

ETSI TS 128 537 V17.3.0 (2022-07)



**5G;
Management and orchestration;
Management capabilities
(3GPP TS 28.537 version 17.3.0 Release 17)**



Reference

RTS/TSGS-0528537vh30

Keywords

5G

ETSI

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Sous-Préfecture de Grasse (06) N° w061004871

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Foreword

This Technical Specification 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:

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- 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, certain 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" shall not to be used as 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 specifies use cases, requirements and procedures for management capabilities of 5G networks.

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 28.532: "Management and orchestration; Generic management services".
- [3] 3GPP TS 28.533: " Management and orchestration; Architecture framework".
- [4] 3GPP TS 28.552: "Management and orchestration; 5G performance measurements".
- [5] 3GPP TS 28.554: "Management and orchestration; 5G end to end Key Performance Indicators (KPI)".
- [6] 3GPP TS 32.422: "Telecommunication management; Subscriber and equipment trace; Trace control and configuration management".

3 Definitions of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in 3GPP 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 3GPP TR 21.905 [1].

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP 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 3GPP TR 21.905 [1].

MnS	Management Service
-----	--------------------

4 Heartbeat

4.1 Overview

The communication between Management Service (MnS) producers and MnS consumers shall be monitored, and communication link breaks between them shall be discovered by MnS consumers as early as possible. The behaviour of the MnS consumers, after detection of communication failure, is outside the scope of the present document.

4.2 Specification level requirements

4.2.1 Use cases

4.2.1.1 Configuring heartbeat notification periodicity

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	To configure the periodicity at which the management service producer shall emit heartbeat notifications to its authorized management service consumer.	
Actors and Roles	An authorized consumer of the management service.	
Telecom resources	The management service producer.	
Assumptions	N/A	
Pre-conditions	The periodicity requested by the management service consumer has a valid value.	
Begins when	The management service consumer sends a request to the management service producer to set the periodicity at which it shall emit heartbeat notifications.	
Step 1	The management service producer receives the request and sets its internal countdown timer to a value (which can be zero) equal to the periodicity requested by the management service consumer.	
Step 2	The management service producer sends a heartbeat notification to all authorized management service consumer(s), provided they previously subscribed to heartbeat notifications.	
Ends when	All the steps identified above are successfully completed.	
Exceptions	One of the steps identified above fails.	
Post-conditions	The notification periodicity has been configured according to the management service consumer request. A heartbeat notification is sent out to all authorized management service consumer(s).	
Traceability	REQ-HB-CTRL-FUN-2.	

4.2.1.2 Requesting immediate heartbeat notification

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	To trigger the emission of an immediate heartbeat notification by the management service producer.	
Actors and Roles	An authorized consumer of the management service.	
Telecom resources	The management service producer.	
Assumptions	N/A	
Pre-conditions	N/A	
Begins when	The soliciting management service consumer sends a request to the management service producer to emit immediately a heartbeat notification.	
Step 1	The management service producer receives the request and sends immediately a heartbeat notification to all authorized management service consumer(s) who had previously subscribed to heartbeat notifications. The management service producer countdown timer is not impacted.	
Ends when	All the steps identified above are successfully completed.	
Exceptions	One of the steps identified above fails.	
Post-conditions	The immediate heartbeat notification has been emitted according to the soliciting management service consumer request.	
Traceability	REQ-HB-CTRL-FUN-3, REQ-HB-NOTIF-FUN-2.	

4.2.1.3 Emitting periodic heartbeat notifications

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	To send periodic heartbeat notifications at the periodicity requested by the management service consumer.	
Actors and Roles	An authorized producer of the management service.	
Telecom resources	The management service consumer.	
Assumptions	The heartbeat notification periodicity has been configured according to the management service consumer request.	Configuring heartbeat notification periodicity
Pre-conditions	N/A	
Begins when	The internal countdown timer managed by the management service producer has reached the value 0.	
Step 1	The management service producer sends a heartbeat notification to all authorized management service consumer(s), provided they previously subscribed to heartbeat notifications.	
Step 2	The management service producer resets its internal countdown timer to the value of the heartbeat notification periodicity.	Configuring heartbeat notification periodicity
Ends when	All the steps identified above are successfully completed.	
Exceptions	One of the steps identified above fails.	
Post-conditions	The periodic heartbeat notification has been emitted to all authorized management service consumer(s) at the requested periodicity.	
Traceability	REQ-HB-NOTIF-FUN-1.	

4.2.2 Requirements

4.2.2.1 Requirements for controlling heartbeat

REQ-HB-CTRL-FUN-1: The management service provider shall have the capability to allow its authorized consumer to read the heartbeat period.

REQ-HB-CTRL-FUN-2: The management service provider shall have the capability to allow its authorized consumer to set the heartbeat period.

REQ-HB-CTRL-FUN-3: The management service provider shall have the capability to allow its authorized consumer to request the emission of an immediate heartbeat notification.

4.2.2.2 Requirements for notifying heartbeat

REQ-HB-NOTIF-FUN-1: The management service provider shall have the capability to send periodic heartbeat notifications to its authorized consumer at the frequency specified by the management service consumer.

REQ-HB-NOTIF-FUN-2: The management service provider shall have the capability to send immediate heartbeat notifications to its authorized consumer, upon request from the management service consumer.

4.3 Procedures for heartbeat

4.3.1 Procedure for configuring heartbeat notification periodicity

Figure 4.3.1-1 illustrates the procedure for configuring the periodicity of heartbeat notifications using operations and notifications of the provisioning MnS (see clause 11.1.1 of [2]).

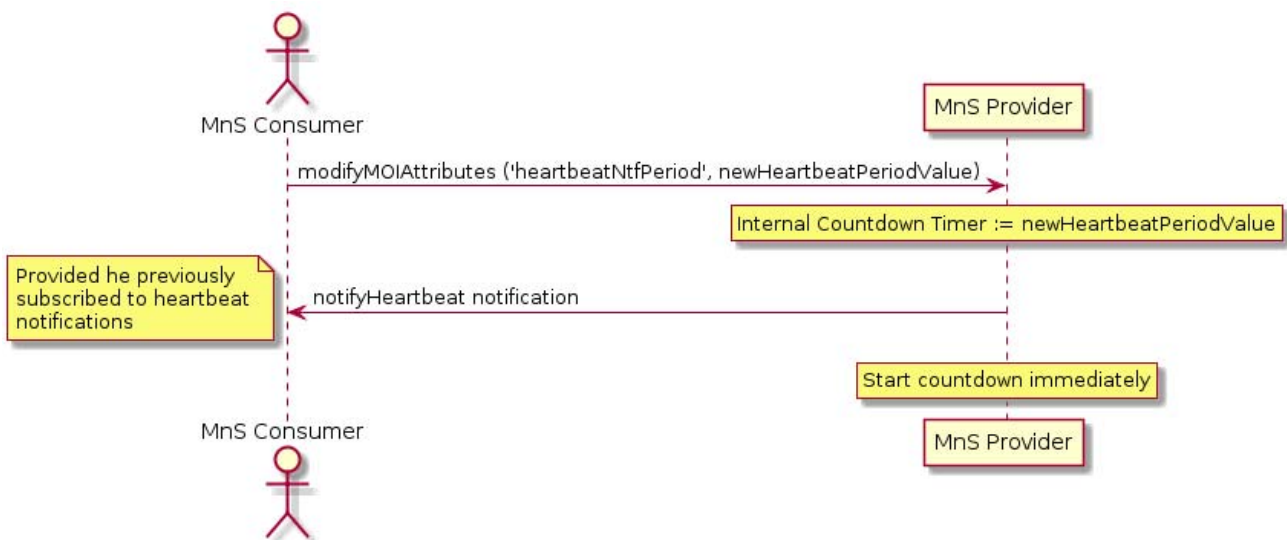


Figure 4.3.1-1: Procedure for configuring heartbeat notification periodicity

4.3.2 Procedure for requesting immediate heartbeat notification

Figure 4.3.2-1 illustrates the procedure for requesting immediate heartbeat notification using operations and notifications of the provisioning MnS (see clause 11.1.1 of [2]).

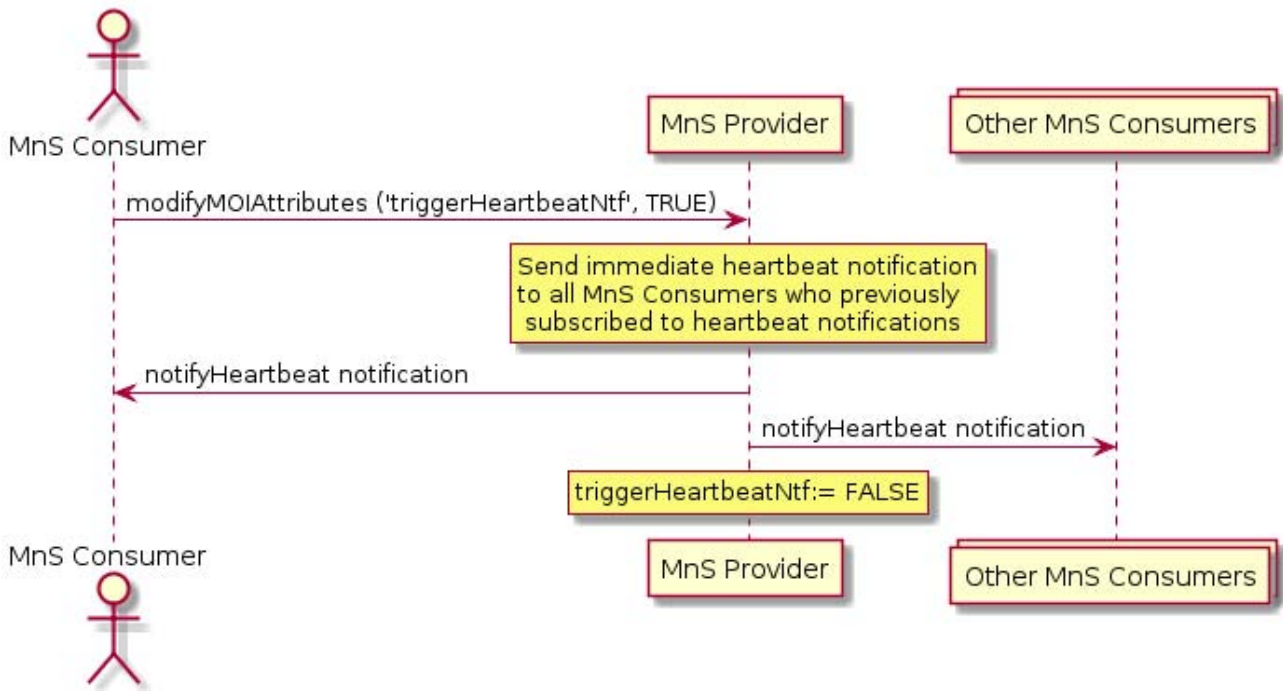


Figure 4.3.2-1: Procedure for requesting immediate heartbeat notification

4.3.3 Procedure for notifying periodic heartbeat notifications

Figure 4.3.3-1 illustrates the procedure for notifying periodic heartbeat notifications using operations and notifications of the provisioning MnS (see clause 11.1.1 of [2]).

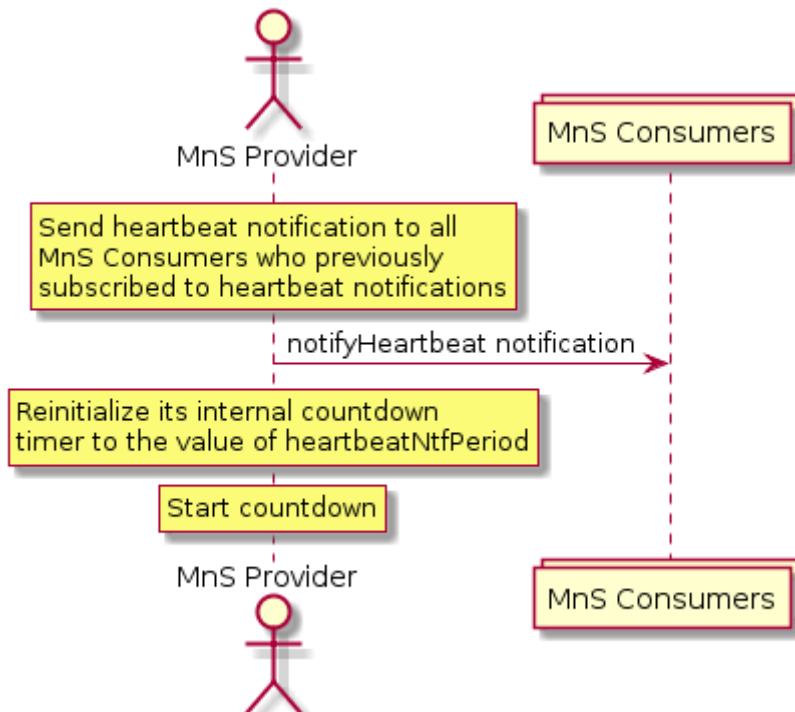


Figure 4.3.3-1: Procedure for notifying periodic heartbeat notifications

5 Discovery of Management Services

5.1 Overview

To enable communication between MnS consumers and MnS producers, MnS consumers need a mechanism to discover MnS producers that are available in the 3GPP management system, and their management capabilities.

To this end, MnS producers need to register themselves with their management capabilities in the 3GPP management system. The data describing a MnS producer and their capabilities is called MnS information or MnS profile. The complete profile or parts thereof is registered in the 3GPP management system. In case registered MnS information changes, the 3GPP management system needs to be updated as well and MnS consumers of the modified MnS producer should be informed.

MnS consumers wishing to discover MnS producers might have different questions. For example, a consumer may wish to know which MnS producers manage a certain geographical area or civic location. Or, after receiving an alarm notification specifying that a specific NF is alarmed, they may wish to know the MnS producers where they can request management data from that NF or to retrieve the configuration of that NF.

5.2 Specification level requirements

5.2.1 Use cases

5.2.1.1 Adding a new management service producer

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	Add a new MnS producer to a 3GPP management system.	
Actors and Roles	Network operator.	
Telecom resources	New MnS producer. MnS discovery service producer.	
Assumptions	New MnS producer is authorized to register the MnS information for a management service to MnS discovery service producer.	
Pre-conditions	-	
Begins when	Network operator wishes to add a new MnS producer to the 3GPP management system.	
Step 1 (M)	Network operator adds the new MnS producer to the 3GPP management system.	
Step 2 (M)	Network operator activates the new MnS producer.	
Step 3 (M)	New MnS producer sends a request to MnS discovery service producer to register the MnS information.	
Step 4 (M)	MnS discovery service producer stores the MnS information.	
Step 5 (M)	MnS discovery service producer sends confirmation to the new MnS producer that the MnS information has been registered.	
Ends when	All the steps identified above are successfully completed.	
Exceptions	One of the mandatory steps fails.	
Post-conditions	MnS discovery service producer has stored the MnS information.	
Traceability	REQ-DMS-CON-1	

5.2.1.2 Removing a management service producer

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	Remove an existing MnS producer in a 3GPP management system.	
Actors and Roles	Network operator.	
Telecom resources	MnS producer. MnS discovery service producer.	
Assumptions	-	
Pre-conditions	MnS discovery service producer has stored the MnS information for the MnS producer. The network operator has decided that it is safe to remove the MnS producer.	
Begins when	Network operator wishes to remove an existing MnS producer in the 3GPP management system.	
Step 1 (M)	Network operator orders removal of the MnS producer.	
Step 2 (M)	MnS producer sends a request to MnS discovery service producer to remove the MnS information related to the MnS Producer.	
Step 3 (M)	MnS discovery service producer removes the MnS information related to the MnS Producer.	
Step 4 (M)	MnS discovery service producer sends confirmation to the MnS producer that the MnS information has been removed.	
Ends when	All the steps identified above are successfully completed.	
Exceptions	One of the mandatory steps fails.	
Post-conditions	MnS discovery service producer has removed the MnS information related to the MnS Producer.	
Traceability	REQ-DMS-CON-1	

5.2.1.3 Adding a new management service consumer

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	Add a new MnS consumer of an MnS provided by a 3GPP management system.	
Actors and Roles	Network operator.	
Telecom resources	New MnS consumer. MnS discovery service producer.	
Assumptions	New MnS consumer is authorized to obtain the MnS information for the available management service(s) from MnS discovery service producer.	
Pre-conditions	MnS information exists in MnS discovery service producer.	
Begins when	Network operator wishes to add a new MnS consumer of an MnS provided by a 3GPP management system.	
Step 1 (M)	Network operator adds the new MnS consumer to the 3GPP management system or to an external system.	
Step 2 (M)	Network operator configures the new MnS consumer with the address of the MnS discovery service producer.	
Step 3 (M)	Network operator activates the new MnS consumer.	
Step 4 (M)	For each MnS that the new MnS consumer wishes to consume, the following steps are repeated.	
Step 4.1 (M)	New MnS consumer sends a request to MnS discovery service producer to read the MnS information for relevant management services. The request may optionally request that the MnS information is filtered by MnS type (e.g. provisioning MnS, fault supervision MnS, performance assurance MnS) and description of MnS components.	
Step 4.2 (M)	MnS discovery service producer reads the stored MnS information of the management service(s) and decides if the MnS data of the management service(s) can satisfy the received request, then sends the relevant MnS information of the management service(s) to the new MnS Consumer.	
Step 4.3 (M)	New MnS consumer reads the MnS information to check if a suitable version of the desired MnS is available. If more than one suitable version exists, the new MnS consumer selects the management service with the highest suitable version of the MnS.	
Step 4.4 (M)	New MnS consumer reads the MnS information for the selected management service to find details of the MnS producer for example root URL for MnS operations and root DN for MnS objects.	
Ends when	All the steps identified above are successfully completed.	
Exceptions	One of the mandatory steps fails.	
Post-conditions	New MnS consumer is ready to use the selected version for each needed MnS.	
Traceability	REQ-DMS-CON-2	

NOTE: MnS information refer to the information used by the consumer to discover the producers of specific Management Services and to derive the addresses of the Management Service.

5.2.2 Requirements

REQ-DMS-1: The 3GPP management system shall provide capabilities allowing MnS producers to register their management capabilities (including the endpoint address) at MnS discovery service producer for use by MnS consumers wishing to interact with these MnS producers.

REQ-DMS-2: The 3GPP management system shall provide capabilities allowing MnS consumers to retrieve the management capabilities registered at MnS discovery service producer by MnS producers.

REQ-DMS-3: The 3GPP management system shall provide capabilities allowing to discover MnS producers that are managing a specified managed entity.

REQ-DMS-4: The 3GPP management system shall provide capabilities allowing to discover the managed entities a MnS producer is responsible for.

6 Managing management data

6.1 Producing and reporting management data

6.1.1 Description

Management data is referring to data produced by radio access network functions, core network functions or management functions and used for management purposes. Management data specified by 3GPP for 5G management is classified into 5G performance measurements as defined by TS 28.552 [4], 5G end to end key performance indicators as defined by TS 28.554 [5] and Trace/MDT data as defined by TS 32.422 [6]. The combined performance measurements and key performance indicators are also called performance metrics.

Management data is produced on request. Therefore, the 3GPP management system needs to enable a data consumer to request management data to be produced. The data requester needs to specify the type of data to be produced as well as the radio access network functions, core network functions and management functions where the data shall be produced. The target managed object instances can be identified in multiple ways:

- The requester can specify the target managed object instances based on the managed object tree (as defined in the 3GPP Network Resource Models) representing the network and management functions. The simplest approach is to directly identify the managed object instances where data shall be produced. More sophisticated approaches allow to specify one or more subtrees where data shall be produced and may allow also to specify managed object classes to select only object instances of specific classes.
- The requester can specify one or multiple of the following selection criteria. The system needs to translate this information into the target managed object instances. The selection criteria need to be deterministic in such a way that the target node(s) can be selected unambiguously.
- Area of interest: In a big network, it makes sense to specify a limited area for which data shall be produced. The area of interest can be expressed for example with a geographical area, one or several cells or one or several tracking areas. The target managed object instances represent network functions serving that area of interest. Geographical areas can be expressed for example with multiple longitude-latitude pairs that define a convex polygon. In the radio domain the geographical area needs to be mapped to the coverage area of cells supported by RAN NE(s). The managed object instances (e.g. NRCeLU, GNBFunction) providing service to these cells can be identified as target managed object instances. Of course the coverage area of the target cell(s) will usually not exactly map to the described shape of the geographical area because, on the one side, the coverage area of cell has no sharp borders due to fast fading effects, on the other side, the coverage area of cells may vary slightly e.g. due to adaptation of the antenna downtilt angle or beamforming configurations. For the mapping between the geographical area and the corresponding managed object instances the cell coverage status at the time of the request shall be used. Later changes affecting the cell coverage shall not be reflected for the mapping.
- Domain e.g. RAN, CN: A consumer might only be interested in analysing and understanding the performance of a particular domain like RAN or Core e.g. in case of recurrent issues, a consumer may want to have understanding of a particular domain only for further actions. In such a scenario, it should be possible to indicate the domain from where consumer wants measurements for its usage.
- Traffic type e.g. user plane or control plane: 5G brings clear separation (CUPS) of user plane and control plane in a network, a consumer may leverage it to identify target managed object instances to have measurements from. For example, the measurement report may be expected from user plane nodes only.
- Slice type e.g. eMBB, URLLC: Consumer may mention a particular slice type (eMBB, URLLC, mMTC, V2X, HMT) as the selection criteria. It may help in narrowing down the target managed object instances, which are part of provided slice type(s).

This MnS to request management data in a simple way shall not be exposed at any network function.

The management data can be requested according to a certain time scheduler. The consumer can e.g. specify a start and stop time or can request for data at specific days of a week or specific hours of a day..

After production the data needs to be reported to the data consumers. Reporting can be based on multiple reporting methods such as file or streaming. Data reporting needs to be requested by the data consumer. The requestor needs to specify the control parameters for reporting such as the reporting method and the address the data shall be delivered to.

Depending on access rights and security settings, data consumers may be subject to restrictions regarding the data they can access.

Data is always produced in some context. The data describing this context is called context data. Context data contains information on all interrelated conditions in which the management data is produced. This includes for example the configuration of the measured network functions, information on the network entity where the network function is running such as vendor name or software version, but also alarms associated to the network function or load conditions.

Data consumers processing management data in an effort to accomplish some task typically benefit when taking context data into account. For that reason data consumers should be able to obtain the context data for the management data they obtain. However, access to certain management data does not automatically imply access to all context data. Access to management data and access to context data may be subject to different data security and data protection considerations.

6.1.2 Use cases

This clause describes the benefits of the subject capability.

Editor's note: This clause will be extended with the benefits of the subject capability.

6.1.3 Requirements

REQ-MDMPR-1: The 3GPP management system shall enable an authorized data consumer to request management data (specified by 3GPP) to be produced.

REQ-MDM-PR-2: The 3GPP management system shall enable an authorized data consumer to request management data specified by 3GPP to be produced by certain managed object instance(s) only. The selection criteria to determine the managed object instance(s) shall be deterministic in such a way that the target node(s) can be selected unambiguously. The managed object instances can be targeted based on:

- Area of interest (e.g. list of cells, list of tracking areas or geographical area).
- Domain (CN or RAN).
- User plane or control plane.
- Slice type (e.g. eMBB, URLLC, mMTC, V2X, HMTTC).

The MnS to request management data specified by 3GPP in a simple way shall not be exposed at any network function.

The mapping of geographical area to corresponding managed object instances reflects the cell coverage status at the time of the request.

REQ-MDM-PR-3: The 3GPP management system shall enable an authorized data consumer to request management data specified by 3GPP to be produced according to a certain time scheduler.

REQ-MDMPR-CON-4: The 3GPP management system shall enable an authorized data consumer to request management data (specified by 3GPP) to be reported to the requesting or another authorized data consumer.

REQ-MDMPR-5: The 3GPP management system shall enable an authorized data consumer to obtain context data for management data. Access to management data does not imply access to context data. Different data privacy considerations may apply.

NOTE: The term "management data specified by 3GPP" relates to

- 5G performance measurements as defined by TS 28.552 [4]
- 5G end to end key performance indicators as defined by TS 28.554 [5], and
- Trace/MDT data as defined by TS 32.422 [6].

6.2 Coordinating management data production

6.2.1 Description

Many consumers can request network or management functions to produce management data. In this context it is beneficial to coordinate data requests at the management level to optimize management data production.

6.2.2 Use cases

This clause describes the benefits of the subject capability.

Editor's note: This clause will be extended with the benefits of the subject capability.

6.2.3 Requirements

REQ-MDMC-CON-1: The 3GPP management system shall coordinate requests from several data consumers to avoid producing multiple times the same data at a certain point of time.

Editor's note: It is tbc what exactly is "same data".

6.3 Storing management data

6.3.1 Description

Storing management data enables reuse of management data for multiple management purposes.

For example, AI/ML models need input data collected over a certain period of time for training purposes. A specific set of collected data may serve different purposes and can therefore be input to multiple AI/ML services. For example, management data collected in a geographical area may be used also for another geographical area when the scenarios in the areas are statistically similar.

Another use case for storing produced data is related to the fact that multiple sets of training data from similar scenarios are typically required. For example, one set of data produced for the rush hour in a subway station on a single weekday is typically not enough for profiling. Many sets produced on many workdays are required.

Stored data is useful when management functions can discover which data has been produced and stored in the past to check if the currently needed data is already available.

6.3.2 Use cases

This clause describes the benefits of the subject capability.

Editor's note: This clause will be extended with the benefits of the subject capability.

6.3.3 Requirements

REQ-MDMS-CON-1: The 3GPP management system shall support the storing of produced management data.

REQ-MDMS-CON-2: The 3GPP management system shall enable an authorized data consumer to discover stored management data.

REQ-MDMS-CON-3: The 3GPP management system shall enable an authorized data consumer to retrieve stored management data.

6.4 Managing external management data

6.4.1 Description

Management data which is specified by 3GPP (clause 6.1.1) can be enriched by additional data not specified by 3GPP. This so-called external management data can be produced by data sources of different nature (e.g. sensors) with different formats.

External management data can be used for example as additional input for network optimization and prediction.

The management system should be able to manage this kind of data. That means data consumers should be able to request external management data to be produced and reported. The management system should provide support for storing it.

The definition of external data sources and the data formats they use is out of scope of this specification.

The target is to define generic management mechanisms that can cope with any kind of external data sources and data formats.

6.4.2 Use cases

This clause describes the benefits of the subject capability.

Editor's note: This clause will be extended with the benefits of the subject capability.

6.4.3 Requirements

REQ-MDMED-CON-1: The 3GPP management system shall enable an authorized data consumer to request external management data to be produced.

REQ-MDMED-CON-2: The 3GPP management system shall enable an authorized data consumer to request external management data to be reported to the requesting or another authorized data consumer.

REQ-MDMED-CON-3: The 3GPP management system shall support the storing of produced external management data.

REQ-MDMED-CON-4: The 3GPP management system shall enable an authorized data consumer to discover stored external management data.

REQ-MDMED-CON-5: The 3GPP management system shall enable an authorized data consumer to retrieve stored external management data.

NOTE: The term "external management data" relates to data not specified by 3GPP.

6.5 Discovery of management data

6.5.1 Description

Discovery of management data mechanism allows MnS consumers to discover what management data can be produced by the 3GPP management system without direct involvement of those MnS services producing the data, which can be time and resource consuming process.

For this mechanism to work MnS producers as entities producing data, need to register what data they can produce by adding a corresponding record in the 3GPP management system.

NOTE: The term "management data produced by 3GPP management system" relates to

- 5G performance measurements as defined by TS 28.552 [4]
- 5G end to end key performance indicators as defined by TS 28.554 [5], and

- Trace/MDT data as defined by TS 32.422 [6].

6.5.2 Use cases

This clause describes the benefits of the subject capability.

Editor's note: This clause will be extended with the benefits of the subject capability.

6.5.3 Requirements

REQ-DMSDIS-CON-1: The 3GPP management system shall enable an authorized data consumer to discover what management data can be produced by 3GPP management system.

7 File management

7.1 File transfer

7.1.1 Description

File management deals with transferring files between MnS producers and MnS consumers.

Existing file transfer protocols are used. These protocols need to comply to requirements specified in this clause.

7.1.2 Use cases

This clause describes the benefits of the subject capability.

Editor's note: This clause will be extended with the benefits of the subject capability.

7.1.3 Requirements

REQ-FMG-1: The file transfer protocol shall preserve the formatting of the file during exchange.

REQ-FMG-2: The file transfer protocol shall preserve the encoding of the file during exchange.

REQ-FMG-3: The MnS producer shall support at least one of the following file transfer protocols: SFTP, FTPES, HTTPS.

REQ-FMG-4: The MnS consumer shall use the file transfer protocol supported by the MnS producer.

7.2 File retrieval from a MnS producer by a MnS consumer

7.2.1 Description

File retrieval is when the MnS consumer retrieves (gets) a file from the MnS producer. Either the MnS consumer retrieves a file from the MnS producer because the MnS consumer receives a file ready notification from the MnS producer or the MnS consumer reads the list of available (ready) files on the MnS producer and decides to retrieve an available file.

7.2.2 Use cases

This clause describes the benefits of the subject capability.

Editor's note: This clause will be extended with the benefits of the subject capability.

7.2.3 Requirements

REQ-FMR-1: The MnS producer shall support the capability allowing a MnS consumer to retrieve (get) a file from the MnS producer.

REQ-FMR-2: The MnS producer shall support the capability allowing a MnS consumer to retrieve the list of files available for transfer from the MnS producer.

REQ-FMR-3: The MnS producer shall support the capability to inform a MnS consumer about files that are available for retrieval.

REQ-FMR-4: The MnS producer shall support the capability to inform a MnS consumer about errors that occurred during the preparation of a file.

REQ-FMR-5: The information transferred to a MnS consumer about an available file shall allow associating the file to the process on the MnS producer that generated the file, if any such process exists and has an identifier.

REQ-FMR-6: The MnS producer shall support the capability allowing a MnS consumer to indicate to the MnS producer, that the MnS consumer does not need a file anymore, such that the MnS producer hides the file in responses to subsequent read requests or decide to delete it altogether.

7.3 File push from a MnS producer to a MnS consumer

7.3.1 Description

For file push, the MnS producer pushes a file to the MnS consumer or a designated file server. Either the MnS producer pushes the file because the MnS consumer requests the MnS producer to push the file or the MnS consumer configures the MnS Producer to push a file based on an event occurring on the MnS producer, such as the availability of a file.

7.3.2 Use cases

This clause describes the benefits of the subject capability.

Editor's note: This clause will be extended with the benefits of the subject capability.

7.3.3 Requirements

REQ-FMP-1: The MnS producer shall support the capability to push a file to a MnS consumer or a designated file server when triggered by a MnS consumer.

REQ-FMP-2: The MnS producer shall support the capability allowing a MnS consumer to trigger the MnS producer to push a file from the MnS consumer or a designated file server.

REQ-FMP-3: The MnS producer shall support the capability to inform the MnS consumer, that has triggered a file push, or any other MnS consumer about the progress of that file push.

REQ-FMP-4: The MnS producer shall support the capability to push a file to the MnS consumer or a designated file server when configured by a MnS consumer.

REQ-FMP-5: The MnS producer shall support the capability for a MnS consumer to configure the MnS producer to push a file to the MnS consumer or a designated file server based on an event occurring on the MnS producer.

REQ-FMP-6: The MnS producer shall support the capability to inform the MnS consumer, that has configured a file push, or any other MnS consumer about the progress of that file push.

7.4 File download from a MnS consumer to a MnS producer

7.4.1 Description

File download is when the MnS producer gets a file from the MnS consumer or a designated file server because the MnS consumer requests the MnS producer to download the file.

7.4.2 Use cases

This clause describes the benefits of the subject capability.

Editor's note: This clause will be extended with the benefits of the subject capability.

7.4.3 Requirements

REQ-FMD-1: The MnS producer shall support the capability to download a file from a MnS consumer or a designated file server when triggered by a MnS consumer.

REQ-FMD-2: The MnS producer shall support the capability allowing a MnS consumer to trigger the MnS producer to download a file from the MnS consumer or a designated file server.

REQ-FMD-3: The MnS producer shall support the capability to inform the MnS consumer that has triggered a file download, or any other consumer about the progress of that file download.

Annex A (informative): Heartbeat PlantUML source code

A.1 Procedure for configuring heartbeat notification periodicity

The following PlantUML source code is used to describe the procedure for configuring heartbeat notification periodicity, as depicted by Figure 4.3.1-1:

```
@startuml
title "Configuring heartbeat notification periodicity"
actor "MnS Consumer" as CONS
participant "MnS Provider" as PROV
CONS -> PROV: modifyMOIAttributes ('heartbeatNtfPeriod', newHeartbeatPeriodValue)

rnote over PROV
  Internal Countdown Timer := newHeartbeatPeriodValue
endrnote

PROV -> CONS: notifyHeartbeat notification
note left
  Provided he previously
  subscribed to heartbeat
  notifications
end note

rnote over PROV
  Start countdown immediately
endrnote

@enduml
```

A.2 Procedure for requesting immediate heartbeat notification

The following PlantUML source code is used to describe the procedure for requesting immediate heartbeat notification, as depicted by Figure 4.3.2-1:

```
@startuml
title "Requesting immediate heartbeat notification"
actor "MnS Consumer" as CONS
participant "MnS Provider" as PROV
collections "Other MnS Consumers" as OTHER
CONS -> PROV: modifyMOIAttributes ('triggerHeartbeatNtf', TRUE)

rnote over PROV
  Send immediate heartbeat notification
  to all MnS Consumers who previously
  subscribed to heartbeat notifications
endrnote
```

```
PROV -> CONS: notifyHeartbeat notification
PROV -> OTHER: notifyHeartbeat notification
```

```
rnote over PROV
  triggerHeartbeatNtf:= FALSE
endnote
```

```
@enduml
```

A.3 Procedure for notifying periodic heartbeat notifications

The following PlantUML source code is used to describe the procedure for notifying periodic heartbeat notifications, as depicted by Figure 4.3.3-1:

```
@startuml
title "Notifying periodic heartbeat notifications"

actor "MnS Provider" as PROV
collections "MnS Consumers" as CONS

rnote over PROV
  Send heartbeat notification to all
  MnS Consumers who previously
  subscribed to heartbeat notifications
endnote

PROV -> CONS: notifyHeartbeat notification

rnote over PROV
  Reinitialize its internal countdown
  timer to the value of heartbeatNtfPeriod
endnote

rnote over PROV
  Start countdown
endnote

@enduml
```


Annex B (informative): Change history

Change history							
Date	Meeting	TDoc	CR	Rev	Cat	Subject/Comment	New version
2020-03	SA#87-e					Upgrade to changecontrol version	16.0.0
2021-03	SA#91e	SP-210152	0003	-	B	Add use cases for discovery of management services	17.0.0
2021-09	SA#93e	SP-210864	0004	1	C	Add support for discovery of management services	17.1.0
2021-09	SA#93e	SP-210876	0005	-	B	Add requirements for data management	17.1.0
2021-09	SA#93e	SP-210875	0006	-	B	Add requirements for file management	17.1.0
2021-12	SA#94e	SP-211467	0007	1	C	Clarifications into existing use cases	17.2.0
2021-12	SA#94e	SP-211467	0008	-	C	Clarifications into existing requirements	17.2.0
2022-06	SA#96	SP-220564	0009	1	F	Editorial Corrections	17.3.0
2022-06	SA#96	SP-220505	0010	-	B	Add requirements for management data collection and discovery	17.3.0

History

Document history		
V17.2.0	May 2022	Publication
V17.3.0	July 2022	Publication