8, 6.7 (Note 2)	

MVP-PERF-THR-5a: Uplink L1 throughput for varying channel conditions to plot between throughput and SINR,
MVP-PERF-THR-5b: Uplink Application throughput for varying channel conditions to plot between throughput and SINR,
MVP-PERF-THR-5c: Uplink Spectral Efficiency for varying channel conditions to plot between SE and SINR:

Description	Test Method and Configuration	Performance Value Range
Measure of UE UL throughput when the radio conditions of UE change gradually.	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clauses 4.8, 6.8 (Note 2)	

6.4   Latency Related Metrics

MVP-PERF-LAT-1: RRC Setup Time:

Description	Test Method and Configuration	Performance Value Range
Amount of time to setup a radio connection. Setup time is time difference between MSG3 and MSG5 under varying radio conditions from excellent to poor.	**NOTE:** There is no TIFG or 3GPP specification clause that directly specifies configuration and method for performing tests to evaluate this performance metric. However, test methods and procedures in clauses 6.4/6.7/8.3 could be leveraged to develop the procedure/configuration for this performance metric (Note 2).	<= 25ms (Note 1)

MVP-PERF-LAT-2: Ping Round Trip Time:

Description	Test Method and Configuration	Performance Value Range
Measure of E2E latency incurred within the Open RAN system.	**NOTE:** There is no TIFG or 3GPP specification clause that directly specifies configuration and method for performing tests to evaluate this performance metric and needs to be developed. The test configuration shall facilitate configuration of different size of ping messages of up to 1340 bytes (Note 2).	Lab: <= 23 ms Field: <= 60 ms <= 25 ms median (Note 1)

MVP-PERF-LAT-3: 5G SA registration time:

Description	Test Method and Configuration	Performance Value Range
Amount of time to successfully register the UE with the SA core. The Registration Time latency is measured by calculating the time between Registration Request to Registration Complete.	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clause 5.3 (Note 2)	

MVP-PERF-LAT-4: 5G SA deregistration time:

Description	Test Method and Configuration	Performance Value Range
Amount of time to successfully deregister the UE with the SA core. The De-registration Time latency is measured by calculating the time between De-registration Request to Signaling Connection Release.	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clause 5.3 (Note 2)	

6.5   Capacity Related Metrics

MVP-PERF-CAP-1a: Downlink aggregated cell L1 throughput,
MVP-PERF-CAP-1b: Cell based average DL L1 spectral efficiency:

NOTE: Vendor shall evaluate and report the SE results for different configurations including but not limited to channel bandwidths, layers, and MCS as standardized within 3GPP for North American spectrum bands.

Description	Test Method and Configuration	Performance Value Range
Measure of DL spectrum use in terms of throughput (bps) per spectrum bandwidth (Hz).	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clauses 4.8, 6.9 (Note 2)	

MVP-PERF-CAP-2a: Uplink aggregated cell L1 throughput,
MVP-PERF-CAP-2b: Cell based average UL L1 spectral efficiency:

NOTE: Vendor shall evaluate and report the SE results for different configurations including but not limited to channel bandwidths, layers, and MCS as standardized within 3GPP for North American spectrum bands.

Description	Test Method and Configuration	Performance Value Range
Measure of UL spectrum use in terms of throughput (bps) per spectrum bandwidth (Hz).	O-RAN.TIFG.E2E-Test.0-R003-v06.00, 4.8, Clause 6.10 (Note 2)	

MVP-PERF-CAP-3: Simultaneous RRC_CONNECTED UEs (max. # of RRC_CONNECTED UEs):

Description	Test Method and Configuration	Performance Value Range
Measure of the maximum number of UEs (each with minimal U-Plane traffic) that can be simultaneously maintained in RRC_CONNECTED state to benchmark C-plane capacity	O-RAN.TIFG.E2E-Test.0-R003-v06.00, 4.8, Clause 8.1 (Note 2)	

6.6 Mobility Related Metrics

NOTE: Intra-O-RU handovers in this Section refers to inter-frequency handovers within the same O-RU.

MVP-PERF-MOB-1: Handover Success Rate:

Description	Test Method and Configuration	Performance Value Range
Measure of sustaining an active connection as the user moves across coverage of different cells for the following scenarios: -- Intra-O-RU, Intra-O-DU, Intra-O-CU (Central Unit) handover -- Inter-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-RU, Inter-O-DU, Intra-O-CU handover -- Inter-RU, Inter-DU, Inter-CU Xn handovers -- Inter-RU, Inter-DU, Inter-CU N2 handovers	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clauses 5.4, 5.5, 5.6 (Note 2)	>99.99% (Note 1)

MVP-PERF-MOB-2: Handover Interruption Time:

Description	Test Method and Configuration	Performance Value Range
Measure of service interruption during a handover. It is time difference between the RRCReconfiguration message (to initiate Handover) received by the UE to RRC reconfiguration complete received at the target cell for the following scenarios: -- Intra-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-RU, Inter-O-DU, Intra-O-CU handover -- Inter-RU, Inter-DU, Inter-CU Xn handovers -- Inter-RU, Inter-DU, Inter-CU N2 handovers	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clauses 5.4, 5.5, 5.6 (Note 2)	<= 52 ms for FR1 − FR1 <= 72 ms for FR2 − FR1 <= 157 ms for FR2 − FR2 <= 177 ms for FR1 − FR2 For field As specified in TS 38.133, Clause 6.1

MVP-PERF-MOB-3: DL packet loss during handover:

Description	Test Method and Configuration	Performance Value Range
Measure of DL packet loss during a handover for the following scenarios: -- Intra-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-RU, Inter-O-DU, Intra-O-CU handover -- Inter-RU, Inter-DU, Inter-CU Xn handovers -- Inter-RU, Inter-DU, Inter-CU N2 handovers	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clauses 5.4, 5.5, 5.6 (Note 2)	

MVP-PERF-MOB-4: UL packet loss during handover:

Description	Test Method and Configuration	Performance Value Range
Measure of UL packet loss during a handover for the following scenarios: -- Intra-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-RU, Inter-O-DU, Intra-O-CU handover -- Inter-RU, Inter-DU, Inter-CU Xn handovers -- Inter-RU, Inter-DU, Inter-CU N2 handovers	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clauses 5.4, 5.5, 5.6 (Note 2)	

MVP-PERF-MOB-5: Call drop due to unsuccessful handover:

Description	Test Method and Configuration	Performance Value Range
Measure of session failure due to unsuccessful handover procedure for the following scenarios: -- Intra-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-RU, Inter-O-DU, Intra-O-CU handover -- Inter-RU, Inter-DU, Inter-CU Xn handovers -- Inter-RU, Inter-DU, Inter-CU N2 handovers	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clauses 5.4, 5.5, 5.6 (Note 2)	

MVP-PERF-MOB-6: Application DL Throughput before and after a successful handover:

Description	Test Method and Configuration	Performance Value Range
Measure of to ensure application level DL throughput before and after a successful handover for the following scenarios: -- Intra-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-RU, Inter-O-DU, Intra-O-CU handover -- Inter-RU, Inter-DU, Inter-CU Xn handovers -- Inter-RU, Inter-DU, Inter-CU N2 handovers	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clauses 5.4, 5.5, 5.6 (Note 2)	$\text{Throughput}_{after} \geq \text{Throughput}_{before}$

MVP-PERF-MOB-7: L1 DL Throughput before and after a successful handover:

Description	Test Method and Configuration	Performance Value Range
Measure of L1 DL throughput before and after a successful handover for the following scenarios: -- Intra-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-RU, Inter-O-DU, Intra-O-CU handover -- Inter-RU, Inter-DU, Inter-CU Xn handovers -- Inter-RU, Inter-DU, Inter-CU N2 handovers	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clauses 5.4, 5.5, 5.6 (Note 2)	$\text{Throughput}_{after} \geq \text{Throughput}_{before}$

MVP-PERF-MOB-8: L3 DL Throughput before and after a successful handover:

Description	Test Method and Configuration	Performance Value Range
Measure of L3 DL throughput before and after a successful handover or the following scenarios: -- Intra-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-RU, Inter-O-DU, Intra-O-CU handover -- Inter-RU, Inter-DU, Inter-CU Xn handovers -- Inter-RU, Inter-DU, Inter-CU N2 handovers	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clauses 5.4, 5.5, 5.6 (Note 2)	$\text{Throughput}_{after} \geq \text{Throughput}_{before}$

MVP-PERF-MOB-9: Application UL Throughput before and after a successful handover:

Description	Test Method and Configuration	Performance Value Range
Measure of application level UL throughput before and after a successful handover for the following scenarios: -- Intra-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-RU, Inter-O-DU, Intra-O-CU handover -- Inter-RU, Inter-DU, Inter-CU Xn handovers -- Inter-RU, Inter-DU, Inter-CU N2 handovers	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clauses 5.4, 5.5, 5.6 (Note 2)	$Throughput_{after} \geq Throughput_{before}$

MVP-PERF-MOB-10: L1 UL Throughput before and after a successful handover:

Description	Test Method and Configuration	Performance Value Range
Measure of L1 UL throughput before and after a successful handover for the following scenarios: -- Intra-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-RU, Inter-O-DU, Intra-O-CU handover -- Inter-RU, Inter-DU, Inter-CU Xn handovers -- Inter-RU, Inter-DU, Inter-CU N2 handovers	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clauses 5.4, 5.5, 5.6 (Note 2)	$Throughput_{after} \geq Throughput_{before}$

MVP-PERF-MOB-11: L3 UL Throughput before and after a successful handover:

Description	Test Method and Configuration	Performance Value Range
Measure of L3 UL throughput before and after a successful or the following scenarios: -- Intra-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-RU, Inter-O-DU, Intra-O-CU handover -- Inter-RU, Inter-DU, Inter-CU Xn handovers -- Inter-RU, Inter-DU, Inter-CU N2 handovers	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clauses 5.4, 5.5, 5.6 (Note 2)	$Throughput_{after} \geq Throughput_{before}$

6.7 Services Related Metrics

MVP-PERF-VNR-1: VoNR Call Setup Success Rate:

Description	Test Method and Configuration	Performance Value Range
Measure of successfully setting up voice calls and represents the percentage of Mobile Originating (MO) and Mobile Terminating (MT) call attempts that were successful	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clause 7.5.1-4 (Note 1)	> 99% (Note 1)

MVP-PERF-VNR-2: VoNR Call Setup Time:

Description	Test Method and Configuration	Performance Value Range
Amount of time to setup a MO VoNR call. VoNR call setup time is the difference between transmission of SIP invite by the UE to reception of the 180 ringing by the UE	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clause 7.5.1-4 (Note 2)	< 2.5 seconds (Note 1)

MVP-PERF-VNR-3: VoNR Handover Success Rate:

Description	Test Method and Configuration	Performance Value Range
Measure of sustaining voice media and signaling radio bearers as the user moves across coverage of different sites for the following scenarios: -- Intra-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-RU, Inter-O-DU, Intra-O-CU handover -- Inter-RU, Inter-DU, Inter-CU Xn based handovers -- Inter-RU, Inter-DU, Inter-CU N2 based handovers	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clauses 7.5.2, 7.5.3, 7.5.4 (Note 2)	$\geq$ 99.99% (Note 1)

MVP-PERF-VNR-4: VoNR Handover - Real-time Transport Protocol (RTP) Packet loss %:

Description	Test Method and Configuration	Performance Value Range
Measure of DL and UL RTP packets lost during a handover for the following scenarios: -- Intra-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-RU, Inter-O-DU, Intra-O-CU handover -- Inter-RU, Inter-DU, Inter-CU Xn handovers -- Inter-RU, Inter-DU, Inter-CU N2 handovers	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clauses 7.5.2, 7.5.3, 7.5.4 (Note 2)	

MVP-PERF-VNR-5: VoNR Handover - UE Packet delay:

Description	Test Method and Configuration	Performance Value Range
Measure of DL and UL delay experienced for voice media packets during a handover for the following scenarios: -- Intra-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-O-RU, Intra-O-DU, Intra-O-CU handover -- Inter-RU, Inter-O-DU, Intra-O-CU handover -- Inter-RU, Inter-DU, Inter-CU Xn handovers -- Inter-RU, Inter-DU, Inter-CU N2 handovers	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clauses 7.5.2, 7.5.3, 7.5.4 (Note 2)	

MVP-PERF-VNR-6: VoNR Mean Opinion Score:

Description	Test Method and Configuration	Performance Value Range
Measure of sustaining and maintain VoNR call quality for MT and MO calls.	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clause 7.51-4 (Note 2)	> 3.5 (Note 1)

MVP-PERF-VNR-7: VoNR Packet Loss Rate:

Description	Test Method and Configuration	Performance Value Range
Measure of ensuring minimal RTP packet drops for MT and MO calls.	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clause 7.5.1-4 (Note 2)	< 1% (Note 1)

MVP-PERF-VNR-8: VoNR muting Rate:

Description	Test Method and Configuration	Performance Value Range
Measure of minimizing the occurrence of a dropped VoNR packets that results in muting for MT and MO calls.	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clause 7.5.1-4 (Note 2)	< 1% (Note 1)

MVP-PERF-VNR-9: VoNR One way call:

Description	Test Method and Configuration	Performance Value Range
Measure of minimizing the occurrence of a way-one way call setup for MT and MO calls.	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clause 7.5.1-4 (Note 2)	< 1% (Note 1)

MVP-PERF-VNR-10: VoNR Call Block rate:

Description	Test Method and Configuration	Performance Value Range
Measure of minimizing the occurrence of a VoNR call setup failure for MT and MO calls.	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clause 7.5.1-4 (Note w)	< 0.01%

MVP-PERF-WEB-1: Domain Name System (DNS) Resolution Time:

Description	Test Method and Configuration	Performance Value Range
Time measured from when the client sends a DNS query to when the DNS responds with an IP address in milliseconds/seconds. This KPI should be recorded if DNS is used.	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clause 7.1.1 (Note 2)	< 1 seconds (Note 1)

MVP-PERF-WEB-2: Time to First Byte (TTFB):

Description	Test Method and Configuration	Performance Value Range
Time measured from when the client makes the HTTP request to when the first byte of the page (page size: 2MB) is received in milliseconds/seconds.	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clause 7.1.1 (Note 2)	< 3 seconds (Note 1)

MVP-PERF-WEB-3: Page Load Time:

Description	Test Method and Configuration	Performance Value Range
Time measured from when the client places the request to when the page (page size: 2 MB) is completely loaded in seconds.	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clause 7.1.1 (Note 2)	<12 seconds (Note 1)

MVP-PERF-WEB-4: Application DL throughput (Mbps):

Description	Test Method and Configuration	Performance Value Range
This is the average application layer throughput to download the page (page size: 2 MB) in kbps.	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clause 7.1.1 (Note 2)	Same as for DL throughput performance metric for comparable radio condition in MVP-PERF-THR-3a (Note 1).

MVP-PERF-FILDL-1: Time taken to Download File:

Description	Test Method and Configuration	Performance Value Range
This is the time required to upload the file (file size: 1 GB) in seconds.	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clause 7.1.2 (Note 2)	

MVP-PERF-FILDL-2: Application DL throughput (Mbps):

Description	Test Method and Configuration	Performance Value Range
This is the average application layer throughput to download the file (file size: 1 GB) in kbps.	O-RAN.TIFG.E2E-Test.0 R003-v06.00, Clause 7.1.2 (Note 2)	Same as for DL throughput performance metric for comparable radio condition in MVP-PERF-THR-3a (Note 1).

MVP-PERF-FILUL-1: Time taken to Upload File:

Description	Test Method and Configuration	Performance Value Range
This is the time required to upload the file (file size: 1 GB) in seconds.	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clause 7.1.2 (Note 2)	

MVP-PERF-FILUL-2: Application UL throughput (Mbps):

Description	Test Method and Configuration	Performance Value Range
This is the average application layer throughput to upload the file (file size: 1 GB) in kbps.	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clause 7.1.2 (Note 2)	Same as for UL throughput performance metric for comparable radio condition MVP-PERF-THR-3a (Note 1).

6.8   Availability and load/stress testing related metrics

MVP-PERF-LOAD-1: Long hours stability Testing (successfully tested hours):

Description	Test Method and Configuration	Performance Value Range
Measure of the ability to continuously operate for a minimum of 24 hours.	O-RAN.TIFG.E2E-Test.0-R003-v06.00 **NOTE:** The traffic model example specified in 8.4 of the TIFG specification can be utilized, Clauses 8.4, 8.5 (Note 2).	

MVP-PERF-LOAD-2: RRC Access Success Rate:

NOTE: Unlike metric # which is for a single UE, this metric is for an emulated load comprising of a large number of UEs sending and receiving user data.

Description	Test Method and Configuration	Performance Value Range
Measure of successfully setting up radio resource connection and represents the percentage # of radio connection attempts that were successful across all UEs.	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clause 8.3 (Note 2)	

MVP-PERF-LOAD-3: Packet Error Rate:

NOTE: Unlike metric # which is for a single UE, this metric is for an emulated load comprising of a large number of UEs sending and receiving user data.

Description	Test Method and Configuration	Performance Value Range
Measure of the rate of PDUs processed by the RLC layer but are not successfully delivered to the Packet Data Convergence Protocol (PDCP) layer [3GPP TS 23.501]. Average DL and UL packet error rates are to be measured and reported.	O-RAN.TIFG.E2E-Test.0-R003-v06.00, Clause 8.3 (Note 2)	

6.9   Radiofrequency (RF) Performance

MVP-PERF-RF-1: RF Transmitter:

Description	Test Method and Configuration	Performance Value Range
Measure of transmitter performance for Conducted and Over the Air (OTA) RF setups related to each of the following: signal quality, transmitter ON/OFF, dynamic range, Adjacent Channel Leakage Ratio (ACLR), operating band unwanted emissions, spurious emissions and intermodulation metrics specified in [3GPP-3].	38.141-1 38.141-2 (Note 2)	As specified in [3GPP-3] (Note 1)

MVP-PERF-RF-2: RF Receiver:

Description	Test Method and Configuration	Performance Value Range
Measure of receiver performance for Conducted and OTA RF setups related to each of the following: receiver sensitivity, dynamic range, adjacent channel selectivity, in-band and out of band blocking, receiver spurious emissions, receiver intermodulation metrics specified in [3GPP-3].	38.141-1 38.141-2 (Note 2)	As specified in [3GPP-3] (Note 1)

MVP-PERF-RF-3: RF Demodulation:

Description	Test Method and Configuration	Performance Value Range
Measure of demodulation performance for Conducted and OTA RF setups related to each of the following: Physical Uplink Shared Channel (PUSCH), PUCCH, PRACH specified in [3GPP-3].	38.141-1 38.141-2 (Note 2)	As specified in [3GPP-3] (Note 1)

7 O-CLOUD REQUIREMENTS

This Section describes the O-Cloud requirements based primarily upon a subset of O-RAN WG6: Cloudification & Orchestration Workgroup technical specifications. The requirements cover general O-Cloud infrastructure, hardware accelerator management, precision time protocol, and the O-Cloud O2 interface to the SMO as depicted in Figure 2.

NOTE: This section may include O-RAN O2 interface requirements that have not yet fully attained stage 3 specifications.

MVP-OCLOUD-O2-1: For O-Clouds that support the O2DMS Kubernetes profile, Kubernetes shall provide workload lifecycle management services as specified in [O-RAN-9].

MVP-OCLOUD-O2-2: For O-Clouds that support the O2dms European Telecommunications Standards Institute (ETSI) Network Functions Virtualization (NFV) profile for Virtual Machine (VM)-based deployments, ETSI NFV shall provide lifecycle management services as specified in [O-RAN-10].

MVP-OCLOUD-O2-3: All O-Cloud implementations shall support the O2 services, and their requirements allocated to the role of the O-Cloud as specified in [O-RAN-12].

MVP-OCLOUD-O2-4: O-Cloud telemetry shall minimally consist of Fault, Performance, and Configuration Data as specified in [O-RAN-12].

MVP-OCLOUD-O2-5: O-Cloud shall provide the collection of fault information for O-Cloud resources as specified in [O-RAN-12].

MVP-OCLOUD-O2-6: O-Cloud shall provide the enforcement of placement rules when associated with a workload as specified in [O-RAN-12].

MVP-OCLOUD-O2-7: O-Cloud shall provide an O2 interface to facilitate (Fault, Configuration, Accounting, Performance, and Security) FCAPS for its infrastructure as specified in [O-RAN-12].

MVP-OCLOUD-O2-8: O-Cloud shall provide an O2 interface to facilitate FCAPS for workloads that utilize its infrastructure as specified in [O-RAN-12].

MVP-OCLOUD-O2-9: O-Cloud shall provide an O2 interface to provide Life Cycle Management (LCM) of its infrastructure as specified in [O-RAN-12].

MVP-OCLOUD-O2-10: O-Cloud shall provide an O2 interface to provide LCM for workloads that utilize its infrastructure as specified in [O-RAN-12].

MVP-OCLOUD-O2-11: O-Cloud platform shall support discovering server hardware node features as specified in [O-RAN-12].

MVP-OCLOUD-O2-12: O-Cloud platform shall integrate with physical hardware Board Management Controller (BMC) and provide all FCAPS data for that hardware via O2 interface as specified in [O-RAN-12].

MVP-OCLOUD-O2-13 O-Cloud platform shall support continuous logging as specified in [O-RAN-12].

MVP-OCLOUD-GEN-1: O-Cloud shall have the ability to time-correlate its log entries as specified in [O-RAN-12].

MVP-OCLOUD-GEN-2: O-Cloud platform shall support Kubernetes worker node and controller node all-in-one node implementation topology for RAN site applications (e.g., CU/DU application). As specified in [O-RAN-15].

MVP-OCLOUD-GEN-3: O-Cloud platform shall support Kubernetes worker nodes and controller nodes as separate implementations at different servers or/and at different physical locations. i.e., K8s worker nodes and K8s controller nodes are deployed at separate servers. As specified in [O-RAN-15].

MVP-OCLOUD-GEN-4: O-Cloud platform shall support the Multi Networking feature in Kubernetes using Custom Resource Definitions (CRD)-based network objects in Kubernetes as specified in [O-RAN-15].

MVP-OCLOUD-GEN-5: O-Cloud platform shall support Single Root IO Virtualization (SR-IOV) and provides a low-latency interface for both packet I/O and acceleration interfaces as specified in [O-RAN-15], Clause 4.1.4.

MVP-OCLOUD-GEN-6: O-Cloud platform shall support PCI pass-through in case only one container needs to use the networking interface to provide high performance and low latency without using a virtual switch as specified in [O-RAN-15].

MVP-OCLOUD-GEN-7: O-Cloud platform shall support basic core affinity for Cloud-Native Network Functions (CNFs). It is required to pin real- time threads to specific Central Processing Unit (CPU) cores in order to improve performance and meet real-time latency as specified in [O-RAN-15].

MVP-OCLOUD-GEN-8: O-Cloud platform shall support the implementation of userspace networking for K8S containers, e.g., Data Plane Development Kit (DPDK) as specified in [O-RAN-15].

MVP-OCLOUD-GEN-9: O-Cloud platform shall support Shared Storage solution with High Availability to provide resiliency and support automatic failover of the workload with multi-node deployment as specified in [O-RAN-15], clause 3.2.1.

MVP-OCLOUD-GEN-10 O-Cloud platform shall support isolation and guarantee workload performance requirements in the use case where multiple workloads share the same physical host as specified in [O-RAN-15], clause 5.2.4.

MVP-OCLOUD-PTP1: O-Cloud shall support the O-Cloud Notification Application Programming Interface (API) event producer requirements to enable cloud workloads to receive PTP events/status as specified in [O-RAN-11].

MVP-OCLOUD-PTP2: O-Cloud platform shall support Precision Time Protocol (PTP) with IEEE1588v2 in compliance with G.8275.1 to provide synchronization for Open Fronthaul as specified in [O-RAN-15].

MVP-OCLOUD-PTP3: O-Cloud platform shall support all ORAN defined S-plane configurations (LLS-C1, LLS-C2, LLS-C3,) as specified in [O-RAN-15], Clause 4.2.

MVP-OCLOUD-AAL-1: O-Cloud platform shall support configuration, lifecycle management of firmware, and interfacing with hardware accelerators providing offload functions (e.g., Field Programmable Gate Arrays (FPGAs), Graphics Processing Unit (GPU), eASIC) as specified in [O-RAN-13].

8   MANAGEMENT REQUIREMENTS

This Section describes the management requirements for O-RAN system primarily focusing on SMO. The requirements cover general SMO functionalities needed to manage O-RAN Network Functions, O-Cloud, and rApps as depicted in Figure 2.

NOTE: This Section may include interface requirements that have not yet fully attained stage 3 specifications.

MVP-MGMT-O1-1: SMO shall support the O1 services and their requirements allocated to the role of the SMO as specified in [O-RAN-17] [O-RAN-18].

MVP-MGMT-O2-1: SMO shall support the O2 services and their requirements allocated to the role of the SMO as specified in [O-RAN-12].

MVP-MGMT-O2-2: SMO shall be able to correlate Managed Element telemetry to Infrastructure telemetry to aggregate faults and alarms to a root cause as specified in [O-RAN-12].

MVP-MGMT-O2-3: SMO shall be able to correlate a Managed Element to its deployment telemetry to aggregate faults and alarm to a root cause as specified in [O-RAN-12].

MVP-MGMT-O2-4: SMO shall be able to correlate a Managed Element to its deployment components as specified in [O-RAN-12].

MVP-MGMT-OFMP-1: SMO shall support Open Fronthaul M-Plane services and their requirements allocated to the role of the SMO as specified in [O-RAN-17].

MVP-MGMT-NonRTRIC-1: SMO shall support the Non-RT RIC framework as specified in [O-RAN-18].

MVP-MGMT-NonRTRIC-2: SMO shall support Non-RT RIC rApp Management service as specified in [O-RAN-22].

MVP-MGMT-NonRTRIC-3: SMO shall support Non-RT RIC R1 service as specified in [O-RAN-22].

MVP-MGMT-CoreSvcs-1: SMO shall support Data Management and Exposure (DME) Service to both expose and discover data elements made available as specified in [O-RAN-18].

MVP-MGMT-CoreSvcs-2: SMO shall support Service Management and Exposure (SME) Service to both expose and discover services available within SMO and Non-RT RIC as specified in [O-RAN-18].

MVP-MGMT-CoreSvcs-3: SMO shall support Inventory of the O-Cloud as specified in [O-RAN-12].

MVP-MGMT-CoreSvcs-4: SMO shall support inventory of the RAN Network Functions (NFs) as specified in [O-RAN-12].

MVP-MGMT-CoreSvcs-5: SMO shall support inventory of the transport used for the mid-haul as specified in [O-RAN-12].

MVP-MGMT-CoreSvcs-6: SMO shall support topology of the RAN NFs as specified in [O-RAN-12].

MVP-MGMT-CoreSvcs-7: SMO shall support topology of the O-Cloud as specified in [O-RAN-12].

MVP-MGMT-CoreSvcs-8: SMO shall support orchestration of the NF deployments as specified in [O-RAN-12].

MVP-MGMT-CoreSvcs-9: SMO shall support on-boarding of the NFs and rApps as specified in [O-RAN-12].

MVP-MGMT-LCM-1: SMO shall provide the full LCM of multiple Kubernetes clusters, and O-Cloud nodes deployed on multiple geographically distributed sites as specified in [O-RAN-15] [O-RAN-19].

9   SECURITY REQUIREMENTS

This Section describes security requirements primarily based upon the O-RAN Security Requirements and Controls Specification [O-RAN-8] and 3GPP TS 33.501 [3GPP-4]. The security specifications from the O-RAN Alliance are guided by NIST SP 800-207, Zero Trust Architecture [OTH-1] to protect against external and internal threats. The specified security controls provide confidentiality, integrity, availability, authentication and authorization protections to mitigate risks from internal and external threats.

The remainder of this section provides the specified security controls for the O-RAN assets considered in-scope for the MVP, as specified in section 4. Security controls are also provided to follow industry best security practices as specified by the O-RAN Alliance in [O-RAN-8].

NOTE: The location of security servers (e.g., Key Management server, Open Authentication (OAuth) server, Public Key Infrastructure (PKI) server, etc.) is operator implementation dependent.

NOTE: Developers are recommended to put security at the core of the Software Development Life Cycle (SDLC) by utilizing best practices such as NIST DevSecOps [OTH-3], NIST SSDF [OTH-4], BSA Framework for Secure Software [OTH-5], or SAFECode [OTH-6]. See [OTH-2], Recommendation-SWDev-Indus-1, and Secure by Design [OTH-7].

9.1   SMO Security Requirements

MVP-SEC-SMO-01: SMO shall support confidentiality and integrity protection for the O1 interface using Transport Layer Security (TLS) 1.2 and 1.3 as specified in [O-RAN-8], clauses 5.1.1 and 5.2.2.

MVP-SEC-SMO-02: SMO shall support authentication for the O1 interface using Mutual Transport Layer Security (mTLS) 1.2 and 1.3 and PKI-based X.509 certificates as specified in [O-RAN-8], clauses 5.1.1 and 5.2.2.

MVP-SEC-SMO-03: SMO shall support confidentiality and integrity protection for the O2 interface using TLS 1.2 and 1.3 as specified in [O-RAN-8], clauses 5.1.1 and 5.2.3.

MVP-SEC-SMO-04: SMO shall support authentication for the O2 interface using mTLS 1.2 and 1.3 and PKI-based X.509 certificates as specified in [O-RAN-8], clauses 5.1.1 and 5.2.3.

MVP-SEC-SMO-05: SMO shall support confidentiality and integrity protection for SMO internal communication using TLS 1.2 and 1.3 as specified in [O-RAN-8], clause 5.1.1.

MVP-SEC-SMO-06: SMO shall support authentication for SMO internal communication using mTLS 1.2 and 1.3 and PKI-based X.509 certificates as specified in [O-RAN-8], clause 5.1.1.

MVP-SEC-SMO-07: SMO shall support authorization using OAuth 2.0 as specified in [O-RAN-8], clause 5.1.1.

MVP-SEC-SMO-08: SMO shall support confidentiality and integrity protection using TLS 1.2 and 1.3 for the Open Fronthaul M-Plane interface as specified in [O-RAN-8], clauses 5.1.6 and 5.2.5.

MVP-SEC-SMO-09: SMO shall support authentication using mTLS 1.2 and 1.3 for the Open Fronthaul M-Plane interface as specified in [O-RAN-8], clauses 5.1.6 and 5.2.5.

MVP-SEC-SMO-10: SMO shall support authorization using Network Access Control Model (NACM) for the Open Fronthaul M-Plane interface as specified in [O-RAN-8], clause 5.2.5.4.

MVP-SEC-SMO-11: Non-RT RIC shall support confidentiality and integrity protection for SMO internal communication using TLS 1.2 and 1.3 as specified in [O-RAN-8], clause 5.1.1.2.2.

MVP-SEC-SMO-12: Non-RT RIC shall support authentication for SMO internal communication using mTLS 1.2 and 1.3 and PKI-based X.509 certificates as specified in [O-RAN-8], clause 5.1.1.2.2.

MVP-SEC-SMO-13: Non-RT RIC shall support authorization using OAuth 2.0 as specified in [O-RAN-8], clauses 5.1.2.

MVP-SEC-SMO-14: rApps shall support confidentiality and integrity protection using TLS 1.2 and 1.3 for the R1 interface as specified in [O-RAN-8], clauses 5.1.1.2.2 and 5.2.6.

MVP-SEC-SMO-15: rApps shall support authentication using mTLS 1.2 and 1.3 and PKI-based X.509 certificates for the R1 interface as specified in [O-RAN-8], clauses 5.1.1.2.2 and 5.2.6.

MVP-SEC-SMO-16: rApps shall support authorization using OAuth 2.0 as specified in [O-RAN-8], clause 5.1.2.

9.2   O-CU Security Requirements

MVP-SEC-O-CU-01a: O-CU-CP shall support confidentiality, integrity, and replay protection using Internet Protocol Security (IPsec) for the F1-C interface as specified in [O-RAN-8], clause 5.1.4.

MVP-SEC-O-CU-01b: O-CU-CP shall support confidentiality, integrity, and replay protection using Datagram Transport Layer Security (DTLS) for the F1-C interface as specified in [O-RAN-8], clause 5.1.4.

MVP-SEC-O-CU-02: O-CU-UP shall support confidentiality, integrity, and replay protection using IPsec for the F1-U interface as specified in [O-RAN-8], clause 5.1.4.

MVP-SEC-O-CU-03: O-CU-CP shall support mutual authentication and authorization for Operations, Administration, and Management (OAM) as specified in [3GPP-4], clause 5.3.4.

MVP-SEC-O-CU-04: O-CU-UP shall support mutual authentication and authorization for OAM as specified in [3GPP-4], clause 5.3.4.

MVP-SEC-O-CU-05: O-CU-CP shall support confidentiality and integrity protection for the O1 interface using TLS 1.2 and 1.3 as specified in [O-RAN-8], clause 5.2.2.

MVP-SEC-O-CU-06: O-CU-CP shall support authentication for the O1 interface using mTLS 1.2 and 1.3 and PKI-based X.509 certificates as specified in [O-RAN-8], clause 5.2.2.

MVP-SEC-O-CU-07: O-CU-UP shall support confidentiality and integrity protection for the O1 interface using TLS 1.2 and 1.3 as specified in [O-RAN-8], clause 5.2.2.

MVP-SEC-O-CU-08: O-CU-UP shall support authentication for the O1 interface using mTLS 1.2 and 1.3 and PKI-based X.509 certificates as specified in [O-RAN-8], clause 5.2.2.

MVP-SEC-O-CU-09a: O-CU-CP shall support confidentiality, integrity, and replay protection using IPsec for the E1 interface as specified in [O-RAN-8], clause 5.1.4.

MVP-SEC-O-CU-09b: O-CU-CP shall support confidentiality and integrity protection using DTLS for the E1 interface as specified in [O-RAN-8], clause 5.1.4.

MVP-SEC-O-CU-10a: O-CU-CP shall support confidentiality and integrity protection using IPsec for the Xn-C interface as specified in [O-RAN-8], clause 5.1.4.

MVP-SEC-O-CU-10b: O-CU-CP shall support confidentiality, integrity, and replay protection using DTLS for the Xn-C interface as specified in [O-RAN-8], clause 5.1.4.

MVP-SEC-O-CU-11: O-CU-UP shall support confidentiality, integrity, and replay protection using IPsec for the Xn-U interface as specified in [O-RAN-8], clause 5.1.4.

MVP-SEC-O-CU-12: O-CU-CP shall support RRC confidentiality, integrity and replay protection with the PDCP protocol as specified in [O-RAN-8], clause 5.1.4.

MVP-SEC-O-CU-13: O-CU-UP shall support user plane data confidentiality protection with the PDCP protocol as specified in [O-RAN-8], clause 5.1.4.

MVP-SEC-O-CU-14: O-CU-CP shall follow the security requirements in [3GPP-4], clauses 5.3.5 and 5.3.7.

MVP-SEC-O-CU-15: O-CU-UP shall follow the security requirements in [3GPP-4], clauses 5.3.5 and 5.3.6.

9.3   O-DU Security Requirements

MVP-SEC-O-DU-01a: O-DU shall support confidentiality and integrity protection using IPsec for the F1-C interface as specified in [O-RAN-8], clause 5.1.5.

MVP-SEC-O-DU-01b: O-DU shall support confidentiality and integrity protection using DTLS for the F1-C interface as specified in [O-RAN-8], clause 5.1.5.

MVP-SEC-O-DU-02: O-DU shall support confidentiality and integrity protection using IPsec for the F1-U interface as specified in [O-RAN-8], clause 5.1.5.

MVP-SEC-O-DU-03a: O-DU shall support confidentiality and integrity protection using TLS 1.2 and 1.3 for the Open Fronthaul M-Plane interface as specified in [O-RAN-3] clause 5.4 and [O-RAN-8], clauses 5.1.5 and 5.2.5.4.

MVP-SEC-O-DU-03b: O-DU shall support confidentiality and integrity protection using Secure Shell Protocol (SSH) v2.0 for the Open Fronthaul M-Plane interface as specified in [O-RAN-3], clause 5.4 and [O-RAN-8], clauses 5.1.5 and 5.2.5.4.

MVP-SEC-O-DU-04: O-DU shall support authentication using mTLS 1.2 and 1.3 for the Open Fronthaul M-Plane interface as specified in [O-RAN-8], clauses 5.1.5 and 5.2.5.4.

MVP-SEC-O-DU-05: O-DU shall support authorization using NACM for the Open Fronthaul M-Plane interface as specified in [O-RAN-8], clauses 5.1.5 and 5.2.5.4.

MVP-SEC-O-DU-06: O-DU shall support port-based access control with authentication and authorization using IEEE 802.1X for the Open Fronthaul point-to-point Local Area Network (LAN) segments as specified in [O-RAN-8], clauses 5.1.5, 5.2.5.4, and 5.2.5.5.

MVP-SEC-O-DU-07: O-DU shall support mutual authentication and authorization for OAM as specified in [3GPP-4], clause 5.3.4.

MVP-SEC-O-DU-08: O-DU shall support confidentiality and integrity protection for the O1 interface using TLS 1.2 and 1.3 as specified in [O-RAN-8], clause 5.2.2.

MVP-SEC-O-DU-09: O-DU shall support authentication for the O1 interface using mTLS 1.2 and 1.3 and PKI-based X.509 certificates as specified in [O-RAN-8], clause 5.2.2.

9.4   O-RU Security Requirements

MVP-SEC-O-RU-01a: O-RU shall support confidentiality and integrity protection using TLS 1.2 and 1.3 for the Open Fronthaul M-Plane interface as specified in [O-RAN-3] clause 5.4 and [O-RAN-8], clauses 5.1.6 and 5.2.5.4.

MVP-SEC-O-RU-01b: O-RU shall support confidentiality and integrity protection using SSH v2.0 for the Open Fronthaul M-Plane interface as specified in [O-RAN-3] clause 5.4 and [O-RAN-8], clauses 5.1.6 and 5.2.5.4.

MVP-SEC-O-RU-02: O-RU shall support authentication using mTLS 1.2 and 1.3 for the Open Fronthaul M-Plane interface as specified in [O-RAN-8], clauses 5.1.6 and 5.2.5.4.

MVP-SEC-O-RU-03: O-RU shall support authorization using NACM for the Open Fronthaul M-Plane interface as specified in [O-RAN-8], clauses 5.1.6, and 5.2.5.4.

MVP-SEC-O-RU-04: O-RU shall support port-based access control with authentication and authorization using IEEE 802.1X for the Open Fronthaul point-to-point LAN segments as specified in [O-RAN-8], clauses 5.1.6, 5.2.5.4, and 5.2.5.5.

MVP-SEC-O-RU-05: O-RU shall support mutual authentication and authorization for OAM as specified in [3GPP-4], clause 5.3.4.

9.5   O-Cloud Security Requirements

MVP-SEC-O-Cloud-01: O-Cloud Platform shall provide a hardware root of trust from which to build a chain of trust as specified in [O-RAN-8], clause 5.1.8.7.2.

MVP-SEC-O-Cloud-02: O-Cloud Platform shall verify the digital signatures of O-Cloud Platform software prior to installation of the software as specified in [O-RAN-8], clause 5.1.8.3.2.

MVP-SEC-O-Cloud-03: O-Cloud Platform shall support access management to O-Cloud resources based on Role-Based Access Control (RBAC) as specified in [O-RAN-3], clause 5.1.8.1.2.

MVP-SEC-O-Cloud-04: O-Cloud Platform shall support Multi-Factor Authentication (MFA) as specified in [O-RAN-8], clause 5.1.8.1.2.

MVP-SEC-O-Cloud-05: O-Cloud Platform software shall support confidentiality and integrity protection for the O2 interface using TLS 1.2 and 1.3 as specified in [O-RAN-8], clauses 5.1.1 and 5.2.3.

MVP-SEC-O-Cloud-06: O-Cloud Platform software shall support authentication for the O2 interface using mTLS 1.2 and 1.3 and PKI-based X.509 certificates as specified in [O-RAN-8], clauses 5.1.1 and 5.2.3.

MVP-SEC-O-Cloud-07: O-Cloud shall support encryption of all sensitive data at rest as specified in [O-RAN-8], clause 5.1.8.6.2.

NOTE: O-Cloud Platform software vendors are recommended to support Kubernetes hardening, including secure runtime, updates, and configuration as described in [OTH-8].

NOTE: O-Cloud Platform vendors are recommended to harden host operating systems, including restricted access to system calls and file systems, strong isolation between OS processes, and minimal privileges on the host by default.

9.6   Additional Security Requirements

MVP-SEC-ADD-01: Open RAN CNFs shall support Application Lifecycle Management as specified in [O-RAN-8], clause 5.3.2.

MVP-SEC-ADD-02: Open RAN architectural elements shall have unused protocols disabled as specified in [O-RAN-8], clause 5.3.3.

MVP-SEC-ADD-03: Open RAN architectural elements shall be able to withstand and recover from a volumetric Distributed Denial of Service (DDoS) attack, on any interface, without system crash as specified in [O-RAN-8], clause 5.3.5.

MVP-SEC-ADD-04: Open RAN architectural elements shall support password hygiene as specified in [O-RAN-8], clause 5.3.7.

MVP-SEC-ADD-05: Open RAN architectural elements shall support PKI with X.509 certificates as specified in [O-RAN-8], clause 5.3.9.

MVP-SEC-ADD-06: Open RAN architectural elements shall support Certificate Management Protocol (CMP) v2 as specified in [O-RAN-8], clause 5.3.9.

MVP-SEC-ADD-07: Open RAN architectural elements shall provide API security as specified in [O-RAN-8], clause 5.3.10.

MVP-SEC-ADD-08: Open RAN architectural elements shall be able to handle unexpected inputs to transport protocols as specified in [O-RAN-8], Clause 5.3.4.

MVP-SEC-ADD-09: Open RAN architectural elements shall provide security event logs as specified in [O-RAN-8], clause 5.3.8 and 5.3.11.

MVP-SEC-ADD-10: Vendors of Open RAN architectural elements shall provide a list of known vulnerabilities in the delivered software as specified in [O-RAN-8], clause 5.3.6.

MVP-SEC-ADD-11: Vendors of Open RAN architectural elements shall provide a Software Bill of Material (SBOM) for the delivered software as specified in [O-RAN-8], clause 6.3.

MVP-SEC-ADD-12: OAM sessions shall be protected as specified in [O-RAN-8], clause 4.2.3.5.

This section captures requirements and IOT profiles for in-scope interfaces specified in section 4.2.

10.1 Open FH M-Plane Interface Requirements

This sub-section captures Open FH M-Plane interface (referred to as M-Plane in this sub-section) requirements as depicted in Figure 2. The requirements being defined impact the O-RU, the O-DU and the SMO respectively based on the chosen deployment model. The M-Plane interface requirements are broadly classified into 3 categories, first category comprises IoT profiles defined for M-Plane in the O-RAN Alliance WG4 IOT specifications [O-RAN-23], second category comprises new configuration entries which can be added to existing profiles and third set of requirements comprise of new requirements which do not map to any existing WG4 M-Plane IOT profile.

10.1   Interface Requirements Specified as Part of IOT Profiles

The M-Plane IOT profiles specified in [O-RAN-23] are test profiles for M-Plane interface IOT testing. Each profile includes a set of configuration parameters designed to meet the critical requirements for testing the M-Plane interface. These profiles are expected to be used by North American mobile operators in their Open RAN deployments

MVP-M-Plane IOT Profile Req-1: The M-Plane interface between the O-DU and the O-RU when deployed using the hierarchical management model, shall support the interface requirements and associated configurations specified as part of the Hierarchical-sudo IOT profile in [O-RAN-23], Annex A, Table A.1.1-1.

MVP-M-Plane IOT Profile Req-2: The M-Plane interface between the SMO and the O-RU, and the interface between O-DU and the O-RU when deployed using the hybrid management model, shall support the interface requirements and associated configurations specified as part of the Hybrid-sudo+nms IOT profile in [O-RAN-23], Annex A, Table A.1.2-1.

MVP-M-Plane IOT Profile Req-3: The M-Plane interface between the O-DU and the O-RU when deployed using the hierarchical management model, shall support the interface requirements and associated configurations specified as part of the Hierarchical-sudo-IPv6 IOT in [O-RAN-23], Annex A, Table A.1.3-1.

MVP-M-Plane IOT Profile Req-4: The M-Plane interface between the SMO and the O-RU, and the interface between O-DU and the O-RU when deployed using the hybrid management model, shall support the interface requirements and associated configurations specified as part of the Hybrid-sudo+nms-IPv6 IOT profile in [O-RAN-23], Annex A, Table A.1.4-1.

10.1.2   New Configuration Entries in the Selected IOT Profiles

The M-Plane interface requirements which are not fulfilled by referring to configuration parameters in existing IOT profiles referred to in Clause 10.1.1 and comprise of new configuration entries in existing M-Plane IOT profiles referred to in Clause 10.1.1 are captured in the below Table. The table below establishes a mapping between ATIS MVP M-Plane functional requirements, the M-Plane IOT profiles those requirements impact and the associated configuration entry proposed to be added to M-Plane IOT specification.

Table 10.1.2.-1: Mapping M-Plane Requirements, IOT Profile, and New Configuration Entry

Requirement Reference	Impacted M-Plane IoT Profile	Configuration Parameter
MVP-SEC-O-DU-03a (refer clause 9.3) MVP-SEC-O-DU-04 (refer clause 9.3) MVP-SEC-O-DU-09 (refer clause 9.3) MVP-SEC-O-RU-01a (refer clause 9.4) MVP-SEC-O-RU-02 (refer clause 9.4)	MVP-M-Plane IOT Profile Req-1	Add new configuration Entry TLS 1.3 for "Hash algorithm for data integrity" and Introduce configuration entries for "Cyphering algorithm". The required configuration entries shall be support for TLS 1.2 and TLS 1.3 in addition to "AES128-CTR
	MVP-M-Plane IOT Profile Req-2	Introduce configuration entries for "Hash algorithm for data integrity". The required configuration entries shall be support for TLS 1.2 and TLS 1.3 in addition to "HMAC-SHA2-256" Introduce configuration entries for "Cyphering algorithm". The required configuration entries shall be support for TLS 1.2 and TLS 1.3 in addition to "AES128-CTR"
	MVP-M-Plane IOT Profile Req-3	Add new configuration Entry TLS 1.3 for "Hash algorithm for data integrity" and "Cyphering algorithm" along with SSHv2 and TLS 1.2.
	MVP-M-Plane IOT Profile Req-4	Add new configuration Entry TLS 1.3 for "Hash algorithm for data integrity" and "Cyphering algorithm" along with SSHv2 and TLS 1.2.

10.1.3　Interface Requirements Not Covered by the Selected IOT Profiles

This sub-section lists a set of additional Open FH M-Plane requirements beyond those captured in sub-sections 10.1.1and 10.1.2.

MVP-MPlane-Intf-1: Configurable priority levels (via the M-Plane) for traffic prioritization of flows shall be supported on each node.

MVP-MPlane-Intf-2: The M-Plane interface shall support alarms specified in [O-RAN-3] Table A.1-1: Common O-RU Alarms based on the below table:

Table 10.1.3-1: List of FH M-Plane Alarms with Support Requirement

Fault ID	Name	Support Required
1	Unit temperature is high	Yes
2	Unit dangerously overheating	Yes
3	Ambient temperature violation	Yes
4	Temperature too low	Yes
5	Cooling fan broken	Shall be supported if the O-RU uses fan-based cooling system
6	No fan detected	Shall be supported if the O-RU uses fan-based cooling system
7	Tuning failure	Shall be supported if the O-RU supports filter tuning fault identification
8	Filter unit faulty	Shall be supported if the O-RU supports filter fault identification
9	Transmission quality deteriorated	Yes

10	RF Module overvoltage protection faulty	Yes
11	Configuring failed	Yes
12	Critical file not found	Yes
13	File not found	Yes
14	Configuration file corrupted	Yes
15	Unit out of order	Yes
16	Unit unidentified	Yes
17	No external sync source	Yes
18	Synchronization Error	Yes
19	TX out of order	Yes
20	RX out of order	Yes
21	Increased BER detected on the optical connection	Yes
22	Post test failed	Yes
23	FPGA SW update failed	Shall be supported If the O-RU is FPGA based
24	Unit blocked	Yes
25	Reset Requested	Yes
26	Power Supply Faulty	Yes
27	Power Amplifier faulty	Yes
28	C/U-plane logical Connection faulty	Yes
29	Transceiver Fault	Yes
30	Interface Fault	Yes
31	Unexpected C/U-plane message content fault	Yes
33	Dying Gasp	Yes
34	Clock source fail	Yes
36	Rx Signal quality deteriorated	Yes
37	High IQ Power	Yes
38	Voltage Standing Wave Ratio (VSWR) high	Shall be supported if O-RU supports VSWR reporting feature
39	Certificate About to Expire	Yes
40	Certificate Expired	Yes

MVP-MPlane-Intf-3a: The O-RU shall support all mandatory and optional counters as specified in the M-Plane specification for the supported features.

MVP-MPlane-Intf-3b: The M-Plane interface shall support exchange of performance counters specified in CUS-Plane specification [O-RAN-2] Table 9.1-1. The Optional counters specified in Table 9.1-1 shall be supported based on the below table:

Counter Name	Support Required
RX_SEQID_ERR	O-RU shall support this counter if O-RU supports parsing ecpriSeqId
RX_SEQID_ERR_C	O-RU shall support this counter if O-RU supports parsing ecpriSeqId
RX_CORRUPT	O-RU shall support this counter if O-RU supports parsing ecpriSeqId
RX_ERR_DROP	Yes

MVP-MPlane-Intf-4: The O-RU shall support O-RU monitoring of C/U-Plane connectivity.

MVP-MPlane-Intf-5: The O-RU shall support the configurable states "admin-state" and "power-state" if the hardware-state feature is supported by the O-RU as specified in [O-RAN-3] clause 9.1.3.2.

MVP-MPlane-Intf-6: The O-RU shall support the read-only O-RU states "oper-state", "availability-state" and "usage-state" as defined in [O-RAN-3] clause 9.1.3.

MVP-MPlane-Intf-7: The O-RU shall support SFTP based secure file transfer over SSH and FTPES based secure file transfer over TLS.

MVP-MPlane-Intf-8: The O-RU shall support Software update procedure as specified in [O-RAN-3] clause 8.8.

MVP-MPlane-Intf-9: The O-RU shall support Factory reset as specified in [O-RAN-3] clause 8.1.2.

MVP-MPlane-Intf-10: The O-RU shall support the standardized logical folders as defined in File system structure as specified in [O-RAN-3] clause 12.2.

MVP-MPlane-Intf-11: If the O-RU supports one or more ALD ports, the corresponding M-Plane procedure shall be supported as specified in [O-RAN-3] clause 14.4.

10.2   Open FH CUS-Plane Requirements and IOT Profiles

This sub-section captures interface requirements and associated IOT profiles for the Open FH CUS-Plane interface depicted in Figure 2. These requirements impact the O-RU and the O-DU. The CUS-Plane interface requirements are broadly classified into three categories: (a) IOT profile as defined for CUS-Plane in the O-RAN Alliance WG4 IOT specifications, (b) new configuration entries which can be added to existing profiles and (c) new requirements which do not map to any existing WG4 CUS-Plane IOT profile.

10.2.1   Interface Requirements Specified as Part of IOT Profiles

The CUS-Plane IOT profiles specified in [O-RAN-23] are test profiles for testing the CUS-Plane interface. Each profile includes a set of configuration parameters designed to meet the critical requirements for testing the fronthaul CUS-Plane interface.

MVP-CUS-Plane IOT Profile Req 1: The O-DU and a CAT-A O-RU shall support the interface requirements and configurations specified as part of Open RAN CUS IOT profile "NR TDD IOT Profile 1 - NR-TDD-FR1-CAT-A-NoBF" in [O-RAN-23], Annex A, Table A.2.1.1-1.

MVP-CUS-Plane IOT Profile Req 2: The O-DU and a CAT-A O-RU shall support the interface requirements and configurations specified as part of Open RAN CUS IOT profile "NR TDD IOT Profile 3 - NR-TDD-FR2-CAT-A-ABF" in [O-RAN-23], Annex A, Table A.2.1.3-1.

MVP-CUS-Plane IOT Profile Req 3: The O-DU and a CAT-B O-RU shall support the interface requirements and configurations specified as part of Open RAN CUS IOT profile "NR TDD IOT M-MIMO Profile 1 - NR-TDD-FR1-CAT-B-mMIMO-RTWeights-BFP" in [O-RAN-23], Annex A, Table A.2.1.4-1.

MVP- CUS-Plane IOT Profile Req 4: The O-DU and a CAT-B O-RU shall support the interface requirements and configurations specified as part of Open RAN CUS IOT profile "NR TDD IOT M-MIMO Profile 2 - NR-TDD-FR1-CAT-B-mMIMO-RTWeights-ModComp" in [O-RAN-23], Annex A, Table A.2.1.5-1.

MVP- CUS-Plane IOT Profile Req 5: The O-DU and a CAT-B O-RU shall support the interface requirements and configurations specified as part of Open RAN CUS IOT profile "NR TDD IOT M-MIMO Profile 3 - NR-TDD-FR1-CAT-B-mMIMO-ChInfo-BFP in [O-RAN-23], Annex A, Table A.2.1.6-1.

MVP- CUS-Plane IOT Profile Req 6: The O-DU and a CAT-B O-RU shall support the interface requirements and configurations specified as part of Open RAN CUS IOT profile "NR TDD IOT M-MIMO Profile 4 - NR-TDD-FR1-CAT-B-mMIMO-ChInfo-ModComp" in [O-RAN-23], Annex A, Table A.2.1.7-1.

MVP- CUS-Plane IOT Profile Req 7: The O-DU and a CAT-B O-RU shall support the interface requirements and configurations specified as part of Open RAN CUS IOT profile "NR FDD IOT Profile 1 - NR-FDD-FR1(15kHzSCS)-CAT-B-DBF" in [O-RAN-23], Annex A, Table A.2.2.1-1.

MVP- CUS-Plane IOT Profile Req 8: The O-DU and a CAT-A O-RU shall support the interface requirements and configurations specified as part of Open RAN CUS IOT profile "NR FDD IOT Profile 4 - NR-FDD-FR1(15kHzSCS)-CAT-A-NoBF" in [O-RAN-23], Annex A, Table A.2.2.4-1.

10.2.2   New Configuration in Selected IOT Profiles

The CUS-Plane interface requirements which are not fulfilled by referring to configuration parameters in existing IOT profiles and comprise new configuration entries in existing CUS-Plane IOT profiles referenced in sub-section 10.2.1 are listed in the below Table. The table establishes a mapping between ATIS MVP functional requirements, the impacted CUS-Plane IOT profiles and the associated configuration entry which must be supported by the CUS-Plane IOT profile in the present MVP.

Requirement Reference	Impacted CUS-Plane IoT Profiles	Configuration Parameters
MVP-FUNC-TDD-16-2	NR-TDD-FR1-CAT-A-NoBF NR-TDD-FR1-CATB-mMIMO-RTWeights-BFP NR-TDD-FR1-CAT-B-mMIMO-RTWeights-ModComp NR-TDD-FR1-CAT-B-mMIMO-ChInfo-BFP NR-TDD-FR1-CAT-B-mMIMO-ChInfo-ModComp	Add new configuration Entries for "TDD Configuration": - DDDSU, S slot has 10 DL, 2 GP, 2 UL symbols
MVP-FUNC-TDD-16-3	NR-TDD-FR2-CAT-A-ABF	Add new configuration Entries for "TDD Configuration": - DDDSU, S slot has 10 DL, 2 GP, 2 UL symbols
MVP-FUNC-TDD-16-4	NR-TDD-FR1-CAT-A-NoBF NR-TDD-FR1-CATB-mMIMO-RTWeights-BFP NR-TDD-FR1-CAT-B-mMIMO-RTWeights-ModComp NR-TDD-FR1-CAT-B-mMIMO-ChInfo-BFP NR-TDD-FR1-CAT-B-mMIMO-ChInfo-ModComp	Add new configuration Entries for "TDD Configuration": - DDDSUUDDDD, S slot has 6 DL, 4 GP, 4 UL symbols
MVP-FUNC-TDD-16-5	NR-TDD-FR1-CAT-A-NoBF NR-TDD-FR1-CATB-mMIMO-RTWeights-BFP NR-TDD-FR1-CAT-B-mMIMO-RTWeights-ModComp NR-TDD-FR1-CAT-B-mMIMO-ChInfo-BFP NR-TDD-FR1-CAT-B-mMIMO-ChInfo-ModComp	Add new configuration Entries for "TDD Configuration": - DDDSUUUUDD, S slot has 6 DL, 4 GP, 4 UL for "TDD Configuration"
MVP-FUNC-BW-16-1	NR-FDD-FR1(15kHzSCS)-CAT-A-NoBF NR-FDD-FR1(15kHzSCS)-CAT-B-DBF	Add new configuration Entries for "Total Channel Bandwidth": - 1CC x 5 MHz - 1CC x 25 MHz - 1CC x 30 MHz - 1CC x 40 MHz - 1CC x 45 MHz
MVP-FUNC-BW-16-1	NR-TDD-FR1-CAT-A-NoBF NR-TDD-FR1-CATB-mMIMO-RTWeights-BFP NR-TDD-FR1-CAT-B-mMIMO-RTWeights-ModComp NR-TDD-FR1-CAT-B-mMIMO-ChInfo-BFP NR-TDD-FR1-CAT-B-mMIMO-ChInfo-ModComp	Add new configuration Entries for "Total Channel Bandwidth": - 1CC x 10 MHz - 1CC x 15 MHz - 1CC x 20 MHz - 1CC x 30 MHz - 1CC x 40 MHz - 1CC x 50 MHz - 1CC x 60 MHz - 1CC x 70 MHz - 1CC x 80 MHz - 1CC x 90 MHz

This section lists a set of interface requirements which are not captured as part of the IOT profiles in sub-section 10.2.1 but are required by the present MVP for operating the fronthaul of the Open RAN system.

MVP-CUSPlane-Intf-1: The O-DU and the CAT-B O-RU shall support the Predefined-beam beamforming method.

MVP-CUSPlane-Intf-2: The O-DU and the O-RU shall support the timing relations for long and short PRACH formats depending on the implementation type Macro or Micro, including at least Formats 0, 1, A3, B4, C0, and C2, F2

MVP-CUSPlane-Intf-3: The O-DU and O-RU shall support flexible eAxC_ID bit-width to allow configurable number of cells and bands.

MVP-CUSPlane-Intf-4: The O-DU and the O-RU shall support sending a single control message for multiple symbols.

MVP-CUSPlane-Intf-5: The O-DU and the O-RU shall support symInc flag or Section Extension 6 or Section Extension 12 to allow multiple symbols in a C-Plane section.

MVP-CUSPlane-Intf-6:The number of compression bits of the Block Floating Point Compression (BFPC) shall be configurable if supported by the O-DU and the O-RU.

MVP-CUSPlane-Intf-7a: The O-DU and the O-RU shall support DMRS-BF for uplink.

MVP-CUSPlane-Intf-7b: For DMRS-BF, the O-DU and O-RU shall support the corresponding Mandatory and Conditional Mandatory features defined in Table 10.2-1 of the O-RAN Alliance specification [O-RAN-2]

10.3   O1 Interface Requirements

This sub-section captures interface requirements the O1 interface depicted in Figure 2. These requirements impact the O-DU, O-CU, and the SMO. The requirements and procedures listed in the table below shall be supported over the O1 interface.

Requirement Type	Requirement/Description	O-RAN Specification [O-RAN-16] References
MVP-O1-Intf-HTTP-1	Management Service producers and consumers that use HTTP shall support HTTP v1.1 or higher	Sub-clause 4.3
MVP-O1-Intf-FTP-1	File Transfer shall be performed using a secure file transfer protocol from or to the File Management MnS Producer (FTPES, or HTTPS)	Sub-clause 4.7
MVP-O1-Intf-FTP-2	The O1 interface shall support Secure file transfer requirements specified in O-RAN Security Protocol Specifications	Sub-clause 4.7
MVP-O1-Intf-GEN-1	An O1 notification shall support a JSON encoded asynchronous notification sent from a MnS producer to a MnS consumer over the O1 interface using REST/HTTPS.	Sub-clause 5.1
MVP-O1-Intf-GEN-2	An O1 notification shall be in one of the following formats: - SDO O1 format; - VES encoded SDO O1 format. SDO formats that are being supported above are 3GPP defined format and O-RAN defined format.	Sub-clause 5.1
MVP-O1-Intf-GEN-3	O-RAN defined O1 PNF and VNF registration notification shall be JSON encoded for sending via REST/HTTPS.	Sub-clause 5.2
MVP-O1-Intf-GEN-4	Schema for O-RAN defined O1 notification shall be specified using OpenAPI	Sub-clause 5.2
MVP-O1-Intf-GEN-5	If VES O1 format is configured to be used, O-RAN defined O1 notification shall be presented in harmonized VES format and schemaReference shall refer to O-RAN defined schema in O-RAN public repository when it is available.	Sub-clause 5.2

MVP-O1-Intf-PMS-1	The provisioning management service producer and consumer shall support the following Network Configuration Protocol (NETCONF) operations as specified in RFC 6241 [IETF-2]: - get - get-config - edit-config - copy-config - delete-config - lock - unlock - close-session - kill-session	Sub-clause 6.1.1
MVP-O1-Intf-PMS-2	The provisioning management service producer and consumer shall support the following NETCONF capabilities as specified in RFC 6241 [IETF-2]: - writable-running - rollback-on-error - validate - xpath	Sub-clause 6.1.1
MVP-O1-Intf-PMS-3	The provisioning management service producer and consumer shall support a running datastore for NETCONF	Sub-clause 6.1.1
MVP-O1-Intf-PMS-4	The provisioning management service producer and consumer shall support YANG1.1, defined in RFC 7950 [IETF-4], including coexistence with YANG Version 1 as specified therein.	Sub-clause 6.1.1
MVP-O1-Intf-PMS-5	The provisioning management service producer shall have the capability to establish a NETCONF session with its authorized consumer upon request from the consumer.	Sub-clause 6.1.1
MVP-O1-Intf-PMS-6	The provisioning management service producer shall support an established NETCONF session until the authorized consumer terminates the session.	Sub-clause 6.1.1
MVP-O1-Intf-PMS-7	The provisioning management service producer shall have the capability to terminate a NETCONF session with its authorized consumer when requested to do so by the authorized consumer.	Sub-clause 6.1.1
MVP-O1-Intf-PMS-8	The provisioning management service producer shall have the capability to make provisioning operation results persistent over a reset.	Sub-clause 6.1.1
MVP-O1-Intf-PMS-9	The provisioning management service producer and consumer shall support NETCONF over SSH or NETCONF over TLS.	Sub-clause 6.1.1
MVP-O1-Intf-PMS-10	The provisioning management service producer shall support/netconf-state/schemas subtree and RPC defined in RFC 6022 [IETF-1] for all supported YANG modules	Sub-clause 6.1.1
MVP-O1-Intf-PMS-11	The provisioning management service producer shall support RFC 6243 [IETF-3] "With-defaults capability for NETCONF" as defined by 3GPP TS 28.532 [3GPP-11], clause 12.1.3.3.2	Sub-clause 6.1.1
MVP-O1-Intf-PMS-12	To create Managed Object Instance the mapping of operations specified in 3GPP TS 28.532 [3GPP-11] clauses 12.1.3.1.1 and 12.1.3.1.2 shall apply.	Sub-clause 6.1.2.2
MVP-O1-Intf-PMS-13	To modify Managed Object Instance attributes the mapping of operations specified in 3GPP TS 28.532 [3GPP-11] clauses 12.1.3.1.1 and 12.1.3.1.4 shall apply.	Sub-clause 6.1.3.2
MVP-O1-Intf-PMS-14	To delete Managed Object Instance the mapping of operations specified in 3GPP TS 28.532 [3GPP-11] clauses 12.1.3.1.1 and 12.1.3.1.5 shall apply.	Sub-clause 6.1.4.2
MVP-O1-Intf-PMS-15	To read Managed Object Instance attributes the mapping of operations specified in 3GPP TS 28.532 [3GPP-11] clauses 12.1.3.1.1 and 12.1.3.1.3 shall apply.	Sub-clause 6.1.5.2
MVP-O1-Intf-PMS-16	The notify Managed Object Instance changes shall support the mapping of notifications specified in 3GPP TS 28.532 [3GPP-11] clause 11.1.1.11	Sub-clause 6.1.6.2
MVP-O1-Intf-PMS-17	NtfSubscriptionControl IOC definition shall be as specified in 3GPP TS 28.622 [3GPP-14] clause 4.3.22 with attribute definitions specified in 3GPP TS 28.622 [3GPP-14] clause 4.4.1.	Sub-clause 6.1.7.2

MVP-O1-Intf-PMS-18	The O1 interface shall support the requirements for NETCONF session establishment specified in RFC 6241 [IETF-2].	Sub-clause 6.1.8.2
MVP-O1-Intf-PMS-19	The O1 interface shall support the requirements for NETCONF session termination specified in RFC 6241 [IETF-2], Section 7.8	Sub-clause 6.1.9.2
MVP-O1-Intf-PMS-20	The O1 interface shall support the requirements for NETCONF lock data store specified in RFC 6241 [IETF-2], Section 7.5	Sub-clause 6.1.10.2
MVP-O1-Intf-PMS-21	The O1 interface shall support the requirements for NETCONF unlock data store specified in RFC 6241 [IETF-2], Section 7.6	Sub-clause 6.1.11.2
MVP-O1-Intf-PMS-22	The O1 interface shall support the requirements for NETCONF commit specified in RFC 6241 [IETF-2], Section 8.4	Sub-clause 6.1.12.2
MVP-O1-Intf-PMS-23	The O1 interface shall support the requirements for the mapping of notifications specified in 3GPP TS 28.532 [3GPP-11] clause 11.1.1.10	Sub-clause 6.1.13.2
MVP-O1-Intf-FSMS-1	The O1 Interface shall support fault notification for sending alarm notifications	Sub-clause 6.2.1.2
MVP-O1-Intf-FSMS-2	The O1 Interface shall support fault notification for alarm notification subscription	Sub-clause 6.2.1.2
MVP-O1-Intf-FSMS-3	The O1 Interface shall support fault notification for alarm notification un-subscription	Sub-clause 6.2.1.2
MVP-O1-Intf-FSMS-4	The O1 Interface shall support fault notification for reading the alarm list	Sub-clause 6.2.1.2
MVP-O1-Intf-FSMS-5	The O1 Interface shall support fault notification for reading the alarm list with a filter	Sub-clause 6.2.1.2
MVP-O1-Intf-FSMS-6	The O1 Interface shall support fault notification for sending changed alarm notifications	Sub-clause 6.2.1.2
MVP-O1-Intf-FSMS-7	The O1 Interface shall support fault notification for sending cleared alarm notifications	Sub-clause 6.2.1.2
MVP-O1-Intf-FSMS-8	The O1 Interface shall support fault notification for sending new alarm notifications	Sub-clause 6.2.1.2
MVP-O1-Intf-FSMS-9	The O1 Interface shall support fault notification for sending alarm list rebuilt notification	Sub-clause 6.2.1.2
MVP-O1-Intf-FSMS-10	The O1 interface shall support the Fault Supervision MnS Producer the capability to store the relevant data of alarms updates if the Fault History Supervision Control and Reporting capability is provided.	Sub-clause 6.2.3.2
MVP-O1-Intf-FSMS-11	The O1 interface shall support the Fault Supervision MnS Producer the capability to store the alarm updates even when the ability to send alarm notifications to subscribed consumer(s) is not available (e.g., during a disturbance), if Fault History Supervision Control and Reporting capability is provided.	Sub-clause 6.2.3.2
MVP-O1-Intf-FSMS-12	The O1 interface shall support the Fault Supervision MnS Producer allow authorized consumers to retrieve the stored alarm updates if Fault History Supervision Control and Reporting capability is provided.	Sub-clause 6.2.3.2
MVP-O1-Intf-FSMS-13	The O1 interface shall support the Fault Supervision MnS Producer the capability to store the notifyAlarmListRebuilt notification if Fault History Supervision Control and Reporting capability is provided. In case, it may also have the capability to store the notifyPotentialFaultyAlarmList notification.	Sub-clause 6.2.3.2
MVP-O1-Intf-FSMS-1	The O1 interface shall support the Fault Supervision MnS Producer the capability to report the perceivedSeverity at the time of the alarm creation, if Fault History Supervision Control and Reporting capability is provided.	Sub-clause 6.2.3.2

MVP-O1-Intf-PAMS-1	The O1 interface shall support the pull-based Performance Data File Reporting method, the requirements specified in 3GPP TS 28.550 [3GPP-13] clause 5.2.2.	Sub-clause 6.3.1.2
MVP-O1-Intf-PAMS-2	The O1 interface shall support the Performance Assurance MnS Producer responsible for the push-based Performance Data File Reporting method the capability to send the NF performance data file to its authorized Performance Assurance MnS Consumer or a designated file server as described in 3GPP TS 28.537 [3GPP-12] clause 7.3.1.	Sub-clause 6.3.1.2
MVP-O1-Intf-PAMS-3	The O1 interface shall support the Performance Assurance MnS Producer responsible for the push-based Performance Data File Reporting method for the file transfer protocols specified in 3GPP TS 28.537 [3GPP-12] clause 7.1.3 in the client role of the protocol.	Sub-clause 6.3.1.2
MVP-O1-Intf-PAMS-4	The O1 interface shall support the Performance Assurance MnS Consumer responsible for the push-based Performance Data File Reporting method for the file transfer protocols specified in 3GPP TS 28.537 [3GPP-12] clause 7.1.3 in the server role of the protocol.	Sub-clause 6.3.1.2
MVP-O1-Intf-PAMS-5	The O1 interface shall support the Performance Assurance MnS Producer responsible for the push-based Performance Data File Reporting method the ability to announce the capability to support notifications related to the completion of the file transfer.	Sub-clause 6.3.1.2
MVP-O1-Intf-PAMS-6	The O1 interface shall support the Performance Assurance MnS Producer responsible for the push-based Performance Data File Reporting method the Performance Assurance MnS Consumers the ability to subscribe to receive notifications related to completion of the file transfer.	Sub-clause 6.3.1.2
MVP-O1-Intf-PAMS-7	The O1 interface shall support the requirements for Streaming PM specified in 3GPP TS 28.550 [3GPP-13] clause 5.2.3.	Sub-clause 6.3.2.2
MVP-O1-Intf-PAMS-8	The O1 interface shall support the requirements for measurement job control specified in TS 28.550 [3GPP-13] clause 5.2.1.	Sub-clause 6.3.3.2
MVP-O1-Intf-PAMS-9	The O1 interface shall support PerfMetricJob IOC definition as specified in 3GPP TS 28.622 [3GPP-14] clause 4.3.31 with attribute definitions as specified in 3GPP TS 28.622 [3GPP-14] clause 4.4.1.	Sub-clause 6.3.3.2
MVP-O1-Intf-PAMS-10	The O1 interface shall support SupportedPerfMetricGroup datatype shall be as specified in 3GPP TS 28.622 [3GPP-14] clause 4.3.32.	Sub-clause 6.3.3.2
MVP-O1-Intf-PAMS-11	The O1 interface shall support ReportingCtrl shall be as specified in 3GPP TS 28.622 [3GPP-14] clause 4.3.33.	Sub-clause 6.3.3.2
MVP-O1-Intf-PAMS-12	The O1 interface shall support YANG solution set for PerfMetricJob IOC shall be as specified in TS 28.623 [3GPP-15] clause D.2.4.	Sub-clause 6.3.3.2
MVP-O1-Intf-TMS-1	The O1 interface shall support both file-based and streaming the requirements for trace data as specified in TS 32.421 [3GPP-17] clause 5.2	Sub-clause 6.4.1.1.2
MVP-O1-Intf-TMS-2	The O1 interface shall support both file-based and streaming trace the requirements for Trace Data Activation as specified in 3GPP TS 32.421 [3GPP-17] clause 5.3.1	Sub-clause 6.4.1.2.2
MVP-O1-Intf-TMS-3	The O1 interface shall support both file-based and streaming trace the requirements for Trace Data Deactivation as specified in 3GPP TS 32.421 [3GPP-17] clause 5.4.1	Sub-clause 6.4.1.3.2
MVP-O1-Intf-TMS-4	The O1 interface shall support both file-based and streaming trace requirements for Trace Recording Session Activation as specified in 3GPP TS 32.421 [3GPP-17] clause 5.3.2	Sub-clause 6.4.1.4.2
MVP-O1-Intf-TMS-5	The O1 interface shall support both file-based and streaming trace requirements for Trace Recording Session Termination as specified in 3GPP TS 32.421 [3GPP-17] clause 5.4.2	Sub-clause 6.4.1.5.2
MVP-O1-Intf-TMS-6	The O1 interface shall support both file-based and streaming trace requirements for managing Minimization of Drive Testing as specified in TS 32.421 [3GPP-17] clause 6	Sub-clause 6.4.2.2
MVP-O1-Intf-TMS-7	The O1 interface shall support requirements for Radio Link Failure reporting as specified in TS 32.421 [3GPP-17] clause 7.	Sub-clause 6.4.3.2

MVP-O1-Intf-TMS-8	The O1 interface shall support requirements for Radio Resource Control (RRC) Connection Establishment Failure (RCEF) reporting as specified in TS 32.421 [3GPP-17] clause 7.	Sub-clause 6.4.4.2
MVP-O1-Intf-TMS-9	The O1 interface shall support both Management and Signaling requirements for TraceJob management via the TraceJob IOC defined in TS 28.622 [3GPP-14] clause 4.30.	Sub-clause 6.4.5.2
MVP-O1-Intf-TMS-10	The O1 interface shall support both Management and Signaling requirements for TraceJob Activation specified in TS 32.421 [3GPP-17] clause 5.3.1.	Sub-clause 6.4.5.2
MVP-O1-Intf-TMS-11	The O1 interface shall support both Management and Signaling requirements for TraceJob deactivation specified in TS 32.421 [3GPP-17] clause 5.4.1.	Sub-clause 6.4.5.2
MVP-O1-Intf-FMS-1	The O1 interface shall support requirements for the notifyFileReady notification as specified in 3GPP TS 28.532 [3GPP-11], clause 11.6.1.1.	Sub-clause 6.5.1.2
MVP-O1-Intf-FMS-2	The O1 interface shall support requirements on the types of files specified in clause 5.2 of 3GPP TS 32.341 [3GPP-16].	Sub-clause 6.5.2.2
MVP-O1-Intf-FMS-3	The O1 interface shall support File Transfer Requirements specified in clause 7.1.3 of 3GPP TS 28.537 [3GPP-12].	Sub-clause 6.5.3.2
MVP-O1-Intf-FMS-4	The O1 interface shall support General File Download requirements specified in clause 7.4.3 of 3GPP TS 28.537 [3GPP-12].	Sub-clause 6.5.4.2
MVP-O1-Intf-HMS-1	The O1 interface shall support Requirements for heartbeat notifications specified in 3GPP TS 28.537 [3GPP-12] clause 4.2.2.2.	Sub-clause 6.6.1.2
MVP-O1-Intf-HMS-2	The O1 interface shall support requirements for heartbeat control specified in 3GPP TS 28.537 [3GPP-12] clause 4.2.2.1.	Sub-clause 6.6.2.2
MVP-O1-Intf-HMS-3	The O1 interface shall support requirements for HeartbeatControl IOC definition as specified in 3GPP TS 28.622 [3GPP-14] clause 4.3.	Sub-clause 6.6.2.2
MVP-O1-Intf-HMS-4	The O1 interface shall support requirements for YANG solution set for HeartbeatControl IOC as in 3GPP TS 28.623 [3GPP-15] clause D.2.6a.	Sub-clause 6.6.2.2
MVP-O1-Intf-PSRMS-1	The O1 interface shall support Specification requirement for Plug and Connect specified in TS 28.314 [3GPP-10] clause 6.2.1	Sub-clause 6.7.1.2
MVP-O1-Intf-PSRMS-2	The O1 interface shall support the PNF Startup and Registration MnS Producer sending the PNF Registration Notifications (see clause 6.7.2.4) upon PNF reset and/or registration events resulting in O1 connection re-establishment.	Sub-clause 6.7.2.2
MVP-O1-Intf-PSMS-1	The O1 interface shall support the PNF software management service producer the capability to provide its authorized consumer, information about the software packages.	Sub-clause 6.8.2.2
MVP-O1-Intf-PSMS-2	The O1 interface shall support the PNF software management service producer the capability to allow its authorized consumer to specify the location of software that is to be downloaded and to specify into which softwarePackage the software is to be stored.	Sub-clause 6.8.3.2
MVP-O1-Intf-PSMS-3	The O1 interface shall support the PNF software management service producer the capability to verify if a software download is in progress and the ability to reject subsequent download commands until the one in progress completes.	Sub-clause 6.8.3.2
MVP-O1-Intf-PSMS-4	The O1 interface shall support the PNF software management service producer the capability to deny download of software if the download request is not valid for the PNF software management service producer.	Sub-clause 6.8.3.2
MVP-O1-Intf-PSMS-5	The O1 interface shall support the PNF software management service producer the capability to download needed files from a software server at a specified location.	Sub-clause 6.8.3.2
MVP-O1-Intf-PSMS-6	The O1 interface shall support the PNF software management service producer the capability to perform integrity checks on downloaded software.	Sub-clause 6.8.3.2

MVP-O1-Intf-PSMS-7	The O1 interface shall support the PNF software management service producer the capability to notify the PNF software management consumer with the software download result.	Sub-clause 6.8.3.2
MVP-O1-Intf-PSMS-8	The O1 interface shall support the PNF software management service producer the capability to confirm that the software in the passive slot targeted for activation is good.	Sub-clause 6.8.4.2
MVP-O1-Intf-PSMS-9	The O1 interface shall support the PNF software management service producer the capability to determine whether the activation of the targeted software requires a reset and/or data migration.	Sub-clause 6.8.4.2
MVP-O1-Intf-PSMS-10	The O1 interface shall support the PNF software management service producer the capability to allow its authorized consumer to activate valid software in a specific softwarePackage.	Sub-clause 6.8.5.2
MVP-O1-Intf-PSMS-11	The O1 interface shall support the PNF software management service producer the capability to verify whether a software activation is in progress and deny a concurrent activation of software.	Sub-clause 6.8.5.2
MVP-O1-Intf-PSMS-12	The O1 interface shall support the PNF software management service producer the capability to deny activation of software if the activation request is not valid for the PNF software management service producer.	Sub-clause 6.8.5.2
MVP-O1-Intf-PSMS-13	The O1 interface shall support the PNF software management service producer the capability to activate the softwarePackage.	Sub-clause 6.8.5.2
MVP-O1-Intf-PSMS-14	The O1 interface shall support the PNF software management service producer the capability to reset the PNF software management service producer if the software activation requires it.	Sub-clause 6.8.5.2
MVP-O1-Intf-PSMS-15	The O1 interface shall support the PNF software management service producer the capability for the PNF software management service producer to send a reset reason notification to its authorized consumer if the activation results in a reset.	Sub-clause 6.8.5.2
MVP-O1-Intf-PSMS-16	The O1 interface shall support the PNF software management service producer the capability to perform data migration on the PNF software management service producer if the software activation requires it.	Sub-clause 6.8.5.2
MVP-O1-Intf-PSMS-17	The O1 interface shall support the PNF software management service producer the capability to fallback to the previously active software if the new software cannot be activated.	Sub-clause 6.8.5.2
MVP-O1-Intf-PSMS-18	The O1 interface shall support the PNF software management service producer the capability to fallback to the factory software if the new and the previously active software cannot be activated.	Sub-clause 6.8.5.2
MVP-O1-Intf-PRMS-1	The O1 interface shall support the PNF Reset MnS Producer the capability for a PNF Reset MnS Consumer to trigger a reset of a HW unit of the PNF Reset MnS Producer on command.	Sub-clause 6.9.1.2
MVP-O1-Intf-PRMS-2	The O1 interface shall support the PNF Reset MnS Producer reset command types conditional and forced.	Sub-clause 6.9.1.2
MVP-O1-Intf-PRMS-3	The O1 interface shall support the PNF Reset MnS Producer be allowed to reject a conditional reset command type.	Sub-clause 6.9.1.2
MVP-O1-Intf-PRMS-4	The O1 interface shall support the PNF Reset MnS Producer is not allowed to reject a valid forced command reset type.	Sub-clause 6.9.1.2
MVP-O1-Intf-PRMS-5	The O1 interface shall support the PNF MnS Producer the capability to inform a PNF MnS Consumer that a reset has occurred and the reason that a HW unit has reset.	Sub-clause 6.9.2
MVP-O1-Intf-PRMS-6	The O1 interface shall support the PNF MnS Producer ability to save the reason for a reset persistently before resetting.	Sub-clause 6.9.2

MVP-O1-Intf-PRMS-7	The O1 interface shall support the PNF MnS Producer to save the reset reason persistently and shall set the reset reason to unknown in the notification, if a reset reason has not been saved persistently due to unexpected error.	Sub-clause 6.9.2
MVP-O1-Intf-CNRMS-1	The O1 interface shall support the Cloudified NF Registration MnS Producer the capability to send a o1NotifyCloudNFRegistration notification to the Cloudified NF Registration MnS Consumer when it has completed instantiation and application initialization; and is ready for final configuration to be managed by the Cloudified NF Registration MnS Consumer.	Sub-clause 6.10.1.2
MVP-O1-Intf-CNRMS-2	The O1 interface shall support the Cloudified NF Registration MnS Producer the capability to send a o1NotifyCloudNFRegistration notification to the Cloudified NF Registration MnS Consumer when it completes a restart.	Sub-clause 6.10.1.2

10.4   O2 Interface Requirements

This sub-section outlines the O2 interface requirements and proceådures for managing the lifecycle of NFs and services related to both VM-based and containerized workloads. These processes are facilitated through the O2dms and O2ims interfaces as specified in [O-RAN-19]. The capabilities and associated use cases pertain to scenarios initiated within the O-Cloud as well as those initiated by the SMO, directed towards the O-Cloud.

10.4.1   DMS Specific O2 Interface Requirements

This sub-section specifies the capabilities, associated use cases and procedures related to DMS that shall be supported over the O2 interface.

10.4.1.1   Capabilities and Requirements for O2-DMS Kubernetes Profile

MVP-O2-IOT-KDMS-1: The O2 interface between the SMO and the O-Cloud shall support the capabilities and procedures outlined in Table 10.4.1.1-1 for containerized workloads.

Table 10.4.1.1-1: Supported Kubernetes O2 DMS Capabilities and Procedures

Supported Capability [O-RAN-20]	Requirement/Description	O-RAN Specification [O-RAN-16] References
NF Deployment Instantiation, sub-clause 3.2.1	The O2 interface shall support the Instantiate NF Deployment procedure.	Sub-clause 3.1.2,
Terminate Network Function on O-Cloud, sub-clause 3.2.5	The O2 interface shall support the Terminate NF Deployment procedure.	Sub-clause 3.1.3
Network Function Deployment Level Healing, sub-clause 3.6.2	The O2 interface shall support the Auto Healing of NF Deployment in a Kubernetes cluster procedure.	Sub-clause 3.1.4.1
	The O2 interface shall support the SMO triggered Healing of NF Deployment in a Kubernetes cluster procedure.	Sub-clause 3.1.4.2
Software Upgrade of NF, sub-clause 3.2.4	The O2 interface shall support the Build-and-Replace Software Upgrade procedure.	Sub-clause 3.1.5.1
Scale Out of NF, sub-clause 3.2.2 & Scale In of NF, sub-clause 3.2.3	The O2 interface shall support the SMO managed scale procedure.	Sub-clause 3.1.6.2
	The O2 interface shall support the Kubernetes Autoscaling procedure.	Sub-clause 3.1.6.3

MVP-O2-IOT-KDMS-2: The O2 interface procedures specified in Table 10.4.1 shall utilize the Kubernetes native APIs and data models specified in sub-clause 4.2, [O-RAN-9].

MVP-O2-IOT-KDMS-3: The O2 interface procedures specified in Table 10.4.1 shall utilize the Kubernetes resource objects specified in sub-clause 4.3, [O-RAN-9].

10.4.1.2. Capabilities and Requirements for O2-DMS ETSI NFV Profile

MVP-O2-IOT-NFVDMS-1: The O2 interface between the SMO and the O-Cloud shall support the capabilities and procedures outlined in Table 10.4.1.2-1 for VM-based workloads not running on top of Kubernetes.

Table 10.4.1.2-1: ETSI NFV O2 DMS Capabilities

Supported Capability [O-RAN-20]	Requirement/Description	O-RAN Specification [O-RAN-16] References
NF Deployment Instantiation, sub-clause 3.2.1	The O2 interface shall support the Instantiate NF Deployment procedure.	Sub-clause 2.4.2.1
Terminate Network Function Deployment on O-Cloud, sub-clause 3.2.5	The O2 interface shall support the Terminate NF Deployment procedure.	Sub-clause 2.4.2.2
Query Information, sub-clause 3.1.11	The O2 interface shall support the Query NF Deployment information procedure.	Sub-clause 2.4.2.3
Network Function Deployment Level Healing, sub-clause 3.6.2	The O2 interface shall support the On-demand healing procedure.	Sub-clause 2.4.2.4.2
Scale Out of NF, sub-clause 3.2.2 & Scale In of NF, sub-clause 3.2.3	The O2 interface shall support the Auto-healing procedure.	Sub-clause 2.4.2.4.3
VLAN Allocation Use Case, sub-clause 3.9.1 & VLAN Deallocation, sub-clause 3.9.2	The O2 interface shall support the Scaling based on management request procedure.	Sub-clause 2.4.2.5.2
Software Upgrade of NF, sub-clause 3.2.4	The O2 interface shall support the Auto-scaling procedure.	Sub-clause 2.4.2.5.3
	The O2 interface shall support the Change external connectivity of an NF Deployment procedure.	Sub-clause 2.4.2.6
	The O2 interface shall support the Change current NF Deployment package procedure.	Sub-clause 2.4.2.7
	The O2 interface shall support the Change NF Deployment flavour procedure.	Sub-clause 2.4.2.8
	The O2 interface shall support the Get alarm list procedure.	Sub-clause 2.4.3.1
	The O2 interface shall support the Alarm Notification procedure, Notify.	Sub-clause, 2.4.3.2
	The O2 interface shall support the Acknowledge alarm procedure	Sub-clause 2.4.3.3
	The O2 interface shall support the Create PM job procedure.	Sub-clause 2.4.4.1
	The O2 interface shall support the Query/read PM job information procedure.	Sub-clause 2.4.4.2
	The O2 interface shall support the Delete a PM job procedure.	Sub-clause 2.4.4.3
	The O2 interface shall support the Create a threshold procedure.	Sub-clause 2.4.4.4
	The O2 interface shall support the Query/read threshold information procedure.	Sub-clause 2.4.4.5
	The O2 interface shall support the Delete a threshold procedure.	Sub-clause 2.4.4.6
	The O2 interface shall support the Sending performance related notifications procedure.	Sub-clause 2.4.4.7
	The O2 interface shall support the Obtaining performance reports procedure.	Sub-clause 2.4.4.8

MVP-O2-IOT-NFVDMS-2: The O2 interface procedures specified in Table 10.4.1.2-1 shall utilize the APIs and data models specified in clause 3, [O-RAN-10].

10.4.1.3   Additional O2-DMS Requirements

This sub-section lists additional O2-DMS capabilities that need to be supported as part of the O2-DMS interface. The procedures associated with these capabilities are being developed or are to be developed.

MVP-O2-IOT-DMS-1: The O2 interface between the SMO and the O-Cloud shall support the O-Cloud Drain Node capability ETSI/NFV based O-Cloud deployment outlined in clause 3.12.2, [O-RAN-20].

10.4.2   IMS Specific O2 Interface Requirements

MVP-O2-IOT-IMSSVCS-1: The O2 interface between the SMO and the O-Cloud shall support the IMS capabilities and procedures outlined in Table 10.4.2-1, for both containerized and VM-based workloads.

Table 10.4.2-1: O2 IMS Capabilities

Supported Capability [O-RAN-20]	Requirement/Description	O-RAN Specification [O-RAN-16] References
O-Cloud Inventory Update, sub-clause 3.1.4	The O2 interface shall support the O-Cloud Information Query procedure associated with the O2ims_InfrastructureInventory Service.	Sub-clause 2.1.2
Alarm Notification, sub-clause 3.7.2	The O2 interface shall support the O2ims Alarm Subscribe/Notify procedure associated with the O2ims_InfrastructureMonitoring Service.	Sub-clause 2.1.3.1.2.4
Alarm Query, sub-clause 3.7.3	The O2 interface shall support the Query O2ims_ InfrastructureAlarmInformation procedure associated with the O2ims_ InfrastructureMonitoring Service.	Sub-clause 2.1.3.1.2.1
Alarm Acknowledge/Clear, sub-clause 3.7.7	The O2 interface shall support the O2ims_ InfrastructureAlarmAcknowledge procedure associated with the O2ims_ InfrastructureMonitoring Service.	Sub-clause 2.1.3.1.2.2
	The O2 interface shall support the O2ims_InfrastructureAlarmClear procedure associated with the O2ims_InfrastructureMonitoring Service.	Sub-clause 2.1.3.1.2.3
Alarm Purge, sub-clause 3.7.13	The O2 interface shall support the O2ims_InfrastructureAlarmPurge procedure associated with the O2ims_InfrastructureMonitoring Service.	Sub-clause 2.1.3.1.2.5
Alarm List Configuration, sub-clause 3.7.11	The O2 interface shall support the O2ims_AlarmListConfigure procedure associated with the O2ims_InfrastructureMonitoring Service.	Sub-clause 2.1.3.1.2.6
Performance Measurement Job Query, sub-clause 3.8.6	The O2 interface shall support the O2ims_ PerformanceMeasurementJobQuery procedure associated with the O2ims_InfrastructureMonitoring Service.	Sub-clause 2.1.3.2.2.1
Performance Management Configuration, sub-clause 3.8.15	The O2 interface shall support the O2ims_ PerformanceMeasurementJobConfigure procedure associated with the O2ims_InfrastructureMonitoring Service.	Sub-clause 2.1.3.2.2.2
Performance Measurement Job Creation, sub-clause 3.8.1	The O2 interface shall support the O2ims_ PerformanceMeasurementJobCreate procedure associated with the O2ims_InfrastructureMonitoring Service.	Sub-clause 2.1.3.2.2.3
Performance Management Subscription, sub-clause 3.8.2	The O2 interface shall support the O2ims_ PerformanceManagementSubscriptionCreate procedure associated with the O2ims_InfrastructureMonitoring Service.	Sub-clause 2.1.3.2.2.4
Logging Configuration, sub-clause 3.7.10	The O2 interface shall support the O2ims_ InfrastructureLoggingConfiguration procedure associated with the O2ims_InfrastructureMonitoring Service.	Sub-clause 2.1.3.3.2.1
Log Query, sub-clause 3.7.8	The O2 interface shall support the O2ims_InfrastructureLoggingQuery procedure associated with the O2ims_InfrastructureMonitoring Service.	Sub-clause 2.1.3.3.2.2
Provisioning, sub-clause 3.11	The O2 interface shall support the O2ims Lifecycle Notification procedure associated with the O2ims_InfrastructureLifeCycleManagement Service.	Sub-clause 2.1.6.2.1

10.4.2.1　Additional O2-IMS Requirements

This sub-section lists additional O2-IMS capabilities that need to be supported as part of the O2-IMS interface. The procedures associated with these capabilities are being developed or are to be developed.

MVP-O2-IOT-IMSSVCS-2: The O2 interface between the SMO and the O-Cloud shall support the O-Cloud Platform Software Installation capability outlined in sub-clause 3.1.2, [O-RAN-20].

MVP-O2-IOT-IMSSVCS-3: The O2 interface between the SMO and the O-Cloud shall support the O-Cloud Registration and Initialization capability outlined in sub-clause 3.1.3, [O-RAN-20].

MVP-O2-IOT-IMSSVCS-4: The O2 interface between the SMO and the O-Cloud shall support the O-Cloud Platform Software Update capability outlined in sub-clause 3.1.6, [O-RAN-20].

MVP-O2-IOT-IMSSVCS-5: The O2 interface between the SMO and the O-Cloud shall support the O-Cloud Query capability outlined in sub-clause 3.1.11, [O-RAN-20].

MVP-O2-IOT-IMSSVCS-6: The O2 interface between the SMO and the O-Cloud shall support the O-Cloud Node Level Healing capability outlined in sub-clause 3.6.3, [O-RAN-20].

MVP-O2-IOT-IMSSVCS-7: The O2 interface between the SMO and the O-Cloud shall support the O-Cloud Node Backup capability for ETSI/NFV based O-Cloud deployment outlined in sub-clause 3.6.4, [O-RAN-20].

MVP-O2-IOT-IMSSVCS-8: The O2 interface between the SMO and the O-Cloud shall support the VLAN Allocation capability outlined in sub-clause 3.9.1, [O-RAN-20].

MVP-O2-IOT-IMSSVCS-9: The O2 interface between the SMO and the O-Cloud shall support the VLAN Deallocation capability outlined in sub-clause 3.9.2, [O-RAN-20].

MVP-O2-IOT-IMSSVCS-10: The O2 interface between the SMO and the O-Cloud shall support the Network Slice Creation capability outlined in sub-clause 3.10.1, [O-RAN-20].

MVP-O2-IOT-IMSSVCS-11: The O2 interface between the SMO and the O-Cloud shall support the Network Slice Deletion capability outlined in sub-clause 3.10.2, [O-RAN-20].

MVP-O2-IOT-IMSSVCS-12: The O2 interface between the SMO and the O-Cloud shall support the Network Resource Provisioning for Underlay Network capability outlined in sub-clause 3.11.1, [O-RAN-20].

MVP-O2-IOT-IMSSVCS-13: The O2 interface between the SMO and the O-Cloud shall support the Create Kubernetes (K8s) Cluster capability outlined in sub-clause 3.11.2 [O-RAN-20].

MVP-O2-IOT-IMSSVCS-14: The O2 interface between the SMO and the O-Cloud shall support the Delete Kubernetes (K8s) Cluster capability outlined in sub-clause 3.11.3 [O-RAN-20].

MVP-O2-IOT-IMSSVCS-15: The O2 interface between the SMO and the O-Cloud shall support the Update O-Cloud Node Cluster capability outlined in sub-clause 3.11.4 [O-RAN-20].

MVP-O2-IOT-IMSSVCS-16: The O2 interface between the SMO and the O-Cloud shall support the O-Cloud Cordon and Uncordon capability for ETSI/NFV based O-Cloud deployment outlined in sub-clause 3.12.3 [O-RAN-20].

MVP-O2-IOT-IMSSVCS-17: The O2 interface between the SMO and the O-Cloud shall support the Hearbeat Subscription capability outlined in sub-clause 3.13.1 [O-RAN-20].

10.5　F1 Requirements and IOT Profiles

O-RAN.WG5.C.1-R003-v12.02 [O-RAN-21] captures a set of profiles (message flows and IE definitions) for C-plane procedures and functions to achieve interoperability among different vendors. This sub-section identifies a subset of these profiles as requirements for the F1-c interface depicted in Figure 2.

The C-plane use-cases, associated procedures and profiles listed in table below shall be supported over the F1-c interface.

Table 10.5-1: F1-c Interface Requirements

Use-case	Procedure	Sub-clause in O-RAN Reference Specification [O-RAN-21]
F1-Setup	F1-SETUP	4.2.3.1
Cell addition	gNB-DU CONFIGURATION UPDATE	4.2.4.1.2.1
Cell deletion	gNB-DU CONFIGURATION UPDATE	4.2.4.1.2.2
Service Status change	gNB-DU CONFIGURATION UPDATE	4.2.4.1.2.3
Cell modification	gNB-DU CONFIGURATION UPDATE	4.2.4.1.2.4
Cell activation	gNB-CU CONFIGURATION UPDATE	4.2.5.1.2.1
Cell deactiation	gNB-CU CONFIGURATION UPDATE	4.2.5.1.2.2
Cell modification - update of gNB-CU generated SIB information	gNB-CU CONFIGURATION UPDATE	4.2.5.1.2.3
Cell barring	gNB-CU CONFIGURATION UPDATE	4.2.5.1.2.4
Paging (CN-initiated)	PAGING	4.2.6
Public warning initiation	WRITE-REPLACE-WARNING	4.2.7
Served Cell information update (Cell add/mod/delete/deactivate)	NG-RAN NODE CONFIGURATION UPDATE	4.2.8
Resource Status Reporting Initiation	MOBILITY LOAD BALANCING	4.2.9.1
Resource Status Reporting	MOBILITY LOAD BALANCING	4.2.9.2
UE context creation (service request)	UE INITIAL ACCESS	6.1.1
UE context creation (registration request)	UE INITIAL ACCESS	6.1.2
UE context release - DU initiated	DU InItiated UE CONTEXT RELEASE	6.2.1
UE context release - CU initiated	CU InItiated UE CONTEXT RELEASE	6.2.2
Scell to be setup/removed	gNB-CU UE CONTEXT MODIFICATION	6.3.1.1
DRB to be setup	gNB-CU UE CONTEXT MODIFICATION	6.3.1.2
DRB to be released	gNB-CU UE CONTEXT MODIFICATION	6.3.1.3
DRX cycle activation/deactivation	gNB-CU UE CONTEXT MODIFICATION	6.3.1.4
SRB to be released	gNB-CU UE CONTEXT MODIFICATION	6.3.1.5
DRB to be modified	gNB-CU UE CONTEXT MODIFICATION	6.3.1.6
UE AMBR (for UL) modification	gNB-CU UE CONTEXT MODIFICATION	6.3.1.7
Inter gNB-Handover, with Xn	INTER gNB HANDOVER	6.4.1.3
Inter gNB-Handover, without Xn	INTER gNB HANDOVER	6.4.1.5
Intra-gNB-DU, Intra Cell Handover	INTRA gNB HANDOVER	6.5.1
Intra-gNB-DU, Inter Cell Handover	INTRA gNB HANDOVER	6.5.2
Inter gNB-DU Handover	INTRA gNB HANDOVER	6.5.3
RRC Connection Re-establishment (Intra gNB-DU)	RRC CONNECTION RE-ESTABLISHMENT	6.10.1
RRC Connection Re-establishment (Inter gNB-DU)	RRC CONNECTION RE-ESTABLISHMENT	6.10.2
RRC Connection Re-establishment reject with RRC Setup	RRC CONNECTION RE-ESTABLISHMENT	6.10.3
RRC Connection Re-establishment (Inter-gNB-CU)	RRC CONNECTION RE-ESTABLISHMENT	6.10.4

System Information Deliery	SYSTEM INFORMATION	6.11.1
S-NG-RAN Node Addition	S-NG-RAN NODE ADDITION	7.1.1
M-NG-RAN node initiated SN modification (PDU Session addition)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.1
M-NG-RAN node initiated SN modification (PDU Session Release)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.2
M-NG-RAN node initiated SN modification (PDU Session Modification with QoS flow addition)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.3.1
M-NG-RAN node initiated SN modification (PDU Session Modification with QoS flow release)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.3.2
M-NG-RAN node initiated SN modification (PDU Session Modification with 5QI change)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.3.3
M-NG-RAN node initiated SN modification (Security Key change)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.4
M-NG-RAN node initiated SN modification (SCG Configuration Query)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.5
M-NG-RAN node initiated SN modification (Allowed Band Combination list update)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.6
M-NG-RAN node initiated SN modification (Allowed Band Combination list update)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.7
M-NG-RAN node initiated SN modification (Measurement Gap Coordination Procedure)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.8
S-NG-RAN node initiated SN modification with MN involvement (PDU Session Release)	S-NG-RAN NODE MODIFICATION, SN INITIATED	7.2.2.2
S-NG-RAN node initiated SN modification with MN involvement (Security Key Change)	S-NG-RAN NODE MODIFICATION, SN INITIATED	7.2.2.3
S-NG-RAN node initiated SN modification with MN involvement (PSCell change, Intra gNB-DU)	S-NG-RAN NODE MODIFICATION, SN INITIATED	7.2.2.4
S-NG-RAN node initiated SN modification with MN involvement (PSCell change, Inter gNB-DU)	S-NG-RAN NODE MODIFICATION, SN INITIATED	7.2.2.5
S-NG-RAN node initiated SN modification without MN involvement (Scell(s) addition/release: SRB3 not supported)	S-NG-RAN NODE MODIFICATION, SN INITIATED W/O MN INVOLVEMENT	7.2.3.1
M-NG-RAN node initiated SN release without keeping UE	S-NG-RAN NODE RELEASE	7.3.1
M-NG-RAN node initiated SN release with keeping UE	S-NG-RAN NODE RELEASE	7.3.2
S-NG-RAN node initiated S-NG-RAN Node Release	S-NG-RAN NODE RELEASE	7.3.3
Master Node to gNB Change (transfer UE context data from a source MN to a target gNB)	MN TO GNB CHANGE PROCEDURE	7.6.1
Inter-Master Node handover without Secondary Node change	INTER-MASTER NODE HANDOVER	7.7.1
Inter-Master Node handover with Secondary Node change	INTER-MASTER NODE HANDOVER	7.7.2
SN Initiated SN Change	S-NG-RAN NODE CHANGE	7.8.1
MN Initiated SN Change	S-NG-RAN NODE CHANGE	7.8.2

10.6 Xn Requirements and IOT Profiles

O-RAN.WG5.C.1-R003-v12.02 [O-RAN-21] captures a set of profiles (message flows and IE definitions) for C-plane procedures and functions to achieve interoperability among different vendors. This sub-section identifies a subset of these profiles as requirements for the Xn-c interface depicted in Figure 2.
The C-plane use-cases, associated procedures and profiles listed in table below shall be supported over the Xn-c interface.

Table 10.6-1: Xn-c Interface Requirements

Use-case	Procedure	Sub-clause in O-RAN Reference Specification [O-RAN-21]
Xn Setup	Xn SETUP	4.2.1
Reset	RESET	4.2.2.1
Reset(gNB-CU initiated)	RESET	4.2.2.3
Reset (gNB-DU initiated)	RESET	4.2.2.4
Served Cell information update (Cell add/mod/delete/deactivate)	NG-RAN NODE CONFIGURATION UPDATE	4.2.8
Resource Status Reporting Initiation	MOBILITY LOAD BALANCING	4.2.9.1
Resource Status Reporting	MOBILITY LOAD BALANCING	4.2.9.2
Inter gNB Handover message flow for Xn	INTER gNB HANDOVER	6.4.1.1
S-NG-RAN Node Addition	S-NG-RAN NODE ADDITION	7.1.1
M-NG-RAN node initiated SN modification (PDU Session addition)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.1
M-NG-RAN node initiated SN modification (PDU Session Release)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.2
M-NG-RAN node initiated SN modification (PDU Session Modification with QoS flow addition)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.3.1
M-NG-RAN node initiated SN modification (PDU Session Modification with QoS flow release)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.3.2
M-NG-RAN node initiated SN modification (PDU Session Modification with 5QI change)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.3.3
M-NG-RAN node initiated SN modification (Security Key change)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.4
M-NG-RAN node initiated SN modification (SCG Configuration Query)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.5
M-NG-RAN node initiated SN modification (Allowed Band Combination list update)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.6
M-NG-RAN node initiated SN modification (Allowed Band Combination list update)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.7
M-NG-RAN node initiated SN modification (Measurement Gap Coordination Procedure)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.8
S-NG-RAN node initiated SN modification with MN involvement (PDU Session Release)	S-NG-RAN NODE MODIFICATION, SN INITIATED	7.2.2.2
S-NG-RAN node initiated SN modification with MN involvement (Security Key Change)	S-NG-RAN NODE MODIFICATION, SN INITIATED	7.2.2.3
S-NG-RAN node initiated SN modification with MN involvement (PSCell change, Intra gNB-DU)	S-NG-RAN NODE MODIFICATION, SN INITIATED	7.2.2.4

S-NG-RAN node initiated SN modification with MN involvement (PSCell change, Inter gNB-DU)	S-NG-RAN NODE MODIFICATION, SN INITIATED	7.2.2.5
S-NG-RAN node initiated SN modification without MN involvement (Scell(s) addition/release: SRB3 not supported)	S-NG-RAN NODE MODIFICATION, SN INITIATED W/O MN INVOLVEMENT	7.2.3.1
M-NG-RAN node initiated SN release without keeping UE	S-NG-RAN NODE RELEASE	7.3.1
M-NG-RAN node initiated SN release with keeping UE	S-NG-RAN NODE RELEASE	7.3.2
S-NG-RAN node initiated S-NG-RAN Node Release	S-NG-RAN NODE RELEASE	7.3.3
UE measurement transfer	RRC TRANSFER	7.5.1
Master Node to gNB Change (transfer UE context data from a source MN to a target gNB)	MN TO GNB CHANGE PROCEDURE	7.6.1
Inter-Master Node handover without Secondary Node change	INTER-MASTER NODE HANDOVER	7.7.1
Inter-Master Node handover with Secondary Node change	INTER-MASTER NODE HANDOVER	7.7.2
SN Initiated SN Change	S-NG-RAN NODE CHANGE	7.8.1
MN Initiated SN Change	S-NG-RAN NODE CHANGE	7.8.2
RRC Connection Re-establishment (Inter-gNB-CU)	RRC CONNECTION RE-ESTABLISHMENT	6.10.4
System Information Deliery	SYSTEM INFORMATION	6.11.1
S-NG-RAN Node Addition	S-NG-RAN NODE ADDITION	7.1.1
M-NG-RAN node initiated SN modification (PDU Session addition)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.1
M-NG-RAN node initiated SN modification (PDU Session Release)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.2
M-NG-RAN node initiated SN modification (PDU Session Modification with QoS flow addition)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.3.1
M-NG-RAN node initiated SN modification (PDU Session Modification with QoS flow release)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.3.2
M-NG-RAN node initiated SN modification (PDU Session Modification with 5QI change)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.3.3
M-NG-RAN node initiated SN modification (Security Key change)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.4
M-NG-RAN node initiated SN modification (SCG Configuration Query)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.5
M-NG-RAN node initiated SN modification (Allowed Band Combination list update)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.6
M-NG-RAN node initiated SN modification (Allowed Band Combination list update)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.7
M-NG-RAN node initiated SN modification (Measurement Gap Coordination Procedure)	S-NG-RAN NODE MODIFICATION, MN INITIATED	7.2.1.8
S-NG-RAN node initiated SN modification with MN involvement (PDU Session Release)	S-NG-RAN NODE MODIFICATION, SN INITIATED	7.2.2.2
S-NG-RAN node initiated SN modification with MN involvement (Security Key Change)	S-NG-RAN NODE MODIFICATION, SN INITIATED	7.2.2.3
S-NG-RAN node initiated SN modification with MN involvement (PSCell change, Intra gNB-DU)	S-NG-RAN NODE MODIFICATION, SN INITIATED	7.2.2.4

S-NG-RAN node initiated SN modification with MN involvement (PSCell change, Inter gNB-DU)	S-NG-RAN NODE MODIFICATION, SN INITIATED	7.2.2.5
S-NG-RAN node initiated SN modification without MN involvement (Scell(s) addition/release: SRB3 not supported)	S-NG-RAN NODE MODIFICATION, SN INITIATED W/O MN INVOLVEMENT	7.2.3.1
M-NG-RAN node initiated SN release without keeping UE	S-NG-RAN NODE RELEASE	7.3.1
M-NG-RAN node initiated SN release with keeping UE	S-NG-RAN NODE RELEASE	7.3.2
S-NG-RAN node initiated S-NG-RAN Node Release	S-NG-RAN NODE RELEASE	7.3.3
Master Node to gNB Change (transfer UE context data from a source MN to a target gNB)	MN TO GNB CHANGE PROCEDURE	7.6.1
Inter-Master Node handover without Secondary Node change	INTER-MASTER NODE HANDOVER	7.7.1
Inter-Master Node handover with Secondary Node change	INTER-MASTER NODE HANDOVER	7.7.2
SN Initiated SN Change	S-NG-RAN NODE CHANGE	7.8.1
MN Initiated SN Change	S-NG-RAN NODE CHANGE	7.8.2

10.7   R1 Interface Requirements

This sub-section captures interface requirements for the R1 interface depicted in Figure 2. These requirements impact rApps, the non-Real-Time RIC, and the SMO. Table 10.7-1 lists the R1 interface requirements that shall be supported.

Table 10.7-1: R1 Interface Requirements

Requirement Type	Requirement/Description	O-RAN Specification Reference
MVP-R1-SME-1	The R1 Interface shall support the registration of services produced by rApp	[O-RAN-24], sub-clause 5.3
MVP-R1-SME-2	The R1 Interface shall support the update of the registered services produced by rApp	[O-RAN-24], sub-clause 5.3
MVP-R1-SME-3	The R1 Interface shall support to deregister the registered services produced by rApp	[O-RAN-24], sub-clause 5.3
MVP-R1-SME-4	The R1 Interface shall support the discovery of registered services, produced either by rApp or by the SMO/Non-RT RIC framework functions	[O-RAN-24], sub-clause 5.3
MVP-R1-SME-5	The R1 Interface shall support use of JSON Web Token in invocation of discovered services, produced either by rApp or by the SMO/Non-RT RIC framework functions	[O-RAN-22] sub-clause 5.2.6, [O-RAN-27] sub-clause 4.2
MVP-R1-SME-6	The R1 Interface shall support subscription to notification of changes in the registered services, produced either by rApp or by the SMO/Non-RT RIC framework functions	[O-RAN-24], sub-clause 5.3
MVP-R1-SME-7	The R1 Interface shall support unsubscription to notification of changes in the registered services, produced either by rApp or by the SMO/Non-RT RIC framework functions	[O-RAN-24], sub-clause 5.3
MVP-R1-SME-8	The R1 Interface shall support notification of changes in the registered services, produced either by rApp or by the SMO/Non-RT RIC framework functions	[O-RAN-22] sub-clause 5.1, [O-RAN-26] sub-clause 6.3, [O-RAN-24] sub-clause 5.3, 6.4
MVP-R1-SME-9	The R1 interface shall support subscription of notifications for added/updated/removed registration services	[O-RAN-25], sub-clause 5.1.3

MVP-R1-SME-10	The R1 interface shall support unsubscription of notifications for added/updated/removed registration services	[O-RAN-25], sub-clause 5.1.3
MVP-R1-DME-1	The R1 Interface shall support the registration of datatypes as DME Types produced by rApp	[O-RAN-24], sub-clause 5.4
MVP-R1-DME-2	The R1 Interface shall support the update of the registered datatypes as DME Types produced by rApp	[O-RAN-24], sub-clause 5.4
MVP-R1-DME-3	The R1 Interface shall support the deregistration of registered datatypes as DME Types produced by rApp	[O-RAN-24], sub-clause 5.4
MVP-R1-DME-4	The R1 Interface shall support the discovery of registered datatypes as DME Types, produced either by rApp or by the SMO/Non-RT RIC framework functions	[O-RAN-22] sub-clause 5.2, [O-RAN-26] sub-clause 7.2, [O-RAN-24] sub-clause 5.4, 7.2
MVP-R1-DME-5	The R1 Interface shall support the subscription of data for a registered datatype as DME Type	[O-RAN-25], sub-clause 5.1.3
MVP-R1-DME-6	The R1 Interface shall support the notification of data availability for the subscribed rApps	[O-RAN-24], sub-clause 5.4
MVP-R1-DME-7	The R1 Interface shall support unsubscribe from data for a datatype that had been previously subscribed	[O-RAN-24], sub-clause 5.4
MVP-R1-DME-8	The R1 interface shall support the delivery of data over Kafka for streaming data	[O-RAN-22] sub-clause 5.2, [O-RAN-26] sub-clause 7.3, [O-RAN-24] sub-clause 5.4, 7.4, 7.5, 7.7
MVP-R1-DME-9	The R1 Interface shall support delivery of file-based data over HTTPS via PUSH method	[O-RAN-22] sub-clause 5.2, [O-RAN-26] sub-clause 7.3, [O-RAN-24] sub-clause 5.4, 7.4, 7.5, 7.7
MVP-R1-DME-10	The R1 Interface shall support delivery of file-based data over HTTPS via PULL method	[O-RAN-22] sub-clause 5.2, [O-RAN-26] sub-clause 7.3, [O-RAN-24] sub-clause 5.4, 7.4, 7.5, 7.7
MVP-R1-RANNFOAM-1	The R1 Interface shall support retrieving configuration schema related to O-RAN managed entities for rApps	[O-RAN-22] sub-clause 5.4, [O-RAN-24], sub-clause 5.5, 8.4
MVP-R1-RANNFOAM-2	The R1 Interface shall support retrieving configuration data related to O-RAN managed entities for rApps	[O-RAN-22] sub-clause 5.4, [O-RAN-26] sub-clause 8.1, [O-RAN-24] sub-clause 5.5, 8.5
MVP-R1-RANNFOAM-3	The R1 Interface shall support to write configuration changes related to O-RAN managed entities for rApps	[O-RAN-22] sub-clause 5.4, [O-RAN-26] sub-clause 8.1, [O-RAN-24] sub-clause 5.5, 8.6
MVP-R1-RANNFOAM-5	The R1 Interface shall support retrieving performance data related to O-RAN managed entities for rApps	[O-RAN-24], sub-clause 5.5
MVP-R1-RANNFOAM-6	The R1 Interface shall support retrieving alarm data related to O-RAN managed entities for rApps	[O-RAN-24], sub-clause 5.5
MVP-R1-rApp-1	The R1 Interface shall support functionality to obtain the performance information related to rApps	[O-RAN-18] sub-clause 5.1
MVP-R1-rApp-2	The R1 Interface shall support functionality to obtain the fault information related to rApps	[O-RAN-18] sub-clause 5.1
MVP-R1-rApp-3	The R1 interface shall support functionality to obtain logging information related to rApps	[O-RAN-18] sub-clause 5.1
MVP-R1-rApp-4	The R1 interface shall support functionality to obtain tracing information related to rApps	[O-RAN-18] sub-clause 5.1

ANNEX: CHANGE HISTORY

Version	Date	Brief Description of Change
1.0	17 September, 2024	Initial version of the MVP
1.1	24 October, 2024	i) Addition of change history Annex ii) Editorial corrections across various sections iii)Technical updates to requirements MVP-FUNC-BAS-1, MVP-FUNC-TDD-16-2 to MVP-FUNC-TDD-16-4 iv) Addition of MVP-FUNC-MIMO-16-8a v) MVP-FUNC_MIMO-17-1 was removed because it is a 3GPP Rel-18 related requirement
2.0	10 February, 2025	i) Addition of Section 10 covering requirements for Open FH M-Plane, Open FH CUS Plane, O1, O2, F1, Xn, and R1 interfaces ii) Update ORAN-specifications to the most recent release version in Section 2

MVP

Open RAN Minimum Viable Profile

An ATIS Initiative

www.atis.org
For information, contact ATIS at (202) 628-6380.