3GPP TSG SA WG5 Meeting 143-e S5-223131

**e-meeting, 9 -17 May 2022**

**Source: Nokia**

**Title: Removing recommendations options**

**Document for: Approval**

**Agenda Item: 6.6.5**

# 1 Decision/action requested

This contribution is for approval.

# 2 References

[x] TR 28.809 Study on enhancement of management data analytics

# 3 Rationale

In [x] 3GPP SA5 introduced the notion of recommendation as MDA output. MDA recommendations aim to provide several diverse potential solutions, which can help the MDA MnS consumer to decide the optimal one.

To provide recommendations, the MnS Producer relies upon, besides the analysis logic the decision logic too that helps to determine recommendations. To what extend a decision logic is needed for analytics? This needs to be discussed.

In addition, what would the nature of a recommendation be? This is currently not clear since in TS 28.104 there are proposals for potential configurations or proposals that introduce policies as recommendations or proposals that introduce selection or avoidance and may also be other forms of recommendations that currently are not even discussed. How would an MDA MnS consumer handle a set of different recommendations, which may even contract each other? This is an open issue.

But most important currently, the way recommendations are modeled is different per use case. A common way to model recommendations is an open issue that needs to capture certain parameters for example time duration, confidence degree, significance, etc. TS 28.104 provides potential recommendations that cannot be applicable since there is a luck of a model that can help in implementing them. This is a significant gap.

We believe that this topic is important for analytics but needs more time to get matured. For these reasons and also since there is not much time as Rel-17 will close in the next 2 meetings, we propose to remove recommendations from TS 28.104 Rel-17 both in requirements and MDA data, in order to allow the appropriate time to discuss and model a solution, which will be adopted by the industry and can be implemented.

# 4 Detailed proposal

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| **1st Modified Section** |

# 7 MDA use cases and requirements

## 7.1 General

## 7.2 MDA capabilities

### 7.2.1 Coverage related analytics

#### 7.2.1.1 Coverage problem analysis

##### 7.2.1.1.1 Description

This MDA capability is for analysis of coverage related problem.

##### 7.2.1.1.2 Use case

The RAN coverage problem may cause UEs to be out of service or result in a downgrade of network performance offered to the UEs, such as failure of random access, paging, RRC connection establishment or handover, low data throughput, abnormal releases of RRC connection or UE context, and dissatisfied QoE.

There are various types of coverage problems, e.g., weak coverage, a coverage hole, a pilot pollution, an overshoot coverage, or a DL and UL channel coverage mismatch, etc., caused by different sorts of reason, such as insufficient or weak transmission power, blocked by constructions and/or restricted by terrain.

The 5G related coverage problem may exist in NR, in E-UTRA or both.

To unravel a coverage problem, it is necessary for MDAS consumer to determine the details about when and where the problem occurred or likely to occur, and the type and cause(s) of the problem. Therefore, it is desirable for MDA to correlate and analyze multifold data (such as performance measurements, MDT reports, RLF reports, RCEF reports, UE location reports, together with the geographical, terrain and configuration data of the RAN) to detect and describe the problem with detailed information.

The RAN coverage related problems can cause network performance degradation and in the extreme cases can result into service degradation. So besides identifying the problems after they have happened, it is also necessary to proactively avoid the RAN coverage related problems even when given the capabilities to counteract the problems.

To avoid coverage related problems or to proactively undertake actions to avoid their occurrence, the consumer of MDA MnS may wish to know the characteristics and quality of the coverage of the RAN. This may be expressed graphically on a Map, called a Radio Environment Map, that shows the coverage quality for a set of cells. Such a map may be constructed e.g., to show the RSRP or the SINR of the cells as derived from the observed UE performance or from radio configuration parameters of the cells including transmit powers, antenna gains, antenna tilts, etc. It is desirable that the provider of MDAS can provide the Radio Environment Map in an appropriate graphical form.

Moreover, where a new RAN node is provisioned, the provider of MDAs should be able to take the coverage of existing cells as defined by a Radio Environment Map and derive the configuration of the new cell and the existing cells to optimize the coverage. Image analytics to identify the most optimized set of initial radio configurations that can be assigned to a new RAN NE.

##### 7.2.1.1.3 Requirements

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| **Requirement label** | **Description** | **Related use case(s)** |
| **REQ-COV\_MDA-01** | MDA capability for coverage problem analysis shall be able to provide the analytics for issues including, weak coverage, coverage holes, pilot pollution, overshoot coverage, or DL and UL channel coverage mismatch. | Coverage problem analysis |
| **REQ-COV\_MDA-02** | MDA capability for coverage problem analysis shall be able to provide the analytics for area specific coverage problem analysis. | Coverage problem analysis |
| **REQ-COV\_MDA-03** | MDA capability for coverage problem analysis shall be able to provide a radio environment map that graphically describes the radio coverage characteristics (e.g., RSRP or SINR) of the selected cluster of cells. | Coverage problem analysis |
| **REQ-COV\_MDA-04** | MDA capability for coverage problem analysis shall be able to provide configurations of a configurations of a RAN node based on the radio environment map that graphically describes the radio coverage characteristics (e.g., RSRP or SINR) of a selected cluster of cells. | Coverage problem analysis |

#### 7.2.1.2 Slice coverage analysis

##### 7.2.1.2.1 Description

This MDA capability is for the slice coverage analysis

##### 7.2.1.2.2 Use case

The slice coverage is one of the indicators when a 3rd party (i.e., slice tenant) issues a slice request and is mapped into the desired geographical coverage area with the available radio coverage which depends on the base station planning and deployment. In order to map the desired slice coverage perfectly, MDA can be used to optimize the slice coverage on the slice instantiation and runtime considering (i) slice-aware statistics, e.g., slice-UE distributions and mobility patterns, (ii) slice SLA and (iii) access node capabilities.

In 5G the notion of coverage is represented by a set of one or more Tracking Areas (TAs), which are contained in a Registration Area (RA), which is assigned to a UE once it registers to the network. Depending on the MDA MnS producer output, TA and RA planning, i.e., grouping cells to form a TA and then TAs to an RA, can be optimized and the RAN parameters can be adjusted to shape the cell edges and load distribution. The main objective is to fulfill a given slice SLA involving as few cells as possible by leveraging the benefits of adjusting cell configurations for satisfying the desired coverage.

##### 7.2.1.2.3 Requirements

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| **Requirement label** | **Description** | **Related use case(s)** |
| **REQ-NS\_COV\_MDA-01** | MDA capability for slice coverage analysis shall be able to provide the analytics output describing the slice coverage, slice availability and slice prediction information. | Slice coverage analysis |
| **REQ-NS\_COV\_MDA-02** | MDA capability for slice coverage analysis shall be able to provide the analytics of the mapping between slice coverage and actual radio deployment. | Slice coverage analysis |
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#### 7.2.1.3 Paging optimization analysis

##### 7.2.1.3.1 Description

This MDA capability deals with enabling various functionalities related to paging optimization.

##### 7.2.1.3.2 Use Case

As per the current procedures, if the UE goes out-of-coverage (OOC) the paging which was initiated by the network Access and Mobility Management Function (AMF) fails. The re-attempts continue to fail until UE comes in the coverage and reacts to the paging attempts. This repetitive paging attempts result in the wastage of network resources. As an example, the use case includes a user or a group of users getting into an area, with no cellular coverage on a regular basis for a considerably long duration, for e.g., the user gets into a shielded room for some testing purpose every day for a defined period. The Network initiated paging for such users will fail until they are back in the area with cellular coverage. This would result in in-efficient network resource usage.

It is desirable to use MDAS (Management data analytic service) to optimize the current paging procedures in 5G networks. MDAS producer provides an analytics output containing the user(s) paging analytics indicating the time window at which the user is OOC on a regular basis at the particular location and hence will not be able to respond on a network-initiated paging. Based on the output MDAS consumer (e.g., AMF, gNB) decides on whether, when and where to initiate or not to initiate the paging procedures, thereby ensuring the efficient paging procedures and optimal network resource utilization, as paging can be initiated only when there are more chances for it to be successful.

##### 7.2.1.3.3 Requirements

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| **Requirement label** | **Description** | **Related use case(s)** |
| **REQ-PAG\_MDA-01** | MDA capability for paging optimization analysis shall be able to provide analytics output describing paging result patterns for a particular user or a group of users. | Paging optimization analysis |
| **REQ-PAG\_MDA-02** | MDA capability for paging optimization analysis shall be able to provide analytics output describing paging result patterns based on geographical area. | Paging optimization analysis |
| **REQ-PAG\_MDA-03** | MDA capability for paging optimization analysis shall be able to provide analytics output describing the paging result patterns based on successful and un-successful paging attempts at a particular time and duration based on geographical area. | Paging optimization analysis |
| **REQ-PAG\_MDA-04** | MDA capability for paging optimization analysis shall be able to provide analytics output describing the paging result patters to contain the following information:  - Identification of the user or a group of users.  - Identify the geographical area of concern  - Prediction of the time window during which UE is out-of-coverage periodically.  - Prediction of the last known location before UE going out-of-coverage periodically.  - | Paging optimization analysis |

### 7.2.2 SLS analysis

#### 7.2.2.1 Service experience analysis

##### 7.2.2.1.1 Description

This MDA capability is for the service experience analysis.

##### 7.2.2.1.2 Use case

Service experience of end user is key indicator that directly reflects the user satisfaction degree. In 5G system, the diversity of network services is expanding all the time and the requirements of different services especially form vertical users are being standardized. Considering these diverse requirements and expectation from end user perspective (e.g., priorities of SLA related attributes such as latency, throughput, maximum user number or different required values of these attributes), the service experience as a comprehensive indicator need to be extensively analysed.

##### 7.2.2.1.3 Requirements

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| **Requirement label** | **Description** | **Related use case(s)** |
| **REQ-SER\_EXP\_MDA -01** | MDA capability for service experience analysis shall be able to identify the type of service experience issue, e.g., RAN issue, CN issue, TN issue, UE issue, service provider issue. | Service experience analysis |
| **REQ-SER\_EXP\_MDA -02** | MDA capability for service experience analysis shall be able to provide the analytics output with following information describing the current service experience aspects and potentially future prediction:  - The predicted service experience or observed service experience statistics.  - Service experience degradation root cause analysis. | Service experience analysis |
| **REQ-SER\_EXP\_MDA -03** | MDA capability for service experience analysis shall be able to provide the level of service experience | Service experience analysis |
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#### 7.2.2.2 Network slice throughput analysis

##### 7.2.2.2.1 Description

This MDA capability is for the network slice throughput analysis.

##### 7.2.2.2.2 Use case

Throughput is of great importance which represents the end users' experiences and also reflects the network problems, e.g., low UE throughput may be caused by the resource shortage. In order to satisfy the requirements of dL/ulThptPerSlice in the ServiceProfile, MDAS may be utilized for throughput related analysis/predictions for network slice instance.

MDAS producer allows the consumer to request to analyse the network slice throughput related issues and identify the root cause to assist throughput assurance. Network slice throughput analysis can be for a specific domain or for cross-domain. The two levels of MDAS producers worked in a coordinated way to assure the throughput performance. The producer of MDAS is capable to provide the MDA report including the network slice throughput analytics output.

##### 7.2.2.2.3 Requirements

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| **Requirement label** | **Description** | **Related use case(s)** |
| **REQ-THR\_MDA-1** | MDA capability for network slice throughput analysis shall be able to identify the network slice throughput issue, including, RAN issue, CN issue. | Network slice throughput analysis |
| **REQ-THR\_MDA -2** | MDA capability for network slice throughput analysis shall be able to provide the root cause analysis of the network slice throughput issue. | Network slice throughput analysis |
| **REQ-THR\_MDA -3** | MDA capability for network slice throughput analysis shall be able to provide the analytics output of the network slice throughput which contain the following information:  - Network slice throughput statistics,  - Network slice throughput predictions. | Network slice throughput analysis |
| **REQ-THR\_MDA-04** | MDA capability for network slice throughput analysis shall be able to provide the prompt when the network slice throughput exceeds or falls below a certain threshold. | Network slice throughput analysis |

#### 7.2.2.3 Network slice traffic prediction

##### 7.2.2.3.1 Description

This MDA capability is to predict network slice traffic patterns.

##### 7.2.2.3.2 Use case

It is desirable to use MDAS to get the network slice traffic predictions including individual traffic predictions on each of the constituent network functions instances present in the network slice. The individual traffic predictions can be used for better resource management of the network slice. For example, resources can be pre-configured considering the predicted traffic on the network slice.

##### 7.2.2.3.3 Requirements

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| **Requirement label** | **Description** | **Related use case(s)** |
| **REQ-TRA\_MDA--01** | MDA capability for network slice traffic prediction shall be able to provide the network slice traffic analytics output describing traffic prediction of the network slice including its constituent network functions. | Network slice traffic prediction |
| **REQ-TRA\_MDA-02** | MDA capability for network slice traffic prediction shall be able to provide the network slice traffic analytics output describing the traffic predictions for each constituent network function instance in the network slice. | Network slice traffic prediction |
| **REQ-TRA\_MDA-03** | MDA capability for network slice traffic prediction shall be able to provide output providing traffic prediction for the network slice which include the following information:  - Predicted uplink and downlink throughput on each User Plane Function instance (UPF) present in the network slice.  - Predicted number of Packet Data Unit (PDU) session for each Session Management Function (SMF) instance present in the network slice.  - Predicted number of UE or Registered subscriptions for each AMF instance present in the network slice.  - Predicted maximum packet size for each UPF instance present in the network slice.  - Predicted UE uplink and downlink throughput on each gNodeB (gNB) instance present in the network slice.  - Predicted number of UE for each gNB/NR cell instance present in the network slice. | Network slice traffic prediction |

#### 7.2.2.4 E2E latency analysis

##### 7.2.2.4.1 Description

This MDA capability is for E2E latency related issue analysis.

##### 7.2.2.4.2 Use case

E2E latency is an important parameter for URLLC services. User data packets should be successfully delivered within certain time constraints to satisfy the end users requirements. Latency could be impacted by the network capability and network configurations. These factors may be the root cause if the latency requirements cannot be achieved. Packet transmission latency may dynamically change if these factors change. The latency requirement should be assured even if some of the network conditions may degrade. It is important for the MDAS producer to analyze the latency related issues to support SLS assurance.

##### 7.2.2.4.3 Requirements

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| **Requirement label** | **Description** | **Related use case(s)** |
| **REQ-LAT\_MDA-01** | MDA capability for E2E latency analytics shall be able to identify the type of the E2E latency issue, including, RAN latency issue, CN latency issue, TN latency issue, UE latency issue，service provider latency issue. | E2E latency analytics |
| **REQ-LAT\_MDA-02** | MDA capability for E2E latency analytics shall be able to provide the root cause analysis of the E2E latency issue. | E2E latency analytics |
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#### 7.2.2.5 Network slice load analysis

##### 7.2.2.5.1 Description

This MDA capability is for network slice load analysis.

##### 7.2.2.5.2 Use cases

Network slice load may vary during different time periods. Therefore, network resources allocated initially could not always satisfy the traffic requirements, for example, the network slice may be overloaded or underutilized. Overload of signalling in control plane and/or user data congestion in user plane will lead to underperforming network. Besides, allocating excessive resources for network slice with light load will decrease resource efficiency.

The analysis of network slice load should consider the load of services with different characteristics (e.g., QoS information, service priority), load distribution to derive the corresponding resource requirements. Load distribution analytic result may be provided, e.g., load distribution for network slices, different locations and/or time periods etc.

Traffics and resources related performance measurements and UE measurements can be utilized by MDAS producer to identify degradation of the performance measurements and KPI documented in an SLS due to load issues, e.g., radio resource utilization.. This analytics results can be considered as an input to support SLA assurance to perform further evaluation.

##### 7.2.2.5.3 Requirements

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| **Requirement label** | **Description** | **Related use case(s)** |
| **REQ-NS\_LOAD\_MDA-01** | MDA capability for network slice load analytics shall be able to identify the domain of the network slice load issue, including, RAN issue, CN issue. | network slice load analytics |
| **REQ-NS\_LOAD\_MDA-02** | MDA capability for network slice load analytics shall be able to identify the phase of the network slice load issue, e.g., historic/ongoing/potential network slice load issue | network slice load analytics |
| **REQ-NS\_LOAD\_MDA-03** | MDA capability for network slice load analytics shall be able to identify the state of the network slice load issue, e.g., overload/underutilized network slice load issue. | network slice load analytics |
| **REQ-NS\_LOAD\_MDA-04** | MDA capability for network slice load analytics shall be able to identify the list of the network entities which are involved in the network slice load issue. | network slice load analytics |
| **REQ-NS\_LOAD\_MDA-05** | MDA capability for network slice load analytics shall be able to provide analytics related to network slice load within specified time schedules and geographic locations or target objects. | network slice load analytics |
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### 7.2.3 MDA assisted fault management

#### 7.2.3.1 Failure prediction

##### 7.2.3.1.1 Description

This MDA capability is for failure prediction

##### 7.2.3.1.2 Use case

There are multiple sources of faults which may cause the 5G system to fail to provide the expected service. These faults and the associated failures need extensive troubleshooting. In order to reduce network and service failure time and performance degradation, it is necessary to supervise the status of various network functions and resources, and predict the running trend of network and potential failures to intervene in advance. These predictions can be used by the management system to autonomously maintain the health of the network, e.g., recovery actions on a network function related to the predicted potential failure.

Due to the fact that failure prediction could depend on the existing alarm incidents and relevant historical and real-time data (performance measurement information, configuration data, network topology information, etc.), there is a possibility for MDA to be used in conjunction with AI/ML technologies for model training and potential failures prediction.

In order to avoid the occurrence of failures and abnormal network states, it is necessary for users to obtain the required details of potential failure and the corresponding degradation trend (abnormal KPI, performance measurement information, possible alarm type, fault root cause, etc.). Therefore, MDA, may in conjunction with AI/ML technology, be required to obtain basic health maintenance knowledge (e.g., the relationship between the failures or potential failures and the related maintenance actions) through predefined expertise or model training, so as to effectively predict potential failures. The basic health maintenance knowledge could be updated with feedback.

##### 7.2.3.1.3 Requirements

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| **Requirement label** | **Description** | **Related use case(s)** |
| **REQ-FAILURE\_PRED\_MDA-01** | MDA capability for failure prediction shall be able to collect, correlate, filter and analyse the required data (including, alarm information, historical and real-time data) as inputs for analytics and provide the analytics output. | Failure prediction |
| **REQ-FAILURE\_PRED\_MDA-02** | MDA capability for failure prediction shall be able to obtain basic health maintenance knowledges (including, the relationship between the failures or potential failures and the related maintenance actions) through predefined expertise or model training. | Failure prediction |
| **REQ-FAILURE\_PRED\_MDA-03** | MDA capability for failure prediction shall be able to provide the analytics output including predictions of potential service failures. | Failure Prediction |

### 7.2.4 MDA assisted Energy Saving

#### 7.2.4.1 Energy saving analysis

##### 7.2.4.1.1 Description

This MDA capability is for the energy saving analysis.

##### 7.2.4.1.2 Use cases

Operators are aiming at decreasing power consumption in 5G networks to lower their operational expense with energy saving management solutions. Energy saving is achieved by activating the energy saving mode of the NR capacity booster cell or 5GC NFs (e.g., UPF etc.). The energy saving decision making is typically based on the load information of the related cells/UPFs, and the energy saving policies set by operators. To achieve an optimized balance between the energy consumption and the network performance, MDA can be used to assist the MDAS consumer to make energy saving decisions.

To make the energy saving decision, it is necessary for MDAS consumer to determine where the energy efficiency issues (e.g., high energy consumption, low energy efficiency) exist, and the cause of the energy efficiency issues. Therefore, it is desirable for MDA to correlate and analyze the energy saving related performance measurements (e.g., PDCP data volume of cells, power consumption, etc.) and the network analysis data (e.g., observed service experience related network data analytics) to provide the analytics results which indicate current network energy efficiency. In some low-traffic scenarios, consumers may expect to reduce energy consumption to save energy. In this case, the consumer may request the MDAS producer to report only high energy consumption issue related analytics results. When the consumer expects to improve energy efficiency, although it may lead to high energy consumption in network or in certain parts of network, then the related issue is the low energy efficiency one. In that case, the consumer may request analytics results related to low energy efficiency issue. So the target could be to enhance the performance of NF for a given energy consumption. This will result in higher Energy Efficiency of network.

To make the energy saving decision, it is necessary for MDAS consumer to determine which energy efficiency (EE) KPI related factor(s) (e.g., traffic load, end-to-end latency, active UE numbers, etc.) are affected or potentially affected. The MDAS producer can utilize historical data to predict the EE KPI related factors (e.g., load variation of cells at some future time, etc.). The prediction result of these information can then be used by operators to make energy-saving decision to guarantee the service experience.

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##### 7.2.4.1.3 Requirements

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| **Requirement label** | **Description** | **Related use case(s)** |
| **REQ-ES\_MDA-01** | MDA capability for energy saving analysis shall be able to identify the energy efficiency issue (including high energy consumption, low energy efficiency), and identify the cell/NFs or location area of where the indicated energy efficiency issue exists. | Energy saving analysis |
| **REQ-ES\_MDA-02** | MDA capability for energy saving analysis shall be able to identify the root cause of the energy efficiency issue when necessary. | Energy saving analysis |
| **REQ-ES\_MDA-03** | MDA capability for energy saving analysis shall be able to utilize the network status analysis and predictions information of the energy efficiency KPI factors (including, traffic load trends) to assist achieving energy saving. | Energy saving analysis |
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### 7.2.5 MDA assisted mobility management

#### 7.2.5.1 Mobility performance analysis

##### 7.2.5.1.1 Description

This MDA capability is for the mobility performance analysis.

##### 7.2.5.1.2 Use case

The mobility performance related problems may result from too-early/too-late/ping-pong handovers due to inappropriate handover parameters. MDAS can be used to analyse service experience and network performance during handover period in different mobility scenarios.

In different NSA and SA deployment architecture scenarios, handover mechanisms (e.g., DAPS, CHO or RACH-less handover) will have different impacts on the mobility performance. The analytics report to identify the most optimal handover mechanism may be provided by MDAS producer.

##### 7.2.5.1.3 Requirements

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| **Requirement label** | **Description** | **Related use case(s)** |
| **REQ-MRO\_MDA-01** | MDA capability for mobility performance issue analysis shall be able to provide the mobility performance in NSA and SA deployment architectures. | Mobility performance issue analysis |
| **REQ-MRO\_MDA-02** | MDA capability for mobility performance issue analysis shall be able to provide the mobility issue analysis including too-early handovers, too-late handovers and ping-pong handovers. | Mobility performance issue analysis |
| **REQ-MRO\_MDA-03** | MDA capability for mobility performance issue analysis shall be able to identify the most optimal handover mechanism including DAPS, CHO or RACH-less handover. | Mobility performance issue analysis |
| **REQ-MRO\_MDA-04** | MDA capability for mobility performance issue analysis shall be able to provide the area specific mobility performance analysis. | Mobility performance issue analysis |

#### 7.2.5.2 Handover optimization analysis

##### 7.2.5.2.1 Description

This MDA capability is for the handover optimization analysis.

##### 7.2.5.2.2 Use cases

###### 7.2.5.2.2.1 Handover optimization

Current handover procedures are mainly based on radio conditions for selecting the target gNB upon a handover. The target gNB accepts or rejects the handover (HO) request depending on various conditions. In virtualized environment, the HO may be rejected due to inadequate available resources within the target gNB. The notion of resources may include virtual resources (e.g., compute, memory) and/or radio resources (e.g., PRB, RRC connected users). If the HO request is rejected, a UE will try to connect to a different gNB until the request is successfully accepted. Several target gNBs can be tried until the request is successfully accepted. This process can result in wastage of UE and network resources, while it may also introduce service disruption due to increased latency and radio link failures (RLFs). It also introduces inefficiency in the HO or other network procedures.

To address this handover optimization issue, it is desirable to use MDA (Management data analytics) to provision and/or select a particular target gNB for handover in order to reduce or even avoid HO rejections. The MDAS producer provides a HO optimization analytics output containing the current and future/predicted resource consumption, resources capabilities and other KPIs' status for the available target gNB(s).

###### 7.2.5.2.2.2 Handover optimization based on UE Load

The target node, eNB, may not have adequate resources to accept certain handover requests. In the context of network virtualization, these resources may include not only legacy radio resources, but also virtual resources such as processor and memory. Handover optimization can benefit from knowledge about the projected UE load on the target cell including additional radio and virtual resources.

##### 7.2.5.2.3 Requirements

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| **Requirement label** | **Description** | **Related use case(s)** |
| **REQ-MOB\_MDA-01** | MDA capability for handover optimization shall be able to provide the analytics output related to current statistics and future predictions of virtual resource consumption of gNB. | Handover optimization |
| **REQ-MOB\_MDA-02** | MDA capability for handover optimization shall be able to provide the analytics output related to current statistics and future predictions of radio resource consumption of gNB. | Handover optimization |
| **REQ-MOB\_MDA-03** | MDA capability for handover optimization shall be able to provide an analytics output indicating a selection priority for the target cell, among a set of candidate inter-frequency cells. | Handover optimization |
| **REQ-MOB\_MDA-04** | MDA capability for handover optimization shall be able to provide an analytics output indicating a list of target cells to spare, i.e., avoid, a handover for an indicated time period. | Handover optimization |
| **REQ-MOB\_MDA-05** | MDA capability for handover optimization shall be able to provide the analytics output describing inter-frequency target cell selection for handover including information for provisioning or selecting a target gNB with respect to a specific service or slice, if the same Network Slice Instance (NSI) is available in both the current and target gNB. | Handover optimization |
| **REQ-MOB\_MDA-06** | MDA capability for handover optimization shall be able to provide the analytics output describing inter-frequency target cell selection for handover including indication of current and expected QoE (for the UE) at the current and target gNB. | Handover optimization |
| **REQ-MOB\_MDA-07** | MDA capability for handover optimization shall be able to provide the analytics output including the following information that can be used to optimize handover decisions:  - Indication on whether the target gNB is optimal for handover.  - | Handover optimization |
| **REQ-MOB\_MDA-08** | MDA capability for handover optimization shall be able to provide an analytics output indicating the projected UE load with respect to virtual resource and radio resource on the target cell. | Handover optimization based on UE Load |

#### 7.2.5.3 Inter-gNB beam selection optimization

##### 7.2.5.3.1 Description

This MDA capability is for inter-gNB beam selection optimization.

##### 7.2.5.3.2 Use case

With the deployment of 5G networks, Massive MIMO has been used on a large scale. Beamforming, as a key technology to reduce user interference, which can suppress interference signals in non-target directions and enhance sound signals in target directions, is always combined with Massive MIMO to further decrease interference. A cell can make use of multiple beams for serving residing users (SSB or CSI-RS) with each user served by a single beam at a time. The cell level quality can be represented as an aggregated metric over one or more beams. So, although handover is performed between two 5G cells, the granularity of handover can be further broken down to beam level.

The handover of beams could be performed if the network resource or the user's state have changed to obtain better network performance. Beam optimization includes the handover between different beams and configuration of beam parameters.

In order to avoid selecting the wrong beam to perform RACH on the target cell and causing RLF of the UE, MDA can be used to prioritize and/or select the beam in case of handover for a specific target cell. MDA can provide a beam level HO optimization analysis considering information on the handover performance of different beam combinations between the source and target cell pairs. Beams of the target cell with a successful handover are preferred in the selection.

MDA could also provide priority options for beam selection. The MDA MnS consumer may adjust the priorities for the beam selection at HO, i.e., the beam combinations that are likely to succeed are prioritized, less optimal beam combinations are down prioritized. The target cell may also obtain analytics to allocate RACH resources in a way that ensures HO success.

In order to optimize antenna and beam configuration, so as to reduce energy loss and enhance network performance, MDA can be used to analyze the current network status.

##### 7.2.5.3.3 Requirements

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| **Requirement label** | **Description** | **Related use case(s)** |
| REQ-HO\_BEAM\_OPT-01 | MDA capability for inter-gNB beam selection optimization shall be able to provide the analytics of the handover performance of beam pair combinations between cell pairs. | Inter-gNB beam selection optimization |
| REQ-HO\_BEAM\_OPT-02 | MDA capability for inter-gNB beam selection optimization shall be able to provide an indication if a beam pair is to be prioritized or down prioritized. | Inter-gNB beam selection optimization |
| REQ-HO\_BEAM\_OPT-03 | MDA capability for inter-gNB beam selection optimization shall be able to provide feasible antenna and beam configuration analysis. | Inter-gNB beam selection optimization |

### 7.2.6 MDA assisted critical maintenance management

#### 7.2.6.1 RAN Node Software Upgrade

##### 7.2.6.2.1 Description

This MDA capability is for network critical maintenance during RAN node software upgrade process.

##### 7.2.6.2.2 Use case

As per the current mechanism of software upgrade at RAN node results in service disruption or huge operational cost. Consider a scenario, when a RAN Node is required to shut down manually to undergo critical maintenance for a very short duration of time. Software upgrade can be one such critical maintenance scenario. In such cases, all the resources (bearer, security functions, mobility management) that are managed by this RAN Node need to be purged and reconfigured at another RAN Node (standby RAN Node) or if another RAN Node is not available then resources will be reconfigured again when former RAN Node comes up after software upgrade. Both the situations lead to additional operational expenses and data loss. Operational expense in terms of all the resources to be released/attached again and data loss for all GBR sessions/bearer.

It is expected to use MDAS to optimize the procedure of software upgrade at RAN Node by providing the right time to execute the required upgrade. The software upgrade should be automatically initiated by the OAM system, once configured, during the time frame when the expected impacts are minimum i.e., at the optimal time when there would be minimum expected operational cost and data loss. The Optimal Time (current or futuristic) can be derived by collecting and analysing the data related to DRBs including GBR/non-GBR, state, modification count, ongoing handover etc. MDAS can utilize historical data and AI/ML (e.g., time series based) algorithm to derive the future optimal time frame for software upgrade.

Note: RAN Node above refers to CU-CP in case of gNB split case.

##### 7.2.6.2.3 Requirements

|  |  |  |
| --- | --- | --- |
| **Requirement label** | **Description** | **Related use case(s)** |
| **REQ-SWA\_MDA-01** | MDA capability for RAN Node software upgrade shall be able to provide the DRB info analytics output describing the DRBs info at a particular RAN Node(s). | RAN Node software upgrade |
| **REQ-SWA\_MDA-02** | MDA capability for RAN Node software upgrade shall be able to provide the DRB info analytics output describing the DRB info based on the following DRB characteristics; type (GBR/non-GBR), state (idle/active), modification count (indicating number of times, this bearer has gone for modification since its creation), handover in-progress (indicates whether the bearer is undergoing handover or not). | RAN Node software upgrade |
| **REQ-SWA\_MDA-03** | MDA capability for RAN Node software upgrade shall be able to provide output describing the DRB info that contain the following information:  - Time frame/duration at which the output is generated,  - Whether RAN Node is optimal for upgrade at present,  - Whether RAN Node will be optimal for upgrade during a future time frame. This will also provide a future frame,  - Total number of GBR and non-GBR DRBs at future point of time frame. This will also provide a future frame. | RAN Node software upgrade |

## 7.3 MDA MnS

### 7.3.1 MDA request and control

#### 7.3.1.1 Description

The MDA request and control allow any authorized MDA MnS consumer to request management data analytics.

#### 7.3.1.2 Use case

The MDA MnS consumer can request the MDA MnS producer to provide MDA output for a list of specified type of analytics, i.e., MDA type, which corresponds to an MDA capability, which is to support analytics for a set of data or analytics for a certain PM, KPI, trace or QoE data. The MDA MnS consumer may introduce control attributes related to the MDA output with respect to the geographic location (i.e., area scope) and/or the target objects, e.g., managed elements, time schedule for obtaining an MDA output, time conditions related to the preparation of MDA output, and potential filter conditions to be met before an MDA output is made available, e.g., load or delay threshold crossing related to a target object. The geographical location indicates an area of interest for obtaining MDA output and target objects include affected objects or objects of interest for obtaining MDA output.

The MDA MnS consumer may control the MDA output attributes related to, e.g., time schedule, geographical location, target objects, etc., and has the capability to modify them at any point in time. The MDA MnS consumer can request the MDA MnS producer to generate an MDA output that contains numeric output results, e.g., average, normal distribution, etc., or root case analysis, e.g., alarm prediction.

The MDA MnS consumer can be informed with an acknowledgment if the request was successful. If the request was not successful, the consumer is informed about potential errors indicating the reasons. The MDA MnS consumer can also deactivate the MDA reporting control request once it is no longer needed.

#### 7.3.1.3 Requirements

|  |  |  |
| --- | --- | --- |
| **Requirement label** | **Description** | **Related use case(s)** |
| **REQ-MDA-CONT-01** | The MDA MnS producer shall have the capability to allow any authorized MDA MnS consumer to request MDA output, while indicating its selection on the MDA type. | **All use cases** |
| **REQ-MDA-CONT-02** | The MDA MnS producer shall have the capability to allow any authorized MDA MnS consumer to request MDA output, while indicating its selection on the reporting time schedule. | **All use cases** |
| **REQ-MDA-CONT-03** | The MDA MnS producer shall have the capability to allow any authorized MDA MnS consumer to request MDA output, while indicating its selection on geographic location and/or the target objects if applicable. | **All use cases** |
| **REQ-MDA-CONT-04** | The MDA MnS producer shall have the capability to allow any authorized MDA MnS consumer to request MDA output, while indicating its selection on the time schedule related to MDA results. | **All use cases** |
| **REQ-MDA-CONT-05** | The MDA MnS producer shall have the capability to allow any authorized MDA MnS consumer to modify the attributes related to the requested MDA output. | **All use cases** |
| **REQ-MDA-CONT-6** | The MDA MnS producer shall have the capability to allow any authorized MDA MnS consumer to specify filter conditions on target objects based on threshold crossing for MDA output when this is applicable. | **All use cases** |

### 7.3.2 Obtaining MDA Output

#### 7.3.2.1 Description

Following a successful MDA request any authorized MDA MnS consumer can obtain management data analytics from the corresponding MDA MnS producer. The MDA MnS consumer can control the MDA output by modifying the attributes related to the MDA request at any point in time.

7.3.2.2 Use case

The MDA MnS consumer can obtain MDA output when the conditions indicated in the MDA request are met. An MDA output can contain one or more MDA results, which may be: (i) numeric, e.g., average, etc., (ii) root cause analysis, e.g., alarm prediction. These results may be related to one or more MDA types, which correspond to MDA capabilities, and can also contain information regarding the time schedule or the validity time of the provided MDA output.

MDA MnS consumers can request and obtain different MDA output results. The MDA MnS consumer may also obtain information regarding the geographic location and/or the target objects, e.g., managed elements, related to the provided MDA result – from the corresponding element.

The MDA MnS consumer may obtain MDA output results either by pulling or pushing mechanisms. Any MDA output may be obtained once it is prepared or when the specified MDA request and control conditions are met.

#### 7.3.2.3 Requirements

|  |  |  |
| --- | --- | --- |
| **Requirement label** | **Description** | **Related use case(s)** |
| **REQ-MDA\_REP-01** | The MDA MnS producer shall have a capability allowing MDA MnS consumers to obtain analytics output from the MnS producer. | **All use cases** |
| **REQ-MDA\_REP-02** | The MDA MnS producer shall have a capability allowing MDA MnS consumers to indicate if produced analytics output shall be pushed to the MDA MnS consumer or whether the MDA MnS consumer pulls the data. | **All use cases** |
| **REQ-MDA\_REP-03** | The MDA MnS producer shall allow MDA MnS consumer to obtain the geographic location and/or the target objects related to the MDA output if applicable. | **All use cases** |
| **REQ-MDA\_REP-04** | The MDA MnS producer shall allow MDA MnS consumer to obtain time schedule information related to the MDA output. | **All use cases** |

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# 8 MDA capability data definitions

## 8.1 Introduction

### 8.1.1 MDA Types

The output of MDA can be related to a particular capability as described in section 7, where an MDA type can indicate a specific MDA capability corresponding to a predefined use case.

The MDA capabilities may also support analytics of a set of data or analytics for certain PMs, KPIs, trace data, QoE or other type of data. Analytics related to the set of data relies on multiple raw, or already processed input data enabling an MDA MnS producer to provide more complex MDA output. Analytics related to certain set of data including PMs, KPIs, trace or QoE data may rely on these specific categories of data.

MDA MnS consumers may request output for MDA types related to analytics of a set of data or analytics for certain PMs, KPIs, trace or QoE data.

## 8.2 About analytics

### 8.2.1 About enabling data

Analytics are capability-specific, and the present document provides the enabling data for each MDA capability in the respective tables. It is not restrictive or mandatory to use the analytics inputs exactly the same as the provided enabling data for implementation, and other (additional or different) data are also allowed in order to facilitate the production of analytics outputs.

### 8.2.2 About analytics outputs

For analytics outputs, there are 1) common information elements that can be generated by MDA and be applicable for all MDA capabilities, 2) capability-specific information elements, and 3) optionally vendor specific extensions. The common information elements are provided in clause 8.3, and the capability-specific information elements are provided per MDA capability in clause 8.4 of the present document.

## 8.3 Common information elements of analytics outputs

There are some information elements that are common for all analytics outputs, i.e., these common information elements form a subset of all analytics outputs.

### 8.3.1 Common information element definitions

The common information elements of the analytics outputs are defined in table 8.3.1-1.

Table 8.3.1-1: Common information elements of analytics outputs

|  |  |  |  |
| --- | --- | --- | --- |
| Information element | Definition | Support qualifier | Properties |
| MDAType | It indicates the MDA type.  The allowed values are the MDA type names defined for each MDA capability respectively in clause 8.4. | M | type: string  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| AnalyticsId | The identifier of the analytics output. | M | type: string  multiplicity: 1  isOrdered: N/A  isUnique: True  defaultValue: None  isNullable: False |
| AnalyticsOutputGenerationTime | It indicates the time when the analytics output is generated. | M | type: DateTime  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |

## 8.4 Data definitions per MDA capability

### 8.4.1 Coverage related analytics

#### 8.4.1.1 Coverage problem analysis

##### 8.4.1.1.1 MDA type

The MDA type for coverage problem analysis is: CoverageAnalytics.CoverageProblemAnalysis.

##### 8.4.1.1.2 Enabling data

The enabling data for coverage problem analysis are provided in table 8.4.1.1.2-1.

For general information about enabling data, see clause 8.2.1.

Table 8.4.1.1.2-1: Enabling data for coverage problem analysis

|  |  |  |
| --- | --- | --- |
| Data category | Description | References |
| Performance measurements | SS-RSRP distribution per SSB (beam) of serving NR cell | SS-RSRP distribution per SSB (clause 5.1.1.22.1 of TS 28.552 [4]). |
| SS-RSRP distribution per SSB (beam) of neighbor NR cell | Editor’s note: to be defined in TS 28.552 |
| RSRP distribution of neighbor E-UTRA cell for an NR cell | Editor’s note: to be defined in TS 28.552 |
| Power headroom distribution for NR cell | Type 1 power headroom distribution (clause 5.1.1.26.1 of TS 28.552 [4]). |
| Wideband CQI distribution for NR cell | Wideband CQI distribution (clause 5.1.1.11.1 of TS 28.552 [4]). |
| Timing Advance distribution for NR cell | Editor’s note: to be defined in TS 28.552 |
| Number of UE Context Release Request (gNB-DU initiated) | Number of UE Context Release Request (gNB-DU initiated) (clause 5.1.3.5.1 of TS 28.552 [4]). |
| Number of UE Context Release Request per SSB (gNB-DU initiated) | Editor’s note: to be defined in TS 28.552 |
| Number of UE Context Release Requests (gNB-CU initiated) | Number of UE Context Release Request (gNB-CU initiated) (clause 5.1.3.5.2 of TS 28.552 [4]). |
| Number of UE Context Release Requests per SSB (gNB-CU initiated) | Editor’s note: to be defined in TS 28.552 |
| RSRP related measurements for ng-eNB | RSRP related measurements (clause 6.1 of TS 32.425 [12]). |
| UE power headroom related measurements for ng-eNB | UE power headroom related measurements (clause 6.3 of TS 32.425 [12]). |
| Wideband CQI distribution for ng-eNB | Wideband CQI distribution (clause 4.10.1.1 of TS 32.425 [12]). |
| Average sub-band CQI for ng-eNB | Average sub-band CQI (clause 4.10.1.2 of TS 32.425 [12]). |
| UE Rx – Tx time difference related measurements for ng-eNB | UE Rx - Tx time difference related measurements (clause 6.4 of TS 32.425 [12]). |
| AOA related measurements for ng-eNB | AOA related measurements (clause 6.5 of TS 32.425 [12]). |
| Timing Advance distribution for ng-eNB | Timing Advance Distribution (clause 4.10.2 of TS 32.425 [12]). |
| Number of UE CONTEXT Release Request initiated by ng-eNodeB | Number of UE CONTEXT Release Request initiated by eNodeB/RN (clause 4.1.5.1 of TS 32.425 [12]). |
| MDT reports | MDT reports containing RSRPs of the serving cell and neighbour cells, and UE location. | RSRPs and UE location of M1 measurements for NR in TS 32.422 [6] and TS 32.423 [7]. |
| RLF reports | RLF reports containing RSRPs of the last serving cell and neighbour cells, and UE location. | RLF data collection and RLF reporting in TS 32.422 [6], and rlf-Report-r16 in TS 38.331 [13]. |
| RCEF reports | RCEF reports containing RSRPs of NR cell where the RRC connection establishment failed and neighbour cells, and UE location. | RCEF data collection and RCEF reporting in TS 32.422 [6], and ConnEstFailReport-r16 in TS 38.331 [13]. |
| UE location reports | UE location information provided by the LMF services which can be used to correlate with the MDT reports. | The UE location information provided by LMF via service-based interface (see TS 23.273 [14]). |
| Geographical data | The geographical information (longitude, latitude, altitude) of the deployed RAN (NG-RAN and E-UTRAN). | Editor’s note: to be defined in TS 28.622/623 or 28.541. |
| Configuration data | The NRMs containing the attributes affecting the coverage for (NG-RAN and E-UTRAN). | NRCellDU IOC, NRSectorCarrier IOC, BWP IOC, CommonBeamformingFunction IOC, and Beam IOC in TS 28.541 [15];  EUtranGenericCell IOC in TS 28.658 [16];  SectorEquipmentFunction IOC, AntennaFunction IOC, and TMAFunction IOC in TS 28.662 [17]. |

##### 8.4.1.1.3 Analytics output

The specific information elements of the analytics output for coverage problem analysis, in addition to the common information elements of the analytics outputs (see clause 8.3), are provided in table 8.4.1.1.3-1.

Table 8.4.1.1.3-1: Analytics output for coverage problem analysis

|  |  |  |  |
| --- | --- | --- | --- |
| Information element | Definition | Support qualifier | Properties |
| CoverageProblemId | The identifier of the coverage problem. | M | type: string  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| CoverageProblemType | Indication of type of the coverage Problem.  The allowed value is one of the enumerated values: WeakCoverage, CoverageHole, PilotPollution, Overshoot coverage, DlUlChannelCoverageMismatch, Other. | M | type: enumeration  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| CoverageProblemAreas | Geographical location areas where the coverage problem occurred. | O | type: GeoArea (see TS 28.622, to be confirmed)  multiplicity: \*  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| ProblematicCells | The CGIs of cells where the coverage problem occurred. | M | type: Integer  multiplicity: \*  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
|  |  |  |  |

### 8.4.2 SLS analysis

#### 8.4.2.1 Service experience analysis

##### 8.4.2.1.1 MDA type

The MDA type for Capability-Service experience analysis is: SLSAnalysis.ServiceExperienceAnalysis.

##### 8.4.2.1.2 Enabling data

The enabling data for service experience analysis are provided in table 8.4.2.1.2-1.

Table 8.4.2.1.2-1: Enabling data for service experience analysis

|  |  |  |
| --- | --- | --- |
| Data category | Description | References |
| Performance measurements | Average e2e uplink/downlink delay for a network slice | Average e2e uplink/downlink delay for a network slice (in 6.3.1.8 in TS 28.554 [5]); |
| Integrated uplink/downlink delay in RAN | Integrated downlink delay in RAN (6.3.1.2 in TS 28.554 [5]); Integrated uplink delay in RAN (6.3.1.7 in TS 28.554 [5]); |
| Round-trip packet delay | Round-trip packet delay between PSA UPF and NG-RAN (5.4.8 in TS 28.552 [4]) |
| UL/DL throughput for network and Network Slice Instance | Upstream throughput for network and Network Slice Instance (6.3.2 in TS 28.554 [5]); Downstream throughput for Single Network Slice Instance (6.3.3 in TS 28.554 [5]) |
| RAN UE Throughput | RAN UE Throughput (6.3.6 in TS28.554 [5]) |
| Throughput at N3 interface | Upstream Throughput at N3 interface (6.3.4 in TS28.554 [5]); Downstream Throughput at N3 interface (6.3.5 in TS28.554 [5]); |
| QoE Data | The QoE data of the different services | QoE data (TS 26.247 [22] and TS 26.114 [23] can be acquired through the procedures defined in TS 28.405 [8]). |

##### 8.4.2.1.3 Analytics output

The specific information elements of the analytics output for service experience analysis, in addition to the common information elements of the analytics outputs (see clause 8.3), are provided in table 8.4.2.1.3-1.

Table 8.4.2.1.3-1: Analytics output for Service experience analysis

|  |  |  |  |
| --- | --- | --- | --- |
| Information element | Definition | Support qualifier | Properties |
| ServiceExperienceId | The identifier indicates the analytics report is related with service experience analysis. | M | type: string  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| ServiceExperienceIssueType | Indication of the service experience issue type.  The allowed value is one of the enumerated values: RAN issue, CN issue, both | M | type: ENUM  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| AffectedObjects | The managed object instances where the service experience is applicable, e.g., SubNetwork Instance, NetworkSlice Instance, S-NSSAI. | O | type: DN  multiplicity: 1..\*  isOrdered: False  isUnique: True  defaultValue: None  isNullable: False |
| ServiceExperienceStatistics | The statistics of the level of service experience for a service in a certain time period, e.g. there are five levels which are represented by 1, 2, 3, 4, 5 where level 1 represents the users are enduring bad experience while level 5 represents the users’ requirements are perfectly satisfied. | O | type: ENUM  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| ServiceExperiencePredictions | The predictions of the level of service experience for a service in a certain time period. | O | type: ENUM  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |

#### 8.4.2.2 Network slice throughput analysis

##### 8.4.2.2.1 MDA type

The MDA type for Capability-Network slice throughput analysis is: SLSAnalysis.NetworkSliceThroughputAnalysis

##### 8.4.2.2.2 Enabling data

The enabling data for network slice throughput analysis are provided in table 8.4.2.2.2-1.

**Table 8.4.2.2.2-1: Enabling data for network slice throughput analysis**

|  |  |  |
| --- | --- | --- |
| **Data category** | **Description** | **References** |
| Performance measurements | UL/DL throughput for network and Network Slice Instance | Upstream throughput for network and Network Slice Instance as defined in 6.3.2 in TS 28.554 [5]; Downstream throughput for Single Network Slice Instance as defined in 6.3.3 in TS 28.554 [5] |
| RAN UE Throughput | RAN UE Throughput as defined in 6.3.6 in TS28.554 [5] |
| Throughput at N3 interface | Upstream Throughput at N3 interface as defined in 6.3.4 in TS28.554 [5]; Downstream Throughput at N3 interface as defined in 6.3.5 in TS28.554 [5]; |

##### 8.4.2.2.3 Analytics output

The specific information elements of the analytics output for network slice throughput analysis, in addition to the common information elements of the analytics outputs (see clause 8.3), are provided in table 8.4.2.2.3-1.

Table 8.4.2.2.3-1: Network slice throughput analysis output

|  |  |  |  |
| --- | --- | --- | --- |
| Information element | Definition | Support qualifier | Properties |
| NetworkSliceThroughputIssueId | Network slice throughput issue identifier | M | type: string  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| NetworkSliceThroughputIssueType | Indication of the network slice throughput issue type  The allowed value is one of the enumerated values: RAN issue, CN issue, both | M | type: ENUM  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| NetworkSliceThroughputUserStatistics | The statistics of the UL and/or DL network slice throughput in a certain time period. The value indicates  the average percentage of users, for which the required SLS throughput satisfies | O | type: integer  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| NetworkSliceThroughputTimeStatistics | The statistics of the UL and/or DL network slice throughput in a certain time period. The value indicates the  average percentage of time, during which the required SLS throughput satisfies | O | type: integer  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| NetworkSliceThroughputUserPredictions | The predictions of the UL and/or DL network slice throughput in a certain time period. The value indicates the average percentage of users, for which the required SLS throughput could be met | O | type: integer  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| NetworkSliceThroughputTimePredictions | The predictions of the UL and/or DL network slice throughput in a certain time period. The value indicates the average percentage of time, during which the required SLS throughput could be met. | O | type: integer  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |

#### 8.4.2.3 Network slice traffic prediction

##### 8.4.2.3.1 MDA type

The MDA type for capability Network slice traffic prediction is: SLSAnalysis.NetworkSliceTrafficAnalysis.

##### 8.4.2.3.2 Enabling data

The enabling data for network slice traffic prediction analysis are provided in table 8.4.2.3.2-1.

**Table 8.4.2.3.2-1: Enabling data for network slice traffic prediction analysis**

|  |  |  |
| --- | --- | --- |
| **Data category** | **Description** | **References** |
| Performance measurements | UL/DL throughput for network slice. | Upstream throughput for network and Network Slice Instance (6.3.3 in TS28.554 [5]); Downstream throughput for Single Network Slice Instance (6.3.4 in TS28.554 [5]) |
| Number of incoming and outgoing octets of GTP packet on N3 | See 5.4.1.4 and 5.4.1.3 in TS 28.541[5]). |
| UL/DL UE throughput for network slice | RAN UE Throughput (6.3.6 in TS28.554 [5]) |
| Number of PDU sessions of network slice | Mean number of PDU sessions of network and network Slice Instance (6.4.1 in TS28.554 [5]) |
| Number of registered subscribers of a network slice instance | Mean registered subscribers of network and network slice through AMF (see 6.2.1 in TS28.554 [5]) |
| Maximum packet size for a network slice | Maximum packet size for a network slice subnet (see 6.3.11 of TS 28.541[5]) |

##### 8.4.2.3.3 Analytics output

The specific information elements of the analytics output for network slice traffic prediction analysis, in addition to the common information elements of the analytics outputs (see clause 8.3), are provided in table 8.4.2.3.3-1.

**Table 8.4.2.3.3-1: Analytics output for network slice load analysis**

|  |  |  |  |
| --- | --- | --- | --- |
| Information element | Definition | Support qualifier | Properties |
| trafficProjections | This specifies the traffic projections for a slice. | M | type: TrafficProjections  multiplicity: \*  isOrdered: N/A  isUnique: True  defaultValue: None  isNullable: False |

#### 8.4.2.4 E2E latency analysis

##### 8.4.2.4.1 MDA type

The MDA type for Capability-E2E latency analysis is: SLSAnalysis.E2ElatencyAnalysis.

##### 8.4.2.4.2 Enabling data

The enabling data for E2E latency analysis are provided in table 8.4.2.4.2-1.

Table 8.4.2.4.2-1: Enabling data for E2E latency analysis

|  |  |  |
| --- | --- | --- |
| Data category | Description | References |
| Performance measurements | Average e2e UL/DL delay for a network slice | Average e2e uplink delay for a network (6.3.1.8.1 in TS 28.554 [5]); Average e2e downlink delay for a network slice (6.3.1.8.2 in TS 28.554 [5]). |
| Integrated uplink/downlink delay in RAN | Integrated downlink delay in RAN (6.3.1.2 in TS 28.554 [5]); Integrated uplink delay in RAN (6.3.1.7 in TS 28.554 [5]); |
| Round-trip Packet Delay | Round-trip packet delay between PSA UPF and NG-RAN (5.4.8 TS 28.552 [4]) |

##### 8.4.2.4.3 Analytics output

The specific information elements of the analytics output for E2E latency analysis, in addition to the common information elements of the analytics outputs (see clause 8.3), are provided in table 8.4.2.4.3-1.

**Table 8.4.2.4.3-1: Analytics output for E2E latency analysis**

|  |  |  |  |
| --- | --- | --- | --- |
| Information element | Definition | Support qualifier | Properties |
| E2ELatencyIssueId | The identifier indicates the output is for E2E latency issue analysis | M | type: String  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| E2ELatencyIssueType | Indication the type of the E2E latency issue.  The allowed value is one of the enumerated values: RAN latency issue, CN latency issue | M | type: ENUM  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| AffectedObjects | The managed object instances of subnetwork, managed elements or network slices where the latency issue happens | O | type: DN  multiplicity: 1..\*  isOrdered: False  isUnique: True  defaultValue: None  isNullable: False |

#### 8.4.2.5 Network slice load analysis

##### 8.4.2.5.1 MDA type

The MDA type for Capability- Network slice load analysis is: SLSAnalysis.NetworkSliceLoadAnalysis.

##### 8.4.2.5.2 Enabling data

The enabling data for network slice load analysis are provided in table 8.4.2.5.2-1.

**Table 8.4.2.5.2-1: Enabling data for network slice load analysis**

|  |  |  |
| --- | --- | --- |
| **Data category** | **Description** | **References** |
| Performance measurements | Number of PDU sessions of network slice | Mean number of PDU sessions of network and network Slice Instance (6.4.1 in TS28.554 [5]) |
| Number of PDU Sessions successfully setup | Number of PDU Sessions successfully setup (5.1.1.5 in TS28.552 [4]) |
| Mean Number of PDU sessions | Number of PDU sessions(Mean) (5.3.1.1 in TS28.552 [4]) |
| Network Data Analytics | Analysis results from the control plane produced by NWDAF | Analytics data from NWDAF in TS23.288 [10] including e.g. Slice load level related network data analytics clause 6.3, and the analytics for user plane performance (i.e., average/maximum traffic rate, average/maximum packet delay, average packet loss rate in clause 6.14. |
| Configuration data | MOIs of the cells, NW slice/NW slice subnet, 5GC NFs | NRM information TS 28.541 [15] |

##### 8.4.2.5.3 Analytics output

The specific information elements of the analytics output for network slice load analysis, in addition to the common information elements of the analytics outputs (see clause 8.3), are provided in table 8.4.2.5.3-1.

**Table 8.4.2.5.3-1: Analytics output for network slice load analysis**

|  |  |  |  |
| --- | --- | --- | --- |
| Information element | Definition | Support qualifier | Properties |
| NetworkSliceLoadIssueId | The identifier indicates the output is for Network slice instance load analysis | M | type: string  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| NetworkSliceLoadIssueDomain | Indicates the domain of the network slice instance load issue  The allowed value is one of the enumerated values: RAN issue, CN issue | M | type: ENUM  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| NetworkSliceLoadIssuePhase | Indicates the phase of the network slice instance load issue  The allowed value is one of the enumerated values: historic network slice load issue, ongoing network slice load issue, potential network slice load issue | M | type: ENUM  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| NetworkSliceLoadIssueType | Indicates the type of the network slice instance load issue  The allowed value is one of the enumerated values: overload network slice load issue, underutilized network slice load issue | M | type: ENUM  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| AffectedObjects | The managed object instances involved in the network slice instance load problem | O | type: DN  multiplicity: 1..\*  isOrdered: False  isUnique: True  defaultValue: None  isNullable: False |
| NetworkSliceLoadDistribution | Describes the detailed load distribution or predictive distribution, e.g. load distribution for a network slice instance at a certain location or in a certain time period. | O | type: list  multiplicity: \*  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |

### 8.4.3 MDA assisted fault management

#### 8.4.3.1 MDA assisted failure prediction

##### 8.4.3.1.1 MDA type

The MDA type for failure prediction analysis is: MDAAssistedFaultManagement.FailurePrediction.

##### 8.4.3.1.2 Enabling data

The enabling data for failure prediction analysis are provided in table 8.4.3.1.2-1.

For general information about enabling data, see clause 8.2.1.

Table 8.4.3.1.2-1: Enabling data for fault predication analysis

|  |  |  |
| --- | --- | --- |
| Data category | Description | References |
| Performance measurements | The deteriorated performance or the abnormal performance measurements based on certain performance monitoring threshold.  3GPP management system may monitor a set of performance measurements and their thresholds, so as to support the analytics of prediction of a network service failure. | The performance measurements as defined in TS 28.552 [4] |
| Alarm notifications | Alarm information, e.g., the alarm notification of network functions. | Alarm information and notifications as per TS 28.532 [11] |
| Configuration data | MOIs of the cells, UPFs and SMFs. | TS 28.541 [15] |
| Network analytics data | The control plane analysis result from the NWDAF, e.g., observed service experience related network data analytics. | TS 23.288 [10] |

##### 8.4.3.1.3 Analytics output

The specific information elements of the analytics output for failure prediction analysis, in addition to the common information elements of the analytics outputs (see clause 8.3), are provided in table 8.4.3.1.3-1.

Table 8.4.3.1.3-1: Analytics output for fault prediction analysis

|  |  |  |  |
| --- | --- | --- | --- |
| Information element | Definition | Support qualifier | Properties |
| FailurePredictionObject | Indication of NR cells or NFs where the failure related issues occurred or potentially occur. | M | type: DN  multiplicity: 1..\*  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| PotentialFailureType | Indication of type of issues that can cause the failures.  NOTE: The values can be defined as a list of example values: "Operational Violation", "Physical Violation" and "Time Domain Violation". See alarmType described in TS 28.532 [11]. | M | type: string  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| EventTime | This field holds the time of potential failure predicted.  Examples: "20:15:00", "20:15:00-08:00" (for 8 hours behind UTC). | M | type: DateTime  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| IssueID | This filed holds the ID of this failure prediction which is reported.  When reports, this identifier can be used to provide the information to management system to maintain. | M | type: string  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| PerceivedSeverity | This field holds the value to indicate relative level of urgency for operator attention.  NOTE: the value can be Critical, Major, Minor, Warning, Indeterminate, Cleared, see ITU-T Recommendation X.733. | M | type: ENUM  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |

Editor’s note: the IssueID can be updated if agree to use another identity to identify the failure prediction reported in TS 28.104.

### 8.4.4 MDA assisted energy saving

#### 8.4.4.1 MDA type

The MDA type for energy saving analysis is: MDAAssistedEnergySaving.EnergySavingAnalysis.

#### 8.4.4.2 Enabling data

The enabling data for coverage problem analysis are provided in table 8.4.4.2-1.

For general information about enabling data, see clause 8.2.1.

Table 8.4.4.2-1: Enabling data for energy saving analysis

|  |  |  |
| --- | --- | --- |
| Data category | Description | References |
| Performance measurements | PNF Power Consumption: power consumed over the measurement period | Clause 5.1.1.19.2 of TS 28.552 [4] |
| PNF Energy consumption: energy consumed | Clause 5.1.1.19.3 of TS 28.552 [4] |
| SS-RSRP distribution per SSB (beam) of serving NR cell | Clause 5.1.1.22.1 of TS 28.552 [4]. |
| SS-RSRP distribution per SSB (beam) of neighbor NR cell | Clause 5.1.1.22.1 of TS 28.552 [4]. |
| PDCP Data Volume of NR cells: PDCP data volume delivered in the downlink and uplink; | Clause 5.1.2.1 and 5.1.3.6 of TS 28.552 [4] |
| Traffic load variation: PRB utilization rate, RRC connection number, etc. | Clause 5.1.1.2 and 5.1.1.4 of TS 28.552 [4] |
| UE throughput: UE throughput in downlink and uplink | Clause 5.1.1.3 of TS 28.552 [4] |
| Delay related measurements of UPF | Clause 5.4 of TS 28.552 [4] |
| Data volume of UPF | Clause 5.4 of TS 28.552 [4] |
| Virtual resource usage of NF: The virtual CPU usage, virtual memory usage, virtual disk usage of virtual network functions; | Clause 5.7.1 of TS 28.552 [4] |
| MDT reports | The RSRPs of UE measurements. | RSRPs of M1 measurements in TS 32.422 [6] and TS 32.423 [7]. |
| The RSRQs of UE measurements. | RSRQs of M1 measurements in TS 32.422 [6] and TS 32.423 [7]. |
| The UE location information. | UE location of M1 measurements in TS 32.422 [6] and TS 32.423 [7]. |
| QoE Data | The measurements that are collected are DASH and MTSI measurements. | TS 28.406 [9] |
| Configuration data | MOIs of the cells, UPFs and SMFs. | TS 28.541 [15] |
| Network analytics data | The control plane analysis result from the NWDAF, e.g., observed service experience related network data analytics. | TS 23.288 [10] |

#### 8.4.4.3 Analytics output

The specific information elements of the analytics output for energy saving analysis, in addition to the common information elements of the analytics outputs (see clause 8.3), are provided in table 8.4.4.3-1.

Table 8.4.4.3-1: Analytics output for energy saving analysis

|  |  |  |  |
| --- | --- | --- | --- |
| Information element | Definition | Support qualifier | Properties |
| EnergyEfficiencyProblematicObject | Indication of NR cells or NFs where the energy efficiency issues occurred or potentially occur. | M | type: DN  multiplicity: 1..\*  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| EnergyEfficiencyProblemType | Indication of type of the energy efficiency issues.  The allowed value is one of the enumerated values: HighEnergyConsumption, LowEenergyEfficiency, Other, Unknown. | M | type: enumeration  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| TrafficLoadTrends | The predictions of the trends of traffic load in a certain time period. The predictions include the traffic load of the issue cell(s) and neighboring cell(s). | M | type:TrafficLoadTrend  multiplicity: 1..\*  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
|  |  |  |  |
| StatisticsOfCellsEsState | The statistic result of current energy saving state of the cells at a certain time, which can be used by consumers to make analysis (e.g., observed service experience analysis made by NWDAF) or to make decision (e.g., enter/exit the energy saving state based on the current energy saving state). | O | type: StatisticOfCellEsState  multiplicity: 1..\*  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |

### 8.4.5 MDA assisted mobility management

#### 8.4.5.1 Mobility performance analysis

##### 8.4.5.1.1 MDA type

The MDA type for mobility performance analysis is: MobilityManagementAnalytics.MobilityPerformanceAnalysis.

##### 8.4.5.1.2 Enabling data

The enabling data for mobility performance analysis are provided in table 8.4.5.1.2-1.

For general information about enabling data, see clause 8.2.1.

Table 8.4.5.1.2-1: Enabling data for mobility performance analysis

|  |  |  |
| --- | --- | --- |
| Data category | Description | References |
| Performance measurements | Inter-gNB handovers | Inter-gNB handovers (clause 5.1.1.6.1 of TS 28.552 [4]). |
| Intra-gNB handovers | Inter-gNB handovers (clause 5.1.1.6.4 of TS 28.552 [4]). |
| Inter-gNB DAPS handovers | Inter-gNB handovers (clause 5.1.1.6.2 of TS 28.552 [4]). |
| Intra-gNB DAPS handovers | Inter-gNB handovers (clause 5.1.1.6.3 of TS 28.552 [4]). |
| Inter-gNB conditional handovers | Inter-gNB handovers (clause 5.1.1.6.6 of TS 28.552 [4]). |
| Intra-gNB conditional handovers | Inter-gNB handovers (clause 5.1.1.6.7 of TS 28.552 [4]). |

##### 8.4.5.1.3 Analytics output

The specific information elements of the analytics output (MDA report) for mobility performance analysis, in addition to the common information elements of the analytics outputs (see clause 8.3), are provided in table 8.4.5.1.3-1.

Table 8.4.5.1.3-1: Analytics output for Mobility Performance analysis

|  |  |  |  |
| --- | --- | --- | --- |
| Information element | Definition | Support qualifier | Properties |
| mobilityPerformance IssueIdentifier | The identifier of the mobility performance issue analysis; | M | type: integer  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| mobilityPerformance IssueRootCause | The root cause of mobility performance issues.  The allowed value is one of the enumerated values: too long mobility interruption time, poor coverage of the cell-edge, inappropriate handover parameters, other. | M | type: ENUM  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| mobilityPerformance IssueLocation | Geographical location areas where the mobility performance issue occurred. | O | type: GeoArea (see TS 28.622, to be confirmed)  multiplicity: \*  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |

### 8.4.6 Maintenance management related analytics

#### 8.4.6.1 Maintenance management analysis

##### 8.4.6.1.1 MDA type

The MDA type for maintenance management is: Maintenance.MaintenanceAnalytics.

##### 8.4.6.1.2 Enabling data

The enabling data for maintenance management analysis are provided in table 8.4.6.1.2-1.

For general information about enabling data, see clause 8.2.1.

Table 8.4.6.1.2-1: Enabling data for maintenance analysis

|  |  |  |
| --- | --- | --- |
| Data category | Description | References |
| Performance Measurements | Number of Active DRB. | Mean number of DRBs being allocated (clause 5.1.1.10.9 of TS 28.552[4]). |
| Number of bearers undergoing handover | Number of requested preparations for handovers from 5GS to EPS (clause 5.1.1.6.3.1 of TS 28.552[4]).  Number of requested resource allocations for handovers from EPS to 5GS (clause 5.1.1.6.3.4 of TS 28.552[4])  Number of requested preparations for EPS fallback handovers (clause 5.1.1.6.3.10 of TS 28.552[4])  Number of successful executions for EPS fallback handovers (clause 5.1.1.6.3.13 of TS 28.552[4]) |
| Number of bearers being recovered from the error state. | Editors Note: to be defined in TS 28.552. |
| Number of successful bearer modification | Number of QoS flows attempted to modify (clause 5.1.1.13.4.1 of TS 28.552[4]) |

##### 8.4.6.1.3 Analytics output

The specific information elements of the analytics output for maintenance management analysis, in addition to the common information elements of the analytics outputs (see clause 8.3), are provided in table 8.4.6.1.3-1.

Table 8.4.6.1.3-1: Analytics output for maintenance analysis

|  |  |  |  |
| --- | --- | --- | --- |
| Information element | Definition | Support qualifier | Properties |
| CurrentUpgradeOptimal | This data type defines whether gNB can be upgrade at present. | M | type: CurrentUpgrade  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: none  isNullable: False |
| FutureUpgradeOptimal | This data type defines whether the gNB can be upgrade in future and when. | M | type: FutureUpgrade  multiplicity: \*  isOrdered: N/A  isUnique: N/A  defaultValue: none  isNullable: False |
| gNBID | This identifies the gNB |  | type: String  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: none  isNullable: False |

## 8.5 Data type definitions



### 8.5.4 TrafficLoadTrend <<dataType>>

#### 8.5.4.1 Definition

This data type specifies the type of TrafficLoadTrend.

#### 8.5.4.2 Information elements

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Definition | Support qualifier | Properties |
| CellId | It indicates the cell for which the traffic load prediction is performed. | M | type: Integer  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| StartTime | It indicates the start time that are used for prediction. | M | type: DateTime  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| EndTime | It indicates the end time that are used for prediction. | M | type: DateTime  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| TrafficLoadList | It provides a list of PRB usage based on a specific granularity. | M | type: Integer  multiplicity: 1..\*  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |











### 8.5.8 StatisticOfCellEsState <<dataType>>

#### 8.5.8.1 Definition

This data type specifies the type of statistics of cells energy saving state in the analytics output.

#### 8.5.8.2 Information elements

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Definition | Support qualifier | Properties |
| CellId | It indicates the cell for which the statistics is performed. | M | type: DN  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| StartTime | It indicates the start time that are used for statistics. | M | type: DateTime  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| EndTime | It indicates the end time that are used for statistics. | M | type: DateTime  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| RatioOfEsStateTime | It provides the ratio of the time when the cell is in the energy saving state to the total time between StartTime and EndTime. | M | type: Real  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |

### 8.5.9 CurrentUpgrade <<dataType>>

#### 8.5.9.1 Definition

This data type specifies whether it is optimal to upgrade the gNB at present.

#### 8.5.9.2 Information elements

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Definition | Support qualifier | Properties |
| CurrentUpgradeOptimal | Boolean attribute indicating whether RAN Node can be upgrade at present. |  | type: Boolean  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| numberOfGBRDRB | This specifies the total number of GBR bearer at present |  | type: Integer  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| NumberOfNonGBRDRB | This specifies the total number of non-GBR bearer at present |  | type: Integer  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |

### 8.5.10 FutureUpgrade <<dataType>>

#### 8.5.10.1 Definition

This data type specifies whether it is optimal to upgrade the gNB at a future point of time.

#### 8.5.10.2 Information elements

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Definition | Support qualifier | Properties |
| FutureUpgradeOptimal | Boolean attribute indicating whether RAN Node can be upgrade at a future point of time. | M | type: Boolean  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| OptimalTime | This specifies the future time at which the gNB can be upgraded optimally.  This shall be present only if the FutureUpgradeOptimal is TRUE | CM | type: DateTime  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| numberOfGBRDRB | This specifies the total number of GBR bearer which will be present at the time stamp provided by the attribute OptimalTime.  This shall be present only if the FutureUpgradeOptimal is TRUE | CM | type: Integer  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| NumberOfNonGBRDRB | This specifies the total number of non-GBR bearer which will be present at the time stamp provided by the attribute OptimalTime.  This shall be present only if the FutureUpgradeOptimal is TRUE | CM | type: Integer  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |

### 8.5.11 TrafficProjections <<dataType>>

#### 8.5.11.1 Definition

This data type specifies the traffic projection for a slice.

#### 8.5.11.2 Information elements

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Definition | Support qualifier | Properties |
| ProjectionTime | The time duration for which the projections are made | M | type: ProjectionDuration  multiplicity: 1  isOrdered: N/A  isUnique: True  defaultValue: None  isNullable: False |
| UPFProjections | This specifies the traffic projection of a UPF in the slice. | M | type: UPFProj  multiplicity: 1  isOrdered: N/A  isUnique: True  defaultValue: None  isNullable: False |
| gNBProjections | This specifies the traffic projection of a gNB in the slice. | M | type: gNBProj  multiplicity: 1  isOrdered: N/A  isUnique: True  defaultValue: None  isNullable: False |
| SMFProjections | This specifies the projected number of PDU session of a SMF in the slice. | M | type: Integer  multiplicity: 1  isOrdered: N/A  isUnique: True  defaultValue: None  isNullable: False |
| AMFProjections | This specifies the projected number of registered subscriber of an AMF in the slice. | M | type: Integer  multiplicity: 1  isOrdered: N/A  isUnique: True  defaultValue: None  isNullable: False |

### 8.5.12 UPFProj <<dataType>>

#### 8.5.12.1 Definition

This data type specifies the traffic projection for a UPF.

#### 8.5.12.2 Information elements

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Definition | Support qualifier | Properties |
| ULThroughput | The projected average UL throughput for a single UPF in the slice, over the time duration indicated by projectionTime attribute. The unit is kbit/s.  This is the projection of the Upstream Throughput at N3 interface KPI defined in [5] | M | type: Integer  multiplicity: 1  isOrdered: N/A  isUnique: True  defaultValue: None  isNullable: False |
| DLThroughput | The projected average DL throughput for a single UPF in the slice, over the time duration indicated by projectionTime attribute. The unit is kbit/s.  This is the projection of the Downstream Throughput at N3 interface KPI defined in [5] | M | type: Integer  multiplicity: 1  isOrdered: N/A  isUnique: True  defaultValue: None  isNullable: False |
| MaxPktSize | The projected average maximum packet size for a single UPF in the slice, over the time duration indicated by projectionTime attribute. | O | type: Integer  multiplicity: 1  isOrdered: N/A  isUnique: True  defaultValue: None  isNullable: False |

### 8.5.13 gNBProj <<dataType>>

#### 8.5.13.1 Definition

This data type specifies the traffic projection for a gNB.

#### 8.5.13.2 Information elements

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Definition | Support qualifier | Properties |
| ULUEThroughput | The projected average UL UE throughput in the slice, over the time duration indicated by projectionTime attribute. The unit is kbit/s.  This is the projection of the UL RAN UE throughput KPI defined in [5] | M | type: Integer  multiplicity: 1  isOrdered: N/A  isUnique: True  defaultValue: None  isNullable: False |
| DLUEThroughput | The projected average DL throughput in the slice, over the time duration indicated by projectionTime attribute. The unit is kbit/s.  This is the projection of the DL RAN UE throughput KPI defined in [5] | M | type: Integer  multiplicity: 1  isOrdered: N/A  isUnique: True  defaultValue: None  isNullable: False |

|  |
| --- |
| **End of Modified Section** |