|  |  |
| --- | --- |
| 3GPP TR 28.835 V18.0.1 (2023-06) | |
| Technical Report | |
| 3rd Generation Partnership Project;  Technical Specification Group Services and System Aspects;  Management and orchestration;  Study on management aspects of 5G Multiple Operator Core Network (MOCN) network sharing phase 2  (Release 18) | |
|  | |
|  | 3GPP-logo_web |
|  | |
| The present document has been developed within the 3rd Generation Partnership Project (3GPP TM) and may be further elaborated for the purposes of 3GPP. The present document has not been subject to any approval process by the 3GPPOrganizational Partners and shall not be implemented. This Specification is provided for future development work within 3GPPonly. The Organizational Partners accept no liability for any use of this Specification. Specifications and Reports for implementation of the 3GPP TM system should be obtained via the 3GPP Organizational Partners' Publications Offices. | |

|  |
| --- |
|  |
| ***3GPP***  Postal address  3GPP support office address  650 Route des Lucioles - Sophia Antipolis  Valbonne - FRANCE  Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16  Internet  http://www.3gpp.org |
| ***Copyright Notification***  No part may be reproduced except as authorized by written permission. The copyright and the foregoing restriction extend to reproduction in all media.  © 2023, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).  All rights reserved.  UMTS™ is a Trade Mark of ETSI registered for the benefit of its members  3GPP™ is a Trade Mark of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners LTE™ is a Trade Mark of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners  GSM® and the GSM logo are registered and owned by the GSM Association |

Contents

Foreword 4

1 Scope 6

2 References 6

3 Definitions of terms, symbols and abbreviations 6

3.1 Terms 6

3.2 Symbols 6

3.3 Abbreviations 6

4 Concepts and overview 7

5 Key issues and potential solutions 7

5.1 Issue #1: Management requirement for different POP's network operation 7

5.1.1 Description 7

5.1.2 Potential solution 7

5.2 Issue #2: Performance measurements without PLMN ID at NRCellCU 7

5.2.1 Description 7

5.2.2 Potential solutions 8

5.2.2.1 Solution 1 8

5.2.2.2 Solution 2 9

5.3 Issue #3: Management requirement between MOP-NM and MOP-SR-DM 10

5.3.1 Description 10

5.3.2 Potential solution 10

5.4 Issue #4: Service-based management architecture for MOCN 12

5.4.1 Description 12

5.4.2 Potential solution 13

5.5 Issue #5: Use of MSAC for MOCN sharing scenarios 14

5.5.1 Description 14

5.5.2 Potential solution 14

5.6 Issue #6: PLMN-related attribute requirement for operator specific IOC 14

5.6.1 Description 14

5.6.2 Potential solution 14

5.7 Issue #7: 5QI-related attribute requirement for operator specific IOC 15

5.7.1 Description 15

5.7.2 Potential solutions 15

5.7.2.1 Solution 1 15

5.7.2.2 Solution 2 15

5.7.2.3 Solution 3 16

5.8 Issue #8: PLMN granularity requirement of performance measurements for MOCN 17

5.8.1 Description 17

5.8.2 Potential solution 17

6 Conclusion and Recommendation 17

6.1 Issue #1: Management requirement for different POP's network operation 17

6.2 Issue #2: Performance measurements without PLMN ID at NRCellCU 18

6.3 Issue #3: Management requirement between MOP-NM and MOP-SR-DM 18

6.4 Issue #4: Service-based management architecture for MOCN 19

6.5 Issue #5: Use of MSAC for MOCN sharing scenarios 19

6.6 Issue #6: PLMN-related attribute requirement for operator specific IOC 19

6.7 Issue #7: 5QI-related attribute requirement for operator specific IOC 19

6.8 Issue #8: PLMN granularity requirement of performance measurements for MOCN 20

Annex A: Change history 21

# Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

In the present document, modal verbs have the following meanings:

**shall** indicates a mandatory requirement to do something

**shall not** indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

**should** indicates a recommendation to do something

**should not** indicates a recommendation not to do something

**may** indicates permission to do something

**need not** indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

**can** indicates that something is possible

**cannot** indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

**will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

**might not** indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

**is** (or any other verb in the indicative mood) indicates a statement of fact

**is not** (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

# 1 Scope

The present document studies on potential requirements, impact on interaction between MOP and POP/NEP, and management architecture and more potential performance measurements of 5G MOCN network sharing.

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 28.541: "5G Network Resource Model (NRM); Stage 2 and stage 3".

[3] 3GPP TS 28.552: "5G performance measurements".

[4] 3GPP TS 32.130: "Network sharing; Concepts and requirements".

[5] 3GPP TS 28.533: " Architecture framework".

[6] 3GPP TS 28.622: " Generic Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS) ".

[7] 3GPP TS 28.658: "Telecommunications management; Evolved Universal Terrestrial Radio Access Network (E-UTRAN) Network Resource Model (NRM) Integration Reference Point (IRP): Information Service (IS)".

[8] 3GPP TS 28.532: " Management and orchestration; Generic management services".

# 3 Definitions of terms, symbols and abbreviations

## 3.1 Terms

For the purposes of the present document, the terms given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

## 3.2 Symbols

Void

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

# 4 Concepts and overview

5G network sharing, especially the 5G MOCN scenario, is essential to save construction costs for network operators. So far, requirements of configuration, management authority and performance measurement for network sharing have been covered in TS 32.130 [4]. The NRM and part of performance measurement for 5G MOCN network sharing have been defined in TS 28.541 and TS 28.552 [3]. With the deployment and operation of 5G MOCN network sharing, more and more new detailed management requirements need be investigated for 5G MOCN network sharing. For example, preventing data modification by MOP-NM and ensuring data fairness per POP, MOP-NM needs to get different data from MOP-SR-DM, and put different data to different POP-NM. The performance measurement in TS 28.552 [3] cannot fully evaluate the network performance of 5GMOCN network sharing.

To enhance the sharing mechanism, the present document studies on management aspects of 5G MOCN network sharing, including potential requirements, impact on interaction between MOP and POP/NEP, and management architecture, and more potential performance measurements in management system.

# 5 Key issues and potential solutions

## 5.1 Issue #1: Management requirement for different POP's network operation

### 5.1.1 Description

For 5G MOCN Networking Sharing, different POP needs different data for personalized operation and maintenance services (e.g. mobility management measurements focused by POP A, packet delay measurements focused by POP B). POP-NM needs to get different data from MOP-NM for POPs' network operation.

### 5.1.2 Potential solution

1. In NG-RAN, according to different POPs' operation requirements, the 3GPP management system of the MOP shall have capability to report different operator-specific configuration (e.g. NROperatorCellCU) and performance measurement jobs (e.g. job containing mobility management measurements focused by POP A, job containing packet delay measurements focused by POP B) for each POP.

2. In NG-RAN, ensuring alarm continuity, the 3GPP management system of the MOP shall have capability to provide full operator-specific alarm data for each POP.

## 5.2 Issue #2: Performance measurements without PLMN ID at NRCellCU

### 5.2.1 Description

In TS 28.541 [2], the NRCellCU IOC with pLMNInfoList attribute can naturally distinguish PLMN granularity. However, some performance measurements that do not contain PLMN information are collected at NRCellCU in TS 28.552 [3]. These measurements, which are based on the message without PLMN Id information, are inappropriate to be collected from NRCellCU. For example, the NRCellCU which distinguishes PLMN granularity cannot collect RRC.ConnEstabAtt and RRC.ReEstabAtt (See TS 28.552 [3]) measurements.

For 5G MOCN network sharing, some potential solutions need to be studied to support above performance measurements without PLMN ID.

### 5.2.2 Potential solutions

#### 5.2.2.1 Solution 1

1. The following enhanced NR NRM solution is proposed:

Introduce new OperatorCU <<IOC>> name-contained by GNBCUCPFunction<<IOC >> to represent operator specific gNB level information (including operator specific gNB Id, gNBIdlength, pLMNId), and new NROperatorCellCU<<IOC>> name-contained by OperatorCU<<IOC>> to represent operator specific cell level information (including operator specific CelllocalId, PLMNInfoList). Which means individual OperatorCU instance and NROperatorCellCU needs to be created and configured for each POP.

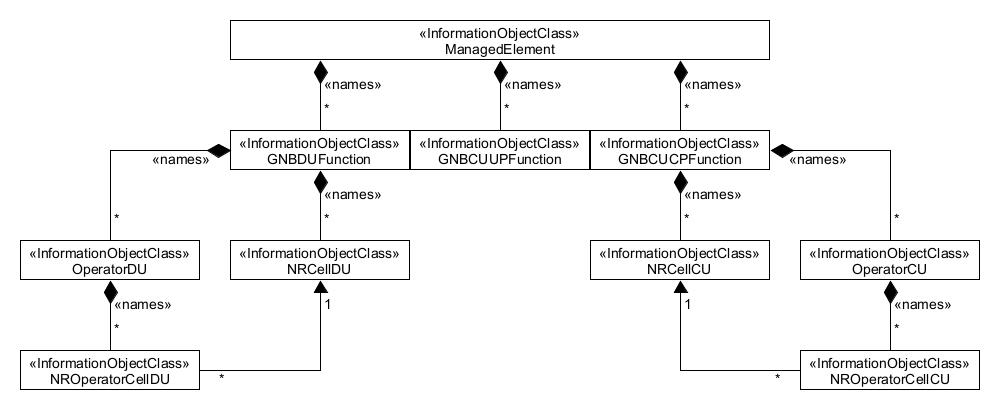


Figure 5.2-1: NR NRM enhancement to support NG-RAN sharing MOCN network sharing

The OperatorCU <<IOC>> contains attributes to support operator specific gNB-CU level information (including gNB Id, gNBIdLength, PLMNId) to support 5G Multi-Operator Core Network (5G MOCN) network sharing. Individual instance of OperatorCU <<IOC>> should be created and configured for each POP. When configured the attributes override those in parent GNBCUCPFunction instance.

The OperatorCU<<IOC>> is only used to support MOCN. If the MOCN is not supported, this IOC is not used.

The OperatorCU<<IOC>> includes attributes inherited from TOP IOC and the following attributes:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Attribute name | Support Qualifier | isReadable | isWritable | isInvariant | **isNotifyable** |
| gNBId | M | T | T | F | T |
| gNBIdLength | M | T | T | F | T |
| pLMNId | M | T | T | F | T |

NROperatorCellCU<<IOC>>

The NROperatorCellCU <<IOC>> contains attributes to support operator specific cell level information (including cellLocalId, pLMNInfoList) to support 5G Multi-Operator Core Network (5G MOCN) network sharing. Individual instance of NROperatorCellCU <<IOC>> should be created and configured for each POP. When configured the attributes override those in associated NRCellCU instance.

The NROperatorCellCU <<IOC>> is only used to support MOCN. If the MOCN is not supported, this IOC is not used.

The NROperatorCellCU <<IOC>> includes attributes inherited from TOP IOC and the following attributes:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Attribute name | Support Qualifier | isReadable | isWritable | isInvariant | **isNotifyable** |
| cellLocalId | M | T | T | F | T |
| pLMNInfoList | M | T | T | F | T |
| **Attribute related to role** |  |  |  |  |  |
| nRCellCURef | M | T | T | F | T |

Some updates are needed for NRCellCU IOC, NRCellRelation IOC and ExternalNRCellCU IOC in the existing NR NRM.

- The Support Qualifier for attribute "cellLocalId " and "pLMNInfoList" in existing NRCellCU IOC needs to be changed to "CM", the condition is " If MOCN Network Sharing is configured the value is not used ".

- The define of existing NRCellRelation IOC needs to be added: In the MOCN networking sharing scenario, the NRCellCU instance of the target cell and source cell need to be changed an NROperatorCU instance.

- The define of existing ExternalNRCellCU IOC needs to be added: In the MOCN networking sharing scenario, ExternalNRCellCU IOC represents the properties of an NROperatorCellCU controlled by another Management Service Provider.

- Operator specific measurements can be collected and reported within OperatorCU<<IOC>> and NROperatorCellCU<<IOC>>, Operator agnostic measurements can be collected and reported within GNBCUCPFunction<<IOC>> and NRCellCU<<IOC>>.

- The following NR NRM fragments need to be added.

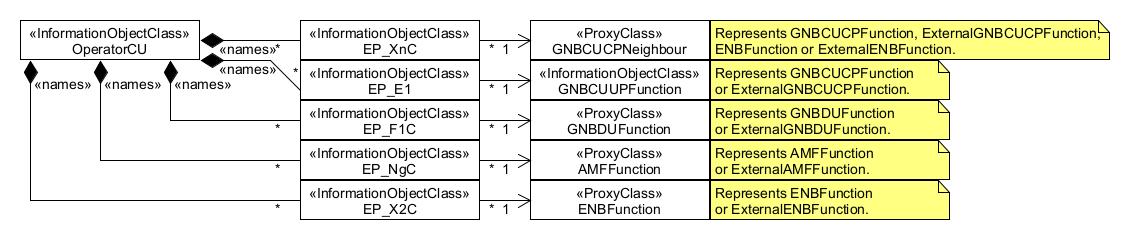


Figure 5.2-2 NRM for Eps to support <<IOC>>OperatorCU for NG-RAN MOCN network sharing

For the scenario of individual interfaces for NG-RAN MOCN network sharing, EP\_XnC, EP\_E1, EP\_F1C, EF\_NgC and EP-X2C name contained by OperatorCU can be used to represent individual interfaces for each POP.

#### 5.2.2.2 Solution 2

In this solution, NRCellDU is added as the measurement object class to the attempt and failure measurements of RRC connection related measurements. Detailedly, the following modification is applied to the measurements "5.1.1.15.1 Attempted RRC connection establishments", "5.1.1.15.3 Failed RRC connection establishments", "5.1.1.17.1 Number of RRC connection re-establishment attempts", "5.1.1.17.4 Number of RRC connection re-establishment attempts followed by RRC Setup", "5.1.1.18.1 Number of RRC connection resuming attempts", "5.1.1.18.4 RRC connection resuming followed by network release", "5.1.1.18.5 RRC connection resuming followed by network suspension", "5.1.1.18.6 Number of RRC connection resuming attempts followed by RRC Setup".

\*\*\*\*\*\*\*\* the proposed modification: \*\*\*\*\*\*\*\*\*

f) NRCellCU (for all scenarios except MOCN network sharing with multiple Cell Identity broadcast scenario),

NRCellDU (for MOCN network sharing with multiple Cell Identity broadcast scenario).

\*\*\*\*\*\*\*\* the proposed modification end \*\*\*\*\*\*\*\*\*

Based on the above mentioned modifications, for MOCN network sharing with multiple Cell Identity broadcast scenario, the corresponding KPI formulas can be:

1) RRC connection setup success rate

RRC connection setup success rate = ∑NRCellCU.RRC.ConnEstabSucc/NRCellDU.RRC.ConnEstabAtt.

That is RRC connection setup success rate on NRCellDU level the measurement shall be the averaged over all NRCellCUs Associated NRCellDU where NRCellCU.cellLocalId equeals NROperatorCellDU.cellLocalId and NROperatorCellDU.nRCellDURef equeals NRCellDU

2) RRC connection re-establishment success rate

RRC connection re-establishment success rate = (∑NRCellCU.RRC.ReEstabSuccWithUeContext+∑NRCellCU.RRC.ReEstabSuccWithoutUeContext + NRCellDU. RRC.ReEstabFallbackToSetupAtt) / NRCellDU.RRC.ReEstabAtt.

That is RRC connection re-establishment success rate on NRCellDU level the measurement shall be the averaged over all NRCellCUs Associated NRCellDU where NRCellCU.cellLocalId equeals NROperatorCellDU.cellLocalId and NROperatorCellDU.nRCellDURef equeals NRCellDU

3) RRC connection resuming success rate

RRC connection resuming success rate = (∑NRCellCU.RRC.ResumeSucc + ∑NRCellCU.RRC.ResumeSuccByFallback+ NRCellDU.RRC.ResumeFollowedbyNetworkRelease +NRCellDU.RRC.ResumeFollowedbySuspension +NRCellDU.ResumeFallbackToSetupAtt) / NRCellDU.RRC.ResumeAtt.

That is RRC connection resuming success rate on NRCellDU level the measurement shall be the averaged over all NRCellCUs Associated NRCellDU where NRCellCU.cellLocalId equeals NROperatorCellDU.cellLocalId and NROperatorCellDU.nRCellDURef equeals NRCellDU.

## 5.3 Issue #3: Management requirement between MOP-NM and MOP-SR-DM

### 5.3.1 Description

For 5G MOCN Networking Sharing, different POP needs different data for personalized operation and maintenance services (e.g. mobility management measurements focused by POP A, packet delay measurements focused by POP B). MOP-NM needs to sent different data to POP-NM for POPs' network operation.

Preventing data modification by MOP-NM and ensuring data fairness per POP, different configuration and performance measurements for each POP on MOP-SR-DM need to be forwarded to MOP-NM. Then the MOP-NM sent these data to POP-NM directly. Ensuring alarm ID continuity, different alarm data for each POP on MOP-NM need to be forwarded to each POP. The existing specifications do not provide some descriptions of these data flows and interface details for NG-RAN MOCN network sharing scenario.

### 5.3.2 Potential solution

1. The use cases of configuration, performance measurements for NG-RAN MOCN network sharing scenario can be added in TS 32.130 [4]. For example, the data flow of configuration and performance measurements is depicted in figure 5.3-1.



Figure 5.3-1: Data flow of configuration and performance measurements for NG-RAN MOCN network sharing scenario

1. The use case of alarm data for NG-RAN MOCN network sharing scenario can be added in TS 32.130 [4]. For example, the data flow of alarm data is depicted in figure 5.3-2.



Figure 5.3-2: Data flow of alarm data for NG-RAN MOCN network sharing scenario

1. Individual PerfMetricJob instance can be created and configured for each POP.

2. The following attribute pLMNId can be added to PerfMetricJob IOC defined in TS 28.622 [6] and used to identify the POP.

The optional attribute pLMNId can be used to establish operator-instance of PerfMetricJob IOC. The attribute performanceMetrics and optional attribute pLMNId together define the performance metrics to be produced according to individual POP's requirements for MOCN scenario.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Attribute name | S | isReadable | isWritable | isInvariant | isNotifyable |
| pLMNId | CO | T | T | F | T |

The attribute constraint of pLMNId shall be added as follows:

|  |  |
| --- | --- |
| Name | Definition |
| pLMNId | This attribute should be supported, when the MnS producer supports the PLMN specific jobs for MOCN scenario. |

The definition of pLMNId can see in the following table.

| Attribute Name | Documentation and Allowed Values | Properties |
| --- | --- | --- |
| pLMNId | This parameter defines the information of a PLMN identification and is used to distinguish operator granularity. It is defined in TS 28.658 [7].  allowedValues: N/A | type: PLMNId  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |

1. The getMOIAttribute operation defined in TS 28.532 [8] shall have capability to filter operator-specific managed objects.

The optional parameter "filter" shall support operator-instance filtering. The pLMNId can be one filter criteria, which is applied to the objects in the sub-tree of baseObjectInstance.

2. The getAlarmList operation defined in TS 28.532 [8] shall have capability to filter operator-specific alarms.

The optional parameter "filter" shall support operator-instance filtering. The pLMNId can be one filter criteria, which is applied to the objects selected by the "baseObjectInstance" parameter. MnS producer shall apply pLMNId on AlarmInformation instances in AlarmList when constructing its output parameter AlarmInformationList.

## 5.4 Issue #4: Service-based management architecture for MOCN

### 5.4.1 Description

The management architecture of network sharing in TS 32.130 [4] is not service-based management architecture, which cannot meet the management requirements of 5G MOCN network sharing. The Service Based Management Architecture (SBMA) need to be provided for MOCN networking sharing.

### 5.4.2 Potential solution

An example of the service-based management architecture for MOCN is depicted in figure 5.4-1. It is compliant with 3GPP management reference models (TS 28.533 [5] and TS 32.130 [4]).



Figure 5.4-1: An example of service-based management architecture for MOCN

The service-based management architecture for MOCN shows that management functions may interact by consuming management services produced by other management functions:

- POP 3GPP Mgmt. System can consume MnS(s) provided by MOP OSS.

- MOP OSS provides a set of MnS(s) for POP 3GPP Mgmt. System and consumes MnS(s) provided by MOP 3GPP Mgmt. System.

- MOP 3GPP Mgmt. System provides a set of MnS(s) for MOP OSS.

## 5.5 Issue #5: Use of MSAC for MOCN sharing scenarios

### 5.5.1 Description

For MOCN Networking Sharing and POP's network operation requirements, each POP needs to get and view some individual requirement data from MOP-SR-DM directly. In TS 32.130 [4], the data of MOP-SR-DM is transmitted to POP-NM through MOP-NM, which cannot meet the real-time acquisition and viewing data requirements of each POP. This data of MOP-SR-DM contain configuration data, performance data and alarms here. According to the POP's real-time data requirements, MOP-SR-DM needs to allow each POP to be able to access and provide relevant system user permissions for each POP.

### 5.5.2 Potential solution

The MOP-SR-DM shall allow authorized POP users to access, read and download data of configuration, performance measurements and alarms.

Editor's note: The remote access requirement of MOP-SR-DM could reuse the solution from the role-based access control capability of work item MSAC (which will be updated with a specification clause in the future).

## 5.6 Issue #6: PLMN-related attribute requirement for operator specific IOC

### 5.6.1 Description

For MOCN networking sharing and POP's network operation requirements, each POP needs to get some individual operator-specific data from MOP-SR-DM or MOP-NM. Some IOCs defined in TS 28.541 [2] should create and configure an instance for each POP, but the PLMN-related attribute of these IOCs are not defined. Some of the operations defined in TS 28.532 [8] shall have capability to filter operator-specific object instances via the PLMN-related attribute. According to the POP's data requirements and supporting the operation PLMN-filtering capability, some operator specific IOCs need to add PLMN-related attribute for creating different POPs' object instances. In addition, the operator specific IOCs mainly include two categories: specific IOCs for NRM NG-RAN MOCN network sharing(e.g. OperatorDU) and operator-related IOCs whose instances or attributes can be configured for each POP(e.g. configurable5QISet).

### 5.6.2 Potential solution

1. The OperatorDU IOC defined in TS 28.541 [2] shall add PLMN-related attributes.

The pLMNId attribute shall be added as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Attribute name | S | isReadable | isWritable | isInvariant | **isNotifyable** |
| pLMNId | M | T | T | F | T |

2. The GNBDUFunction IOC defined in TS 28.541 [2] shall add PLMN-related attributes.

The pLMNId attribute shall be added as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Attribute name | S | isReadable | isWritable | isInvariant | **isNotifyable** |
| pLMNId | O | T | T | F | T |

## 5.7 Issue #7: 5QI-related attribute requirement for operator specific IOC

### 5.7.1 Description

For MOCN RAN network sharing and POP's network operation requirements, each POP needs to get some individual operator-specific data from MOP-SR-DM or MOP-NM.

### 5.7.2 Potential solutions

#### 5.7.2.0 General

To configure operator specific 5QI an optional attribute can be added to the Configurable5QISet to identify the operator to which the 5QI set applies.

#### 5.7.2.1 Solution 1

1. The Configurable5QISet IOC defined in TS 28.541 [2] could be updated to include PLMN-related attributes identifying each POP.

2. The potential NRM changes to support above could include:

New attribute added to Configurable5QISet:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Attribute name | S | isReadable | isWritable | isInvariant | **isNotifyable** |
| pLMNId | CM | T | T | F | T |

with constraint:

|  |  |
| --- | --- |
| Name | Definition |
| pLMNId S | Condition: The NG-RAN Multi-Operator Core Network (NG-RAN MOCN) network sharing with multiple Cell Identity broadcast feature is supported. |

1. Such updated Configurable5QISet could be used to create a 5QI set for each POP's pre-configured 5QIs in MOCN networking sharing scenario.

#### 5.7.2.2 Solution 2

To configure operator specific 5QI sets, new attributes could be added to the OperatorDU to refer to operator specific 5QI sets.

This would not impact the Configurable5QISet definition and keeps the 5QI set configuration the same for RAN MOCN network sharing, and non-sharing scenarios.

1. The OperatorDU IOC defined in TS 28.541 [2] could be updated to include a reference to a specific 5QI set.

2. The potential NRM changes to support above could include:

New attributes added to OperatorDU:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Attribute name | S | isReadable | isWritable | isInvariant | **isNotifyable** |
| configurable5QISetRef | CO | T | T | F | T |
| dynamic5QISetRef | CO | T | F | F | T |

with constraints:

|  |  |
| --- | --- |
| Name | Definition |
| configurable5QISetRef | Condition: The NG-RAN Multi-Operator Core Network (NG-RAN MOCN) network sharing with operator specific 5QI is supported. |
| dynamic5QISetRef | Condition: The NG-RAN Multi-Operator Core Network (NG-RAN MOCN) network sharing with operator specific 5QI is supported. |

1. One instance of Configurable5QISet IOC defined in TS 28.541 [2] is created for each POP to support different POP's pre-configured 5QIs in MOCN RAN network sharing scenario.

2. The Configurable5QISet instance should be contained under the same GNBDUFunction MOI as the operator specific OperatorDU is contained.

3. Each operator's OperatorDU instance references their specific 5QI set via the new reference attribute (configurable5QISetRef).

#### 5.7.2.3 Solution 3

To configure operator specific 5QI sets, new attributes could be added to the Configurable5QISet to refer to operator specific DUs.

This would impact the Configurable5QISet definition and make the 5QI set configuration different for RAN MOCN network sharing, and non-sharing scenarios.

1. The Configurable5QISet IOC defined in TS 28.541 [2] could be updated to include a reference to a specific OperatorDU instance.

2. The potential NRM changes to support above could include:

New attributes added to Configurable5QISet:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Attribute name | S | isReadable | isWritable | isInvariant | **isNotifyable** |
| operatorDURef | CO | T | T | F | T |

with constraints:

|  |  |
| --- | --- |
| Name | Definition |
| operatorDURef | Condition: The NG-RAN Multi-Operator Core Network (NG-RAN MOCN) network sharing with operator specific 5QI is supported. |

1. One instance of Configurable5QISet IOC defined in TS 28.541 [2] is created for each POP to support different POP's pre-configured 5QIs in MOCN RAN network sharing scenario.

2. Each Configurable5QISet instance should be contained under the same GNBDUFunction MOI as the operator specific OperatorDU is contained.

3. Each operator's Configurable5QISet instance references their specific OperatorDU instance via the new reference attribute (operatorDURef).

## 5.8 Issue #8: PLMN granularity requirement of performance measurements for MOCN

### 5.8.1 Description

For management requirements of MOCN networking sharing, MOP-NM needs to get some PLMN granularity performance measurements to support the POP's network operation. For an operator in a shared network, cell-level metrics cannot meet the requirements of a single operator for network evaluation and optimization. The 3GPP management system of the MOP has the capability to collect and report some measurements in PLMN granularity for each POP. However, in TS 28.552 [3], some measurements(e.g. PDU session management measurements, DRB related measurements) have not yet been differentiated the PLMN granularity. So some non-PLMN performance measurements need add PLMN granularity in MOCN networking sharing scenario.

### 5.8.2 Potential solution

1. At NRCellCU, some performance measurements defined in TS 28.552 [3] need to add PLMN granularity.

The PLMN granularity need to be added in the following performance measurements:

|  |  |
| --- | --- |
| Category | Measurement Name |
| RRC connection number | Max number of stored inactive RRC Connections |
| PDU Session Management | Number of PDU Sessions requested to setup |
| Number of PDU Sessions successfully setup |
| Number of PDU Sessions failed to setup |
| DRB related measurements | Mean number of DRBs being allocated |
| Peak number of DRBs being allocated |
| QoS flow setup | Number of QoS flow attempted to setup |
| Number of QoS flow successfully established |
| Number of QoS flow failed to setup |
| QoS flow modification | Number of QoS flows attempted to modify |
| Number of QoS flows successfully modified |
| Number of QoS flows failed to modify |
| QoS flow release | Number of released active QoS flows |
| 5QI 1 QoS Flow Duration Monitoring | Average Normally Released Call (5QI 1 QoS Flow) Duration |
| Average Abnormally Released Call (5QI 1 QoS Flow) Duration |
| Distribution of Normally Released Call (5QI 1 QoS Flow) Duration |
| Distribution of Abnormally Released Call (5QI 1 QoS Flow) Duration |

2. At NRCellDU, some performance measurements defined in TS 28.552 [3] need to add PLMN granularity.

The PLMN granularity need to be added in the following performance measurements:

|  |  |
| --- | --- |
| Category | Measurement Name |
| Number of Active Ues | Max number of Active UEs in the UL per cell |
| Paging Measurement | Number of paging records received by the NRCellDU |

# 6 Conclusion and Recommendation

## 6.1 Issue #1: Management requirement for different POP's network operation

The study has identified management requirements and solutions for different POP's network operation in NG-RAN.

In NG-RAN, to manage different POP's data for personalized operation and maintenance services, the study has identified that the management system of MOP has the capability to report different operator-specific configuration and performance measurements and to provide operator-specific alarm data for each POP.

For MOCN network sharing, it is recommended to start further normative work in TS 32.130 [4] for NG-RAN.

## 6.2 Issue #2: Performance measurements without PLMN ID at NRCellCU

The study has identified the issue and solutions for NRCellCU to collect performance measurements without PLMN ID. There are two solutions to address key issue#2 in the present document. These solutions propose the principle that the new or existing IOCs are able to support the collection of these common and operator specific measurements.

- Solution 1 proposes that new IOCs (i.e. OperatorCU, NROperatorCellCU) could be added to the NR NRM to support NG-RAN sharing MOCN network sharing. The OperatorCU and NROperatorCellCU to represent the operator specific part can collect PLMN related measurements. The NRCellCU to represent the common part of the CU can collect these common measurements (i.e. RRC.ConnEstabAtt and RRC.ReEstabAtt ).

- Solution 2 proposes that NRCellDU is added as the measurement object class to the attempt and failure measurements of RRC connection related measurements.

The comparison of solutions is shown in the following table.

Table 6.2-1: Comparison of solutions of Issue#2

|  |  |  |
| --- | --- | --- |
| Dimensions | Solution 1 | Solution 2 |
| Measurement object impact | No change.  The object of these measurements is still NRCellCU. | NRCellDU.  The measurement object is NRCellDU, and the statistical point (such as RRC signalling) is in CU. The protocol layers of the two do not match. |
| Compatibility evaluation | The solution can meet potential new common performance measurement requirements of the NRCellCU. | Only resolve issues with the attempt and failure measurements of RRC connection related measurements.  The solution cannot meet potential new common performance measurement requirements of the NRCellCU. |
| The impacts of technical specifications | TS 28.541  Higher impact on the NR NRM to support NG-RAN sharing MOCN network sharing. | TS 28.552  Higher impact on the measurement object class of existing performance measurements. |
| ROI | Complex for collecting non-PLMN measurements, causing big migration of configurations | Simple solution for collecting non-PLMN measurements |

For key issue #2 and two solutions, they need further study and no normative work.

## 6.3 Issue #3: Management requirement between MOP-NM and MOP-SR-DM

The study has identified management requirements and solutions for personalized operation and maintenance services between MOP-NM and MOP-SR-DM. MOP-NM needs to sent different data to POP-NM for POPs' network operation.

It is recommended to start further normative work focusing on the following main aspects in TS 32.130 [4] for stage 1.

- Adding use cases for operator-specific configuration, performance measurements and alarm data for NG-RAN MOCN network sharing scenario in TS 32.130.

It is recommended to clarify how existing IOCs could be used in the context of network sharing scenarios in TS32.130[4].

## 6.4 Issue #4: Service-based management architecture for MOCN

The study has identified Service-based management architecture for MOCN.

To meet the management requirements of 5G MOCN network sharing, the study has depicted the overall picture of an example of service-based management architecture for MOCN compliant with 3GPP management reference models and specified management function interactions based on the architecture.

For MOCN network sharing, it is recommended to add the potential solution "An example of the service-based management architecture for MOCN" as informative annex to TS 32.130 [4].

## 6.5 Issue #5: Use of MSAC for MOCN sharing scenarios

The study has identified use of MSAC for MOCN sharing scenarios.

To get and view some individual requirement data from MOP-SR-DM directly, the study has identified that the management system of MOP-SR-DM has the capability to allow authorized POP users to access, read and download data of configuration, performance measurements and alarms. The access requirement of MOP-SR-DM could use the role-based access control solution of MSAC (which will be updated with a specification clause in the future). The existing general solutions in MSAC will be used.

For MOCN network sharing, recommendations will be added describing how to use existing access control solution of MSAC in TS 32.130 [4]. No new normative work is required for MSAC.

## 6.6 Issue #6: PLMN-related attribute requirement for operator specific IOC

The study has identified PLMN-related attribute requirement for operator specific IOC.

For MOCN networking sharing and POP's network operation requirements, each POP needs to get some individual operator-specific data from MOP-SR-DM or MOP-NM. The study has specified pLMNId of OperatorDU IOC and GNBDUFunction IOC.

For MOCN networking sharing, it is recommended to start further normative work in TS 28.541 [2].

## 6.7 Issue #7: 5QI-related attribute requirement for operator specific IOC

The study has identified 5QI-related attribute requirements and solutions for configuring operator specific 5QI. There are three solutions to address key issue#7 in the present document. These solutions propose the principle that operator related IOCs whose instances or attributes can be configured for each POP.

The comparison of solutions is shown in the followings.

Table 6.7-1: Comparison of solutions of Issue#7

|  |  |  |
| --- | --- | --- |
| Solution | Solution Summary | Solution Evaluation |
| 1 | Solution 1 proposes that the existing Configurable5QISet IOC be updated to include optional PLMN information. | The solution would result in 5QI sets being defined differently for RAN sharing and non-sharing scenarios. |
| 2 | Solution 2 proposes that new attributes could be added to the OperatorDU to refer to operator specific 5QI sets. | The solution provides a clear association between operator specific IOCs (i.e. OperatorDU) and associated 5QI (i.e. Configurable5QISet). This would not impact the Configurable5QISet definition and keeps the 5QI set configuration the same for RAN MOCN network sharing, and non-sharing scenarios. |
| 3 | Solution 3 proposes that new attributes could be added to the Configurable5QISet to refer to operator specific DUs. | The solution provides a clear association between operator specific IOCs (i.e. OperatorDU) and associated 5QI (i.e. Configurable5QISet). This would impact the Configurable5QISet definition and make the 5QI set configuration different for RAN MOCN network sharing, and non-sharing scenarios. |

For key issue #7, it is concluded that solution 2 is used as the baseline for further normative work in TS 28.541 [2].

## 6.8 Issue #8: PLMN granularity requirement of performance measurements for MOCN

The study has identified PLMN granularity requirements and solutions of performance measurements for MOCN.

For management requirements of MOCN networking sharing, the study has identified the management system of MOP has the capability to collect and report some measurements in PLMN granularity for each POP.

For MOCN networking sharing, it is recommended to add PLMN granularity in some performance measurements at NRCellCU and NRCellDU defined in TS 28.552 [3].

Annex A:  
Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2022-04 | SA5#142e | S5-222297  S5-222308  S5-222343  S5-222663 |  |  |  | 1. TR 28.835-0.0.0 initial skeleton  2. pCR Add scope to TR 28.835  3. pCR Add key issue management requirement for different POP's network operation  4. pCR Add key issue performance measurements without PLMN ID at NRcellCU | 0.1.0 |
| 2022-05 | SA5#143e | S5-223602  S5-223603  S5-223604 |  |  |  | 1. pCR TR 28.835 Add concepts and overview  2. pCR TR 28.835 Add key issue management requirement between MOP-NM and MOP-SR-DM  3. pCR TR 28.835 Add key issue service-based management architecture for MOCN | 0.2.0 |
| 2022-06 | SA5#144e | S5-224162  S5-224165  S5-224432 |  |  |  | 1.pCR TR 28.835 Add key issue remote access requirement of MOP-SR-DM for each POP  2.pCR TR 28.835 Add potential solution for remote access requirement of MOP-SR-DM for each POP  3.pCR TR 28.835 Add potential solution for management requirement between MOP-NM and MOP-SR-DM | 0.3.0 |
| 2022-08 | SA5#145e | S5-225413  S5-225815  S5-225816  S5-225817 |  |  |  | - pCR TR 28.835 Add potential solutions for performance measurements without PLMN ID at NRcellCU  - pCR TR 28.835 Add potential solution for PLMN-related attribute requirement for operator specific IOC  - pCR TR 28.835 Add key issue PLMN-related attribute requirement for operator specific IOC  - pCR TR 28.835 Update potential solution for management requirement between MOP-NM and MOP-SR-DM | 0.4.0 |
| 2022-11 | SA5#146 | S5-226527  S5-226989  S5-226991 |  |  |  | - pCR TR 28.835 Add key issue on PLMN granularity requirement of performance measurements for MOCN  - pCR TR 28.835 Add Issue for Operator Specific 5QI  - pCR TR 28.835 Add potential solution for issue on PLMN granularity requirement of performance measurements for MOCN | 0.5.0 |
| 2023-03 | SA5#147 | S5-232523  S5-232524  S5-232526 |  |  |  | pCR TR 28.835 Add conclusion and recommendation for issue #7.doc  pCR TR 28.835 Add conclusion and recommendation for issue #8.doc  pCR TR 28.835 Add conclusion and recommendation for issue #6.doc | 0.6.0 |
| 2023-05 | SA5#149 | S5-234372  S5-234543  S5-234544  S5-234545  S5-234546 |  |  |  | - pCR TR 28.835 Add conclusion and recommendation for issue #2  - pCR TR 28.835 Modify description, solution and add conclusion on issue #1  - pCR TR 28.835 Modify description, solution and add conclusion on issue #3  - pCR TR 28.835 Modify service-based management architecture for MOCN and add conclusion for issue #4  - pCR TR 28.835 Modify potential solution and add conclusion for issue #5 | 0.7.0 |
| 2023-06 | SA#100 | SP-230642 |  |  |  | Presented for information and approval | 1.0.0 |
| 2023-06 | SA#100 |  |  |  |  | Upgrade to change control version | 18.0.0 |
| 2023-06 | SA#100 |  |  |  |  | EditHelp review | 18.0.1 |