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TECHNICAL SPECIFICATION

**5G;
Management and Orchestration;
Network and services operations for energy utilities
(3GPP TS 28.318 version 18.1.0 Release 18)**

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In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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Contents

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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where:

x   the first digit:

   1   presented to TSG for information;

   2   presented to TSG for approval;

   3   or greater indicates TSG approved document under change control.

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

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

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

shall   indicates a mandatory requirement to do something

shall not   indicates an interdiction (prohibition) to do something

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

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

should   indicates a recommendation to do something

should not   indicates a recommendation not to do something

may   indicates permission to do something

need not   indicates permission not to do something

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

can   indicates that something is possible

cannot   indicates that something is impossible

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

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

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

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

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

In addition:

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

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

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

Introduction

The present document addresses management and orchestration services to support network operations related to energy utilities, an industry sector that uses telecommunications extensively.

There is a cross-dependency between the power supply provided to the MNO's network infrastructure by the energy utility, and the telecommunications connectivity service provided to the DSO's network infrastructure by the MNO. Diverse applications are used to operate and manage energy systems. These applications require very high communication service availability. High availability of the energy system directly benefits the availability of the 5G system.

1   Scope

The present document provides normative specifications of Stage 1, stage 2, and stage 3 to realize network and service operations to support energy utility use cases by 5G networks.

The present document does not specify all aspects required to support network service operations for energy utilities. Annex D identifies unspecified configuration and functionality that are needed in order to complement the normative specification. This configuration and functionality that is not standardized has to be supported in order to deploy and operate the management services specified in the present document.

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]   DIRECTIVE (EU) 2019/ 944 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL - of 5 June 2019 - on common rules for the internal market for electricity and amending Directive 2012/ 27/ EU (europa.eu)
https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019L0944&from=EN

[3]   IEC TC 57
https://www.iec.ch/ords/f?p=103:7:511571509228708::::FSP_ORG_ID,FSP_LANG_ID:1273,25

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

[5]   Void.

[6]   Void.

[7]   Sendin, A., Stafford, J., Grilli, A., "Utilities and Telecommunications in a Nutshell", EUTC, Ediciones Experiencia, 2022.

[8]   3GPP TS 22.104, "Service requirements for cyber-physical control applications in vertical domains; Stage 1".

[9]   3GPP TS 22.261, "Service requirements for the 5G system; Stage 1"

[10]   IEC TR 61000-3-6 Electromagnetic compatibility (EMC) - Part 3-6: Limits - Assessment of emission limits for the connection of distorting installations to MV, HV and EHV power systems.

[11]   IETF RFC 1628, "UPS Management Information Base", May 1994.

[12]   ETSI ES 202 336-3: "Environmental Engineering (EE); Monitoring and Control Interface for Infrastructure Equipment (Power, Cooling and Building Environment Systems used in Telecommunication Networks); Part 3: AC UPS power system control and monitoring information model".

[13]   Void.

[14]   3GPP TS 28.552: "Management and orchestration; 5G performance measurements".

[15]   3GPP TS 28.554: "Management and orchestration; 5G end to end Key Performance Indicators (KPI)".

[16]   Void.

[17]   3GPP TS 38.473: "NG-RAN; F1 Application Protocol (F1AP)".

[18]   3GPP TS 23.003: "Numbering, addressing and identification".

[19]   3GPP TS 32.300: "Telecommunication management; Configuration Management (CM); Name convention for Managed Objects".

[20]   3GPP TS 28.622: "Telecommunication management; Generic Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)".

[21]   3GPP TS 28.541: " Management and orchestration; 5G Network Resource Model (NRM); Stage 2 and stage 3".

[22]   ETSI ES 202 336-11: "Environmental Engineering (EE); Monitoring and control interface for infrastructure equipment (Power, Cooling and environment systems used in telecommunication networks); Part 11: Battery system with integrated control and monitoring information model".

[23]   3GPP TS 28.623: "Telecommunication management; Generic Network Resource Model (NRM) Integration Reference Point (IRP); Solution Set (SS) definitions".

[24]   3GPP TS 28.532: "Management and orchestration; Generic management services".

3   Definitions of terms, symbols and abbreviations

3.1   Terms

For the purposes of the present document, the terms given in 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].

Distribution System Operator: an organization that is responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution system in a given area to meet demands for the distribution of electricity.

   NOTE 1:   The organization is responsible also for interconnections with other systems and for enduring the long term availability of the system. See DIRECTIVE (EU) 2019/ 944 [2].

Distribution Automation: A family of technologies, systems and processes (including sensors, actuators, processors, communication networks, switches, etc.) that enable the remote, real-time monitoring, operation, and optimization of utility distribution systems on the field.

Remote Terminal Unit: a host in a customer network.

   NOTE 2: How this equipment is operated is out of the scope of 3GPP standardization.

Uninterruptable Power Supply: an independent source of energy that, for a limited time duration, can sustain operations normally despite an interruption of energy distribution services. [11][12]

Customer Premises Equipment: a component of communications infrastructure that is installed in the facility owned by a customer.

Energy Supply: The delivery of electricity to a physical location. This is typically realized by placing two or more wires coming from a DSO at a geographical location and connecting those wires to a metering device.

   NOTE 3:   The output of the metering device provides electricity to a DSO customer. In the Utility Industry this is known as the point of common coupling (PCC) [10].

Energy Supply ID: A unique identity that is assigned by the DSO to every point where electric Energy Supply is provided to an energy consumer. Each physical component of a 5G network may be associated with one Energy Supply

ID. Every MOI in a MIB that collectively represents the physical component may be associated with that same Energy Supply ID.

NOTE 4: Multiple physical components of the 5G network may share the same Energy Supply ID (e.g. co-located components such as CU, DU and RU may have the same Energy Supply ID) although it cannot be assumed that different physical components share the same Energy Supply ID (a specific physical implementation cannot be mandated). The site operator has sufficient knowledge to associate an Energy Supply ID with a specific physical 5G network component. This Energy Supply ID could optionally be associated with every MOI that collectively represents the physical component. It is assumed that the site operator will inform the MNO of this association.

Rapid Intervention: A procedure described in Annex C.3 for support of recovery of the energy system for distribution systems without redundant topology.\

Rapid Recovery: A procedure described in Annex C.3 for support of communication service.

site operator: A business entity who operates infrastructure on behalf of MNOs, in some networking scenarios, for base station(s) and/or cell site(s).

NOTE 4: The site operator is the only entity to have a direct OAM&P connection to the network elements that comprise the site.

NOTE 5: This entity supports telecommunications operations and management, e.g. in network sharing scenarios. The site operator is a Master Operator (MOP) as defined in 32.130. [4]

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].

CPE	Customer Premises Equipment
DA	Distribution Automation
DSO	Distribution System Operator
ESI	Energy Supply ID
PCC	Point of Common Coupling
RTU	Remote Terminal Unit
SCADA	Supervisory Control And Data Acquisition
UPS	Uninterruptable Power Supply

4   Overview

4.1   General

The present document specifies exposed management services that enable improved operation of energy utility networks used for energy distribution. Energy service can be logically considered as four components: generation, transmission, distribution and consumption points. In a typical energy system, there are few centralized generation facilities (e.g. nuclear, thermal and hydro plants), where nature's energy is converted into electricity. Then, there are a limited number of high power transmission lines covering great distance with the minimum of energy loss. Then, a great many sites are part of medium and low voltage distribution networks. The distribution system transforms and delivers energy to customers. Finally, there is an extremely large number of consumption points (i.e. every household, business, public infrastructure site such as traffic lights at an intersection.) This simple model of the energy service delivery system is depicted in Figure 4.1-1.
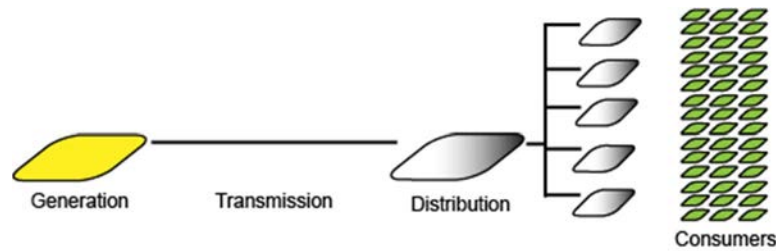
Figure 4.1-1: Energy service delivery system

Diverse standardized "smart grid" services are used to manage the energy system effectively - with high availability, safety and efficiency. IEC, IEEE and other organizations standardize these services. To support these services, diverse communication systems are employed, including optical fiber, mobile telecommunications, power line communications and others. The services are generally defined at the application layer, meaning that they can operate over any access. The choice of which access to employ is made by energy service operators, and is determined by many factors outside of the scope of the present document. In many deployments, the choice is to employ mobile telecommunications to support smart grid services. [7]

Since there are few energy generators and the requirements of transmission facilities are not changing that much over time, the focus for smart energy services and the communication systems that they rely on are mainly on distribution services. The distribution grid is the part of the energy system that is on the outer part of the system, the one closer to end-customers and, thus, the most extensive one. It is here that the energy system is changing fastest, as distributed energy generation, distributed energy storage and other trends disrupt the simpler top-down hierarchy of generation, transmission, distribution, consumption. Though there are smart grid services associated with consumption and distributed generation, these use cases and requirements have not been further developed as part of the present document.

Supporting the communication requirements of the distribution system is the focus of the present document. These networks, operated by Distribution System Operators (DSOs), aim at extremely high availability. The services employed in the distribution system include SCADA and DA [3], which can detect and correct abnormalities, reconfigure and restart services rapidly. If remote operations and monitoring is not available, when the electrical grid operations need it, it can result in service outages of much longer duration, sometimes requiring manual intervention by a service technician sent to the affected site.

An important form of 'fate sharing' exists between mobile telecommunications networks and the energy system. If energy service interruptions persist, the mobile telecommunications network will also become unavailable once the sites' independent energy storage and generation capacity are exhausted. If the mobile telecommunications service is interrupted, smart grid services will also be interrupted in a significant number of sites, leading to increasing risk of energy service outages over time. These scenarios are considered further in the present document.

Telecom management service exposure requirements, procedures and solution set details are specified to improve communication service availability to DSOs.

4.2   Background

The topics described in clause 4.1 have been considered in stage 1 standardization in 3GPP. Relevant requirements are specified in TS 22.104 [8] and TS 22.261 [9]. These stage 1 service requirements were considered to motivate and scope an investigation of stage 1 telecom management requirements.

5   Requirements

5.1   General

Subclauses of clause 5 of the present document include use case descriptions and the stage 1 requirements.

5.2 Exposing performance and prediction information for high availability

5.2.1 Description

To monitor and control its distribution grid (see clause 4), the DSO uses thousands of 3GPP compatible UEs (User Equipment, [7]). These UEs are spread across a wide geographical area, just like the distribution grid the UEs support. The DSO uses the UEs to provide connectivity to the monitor and control infrastructure of the distribution grid. This infrastructure and its operation are outside the scope of the present document. This infrastructure has very high availability service requirements. To fulfil these requirements, highly available communication is required. To achieve this highly available communication, the DSO monitors performance of communications services they use. If and when the DSO deems it necessary, the DSO proactively activates additional communication services.

It is currently possible for a DSO to gather the following information autonomously, with no support of the standard defined in the present document.

The DSO knows the location (lat/long) of each of its UEs.

Because of a UE's connectivity to the 3GPP network, details of the 3GPP connection (available in the UE radio module) are available to each UE.

The DSO knows the received signal strength at each UE.
The DSO knows the cellID of each UE.
The DSO knows the radio access technology providing the connection to each UE.

In addition to using the UEs to provide internet connectivity to the monitor and control infrastructure, the DSO regularly sends "over the top" signals (e.g. ICMP ping messages) between the UEs, and collects performance information on this traffic. Example of this information include availability and latency in the entire data path connecting the UE with the DSO application server. This path may comprise other networks in addition to 3GPP networks, e.g. WAN networks.

The DSO is able to configure the frequency and granularity of the over-the-top data collection. Based on analysis of the collected over the top data, past and present, the DSO can determine, based on the current performance of the E2E connection, if a change to a backup communication system is merited.

Similar data is maintained by standards compliant 3GPP management systems. The DSO benefits from a means to supplement or replace the collected over-the-top data with information from the MNO 3GPP management system, as the data that is collected is more precise and specific to the 3GPP system instead of end-to-end. Using this data also benefits the DSO as they can more easily identify the root cause of problems, when they arise.

The use case is

1. The DSO contacts the MNO 3GPP Management system.
2. The DSO requests collection of performance measurements on specific cells or cells in a specific area, as described in Annex A.
3. The DSO registers to receive reports of the performance measurements.
4. The DSO can update or delete the configuration of the measurements or reports.
5. Reports are generated according to the request.

5.2.2 Requirements

Requirement label	Description	Related use cases
REQ-5.2-1	The 3GPP management system shall, subject to mobile network operator policy, regulatory requirements and contractual obligations, allow the DSO to request collection and reporting of the following PM data: • Average delay DL air-interface	Exposing performance and prediction information for high availability

		- Average delay UL on over-the-air interface - Average DL UE throughput in gNB - Average UL UE throughput in gNB - Packet Uu Loss Rate in the DL per DRB per UE - UL PDCP SDU Loss Rate - Cell/network availability	
REQ-5.2.2	The 3GPP management system shall, subject to mobile network operator policy, regulatory requirements and contractual obligations, allow the DSO to specify the collection of performance information concerning specific cells or specific geographical area.		Exposing performance and prediction information for high availability

5.3　Exposed coordinated recovery requirements

5.3.1　Description

Energy system recovery of the distribution system is needed following both planned and unplanned interruptions of energy service. Annex C provides background information on the two supported use cases, corresponding the requirements listed in clause 5.3.2.

In summary, the following functionality is supported for both use cases described in Annex C.2 and C.3.

- The MNO can provide information regarding critical sites to the DSO, including their Energy Supply ID, UPS capacity of the site, base station ID if applicable. This information does not change often, but can be updated over time.

- The DSO can inform the MNO of the start and stop of energy outages, including the list of affected sites or locations.

- The DSO can request information from the MNO including the UPS capacity of the site, which may change over time.

The DSO can then perform remotely controlled operations to restore energy distribution service taking into account the UPS capacity of sites that are essential to telecommunication service and feasibility of MNO's intervention at a site. Specifically, DSOs will strive to restore energy distribution support to substations that rely on telecommunications for remote operations, while communication is still possible. This process is termed Rapid Recovery and is described in annex C.2. The process of recovery in these scenarios is termed Rapid Intervention.

The following functionality is supported for energy system recovery in scenarios in which there is no redundant energy distribution topology, as described in Annex C.3.

- The DSO can provide the MNO with the expected restoration time of energy distribution services affecting a specific set of MNO site, if the energy distribution service recovery were to proceed without the possibility of remote operations.

NOTE 1:　This is the restoration time in cases that the DSO assumes that no telecommunication is possible to restore energy service. This is the 'normal situation' after roughly 15 minutes of energy outage throughout most of the world.

- The DSO can provide the MNO with the distribution lines restoration time i.e. expected beginning time of MNO's Rapid Intervention to end an energy outage affecting a specific set of sites or locations.

NOTE 2:　This is the time where electrical distribution service can be restored, e.g. after repairing a damaged distribution line.

- The DSO can provide the MNO with the expected duration of Rapid Intervention.

- The DSO can provide the MNO with the prioritised location or sites where the distribution energy services are more critical to be restored quickly.

NOTE 3: The DSO is aware of which base stations serve the UEs in their distribution substations, as each UE captures identifiers including the eNB-LCID. If the MNO is aware of both the timing of Rapid Intervention requirements (REQ-5.3-5 and REQ-5.3-6 below) and the priority locations, there is the possibility the MNO can arrange to support telecommunication services where and when they are essential.

- The MNO can provide the DSO with information regarding which MNO sites can provide Rapid Intervention service to the DSO at what time and for how long, so the DSO can restore energy service at an arranged time, in an arranged region, for the arranged duration.

5.3.2 Requirements

The following requirements apply to use cases with coordinated recovery with redundant topology (see Annex C.2).

Requirement label	Description	Related use cases
REQ-5.3-1	The 3GPP management system should support, subject to operator policy, regulatory requirements and contractual obligations, for the DSO to obtain the following information from the MNO. For each 'site' for which energy service is critical to the MNO's services the following information is provided: - Energy Supply ID; - UPS Capacity of the site (Total installed capacity and remaining capacity at the time at which this information is obtained) The units of remaining capacity in minutes of operation of the site; - Base Station ID (if applicable. The site may not be a base station, e.g. it could be data centre or other facility.)	Energy service recovery with redundant energy distribution topology
REQ-5.3-2	The 3GPP management system should support, subject to operator policy, regulatory requirements and contractual obligations, the capability to enable the DSO to provide the MNO with information concerning either the beginning time or end time, or both, of an energy service outage and the effected and or restored sites or locations, including at least: - Beginning time of outage; - Expected ending time of the outage. This applies only for redudant topology recovery, as described in Annex C.2. - Energy Supply IDs of affected sites; - Base Station IDs (if applicable. The site may not be a base station, e.g. it could be data centre or other facility.)	Energy service recovery with redundant energy distribution topology
REQ-5.3-3	The 3GPP management system should support, subject to operator policy, regulatory requirements and contractual obligations, the capability to enable the DSO to obtain information from the MNO concerning the UPS capacity corresponding to a specific site including at least: - UPS capacity (in some units of duration).	Energy service recovery with redundant energy distribution topology

The following requirements apply to use cases with coordinated recovery without redundant topology (see Annex C.3).

Requirement label	Description	Related use cases
REQ-5.3-5	This requirement includes REQ-5.3-2, with the following extensions: - the expected restoration time of energy distribution services, such as repair or replacement of interrupted distribution cables, etc. for effected sites; - the expected start time, serving base stations and prioritized locations of Rapid Intervention; - the expected duration and, serving base stations and location of Rapid Intervention.	Energy service recovery without redundant energy distribution topology
REQ-5.3-6	The 3GPP management system should support, subject to operator policy, regulatory requirements and contractual obligations, the capability to enable the MNO to provide the DSO with information concerning: - the time and duration for which MNO's communication service for DSO Rapid Recovery will be enabled for a particular site or location.	Energy service recovery without redundant energy distribution topology

6 Informational model definitions

6.1 Imported and associated information

6.1.1 Imported information entities and local labels

Label reference	Local label
TS 28.622 [20], IOC, PerfMetricJob	PerfMetricJob
TS 28.622 [20], IOC, ThresholdMonitor	ThresholdMonitor
TS 28.622 [20], IOC, NtfSubscriptionControl	NtfSubscriptionControl
TS 28.622 [20], choice, AreaOfInterest	AreaOfInterest

6.1.2 Associated information entities and local labels

Label reference	Local label
TS 28.622 [20], IOC, ManagedElement	ManagedElement
TS 28.622 [20], IOC, SubNetwork	SubNetwork

6.2 Class diagrams

6.2.1 Relationships

This clause provides the overview of the relationships of relevant classes in UML. Subsequent clauses provide more detailed specification of various aspects of these classes.

The following figure shows the containment/naming hierarchy and the associations of the classes defined in the present document.
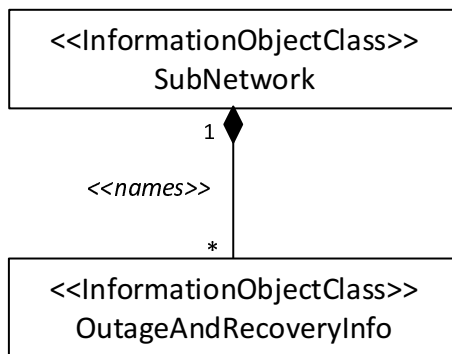
Figure 6.2.1-1: DSO Rapid Recovery NRM fragment
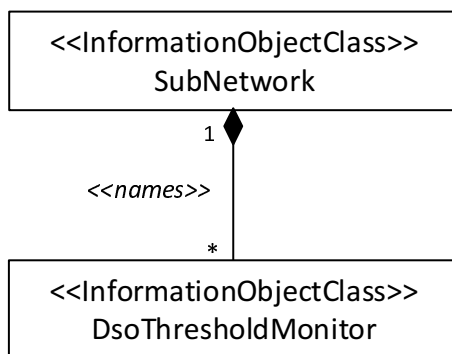

Figure 6.2.1-2: DSO Threshold Monitoring NRM fragment

6.2.2   Inheritance

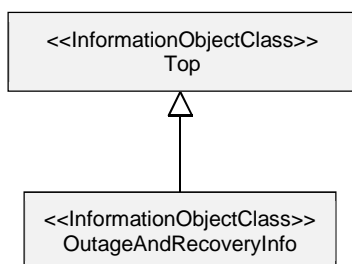This clause depicts the inheritance relationships.

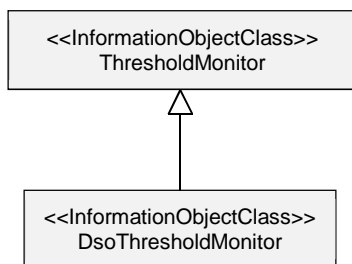**Figure 6.2.2-1: DSO Rapid Recovery NRM fragment**

Figure 6.2.2-2: DSO Threshold Monitoring NRM fragment

6.3 Class definitions

6.3.1 OutageAndRecoveryInfo

6.3.1.1 Definition

This IOC represents the mutual information exchanged between DSO and MNO, for a particular instance of an energy outage at a particular location, to achieve Rapid Recovery of DSO's energy service outage for a site/location which requires service restoration.

outageStartTime is used by the DSO to inform the MNO about the time when the outage of the energy service has occurred.

expectedOutageEndTime is used by the DSO to inform the MNO about the time when the service is expected to be restored through manual dispatch and processes, i.e. by not using rapid recovery mechanisms. In case the end of the outage cannot be estimated, the field is not filled.

dsoRapidInterventionTime is used by the DSO to inform the MNO about the start time from when the DSO expects that they will need telecommunication service to control devices in order to perform rapid intervention.

    NOTE: Telecommunication service enable rapid intervention to start.

dsoRapidInterventionDuration is used by the DSO to inform the MNO about the duration for which the DSO requires telecommunication services from the MNO, beginning with dsoRapidInterventionTime.

mnoInterventionTime is used by the MNO to inform the DSO about the time when MNO will actually be able to provide telecommunication service to enable rapid intervention.

mnoInterventionDuration is used by the MNO to inform the DSO about the duration for which a MNO will actually be able to provide telecommunication service to enable rapid intervention, starting with mnoInterventionTime.

mnoMaxServiceDuration is used by the MNO to inform the DSO about the current estimated remaining time that the MNO is able to provide telecommunication service in the given "affectedArea".

affectedArea is used by the DSO to inform the MNO about the area affected by the outage of the energy service. Different stakeholders are having different knowledge about the topology of the network and thus have different possibilities to identify objects in the network.

isAffectedAreaPriority indicates whether the location of DSO substation needs recovery on priority by using smart energy services or not.

actualOutageEndTime is used by the DSO to indicates the end of outage incident i.e the time at which DSO finally has restored its energy distribution services.

6.3.1.2 Attributes

Attribute name	Support Qualifier	isReadable	isWritable	isInvariant	isNotifyable
outageStartTime	M	T	T	F	T
expectedOutageEndTime	M	T	T	F	T
dsoRapidInterventionTime	M	T	T	F	T
dsoRapidInterventionDuration	M	T	T	F	T
mnoInterventionTime	M	T	F	F	T
mnoInterventionDuration	M	T	F	F	T
mnoMaxServiceDuration	M	T	F	F	T
affectedArea	M	T	T	F	T
isAffectedAreaPriority	M	T	T	F	T
actualOutageEndTime	M	T	T	F	T

6.3.1.3 Attribute constraints

None.

6.3.1.4 Notifications

The common notifications defined in clause 4.5 of [20] are valid for this IOC.

6.3.2 EnergyServiceLocation <<datatype>>

6.3.2.1 Definition

This <<datatype>> defines the area/location of the service outage.

This is defined as CGI and/or energySupplyId. This defines the regions/locations where the DSO subsystems are situated.

The attribute CGI is of type NrCellId , which provides the affected area by either a geographical area or a list of cell ids of the different RAN technologies.

The energySupplyId identifies the MNO facility that is using the DSO energy services. The energySupplyId is known between both the parties using out-of-band mechanisms hence not subject to standardisation.

Thise energySupplyId, used extensively in this class definition is known to both the MNO and DSO and is the means by which information is organized, essentially the 'key identifier' used to exchange information about specific sites, which is essential for most Rapid Recovery actions (see Annex C.2) and Rapid Intervention actions (see Annex C.3).

6.3.2.2 Attributes

Attribute name	S	isReadable	isWritable	isInvariant	isNotifyable
CGI	M	T	T	F	T
energySupplyId	M	T	T	F	T

6.3.2.3 Attribute constraints

None.

6.3.2.4 Notifications

The subclause 6.3.1.4 of the <<IOC>> using this <<dataType>> as one of its attributes, shall be applicable.

6.3.3 DsoThresholdMonitor

6.3.3.1 Definition

This IOC includes information which DSO shares with MNO for network performance monitoring.

The attribute targetThresholdLocation specifies the location of the object instances that are to be monitored. This may require to instantiate a PerfMetricJob, as appropriate.

This IOC includes attributes inherited from ThresholdMonitor IOC (defined in TS 28.622 [21]) and the following attribute:

6.3.3.2 Attributes

Attribute name	S	isReadable	isWritable	isInvariant	isNotifyable
targetThresholdLocation	M	T	T	F	T

6.3.3.3   Attribute constraints

None.

6.3.3.4   Notifications

The common notifications defined in clause 4.5 of [20] are valid for this IOC.

6.4   Attribute definitions

6.4.1   Attribute properties

The following table defines the properties of attributes specified in the present document in addition to those existing in clause 4.4.1 of [20].

affectedArea	It defines the area/location of the DSO service outage. These are the regions/locations where DSO subsystems are situated. It is an aggregation of: • CGI, which provides the affected area by either a geographical area or a list of cell ids. • energySupplyId, which identifies the MNO facility that is using DSO energy services. The energySupplyId is communicated between both the parties using out-of-band mechanisms hence not subject to standardisation.	Type: EnergyServiceLocation multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
outageStartTime	It informs about the time when the outage of the DSO energy service has occurred at the location provided by the attribute affectedArea. Along with outage location and expected recovery time this would be beneficial for MNO to plan and prepare its UPS power backup at different site locations for its crucial communication services and also for assisting DSO for rapid intervention.	type: DateTime multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
expectedOutageEndTime	It informs about the time when the service is expected to be restored through manual dispatch and processes. In case the end of the outage cannot be estimated, the field is not filled. This is usually a longer time period that may not be acceptable for some crucial public services like hospitals.	type: DateTime multiplicity: 0..1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: True
dsoRapidInterventionTime	It defines the time at which DSO restores its Energy feeder service. This is the time from when the DSO expects rapid intervention to start. From this time a DSO can use its automated smart energy services e.g SCADA to recover its distribution services much quicker in substations instead of manual processes.	type: DateTime multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
dsoRapidInterventionDuration	Time interval for which the DSO requires rapid intervention services from the MNO to restore its energy distribution services rapidly. The time interval starts with dsoRapidInterventionTime. This time duration is defined in minutes. allowedValues: Integer with a minimum value of 1	Type: Integer multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
isAffectedAreaPriority	It indicates whether the location of DSO substation needs recovery on priority by using smart energy services or not. This can be used by MNO to ascertain the gNBs at which the UPS power needs to be reserved as part of MNO Rapid Intervention. The default value is "False". allowedValues: True, False	Type: Boolean multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: False isNullable: False
mnoInterventionTime	It defines the time at which a MNO will actually be able to provide dedicated communication services to DSO (as rapid intervention) depending on its UPS backup status, other critical service venues etc. DSO needs this to use its smart energy services like SCADA for recovering its energy distribution services.	type: DateTime multiplicity: 0..1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: True
mnoInterventionDuration	It defines the time duration for which a MNO will actually be able to provide dedicated communication services to DSO (as rapid intervention) depending on its UPS backup status, other critical service venues etc. The interval starts with mnoInterventiontime. This time duration is defined in minutes. allowedValues: Integer with a minimum value of 1	Type: Integer multiplicity: 0..1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: True
actualOutageEndTime	It defines the time at which DSO finally restores its energy distribution services rapidly by using rapid intervention. This time is much smaller than expectedOutageEndTime.	type: DateTime multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
CGI	This attribute defines the set of cells, that are affected by the outage. The affected area is defined by a list of cell ids.	type: NrCellId multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False

energySupplyId	energySupplyId identifies the MNO facility (e.g. base station) using DSO energy services. The energySupplyId is communicated between both the parties using out-of-band mechanisms hence not subject to standardisation. A meter with a unique energySupplyId is installed by DSO in the MNO site.	type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
mnoMaxServiceDuration	It defines the remaining time duration for which MNO site can operate on its UPS backup at a given time i.e. capacity of UPS backup in terms of time duration (e.g. minutes) for which it can provide power supply to MNO site from a given time. It is defined in minutes. allowedValues: Integer with a minimum value of 1 [NOTE1]	type: Integer multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
targetThresholdLocation	This attribute specifies the location of the object instances that are to be monitored.	Type: AreaOfInterest multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
NOTE 1: The value of mnoMaxServiceDuration can be taken from IETF RFC 1628 [11], upsEstimatedMinutesRemaining. ETSI ES 202 336-11 [12] defines a field "Estimated remaining battery autonomy (time) during discharge" as provided by the monitoring and control interface for battery system with integrated control and monitoring information model, however there is no corresponding stage 3 definition of this value.		

6.5 Performance Measurements and KPIs for NSOEU

The performance measurements and KPIs for NSOEU are defined in TS 28.552 [14] and TS 28.554 [15].

6.6 Common notifications

Refer to clause 4.5.2 of [20] for Configuration notifications.

Refer to clause 4.5.3 of [20] for Threshold Crossing notifications.

7 Stage 3 definitions

7.1 OpenAPI document for DSO NRM

The OpenAPI/YAML definitions for DSO NRM (including DSO Rapid Recovery NRM fragment and DSO Threshold Monitoring NRM fragment) are specified in 3GPP Forge, refer to clause 4.3 of TS 28.623 [23] for the Forge location. An example of Forge location is: "https://forge.3gpp.org/rep/sa5/MnS/-/tree/Tag_Rel18_SA104/".

Directory: OpenAPI

File: TS28318_DsoNrm.yaml

Annex A (informative): Procedures

A.1 Exposing performance and prediction information for high availability

A.1.1 DSO is trusted and supported by network operator, non-split gNB

A.1.1.1 General

In this scenario the DSO consumer, is recognized by the network operator as a trusted entity that is allowed to read from and write to selected producers and corresponding MOIs in one or more MIBs controlled by the network operator. In this basic scenario, the network operator supports the DSO consumer by providing specific necessary information such as a Distinguished Name of producer(s) and MOI(s), by some means not described in this TS. This scenario is specific to a non-split gNB.

A.1.1.2 Signal flow

The DSO making use of a DSO managed service consumer (DSO consumer) wants to receive performance metric reports from one or more specific cell sites. These reports are provided continuously over the monitoring interval with the requested granularity. The DSO consumer is in possession of the following information:

the identity of the cell site: base station ID, or

the estimated location of the cell site antenna

NOTE: Based upon the identity of the cell site, the location of the cell site, or both, the MNO supplies to the DSO the DN and any required scoping parameters for PerfMetricJob MOI(s), ThresholdMonitor MOI(s) and NtfSubscriptionControl MOI(s).

The MNO exposes a MnS producer (termed in this clause 'network operator producer').

Figure A.1.1.2-1 Create PerfMetricJob

A. PerfMetricJob

    1. The DSO consumer sends createMOI to the producer with the following parameters: managedObjectClass = PerfMetricJob, managedObjectInstance = {DN supplied by the MNO}, attributeListIn as defined in the following table:

Attribute name	Value
administrativeState	-
operationalState	-
jobId	pmj_group_0001
performanceMetrics	DRB.AirIfDelayDL_PLMN, DRB.AirIffDelayUl_PLMN, DRB.UEThpDL.PLMN, DRB.UEThpUL.PLMN, CellAvailability$_{NRCellDU}$
granularityPeriod	60
objectInstances	included if supplied by the MNO
rootObjectInstances	included if supplied by the MNO
reportingCtrl	fileReportingPeriod = 3 notificationRecipientAddress = URL
_linkToFiles	-

jobID is chosen by the DSO, this example uses jobID = pmj_group_0001 to identify the performance measurements from one cell or group of cells as identified by the MNO-supplied DN and optionally objectInstances & rootObjectInstances.

PLMN used to specify the performance metrics. It is supplied by MNO.

granularityPeriod is chosen by the DSO, this example uses 60 seconds.

reportingCtrl uses implicit notification subscription. The fileReportingPeriod is chosen by the DSO, this example uses 3 minutes. The notificationRecipientAddress is chosen by the DSO, in this example it is the URL where the notifyMOICreation and notifyMOIDeletion notification types shall be sent.

2. The network operator producer creates "PerfMetricJob" data collection job, Files and NtfSubscriptionControl MOIs.

3. The network operator producer sends notifyMOICreation to the notificationRecipientAddress included in reportingCtrl.

4. The producer sends createMOI response to the DSO consumer with output parameters as defined in the following table:

Attribute name	Value
attributeListOut	name / value pairs of the attributes of the new object
status	OperationSucceeded | OperationFailed

The DSO consumer stores the attribute name/value pairs.

On OperationSucceeded, metric production is now active on the in-scope object instances whose object class matches the object class associated to the specified performance metrics. A notification subscription has been created.

Repeat steps 1 - 4 for each cell site (or group of cell sites as determined by DN information provided by MNO) where performance metric information is wanted.

Figure A.1.1.2-2 Create ThresholdMonitor (rapid)

B.1 ThresholdMonitor for rapidly changing PMs

5. The DSO consumer sends createMOI for ThresholdMonitor to monitor the performance measurements for rapidly changing PMs including measurement for latency, packet loss and throughput , using the following parameters: managedObjectClass = ThresholdMonitor, managedObjectInstance = {DN supplied by MNO}, attributeListIn as defined in the following table:

Attribute name	Value
administrativeState	-
operationalState	-
thresholdInfoList	ThresholdInfo performanceMetrics=DRB.AirIfDelayDl_PLMN thresholdDirection=UP_AND_DOWN thresholdValue=70.0 hysteresis=20.0 ThresholdInfo performanceMetrics=DRB.AirIfDelayUl_PLMN thresholdDirection=UP_AND_DOWN thresholdValue=70.0 hysteresis=20.0 ThresholdInfo performanceMetrics=DRB.UEThpDl.PLMN (kbit/s) thresholdDirection= UP_AND_DOWN thresholdValue=100000.0 Hysteresis=10000.0 ThresholdInfo performanceMetrics=DRB.UEThpUl.PLMN (kbit/s) thresholdDirection= UP_AND_DOWN thresholdValue=10000.0 Hysteresis=1000.0
monitorGranularityPeriod	180
objectInstances	included if supplied by the MNO
rootObjectInstances	included if supplied by the MNO

In this example, a ThresholdInfo datatype will be included for each performance metric that was included in the creation of the corresponding PerfMetricJob MOI where rapidly threshold monitoring is desired.

A threshold monitor is created for delay at the air interface in both DL and UL. In this example, the threshold is set at 7 ms with hysteresis of 2 ms in both the DL and UL. PLMN is provided by the MNO.

A threshold monitor is created for UE throughput in both the DL and UL. In this example, the threshold is set at 100 Mbps with hysteresis of 20 Mbps in the DL and at 10 Mbps with hysteresis of 1 Mbps in the UL.

monitorGranularityPeriod = 180 seconds, multiple of 3 X granularityPeriod established in the PerfMetricJob above.

scope information is included if provided by the MNO.

[ThresholdInfo will also contain an attribute for the location (Lat/long, TAC, cellid). This is used to scope the object instance to be monitored.]

6. The network operator producer creates "ThresholdMonitor" MOI.

7. The network operator producer sends notifyMOICreation to the notificationRecipientAddress in step 1.

8. The producer sends createMOI response to the DSO consumer with output parameters as defined in the following table:

Attribute name	Value
attributeListOut	name / value pairs of the attributes of the new object
status	OperationSucceeded | OperationFailed

The DSO consumer stores the attribute name/value pairs.

Repeat steps 5 - 8 for cell site (or group of cell sites as determined by DN information provided by MNO) where rapidly changing threshold monitoring is required.

Figure A.1.1.2-3 Create ThresholdMonitor (slow)

B.2   ThresholdMonitor for slowly changing PMs

9. The DSO consumer sends createMOI for a second ThresholdMonitor to monitor the performance measurements for slowly changing PMs like cell availability, using the following parameters: managedObjectClass = ThresholdMonitor, managedObjectInstance = {DN supplied by MNO}, attributeListIn as defined in the following table:

Attribute name	Value
administrativeState	-
operationalState	-
thresholdInfoList	ThresholdInfo performanceMetrics=CellAvailability$_{NRCellIDU}$ thresholdDirection=UP_AND_DOWN thresholdValue=99.0 hysteresis=0.5
monitorGranularityPeriod	3,600
objectInstances	included if supplied by the MNO
rootObjectInstances	included if supplied by the MNO

In this example, a ThresholdInfo datatype will be included for each performance metric that was included in the creation of the corresponding PerfMetricJob MOI where slowly changing threshold monitoring is desired.

A threshold monitor is created for cell availability. In this example, the threshold is set at 99.0% with hysteresis of 0.5%.

monitorGranularityPeriod = 3,600 seconds (1 hour), multiple of 3 X granularityPeriod established in the PerfMetricJob above.

scope information is included if provided by the MNO.

[ThresholdInfo will also contain an attribute for the location (Lat/long, TAC, cellid). This is used to scope the object instance to be monitored.]

10. The network operator producer creates "ThresholdMonitor" MOI.

11. The network operator producer sends notifyMOICreation to the notificationRecipientAddress in step 1.

12. The producer sends createMOI response to the DSO consumer with output parameters as defined in the following table:

Attribute name	Value
attributeListOut	name / value pairs of the attributes of the new object
status	OperationSucceeded | OperationFailed

The DSO consumer stores the attribute name/value pairs.

Repeat steps 9 – 12 for each cell site (or group of cell sites as determined by DN information provided by MNO) where slowly changing threshold monitoring is required.
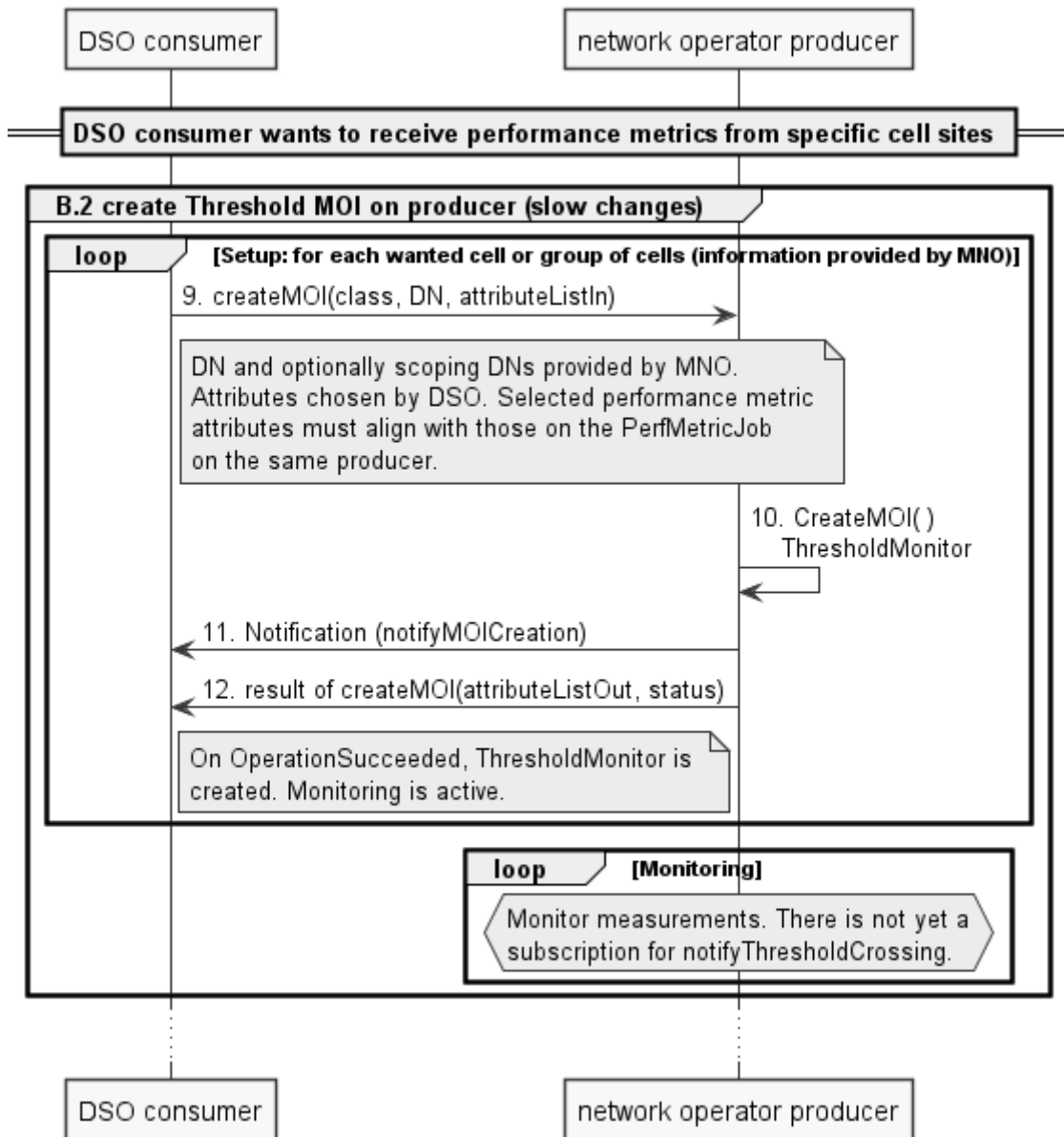
Figure A.1.1.2-4 Create NtfSuscriptionControl

C. NtfSubscriptionControl

13. The DSO consumer sends createMOI for NtfSubscriptionControl to subscribe for the required notifications with the following parameters: managedObjectClass = NtfSubscriptionControl, managedObjectInstance = {DN supplied by the MNO}, attributeListIn as defined in the following table:

Attribute name	Value
notificationRecipientAddress	URL
notificationTypes	notifyFileReady, notifyFilePreparationError, notifyThresholdCrossing
scope	included if supplied by the MNO
notificationFilter	-

notificationRecipientAddress is specified by the DSO and is the URL where the notifications shall be sent. In this example it is the same URL as provided to PerfMetricJob in step 1 above, although the DSO consumer may select a different URL in this current step.

notificationTypes = notifyFileReady, notifyFilePreparationError, notifyThresholdCrossing

scope information is included if provided by the MNO.

14. The network operator producer creates "NtfSubscriptionControl" job.

15. The network operator producer sends notifyMOICreation to the notificationRecipientAddress in step 1.

16. The producer sends createMOI response to the DSO consumer with output parameters as defined in the following table:

Attribute name	Value
attributeListOut	name / value pairs of the attributes of the new object
status	OperationSucceeded | OperationFailed

The DSO consumer stores the attribute name/value pairs.

Repeat steps 13 - 16 for each cell site (or group of cell sites as determined by DN information provided by MNO)where threshold monitoring and file notification are required.
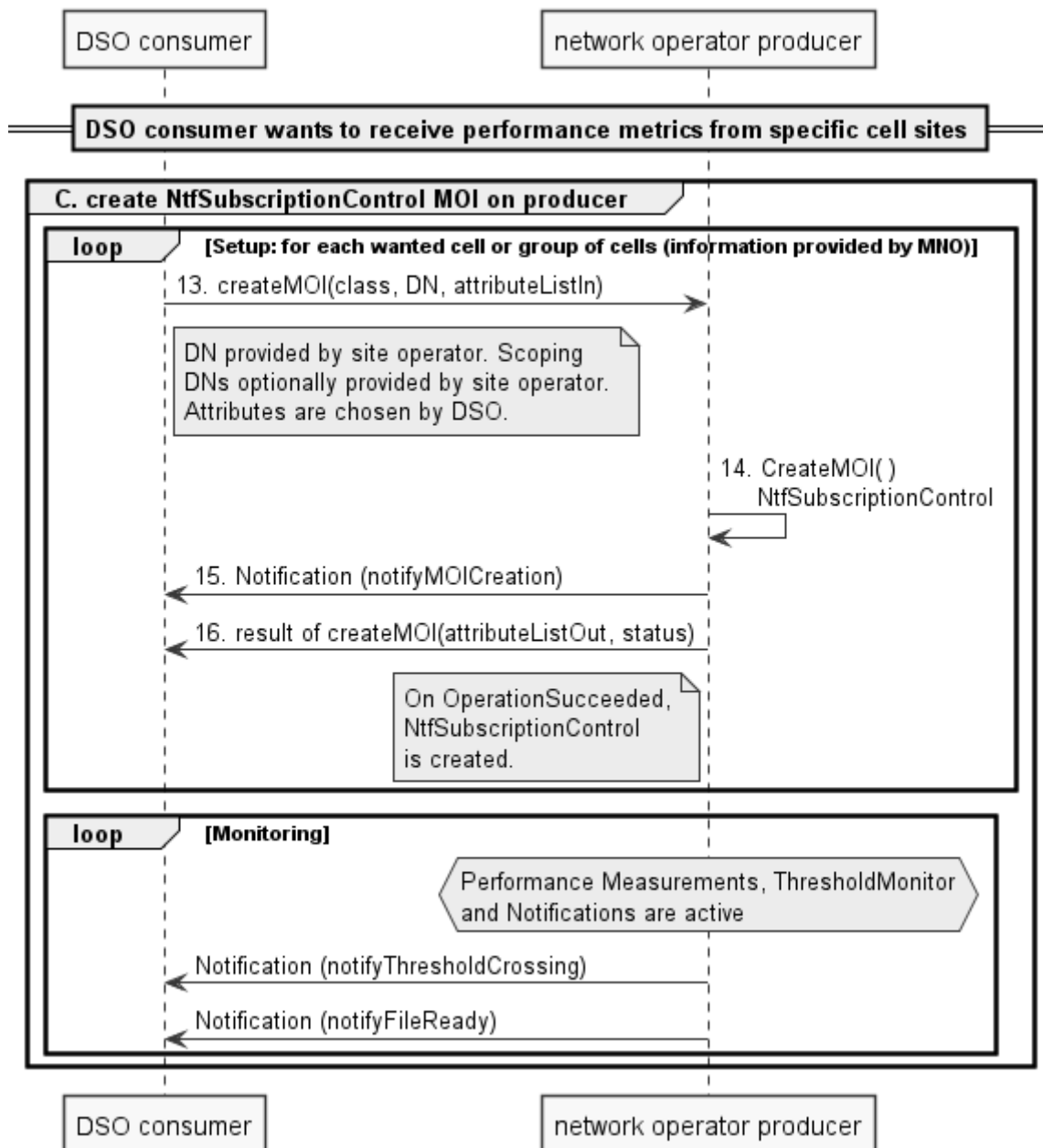
A.1.1.3   Signal flow – completion

The DSO, making use of a DSO managed service consumer (DSO consumer) wants to end performance metric reports from one or more specific cell sites which were previously setup for performance metric reporting. For ultimate deactivation of metric production and threshold monitoring the MnS consumer should delete the job and monitor to free up resources on the MnS producer.

NOTE: dMNO, making use of a MnS producer (termed in this clause 'network operator producer') provides to the DSO the DN and any required scoping parameters for PerfMetricJob MOI (s), ThresholdMonitor MOI(s) and NtfSubscriptionControl MOI(s).

Figure A.1.1.3-1

A. PerfMetricJob

1. The DSO consumer sends deleteMOI to the producer with the following parameters: baseObjectInstance = {DN supplied by the MNO}, scopeType, scopeLevel and Filter are optional and shall be included if supplied by the MNO.

2. The network operator producer deletes "PerfMetricJob" data collection job.

3. The network operator producer sends notifyMOIDeletion to the notificationRecipientAddress in section C, step 9 above.

4. The network operator producr sends deleteMOI response to the DSO consumer with output parameters as defined in the following table:

Attribute name	Value
deletionList	LIST OF SEQUENCE <ManageedEntity DN, ManagedEntity class name>
status	OperationSucceeded | OperationFailed | OperationPartiallySucceeded

Best effort synchronization applies; all managed objects selected for this operation will perform the operation if possible regardless of whether some managed objects fail to perform it. The managed objects selected for this operation are specified by information provided by the MNO.

When the "PerfMetricJob" is deleted, the ongoing reporting period shall be aborted.

B. ThresholdMonitor

5. The DSO consumer sends deleteMOI to the producer with the following parameters: baseObjectInstance = {DN supplied by the MNO}, scopeType, scopeLevel and Filter are optional and shall be included if supplied by the MNO.

6. The network operator producer deletes "ThresholdMonitor" data collection job.

7. The network operator producer sends notifyMOIDeletion to the notificationRecipientAddress in section C, step 9 above.

8. The network operator producr sends deleteMOI response to the DSO consumer with output parameters as defined in the following table:

Attribute name	Value
deletionList	LIST OF SEQUENCE <ManageedEntity DN, ManagedEntity class name>
status	OperationSucceeded | OperationFailed | OperationPartiallySucceeded

Best effort synchronization applies; all managed objects selected for this operation will perform the operation if possible regardless of whether some managed objects fail to perform it.

C. NtfSubscriptionControl

9. When the DSO consumer does not wish to receive notifications any more, it shall delete the corresponding `NtfSubscriptionControl` instance. The DSO consumer sends deleteMOI to the producer with the following parameters: baseObjectInstance = {DN supplied by the MNO}, scopeType, scopeLevel and Filter are optional and shall be included if supplied by the MNO.

10. The network operator producer deletes "NtfSubscriptionControl" job.

11. The network operator producr sends deleteMOI response to the DSO consumer with output parameters as defined in the following table:

Attribute name	Value
deletionList	LIST OF SEQUENCE <ManageedEntity DN, ManagedEntity class name>
status	OperationSucceeded | OperationFailed | OperationPartiallySucceeded

A.1.2 DSO is trusted and supported by network operator, split gNB

A.1.2.1 General

In this scenario the DSO consumer, is recognized by the network operator as a trusted entity that is allowed to read from and write to selected producers and corresponding MOIs in one or more MIBs controlled by the network operator. In this basic scenario, the network operator supports the DSO consumer by providing specific necessary information such as a Distinguished Name of producer(s) and MOI(s), by some means not described in this TS. This scenario is specific to a split gNB.

A.1.2.2 Signal flow

The DSO, making use of a DSO managed service consumer (DSO consumer) wants to receive performance metric reports from one or more specific cell sites. These reports are provided continuously over the monitoring interval with the requested granularity. The DSO consumer is in possession of the following information:

the identity of the cell site: base station ID, or

the estimated location of the cell site antenna

NOTE: Based upon the identity of the cell site, the location of the cell site, or both, the MNO supplies to the DSO the DN and any required scoping parameters for PerfMetricJob MOI(s), ThresholdMonitor MOI(s) and NtfSubscriptionControl MOI(s).

The MNO exposes a MnS producer (termed in this clause 'network operator producer').
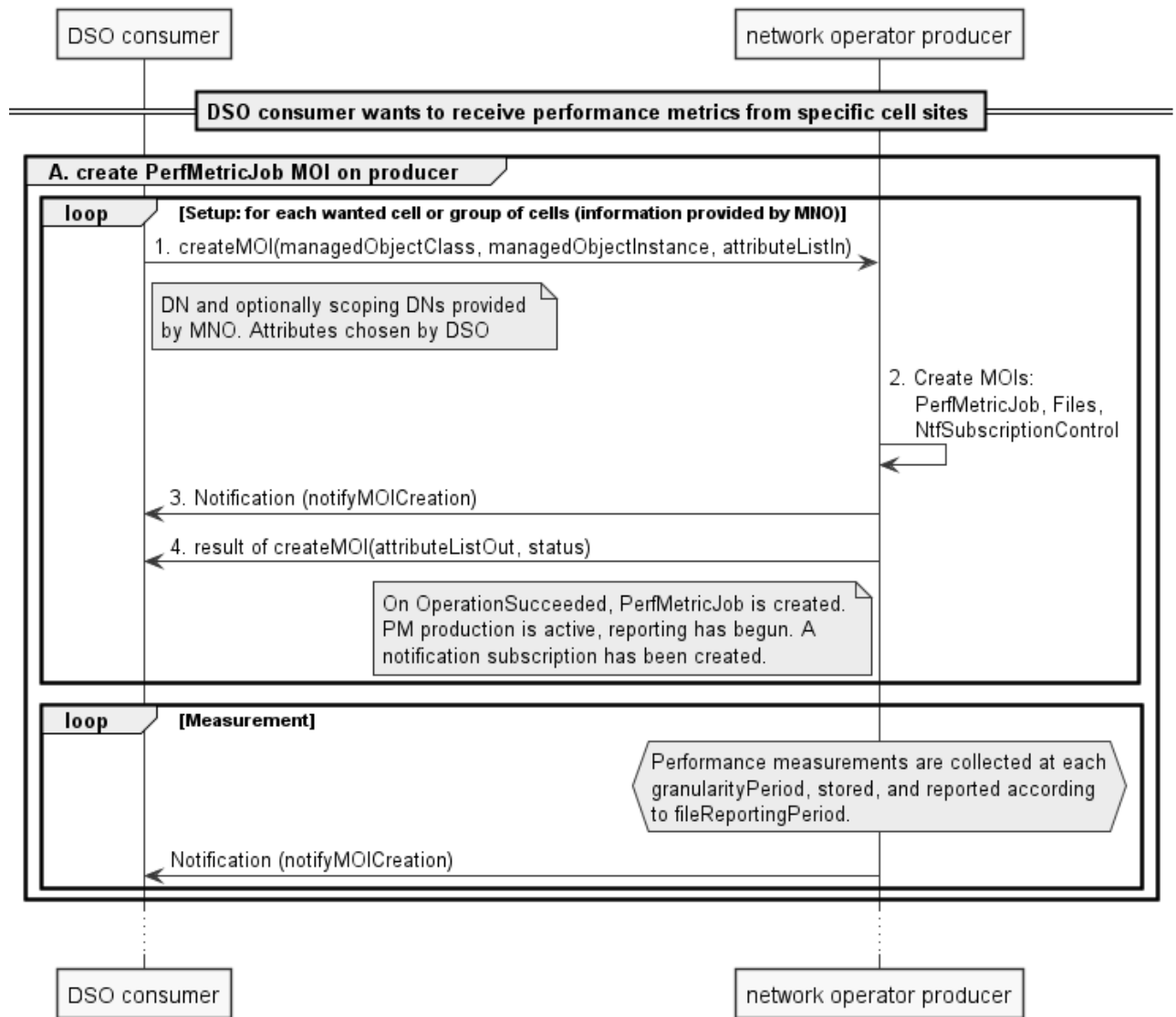
Figure A.1.2.2-1 Create PerfMetricJob

A. PerfMetricJob

1. The DSO consumer sends createMOI to the network operator producer with the following parameters: managedObjectClass = PerfMetricJob, managedObjectInstance = {DN supplied by the MNO}, attributeListIn as defined in the following table:

Attribute name	Value
administrativeState	-
operationalState	-
jobId	pmj_group_0001
performanceMetrics	DRB.AirIfDelayDL_PLMN, DRB.AirIfDelayUl_PLMN, DRB.UEThpDL.PLMN, DRB.UEThpUL.PLMN, DRB.PacketLossRateUL SO.CellInServiceTotal.NCGI SO.CellOOSTimeTotal.NCGI SO.CellOOSTimeAverage.NCGI $CellAvailAvg_{TimeCU}$ $NwAvailAvg_{TimeRAN}$
granularityPeriod	7200
objectInstances	included if supplied by the MNO
rootObjectInstances	included if supplied by the MNO
reportingCtrl	fileReportingPeriod = 120 notificationRecipientAddress = URL
_linkToFiles	-

jobID is chosen by the DSO, this example uses jobID = pmj_group_0001 to identify the performance measurements from one cell or group of cells as identified by the MNO-supplied DN and optionally objectInstances & rootObjectInstances.

PLMN used to specify the performance metrics. It is supplied by MNO.

granularityPeriod is chosen by the DSO, this example uses 7200 seconds (2 hours).

reportingCtrl uses implicit notification subscription. The fileReportingPeriod is chosen by the DSO, this example uses 120 minutes. The notificationRecipientAddress is chosen by the DSO, in this example it is the URL where the notifyMOICreation and notifyMOIDeletion notification types shall be sent.

2. The network operator producer creates "PerfMetricJob" data collection job, Files and NtfSubscriptionControl MOIs.

3. The network operator producer sends notifyMOICreation to the notificationRecipientAddress included in reportingCtrl.

4. The network operator producer sends createMOI response to the DSO consumer with output parameters as defined in the following table:

Attribute name	Value
attributeListOut	name / value pairs of the attributes of the new object
status	OperationSucceeded | OperationFailed

The DSO consumer stores the attribute name/value pairs.

On OperationSucceeded, metric production is now active on the in-scope object instances whose object class matches the object class associated to the specified performance metrics. A notification subscription has been created.

Repeat steps 1 - 4 for each cell site (or group of cell sites as determined by DN information provided by MNO) where performance metric information is wanted.

Figure A.1.2.2-2 Create ThresholdMonitor (rapid)

B.1   ThresholdMonitor for rapidly changing PMs

5. The DSO consumer sends createMOI for ThresholdMonitor to monitor the performance measurements for
    rapidly changing PMs including measurement for latency, packet loss and throughput, using the following
    parameters: managedObjectClass = ThresholdMonitor, managedObjectInstance = {DN supplied by MNO},
    attributeListIn as defined in the following table:

Attribute name	Value
administrativeState	-
operationalState	-
thresholdInfoList	ThresholdInfo performanceMetrics=DRB.AirIfDelayDl_PLMN thresholdDirection=UP_AND_DOWN thresholdValue=70.0 hysteresis=20.0 ThresholdInfo performanceMetrics=DRB.AirIfDelayUl_PLMN thresholdDirection=UP_AND_DOWN thresholdValue=70.0 hysteresis=20.0 ThresholdInfo performanceMetrics=DRB.UEThpDl.PLMN (kbit/s) thresholdDirection= UP_AND_DOWN thresholdValue=100000.0 Hysteresis=10000.0 ThresholdInfo performanceMetrics=DRB.UEThpUl.PLMN (kbit/s) thresholdDirection= UP_AND_DOWN thresholdValue=10000.0 Hysteresis=1000.0 ThresholdInfo performanceMetrics=DRB.PacketLossRateUl (1 ~ 1E6) thresholdDirection=UP thresholdValue=20000 Hysteresis=_
monitorGranularityPeriod	14400
objectInstances	included if supplied by the MNO
rootObjectInstances	included if supplied by the MNO

In this example, a ThresholdInfo datatype will be included for each performance metric that was included in the creation of the corresponding PerfMetricJob MOI where rapidly threshold monitoring is desired.

A threshold monitor is created for delay at the air interface in both DL and UL. In this example, the threshold is set at 7 ms with hysteresis of 2 ms in both the DL and UL. PLMN is provided by the MNO.

A threshold monitor is created for UE throughput in both the DL and UL. In this example, the threshold is set at 100 Mbps with hysteresis of 20 Mbps in the DL and at 10 Mbps with hysteresis of 1 Mbps in the UL.

A threshold monitor is created for UL PacketLoss. In this example, the threshold is set at 0.02% packetloss.

monitorGranularityPeriod = 14400 seconds, multiple of 2 X granularityPeriod established in the PerfMetricJob above.

scope information is included if provided by the MNO.

[ThresholdInfo will also contain an attribute for the location (Lat/long, TAC, cellid). This is used to scope the object instance to be monitored.]

6. The network operator producer creates "ThresholdMonitor" MOI.

7. The network operator producer sends notifyMOICreation to the notificationRecipientAddress in step 1.

8. The network operator producer sends createMOI response to the DSO consumer with output parameters as defined in the following table:

Attribute name	Value
attributeListOut	name / value pairs of the attributes of the new object
status	OperationSucceeded | OperationFailed

The DSO consumer stores the attribute name/value pairs.

Repeat steps 5 - 8 for each cell site (or group of cell sites as determined by DN information provided by MNO) where rapidly changing threshold monitoring is required.

Figure A.1.2.2-3 Create ThresholdMonitor (slow)

B.2   ThresholdMonitor for slowly changing PMs

9. The DSO consumer sends createMOI for a second ThresholdMonitor to monitor the performance measurements for slowly changing PMs like cell availability, using the following parameters: managedObjectClass = ThresholdMonitor, managedObjectInstance = {DN supplied by MNO}, attributeListIn as defined in the following table:

Attribute name	Value
administrativeState	-
operationalState	-
thresholdInfoList	ThresholdInfo performanceMetrics= SO.CellOOSTimeAverage.NCGI thresholdDirection=UP_AND_DOWN thresholdValue=1800 ThresholdInfo performanceMetrics= CellAvailAvg$_{TimeCU}$ thresholdDirection=UP_AND_DOWN thresholdValue=600 ThresholdInfo performanceMetrics= NwAvailAvg$_{TimeRAN}$ thresholdDirection=UP_AND_DOWN thresholdValue=300
monitorGranularityPeriod	43200
objectInstances	included if supplied by the MNO
rootObjectInstances	included if supplied by the MNO

In this example, a ThresholdInfo datatype will be included for each performance metric that was included in the creation of the corresponding PerfMetricJob MOI where slowly changing threshold monitoring is desired.

Three threshold monitors are created for cell availability. In this example, the threshold is set at 1800 seconds (30 minutes) for metric SO.CellOOSTimeAverage.NCGI.

monitorGranularityPeriod = 43200 seconds (12 hours), multiple of 6 X granularityPeriod established in the PerfMetricJob above.

scope information is included if provided by the MNO.

[ThresholdInfo will also contain an attribute for the location (Lat/long, TAC, cellid). This is used to scope the object instance to be monitored.]

10. The network operator producer creates "ThresholdMonitor" MOI.

11. The network operator producer sends notifyMOICreation to the notificationRecipientAddress in step 1.

12. The network operator producer sends createMOI response to the DSO consumer with output parameters as defined in the following table:

Attribute name	Value
attributeListOut	name / value pairs of the attributes of the new object
status	OperationSucceeded | OperationFailed

The DSO consumer stores the attribute name/value pairs.

Repeat steps 9 – 12 for each cell site (or group of cell sites as determined by DN information provided by MNO) where slowly changing threshold monitoring is required.
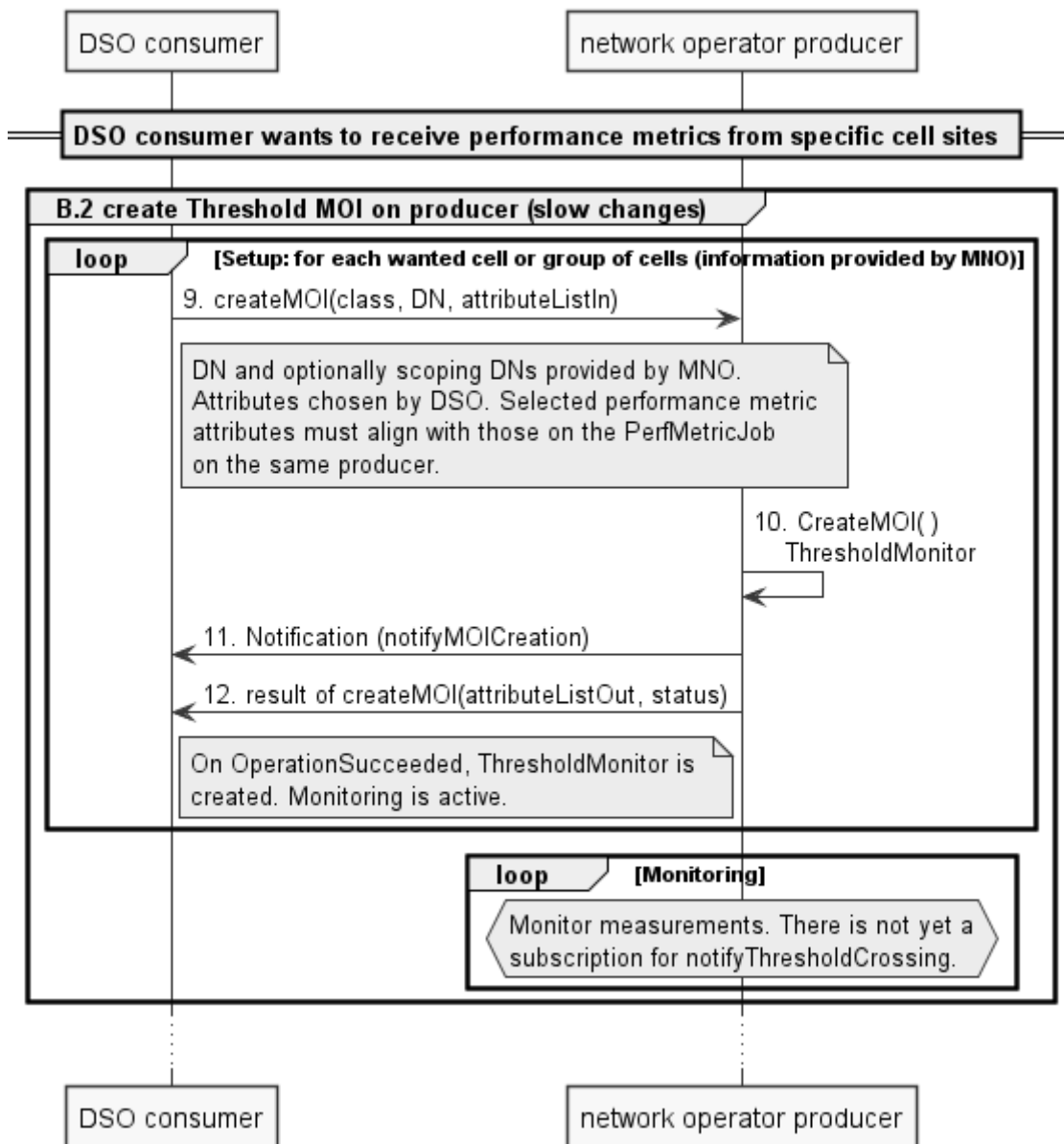
Figure A.1.2.2-4 Create NtfSuscriptionControl

C.   NtfSubscriptionControl

13. The DSO consumer sends createMOI for NtfSubscriptionControl to subscribe for the required notifications with the following parameters: managedObjectClass = NtfSubscriptionControl, managedObjectInstance = {DN supplied by the MNO}, attributeListIn as defined in the following table:

Attribute name	Value
notificationRecipientAddress	URL
notificationTypes	notifyFileReady, notifyFilePreparationError, notifyThresholdCrossing
scope	included if supplied by the MNO
notificationFilter	-

notificationRecipientAddress is specified by the DSO and is the URL where the notifications shall be sent. In this example it is the same URL as provided to PerfMetricJob in step 1 above, although the DSO consumer may select a different URL in this current step.

notificationTypes = notifyFileReady, notifyFilePreparationError, notifyThresholdCrossing

scope information is included if provided by the MNO.

14. The network operator producer creates "NtfSubscriptionControl" job.

15. The network operator producer sends notifyMOICreation to the notificationRecipientAddress in step 1.

16. The network operator producer sends createMOI response to the DSO consumer with output parameters as defined in the following table:

Attribute name	Value
attributeListOut	name / value pairs of the attributes of the new object
status	OperationSucceeded | OperationFailed

The DSO consumer stores the attribute name/value pairs.

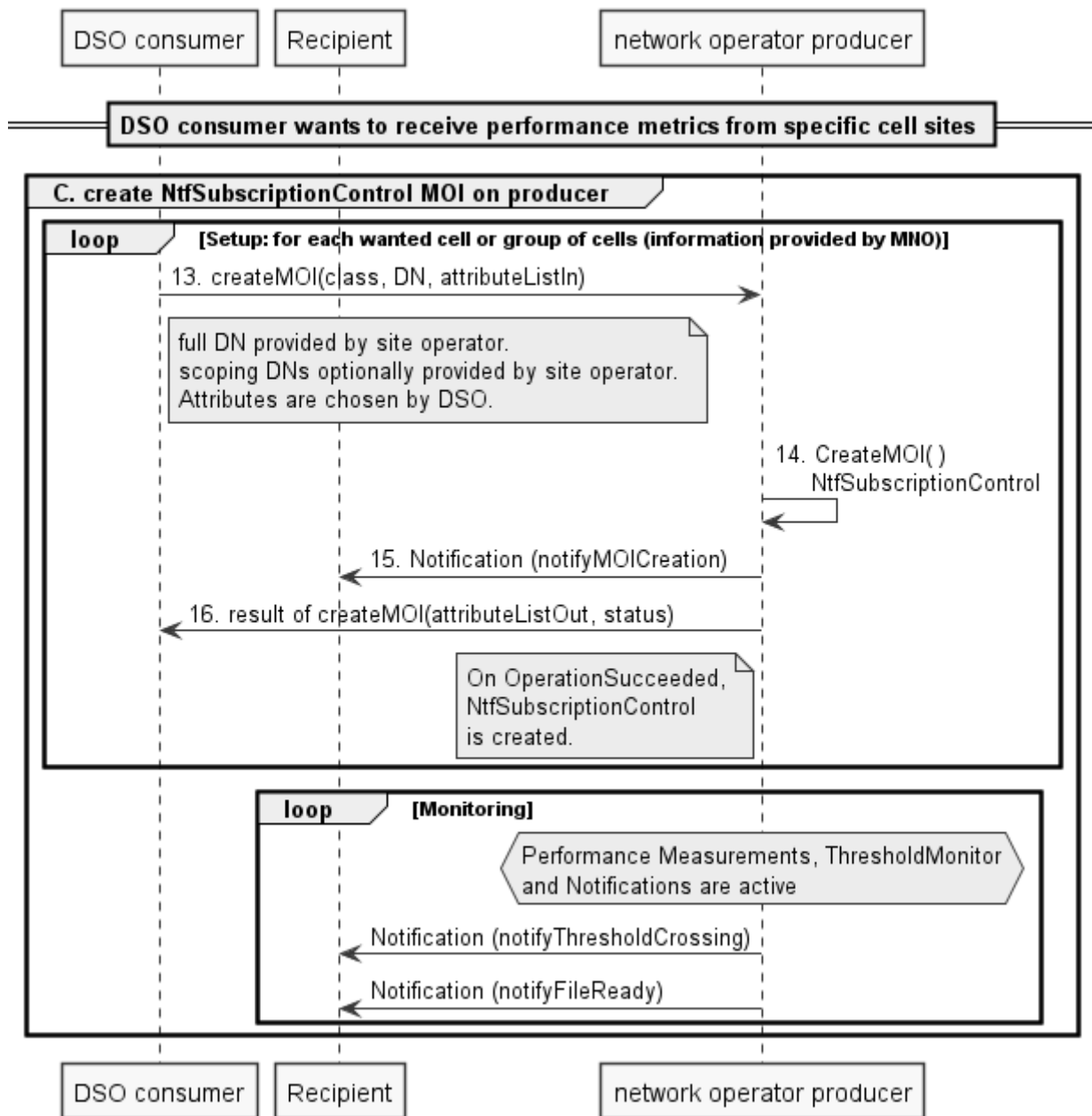Repeat steps 13 - 16 for each cell site (or group of cell sites as determined by DN information provided by MNO) where threshold monitoring and file notification are required.

A.1.2.3   Signal flow – completion

The DSO, making use of a DSO managed service consumer (DSO consumer) wants to end performance metric reports from one or more specific cell sites which were previously setup for performance metric reporting. For ultimate deactivation of metric production and threshold monitoring the MnS consumer should delete the job and monitor to free up resources on the MnS producer.

NOTE: MNO, making use of a MnS producer (termed in this clause 'network operator producer') provides to the DSO the DN and any required scoping parameters for PerfMetricJob MOI(s), ThresholdMonitor MOI(s) and NtfSubscriptionControl MOI(s).
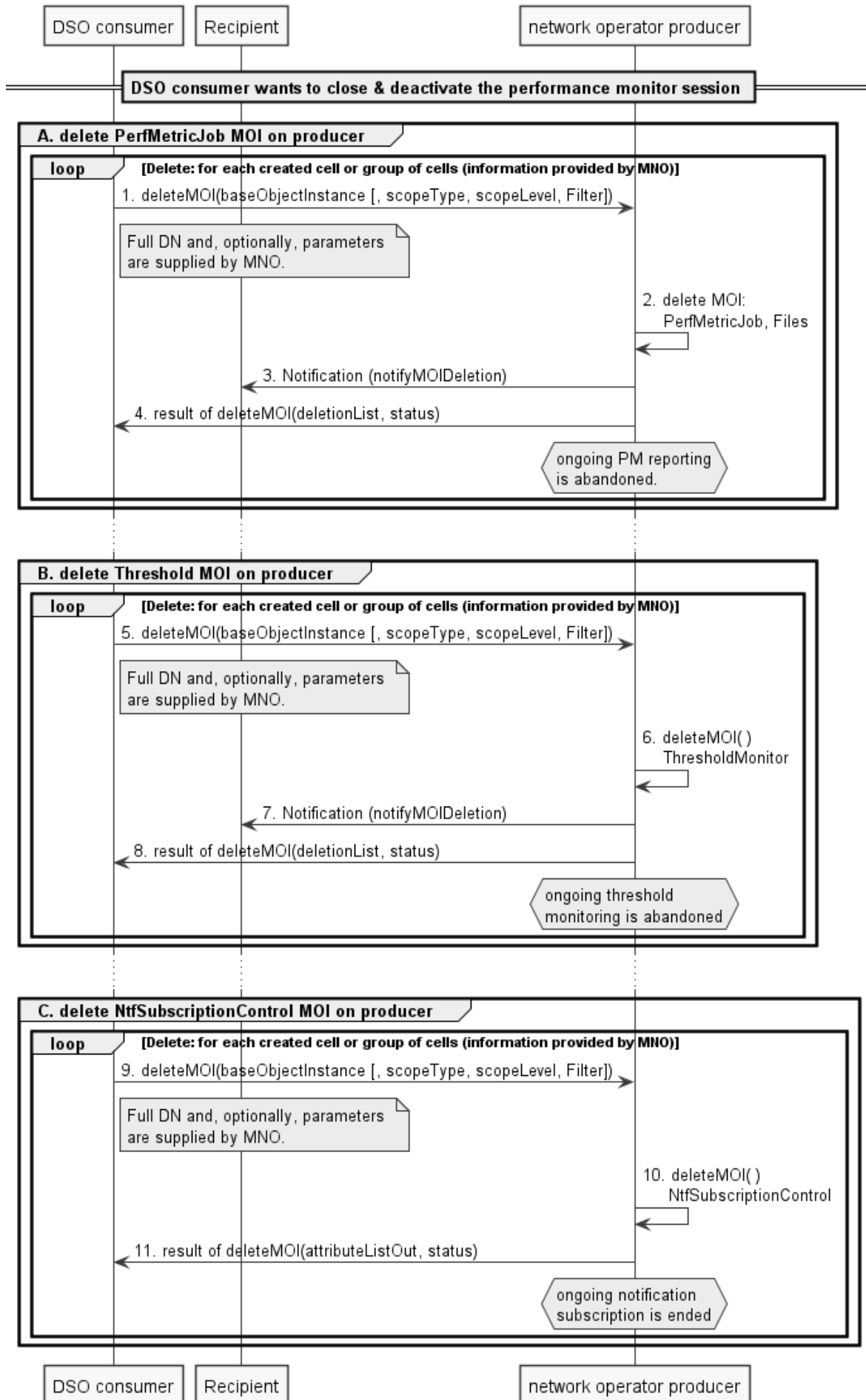
Figure A.1.2.3-1

A. PerfMetricJob

1. The DSO consumer sends deleteMOI to the producer with the following parameters: baseObjectInstance = {DN supplied by the MNO}, scopeType, scopeLevel and Filter are optional and shall be included if supplied by the MNO.

2. The network operator producer deletes "PerfMetricJob" data collection job.

3. The network operator producer sends notifyMOIDeletion to the notificationRecipientAddress in section C, step 9 above.

4. The producr sends deleteMOI response to the DSO consumer with output parameters as defined in the following table:

Attribute name	Value
deletionList	LIST OF SEQUENCE <ManageedEntity DN, ManagedEntity class name>
status	OperationSucceeded | OperationFailed | OperationPartiallySucceeded

Best effort synchronization applies; all managed objects selected for this operation will perform the operation if possible regardless of whether some managed objects fail to perform it. The managed objects selected for this operation are specified by information provided by the MNO.

When the "PerfMetricJob" is deleted, the ongoing reporting period shall be aborted.

B. ThresholdMonitor

5. The DSO consumer sends deleteMOI to the network operator producer with the following parameters: baseObjectInstance = {DN supplied by the MNO}, scopeType, scopeLevel and Filter are optional and shall be included if supplied by the MNO.

6. The network operator producer deletes "ThresholdMonitor" data collection job.

7. The network operator producer sends notifyMOIDeletion to the notificationRecipientAddress in section C, step 9 above.

8. The producr sends deleteMOI response to the DSO consumer with output parameters as defined in the following table:

Attribute name	Value
deletionList	LIST OF SEQUENCE <ManageedEntity DN, ManagedEntity class name>
status	OperationSucceeded | OperationFailed | OperationPartiallySucceeded

Best effort synchronization applies; all managed objects selected for this operation will perform the operation if possible regardless of whether some managed objects fail to perform it.

C. NtfSubscriptionControl

9. When the DSO consumer does not wish to receive notifications any more, it shall delete the corresponding NtfSubscriptionControl instance. The DSO consumer sends deleteMOI to the network operator producer with the following parameters: baseObjectInstance = {DN supplied by the MNO}, scopeType, scopeLevel and Filter are optional and shall be included if supplied by the MNO.

10. The network operator producer deletes "NtfSubscriptionControl" job.

11. The network operator producr sends deleteMOI response to the DSO consumer with output parameters as defined in the following table:

Attribute name	Value
deletionList	LIST OF SEQUENCE <ManageedEntity DN, ManagedEntity class name>
status	OperationSucceeded | OperationFailed | OperationPartiallySucceeded

A.2 Energy utility and telecommunication coordinated rapid recovery of energy service procedure

A.2.1 General

Coordinated energy service recovery requirements are given in clause 5.3. The use cases supported are described in Annex C.

The functionality supported by the signalling flow is:

- A: Inititialization (to initialize the rest of the defined operations). As interaction between MnSs involves creation of a MOI the listed operations precede the other operations listed below.

- B: MNO informs DSO of changes (e.g. to update the list of essential sites and their related information).

- C: DSO updates the information (e.g. to update the expected end of an energy outage).

- D: DSO retrieves the changes (e.g. to query the UPS available time for a site from the MNO).

A.2.2 Signal flow

In the procedure below A occurs before B, C and D are possible. B, C and D can occur at any time after A completes, in any order.
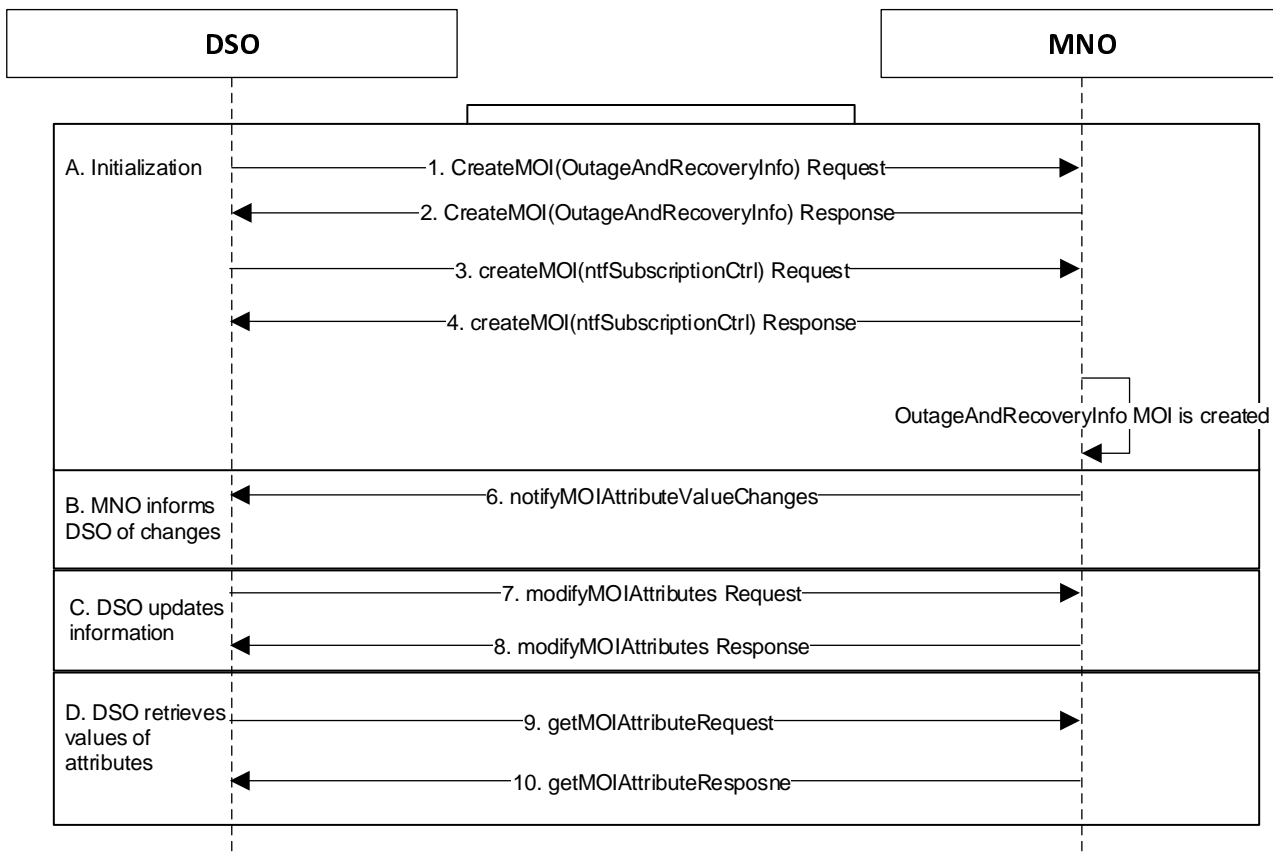

Figure A.2.2-1: Coordinated Rapid Recovery and strategic outage plan Procedure

1. In order to be able to provide energy service outage and recovery related information for MNO, DSO sends createMOI request for OutageAndRecovery IOC which contains information attributes for outage and rapid recovery by DSO.

2. MnS producer in MNO creates the OutageAndRecovery MOI that contains this information for the applicable site. Which site is applicable depends on the attribute affectedArea that is sent in the createMOI request in step 1. createMOI response is sent by MNO MnS producer to DSO.

3. In order to be able to get automatically notified of the creation of the MOIs or any changes in the attribute information in the MOIs, DSO sends createMOI request for NtfSubscriptionControl IOC to MNO. The notification that can be subscribed for is defined using notificationTypes attributes. See clause 4.4.1 of TS 28.622.

4. The MnS Producer in MNO sends the response.

5. MnS producer in MNO instantiate the OutageAndRecovery IOC. This is name-contained by OutageAndRecovery IOC created in step 1.

NOTE 1: In step 6, if done, a subscription is created such that, subject to parameters in the NtfSubscriptionControl IOC, notifications are sent from the MNO to the DSO. This allows, for example, the MNO to notify the DSO of changes in the maxServiceDuration over time. This step is shown as step 6 below.

6. If there is a change in the attribute values, the MNO sends a notifyMOIAttributeValueChanges notification to inform DSO about the changes. The example of the change can include change of the maxServiceDuration.

NOTE 2: In steps 7 and 8 below, there is a change in an attribute of the MOI. This is done by DSO to inform MNO on the changes, e.g. information about an expected outage for a specific site.

7. DSO can modify/update any information like outage start time stamp by sending a modifyMOIAttributes request to MNO. DSO can create/read/update/delete (CRUD operations) the information in the MOI by using provisioning MnS (defined in TS 28.532 [24]).

8. MNO MnS producer provides the modify response to the DSO.

NOTE 3: In steps 9 and 10 below, the DSO requests and receives respectively the current value of one or more attribute(s).

9. DSO can also query the maxServiceDuration as and when required by using the getMOIAttributes operation. For example the information could include identity of DSO energy supply meter, MNO base station, remaining MaxServiceDuration of a particular site, etc. DSO requests the required information from the MNO by using getMOIAttributes operation.

10. MNO provides the required information in the response to the DSO.

Annex B (informative): Coordinated energy service recovery business relationship model

From a functional perspective, the present document defines exposure of information between the DSO and the MNO in order to achieve coordinated energy service recovery.

This annex reports on the business relationship between the DSO and a MNO with regards to exposing information from cell/network sites. It might happen that some of these sites are not directly operated by the MNO the DSO has the contract with, but by a third party instead (e.g. other MNO or a TowerCos). The business relationship between the MNO and site operator(s), and the technical integration of their management system, shall remain opaque to the DSO

In the specific case of energy service recovery, the DSO provides information to the MNO regarding outages starting and stopping, where these outages will occur, expected times for recovery, and more. The MNO provides information pertaining to sites that are essential for providing telecommunication services relevant to the DSO. This interaction is shown in Figure B-1, below.
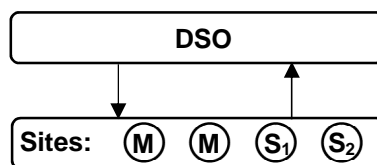
Figure B.1: Business relationships and interaction relevant to coordinated energy recover

In Figure B-1, the sites are differentiated by the letters M, S_1 and S_2. The M sites refer to those operated by the MNO, those with S and subscript values represent sites operated by third parties, e.g. a shared network cell site. The information that is shared with the DSO refers to these sites, including:

- their Energy Supply ID

- their estimated remaining UPS capacity, "Estimated remaining battery autonomy (time) during discharge" as provided by the monitoring and control interface for battery system with integrated control and monitoring information model, ETSI ES 202 336-11 [22] or IETF RFC 1628 remainingUpsBackupDuration [11] .

Annex C (informative): Coordinated energy recovery use cases supported

C.1 General

The present document considers two distinct coordinated energy recovery scenarios. These are described in this annex for clarity and completeness.

There is clearly a mutual interest in coordination between telecommunications and energy service operations to achieve rapid recovery of energy service. This is not only true for the MNO, who benefits from the availability of supplied power, but also of the DSO who needs mobile telecommunication service to restore and maintain the operation of its grid.

Energy service interruptions may occur in many parts of the energy system, ultimately effecting the end customer. Coordinated energy recovery scenarios does not consider every service interruption scenario. It rather concentrates on one specific level of the system. Please see Figure 4.1-1, which includes the 'distribution' component of the system. It is at the distribution level of the system that coordinated recovery is enabled by specification in the present document. The remainder of the task of efficient recovery is out of scope.

C.2 Scenario #1: Energy service recovery with redundant energy distribution topology

This use case concentrates on the distribution aspects, which is depicted above as a single level in a hierarchy, but in fact may have a series of sub-stations between high voltage transmission and the final distribution to energy consumers.

Interruptions occur in the distribution system, as at some level, the medium voltage network may require local reconfigurations or suffer unplanned loss of distribution service (e.g. due to distribution cable damage, etc.) The resulting energy service interruptions last a variable amount of time (from minutes to hours.)

The normal situation is that a utility may need to disconnect a certain Medium Voltage feeder, or more often, it gets disconnected for accidental reasons. As the grid does not automatically re-connect this feeder to an active one, there will be a power outage in all points of supply connected to it while the power is being restored. The procedures and times to reconnect the affected feeder would be the same if for any reason this has been caused by a planned operation, an unexpected incident, or if it is a major grid problem.

In the recovery procedures, the DSO network operations centre needs to restore power in a certain order commonly for operational reasons, and for regulatory compliance: the order includes prioritizing the more important energy consumers (e.g., Hospitals, government sites).

This prioritization may also include major MNOs' sites, such as base stations and core network sites to restore communication services, which is in the interest of both MNO and DSO stakeholders. This prioritized recovery of MNO sites is enabled by this use case.

It is here where a standardized mechanism connecting DSOs and MNOs is beneficial. This use case describes the information and operations that occur on that interface.

The DSO is aware of each point of supply (to an energy consumer), by means of the Energy Supply ID. The MNO needs to let the DSO know the relevant Energy Supply IDs, so that the utility can know where they connect to its feeders. Another critical information element is the power back up installed by the MNO in each site (including 'back up' base stations), and its current expected duration. In addition, for each Energy Supply ID, base station, e.g. eNB, IDs (serving the cell IDs) served by the base station as shown in figure 6.2.1-2 below.
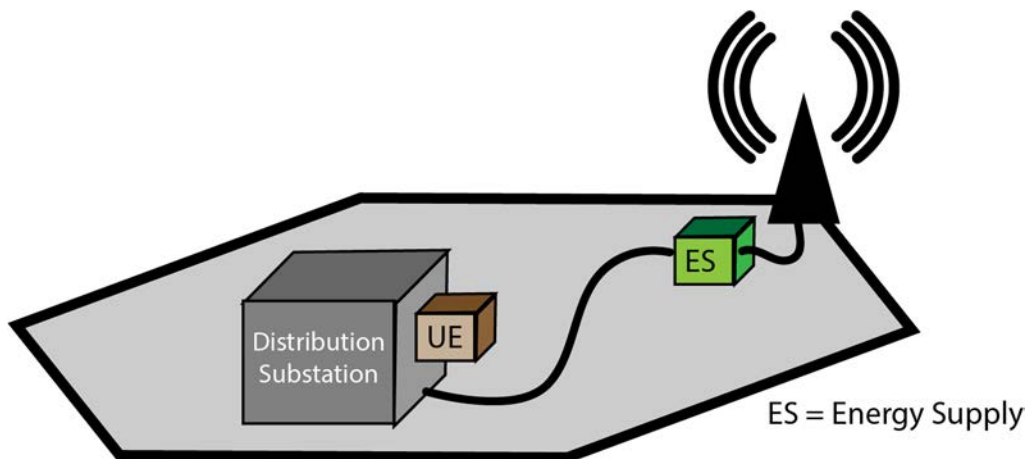
Figure C.2-1: Local recovery scenario

NOTE 1: The representation of the ID above corresponds to the Energy Supply termination of the base station site. In the figure the energy supply is represented as providing energy to a base station. The applicability of the scenario is broader, however, as it concerns any site (including data centres or other facilities.)

The correspondence between the communication system serving the distribution substation by means of a UE (camped in the depicted cell), the Energy Supply ID of the base station and the ID of the base station enables the DSO to identify important operational aspects, such as:

(a) the impact of the distribution substation interrupting service: specifically the base station that the distribution substation relies on will have its power supply interrupted;

(b) upon recovery of the distribution substation, which substations may be high priority for resumption of service.

As implied in Figure C.2-1, there is a dependency that the DSO has on the MNO in that the DSO relies upon data connectivity to smart energy equipment in the distribution system. Through the use of smart energy services, restoration of energy service is rapid and reliable. If the energy substation lacks data connectivity, it is sometimes necessary to send a technician to the site to restore service, which is time consuming.

Within the distribution substation is a router, a kind of customer premises equipment (CPE) that communicates as a router that supports a mobile interface, shown as the UE. Beyond the CPEs DSO Remote Terminal Units (RTUs) are connected. The DSO monitors and controls the RTUs as part of normal operations, especially in the event of a service outage.

Other information exposed by the new mechanism is dynamic.

The figure below depicts the situation at the time of a failure and what is needed in order to restore energy service.
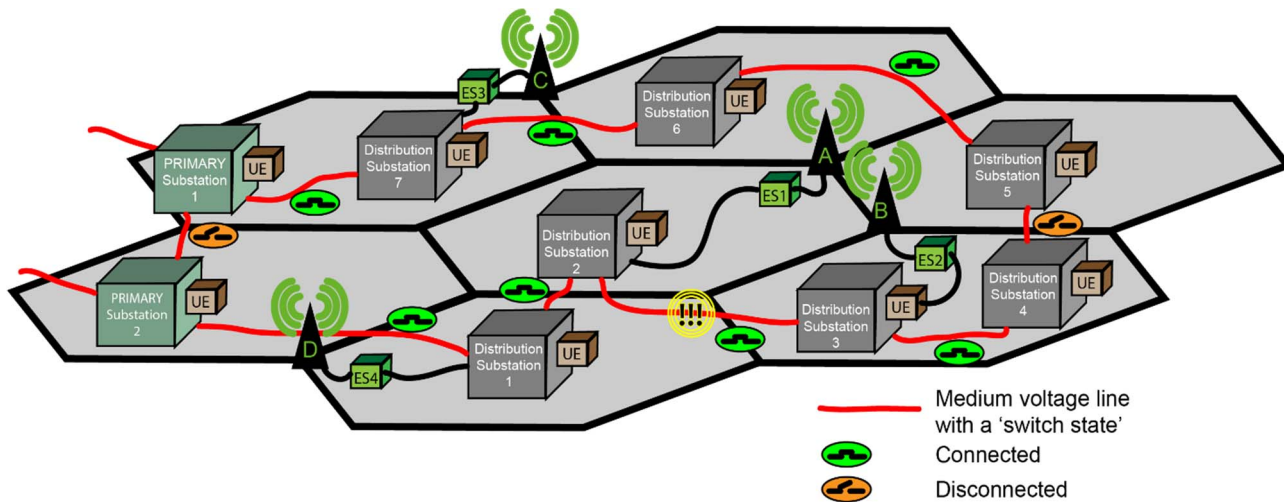

Figure C.2-2: Local failure event

NOTE 2: In Figures.C.2-1 and C.2-2, the green cubes labelled 'ES' represent energy supply points, associated with an Energy Supply ID.

The red lines above are medium voltage lines between energy distribution substations (DS). Note that initially Primary Substation (PS) 1 feeds DS7, DS6 and DS5, and PS2 feeds DS1, DS2, DS3 and DS4.

Between DS2 and DS3 there is a distribution failure. This has the result of causing DS3 and DS4 to no longer be able to maintain the energy distribution service to customers.

Note that the topology of energy distribution lines is redundant. In order to achieve distribution successfully through this redundant topology, energy service has to be **switched on and off** at corresponding distribution substations. This for example could be done between DS4 and DS5 to feed restore service to all substations. The switching is disruptive of energy service. For some time, energy supplied by the distribution substation to the energy customers is off-line. This would result in the following topology:
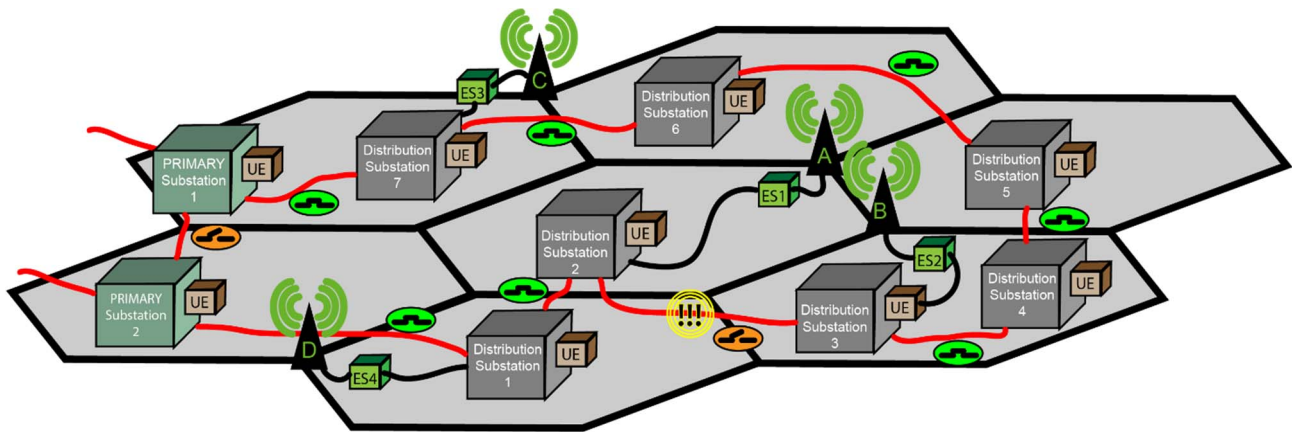

Figure C.2-3: Local failure restored

The topology in Figure C.2-2 is altered so that DS4 and DS5 are now connected, accepting the medium voltage line between DS2 and DS3 are disconnected. PS1 and PS2 remain disconnected; they represent another level of redundancy in the system.

If the process of switching on and off until a stable configuration is achieved has to be done **manually** the process can take considerable time (e.g. hours) as technicians has to be on-site to control the substation configuration. Although the RTU connectivity is instrumental, the technicians have to communicate among themselves and with the utility Control Centre as well, e.g. using mobile telecommunications. However, if the process takes a long time - the mobile telecommunication infrastructure, as shown by base station A and base station B, will likely have exhausted their Uninterruptable Power Supply (UPS), further complicating recovery procedures.

The alternative investigated in this use case involves taking into account the configuration (as described in Figure C.2-1) and dynamic information obtained from the 3GPP network management system concerning the **current capacity (expected remaining duration of service) of the UPS in each of the MNO's infrastructure sites.**

NOTE 3: Please see Annex X concerning exposing information and capabilities of sites that are not operated by the mobile network operator. In this annex, it is assumed that the MNO exposes all such information and capabilities on behalf of all sites in their network, even those that are operated by third parties.

Using smart energy services (principally Distribution Automation), it is possible to perform the 'switch on and off' procedures rapidly, within minutes, and reconfigure the network. There will still be transient electrical service outages to the customers that the distribution substations serves.

Taking into account (a) which mobile network infrastructure sites (i.e. base stations) are critical to service and which cells they serve, (b) the corresponding Energy Supply ID, (c) the distribution substation (UEs) that rely on these base stations, (d) the remaining UPS capacity available in the sites, it is possible for the DSO to plan the 'switch on / switch off process' to avoid any interruption of service. This is done by **selective ordering** of the switch on / switch off activity, to avoid exhausting any mobile network infrastructure UPS - especially where this base station (etc.) serves to enable communication services to a distribution substation.

Note that in figure C.2-2, the cell in which each is located is served by a base station that can be affected by 'switching off.' It is also known to the DSO that e.g. DS2 is served by A and (secondarily) by base station B. Knowledge of this

redundancy can also be of benefit to the planning of the DSO, to prevent in the worst case that both base stations UPS capacity is exhausted and there is no way to restore energy service to these sites.

In order to support the process described above, another example of dynamic real-time information is the 'real' current back up power available at the base station, at any moment in time; the intention is to see how much time the DSO has to restore the power before service interruption compromises the MNO's operation.

Use case actors

DSO network operations centre 'management system'

The DSO network operations centre management system (DSO-MS) maintains operational information to inform DSO network operations.

MNO network operations centre 'management system'

The MNO network operations centre management system (MNO-MS) has and can expose operational information to DSOs concerning the network's configuration and status.

The MNO-MS is a 3GPP management system and the DSO-MS is not a 3GPP management system, however it supports mechanisms that are defined by 3GPP standards (e.g. it uses 'northbound interfaces' exposed by the 5G network management system.)

Use case service flow

Preconditions:

There is a feeder, whose operation requires smart energy services. The smart energy services are available through DSO equipment RTUs. These RTUs are connected with a router, a CPE in the DSO site, that supports a mobile telecommunications interface, a UE.

The DSO can obtain information from each UE in the DSO network. The DSO-MS is aware of the Base station ID of the serving base station for each UE.

On a regular basis, e.g. daily, the DSO-MS obtains 'static information' from the MNO-MS. The DSO-MS is aware which base stations each of the DSO's UE camp on. The DSO-MS is also aware of which base stations rely on which Distribution Substation.

Service Flow: MNO-DSO coordination to achieve rapid energy service outage recovery
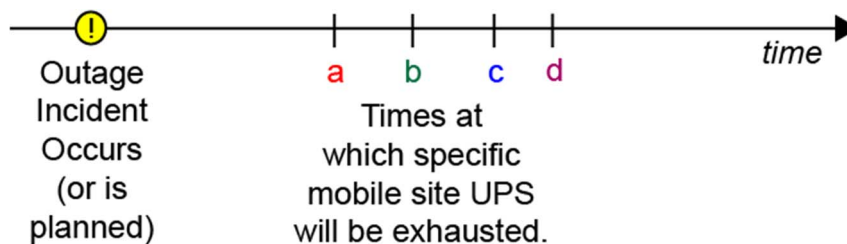
Figure C.2-4: Timeline for Restoration of a Distribution Substation

1. The DSO-MS uses the standardized mechanism to identify an energy service outage at a particular Distribution Substation (or set of Distribution Substations).

   This is shown in Figure C.2-4 as the time of the outage incident.

2. The DSO-MS uses the standardized mechanism to request information from the MNO-MS, to identify the UPS capacity of the base stations in the vicinity of the outage, where the distribution substations will need to be switched on and off. This is shown in Figure C.2-4 as a, b, c, d which correspond to base stations A, B, C and D.

   This request may be done repeatedly, over time, so that the DSO-MS can track the status of the MNO-MS. The MNO-MS should inform the DSO-MS of the current UPS status for a site corresponding to specific Energy Supply ID.

NOTE 4: It is especially important for the MNO-MS to inform the DSO-MS of the UPS status of sites that are Base Stations.

3. The DSO-MS can use the standardized mechanism to inform the MNO-MS of which sites (using the Energy Supply ID known by both the MNO and the DSO) will experience an outage. The DSO can inform the MNO in advance of a planned outage, e.g. when switching on and off will take place.

4. The DSO will actively switch on and off the medium voltage topology at the different distribution stations seeking to establish a stable and sufficient topology. The DSO will prioritize switching involving DS1 so that the UPS of base station A is not exhausted, because 'a' will expire first as shown in Figure C.2-4.

5. A stable and sufficient medium voltage distribution topology is established without exhausting any of the UPS capacity of the base stations and other critical mobile infrastructure sites.

Post-conditions:

The DSO-MS has informed the MNO-MS before, during and after an energy service outage.

The DSO-MS has been able to obtain dynamic UPS information corresponding to mobile infrastructure sites throughout the recovery process.

Service Result:

Energy service is restored to the MNO sites and to the rest of the DSO's energy service customers efficiently, without requiring manual intervention.

C.3   Scenario #2: Energy service recovery without redundant energy distribution topology

This use case is a variation on clause C.2 above.

In C.3, a redundant topology offers the opportunity to adjust the switching of medium voltage lines for energy distribution. When there is a failure of one of these lines, it is possible to adjust the topology to re-establish energy supply to all distribution substations.

This possibility exists only if there is a redundant topology. There are scenarios in which there is no redundant topology, either because a substation is remotely located or because the redundant topology is sufficiently damaged that a sufficient network cannot be re-established. This use case addresses these scenarios.
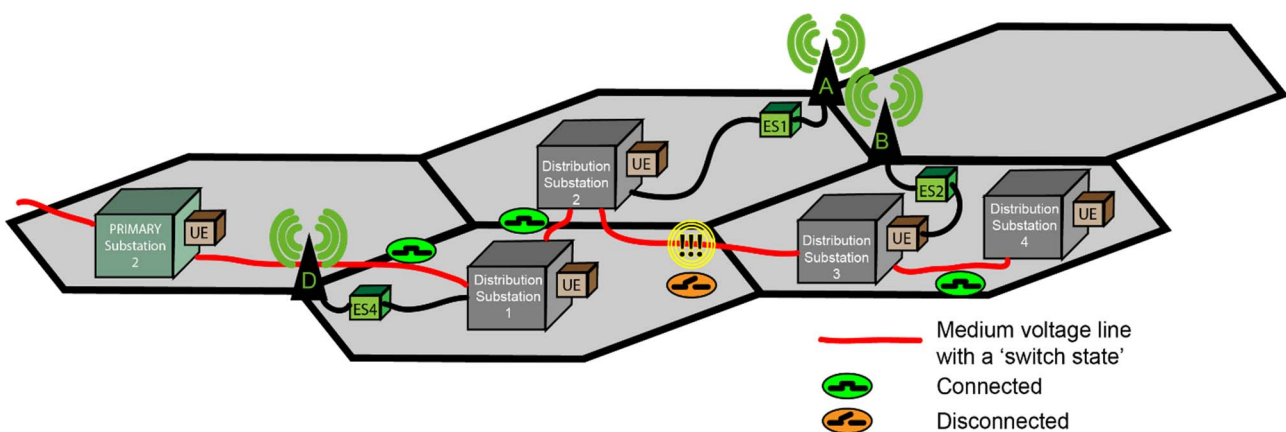
Figure C.3-1: Local Failure Event of feeder of Distribution Substations without Redundant Topology

In figure C.3-1, there is a failure in the distribution line between Distribution Substation 2 and Distribution substation 3. This will result in a failure to supply energy to ES2, and thereby base station B.

In this use case, it is necessary to re-establish the energy supply between substation 2 and substation 3 prior to resuming service in substation 3 and 4.

Once this has been re-established the topology is restored as shown in Figure C.3-2.
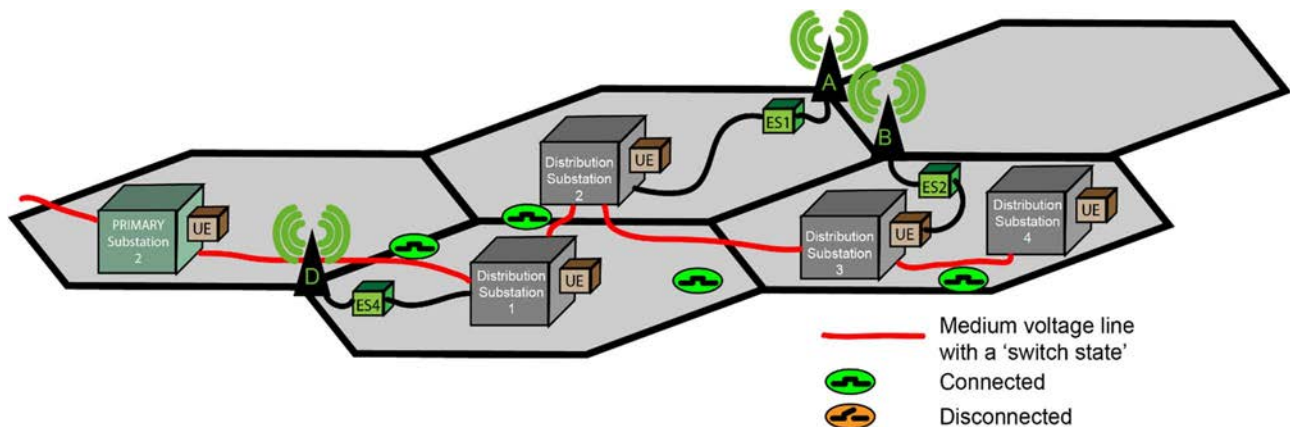
Figure C.3-2: Restored Energy feeder to Distribution Substations

At the point when the distribution is again possible, it is necessary to resume service at distribution substation 3 and 4. However, as some time has elapsed, the UPS capacity of B will be exhausted. This will mean that any smart energy automated operations to distribution substation 3 and 4 will be impossible. Manual intervention to restart service will require substantially more time than automated response.

For this reason, this use case suggests a new operational capability to achieve rapid coordinated recovery. In this approach the DSO informs the MNO to reserve UPS capacity in certain sites, so that it will be possible to resume telecom operations subsequent to the resumption of energy distribution service. If energy distribution service does not resume, after the UPS capacity becomes exhausted, telecom operations will become impossible.

Use case actors

DSO network operations centre 'management system'

The DSO network operations centre management system (DSO-MS) maintains operational information used for DSO network operations. The DSO-MS supports interfaces defined in this use case. All other aspects of the DSO-MS are out of scope of 3GPP specification. The DSO-MS is a consumer of the 3GPP management system.

MNO operations centre 'management system'

The MNO operations centre management system (MNO-MS) has and can expose operational information to DSOs concerning the network's configuration and status. The -MS as discussed in this use case can be considered a producer of management interfaces consumed by the DSO-MS. The MNO-MS is effectively a standardized subset of interfaces and semantics of the 3GPP management system. The MNO-MS is a 3GPP management system for 5G and the DSO-MS is not a 3GPP management system, however it supports mechanisms that are defined by 3GPP standards (e.g. it uses 'northbound interfaces' exposed by the 5G network management system.)

Sites that are not managed by the MNO, e.g. for shared network operations, can be included in the exposed information and capabilities by means that are out of scope of 3GPP standardization.

Use case service flow

Preconditions:

The purpose of the following description is to explain the scenario in which the energy utility operates a network by means of diverse accesses. It is important to mention that other access systems are used to access the energy utility site networks as well, but only access via the mobile telecommunication system is in of scope of this use case.

An energy utility maintains many energy distribution substations. Each is an energy utility infrastructure site that is responsible for distribution of energy to customer sites. This energy utility infrastructure site's operation requires smart energy services. The smart energy services are used to manage and control DSO equipment. This equipment is present on a local area network in the energy utility infrastructure site, which is accessed (e.g. as a VLAN) over any access. In this use case, the access that is used is 3GPP access. A UE is used effectively to carry DSO energy utility infrastructure site communication opaquely (that is, as encrypted traffic) to the Utility Service Provider Network.

The DSO can obtain information from each UE that is used to provide access to the DSO networks. The DSO is, by means of this information obtained from UEs in the DSO network, aware of the Base station ID of the serving base station for each UE.

NOTE 1: The MNO exposed information regarding the base station ID and its associated Energy Supply ID and UPS status enables the DSO to determine which of the UEs deployed in their network will eventually be affected if the supply is out of service.

On a regular basis, e.g. daily, the DSO-MS reads information from the MNO-MS exposed 3GPP management system MnS Producer's exposed interfaces. The DSO-MS is aware which base stations each of the DSO's UE camp on. The DSO-MS is also aware of which base stations rely on which Distribution Substation.

Service Flow:
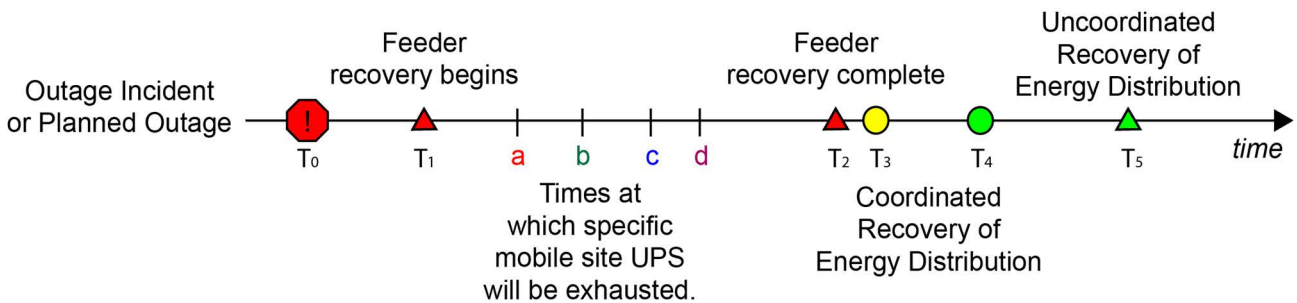
Figure C.3-3: Timeline for Restoration of a Distribution Substation

1. At some time (T_0) there is an outage incident either a planned or unplanned incident.

2. The DSO-MS uses the standardized mechanism to request information from the MNO-MS, to identify the UPS capacity, including remaining time of operation, of the base stations in the vicinity of the outage, where the distribution substations will need to be switched on and off.

   This request may be done repeatedly, over time, so that the DSO-MS can track the status of the MNO-MS. The MNO-MS should inform the DSO-MS of the current UPS status for a specific Energy Supply ID.

NOTE 2: It is especially important for the MNO-MS to inform the DSO-MS of the UPS status of sites that are Base Stations.

3. At some subsequent time (T_1), the energy utility begins restoration of energy feeder lines or other affected infrastructure.

4. The period of time that will elapse before the restoration of energy service from some set of distribution substations will be longer than the UPS capacity of the mobile infrastructure sites. This use case assumes that the MNO knows or can estimate the remaining time of operation after T_0 given the UPS capacity of different mobile infrastructure sites, as received in step 2, shown as a, b, c, d in Figure C.3-3. That is, T_2 occurs *after* the UPS capacity is exhausted in the sites affected by the energy outage. This use case assumes that the DSO knows or can estimate time at which energy distribution service can resume, shown as T_2 in figure C.3-3. This may not be the exact time at which resumption of energy service can resume, which is shown as T_3. T_2 is an estimate when the energy feeder will have recovered, while T_3 represents the time at which energy feeder service resumes and restoration of distribution is possible.

5. The energy feeder for one or more energy distribution substations is now complete. At this point, it will be possible to restore energy distribution. However, operations are required at the distribution substation. This can be performed by smart energy services remotely if there is network coverage. The starting time, when the MNO provides service with remaining UPS capacity, is shown in Figure C.3-3 as T_3. The smart energy services to restore energy distribution services to all customers, including the MNO, is shown as T_4.

   There are two alternatives for how the restoration can occur. Manually, as described in 6a, or with remote intervention, as described in 6b.

6a. Without prior arrangement, there will be no UPS capacity remaining in the infrastructure that serves the distribution substations that have restored power. In this case, manual intervention is required to restore energy distribution. This will be complete after a substantial period of time (T_5).

6b. Alternatively, prior arrangement can be made so UPS capacity will remain in the infrastructure at the time it is needed to restore energy distribution service. This prior arrangement is described in the steps below, and consists of operations between the DSO-MS and MNO-MS.

This Rapid Recovery process enables the situation that, at time (T_3), the MNO is able to use remaining UPS capacity to offer telecommunication service at the time at which the DSO will perform remote operations by means of data communications to restore service in the sites affected by the outage, and operates them until the outage concludes.

6.b.1. In this use case, the DSO-MS communicates to the MNO-MS:

- the affected sites (identified by the associated Energy Supply IDs) by the outage

- the time X after which recovery is possible

- the time Y (that is a certain interval of time after X) that the recovery is expected to complete (a small number of minutes)

The MNO (or the site operator of a site essential to the MNO that is operated by a third party, see annex B), knowing this, has the opportunity to manage the use of the UPS in the affected sites so that they do not exhaust at time (a, b, c, d, etc.). Rather, capacity sufficient for operation of the base station between time X and Y is reserved. Figure C.3-4 below shows a concrete example of this interaction.
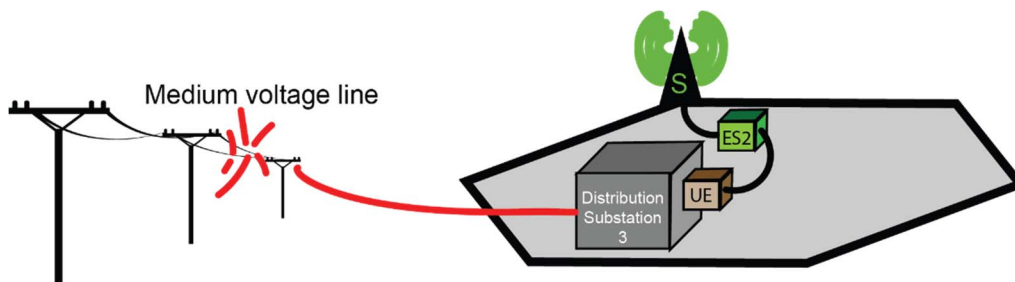

Figure C.3-4: Example of Restoration Scenario of a Distribution Substation

Table C.3-1: Example Sequence of Restoration of a Distribution Substation

Time	Event
00:34	A storm rages and causes power lines to collapse in the mountain province. Energy distribution service by Distribution Substation 3 is no longer possible!
00:36	The DSO informs the MNO that there has been an energy distribution incident that will affect site S. The DSO expects to repair the medium voltage line by 02:45, and if telecommunications service permits it, remote control (using Distribution Automation and SCADA controls) of all sites served by Distribution Substation 3 can be restored - by 02:50. In terms of the procedure step 5a, X=0:2:45, Y = 5 minutes.
00:40	The MNO conserves energy as appropriate to conserve 5 minutes of operating capacity of their UPS reserve.
02:38	The DSO informs the MNO that the feeder line is restored. Remote control restoration of service can begin now. This is T_2 in Figure C.3-3.
02:43	The MNO resumes operation at site S. The DSO is informed that the service has resumed.
02:47	The DSO completes distribution automation. Site S now has energy service. This is T_4 in Figure C.3-3.

6.b.2. The DSO, after time (T_3), employs smart energy services such as distribution automation or specific SCADA operations to restore service to customers rapidly.

6.b.3. The incident concludes (T_4). Energy distribution service has been restored to the MNO site(s) as well as other energy service customers.

6.b.4 The DSO-MS notifies the MNO-MS that the restore operation is complete.

Service flow result

T_4 occurs before manual uncoordinated recovery of service would be successful (T_5 in Figure C.3-3) Thus, alternative 6.b is superior to 6.a for both the MNO and the DSO.

Service is restored to distribution substation 3 and 4 at T_4, within minutes of the restoration of the medium voltage line between distribution substation 2 and 3 T_3. This is substantially faster than service could be restored if a technician had to visit distribution substation 2 and 3 - represented on Figure C.3-3 as T_5. As a result, service is restored to the MNO sites affected more rapidly than in an uncoordinated incident.

Annex D (informative): Unspecified needed configuration and functionality

D.1 General

The present document provides a specification for management services to support the use cases corresponding to requirements in clause 5.

Some aspects needed to support a DSO deploying a MnS consumer for functionality defined in clause 6 and annex A are not defined in the present document. These aspects are described in this annex.

D.2 Service reachability configuration

In order for a MnS consumer deployed by a DSO to communicate with a MnS producer deployed by an MNO, the DSO needs configuration information. Specifically the network address and port number to access the MnS producer should be known.

For example, the MNO could provide the DSO with a DNS name to obtain the MnS producer service address, as well as a port number.

D.3 Service security management

While authentication and authorization of the MNO by the DSO and the DSO by the MNO are needed, the means by which this is achieved is not specified in the present document.

Further, the communication between the MNO and DSO needs to be secure, including protecting confidentiality and the integrity of the data communicated. The means by which this is achieved is not specified in the present document.

This could be achieved for example by means of an exchange (by some secure means) of credentials between trusted parties and use of a secure communication layer such as TLS.

D.4 Service configuration

The procedures defined in annex A require configuration information before they can be used.

For performance monitoring aspects, the MNO should provide the full DN (corresponding to each cell id) to the DSO to obtain the associated performance metrics. The correspondence between DN [19] and Cell ID [18] is, in the present document, required configuration. This format of this configuration is not specified, nor is the method by which the MNO provides it to the DSO. Not all cell ids are relevant to DSO, so the mapping will be restricted to only those that serve the DSO equipment.

Minimum configuration elements for performance monitoring are as follows:

- DN; as specified in 3GPP TS 32.300 [19].

- Cell ID; as specified in 3GPP TS 23.003 [18].

For coordinated energy service recovery, the DSO needs to know the list of Energy Supply IDs that correspond to critical sites of the MNO. The location is also needed, so that it is possible to identify the critical sites affected when there are energy outages that affect a particular region. The present document does not specify the form of the list of Energy Supply IDs and associated locations, or the means by which it is provided by the MNO to the DSO.

Typical configuration elements for coordinated recovery are as follows:

- Energy Supply ID; As defined by the DSO and known to the MNO.

- Cell ID; as specified in 3GPP TS 23.003 [18].

- Latitude; The latitude of the site.

- Longitude; The longitude of the site.

Annex E (normative): UML source code

Figure A.1.1.2-1

```
'S5-240924 Figure A.1.1.2-1 Create PerfMetricJob
@startuml
skinparam Shadowing false
skinparam Monochrome true
participant "DSO consumer" as Cons
participant "network operator producer" as Prod


== DSO consumer wants to receive performance metrics from specific cell sites ==

group A. create PerfMetricJob MOI on producer

  loop Setup: for each wanted cell or group of cells (information provided by MNO)

    Cons  -> Prod: 1. createMOI(managedObjectClass, managedObjectInstance, attributeListIn)
    Note right Cons
      DN and optionally scoping DNs provided
      by MNO. Attributes chosen by DSO
    End Note

    Prod  -> Prod: 2. Create MOIs:\n    PerfMetricJob, Files,\n    NtfSubscriptionControl

    Cons <- Prod: 3. Notification (notifyMOICreation)

    Cons <-  Prod: 4. result of createMOI(attributeListOut, status)

    Note left Prod
      On OperationSucceeded, PerfMetricJob is created.
      PM production is active, reporting has begun. A
      notification subscription has been created.
    End Note

  end loop for each wanted MOI


  loop Measurement
    hnote over Prod
      Performance measurements are collected at each
      granularityPeriod, stored, and reported according
      to fileReportingPeriod.
    end note

    Cons <- Prod: Notification (notifyMOICreation)
  end loop

end group A.
...

@enduml
```

Figure A.1.1.2-2

```
'S5-240924 Figure A.1.1.2-2 Create ThresholdMonitor (rapid)
@startuml
skinparam Shadowing false
skinparam Monochrome true
participant "DSO consumer" as Cons
participant "network operator producer" as Prod


== DSO consumer wants to receive performance metrics from specific cell sites ==


group B.1 create Threshold MOI on producer (rapid changes)

loop Setup: for each wanted cell or group of cells (information provided by MNO)

Cons  -> Prod: 5. createMOI(class, DN, attributeListIn)
Note right Cons
```

```
DN and optionally scoping DNs provided by MNO.
Attributes chosen by DSO. Selected performance metric
attributes must align with those on the PerfMetricJob
on the same producer.
End Note

Prod  -> Prod: 6. CreateMOI( )\n    ThresholdMonitor
Cons <- Prod: 7. Notification (notifyMOICreation)

Cons <-  Prod: 8. result of createMOI(attributeListOut, status)
Note left Prod
On OperationSucceeded, ThresholdMonitor is
created. Monitoring is active.
End Note

end loop


loop Monitoring
hnote over Prod
Monitor measurements. There is not yet a
subscription for notifyThresholdCrossing.
end note

end loop

end group B

...
@enduml
```

Figure A.1.1.2-3

```
'S5-240924 Figure A.1.1.2-3 Create ThresholdMonitor (slow)
@startuml
skinparam Shadowing false
skinparam Monochrome true
participant "DSO consumer" as Cons
'participant "Recipient" as Recip
participant "network operator producer" as Prod

== DSO consumer wants to receive performance metrics from specific cell sites ==

group B.2 create Threshold MOI on producer (slow changes)

loop Setup: for each wanted cell or group of cells (information provided by MNO)

Cons  -> Prod: 9. createMOI(class, DN, attributeListIn)
Note right Cons
DN and optionally scoping DNs provided by MNO.
Attributes chosen by DSO. Selected performance metric
attributes must align with those on the PerfMetricJob
on the same producer.
End Note

Prod  -> Prod: 10. CreateMOI( )\n    ThresholdMonitor
Cons <- Prod: 11. Notification (notifyMOICreation)

Cons <-  Prod: 12. result of createMOI(attributeListOut, status)
Note left Prod
On OperationSucceeded, ThresholdMonitor is
created. Monitoring is active.
End Note

end loop

loop Monitoring
hnote over Prod
Monitor measurements. There is not yet a
subscription for notifyThresholdCrossing.
end note

end loop

end group B
```

```
...

@enduml
```

Figure A.1.1.2-4

```
'S5-240924 Figure A.1.1.2-4 Create NtfSuscriptionControl
@startuml
skinparam Shadowing false
skinparam Monochrome true
participant "DSO consumer" as Cons
participant "network operator producer" as Prod


== DSO consumer wants to receive performance metrics from specific cell sites ==


group C. create NtfSubscriptionControl MOI on producer

loop Setup: for each wanted cell or group of cells (information provided by MNO)

Cons  -> Prod: 13. createMOI(class, DN, attributeListIn)
Note right Cons
DN provided by site operator. Scoping
DNs optionally provided by site operator.
Attributes are chosen by DSO.
End Note

Prod  -> Prod: 14. CreateMOI( )\n     NtfSubscriptionControl
Cons <- Prod: 15. Notification (notifyMOICreation)


Cons <-  Prod: 16. result of createMOI(attributeListOut, status)
Note left Prod
On OperationSucceeded,
NtfSubscriptionControl
is created.
End Note
end loop

loop Monitoring
hnote over Prod
Performance Measurements, ThresholdMonitor
and Notifications are active
end note

Cons <-  Prod: Notification (notifyThresholdCrossing)
Cons <-  Prod: Notification (notifyFileReady)

end loop
end group


@enduml
```

Figure A.1.1.3-1

```
'S5-240924 Figure A.1.1.3-1
@startuml
skinparam Shadowing false
skinparam Monochrome true
participant "DSO consumer" as Cons
participant "network operator producer" as Prod


== DSO consumer wants to close & deactivate the performance monitor session ==

group A. delete PerfMetricJob MOI on producer

  loop Delete: for each created cell or group of cells (information provided by MNO)

    Cons  -> Prod: 1. deleteMOI(baseObjectInstance [, scopeType, scopeLevel, Filter])
    Note right Cons
      DN and, optionally, parameters
      are supplied by MNO.
    End Note
```

```
     Prod  -> Prod: 2. delete MOI:\n    PerfMetricJob, Files

     Cons <- Prod: 3. Notification (notifyMOIDeletion)

     Cons <-  Prod: 4. result of deleteMOI(deletionList, status)

     hnote over Prod
       ongoing PM reporting
       is abandoned.
     end note

   end loop for each wanted MOI

end group A.
...

group B. delete Threshold MOI on producer

  loop Delete: for each created cell or group of cells (information provided by MNO)

     Cons  -> Prod: 5. deleteMOI(baseObjectInstance [, scopeType, scopeLevel, Filter])
     Note right Cons
           DN and, optionally, parameters
           are supplied by MNO.
     End Note

     Prod  -> Prod: 6. deleteMOI( )\n    ThresholdMonitor
     Cons <- Prod: 7. Notification (notifyMOIDeletion)

     Cons <-  Prod: 8. result of deleteMOI(deletionList, status)

     hnote over Prod
       ongoing threshold
       monitoring is abandoned
     end Note

   end loop

end group B

...

group C. delete NtfSubscriptionControl MOI on producer

  loop Delete: for each created cell or group of cells (information provided by MNO)

     Cons  -> Prod: 9. deleteMOI(baseObjectInstance [, scopeType, scopeLevel, Filter])
     Note right Cons
           DN and, optionally, parameters
           are supplied by MNO.
     End Note

     Prod  -> Prod: 10. deleteMOI( )\n    NtfSubscriptionControl

     Cons <-  Prod: 11. result of deleteMOI(attributeListOut, status)

     hnote over Prod
       ongoing notification
       subscription is ended
     End Note
   end loop

end group

@enduml
```

Figure A.1.2.2-1

```
'S5-240924 Figure A.1.2.2-1 Create PerfMetricJob
@startuml
skinparam Shadowing false
skinparam Monochrome true
participant "DSO consumer" as Cons
participant "network operator producer" as Prod

```

```
== DSO consumer wants to receive performance metrics from specific cell sites ==

group A. create PerfMetricJob MOI on producer

  loop Setup: for each wanted cell or group of cells (information provided by MNO)

    Cons  -> Prod: 1. createMOI(managedObjectClass, managedObjectInstance, attributeListIn)
    Note right Cons
      DN and optionally scoping DNs provided
      by MNO. Attributes chosen by DSO
    End Note

    Prod  -> Prod: 2. Create MOIs:\n    PerfMetricJob, Files,\n    NtfSubscriptionControl

    Cons <- Prod: 3. Notification (notifyMOICreation)

    Cons <-  Prod: 4. result of createMOI(attributeListOut, status)

    Note left Prod
      On OperationSucceeded, PerfMetricJob is created.
      PM production is active, reporting has begun. A
      notification subscription has been created.
    End Note

  end loop for each wanted MOI


  loop Measurement
    hnote over Prod
      Performance measurements are collected at each
      granularityPeriod, stored, and reported according
      to fileReportingPeriod.
    end note

    Cons <- Prod: Notification (notifyMOICreation)
  end loop

end group A.
...
@enduml
```

Figure A.1.2.2-2

```
'S5-240924 Figure A.1.2.2-2 Create ThresholdMonitor (rapid)
@startuml
skinparam Shadowing false
skinparam Monochrome true
participant "DSO consumer" as Cons
participant "network operator producer" as Prod

== DSO consumer wants to receive performance metrics from specific cell sites ==

group B.1 create Threshold MOI on producer (rapid changes)

loop Setup: for each wanted cell or group of cells (information provided by MNO)

Cons  -> Prod: 5. createMOI(class, DN, attributeListIn)
Note right Cons
DN and optionally scoping DNs provided by MNO.
Attributes chosen by DSO. Selected performance metric
attributes must align with those on the PerfMetricJob
on the same producer.
End Note

Prod  -> Prod: 6. CreateMOI( )\n    ThresholdMonitor
Cons <- Prod: 7. Notification (notifyMOICreation)

Cons <-  Prod: 8. result of createMOI(attributeListOut, status)
Note left Prod
On OperationSucceeded, ThresholdMonitor is
created. Monitoring is active.
End Note

end loop


loop Monitoring
hnote over Prod
```

```
Monitor measurements. There is not yet a
subscription for notifyThresholdCrossing.
end note

end loop

end group B

...

@enduml
```

Figure A.1.2.2-3

```
'S5-240924 Figure A.1.2.2-3 Create ThresholdMonitor (slow)
@startuml
skinparam Shadowing false
skinparam Monochrome true
participant "DSO consumer" as Cons
'participant "Recipient" as Recip
participant "network operator producer" as Prod

== DSO consumer wants to receive performance metrics from specific cell sites ==

group B.2 create Threshold MOI on producer (slow changes)

loop Setup: for each wanted cell or group of cells (information provided by MNO)

Cons  -> Prod: 9. createMOI(class, DN, attributeListIn)
Note right Cons
DN and optionally scoping DNs provided by MNO.
Attributes chosen by DSO. Selected performance metric
attributes must align with those on the PerfMetricJob
on the same producer.
End Note

Prod  -> Prod: 10. CreateMOI( )\n    ThresholdMonitor
Cons <- Prod: 11. Notification (notifyMOICreation)

Cons <-  Prod: 12. result of createMOI(attributeListOut, status)
Note left Prod
On OperationSucceeded, ThresholdMonitor is
created. Monitoring is active.
End Note

end loop

loop Monitoring
hnote over Prod
Monitor measurements. There is not yet a
subscription for notifyThresholdCrossing.
end note

end loop

end group B

...

@enduml
```

Figure A.1.2.2-4

```
'S5-240924 Figure A.1.2.2-4 Create NtfSuscriptionControl
@startuml
skinparam Shadowing false
skinparam Monochrome true
participant "DSO consumer" as Cons
participant "network operator producer" as Prod

== DSO consumer wants to receive performance metrics from specific cell sites ==

group C. create NtfSubscriptionControl MOI on producer

loop Setup: for each wanted cell or group of cells (information provided by MNO)
```

```
Cons  -> Prod: 13. createMOI(class, DN, attributeListIn)
Note right Cons
DN provided by site operator.
scoping DNs optionally provided by site operator.
Attributes are chosen by DSO.
End Note

Prod  -> Prod: 14. CreateMOI( )\n     NtfSubscriptionControl
Cons <- Prod: 15. Notification (notifyMOICreation)

Cons <-  Prod: 16. result of createMOI(attributeListOut, status)
Note left Prod
On OperationSucceeded,
NtfSubscriptionControl
is created.
End Note
end loop

loop Monitoring
hnote over Prod
Performance Measurements, ThresholdMonitor
and Notifications are active
end note

Cons <-  Prod: Notification (notifyThresholdCrossing)
Cons <-  Prod: Notification (notifyFileReady)

end loop
end group

@enduml
```

Figure A.1.2.3-1

```
'S5-240924 Figure A.1.2.3-1
@startuml
skinparam Shadowing false
skinparam Monochrome true
participant "DSO consumer" as Cons
'participant "Recipient" as Recip
participant "network operator producer" as Prod

== DSO consumer wants to close & deactivate the performance monitor session ==

group A. delete PerfMetricJob MOI on producer

  loop Delete: for each created cell or group of cells (information provided by MNO)

    Cons  -> Prod: 1. deleteMOI(baseObjectInstance [, scopeType, scopeLevel, Filter])
    Note right Cons
      DN and, optionally, parameters
      are supplied by MNO.
    End Note

    Prod  -> Prod: 2. delete MOI:\n    PerfMetricJob, Files

    Cons <- Prod: 3. Notification (notifyMOIDeletion)

    Cons <-  Prod: 4. result of deleteMOI(deletionList, status)

    hnote over Prod
      ongoing PM reporting
      is abandoned.
    end note

  end loop for each wanted MOI

end group A.
...

group B. delete Threshold MOI on producer

  loop Delete: for each created cell or group of cells (information provided by MNO)

    Cons  -> Prod: 5. deleteMOI(baseObjectInstance [, scopeType, scopeLevel, Filter])
    Note right Cons
        DN and, optionally, parameters
```

```
              are supplied by MNO.
        End Note

        Prod  -> Prod: 6. deleteMOI( )\n    ThresholdMonitor
        Cons <- Prod: 7. Notification (notifyMOIDeletion)

        Cons <-  Prod: 8. result of deleteMOI(deletionList, status)

        hnote over Prod
          ongoing threshold
          monitoring is abandoned
        end Note

     end loop

 end group B

 ...

 group C. delete NtfSubscriptionControl MOI on producer

   loop Delete: for each created cell or group of cells (information provided by MNO)

        Cons  -> Prod: 9. deleteMOI(baseObjectInstance [, scopeType, scopeLevel, Filter])
        Note right Cons
            DN and, optionally, parameters
            are supplied by MNO.
        End Note

        Prod  -> Prod: 10. deleteMOI( )\n    NtfSubscriptionControl

        Cons <-  Prod: 11. result of deleteMOI(attributeListOut, status)

        hnote over Prod
          ongoing notification
          subscription is ended
        End Note
     end loop

 end group

 @enduml
```

Annex F (informative): Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
8.23	SA5 #150	S5-235951				Skeleton	0.0.0
8.23	SA5 #150	S5-225952 S5-235953 S5-235954 S5-235955 S5-235956 S5-236001 S5-236002				Scope Introduction Terms and Acronyms Overview General Annex - Procedures Definition	0.1.0
10.23	SA5 #151	S5-237061 S5-237063 S5-237064 S5-237065 S5-237066 S5-237067 S5-237069 S5-237070 S5-237071 S5-237072 S5-237073				3 Definitions and Acronyms 5.Y Exposed performance monitoring requirements Availability KPI definition Annex A Procedures Annex A Procedures 5.X Exposed coordinated recovery requirements Annex X Coordinated energy service recovery business relationship model Annex Y Coordinated energy recovery use cases 6.X Coordinated energy recovery procedures Address editor's notes Clarifications	0.2.0
11.23	SA5 #152	S5-237800 S5-237953 S5-238218 S5-238221 S5-238222				table of contents PMs and KPI definition for NSOEU Diverse clean ups and alignment Cell Availability performance measurement definition Corrections to Exposed coordinated recovery	
02.24	SA5 #153	S5-240356 S5-240553 S5-240923 S5-240924 S5-240929 S5-240932 S5-240933				Remove the PMs and KPIs for NSOEU UPS Reference Change to include ETSI ES 202 336-11 Configuration, scope adjustment Annex A use case 1 procedure measurements NRM definitions_Network Performance Monitoring Stage 2 Procedure update Coordinated Rapid Recovery NRM definitions_Coordinated Rapid_Recovery Stage 2	0.3.0
2024-03	SA#103	SP-240263				Draft submitted to SA for information and approval	1.0.0
2024-03	SA#103					Upgrade to change control version	18.0.0
2024-06	SA#104	SP-240808	0004	2	F	TS28.318 Rel18 correction to Schema definition Issues for SubNetwork of OpenAPI SS and remove MnS in OpenAPI SS	18.1.0
2024-06	SA#104	SP-240833	0005	-	F	Rel-18 CR TS 28.318 Formatting corrections in clause 6.3.3 for DsoThresholdMonitor	18.1.0
2024-06	SA#104	SP-240833	0006	-	F	Rel 18 CR TS 28.318 correct energySupplyId attribute	18.1.0
2024-06	SA#104	SP-240808	0009	1	F	Rel-18 CR TS 28.318 Editorial modifications and essential corrections	18.1.0

History

Document history		
V18.0.0	May 2024	Publication
V18.1.0	July 2024	Publication